THE

4W MODEL OF DROWNING
FOR LIFESAVING OF
NON-AQUATIC AND SWIMMING ACTIVITIES

PH.D. THESIS

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THE
4W MODEL OF DROWNING
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Abstract

**Purpose:** The purpose of this thesis was to identify who is the casualty, who is the rescuer, where and under what circumstances a drowning incident can occur and to develop a risk assessment model of drowning for lifesaving in swimming and other aquatic and non-aquatic activities.

**Method:** Three studies were undertaken. *Study 1:* The key words ‘drown’, ‘aquatic emergency’, ‘risk factors’, ‘lifeguard’, ‘water safety’, ‘lifesaving’ and ‘rescue’ were used in a literature search aiming to identify quantitative research studies with variables that might involve in a drowning incident. *Study 2:* A criterion sampling method obtained videos (n=41) containing drowning incidents that were visually observed. *Study 3:* A combination of convenience and snowball sampling method obtained 34 semi-structured interviews from water safety professionals and aquatic athletes of different nations. The objective and subjective content of the video was recorded, the interviews were transcribed and both texts were inserted in the software NVIVO for content analysis.

**Conclusions:** (1) When there is human activity in, on, around, near and under an aquatic environment, then, a drowning incident might happen to whomever (due to victim’s or rescuer’s mistake), wherever and under whatever circumstances. (2) The factors that determine the outcome of drowning incidents are, in order of significance, rescuer characteristics (Who 1), casualty characteristics (Who 2), location (Wherever), and general circumstances (Whatever). (3) Rescuer characteristics, and their interaction with other factors (mainly with casualty characteristics), appear to largely determine the outcome of drowning incidents. (4) Risk taking behaviour leads to drowning when casualties are willing to seek pleasure by engaging themselves in aquatic activities with risk that perceive as controllable. (5) The 4W model of drowning is a promising tool in lifesaving and lifeguarding.
I confirm that the thesis is my own work, and that all published or other sources of material consulted have been acknowledged in notes to the text or the bibliography.

I confirm that the thesis has not been submitted for a comparable academic award.

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On Wednesday night, Jesus went to meet His students walking on the sea [...] Going down of the ship Peter walked on the sea approaching Jesus. Watching the strong wind he was scared and started sinking screaming: ‘Master, save me’. Jesus very quickly reached his arm rescuing him and said: ‘Why did you loose your believe?’ Helping him to climb on the ship, wind calmed down [...] (Matthew, 8:22-36)

Bible refers that Jesus Christ saved Peter using the reach rescue technique (Jesus walking on the sea, 2006).

Some night a person saw a dream; he dreamt that he was walking across a beach along with God making on the sand two pairs of footsteps. When he asked the Father not to abandon him even in the most difficult moments of his life, God agreed. Suddenly, sky was divided in two parts and the person started watching scenes of his life like in a movie. He realized that when he mostly needed God, the footsteps on the sand were only one pair. He said: ‘Father, you promised me that you would stay always next to me. I cannot understand why when I mostly needed you the footsteps on the sand were only one pair’. ‘My precious child, I love you and will never leave you. During the difficulties, when you saw one set of footprints it was then that I carried you’.
Dedication

This thesis is dedicated to
my father, Pantelis, who taught me
how to read, and to love education.
my mother, Josephine, who did a starvation strike out of
the Ministry of Education for my rights to study.
my sister, Eleftheria, who studied, worked and
overcame every difficulty next to me.
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To write the acknowledgment’ section of a PhD is another part of the education process and possibly the most enjoyable because it means that the thesis is now completed. Influenced by my research, I started reading other PhD thesis’ acknowledgments. In the past my friends criticized me for being emotional in my books, suggesting that I should use more ‘technical language’. Fortunately I realized that most theses use the same emotional style. It is my intention therefore, to thank, several people who contributed with their unique way for making this research possible.

I cannot find the words to thank my supervisor, Ron Butterly PhD, Principal Lecturer in Leeds Metropolitan University. The first thing that I realized for Ron (during my Master) was his love for Greece, as he visits for more than 25 years Greek islands during holidays. This love for our culture, made me to ask him to supervise me. Ron was more than supervisor for me; he was friend, mentor, and colleague. My second supervisor, David Llewellyn PhD, researcher in Cambridge University, was helpful giving me his support and sharing his experiences about the risk taking behaviour that he has already developed. Without David, I would struggle a lot; he was always open in helping me engaging my interest with his good sense of humor. My fourth supervisor Professor Jonathan Long PhD, for the quality feedback he gave me and for the sense of humor with which he approached my thesis when humor was the only way of dealing with the level of my writing. Senior Lecturer Kevin Hilton PhD, and Professor Alan White PhD helped me with NVIVO and issues related to the qualitative research when I needed them. Nikos Ntoumanis PhD, Senior Lecturer in University of Birmingham, who was one of the first people in UK who believed in me and helped me to get in the MSc program, was also a good friend and advisor; my third supervisor Mike Gray, Director of Carnegie Stadium, because without him I would be unable to be enrolled towards the PhD.

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I thank my parents Pantelis and Josephine for their tremendous love and endless sacrifices. After finishing this work, that required me to study for 8 years, I should start sharing with them more time. Publications are important for improving other’s life, but parents cannot be replaced. Most people say ‘sorry’, ‘thank you’ and ‘I love you’ when it is too late. I just want to make sure that I will tell them those words before it will be too late. My lovely sister and co-worker Eleftheria Avramidou BSc, BEd, DipRLSS because I overcame several obstacles of studying with her support. St Efrem, for the courage I was given by him, during the difficult moments of my effort. I also thank God, for in the moments of joy he walked with me, while, when he disappeared in the moments of despair and in difficulties, it was because he was holding me in his arms.
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Chapter 1: Introduction
Chapter 1: Introduction

1.1 The Drowning Problem

In the developed world, life expectancy has increased significantly over the last century (Suominen, 2002). Technological achievements have created, in contrast to the past, free time from work (Stamiris, n.d.). The modern human being has, more than ever before, a variety of choices on how to spend this time. Regular physical activity predicts a long and healthy life (Suominen, 2002), and recreational activities are popular. Between 1990 and 1994 an increase of 32% was observed in general recreational swimming in the USA (Smith, 1992; Kester, 1996; Fatcett, 2001). This interest in aquatics (Sillitoe & Thorpe, 1986; Euraire, 1996) will naturally increase the possibility of aquatic incidents.

As might be expected, many incidents, life or health threatening situations (table 1.1) and drowning have been related to participation in aquatic activities (Manolios & Mackie, 1988; Department of National Heritage, 1993; Lifesaving Society, 2000a). Drowning often affects healthy people during times of pleasure and leisure (Petridou & Klimentopoulou, 2006). In the year 2000, 409,272 drownings were reported, making drowning the second leading cause of unintentional injury death globally after road traffic accidents (this total includes only accidental drowning and submersion; World Health Organization, n.d.). Cataclysms and transport accidents cause a significant number of drowning deaths and are unintentional (International Life Saving Federation, 2007a) but are excluded from these figures. Research in Asia has shown that in many countries drowning kills more children annually than pertussis, measles, diphtheria, plague, cholera, dengue fever, and typhoid combined and is the leading cause of death in children after infancy (UNICEF & TASC, 2004).
Taken together these findings demonstrate that drowning is a leading cause of death and is a serious problem. However, it is underestimated, because the places in the world with the highest drowning figures are also the places with the lowest number of hospitals and statistics include only the drowning deaths recorded in hospitals. If not-hospitalized drownings were included, global rates could reach 1,200,000 annually, which represents one drowning death nearly every 26 seconds (Connolly, 2008).

Second, the drowning problem is considerably underestimated by the World Health Organization because of the way that an injury death is coded. These codes are based on the International Classification of Diseases (ICD) Supplementary Classification of External Causes of Injury and Poisoning, commonly referred to as E codes. A study in New Zealand (Langley & Smith, n.d.), determined to what degree the use of the ICD drowning codes underestimates the incidence of drowning, how the ‘hidden’ drownings are distributed across the full range of E codes, and finally whether the proportion of drownings which have been hidden has changed over time. That study found that during the period 1977–1992, 1,913 drownings were recorded under six different codes (e.g. E830, accident to watercraft causing submersion; E832, other accidental submersion or drowning in water transport accident; E910, accidental drowning and submersion; E954, suicide and self-inflicted injury by submersion [drowning]; E964, assault by submersion [drowning]; and E984, submersion [drowning] undetermined whether accidentally or purposely inflicted). However, after searching for the term ‘drown’ in accompanying narratives, the researchers identified a total of 2,321 cases, which represented a 21.3% increase on the coding total. The majority (65%) of 408 hidden drownings not coded as such had been coded as E810–E819 (motor vehicle traffic acci-

<table>
<thead>
<tr>
<th>Situation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envenomations from fish, rays</td>
<td>Scharf, 2002</td>
</tr>
<tr>
<td>Shark attack</td>
<td>Manguet, 2001</td>
</tr>
<tr>
<td>Aquatic disasters</td>
<td>Saari et al., 1996</td>
</tr>
<tr>
<td>Injuries caused in waterslides</td>
<td>Baggoley &amp; Redford, 1983</td>
</tr>
<tr>
<td>Fall injury in the bathroom due to combination of water and potentially slippery floor</td>
<td>Routley &amp; Ashby, 1997</td>
</tr>
<tr>
<td>Emergencies during major sporting events</td>
<td>Avramidis, 2007c</td>
</tr>
</tbody>
</table>
These incidents represented 11.4% of the drownings in New Zealand. The remainder of the hidden drownings were evenly distributed between E code groupings E810–E819 (Langley & Smith, n.d.).

1.2 Consequences of Drowning for Casualties, Rescuers and Society
Drownings and unsuccessful attempts to prevent them result in emotional, psychological, physiological, sociological, legal and financial consequences for the casualty, the rescuer and society.

A drowning incident is the most extreme form of aquatic incident and probably the most measurable (Dukes, 1986). Although survival after drowning caused mostly pleasurable near-death experiences leading usually to profound positive changes in the person’s life (Moody, 1975; Greyson, 1982; Avramidis, Holden & Clark Sharp, 2007; Holden, 2008), in some cases the survivors had distressing feelings such as terror, horror, isolation, or guilt (Bush, 2006).

Others linked drowning to post-traumatic stress disorder which is characterized by stressful dreams, the unintentional flashback to the emergency situation, anti-social behaviour, anxiety, panic, insomnia, memory problems, and lack of attention or focus (American Psychiatric Association, 1996; Bouwer & Stein, 1997; Chemtob et al., 1998; Howsepiian, 1998; Silva, Leong, Harry, Ronan & Weinstock, 1998; Moradi, Doost, Taghavi, Yule & Dalgleish, 1999; Alonzo, 2000; Hidalgo & Davidson, 2000). Post-traumatic stress disorder symptoms can appear to both the rescuer and the saved person (Raphael et al., 1983; Jones, 1985; Shepherd & Hodgkinson, 1990; Grosse, 2001) with negative consequences to their psychological health (Goleman, 1995; Howsepiian, 1998; Hidalgo & Davidson, 2000), especially when the drowned person is a child, as that evokes very strong emotions (Shannon, 1991; Meyer, Theodorou & Berg, 2006).

An aquatic emergency leading to death also causes psychological pain for surviving relatives (Triantafillou, 2000). A pediatric water-submersion injury is a devastating situation that impacts on all family members (parents, siblings, grandparents). Such an event alters family functioning and the ability to carry on after the crisis. Ninety per cent of all marriages break up within five years of the death of a child (Borta, 1991).
A drowning leading to death, may also have legal implications for the lifeguard, the facilities or the employer and the local authorities (Forsten & Murphy, 1986; American Red Cross, 1995) through liability (Mone, 1980; Morizot, 2002b) and negligence litigation (Kozlowski, 1992; Connaughton, 1995; 1998; Fawcett, 2001; Griffiths, 2001a; Grosse, 2001; Seghers, 2001; Modell, 2006).

Another consequence of a drowning death is the financial issue. An aquatic incident will also require activation of the emergency services such as helicopters, ambulances, power boats etc. (Gardiner et al., 1985; Schmidt et al., 1995; Jungck & Walther, 1997; Muller, 2002; Vandeveldde, 2002). This incurs high costs for hospitalizing the drowning casualties who survived (Walters, Fraser & Alleyne, 1993; Ellis & Trent, 1995). Cost per life saved in Canada, of people aged five years and older, averages 10,500 CA$ (Barss & Gagnon, 2002). In the USA the annual cost of care per year in a chronic care facility for an impaired survivor of a drowning event was approximately $100,000 (American Academy of Pediatrics, 1993). To better understand the economic cost of drowning, it has been estimated that nearly 17 million US$ would be saved by reducing the drowning rates by 1%. This is roughly the equivalent to maintaining the entire staff of 100 lifeguards in the City of San Diego (Witman, 2008).

1.3 Questions posed by the Consequences of Drowning

Reviewing all the above, the first question that is reasonably posed, is ‘how could a drowning incident be faced or prevented?’ Total drowning deaths have decreased fairly steadily over the past years (Reed, 1998; Mackie, 1999; Hoskin, 2000) but not nullified (Vogelsong, Griffiths & Steel, 2000). Therefore, a greater emphasis on public education to prevent drowning remains in order (Arokiasamy & Krishnan, 1994; Smith, 1995; Reed, 1998). This can possibly be achieved by organizing public swimming sessions (Boudolos, 1989; Ballatore et al., 1990; Davies, 1992; Shaw & D'Angour, 1998), producing publications for coping with drownings in water sports (table 1.2), and a number of other activities (table 1.3).
Table 1.2: Literature of Various Aquatic Activities/Water Sports that Describe Prevention Guidelines or Rescue Techniques to Avoid Drowning.

<table>
<thead>
<tr>
<th>Water Sport</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>rowing</td>
<td>Redgraves, 1995</td>
</tr>
<tr>
<td>canoeing/kayaking</td>
<td>Gordon, 1978; Good, 1979; Seidman, 1992; Avramidis, 1998b; Ferrero, 1998</td>
</tr>
<tr>
<td>rafting</td>
<td>Bennet, 1996; Ferrero, 1998</td>
</tr>
<tr>
<td>snorkeling</td>
<td>Smith, 1985; Brookes, 1987</td>
</tr>
<tr>
<td>power boating, jet skiing</td>
<td>White, 1991; Personal Watercraft Federation et al., 1996a</td>
</tr>
<tr>
<td>yachting</td>
<td>Royal Yachting Association, 1994; 1997; 1998</td>
</tr>
<tr>
<td>boating</td>
<td>Stavridakis, n.d.; Royal Yachting Association, 1994; 1997; Personal Watercraft Federation et al., 1996b; British Marine Industries Federation et al., 1998</td>
</tr>
</tbody>
</table>

Table 1.3: Activities for Drowning Prevention.

<table>
<thead>
<tr>
<th>Preventative Measures</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention strategies</td>
<td>Morgan, 1999; Calabria, 2002; Tate &amp; Lyford, 2002; Whittaker, 2002; Water Safety New Zealand, 2003</td>
</tr>
<tr>
<td>Drowning prevention campaigns</td>
<td>Bennet et al., 2006</td>
</tr>
<tr>
<td>Lifeguard certification tests</td>
<td>Jones, 1994</td>
</tr>
<tr>
<td>Changes in technology and techniques</td>
<td>Giles, 1994</td>
</tr>
<tr>
<td>Educational meetings or workshops</td>
<td>Avramidis, 1997b; 1998c; Franklin &amp; Mitchell, 2003</td>
</tr>
<tr>
<td>Water safety newsletters</td>
<td>Nutech 1999; Singapore Life Saving Society, 2000; Royal Life Saving Society UK, 2002; Royal Life Royal Life Saving Society NZ, 2001; Saving Society Queensland, 2002; Swimming Teachers’ Association, 2003</td>
</tr>
<tr>
<td>Educational water safety DVDs</td>
<td>Terzopoulos, Avramidou &amp; Avramidis 2004</td>
</tr>
<tr>
<td>Affiliations of organizations towards same water safety goals</td>
<td>Avramidis, 2004a</td>
</tr>
<tr>
<td>Computer simulations for training lifesavers</td>
<td>De Vries, 2006</td>
</tr>
</tbody>
</table>
A second question that is raised is ‘what has been done to support the lifeguard profession?’ Though the number of people dying each year confirms drowning as a major social problem worldwide, most studies relate to epidemiological, preventative, and forensic aspects (Bierens, Knape & Gelissen, 2002) without integrating them within an overarching theoretical model. For example, the five-minute Scanning Strategy (Griffiths, 2000b) was developed based on the finding that after 15 minutes of performing a simple task people’s performance on that task tends to deteriorate. Lifeguards should, therefore, change posture and scanning technique every five minutes in an attempt to maintain high levels of effectiveness. The C-Zones (Comfort, Concern, Crises, Critical and Cardiopulmonary resuscitation) are used to explain how a drowning casualty tends to progress through a number of worsening stages or zones (Connolly, 2004a). Similarly Pia (1984) hypothesized that drowning can occur even when a lifeguard is present due to a failure to Recognize the symptoms of drowning (R), due to Intrusion (I), or Distraction (D). However, a more holistic conceptualization of drowning incidents is possible and should give greater insight into the drowning phenomenon. The key concern here is which human behaviours or circumstances make people more vulnerable to drowning? A holistic model of drowning incidents should prove to be a useful tool for teaching lifeguarding and reducing the number of drowning-related deaths. Of course, drownings do not only occur when people are supervised by lifeguards; however, improved understanding may also lead to the reduction of drownings in these alternative circumstances through wider publicity and educational campaigns. While existing studies afford us some insight into the nature of drownings, a holistic model of drowning incidents is clearly needed.

Finally, the third question that is posed by the drowning problem is that even if the water safety education and the support of the lifeguard profession was successful, there would still be people intentionally risking their health or life in an aquatic area. The concept of risk is relevant to making decisions in life; every human activity can be seen to contain risk (Franken, 1998), and risk-taking behaviour can be seen as a central facet of human information processing and part of the larger fields of cognition, personality, motivational and social psychology (Tenenbaum, 1995). The reasons for attempting to avoid risk are obvious, but some people seek experiences that contain potentially fatal risks (see Cronin, 1991; Lightfoot, 1997; Slanger & Rudestam, 1997). Some psychologists desire to understand, predict and control behaviour and mental
Introduction

processes, and the study of risk taking behaviour exemplifies this pursuit (Wade & Tavris, 1993). This thesis addressed this question and others by evaluating a broad range of scientific findings and empirical evidence.

1.4 Possible Answers that will Resolve the Drowning Problem

The results of rigorous and systematic investigations, both of existing and original information, will be important to direct impact on water safety organizations, governments, and local authorities.

Water safety organizations will create new publications based on updated knowledge for warning and educating people (e.g. general public and vulnerable categories like children, the elderly and disabled). Knowing how a human behaves, it will be easier to prevent and avoid drowning. Fewer drowning incidents will lead to an increased amount of money that would otherwise have to be spent for hospitalizing surviving patients.

Governments around the world which, at the moment, lack expertise (Department of National Heritage, 1993) will provide enough supervision and rescue equipment for areas or activities that have so far been deemed safe. They will also be asked to pay appropriate attention to that kind of tragedy by including water safety education in their national curriculum.

Local authorities will arm the lifeguards with the necessary equipment and training. They will also produce warning signs regarding specific characteristics of their aquatic area. The public will then be more aware of these dangers, and will protect themselves appropriately. As the unexpected aquatic emergency will be more expected it will also be easier to cope with. Finally when local authorities apply a risk assessment and provide quality safety services based on the results of this thesis, they will be entitled to achieve the prestigious ‘Blue Flag’ that rewards their beaches and services (CYMEPA & COT, 1997) for meeting its criteria (Hellenic Society for the Protection of Nature, 1999a; 1999b).

However, an important issue to consider is how this research will demonstrate its efficacy. Given prevailing conditions that exist in many countries undeveloped on water safety, they are unlikely to adapt new interventions on the basis
of efficacy studies alone. The conceptual model of public policy (figure 1.1) enhances our understanding of how this research, public policy, and individual practice patterns will interconnect (Proceedings of a Research Conference on Identification and Intervention, 2002).

Based on the above model, knowledge base, social strategy and political will interact to influence public policy. This thesis represents the knowledge base, providing accumulated information on drowning prevention in lifeguarded and non-lifeguarded aquatic areas. Social strategy is a set of established goals and a plan for transforming the knowledge base into policies and practical programmes that address drowning problems. Political will is a measure of institutional support for those policies and programmes. Because official public policy represents the broader expression of political will, influential constituencies try to shape political will and, hence, official public policy (Proceedings of a Research Conference on Identification and Intervention, 2002).
1.5 Aims
Based on the above, the aims of the present study were:

1. to assess the burden of drowning in a sample of aquatic episodes;
2. to establish the single variables that contribute to drowning;
3. to find which combination of variables appear to be present and inter-related in each drowning incident;
4. to formulate the theoretical framework of a model with variables that contribute to a drowning incident; and
5. to suggest a set of water safety recommendations which could be used by governments, water safety organizations, aquatic safety professionals and the general public in order to implement the current findings and promote water safety.

1.6 Objectives
The objectives of the study were to:

1. analyse a sample of aquatic incidents;
2. identify factors that lead to drowning;
3. identify a combination of variables that interrelated in a drowning incident;
4. establish a model with variables that contribute to a drowning incident in lifesaving in swimming and other non-aquatic activities; and
5. create a set of recommendations for the behaviour of people involved in aquatic activities in order to prevent death due to drowning.
Chapter 2:
Literature Review
Chapter 2: Literature Review

2.1 Introduction

This chapter has two aims: first to cover important definitions and aspects related to drowning; and second, to initiate a multi-disciplinary approach from a descriptive epidemiological, sociological, patho-physiological, pedagogical, and psychological perspective.

2.2 Definition and Types of Drowning

2.2.1 Definition of Drowning

To understand how an individual drowns, it is essential to establish what ‘drowning’ means. Some use the term ‘drowning’ (Wintemute, 1992; Everett & Richter, 1993; Heimlich & Spletzer, 1993; Modell, 1993; Leveque, 2000), others the term ‘near-drowning’ (Olshaker, 1992), and others both terms together (see table 2.1; Liller et al., 1993; Bross & Clark, 1995; Haddon, 1995). Finally, some others are dealing with water safety elements, lifesaving or lifeguarding with no clear definition or reference points (e.g. American Red Cross, 1956; 1995; Hartley, 1982, Banham, 1997; Royal Life Saving Society Commonwealth, 1998a, 1998b; St John Ambulance, 1998; Lifesaving Society, 1999b; Whitlock, 2001).

<table>
<thead>
<tr>
<th>Year</th>
<th>D</th>
<th>D &amp; ND</th>
<th>ND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>35</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>1992</td>
<td>44</td>
<td>3</td>
<td>18</td>
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<tr>
<td>1993</td>
<td>51</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>1994</td>
<td>42</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>1995</td>
<td>36</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>1996</td>
<td>31</td>
<td>3</td>
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<tr>
<td>1997</td>
<td>42</td>
<td>10</td>
<td>21</td>
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<tr>
<td>1998</td>
<td>28</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>1999</td>
<td>43</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>2000/1–8</td>
<td>36</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>388</td>
<td>42</td>
<td>146</td>
</tr>
</tbody>
</table>

Note: Data taken from Medline, using the key word ‘drowning’. D=Drowning, ND=Near-Drowning.
A number of definitions of drowning have been suggested over the years (Table 2.2). Szpilman (1997), based on 1,831 cases, established an updated classification for drowning according to severity: drowning is an event that results in respiratory distress due to submersion/immersion in liquid (excluding body liquid). After an international debate, drowning was finally defined in the World Congress of Drowning as the process of experiencing respiratory impairment from submersion/immersion in liquid. Drowning outcomes are classified as death, morbidity and no morbidity (Bierens et al., 2002; Seghers, 2002; Dorp, Knape & Bierens, 2003; World Health Organization, n.d.). Also the task force of Drowning in the World Drowning Congress, based on the Utsten-Style decided to abandon the miscellaneous terms of dry-, wet-, active-, passive-, silent-, secondary-, near-drowning, and near-drowned (Idris et al., 2006). This is because ‘victims labelled as having experienced “passive” or “silent” drowning may not have been passive or silent at all but simply were not observed. Finally, ‘secondary’ drowning is a misnomer because people who develop
acute respiratory distress syndrome after drowning have not undergone a second submersion episode’ (van Beeck et al., 2005, p. 855). According to Idris et al. (2006) ‘the primary outcome of a drowning episode should be categorized as either death or survival. Survival indicates that the drowning victim remained alive after the acute event and following any acute or subacute sequelae. Drowning in which the victims are successfully resuscitated at the scene, but succumb to any condition that is causally related to the drowning should be categorized as deaths due to drowning’ (p. 383). Therefore, the abandoned terms were obtained below in an effort to cover more extensively the past terminology related to drowning.

2.2.2 Submersion and Immersion
‘The terms submersion and immersion describe the circumstances of the accidental event while drowning and near drowning are used to describe the person’s outcome. Immersion is the involuntary entry of a person into a body of water while submersion occurs if the person comes to lie under the water surface. Therefore, submersion occurs after a period of immersion’ (Bierens, 1996, p. 40).

2.2.3 Dry Drowning
Dry drowning is death caused without liquid going into the lungs (Ellis & White, 1994). In 10%–20% of cases of drowning, little or no water is found in the lungs at post-mortem examination. This results from the spasm of the larynx causing death from suffocation before the subsequent relaxation of the muscles has allowed water to enter the lower airways (Ellis & White, 1994; Whatling, 1994). This suggests that these submerged victims underwent laryngospasm to the point of developing sufficient hypoxia to lose consciousness and/or suffer cardiac arrest, but without actually breathing in water. It is important to point out that there are no controlled scientific studies to verify that some drowning victims (who either survived or died) do not aspirate water. Particularly in those victims who are found dead in the water, if evidence of water aspiration is not present, then an equally likely conclusion is that the individual was not alive when they entered the water or at least was not breathing at that point (Modell, 1997). Recently this ‘scientific fact’ was questioned and attributed to a possible in-water sudden death. Szpilman (2002a) analyzing 69 drowning cases (20.6±14 years old, 81% males, 78% salt water) found that only 1.5% of living human victims could be considered as ‘dry-drowning’
although it is not possible to exclude small aspiration. He also concluded that the lack of a high sensitivity/specificity method for ‘post-mortem’ drowning diagnosis explained this forensic error.

2.2.4 Wet Drowning

Wet drowning is death caused by the entry of liquid into the lungs (Ellis & White, 1994). This accounts for approximately 80%–90% of drownings (Ellis & White, 1994; YMCA, 1997), or, based on Szpilman’s (2002a) data, for almost 98.5% of the total drowning incidents. Although there is no difference in treatment from the lifeguard (YMCA, 1997), drowning in fresh water results in death after 2–4 minutes after the heart stops, while drowning in salt water requires 6–7 minutes (Kodelas, 1966). However, an experimental study in the Dead Sea showed that clinical signs of respiratory failure were due to aspiration (water inhaled in the airways rather than ingestion from the blood stream) of water and occurred within 10 minutes of aspiration (Bark et al., 1990). Despite some patho-physiological differences in salt and fresh water drowning, there are no important clinical or therapeutic differences for humans (Orlowski & Szpilman, 2001). The first phase of accidental drowning begins with asphyxia, due to either laryngospasm (10%–15% of cases) or water aspiration. The second phase is characterized by water and electrolyte changes in the blood (Aepli, 1975).

2.2.5 Near-Drowning

This is asphyxia or near-asphyxia and is caused by submersion in water or other liquid, although the person eventually recovers (Whatling, 1994). The annual cost for hospitalizing drowning casualties who survived is high because of the increased number of incidents (American Academy of Pediatrics, 1993; Walters et al., 1993; Ellis & Trent, 1995). If no complications occur, the patient leaves hospital within 48 hours. Nevertheless, some casualties require quality care because of the damage to many body functions. Prognosis of near-drowning depends on early rescue and successful resuscitation.

2.2.6 Secondary Drowning

This drowning is frequently related to near-drowning. It can occur within 72 hours of the primary incident. Water irritates the lungs causing them to create surfactant that destroys oxygen in the lungs. Medical attention and supervision
is necessary for the near-drowned, even if they seem to be completely well (Brewster, 1995; Sims, 1997; Avramidis, 1998a).

2.3 Descriptive Epidemiology of Drowning

The epidemiology of drowning is the study of the distribution and determinants of varying rates of drowning in the human population for the purpose of identifying and implementing measures to prevent the development and spread of drowning (see Caine, Caine & Linder, 1996). Epidemiology has two components of research: descriptive and analytical (Caine, Caine & Linder, 1996; Henning, 2004).

Descriptive epidemiology aims to initiate public health intervention, to estimate the impact of drowning, to determine the distribution and spread of drowning, to generate hypotheses and stimulate research, and to evaluate prevention and control measures (Henning, 2004). It also focuses on identifying and reporting the frequency and pattern of drowning in a population in terms of person, place and time (adapted from Handler, Rosenberg & Monahan, n.d.). For example, in terms of person, frequency studies have shown that drowning and immersion injuries are the leading causes of mortality and morbidity in children (Walsh & Ioli, 1994; Kraus, 1996; Rumbak, 1996; Mackie, 1999), a major cause of death for those in the age group 10–29 years (Lincoln et al., 1996; Nieves et al., 1996) and in older adults (Vaagenes, 1993; Arokiasamy & Krishnan, 1994). Also in terms of place, today, drowning incidents occur not only in underdeveloped countries but also in industrialized countries that have organized lifeguard systems and organizations (see Eaton, 1995; Pearshal, 1991; Bierens, 1996), and in places where lifeguards are present (Royal Life Saving Society Australia, 1998; 1999; 2000; 2001a; Avramidis & Butterfly, 2008). Finally, in terms of time, drowning incidents have been reported in ancient Greek history and mythology (Avramidis & Avramidou, 2005; Avramidis, 2005; 2007a; 2008b), in the Bible (n=6 cases; Avramidis et al., 2007; Avramidis, 2009a), and in contemporary society (To the rescue, 2002; Dorp, Knape & Bierens, 2003).

As mentioned previously, the primary considerations for descriptive epidemiology are frequency and pattern. Frequency evaluates the rate of occurrence
(see table 2.3), and pattern helps analytical epidemiologists suggest risk factors (Christensen, 2003). The more fully a descriptive epidemiological study can describe those mentioned in the above paragraph (e.g. person, place and time), and any correlations between the three, the more likely patterns emerge which may be considered as risk factors for certain kinds of health issues. Those data are then used as an information source for people or to influence public policy (Christensen, 2003).

**Table 2.3: Examples of Place, Time and Person Components for Injury Epidemiology of Drowning.**

<table>
<thead>
<tr>
<th>Place</th>
<th>Time</th>
<th>Person</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1994–1999</td>
<td>321 people of all age groups drowned on average.</td>
<td>Royal Life Saving Society Australia, 2000; 2001b</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1993–1994</td>
<td>Drowning accounted for 18.9% of deaths among 1- to 4-year-olds (n=828 deaths).</td>
<td>Baqui et al., 1998</td>
</tr>
<tr>
<td>Brazil</td>
<td>1979–1998</td>
<td>144,207 deaths (average of 7,210 deaths/year) due to drowning.</td>
<td>Szpilman, 2002b</td>
</tr>
<tr>
<td>Canada</td>
<td>1990–1998</td>
<td>621 people drowned on average</td>
<td>Lifesaving Society, 2000b</td>
</tr>
<tr>
<td>Europe</td>
<td>Annually</td>
<td>Drowning is the second leading cause of death in children aged 1–14 years in Europe.</td>
<td>Vincenten, 2001</td>
</tr>
<tr>
<td>France</td>
<td>Annually</td>
<td>Drowning is the first cause of domestic deaths of children aged 1–4 years.</td>
<td>Briand, 2002</td>
</tr>
<tr>
<td>Germany</td>
<td>Annually</td>
<td>In the Federal Republic of Germany, some 700 people drowned.</td>
<td>Bernett &amp; Haas, 1984</td>
</tr>
<tr>
<td>Greece</td>
<td>Annually</td>
<td>Approximately 300 drowning.</td>
<td>National Statistic Department, 1994</td>
</tr>
<tr>
<td>Iran</td>
<td>1993–1994</td>
<td>Drowning is a leading cause at 10.1% of 5,213 deaths.</td>
<td>Soori &amp; Naghavi, 1999</td>
</tr>
<tr>
<td>Japan</td>
<td>Annually</td>
<td>2,000 children aged 0–14 years drown.</td>
<td>Tanaka, 1993</td>
</tr>
<tr>
<td>Worldwide</td>
<td>2000</td>
<td>449,000 people drowned and a further 1.3 million were injured as a result of a drowning incident that led to the survival of the casualty.</td>
<td>Peden, 2002</td>
</tr>
</tbody>
</table>
2.4 Sociological Approach to Drowning

The sociology of safety focuses on social groups and organizations offering different perspectives on injuries and identifying system or organizational factors that are likely to lead to an injury (Hartle & Bryant, 2006). A number of such sociological aspects that can be related to public health and safety in terms of drowning are the lack of scientific research, the use of outdated rescue techniques, and the lifeguard training and qualification structure.

Although the procedures and equipment used to save a person from drowning are of paramount importance, the amount of scientific research in the field of aquatic safety is limited (see Langendorfer, 2007a; 2007b). Only a few authors have evaluated rescue techniques or constructed drowning detection systems using modern scientific instrumentation (e.g. Miller & Dahl, 1979; 1981; Hay et al., 1975; Daniel & Klauck, 1992; Avramidis, 2001b; 2002a; 2002b; 2003b; Bishop, 2001; Abraldes et al., 2007; Leclerc, 2007). Most water organizations replicate old techniques (Giles, 1994; Giles & Giles, 1998), without critically evaluating their quality and effectiveness (Avramidis, 2001a; 2008). These old techniques were often evolved by trial and error, with little scientific investigation (Dorp, Knape & Bierens, 2003). Although lifesaving organizations teach methods of rescue, there is a lack of data to indicate whether or not the techniques taught are effective (Miller & Dahl, 1979). As a result, rescue techniques rarely alter beyond changes in rescue equipment (Wright, 2006).

Traditionally, drowning reduction has been based on prevention and rescue education, but only at a non-university level. Aquatic safety professionals and the general public usually get relevant training from non-governing organizations, registered charities or private agencies with governmental approval (e.g. National Red Cross, Royal Lifesaving Society, Surf Life Saving Association, Ellis and Associates, and Swimming Teachers’ Association, etc.). Few countries maintain a level of higher education related to lifesaving (Colman et al., 2006). According to the same source, in order to maintain a more scientific attitude in the lifesaving field, efforts to establish a 5-level training and qualification structure (including academic specialization in lifesaving) have been proposed in the European Community.
2.5 Patho-physiological Approach to Drowning

2.5.1 Stages of Drowning
The word ‘drowning’ is used to refer to either the fact of death or the process (e.g. he died by drowning or he is drowning now, respectively) and as an event it has been divided in different ways by various authors. Some authors divide the entire phenomenon into 5 stages (Behob, 1988; Ellis & White, 1994). Examining rats, rabbits and dogs to investigate the course of respiration and circulation during various types of suffocation, Suzuki (1996) concluded there were 4 stages of drowning: surprise and initial apnea; dyspnea; apnea; and terminal respiration. Pia (1994), from a lifeguard perspective divided drowning into: surprise or distress; gasping for air; the instinctive drowning response; submersion; unconsciousness; and death. From a physiological point of view, Orlowski (1987) has divided it into: distress; panic; and submersion. Factors that affect the length of time from submersion to successful resuscitation and conversely to permanent neurological damage or death, include whether the victim entered the water with their lungs maximally deflated or inflated, the presence of concurrent pre-existing disease that would limit resuscitability, the water temperature, the presence of mental or physical impairment, whether the submersion episode was observed in which case an accurate time-line could be constructed, and, finally, whether the victim was just found in the water without witnesses to the preceding events (Modell, 1997).

2.5.2 Drowning and Hypothermia
The range of surrounding temperatures into which a person can be immersed without an effect on core temperature is much smaller in water than in air (Nielsen, 1978). Children and adults, who swam in cold water, had an important decrease of body core temperature below 35°C (Sloan & Keatinge, 1973; Holmer & Bergh, 1974) and 90–120 minutes is near the upper limit of survival in 0°C water (Hayward & Eckerson, 1984). During immersion in cold water, the body attempts to prevent the fall of internal temperature by increasing its metabolism. However, the cooling effects of the water exceed the body’s ability to thermoregulate in these extreme conditions (Nadel, 1977). Despite vigorous shivering, the body temperature of a swimmer will fall in cold water. The time required for the decrease in temperature will vary depending on the temperature of the water and the weather, the body position, body weight, insulating
fat layers and anthropometric values, amount and type of clothing that is worn, water movement (see figure 2.1) and wind speed (Sloan & Keatinge, 1973; Holmer & Bergh, 1974; Nielsen, 1978; Mansell et al., 1990; Tikuisis & Daanen, 2006).

Figure 2.1: Predicted Times to Lethal Hypothermia for Unprotected Immersion in Rough Water for Persons with Different Anthropometric Values.

The beneficial effect of hypothermia is well known, and explains, at least partially, survival in cases of apparently irreversible drowning that led to survival. Potential benefits are the reduced metabolic demands that prevent the adverse effects of hypoxia and the ‘diving reflex’ that short-circuits the blood supply to vital organs (Lopez et al., 1999). This is a reflex by which immersing the face in water, especially cold water, tends to cause bradycardia and peripheral vasoconstriction. Mean aortic pressure is little affected because the reduction in cardiac output balances the increased peripheral resistance that reduces peripheral blood flow (Online Medical Dictionary, 2008).

Newborn infants are particularly prone to hypothermia for a number of reasons (Schulman et al., 1998). First, because although temperature regulation does exist in the newborn it is not fully developed, and some mechanisms may take days or months before they are effective (Edholm, 1978). Second, brown fat present in the newborn infant plays a part in the maintenance of body temperature in the cold; however, it is unlikely that any is left after six months (Ed-
holm, 1978). Third, because children have a less favourable mass-to-surface area ratio, they cool faster than adults (Sloan & Keatinge, 1973). If attention is given to these children during swimming, many will be found shivering, standing in a huddled position with legs together, and with arms folded across the chest (Craig, 1983). Therefore, children are particularly at risk.

Although hypothermia develops quickly in young age groups, it can play a vital role in the chances of survival of the hypothermic person because the brain cools quicker and at the same time is protected from tissue damage. A number of studies found that young age was a good predictor of survival after a drowning accident in hypothermic water (Bierens et al., 1990; Pearn, 1992; Kemp & Sibert, 1991; Fretschner et al., 1993; Fritz et al., 1988; Leitz et al., 1989; Biggart & Bohn, 1990; Krandick & Mantel, 1990; Estebe et al., 1991; Antretter et al., 1994; Avramidis & Butterly, 2008). In contrast, the potential beneficial effect of the rapid development of hypothermia by cold water on the outcome of nearly-drowned children could not be proved, except in a few other studies (Veenhuizen et al., 1994; Suominen et al., 1997). Although the effect of hypothermia can be beneficial (Waters et al., 1994; Nincevic & Mlinaric, 1995; Huckabee et al., 1996; Kumle et al., 1997; Bierens et al., 1995; Avramidis, 2002c, 2002d; Avramidis & Butterly, 2008), many deaths in inland waters occur too rapidly for hypothermia to be responsible (Tipton et al., 1999). Sudden deaths have been attributed to vagal arrest of heart action following the inhalation of cold water in the nasopharynx and glottis (Simon, 1958). Other deaths can be explained by sudden ventricular fibrillation of the heart during the first minutes of immersion, caused by intense reflexes from the cooled skin, especially the cheeks (Gerst, Fleming & Malm, 1966). Free immersion under water is accompanied by the threat of specific disorders which could cause drowning (Nazarkin & Potapov, 1993). However, the majority of rapid deaths in cold water are attributable to drowning, even in good swimmers. Breathing is severely disturbed during the first few minutes of sudden cold immersion (below 10°C), to such a degree that many people find it impossible to control their breathing (Timperman, 1962; Neidhart & Greendyke, 1976; Granberg, 1991; Tipton et al., 1991). This is called ‘cold shock response’ or ‘cold shock reflex’ and is characterized by an initial gasp followed by hyperventilation with rising cardiac output and blood pressure, often leading to rapid drowning (Medi Lexicon International, 2007). From all the
above it seems that cold water can hasten this process of drowning (Goode et al., 1978).

### 2.6 Pedagogical Approach to Drowning

Based on water safety educators across the world, a number of empirical theories or models have been developed to provide effective education for drowning prevention. Such theories and models include the RID factor of drowning (Pia, 1984), the 5-minute scanning strategy (Griffiths, 2000b), the Connolly C-zones (Connolly, 2004a) described in the first chapter, as well as the chain of drowning, lifeguard surveillance protection rules, casualty recognition, and the water safety code that will be described below.

The 5-minute scanning strategy (Griffiths, 2000b) was developed based on the finding that after 15 minutes of performing a simple task, people’s performance on that task tends to deteriorate. Lifeguards should, therefore, change posture and scanning technique every 5 minutes in an attempt to maintain high levels of effectiveness. The C-zones (Comfort, Concern, Crises, Critical and Cardiopulmonary resuscitation) are used to explain how a drowning casualty tends to progress through a number of worsening stages or zones (Connolly, 2004a). Similarly Pia (1984) hypothesized that drowning can occur even when a lifeguard is present, due to a failure to Recognize the symptoms of drowning (R), due to Intrusion (I), or Distraction (D).

#### 2.6.1 Chain of Drowning

Drowning incidents follow a standardized pattern, which can best be described as a chain of linked events. Each link leads directly to drowning or to the next link (Key, 1993; Eaton, 1995). These links are (Royal Society for Prevention of Accidents & Royal Life Saving Society UK, 1993; Eaton, 1995; Avramidis, 2001a; 2002e; 2002f): (1) lack of education (e.g. ignorance of dangers, of educational leaflets, water safety manuals, rescue techniques, preventative strategies, etc.); (2) lack of safety advice (e.g. forecast news for the incoming day’s weather, information regarding unknown aquatic areas that are going to be visited, etc.); (3) lack of protection (e.g. absence of personal flotation devices on board or in other aquatic activities, improper maintenance of commercial or recreational aquatic equipment, etc.); (4) lack of supervision (e.g.
swimming in the absence of a lifeguard, unaccompanied youngsters, etc.); and (5) inability to cope (e.g. due to poor swimming fitness, strong currents, waves, person out of depth, unexpected immersion in cold water, etc.).

2.6.2 Lifeguard Surveillance Protection Rules

A number of protection rules have been suggested for lifeguard surveillance. The 10/20 protection rule was established for pool/water park lifeguard surveillance, and recommends 30 seconds of response time to a drowning incident where 10 seconds is required to detect the casualty and 20 seconds to perform the rescue (Ellis & Fick, 1992; Ellis & White, 1994). The 10/10 protection rule was established later for smaller swimming pools and suggests a 20-second response time to a drowning incident with 10 seconds to detect the casualty and 10 seconds to perform the rescue (YMCA, 1997). Finally, the 30/120 protection rule was established for open water and suggests 150 seconds of response time to a drowning incident: 30 seconds to detect the casualty and 120 seconds to perform the rescue (see Fenner et al., 1999). Although later scientific research questioned the validity of the 10/20 rule (Ellis and Associates & Poseidon Technologies, 2001; DeRosa, 2008), nevertheless, all the above protection rules remain useful tools when combined with other strategies (e.g. 5-minute scanning strategy, and the RID factor; Pia, 1984; Griffiths, 2000a).

2.6.3 Casualty Recognition

After appropriate surveillance the second step for successful rescue is casualty recognition; this requires knowledge about the casualty’s instinctive drowning response and the casualty type. A well trained and supervised lifeguard should be able to detect the casualty’s instinctive drowning response (e.g. a 20- to 60-second surface struggle of the drowning non-swimmer prior to submersion, who is unable to shout for help, thrashing the upper arms laterally; Pia, 1984; 2008). There are four types of internationally accepted casualties (Fenwick, Patrickson & Southgate, 1992; Whatling, 1994; Eaton, 1995; Banham, 1997; Sims, 1997; Lifesaving Society, 1999a):

a. The injured swimmer (figure 2.2a): injured casualties have an awkward position in the water, gripping the injured part of their body (Whatling, 1994; Eaton, 1995).

b. The weak or tired swimmer (figure 2.2b): these casualties are also known in the literature as distressed swimmers (Lifesaving Society, 1999a).
Unless they are rescued, distressed swimmers can become drowning casualties.

c. The non-swimmer (figure 2.2c): these casualties maintain a vertical position in the water. They struggle against drowning on or near the surface (American Red Cross, 1995; Lifesaving Society, 1999a) for only 20–60 seconds (Pia, 1984; 2008). If immediate assistance does not come, they will disappear from the surface and eventually drown.

d. The unconscious swimmer (figure 2.2d): this type of casualty does not create complications during the rescue. Nevertheless, an efficient and fast response is required. In cases where breathing is absent, expired air ventilation must take place in the water if possible.

![Figure 2.2: Casualty Types Described in the International Literature.](image)

(a) Injured Casualty  (b) Weak–Tired Casualty or Distressed Swimmer  (c) Non-Swimmer or Active Drowning Victim  (d) Unconscious Casualty or Passive Drowning Victim

Avramidis (2003).

### 2.6.4 Water Safety Code

The initial measures for preventing drowning are through theoretical education. A large number of guidelines recommend ways of behaviour in, on, or near water. Some of them are (Lifesaving Society, 1999a; Water Safety New Zealand, 2000a; 2000b; 2001a; 2001b; Avramidis, 2001b; 2006):

- Do learn to swim
- Always swim parallel to the shore
- Swim only after 1–3 hours from finishing a meal
- Never mix alcohol and swimming
- Do always wear a personal flotation device
- Children, elderly people, pregnant women, and disabled people must be supervised
- Do swim in lifeguard supervised areas
- Do follow the regulations of the aquatic area (flags, signs etc.)
- Know the local dangers and the weather forecast before you go swimming
- Do not hyperventilate into the water
Do not overestimate your ability and never exceed your limits
Do tell someone where you are going and when you expect to return
Do spend 10 minutes checking the wave pattern and tides before you swim

To make a more flexible educational pattern that could be used not only by adults but also by young children, water safety organizations developed a water safety code, which varies from country to country. It contains such aspects as (Amateur Swimming Association, n.d.; Singapore Life Saving Society, n.d.; 1990; Royal Life Saving Society UK, 1995; Avramidis, 2006; Water Safety Council, n.d.): (a) water is dangerous; (b) spot the danger; (c) take safety advice; (d) never go alone; (e) learn how to help; and (f) float and wait (If in trouble, relax, roll onto your back, wave with one arm).

2.7 Psychological Approach to Drowning

2.7.1 Age Related Behavioral Characteristics
Across the lifecycle the capacity for learning is related to the external environment and will differ between people of various age groups. For example, 6-year-old children (n=20) overestimated their abilities for performing tasks that were well above their capabilities. This overestimation was related to accident proneness and to the attractiveness of the goal. When a child wants to reach an attractive object he/she makes an affirmative judgment of his/her ability. A child will try to initiate a difficult task when a mother expresses joy, but will not when she expresses fear or anger (Plumert, 1995). Also, in the USA children aged 7–15 years old account for 25% of all drownings and 40% of all sports, recreation and exercise (SRE) related emergency department visits. They may be at risk because their co-ordination, psychology, skill or perception is underdeveloped or because they demonstrate initiative, and frequently attempt risky activities copying scenes that they have seen on television (Giotis, 1985; SEGA Lifeguard Potential Program, n.d.; Pelletier et al., 2000). Adolescents and young adults under the age of 25 years have high participation rates in SRE activities and experience almost 33% of all SRE-related injuries. Some younger people do not have adequate experience to protect themselves and they unintentionally take avoidable risks that may be obvious to adults (e.g. swimming in icy water, swimming unattended, etc.). Similarly, some older chil-
Finally, adults might be in danger of drowning for several reasons; first, because they swim outside patrolled areas (n=3,371; Mc Cool, Moran, Ameratunga & Robinson, 2008); second, because they swim after consuming alcohol (Lifesaving Society, 1988; 2000b); third, because young adults and men are more likely to self-report having strong swimming skills, have more frequent at-risk swimming behaviour and lower perception of drowning risk (Mc Cool, Moran, Ameratunga & Robinson, 2008); fourth, adults often overestimate their abilities, particularly when tasks are just beyond their ability (Plumert, 1995).

Table 2.4: Risk Factors for Onset of Risk-Taking Behaviour in Adolescents.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Chronic family conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchrony of biological/psychosocial development</td>
<td>Lack of skills to resist engagement</td>
</tr>
<tr>
<td>Attitudes and beliefs that demonstrate a lack of awareness</td>
<td>Sensation-seeking personality</td>
</tr>
<tr>
<td>Peer group that considers normative behaviour</td>
<td>Depression</td>
</tr>
<tr>
<td>Multiple school transitions</td>
<td>Aggressiveness</td>
</tr>
<tr>
<td>Familial engagement in risk behaviour</td>
<td>Permissive</td>
</tr>
<tr>
<td></td>
<td>Male gender or authoritarian family</td>
</tr>
</tbody>
</table>

Adapted from Irwin & Ryan (1989).

2.7.2 Definition, Types and Features of Risk-Taking Behaviour

Risk is an epidemiological, sociological and psychological idea. It is conceived as reflecting variation in the distribution of possible outcomes, their likelihoods, and their subjective values. It is measured by the probability distribution of possible gains and losses associated with a particular alternative (Pratt, 1964; Arrow, 1965). In other words, to consider behaviour as risk-taking, it must have either a potential outcome without injuries or may result in harm (Irwin, 1989). Risk-taking behaviour is the voluntary participation in behaviours that contain, or seem to contain, a significant degree of risk (Llewellyn, 2003).

Risk can be beneficial to people for a number of reasons. First, because according to the broaden-and-build theory, it may be a means for achieving positive emotions that are important markers of optimal well-being (Fredrickson, 2004). Moments in people’s lives characterized by experiences of positive emotions (e.g. joy, interest, contentment, love, etc.), are moments in which they are not plagued by negative emotions. Consistent with this intuition, the overall balance of people’s positive to negative emotions has been shown to contribute to their subjective well-being (Diener et al. 1991). Second, human beings need to take risks because they desire to explore the world and its ca-
Einstein (1935) argued that humans seek to escape from their personal life into the world of objective perception and thought. Finally, according to others, risk is necessary for achieving learning (Bowman, 2009).

According to Llewellyn (1993), there are three different risk-taking types and five features of risk-taking behaviours. The risk-taking types are: the 'risk avoiders' who avoid activities due to the risks involved; the 'risk reducers' who participate in high-risk activities in spite of the risks involved; and the 'risk optimizers' who participate in high-risk activities partly because of the risks involved (figure 2.3). The first feature of risk taking is that it may be conceptualised as a personality trait expressed through the participation in behaviours that contain a significant degree of risk. Second, 'significant' physical risk behaviour can be defined as behaviour that entails a relatively high probability that something serious will happen (e.g. injury or death). Third, risk taking is a matter of degree, a continuum rather than a dichotomy; it may be simpler to think of people as 'risk takers' and 'non-risk takers' but this is an abstraction that may or may not be useful depending upon the circumstances. From a different perspective everyone is a risk taker, admittedly to differing degrees. The severity and frequency of risk-taking behaviours may be relative to other people’s behaviours rather than any objective benchmark or absolute function. Fourth, risk-taking behaviours must be voluntarily. Individuals exposed to risk are not necessarily risk takers. True risk taking is expressed in behaviours with a full awareness of the risks involved. Fifth, individuals take differing risks in different aspects of their lives; further research is needed to examine whether risk-taking behaviours generalise to the degree that they can be treated as being functionally equivalent in psychological terms.
2.7.3 Rationale about Risk

People take risks for a number of reasons. First, because they have never been hurt, so have been lucky. Lack of any injuries rewards the person's unsafe behaviour. Behaviour that is rewarded by lack of punishment or injury tends to be repeated. Second, because they ignore training, safety rules, signs and precautions. Third, because, they honestly think that this is the only way of doing a specific activity. Fourth, because they expect that misfortunes will happen to others. They believe that they are less likely than the average person to suffer bad things in life and more likely than the average to experience good ones. Therefore they think 'unrealistically optimistically'. Finally, because they decide that is better to risk failing than to avoid trying when the consequences are less aversive (Weinstein, 1980; Plumert, 1995; Rutter, Quine & Albery, 1998; Construction Industry Training Board, 2002).

Considering the above, the question that arises is why some people are willing to take risks in certain areas of their lives and not others (Slanger & Rudestam (1997). The answer might be simply because people may lack the opportunity to participate in certain activities due to financial difficulties, so they possibly try to find different behavioural expressions for the same needs. Also, additional personality traits may predispose people to take certain kinds of risk. For example, people who are low in neuroticism may be more likely to become parachutists than drug users (Llewellyn, 2003). Finally, risk takers may make use of fear to trigger arousal, getting psychological pleasure through the re-
lease of epinephrine and norepinephrine hormones (Zuckerman, 1979). They are usually highly-skilled people (e.g. wind surfers have to have strength to remain on the surf board for a long time in rough weather; Franken, 1998), and do not experience high levels of fear (Fenz & Epstein, 1969; Miles & Priest, 1990). While they behave riskily getting involved in an activity that requires developed coping skills in the face of uncertainty, they feel self-satisfaction (Franken, 1998). Many risky activities require speed or height which triggers an innate anxiety and fear. Those increases in arousal lead to an increase in emotions (Schachter & Singer, 1962).

Given that danger is related to fear, it is difficult to understand why some people seek confrontation with danger (Piet, 1987). One explanation might be that many people become addicted to danger because they feel sensationally high when they see challenge by confronting danger (Garbarino, Kostelny & Dubrow, 1991). A second opinion is that individuals can enjoy danger in risky activities as pleasant if there is the necessary preparation that allows personal control over the risk taking (Slanger & Rudestam, 1997). This is called ‘phenomenological or protective frames’ (Apter, 1982). Where the so-called protective frame is not operative, every risk-taking activity possibly can provoke fear and anxiety (Trimpop, Herr & Kircaldy, 1999). Consequently, if risk takers are anxious in situations that contain fear, risk and danger, because of the activation of norepinephrine they perceive the activities in which they are engaged as fearful, without risk or danger, expecting that the outcome of their risk-taking behaviour will be less negative (Lykken, 1982; Franken et al., 1992). A third explanation is that individuals are more likely to take risks in a voluntary activity (Hewitt et al., 1995) that is recognized as risky by other people (Lightfoot, 1997). Therefore, part of the problem of risk-taking behaviour relies on the relationship between individuals and their social groups, that is the relational context in which a person’s actions (e.g. someone goes scuba diving or sailing alone in rough weather) have meaning. The interview below illustrates clearly the above statements.
My two best friends graduated, so I don’t do as much anymore. We would go swimming in the lake in the middle of winter, race our cars around on some of the back roads, and sometimes get pretty destructive. It was fun but now I am calming down. I am not as inclined to do it alone. It would be lonely. It kind of strengthens the bond of friendship. If it is something risky then you will both remember it fondly, having outgrown it. You think back to the time you drove the car at 90 mph and hit a speed bump and took off in the air. It was kind of scary you remember who was in the car with you.

(Lightfoot, 1997; p. 111).

Risk takers will have to deal at some point with other people who perceive the same activities as dangerous, risky and life threatening (Franken et al., 1992). These people could be lifeguards, for example, who are responsible for preventing dangerous and risky situations. It can also be regulations, flags or warning signs that prohibit given behaviours in, on, under, or around the aquatic environment. According to Franken et al., (1992) risk takers will ignore or disregard information that isn’t consistent with their behaviours because this is the only way of dealing with the discrepancy between their behaviour and the perceptions of other people.

2.7.4 Psychological Profile of High-Risk Sports

Sporting risk takers tend to be confident that they can manage the risks involved, and have friends who also choose to take potentially life-threatening risks (Llewellyn, 2003). They are willing to take physical risks to trigger the ‘fight or flight’ response, as they believe themselves to be in control of the risks; they understand their high arousal as excitement, whereas others interpret similar sensations as fear. This gives them feelings of satisfaction derived from the exercise of control in dangerous circumstances that they perceive to be challenging rather than threatening. Risky situations that do not involve a large degree of personal control (e.g. Russian roulette), are unlikely to appeal to this kind of risk taker (Llewellyn, 2003). Dangerous activities are sought when the reward outweighs the punishment and when a risky sporting activity provides an intrinsically rewarding experience that is unique to the particular form of sporting activity (Cogan, 1999). People of this category are more likely to be males, and may be low in neuroticism, suggesting resilience to adverse stimuli, and low in anxiety, which may partially explain their self-confidence (Llewellyn & Sanchez, in press). If the risk-taking sports participant has to be described in a sentence, one might say that they were a confident and physi-
cally adventurous risk taker motivated by mastery needs. This profile accounts for around 60% of the participation in high-risk sports (Llewellyn, 2003). Risk takers seeking sensation by participating in an activity are more likely to report both a lifetime history and family history of anti-social personality (n=335; Ball, Carroll & Rounsaville, 1994).

2.7.5 Anti-Social Risk-Taking Profile
Anti-social personality might lead to drowning through health risk taking or anti-social risk-taking behaviour. One such example is binge drinking. Many drowning victims are found to have consumed alcohol (Mackie, 1978; Eaton, 1995; Bierens et al., 1996; Smith et al., 2001). One explanation behind this might be that people perceive risky activities as being less dangerous when intoxicated than when sober. To the extent that alcohol intoxication or other drug effects reduce the belief that negative consequences will occur, it seems reasonable to expect an increase in risk-taking behaviour (Fromme, Katz & D'Amico, 1997). For example, adolescents are aware that their behaviour is risky and it is different from the decision-making processes of adults regarding consumption of alcohol and drugs combined with reckless driving (Lightfoot, 1997). Furthermore, in terms of gender, males are more likely to have driven having taken alcohol or narcotics, while females are likely to have ridden in a car with an intoxicated driver (see Lightfoot, 1997). Although there is no later reference for the above finding to understand what is happening between males and females, this finding explains that both are risk-taking behaviours.

2.7.6 Managing Risky Behaviour and Preventing Drowning
Drowning as a result of risk-taking behaviour can be minimized by changing the individual behaviour, social norms, legislation and governmental and institutional policies that will reduce risks and increase protective factors. Two frameworks that may be used for this purpose, are the ‘Programs-That-Work’ and the Haddon Matrix. First, the ‘Programs-That-Work’ (PTW) are health education programmes with credible evidence of effectiveness. If a programme is identified as a PTW on the basis of external review, then it is packaged and made available for dissemination to education and youth agencies. Thousands of educators seek information about PTW (Collins et al., 2002). Second, a systematic approach to drowning prevention using the Haddon Matrix offers the possibility of developing innovative and acceptable interventions in terms of prevention, rescue and treatment. This matrix was implemented
successfully, reducing car-related morbidity and mortality (Haddon, 1970; 1974; 1980; 1989). According to this framework injuries occur in a certain time sequence and under the influence of a number of factors. In terms of time, the framework would involve the pre-event phase (e.g. the time before the event occurs), the event phase (e.g. the precise time of the injury), and the post-event phase (e.g. the time that follows the event phase). On the other hand, factors that involve an injury occurrence are the person who is involved in the injury, the equipment that is involved in the injury, and finally the physical and social environmental situations in which an injury might take place (see Haddon, 1980; Ryan, 1998; McKenna & Hammond, 2007). The combination of these two axes constitutes the Haddon Matrix. Prevention can be focused in any cell of the Haddon Matrix.

Haddon identified a number of strategies that, when used in combination with the matrix, can determine the best possible interventions for a drowning episode (adapted from Haddon, 1980; Virginia Department of Health, 2009):

1. Prevent drowning happening in the first place (e.g. lifeguard presence, warning signs, teaching people swimming)
2. Reduce the amount of the existing hazard (e.g. reduce unguarded locations, prohibit swimming in the deep end of a pool for those wearing arm-bands)
3. Prevent the hazard (e.g. prohibit horse-play, hyperventilation and other dangerous activities in the water)
4. Separate bathers in time or space from the hazard (e.g. prohibit swimming in high tidal waters or wavy seas)
5. Separate people from the hazard by interposing a material barrier (e.g. pool fencing, buoyant objects connected with a line across the beach)
6. Modify the relevant basic qualities of the hazard (e.g. maintain the pool water at temperatures that will not trigger hypothermia)
7. Make the person more resistant to damage (e.g. swimming ability of bathers)
8. Counter the magnitude of a drowning incident (e.g. rescue services, emergency medical services)
9. Stabilize, repair and rehabilitate the drowned person (e.g. effective pre-hospital treatment like cardio-pulmonary resuscitation and defibrillation)
2.8 Summary

This chapter aimed to cover important definitions and aspects related to drowning and to initiate a multi-disciplinary approach from a descriptive epidemiological, sociological, patho-physiological, pedagogical, and psychological perspective. It has shown that drowning continues to be a contemporary serious social and health problem worldwide. It is linked to patho-physiological responses such as hypothermia, cold shock response and diving reflex. A number of empirical pedagogical approaches have been given as a means for preventing drowning. Risk-taking behaviour might lead to drowning. Therefore, it seems that to fully understand drowning a multiple methodological approach is needed. Consequently, the next chapter will explain how injury epidemiology, psychology and pedagogy can be synthesized in a research design in order to create a model of drowning for accident prevention and safety promotion.
Chapter 3: Methodology
3.1 Introduction
The previous chapter shows that to understand drowning a multidisciplinary methodological approach is needed. The most appropriate research tools are those that maximise confidence in judging truth claims (Seale, 1999). Therefore, the aim of the present chapter is first to establish the theoretical basis of the philosophy of research and, second, to explain the methodological procedure that will follow to construct a model of drowning for accident prevention and safety promotion.

3.2 Philosophy of Research

3.2.1 Different Paradigms and Perspectives
Every research study sits within a selected paradigm. A paradigm is the set of practices that guide a scientific area and summarises the beliefs of researchers (Morgan, 2007; Doyle et al., 2009). It is also defined by how we know what we know, the nature of reality and the process of research (Hanson, et al., 2005). Therefore, it will influence the type of research questions and methods chosen by each researcher in a given study (Morgan, 2007). Traditionally, most sport science researchers prefer quantitative research (e.g. positivist paradigm) and fewer prefer qualitative research designs (e.g. constructivist paradigm). Some believe that these paradigms are different and their combination is not possible (Sandelowski, 2001). However, the number of researchers choosing to use qualitative designs is increasing (Creswell, 1994). The rationale behind constructivism is that because there are multiple realities in whatever can be researched, different interpretations may result from any research endeavour (Appleton & King, 2002). The rationale behind the positivist point of view is that research results are not biased by the researcher who, unlike in the qualitative research, is not initiating an in-depth study (Firestone, 1987). In other words, the scientific assumption is that qualitative studies are by nature subjective whereas quantitative studies are objective (Doyle et al., 2009). However, as no research is above criticism the distinguishing mark of good quantitative and qualitative research is the acknowledgement of error (Oakley, 2000). Collectively, the above points suggest a need for another paradigm that will combine the previous two and serve as a useful tool in research design.
3.2.2 Emergence of the Mixed Methods Paradigm

Although mixed methods research is dealing with only one of the components that constitute a paradigm (i.e. ontology, epistemology, methodology), it is now treated within the literature as an emerging research design in recent years (Doyle et al., 2009). It aims to bridge the gap between positivism and constructivism (Johnson & Onwuegbuzie, 2004; Hanson, et al., 2005). The philosophy behind this is that consequences are more important than process and the conclusions of a study justify the paradigm (Johnson & Onwuegbuzie, 2004). Researchers are increasingly identifying the benefits of using a mixed methods design in their studies. Because this is a new way of collecting and analysing scientific data, debate persists as to what constitutes mixed methods research and what are the benefits to researchers and society (Sandelowski, 2001; Bryman, 2007). According to Tashakkori & Creswell (2007, p. 4), mixed methods is defined as ‘research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study’. This definition will change as this type of research approach emerges over the years (Johnson, et al., 2007). Therefore, the question to be asked is whether there is any published literature to suggest that ‘evidence’ can be mixed.

3.2.3 The Basis on which ‘Evidence’ can be Mixed

As shown above there is an extensive debate on whether positivism and constructivism can be compatible and co-exist in a single research design (Howe, 1985; Smith & Heshusius, 1986; Yanchar & Williams, 2006; Bryman, 2007; Morgan, 2007). Some argue that this is impossible because those two paradigms are mutually exclusive (Sandelowski, 2001). Others argue that competition between paradigms is not helpful and that the focus should turn to ways in which qualitative and quantitative research can be mixed (Sale, et al., 2002; Stevenson, 2005). More optimistic authors move beyond this ‘fight’ arguing that the field of mixed methods research can focus on the strengths of quantitative and qualitative research, and identifying how these can be incorporated in a single research design to maximise the strengths and minimise the weaknesses of each other (Johnson & Onwuegbuzie, 2004). The same authors insist that the design of research studies should include combined methods that will be more likely to offer higher chances of answering specific research questions. The philosophy of pragmatism advanced the notion that consequences are more important than process.
The 4W Model of Drowning (Doyle, Brady & Byrne, 2009). It also helps to give insights on how research approaches can be mixed fruitfully (Hoshmand, 2003). Therefore, researchers should use the paradigm that works best in real circumstances. In other words, what works is what is useful and should be used, regardless of the philosophical and paradigmatic debates or any other assumptions (Johnson & Onwuegbuzie, 2004).

3.3 Rationale about the Research Design

3.3.1 The Role of the Researcher
The present thesis was undertaken by a researcher with two distinctive characteristics that determined the type of research approach that was used. First, the researcher was not a sterile quantitative or qualitative scientist who would seek to use a specific paradigm because this was what he was taught to use. The decision to choose a particular paradigm and research approach was led by the type of questions that this thesis aimed to answer. Second, the researcher was a highly qualified aquatic safety professional with related education and work experience in 13 countries, having rescued over 80 people and taught lifesaving and lifeguarding to more than 8,000 others in over 15 countries for 16 years. Because of this, the research questions would be better analyzed and understood. For example, a person who has not personally experienced a drowning incident either as rescuer or victim, might not be in a position to ‘feel’ fully the dynamics of the emergency episode or to empathize with the people involved and ask sensitive questions. On the other hand, the researcher would also attempt to be dispassionate and keep some distance from the research data, in order to be able to ‘encode’ them unattached from the incident in a way that others would have used.

3.3.2 Research Design of the Thesis
Consideration of the previous debate about different paradigms, their strengths and limitations, and the personal characteristics of the researcher, led to the decision to undertake a mixed methods approach constituted by three studies in this thesis (figure 3.1). The first study was a review of quantitative studies, aiming to support the development of the theoretical framework of a 4W model. This model would contain all the variables that could possibly be present during a drowning incident (e.g. rescuer
characteristics, casualty characteristics, place and circumstances of occurrence of a drowning incident). The second study was based on observations of video recorded drowning rescues, aiming to assess whether or not the variables from the first study were present and find possible emerging variables. The third study was based on interviews, aiming to assess whether or not the variables found in the first study were present, and find possible emerging variables, but also to give insights into questions that were left unanswered by the second study. Finally, the variables that were present in all three specific sets of data were synthesized to formulate the 4W model of drowning. All these will be explained below.

**Figure 3.1: Graphical Representation of the Research Design of the Thesis.**

<table>
<thead>
<tr>
<th>Specific Sets of Data</th>
<th>Synthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 1 REVIEW (Review of Quantitative Studies)</td>
<td>1 + 2 + 3 = 4W Model</td>
</tr>
<tr>
<td>Study 2 Qualitative 1 (Videos)</td>
<td></td>
</tr>
<tr>
<td>Study 3 Qualitative 2 (Interviews)</td>
<td></td>
</tr>
</tbody>
</table>

### 3.3.3 Review Study
The first study was an extensive review of the literature on quantitative studies. It was important that this type of research came first in the current research design because the initial aim for the development of the 4W model was to identify as many variables related to drowning as possible. This could better be achieved by reviewing a broad range of quantitative studies that had already examined the drowning problem and located a number of related variables than by undertaking a quantitative or qualitative study with a limited sample. The terms ‘drown’, ‘aquatic emergency’, ‘risk factors’, ‘lifeguard’, ‘water safety’, ‘lifesaving’ and ‘rescue’ were used as key words in a search undertaken to identify literature with variables that might be involved in a drowning incident. The search used academic and professional aquatic safety textbooks that are routinely available in libraries, electronic databases typically
available in academic libraries (e.g. Medline, Sport Discuss, Sport Discuss with Full Text, PsychINFO and PubMed) and search engines (e.g. Google and Yahoo) covering studies that assessed the epidemiology and risk factors of drowning. The available literature was limited to those available and published in Greek and English. Those qualitative data that were generated (i.e. variables related to drowning) were clustered in four pre-determined clusters namely ‘rescuer’, ‘casualty’, ‘place of drowning’ and ‘circumstances of drowning incident’. In an effort to identify as many variables related to drowning as possible, this review study included in the clusters not only variables that were well documented in the literature but also variables that appeared to be related to drowning in case studies. This ensured that possible contributing variables that might have been neglected from the water safety related literature would not be missed and would be given an equal chance of being included in the theoretical framework of the thesis.

3.3.4 Observational Content Analysis

The second study was a qualitative approach based on observation of video recorded rescues of actual or simulated drowning incidents. Although it can be used to examine any piece of recorded communication (e.g. Hart, 1996; Konger, 1996; Shaw, 2002), no studies have used observation content analysis in lifesaving regardless of the mother discipline. Like every method, observational content analysis has advantages and disadvantages that need to be taken into account.

Observational content analysis has three important advantages that made it an approach worth using in this research. Humans perceive the environment almost completely by audio-visual means; as video captured audio-visual information it became extremely useful because it allowed a detailed analysis and coding of the recorded data (Volkmer et al., n.d.). Also video records were a rich source of data for documenting performance which revealed safety, a powerful training tool and provided a reusable record of events that could be repeatedly reviewed and used as research data of critical events, trauma and resuscitation (Mackenzie & Xiao, 2003). Finally, by using observational methods the research could focus on the content of communicative behaviour (Bowers & Courtright, 1984).
Observational content analysis of video recordings is underused in improving safety (Mackenzie & Xiao, 2003) because a number of possible disadvantages may affect the quality of the data. First, there was a dearth of suitable processing and communication supporting platforms that could decide which information should be extracted (Oliveira et al., n.d.). Second, because the researcher was not present at the event, some information could be missing (e.g. the video recording did not start from the beginning of the drowning episode, the amateur camera man was running during the recording and some scenes were not easily observable etc.). Third, some issues may be over-represented or under-represented in a sample of drowning incidents (e.g. a video camera was placed in a given aquatic area and recorded a number of drowning incidents with similar characteristics, as opposed to other drowning episodes that were recorded randomly and non-systematically and therefore the variables that appeared in them did not have the same frequency as in the first). Finally, because the act of being observed initiates change in individuals’ behaviour (e.g. people may not have behaved riskily in an aquatic environment if they knew that no video camera nor bystanders would watch their stunt etc.). All the above disadvantages were inevitable in this type of research but it was hoped that missing information from this study would be reported in the other two studies (study 1 with the review and study 3 with the interviews).

In the present observational content analysis study, using a criterion sampling method, a sample of a number of video recorded aquatic rescues that were available in the public domain were used. To deal with the various disadvantages shown above, the objective and subjective audio and visual content of the video were observed without unsupported assumptions and editorial comments. The audio-visual content was transcribed twice within a period of six months. This text was inserted into the computer software NVivo for content analysis. A number of codes, based on the variables that were found in the first study, were identified within the text. Boolean search with matrix intersection revealed which variables and which combination of variables existed in the drowning episodes. Frequencies were measured and a model framework was suggested based on the frequency with which the variables appeared and the way they interrelated with other variables. Chapter 5 will give a more detailed description of the methodological procedure.
3.3.5 Semi-Structured Interviews

The third study used a qualitative approach based on semi-structured interviews of aquatic safety professionals and aquatics athletes who were involved in a drowning episode. This type of research was thought to be the most appropriate for looking at events that could involve emotions. Also the time lapse which may have occurred would necessitate a very special approach and therefore, it was very important that the voices of the people themselves should be the key source of evidence for the aquatic emergencies that took place. Interviewing people was considered to be a good way to encourage remembering, making interviewees able to document their experiences and perceptions that would then be related to the variables that constituted the 4W model.

A number of issues would inevitably affect the quality of the data. First, by interviewing people who had worked as lifeguards, it was likely that they would report drowning incidents that occurred while they were on duty, over-representing this particular time or season of occurrence and under-representing others. To deal with this, not only lifeguards but also aquatics athletes and other rescue services personnel were interviewed. Second, a number of other variables were assessed based not on scientifically designed measurements but on rough perceptions of the interviewees (e.g. distance of the drowning incident from the shore, water depth, etc.). To deal with this, the participants were asked to give approximate descriptions instead of precise details for those variables.

A combination of convenience and snowball sampling located participants who could describe a drowning episode. Anonymity and confidentiality were maintained. The participants got a participant information sheet and signed an informed consent form. The interview schedule included open-ended questions. The interview was transcribed and inserted into the computer software NVIVO for content analysis. The same methodological procedure as in the previous study (that examined observation of video recorded rescues) was followed. Chapter 6 will give a more detailed description of this methodological procedure.
3.3.6 Synthesis

The variables that were present in all three specific sets of data were synthesized to formulate the 4W model of drowning. More specifically, the variables that were found in the first review study to be related to drowning were assessed in the second and third study (video analysis and interviews) and their frequency was measured. Based upon those frequencies, it was estimated which variable and pair of variables appeared more often in the drowning incidents of the assessed samples of the two studies.

As mentioned previously, the present research design was based on a mixed methods approach. Many reasons have been identified for conducting such a research design. Greene, et al. (1989) identified five purposes and Bryman (2006) 16 reasons. Many of the rationales identified by those two authors are similar; the main rationales proposed by both of them are triangulation, completeness and illustration of data, offsetting weaknesses and providing stronger inferences, answering different research questions and explanation of findings, instrument development and testing that will be discussed below.

3.3.7 Triangulation

Triangulation describes a technique whereby two known points are used to locate a third one for achieving confirmation (Webb et al., 1981; Knafl & Breitmayer, 1989). The important feature of triangulation is the combination of different types of data and also the identification of different research techniques with certain strengths and weakness and their counterbalancing for minimizing threats of validity (Fielding & Fielding, 1986; Knafl & Breitmayer, 1989). When a proposition is confirmed by more than one independent measurement process the uncertainty of its interpretation is reduced (Webb et al., 1981). In the present thesis, evidence of a variable in all three studies will indicate that this variable may exist in actual events.
The application of multiple strategies of triangulation enabled further accuracy of the data set overcoming the intrinsic bias of single method, single observer and single theory studies (Denzin, 1989). Multiple triangulation was achieved in the present thesis by applying four types of triangulation (Table 3.1). First, a kind of researcher triangulation was attempted by maintaining a three-member research team of two PhD supervisors and one student who had a prominent role and different expertise that was evident in the thesis. More specifically, the student conducted the analysis and the supervisory team provided some kind of validation and legitimacy (Mitchell, 1986; Kimtchi et al., 1991). Second, data source triangulation was achieved by using multiple data sources (i.e. review of previous quantitative studies, videos and interviews) (Kimtchi et al., 1991; Shih, 1998). Third, method triangulation was achieved by three methods and data collection techniques (e.g. review of literature, visual observation and interview) which were chosen because each of them could present a different dimension of the research problem (Knafl & Breitmayer, 1989; Kimtchi et al., 1991). Fourth, analysis triangulation was achieved by using more than one strategy to analyse the same set of data (e.g. frequency percentage, multiple qualitative analysis modes etc.) (Kimtchi et al., 1991; Shih, 1998).

Table 3.1: Framework for Evaluating the Completeness of Undertaking Research using Multiple Triangulation.

<table>
<thead>
<tr>
<th>Type of Triangulation</th>
<th>Approach</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Researcher</td>
<td>3-member team with different roles</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>2. Data source</td>
<td>Review of literature</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water safety professionals</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Aquatics athletes</td>
<td>3</td>
</tr>
<tr>
<td>3. Method</td>
<td>Review of video recorded rescues</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Semi-structured interviews</td>
<td>3</td>
</tr>
<tr>
<td>4. Analysis</td>
<td>Descriptive statistical analysis</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>Frequency percentage</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>Multiple qualitative analysis modes</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>Observation content analysis</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Domain analysis linking data</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>Constant comparison</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td></td>
<td>Haddon Matrix</td>
<td>1, 2, 3</td>
</tr>
</tbody>
</table>

Note. Adapted from Shih, (1998).
3.3.8 Completeness and Illustration of Data
A mixed methods research design provided a more complete and comprehensive picture of the drowning problem than single studies (see Doyle et al., 2009). This was because the qualitative research approach used to illustrate findings of quantitative research could help paint a better picture of the drowning problem (Bryman, 2006). In the present research design this was achieved by undertaking a review of quantitative studies whose findings were then used in two qualitative studies that created the 4W model.

3.3.9 Offsetting Weaknesses and Providing Stronger Inferences
Research paradigms can be either quantitative, qualitative or have a mixed methods design. Some interdisciplinary health researchers suggest that qualitative research generates hypotheses and quantitative research tests them (Goering & Streiner, 1996; Morgan, 1998). However, this is a very limited interpretation of the roles of those two types of data, because each study design contributes to knowledge on its own (Morse, 1996). As shown previously, the ‘quality’ of qualitative research is frequently addressed within a debate suggesting that quantitative research is preferable to qualitative (Meyrick, 2006). However, because both types of research can exhibit the same problems, ‘the distinguishing mark of all good research is the awareness and acknowledgement of error’ (Oakley, 2000, p. 72). Qualitative research can contribute to the fields of public health and safety (Black, 1994; Macintyre et al., 2001) but researchers from these fields have little understanding of how to judge its rigour (Meyrick, 2006). Therefore, it is necessary to address the rigour of each one of the three studies and the overall mixed methods research design.

The three studies that were undertaken had a number of strengths and weaknesses (Table 3.2). The main strength of the first review study was that it provided external validity as it was based on a broad literature search of secondary quantitative data. The term ‘external validity’ is fundamental to positivist researchers dealing with quantitative techniques. On the other hand, the main strength of the second and third studies was that they both provided internal credibility, which in qualitative research with a more constructivist approach, is the equivalent of internal validity.
Table 3.2: Rigour of the Three Studies of the Thesis.

<table>
<thead>
<tr>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review</td>
<td>Video Analysis</td>
<td>Semi-Structured Interviews</td>
</tr>
<tr>
<td>Strengths</td>
<td>Internal credibility as the researcher had a number of drowning episodes to observe in-depth providing individual case information.</td>
<td>Internal credibility as the researcher analysed in-depth a number of drowning episodes providing individual case information.</td>
</tr>
<tr>
<td></td>
<td>Data collection was relatively quicker compared to the other two studies.</td>
<td>Researcher could document sequential patterns and change.</td>
</tr>
<tr>
<td></td>
<td>Research results of the reviewed studies were independent of the researcher.</td>
<td>Researcher could get more information about each drowning episode compared to the first study.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identification of local situations, conditions, and stakeholders’ needs.</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Researcher did not have direct control of the data and therefore could not have an in-depth understanding of who, why and when a drowning incident occurred, which is a fundamental requirement in injury epidemiology.</td>
<td>Small sample limited external generalizability of the findings.</td>
</tr>
<tr>
<td></td>
<td>Researcher may have missed out phenomena occurring because of the focus on the development of the 4W model.</td>
<td>Researcher could get less information compared to the third study, from the audio/visual messages that were extracted from each incident.</td>
</tr>
<tr>
<td></td>
<td>Researcher’s 4W variables may have not reflected local constituencies’ understandings.</td>
<td>The results were more easily influenced by the researcher’s personal biases and experiences.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficult to make quantitative predictions.</td>
</tr>
</tbody>
</table>
Following Johnson & Onwuegbuzie, (2004), the mixed methods research design provided a number of strengths. First, the words (i.e. variables related to drowning) and the audio-visual narratives used added meaning to the numbers from the quantitative studies reviewed in study 1. Second, the frequencies in the second and third studies gave more insight into the variables and narratives of the videos and interviews. Third, the researcher generated and tested the development of the 4W model of drowning. Fourth, the research was able to answer a broader range of questions related to drowning because it was not confined to a single method or approach. Fifth, in this three-study sequential design, study 1 results were used to develop and inform the purpose and design of studies 2 and 3 adding sequential validity. Sixth, the strengths of each of the methods compounded the weaknesses of the other two by using all of them in this thesis. For example, the lack of external generalizability of the second and third studies was offset by the external generalizability provided by the first review study. Also the weakness of the possible influence that the researcher could have due to personal experiences and biases in the second study and due to direct contact with participants in the third study, were counter opposed by the results of the first review study that were independent of the researcher. Similarly, the lack of in-depth understanding of the data in the first study was, again, counter opposed by the data provided in the videos and interviews. Seventh, the conclusions were based on stronger evidence and corroboration of findings. Eighth, there were higher opportunities to add insights that might have been missed if only one qualitative or quantitative method had been used. Finally, this mixed methods research produced more applied and theoretical knowledge for drowning prevention and safety promotion.

As shown above, the present research design, like every research, had its own strengths and weaknesses. Utilization of a mixed methods approach could allow the limitations of each approach to be neutralised while strengths were built upon, thereby providing stronger and more accurate inferences (Creswell, et al., 2003; Bryman, 2006). Therefore, by building on the strengths, while acknowledging and limiting the weaknesses of mixed methods research, the complex drowning problem could be addressed in a creative and imaginative way (Doyle et al., 2009).
3.3.10 Answering Different Research Questions
Mixed methods design helped answer research questions that could not be answered by quantitative or qualitative methods alone and offered a wider variety of tools to meet the aims and objectives of the study (Creswell & Plano Clark, 2007). Furthermore, a combination of research approaches was useful in understanding the dynamics of drowning because of the complex nature of phenomena and the range of perspectives that were required. For example, to examine whether a model of drowning could be implemented, there was a need not only to conduct a review of previous studies related to drowning. It was also necessary to see if these variables could be found in a study where the researcher could extract the desired information from the sample with specific questions (i.e. interviews) and in a study where the researcher would be detached from the data (i.e. videos). Similarly, in order to suggest a number of recommendations for drowning prevention and safety promotion a review of previous quantitative published work would provide a wide source of information whereas a number of qualitative studies (i.e. videos and interviews) would provide limited but in-depth information for each drowning episode.

3.3.11 Explanation of Findings
Mixed methods studies used a quantitative or qualitative research approach to explain the data generated from a study using the other research approaches (Doyle et al., 2009). This was useful when unanticipated findings emerged. For example, the findings from the review of quantitative studies (study 1) were followed up and explained by conducting observational content analysis of video recorded rescues (study 2) and semi-structured interviews (study 3) to gain an understanding of the findings obtained.

3.3.12 Instrument Development and Testing
A mixed methods study consisting of a review of quantitative studies followed by two qualitative studies could generate items for inclusion in a model. Although research has been conducted on drowning, this was the first attempt in the water safety literature to examine these aims with such a research design. Previous studies have been related to epidemiological, preventative, and forensic aspects without integrating them within an overarching theoretical model (Bierens, Knape & Gelissen, 2002). Furthermore, in injury epidemiology, research usually begins with the implementation of quantitative
or qualitative studies and continues with the integration and development of a model. In the present design the opposite was chosen. This was attempted in order to ensure that all possible variables that might be involved in a drowning incident would be identified and assessed. As the first study was an extensive review of the literature, its findings would not only have external validity but would also identify a broader number of variables compared to a qualitative study that would inevitably be limited to a small sample. Then, those variables would be used in the two qualitative studies that would follow (more details about the procedures that were followed will be given in chapters 5 and 6). Emerging variables that appeared in the videos and interviews but were not found in the review of the literature were also discussed, aiming to strengthen the validity of the research design from the opposite direction (e.g. starting from the interviews and the video analysis and ending with the review). The present research design added a two-way sequential validity to the thesis: first by conducting a review followed by a video analysis and interviews; second by synthesizing the additional variables that emerged in the two studies with those of the first study to establish the theoretical framework of the 4W model. Finally, systematic consistency was achieved by discussing the variables that appeared to be present in all three studies.

3.3.13 Hypotheses Development and Testing

A quantitative phase of a study was undertaken to develop hypotheses to be tested in a follow-up qualitative phase. A theoretical framework of a model, derived from experience and literature, was constructed. The primary goal of conducting three studies that would constitute the thesis was to test the model with hypothetical inputs (i.e. to see if the analysis of a number of drowning episodes from the videos and interviews would reveal that the examined variables could fit this model). Optimally speaking, the thesis would conclude that some variables were reported in all three studies while some others appeared only in two or one study, and therefore further research would need to be carried out.
3.4 Summary

This chapter had two aims. First, it discussed issues related to the philosophy of research. Research studies can have either quantitative, qualitative or mixed methods designs. Although the qualitative and mixed methods designs are relatively recent, they have been proposed as alternative and supporting research tools for allowing better insight into cases where quantitative research is unable to give answers to various research questions. Second, it tried to explain that a mixed methods research design based on a review of the literature study, followed by two qualitative studies of video recorded drowning rescues and interviews would be attempted. This is the first time that such a research design has aimed to establish a theoretical framework of a model on drowning in the water safety literature. The next three chapters will attempt to describe the three studies that constitute the main part of this thesis.
Chapter 4: 
*The 4W Model of Drowning*
4.1 Introduction

This chapter aims to identify variables that are related to drowning such as who can drown, who can rescue a drowning casualty, under what circumstances, and in which environment and will form the basis of the research as a holistic model of drowning. The research that follows will try to identify each variable individually.

4.2 Who (1): The Casualty

The expression of the early years ‘whomsoever you see in distress recognize in him a fellow man’ (see Pearshal, 1991), inspired thousands of lifesavers across the world. It was an order for every lifesaver who was present at the scene of a drowning incident. However, as the years passed, lifesaving became lifeguarding and rescue was transformed to prevention in order to predict and avoid the unexpected death. A number of variables needed therefore, to be considered for acting preventively (table 4.1).

Table 4.1: Variables that Classify the Casualty as the First Component of the ‘4W’ Model.

| Physical water fitness          |
| Disablility/medical problem     |
| Age                            |
| Gender                         |
| Ethnicity                      |
| Socio-economic background      |
| Demographic area of residence  |
| Number and type of family members |
| Occupation                     |
| Drug/alcohol consumption       |
| Hyperventilation               |
| Suicide–Homicide               |
| Unintentional water activity   |
4.2.1 Physical Water Fitness

Although good swimmers are considered as ‘waterproof’ two Greek case reports describe exactly the opposite. In 1996, Gogo Androultsou, a talented 16-year-old female long distance swimmer and member of the pre-national swimming team, fell unconscious at the bottom of the pool before the end of the daily training session. She was resuscitated unsuccessfully (Hitas, 1996b). Doctors initially revealed cardiac arrest (Hitas, 1996a) but the later post mortem examination revealed that inhalation of peptic liquids (possibly vomit) caused her drowning (Hitas, 1996b). A few days later, Nodas Samartzidis, a 32-year-old male, member and team captain of the Greek national water polo team (319 caps) in extremely good physical fitness, went spear gun fishing with a company of other water polo players (Athlitiki Iho, 1996). He was hyper-ventilating and diving very frequently attempting to catch a fish. For unknown reasons he did not surface again. Coast guard scuba divers recovered his dead body later on from a 40 m depth (Eleftherotipia, 1996). Although the above two examples are only single cases, and someone might argue that they do not provide enough evidence to support claims, they do show clearly that swimming ability is not a variable that can always guarantee safety in indoor or outdoor aquatic activities.

Often, there are news reports, like the above, that the drowned person was a good swimmer. The judgment that a person can swim can never be limited only to the movement of the body through the water for a number of metres. A qualitative judgment must include varied movement patterns and the qualities of movement itself. ‘How’ people swim is far more important than ‘how far’ they can swim (Stallman, Junge, & Blixt, 2002). While breaststroke is often proposed as the first stroke to learn for children and it is also the easiest stroke to swim with the head held above the water for those who dislike placing their face in the water, it was found that this technique increases the energy cost sufficiently to reduce survival time (Stallman et al., 2002). Therefore, any ‘good swimmer’, is not necessary able to cope with an aquatic emergency either as casualty or rescuer.
All of the above raise a series of questions: ‘To what degree are swimming lessons responsible for producing swimming skill? What evidence do we have that swimming lessons and swimming skill are related to reduced risk and rates of drowning?’ (Langendorfer 2008 p.1). Although aquatic experts suggest that teaching a child swimming could save its life in an emergency (Calabria & Lawrence, 2002; Smith & Wigglesworth, 2002), there is still no clear evidence that drowning rates are higher in poor swimmers (Brenner, 2002; Gilchrist et al., 2002) nor that the earlier introduction to aquatic instruction (younger than 2 years old) will translate into earlier mastery of basic skills at the age of 4 years (Parker & Blanksby, 1997). Some have even suggested that better swimming ability might lead to an increase in drowning rates through increased exposure and over-confidence in water. This can happen among young children because swimming lessons reduce the fear of water, and parents might tend to supervise them less closely. Regarding older children and adults, better swimmers are likely to get involved in more aquatic activities with risk settings (Brenner, 2002). A national survey where 5,234 responses were obtained from adults of both sexes, found that an estimated 37% of US adults have limited swimming ability (that was, unfortunately, undefined). Surprisingly, drowning rates did not correspond with reported swimming ability by age group or gender. This contradiction might be explained by other factors; males and young people might spend more time in the water than females, do more risky activities, consume more alcohol and overestimate their swimming abilities, than females and elderly people (Gilchrist et al., 2002).

From all the previous studies it is understood that it is not only the non-swimmers who drown. Being a good swimmer does not guarantee immunity from drowning (Thomas, 1990). The important matter, therefore, is not the level of the swimming ability, or at least this is not the only variable that determines the outcome of an aquatic incident. Gomez (2004) proposed a classification of users within five levels (e.g. analysis of the aquatic skills, body postures, water behaviour, pattern of movement in the water, and reaction to incidents), which confirm the concept ‘skills in the aquatic environment’. Although the study is not descriptive and detailed, it identifies the need for considering bathers more carefully. There are factors other than swimming ability that
cause death due to drowning, and so, prevention strategies should not only be focused on the level of water fitness but also on swimming ability.

4.2.2 Chronic Medical Conditions
Disability can significantly influence behaviour in the water during an emergency situation. Therefore, it is expected that a healthy person will have better chances of surviving from a drowning incident than the disabled person. Some disabilities are more dangerous than others and have presented scientific interest in relation to drowning. People with little or no experience of working with the disabled will tend not to work with them (Hatjiharistos & Avramidis, 2002). They believe that the disabled are excluded from participation in physical activities because of the ‘nature’ of their disability (Melograno & Loovis, 1991). This may happen possibly because they feel unable to provide quality services to the disabled (Melograno & Loovis, 1991; Thompson, 1992). However, as aquatic exercise has been suggested as a medium of rehabilitation for the disabled (Mac Mahon & Gross, 1987; Compton et al., 1989; Weiss & Jamieson, 1988; Rimmer & Kelly, 1989; Zonnenfeld, 1991; Santiago, Coyle, & Kinney, 1993), it is therefore obvious that the disabled should exercise themselves on a regular basis, and thus, some of them may unintentionally become involved in a drowning incident. Lifeguards and other water safety staff need to know how to assist them.

Epilepsy is a very well documented cause of a drowning death while engaged in an aquatic activity (Schmidt, Guggolz, & du Bois, 1991; Jilek & Rwiza, 1992; Lip & Brodie, 1992; Saxena & Ang, 1993; Schmidt & Madea, 1995; Osamura et al., 1997; Spitz, 1998; Verweij & Bierens, 2002). Drowning due to epilepsy has been documented in bath tubs (Schmidt, Guggolz, & du Bois, 1991; Lip & Brodie, 1992; Schmidt & Madea, 1995), swimming pools (public or private), showers, rivers, lakes, jacuzzis and in the sea (figure 4.1; Ryan & Dowling, 1993). Although the age of the drowned person varies (Kemp & Sibert, 1993) and the risk of sudden death is clearly related to the severity of the epilepsy (Jallon, 1999) some studies suggest that it occurs in children aged 5 years or older (Osamura et al., 1997) and adults aged 18–35 years (Bennani & Connolly, 1997). Despite these figures, only a limited number of studies have shown opposite facts, where among those children with epilepsy who died
People with autism have been reported to have drowning deaths. A survey that examined 104 drowning deaths of 0- to 14-year-old British children in the UK from 1988/1989 to 1998/1999 revealed that children with Autistic Spectrum Disorder might be at increased risk of drowning (Sibert et al., 2002). Some organizations underline the importance of providing care to those with mental illness, as there are reported cases where there were drowning incidents.
among them (Royal Society for the Prevention of Accidents & Royal Life Saving Society UK, 1993). Although the literature search failed to find other studies with similar or opposite results, the number of subjects and the fact that in the relatively short period of only two years of the above research so many children with autism drowned, may permit the assumption that autism might be a risk factor for drowning.

Limited evidence suggests that people with Angelman syndrome may drown. A case of drowning of a 6-year-old boy with Angelman syndrome, caused by a chromosome 15q11-q13 deletion, has been reported. This syndrome is characterized by mental retardation, seizures, ataxia, inappropriate laughter, lack of speech, distinctive facial appearance, and more importantly a fascination with water and water-related activities (Ishmael et al., 2002). This study reported a single drowning death, which means that is impossible to generalize from this finding. However, according to the authors, drowning may occur with increased frequency in this population, therefore, carers and parents should be aware of this fascination with water activities. From a scientific point of view, more studies are required for establishing Angelman syndrome as another contributing factor of drowning as the causes of his drowning might be unrelated to this syndrome.

People with other disorders associated with physical impairment, impulsive behaviour, and lack of speech may also have an increased risk. Diagnosis of Roman-Ward syndrome (a form of congenital long QT syndrome) has been made in patients who present drowning incidents leading to survival or death (Ishmael et al., 2002). Also drowning cases associated with cerebral palsy, Down’s syndrome and multiple handicaps with seizures have been reported (Sinaberger, Anderson, & Kraus, 1990). However, further research is required for assessing the level of risk for these groups in terms of drowning.

Pregnancy has been linked with drowning in one study. A study in Matlab, Bangladesh between 1976 and 1993 found that pregnant women or women who had recently given birth aged 15–19 years were nearly three times more likely to die from injuries (including drowning) than women of the same age who were not pregnant (Ronsmans & Khlat, 1999). Although no other study
related pregnancy with drowning, the fact that the above study examined pregnant women within a period of 23 years, provides reasonable evidence that there could be a relationship between pregnancy and drowning.

4.2.3 Age

Regardless of the drowning rates that each age group reaches, it has been shown that children are truly naïve victims in almost all immersion accidents. Their safety depends on the awareness and the sense of water safety against the magnitude of the threat, and on informed legislation and public education to combat the ever-present hazard of water (Pearn et al., 1976). It has been shown that different aquatic environments in different countries, demonstrate a different drowning pattern regarding age. A large amount of research has taken place in order to describe the drowning profile of each age group. Over half of all drowning deaths are of children below the age of 15 years (McGee, Krug, & Peden 2002). Research studies in Asia have shown that in many countries drowning kills more children annually than illnesses like pertussis, measles, diphtheria, plague, cholera, dengue fever, and typhoid combined and is the leading cause of death in children after infancy (UNICEF & TASC, 2004).

Children in the age group 0–5 years have been reported drowned in a number of countries (Branche, 1997; Ahmed et al., 1999; Royal Society for the Prevention of Accidents, 2001; Moon & Long, 2002; Uchiyama et al., 2002; Center for Research and Prevention of Injuries, 2003). Drowning accounted for 43% of deaths in the cohort and 18.9%–20% of deaths occurring in children under 5 years old (Baqui et al., 1998; Hyder et al., 2002). Among all age groups, children of this age group, (and adults aged between 18 and 49 years) have the highest drowning mortality rates worldwide (International Life Saving Federation, 2007a). A drowning incident takes many people by surprise, as it happens silently within seconds, in as little as 2–4 cm of liquid (Vincenten, 2001; Water Safety New Zealand, n.d. a).

Children in the age group 6–14 years have been reported drowned in a number of countries (Royal Society for the Prevention of Accidents, 2001; Center for Research and Prevention of Injuries, 2003). Drowning is the leading cause
of death among children aged 1–14 years in the European Union (figure 4.2). In this age group more than 70% of the victims are boys. In the USA, it has been estimated that for each childhood drowning fatality, another four children are hospitalized and 14 seen in the emergency department and released (Vincenten, 2001). In 1996–2002 Greece’s annual incidence rate of drowning (n=42 cases) was estimated to be about 6/100,000 children aged 0–14 years (Papadatos et al., 2004).

Figure 4.2: The Age Standardized Mortality Rates for Children’s Drowning in European Union Countries in the Age Group 1–14 Years.

![Figure 4.2: The Age Standardized Mortality Rates for Children’s Drowning in European Union Countries in the Age Group 1–14 Years.](image-url)

Taken from the World Health Organization as cited in Vincenten (2001).

People in the age group 15–24 years have been reported drowned in a number of countries (Royal Society for the Prevention of Accidents, 2001; Uchiyama et al., 2002; Center for Research for Prevention of Injuries, 2003). In a study that determined the causes of pediatric recreational wilderness deaths, it was found that 55% of deaths (n=40) were due to drowning in children aged 13–19 in five western Washington counties (Newman et al., 1998). This age group participates in fishing, power boating and walking near the water often under the influence of alcohol (Lifesaving Society, 2000b).

People in the age group 25+ years have been reported drowned in a number of countries (Royal Society for the Prevention of Accidents, 2001; Uchiyama et al., 2002; Water Safety New Zealand, 2003). As shown above, lifeguards
should be more vigilant while they are on duty. Obviously the same message applies to all people who get involved in aquatic activities, because although adults may be reasonably good in making rough guesses at what they are capable of doing, they have difficulties in making precise judgments (Plumert, 1995).

### 4.2.4 Gender

Although the male to female drowning ratio varies from country to country, males always far outnumber females in all European countries and all continents. For example, this ratio is almost 8:1 in Greece, the Netherlands, Brazil and New Zealand (Alexe, Dessipris, & Petridou, 2002; Verweij & Bierens, 2002; Szpilman, 2002b; Water Safety New Zealand, 2003). Specifically, in the 15 countries of the European Union men had an average of 5.2% in the first year of measurement against only 1.3% for females. Also the male: female ratio for the final year of the period 1965–1995, was 4:1, which means that in every year, in all these 15 countries, men drowned more frequently than women (Table 4.2). America and Europe have the highest male: female drowning ratio (4.6:1 and 4.2:1 respectively) compared to the rest of the World Health Organization regions (Table 4.3). However the percentage of drownings in Europe is about average (37,518, 9.1%) compared to the other countries.

The reasons why males drown more often than females are because they expose themselves to the aquatic environment (where submersion is possible) more frequently and drink alcohol near the water (Howland et al., 1996). Also the degree of involvement in sporting activities suggests that the risk taker is usually relatively young, middle class and male, whereas water activities (e.g. kayaking, surfing, scuba diving, etc.) have participation by both sexes equally (Dunn & Gulbis, 1976). A second study (n=87 men and 82 women, mean age=21.8 years), shows that gender did not predict unique variance in the dependent variable of degree of involvement in high-risk recreation (Schrader & Wann, 1999). However, according to national data, the high ranking of drowning as the leading causes of death is mainly due to the high rate of male drowning mortality across all continents. The same also holds true with regard to the contribution of drowning rates to the leading causes of the burden of disease (World Health Organization, n.d.).
Table 4.2: Gender Differences Between the Initial Year and the Last Year (1995) Analyzed in Deaths by Submersion and Drowning in the Countries of the European Union.

<table>
<thead>
<tr>
<th>Country</th>
<th>Years Analyzed</th>
<th>(M+F)¹</th>
<th>(M+F)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>1965–1993</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>France</td>
<td>1965–1994</td>
<td>4.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Ireland</td>
<td>1966–1994</td>
<td>4.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Spain</td>
<td>1967–1994</td>
<td>2.8</td>
<td>1.7</td>
</tr>
<tr>
<td>UK</td>
<td>1965–1993</td>
<td>2.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Austria</td>
<td>1965–1995</td>
<td>4.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>1965–1995</td>
<td>2.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Finland</td>
<td>1965–1995</td>
<td>5.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Germany</td>
<td>1965–1995</td>
<td>2.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Greece</td>
<td>1965–1995</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1965–1995</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Italy</td>
<td>1965–1995</td>
<td>2.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Luxemburg</td>
<td>1967–1995</td>
<td>2.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Portugal</td>
<td>1965–1995</td>
<td>6.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>1965–1995</td>
<td>2.6</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>3.3</strong></td>
<td><strong>1.3</strong></td>
</tr>
</tbody>
</table>

*Note:* Values are presented as ratio of deaths over a population of 100,000 residents. 
(M+F)¹ = initial year analyzed; (M+F)² = last year analyzed. 
Taken from Sabatini & Andreana (2002).

Table 4.3: Global Drowning Deaths by Sex and World Health Organization Region.

<table>
<thead>
<tr>
<th></th>
<th>World Total</th>
<th>AFR</th>
<th>AMR</th>
<th>EMR</th>
<th>EUR</th>
<th>SEAR</th>
<th>WPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>281,717</td>
<td>67,654</td>
<td>20,181</td>
<td>20,712</td>
<td>30,322</td>
<td>55,258</td>
<td>87,600</td>
</tr>
<tr>
<td>Females</td>
<td>127,554</td>
<td>23,311</td>
<td>4,408</td>
<td>6,904</td>
<td>7,196</td>
<td>36,520</td>
<td>49,216</td>
</tr>
<tr>
<td>Total</td>
<td>409,272</td>
<td>90,965</td>
<td>24,589</td>
<td>27,612</td>
<td>37,518</td>
<td>91,778</td>
<td>136,816</td>
</tr>
<tr>
<td>Sex Ratio M:F</td>
<td>2.2:1</td>
<td>2.9:1</td>
<td>4.6:1</td>
<td>3:1</td>
<td>4.2:1</td>
<td>1.5:1</td>
<td>1.8:1</td>
</tr>
<tr>
<td>%</td>
<td>100</td>
<td>22.3</td>
<td>6</td>
<td>6.8</td>
<td>9.1</td>
<td>22.4</td>
<td>33.4</td>
</tr>
<tr>
<td>Rate*</td>
<td>6.8</td>
<td>14.2</td>
<td>3</td>
<td>5.7</td>
<td>4.3</td>
<td>6</td>
<td>8.1</td>
</tr>
</tbody>
</table>

*Note:* AFR=Africa Region; AMR= Americas Region; EMR= Easter Mediterranean Region; EUR= European Region; SEAR= South East Region; WPR= Western Pacific Region. 
*Rate per 100,000 people. 
Taken from Global Burden of Disease, 2000 as cited in WHO (n.d.).

4.2.5 Ethnicity

Drowning rate among coloured people is 2–3 times higher than among whites in the USA (Dietz & Baker, 1974; Kizer, 1983; Palinkas, 1985; Campbell, 1991). Another study revealed that coloured people (n=2,549, 82% whites, 6% coloured) are less likely to be proficient at swimming and have higher rates of drowning (Mael, 1995). Coloured children (5–19 years old) are 1.5–3 times more prone to drown than whites of the same age group (O’ Flaherty & Pirie, 1997). However, in the age group 1–4 years, there is a lower drowning rate among the coloured children compared to that of the whites, possibly because
in this group drownings occur in residential pools, to which many coloured children may not have access, due to their low socio-economic status (Braceh et al., 1994; O’ Flaherty & Pirie, 1997). It is understandable, therefore, that coloured children have higher chances than whites of being involved in a life threatening situation due to drowning.

### 4.2.6 Socio-Economic Background

Considering the socio-economic background as a variable related to drowning, it seems that there is a contradictory situation in different age groups. More precisely, for adults the degree of involvement in high-risk recreational activities has been thought to be related to demographic variables. This is because many high-risk recreational activities require that participants should have a certain socio-economic background in order to be able to buy, maintain and rent the necessary equipment as well as travel to the area where the recreational activity is located (Schrader & Wann, 1999). Such activities could, for example, be scuba diving, sailing, windsurfing, boating etc. On the other hand, the situation is different in the young age groups. Among children, 89% of children below the age of 3 years sometimes bathed without adult supervision due to low maternal education or no schooling, a finding that indicates the dramatic need for injury prevention programmes focused on low-income urban families (see Santer & Stocking, 1991; Muhuri, 1995). According to the 2000 Global Burden of Disease study, about half a million people die from drowning worldwide while annually 1.3 million also survive a drowning incident. More than 90% of these drowning events occurred in low- and middle-income countries (Peden, 2002).

**Table 4.4** shows the burden of drowning deaths and hospitalizations in two high- and two low- and middle-income countries. Both China and India (the countries with the largest populations on Earth, e.g. 1.285 and 1.025 billion people respectively; Economist, 2003) have high drowning mortality rates and together contribute 43% to all drowning deaths worldwide. Also ethnic minority groups generally have higher drowning death rates, possibly due to differences in opportunities to learn to swim (as cited in World Health Organization, n.d.). At least 50% of the families whose child drowned in a bucket (n=15), are
in low socio-economic groups (Department of Trade Industry, 1996) giving the impression of a lack of parental water safety education.

<table>
<thead>
<tr>
<th>Marker</th>
<th>USA</th>
<th>Australia</th>
<th>China</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drowning deaths</td>
<td>3,458</td>
<td>322</td>
<td>129,000</td>
<td>86,000</td>
</tr>
<tr>
<td>Mortality rate</td>
<td>1.25</td>
<td>1.7</td>
<td>10.2</td>
<td>8.5</td>
</tr>
<tr>
<td>Indigenous population mortality rate</td>
<td>3.24</td>
<td>2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of global unintentional drowning mortality</td>
<td></td>
<td></td>
<td>26</td>
<td>17</td>
</tr>
<tr>
<td>White mortality rate</td>
<td>1.19</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of total DALYs</td>
<td>24</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near-drowning</td>
<td>7,840</td>
<td>563</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morbidity rate</td>
<td>2.85</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age-specific morbidity rate (0–4)</td>
<td>26.50</td>
<td>24.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* All rates per 100,000 people. Ranked 1–6 of leading cause of death due to unintentional injury. As cited in WHO (n.d.).

4.2.7 Demographic Area of Residence

People visiting an aquatic area are more likely to get involved in a drowning incident than are the inhabitants. A study conducted within the period 1980–2000 found that people from other countries were twice or three times more likely to die from accidental drowning than urban dwellers from the Netherlands (Verwij & Bierens, 2002). A second study found that people from remote locations are more likely to be involved in non-tidal drowning than surf drowning, although drowning also involved people from more remote or inland locations (Scmertmann & Williamson, 2002). In a third study, Greek citizens living in urban areas have the lowest drowning mortality rates, while the highest drowning mortality rate is seen in semi-urban areas, although the differences were small. Also, foreigners represented 17% of drowning cases, while for other unintentional injuries foreigners comprised 4% of deaths. The authors concluded that this increased risk might reflect their unfamiliarity with the Greek seaside (Alexe et al., 2002). In a fourth study, in Greenland, villages have about twice the mortality from drowning as towns (Bjerregaard, 1990). Finally, ocean drowning in Australia is more likely in persons who live inland or who are tourists (Mackie, 2006).
The area of residence might have an indirect influence and relation with drowning. Particularly, a study revealed that one of the main reasons (59.9%) for Irish schools not providing swimming/water safety instruction as part of the curriculum is the long distance to the nearest pool, so students are not able to attend a regular swimming lesson (National Safety Council, 1997). It seems reasonable to suppose that if water safety/swimming education is a key for drowning prevention (Smith & Wigglesworth, 2002) in the above cases the distance between school and swimming pools becomes a barrier and, therefore, increases the likelihood of drowning incidents occurring.

4.2.8 Number and Type of Family Members

The number and the type of the family members seem to be related with drowning episodes in a number of studies. For example, 70% of all pre-school children who have drowned were in the care of one or both parents at the time of the accident in the USA, but they were distracted from watching their children at the aquatic facilities (Griffiths, 2000a). Pool operators must be vigilant in supervising children under the age of 7 years and in shallow areas, even when they are with their parents (Department of Trade and Industry, 2000). A second study shows that the risk of dying from drowning is related to the age of the mother and much more sharply to the number of living children in the family (Ahmed, Rahman, & van Ginneken, 1999). A third case study shows that the younger mother is likely to be the less experienced in closely supervising her children (e.g. a 16-month-old boy in Brooklyn drowned in a bathtub when left in a bathroom with no lights for 40 minutes while his mother allegedly listened to CDs; Kaufman, 2005). Although this is only a case report, it illustrates well how easily a parent can be distracted and leave a child unattended near the water.

Fourth, children of high school educated, non-working, and hence less-distressed, mothers experience fewer drowning risks (according to Petridou & Klimentopoulou, 2005). Fifth, shared bathing in early childhood without adult supervision is very dangerous, especially for the younger child with immature co-ordination, who is weaker and can slip underwater (Byard et al., 2001). Therefore, it is unrealistic for the parent to expect that an older sibling will guarantee safety and be an effective supervisor (table 4.5; Ross et al., 2003).
Table 4.5: Details of 17 Infants and Toddlers who Drowned in the Bathtub, While Bathing with their Accompanied Siblings.

<table>
<thead>
<tr>
<th>Case no</th>
<th>Victim (age/sex)</th>
<th>Survivor (age/relationship)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8m/F</td>
<td>22m/brother</td>
</tr>
<tr>
<td>2</td>
<td>8m/F</td>
<td>19m/sister</td>
</tr>
<tr>
<td>3</td>
<td>8m/M</td>
<td>24m/sister</td>
</tr>
<tr>
<td>4</td>
<td>8m/M</td>
<td>24m/brother</td>
</tr>
<tr>
<td>5</td>
<td>9m/F</td>
<td>30m/brother</td>
</tr>
<tr>
<td>6</td>
<td>9m/M</td>
<td>30m/sister</td>
</tr>
<tr>
<td>7</td>
<td>10m/F</td>
<td>24m/brother</td>
</tr>
<tr>
<td>8</td>
<td>10m/M</td>
<td>34m/sister</td>
</tr>
<tr>
<td>9</td>
<td>10m/M</td>
<td>31m/brother</td>
</tr>
<tr>
<td>10</td>
<td>10m/M</td>
<td>30m/brother</td>
</tr>
<tr>
<td>11</td>
<td>11m/F</td>
<td>24m/sister</td>
</tr>
<tr>
<td>12</td>
<td>12m/M</td>
<td>30m/brother</td>
</tr>
<tr>
<td>13</td>
<td>16m/F</td>
<td>48m/brother</td>
</tr>
<tr>
<td>14</td>
<td>16m/M</td>
<td>36m/brother</td>
</tr>
<tr>
<td>15</td>
<td>17m/M</td>
<td>30m/brother</td>
</tr>
<tr>
<td>16</td>
<td>17m/M</td>
<td>30m/brother</td>
</tr>
<tr>
<td>17</td>
<td>22m/F</td>
<td>48m/brother</td>
</tr>
</tbody>
</table>

Note: m=month; M=Male; F=Female.
Taken from Byard et al. (2001).

4.2.9 Occupation

Some occupations might be more prone to risk by their nature. A first example of an at-risk occupation is stunts. Stunt men are usually specialized in one or several fields and perform for television, motion pictures, live audiences, competition, and world records registered in the Guinness Book of Records. Usually, but not always (because of the high costs involved), they rehearse these major stunts for months. However, although they claim that the hazards of ordinary life are greater than those of their work, there is always some 5%–20% risk which they cannot foresee. They want to be able to meet the challenges involved, with increased self-esteem, receiving acclaim, and monetary profit as a secondary reward (Piët, 1987). Also, sometimes they must perform their stunt even when the weather conditions are not ideal, because the show must go on or the stunt for the movie film must occur at that particular moment. A small number of drowning incidents with successful outcomes related to this occupation have been reported (e.g. The World’s Most Amazing Videos 2, 2007).
A second example of an at-risk occupation is fishing. Experienced fishermen sometimes drown in accidents at sea. The likelihood of escaping from a fatality on board diminishes the longer the exposure to the hazard at sea. Drowning is the main type of fatal accident at sea. Seamen aged 45–55 years have the highest drowning rates (Rafnsson, Gunnar, & Dottir, 1993). In New Zealand, 134 drowned during fishing, 5 during construction work and 30 during other commercial activity during 1983–2002 (Water Safety New Zealand, 2002). The World Health Organization (n.d.), has stated that 116 per 100,000 people drown during fishing.

A third example of an at-risk occupation is skilled labourers. Figure 4.3 shows that the majority of Australian males and females (i.e. home duties) who drowned between 1992 and 1998 were skilled labourers (Australian Water Safety Council & University of New South Wales, 2000). The relationship between occupation and drowning needs further research in order to establish more ‘at-risk’ occupations.

4.2.10 Drug/Alcohol Consumption
Many drowning victims have alcohol in their blood, but it is not clear whether there is a causal relationship. Moderate alcohol consumption (93.7 ml.kg body water$^{-1}$ of 40% alcohol) does not attenuate the initial ‘cold shock’ responses to a significant extent and therefore it is unlikely that this reduced the risk of drowning on immersion in cold water (Franks et al., 1997). However, the study
had only 16 subjects, thus more research is needed in order to generalize the findings. In another study from 1 May to 21 June 1999, 144 swimmers drowned in Moscow and 94% of them were recorded as ‘drunk when they drowned’ (Smith et al., 2001, as cited in Smith, 2006). The National Institute on Alcohol Abuse and Alcoholism defined at-risk drinking as consumption of more than 4 drinks/occasion for men aged 18–65 years and 3 or more drinks/occasion per day for women of all ages and men aged above 65 years (Hungerford & Polock, 2002). One well-documented study found that compared with the referent of a blood alcohol concentration of 0, the estimated relative risk of death increased even with a blood alcohol concentration of 10mg/dL (Smith et al., 2001). A blood alcohol level of 100 mg/dL can be reached by a 63.5 kg person drinking 3 drinks (e.g. cocktail, glass of wine or beer) and it will take 5–7 hours (Table 4.6) to metabolize that alcohol (Greensher, 1984). Although the previous study does not explain how much or how strong the alcoholic drink is, and it does not say how fast it should be consumed, it is understandable that the influence of alcohol during an aquatic activity could be fatal.

Table 4.6: The Equivalent Blood Ethanol Levels and Metabolic Times for Different Amounts of Alcohol in the USA.

<table>
<thead>
<tr>
<th>Blood Ethanol Level (mg/dL)</th>
<th>Symptoms</th>
<th>Amount Consumed (in no of drinks)</th>
<th>Time needed to metabolize (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cocktails (45 mL [1.5 oz], 50% alcohol)</td>
<td>Beer (360 mL [12oz], 5% alcohol)</td>
</tr>
<tr>
<td>20</td>
<td>Feel good</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>Relaxed</td>
<td>1½</td>
<td>1½</td>
</tr>
<tr>
<td>100</td>
<td>Legal limit</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>150</td>
<td>Intoxicated</td>
<td>4</td>
<td>4½</td>
</tr>
<tr>
<td>300</td>
<td>Drunk</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>500</td>
<td>Dead</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

Taken from Greensher (1984).

On the other hand, alcohol has been reported to be major risk factor and cause of drowning in all countries that maintain files and statistics on drowning, such as the USA, UK, Australia, the Netherlands and Canada (Mackie, 1978; Eaton, 1995; Lifesaving Society, 2000b). Greek boys are in greater danger during their teenage years (15–19 years), possibly because they are interested in participating in aquatic activities at the same time as consuming alcohol (Boubouka & Beta, 2002). Table 4.7 contains a selection of statistics
from different countries that clearly show that a mix of alcohol and water is associated with death.

<table>
<thead>
<tr>
<th>Country</th>
<th>Year(s) of occurrence</th>
<th>Drowning–Alcohol</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1990–1998</td>
<td>Two hundred and twenty-one drowned</td>
<td>Smith et al., 2001</td>
</tr>
<tr>
<td>New Zealand</td>
<td>2002</td>
<td>Twelve (10%) drownings</td>
<td>Water Safety New Zealand, 2003</td>
</tr>
<tr>
<td>Canada</td>
<td>1990–1998</td>
<td>Alcohol was involved in 36% of 1998 incidents involving adult victims</td>
<td>Lifesaving Society, 1998</td>
</tr>
</tbody>
</table>

As an extension to the above facts on alcohol it is obvious that attention should be given to other drugs that can influence perception, cognitive and motor function. Although reports that show that the relationship between drugs and drowning are mostly anecdotal, the relationship between cannabis use and death on the road seems to predict future trends in the water (Mackie, 1978). Illicit drugs were detected in three younger people who drowned in the bathtub (Mackie, 1999). Illicit drug use was found in approximately 60% of tested victims 13 years old and above in boating-related drowning (Morbidity Mortality Weekly Report, 2001).

4.2.11 Hyperventilation

Hyperventilation before holding breath when swimming and diving makes it possible for a person to extend the time under water, but this manoeuvre can cause loss of consciousness due to hypoxia. When people hyperventilate before entering the water, they significantly drop their arterial carbon dioxide tension in order to prolong the time before the normal stimulus of carbon dioxide to breathe takes over. Consequently, arterial oxygen tension is decreased to a level that is incompatible with consciousness and they begin to breathe water (Modell, 1997). Breath-holding experiments indicated that the times between loss of consciousness and death may be no longer than 2.5 minutes (Craig, 1976).
Two types of people have been reported that practise hyperventilation in the water. First, competitive swimmers, particularly sprinters, train hypoxically (maximum effort swims holding their breath). Coaches may consider hypoxic training in competition as a short-cut to conditioning, but it can also shorten lives. Loss of consciousness may be the result of hypoxic training in many competitive swimmers because it combines elements of over-exertion and hyperventilation (Griffiths & Griffiths, 1995). Second, in moments of recreation and leisure this happens to males (n=56 cases), aged 16–20 years (range 12–33 years) who were known to be good swimmers or divers. Further, approximately 80% of the cases occurred in guarded pools. In this instance the findings were those associated with classical drowning preceded by hypoxia and hypercapnia (Craig, 1976). The patterns associated with these cases suggest that those who are responsible for aquatic safety as supervisors or guards of pools could prevent most accidents by watching for young male swimmers who are practising hyperventilation and underwater swimming in competition with themselves or with others (Craig, 1976).

4.2.12 Suicide–Homicide

In the year 2000 approximately one million people died by drowning and between 10–20 times that number attempted suicide (Golgney, 2002). Suicides have been charged as the cause of death due to drowning in numerous studies (Sathyavathi, 1973; Kolmos & Bach, 1987; Canton & Hill, 1990; Lafave et al., 1995; Cullen & Connolly, 1997; Blohm & Puschel, 1998; Coman et al., 2000). Although most people who drown in the Netherlands do so accidentally, for older people suicide is the main cause of drowning (Verweij & Bierens, 2002). In the Netherlands in 1987–1993, 403 people committed suicide (Bierens et al., 1996) and in New Zealand there were 377 suicides and 16 homicides (Water Safety New Zealand, 2002). Suicide is, therefore, a well-documented cause of drowning death in many countries.

4.2.13 Unintentional Water Activity

The Lifesaving Society’s annual drowning research identified that two-thirds of drowning victims had no intention of entering the water and died as a result of this unplanned immersion (Patterson & Beerman, 2002). Drowning is the sec-
ond leading cause of unintentional injury death among adolescents, second only to motor vehicle crashes (Bennet, Quan, & Williams, 2002a).

4.2.14 Religion

Religion has been linked with drowning in the literature only in a few case studies so far. In the first, it was hypothesized that a possible miracle might have been involved in the rescue of a speared fisherman who was found helpless on the surface of the water at sea (Avramidis, 2007b). In the second, three Sikh men drowned while paddling in the Lake District when their turbans became entangled around their feet, arms and necks. The newspaper report noted that ‘the drowning men’s turbans came off in the water and hampered their efforts. When the families saw the dead men in the mortuary they noticed that the turbans had become wrapped around their feet, arms and necks. “It must have made it harder for them to come back up”, Mr. Singh said’ (Jenkins, 2006, p. 21). In a third anecdotal report, a Muslim lady was trapped on a rock while the tide was high. A rescue helicopter approached her but the crew was unable to perform a rescue because they had a different religion. They had to wait until other rescue services with a crew of the same religion as hers came to the place of the incident. Fourth, anecdotal reports reveal that Muslim women participate in aqua aerobic classes wearing their clothing (M. Hunt, personal communication, 24 January 2002). This can affect their swimming ability in several ways, increasing the likelihood of a drowning incident; the clothes become heavy when they are wet. Also during an emergency, clothes do not allow free limb movement while the person is desperate to remain above the surface. One can assume that people who wear clothes because of their religious beliefs, are likely to be discouraged from engaging in aquatic activities where normally the body is exposed. Finally it has been said that people believing in Jehovah, are not allowed to have blood transfusions from donors from other religions. Although those case reports are not enough for establishing religion as a risk factor for injuries and specifically for drowning, it would be interesting to see future research on the topic.
4.3 Who (2): The Rescuer

A rescuer can be either a lifesaver or a lifeguard. Before starting to analyze the factor ‘rescuer’ it is appropriate to define those confusing terms (table 4.8). A lifesaver is a member of the general public who is present in an aquatic emergency and knows how to initiate a rescue (mainly without equipment or using alternative options, e.g. ropes, woods, flotation aids etc.). A lifeguard is the expert aquatic professional in facility safety caring primarily for prevention (Stallman, 2004b). The second has a duty of care and specialized knowledge in preventing (using professional equipment) and rescuing while the first does not. Although in some countries like Australia, ‘lifesavers’ patrol the beaches, it would be more appropriate to distinguish this type of service by using such terminology as ‘volunteer lifeguard’ or ‘amateur lifeguard’ to indicate that they have professional knowledge like a lifeguard but work as volunteers (like the lifesavers), while the paid personnel could be called ‘professional lifeguards’. The distinction between lifesavers and lifeguards, amateurs and professionals has legal, educational and so many other implications (Stallman, 2004b). In Greece, apart from the moral duty and the order of their conscience to save fellowmen, the professional lifeguard has a special legal duty to act as a guarantor of the health and life of bathers, set by policy, and therefore the criminal claim towards him is heavier (Koukourakis, 2004). In this study, each reference to the ‘lifeguard’ indicates ‘professional lifeguard’ (not lifesaver or amateur lifeguard).

<table>
<thead>
<tr>
<th></th>
<th>Lifeguards</th>
<th>Lifesavers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty of care</td>
<td>Professional rescuers</td>
<td>Humanitarian duty</td>
</tr>
<tr>
<td>Specialized equipment</td>
<td>Qualified</td>
<td>Usually no equipment</td>
</tr>
<tr>
<td>Primarily prevention</td>
<td></td>
<td>Always rescue</td>
</tr>
<tr>
<td>Professional rescuers</td>
<td></td>
<td>Amateur rescuers</td>
</tr>
<tr>
<td>Qualified</td>
<td></td>
<td>Not necessarily qualified</td>
</tr>
</tbody>
</table>

The factor ‘lifeguard’ is of major importance as its presence and quality can make the difference between life and death when something goes wrong. Despite continued heavy usage of ocean beaches and open water swimming areas throughout the USA, recent questions have been raised about the efficacy of lifeguards. Some municipal jurisdictions have in fact concluded that having
lifeguards does not add justifiable value to their communities, and have therefore, decided to eliminate lifeguards from their beaches. The primary argument is that lifeguards do not affect the drowning rate perceptibly. Moreover, they argue that their municipalities’ legal liability may be greater when a lifeguard fails to save a drowning victim than it would be if they merely told swimmers to use the beaches at their own risk (Mael, Seck, & Russel, 1998).

Other studies have shown that drowning within the perimeters of the official beaches occur in the absence of lifeguards or while the lifeguards are on strike (Branche et al., 2001; Hartmann & Amar, 2002). There are no recorded drownings at a patrolled beach while swimming between flags (Water Safety New Zealand, 2001b). However, the authors possibly mean that this happens on New Zealand beaches because there are cases in other countries like Greece, where people drown in guarded beaches possibly because only one lifeguard had, by law, to supervise large aquatic areas (Avramidis, 1998a). It has also been estimated that the chances of drowning at a beach protected by lifeguards trained under USLA standards is less than one in 18 million (Branche et al., 2001). If something goes wrong an effective lifeguard team is the last hope for the victim (Avramidis, 2001a; 2009a; Griffiths, 2001a). Stallman (2004a) explained that effective lifeguarding requires skills that could be described as ‘watermarship’. Table 4.9 describes the variables that can lead to the occurrence of a drowning incident from the rescuer’s point of view.

A large amount of literature covers issues and elements of rescue techniques that are used by lifeguards, rescue divers and/or lifesavers (Avramidis, 1997c; 1997d; 1997e; 1997f; 1999b). However it seems that other factors should play a vital role in coping effectively with a drowning incident. The following paragraphs will cover those parameters more extensively.
Table 4.9: Variables that can Lead to the Occurrence of a Drowning Incident from the Rescuer’s Point of View.

<table>
<thead>
<tr>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial training</td>
</tr>
<tr>
<td>Continuing professional development</td>
</tr>
<tr>
<td>Lifeguard qualification updating</td>
</tr>
<tr>
<td>Experience</td>
</tr>
<tr>
<td>Expertise</td>
</tr>
<tr>
<td>Physical strength</td>
</tr>
<tr>
<td>Vision</td>
</tr>
<tr>
<td>Health</td>
</tr>
<tr>
<td>Swimming speed</td>
</tr>
<tr>
<td>Knowledge of the particular dangers of the aquatic area they supervise</td>
</tr>
<tr>
<td>Adequate number of lifeguards and surveillance</td>
</tr>
<tr>
<td>Visible appearance and clothing</td>
</tr>
<tr>
<td>Record keeping and written operating procedures</td>
</tr>
<tr>
<td>Ability to do risk assessment</td>
</tr>
<tr>
<td>Ability to deal as educator</td>
</tr>
<tr>
<td>Ability to recognize instinctive drowning response</td>
</tr>
<tr>
<td>Ability to remain alert</td>
</tr>
<tr>
<td>Ability to react, ignoring bystanders’ apathy</td>
</tr>
</tbody>
</table>

4.3.1 Initial Training

Although there is no scientific evidence on the efficacy of lifeguard training for wet rescues (Ward et al., 1997), a substantial amount of literature on the effectiveness of similar courses (e.g. cardio-pulmonary resuscitation, first aid) has routinely reported that lay people or professionals are often poorly trained, achieving 80% competence (Kaye et al., 1991). Because most lifeguards are relatively young and have limited experience, the quality of certification and training affects their ability and confidence to make a rescue. In a sample of 2,082 lifeguards, 7% (140 guards) responded that their rescue training was less than sufficient regarding how ready they feel for making a rescue, which means that many swimmers were supervised by potentially unprepared guards (Griffiths, Vogelsong, & Steel, 2000). The above finding is very discouraging. Whereas more research is needed in the area for establishing lifeguard certification training as an important factor related to drowning, this previous study underlines the great importance of the initial training as a key issue for preventing/coping with drowning accidents.

Initial training that is given to animal rescuers can enhance the likelihood of a successful rescue on a human life (Avramidis, 1997g; 1999c; 2002g; Avramidis & Avramidou, 2008). First, Newfoundland dogs have been taught to respond when a person is in difficulties in the water (Aberman, 1979; Edie,
1996; Drury & Linn, 1997; Lovett et al., 1997) sometimes putting even their own lives in danger (Avramidis, 2002i). They jump into the water, approach the victims and start towing them back to the shore (Lisiecki, 1989; American Kennel Club, 1992; Avramidis, 1997g). Second, scientists used the theory of Conducive Learning (Danassis, 1991) for training pigeons to identify survivors in the sea-water wearing lifejackets, and warn the pilot of the helicopter by hitting a button with their beak (Atkinson et al., 1990). Third, dolphins have been reported to successfully use their love for saving distressed people (Cousteau, 1975). Finally, Avramidis & Avramidis (2005) have suggested the use of horses, but this was more a recommendation for future research rather than the result of a well-established scientific study that suggested the usefulness of horses in the rescue process.

4.3.2 Certification

The question of what certification an organization, municipality or other management entity should require for entry-rating lifeguards is not easily resolved and therefore a specific guideline is not recommended. It is doubtful that there will eventually be one single lifeguard certification applicable to all types of water bodies and management needs. However, as leading organizations of each country exchange ideas and recognize the best methods for providing prevention and rescue services, their standards will undoubtedly become more similar (McCloy & Dodson, 1980). Exceptionally, three British organizations (the Royal National Lifeboat Institution, the Royal Life Saving Society UK and the Surf Life Saving Association GB) have sat down to negotiate for creating a single standard and beach lifeguard qualification (Lifesavers, 2001a; 2001b), but again this refers only to the beach and does not cover all aquatic environments.

Two possible solutions are suggested for selecting the most appropriate certifications. First, the supervisor of an aquatic area that is not affiliated with a national lifeguard programme should identify the available lifeguard agencies and choose the one that best suits the aquatic area’s needs. Lifeguards should then be certified in co-operation with this organization (McCloy & Dodson, 1980). Second, local aquatic authorities should prefer to use those
organizations that follow or exceed the guidelines of the International Life Saving Federation.

4.3.3 Continuing Professional Development – Lifeguard Qualification Updating

Qualifying a person as a ‘lifeguard’ is only the first step toward achieving a well-trained and competent specialist for a number of reasons (McCloy & Dodson, 1980); first, because the lifeguard knowledge of safety in the pool is not as high as desired. Although people assume that lifeguards continually monitor safety, industry experts and job analysts suggest that safety standards may be somewhat lower to what is thought (Johnson, 2004).

Second, because no matter which certifying agency is considered, two-thirds of the guards in the USA (n=2,082) responded that they received better training at the workplace than they did during the certification course. This underscores the importance of on-the-job or in-service training. Thus realistic situations provided at the pool or beach hold more relevance for guards than information in training manuals or classrooms (Griffiths, Vogelsong, & Steel, 2000).

Third, because a whole body of knowledge and skills must be learned as well as in-service training routines to upgrade skills and to master new skills and techniques. Most lifeguard positions are only seasonal, and it can be assumed that most lifeguards do not have a career that exceeds five years in length. Therefore, it is deemed appropriate that there should be pre-season training annually for both new and recurrent personnel. A policy of annual pre-season training will also serve to document the organization’s commitment to providing high quality and well-trained personnel for the protection of bathers should any questioning of such commitment arise as the result of claims or lawsuits. These pre-season programmes will necessarily be specific to the organization and management of each particular aquatic area (McCloy & Dodson, 1980). The success or failure of any marine safety organization is greatly dependent on the calibre of personnel recruited and the quality of basic training they get (D’Arnall, 1979).
The 4W Model of Drowning

Table 4.10: The Duration of the Lifeguard Qualification in Numerous Organizations Around the World.

<table>
<thead>
<tr>
<th>Country</th>
<th>Agency</th>
<th>Duration of the Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Ellis &amp; Associates</td>
<td>1 year</td>
</tr>
<tr>
<td>UK</td>
<td>Royal Life Saving Society UK</td>
<td>2 years</td>
</tr>
<tr>
<td>UK</td>
<td>Swimming Teachers’ Association</td>
<td>2 years</td>
</tr>
<tr>
<td>UK</td>
<td>Surf Life Saving Association GB</td>
<td>3 years</td>
</tr>
<tr>
<td>Australia</td>
<td>Royal Life Saving Society Australia</td>
<td>1 year</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Cyprus Life Saving Federation</td>
<td>2 years</td>
</tr>
<tr>
<td>Greece</td>
<td>European Lifeguard Academy</td>
<td>2 or 3 years</td>
</tr>
<tr>
<td>Greece</td>
<td>All other Greek agencies</td>
<td>Never expires</td>
</tr>
</tbody>
</table>

The validity of a qualification from a recognized training agent that every lifeguard should hold varies between different countries and organizations (table 4.10). Some argue that re-qualification should take part at least every two years, although practical rescue and resuscitation skills should be practised frequently (Royal Society for the Prevention of Accidents & Royal Life Saving Society UK, 1993). Others argue that the revalidation procedure should occur every year (Ellis & Fick, 1992). Finally, in Greece, the revalidation system varies between the different organizations. For example, while the European Lifeguard Academy maintains a revalidation system (Avramidis, 2001a), the rest of the Greek agencies provide a qualification that never expires, and therefore its holder can work at any time with a questionable level of knowledge, alertness and readiness (Avramidis, 2003a; 1998). This can possibly explain why 50% (n=16) of all candidates at several private schools failed to pass the theoretical section and only 17% passed the examinations of the Greek Coast Guard (Avramidis, 2003a).

4.3.4 Experience

The current literature reveals that the majority of lifeguards who worked in water parks or pools were less experienced in years of employment than those who worked in open water. In one study, a USA national survey revealed that 40% of the lifeguards had worked for up to two seasons, an indication that many lifeguards were novices. Also, 50% of the lifeguard sample (n=3,000) were aged 19 years or under which means that the aquatic health care professionals were quite young (Griffiths, Steel, & Vogelson, 1996) and their age coincided with the age group that most often poses risk-taking behaviour (see Fetro et al., 2001; Brown & Blanton, 2002). Most of them had worked in pools (70%) and water parks (18%) and few in open or inland water (Griffiths, Steel,
& Vogelson, 1996). In another study (n=2,769 lifeguards), 55% of those older
than 23 years said they watch their zones 100% of the time, compared to 45%
of the teenagers younger than 19 years who claimed the same (Griffiths,
Steel, & Vogelsong, 1999). Due to the large samples in the previous two stud-
ies, it seems logical to suppose that the number of working years that one has
as a professional lifeguard is related to the level of their awareness and ex-
perience.

4.3.5 Physical Strength and Swimming Speed
Considering the fact that every lifeguard organization has established its own
standards for examining swimming speed or endurance, a number of ques-
tions arise. Are these standards high? Should they be lower? Are they estab-
lished after measuring the real needs of the aquatic environment? (e.g. pool,
surf, waves etc.). Was this measurement scientifically designed? In response
to the above questions three arguments have been raised.

According to the first argument, the contemporary standards of the timed swim
should be high, as in the past. Sports aquatic facilities are currently struggling
to find qualified lifeguards because young people prefer to work in more finan-
cially attractive jobs. Consequently, the standards for certification have been
lowered (to make qualifications more attainable by a higher number of people)
driving down the national norm, as private companies rush to fill the need for
lifeguards (Wood, 1999). According to some experts, this leads to an unac-
ceptable situation where less fast and strong swimmers achieve the standards
and therefore less competent lifeguards are working, needing to be supported
by rescue tubes while they swim (Brewster, 2007). The argument to support
the claim that lifeguards should be stronger and faster swimmers without
needing to be supported by rescue tubes is that swimming with the rescue
tube across the chest increases form drag, slowing the rescuer down, while
speed is important for the rescue, assessment, and the rescue breathing of a
victim (Leclerc, 2007).

According to the second argument, the organizations have established their
timed swim tests empirically and need to be based on scientific facts for open
water and pool rescues. For open water rescue, a scientific analysis of these
standards showed that an efficient beach lifeguard should be able to swim 400 m in 7.5 minutes, contrary to the non-scientific current belief that recommends a more delayed approach (after 8–10 minutes) in various organizations (table 4.11; Tipton et al., 2002). For pool lifeguard rescue, a scientific analysis (n=33) showed that the YMCA lifeguards who used a specific rescue approach supported by a rescue tube were faster than the American Red Cross lifeguards’ rescue technique (Leclerc, 2007) and therefore, one might argue that the YMCA technique should be preferable in order to save time during the rescue.

Table 4.11: Information About the Times that are Required to be Achieved by Candidate Lifeguards in the Speed Swim and Endurance Tests for Achieving Pool, Water Park or Beach Lifeguard Qualifications.

<table>
<thead>
<tr>
<th>Country</th>
<th>Organization</th>
<th>Speed Swim</th>
<th>Endurance Swim</th>
<th>Qualification</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>RLSS, SLSS GB</td>
<td>400 m</td>
<td>Beach LG</td>
<td>Avramidis,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8–9 mins)</td>
<td></td>
<td>2004b</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>All Greek agencies by law</td>
<td>100 m</td>
<td>Beach LG</td>
<td>Decree-law,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2 min)</td>
<td></td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>International Life Saving</td>
<td>400 m</td>
<td>Surf LG</td>
<td>Wright,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Federation</td>
<td>(10 mins)</td>
<td></td>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>International Life Saving</td>
<td>300 m</td>
<td>Pool LG</td>
<td>Wright,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Federation</td>
<td>(6 mins)</td>
<td></td>
<td>2005</td>
<td></td>
</tr>
</tbody>
</table>

Note: LG=lifeguard; S=Surf; P=Pool.
Data are from different countries.

According to the third argument, the contemporary standards for the timed swim can remain low both in open water and swimming pools without compromising the effectiveness of the rescue. First, in open water they can be lowered because the lack of swimming speed of most of the lifeguards can be replaced by rescue aids (e.g. power boats, rescue boards etc). Because 90% of all drowning deaths occur within 10 m of safety (Orlowski & Szpilman, 2001) the result of Tipton’s et al. (2002) test does not apply to the contemporary demands and therefore, the slow timed swims (compared to Tipton et al.’s suggested times) of the lifeguard organizations should remain as they are. Second, in the swimming pools the timed swim can be lower than in the past and the lifeguards can be supported by a rescue tube without compromising the speed of the rescue because even the longest distances for approaching a drowning casualty can be swum in a reasonably acceptable time (Avramidis, 2008a). For example, the maximum distance in a 50x25 m Olympic size swimming pool (FINA, 2006) that a lifeguard might need to swim would be if the casualty drowned in the exact middle of the pool (e.g. 12.5 m swimming a
width). According to Leclerc, even the least competent participants (Red Cross lifeguards in figure 1, p. 37) were able to swim 25 yards (e.g. 22.75 m) in about 28 seconds. That means that they could swim the required 12.5 m in 15.38 seconds which is an acceptable time for approaching the victim (see Ellis & White, 1994).

From all the above it seems that although we would like to have fast lifeguards because they fit better with the ‘ideal lifeguard’ who we have in mind, in fact this is an outdated perception of the lifeguard profession (Avramidis, 2008a). It is concluded, therefore, that a future scientific study should be undertaken to form a basis for determining the skills and minimum competencies required to rescue another human in an aquatic emergency (Dorp, Knape, & Bierens, 2003) based on the actual distances that need to be covered in open water and swimming pool rescues and not in myths or empirical evidence.

4.3.6 Vision
Although a lifeguard is normally tested on abilities such as water rescue, resuscitation, spinal injury management techniques and swimming speed to pass the examination requirements of the lifeguard qualification, nevertheless, no organization examines their level of vision. Considering that 80% of all the information that a human receives from the environment is visual (Seiller, 1996; 1997) and also that a non-swimmer victim is not able to call for help (Pia, 1974; American Red Cross, 1995; Avramidis, 1998a) it seems vital to make sure that all lifeguards on duty should be able to see accurately in order to detect people in distress.

So far, two studies have been conducted examining the visual acuity of lifeguards. First, a study conducted by the Visual Fitness Institute found that approximately 10% of lifeguards had sub-par vision. It was also found that 1 in 6 lifeguards had prescription eyewear at home but did not use it at the work place. Finally, the lifeguards who volunteered for the research had almost never visited an optometrist or ophthalmologist for eye examinations (Seiller, 1996). Second, Tipton et al. (2007) found that a beach lifeguard supervising 300 m of beach should have a visual acuity of 6/7 or better to detect a casualty’s head in the water. As a result of the first study, lifeguard initiatives were
set up in areas like California, where after thorough investigation they determined that lifeguards needed good visual acuity without the use of contact lenses or glasses. They postulated that contact lenses or glasses might become dislodged or lost during a rescue or scuffle. The state decided to reject candidates with poor vision in one eye, reduced peripheral vision, or severe colour deficiency (Seiller, 1997).

4.3.7 Health
For maintaining quality screening procedures the physical and psychological health of a lifeguard should be medically tested prior employment, as in other social services. For example, for the police, the screening procedures result in the selection of a more psychologically-resilient workforce of officers because a compromised psychological health in this job is associated with graver consequences in an environment where carrying a firearm is a daily requirement (Perrin et al., 2007). Because the lifeguard profession is a safety and emergency responder community job, it should reasonably be expected that similar screening procedures on the psychological (and the physical) health of lifeguards should be established by the water safety organizations.

Although the importance of quality physical and psychological health is clearly vital, only two cases have been reported in the literature related to this issue. In Greece, the beach lifeguards’ physical health is tested by a cardiologist and a pathologist and submitted to the Coast Guard who is responsible for examining and giving work permission to those qualified to work at the beach (Decree-Law, 2000). Also, the International Life Saving Federation has released a position statement about those lifeguards who have epilepsy. The statement recommends that individuals with controlled epilepsy and no unexplained or unpredictable seizure activity who wish to participate in lifeguard patrol duty or in deep water recreation and competition activities, require a seizure-free interval of more than one year prior to participation (Beerman, 2007). Considering all the above, it seems that the employer should require a statement from a physician that certifies that lifeguard candidates have no medical disorder or physical impairment that would interfere with the full performance of the lifeguard’s duties and that they meet the minimum requirements of the employer (MCCloy & Dodson, 1980).
4.3.8 Knowledge of the Particular Dangers of the Aquatic Area they Supervise

To know the dangers that exist in their area is a two-sided coin for lifeguards. First, lifeguards need to be aware of the dangers that exist for themselves. During a rescue lifeguards can be injured by competing against their limits, the forces of nature, and the struggles of the victim (Wernicki & Glorioso, 1991), by running on a rocky beach when attempted to approach an active casualty more rapidly, or even injuring a foot, an ankle or a knee when in a power boat, because of the high impact and instability in heavy or unpredicted surf (Fenner & Erby, 2002; Morizot, 2007). They can also experience strains, exposure, contusions, sprains, and lacerations (Wernicki & Fenner, 2006). These injuries are more or less expected but might have an unknown effect on the quality of the rescue. As the rescuers know that by walking on the sharp rocks they will get injured, it is necessary sometimes to run more slowly in order to protect themselves. Similarly, a crewman who knows from colleagues or from previous personal experience that he might damage his lower limbs when getting into the powerboat, might take care of himself and give less attention to the distressed swimmer. Second, lifeguards need to be aware of the dangers that remain on the beach or at any aquatic environment related to the bathers. When the lifeguard knows that at that particular point in the water there can be whales (see Avramidis, 1998a), dangerous underwater life (see Manguet, 2001; Scharf, 2002), sea currents, waves (see Gilluly et al., 1968; Sallenger et al., 1995), tsunamis (see National Geographic, 2005), tide (see Whatling, 1994), or other dangers, then it is easier to prevent a drowning incident happening.

4.3.9 Adequate Ratio of Lifeguards to Bathers and Surveillance

Lifeguard surveillance depends on the budget restrictions, the quality of the lifeguard services in an aquatic area and the ratio between lifeguards and bathers. First, due to budget restrictions, many lifeguard services cannot provide adequate protection to the entire beach within their jurisdiction, and as a result they distinguish those areas that receive lifeguard protection from those that remain unguarded. Bathers should be made aware of that in order to make an informed choice as to where to swim. Because of the problems of liability, the posting of areas should be undertaken with caution in how the signs are worded. Where the beach population includes many children who
cannot read, or if there is a significant use of the beach by foreigners, international symbols or multilingual signs should be used (Mc Cloy & Dodson, 1980).

Second, in guarded areas the effectiveness of the surveillance depends on the quality of the lifeguard services. Effective lifeguarding requires that the hours of operation should be posted. Lifeguard towers and other facilities should provide uninterrupted visual surveillance of the guarded area and allow a minimum response time to an incident within the lifeguard’s area of responsibility (Mc Cloy & Dodson, 1980). This response time was primarily established to be 30 seconds in pools/water parks (based on the 10/20 protection rule that requires 10 seconds to detect the casualty and 20 seconds to perform a rescue; Ellis & Fick, 1992; Ellis & White, 1994), and 150 seconds in open water (based on the 30/120 protection rule that requires 30 seconds to detect the casualty and 120 seconds to perform the rescue; see Avramidis, 2001a). Although later scientific research questioned its validity (Ellis and Associates, & Poseidon Technologies, 2001; DeRosa, 2008), nevertheless, these remain useful tools when combined with other strategies (e.g. the 5-minute scanning strategy, and the RID factor that were described in the introduction; Pia, 1984; Griffiths, 2000a).

Finally, the issue of whether the ratio of lifeguards to bathers is adequate is a two-sided coin. The first side is that there might be an adequate number of lifeguards, but there are more bathers than expected. In the USA, public pools have become increasingly popular recreational destinations. However, risks of any type increase when a facility designed to comply with minimum criteria experiences maximum bather ‘loads’ (Schwartz, 1998). For example, the bather load might increase due to an unexpected tourist or school visit to the area. The second is that there might be fewer than the number of lifeguards required by law. Although most nations have guidelines for supervising aquatic environments’ safely, the number of lifeguards required may not be specified. For example, in Greece only a single pool lifeguard is required for every 300 bathers (King Decree, 1973) and only a single beach lifeguard per 600 m of beach (Decree Law, 2000). Bearing in mind that in other countries the same numbers are always higher for both pool and beach (e.g. guard:bather ratio is in Brazil 2:500 m of beach), it is therefore understandable why Greece has
such a high drowning rate compared to the rest of the European and non-European countries (Sabatini & Andreana, 2002). An Australian study revealed that the safest beach area to scan and supervise (by a single beach lifeguard) was 106 m width x 86 m distance from the water’s edge to the sea; Fenner & Harrison, 2002). These figures illustrate well the need for a more adequate system that will recommend the most appropriate number of lifeguards to be on duty at given aquatic areas.

4.3.10 Visible Appearance and Personal Protective Equipment

Lifeguards and other rescue workers should wear appropriate personal protective equipment with high visibility. In terms of personal protective equipment, it is intended to be worn or held by a person to protect them against risks to their health or safety but cannot be regarded as a set of clothing that will protect the individual from all hazards. What is protective in one environment will be a hazard in another. For example, an unspecified number of military recruits have died of heat stroke when undertaking strenuous activity while dressed in wet suits on dry land (Calland, 2000). In terms of visibility, lifeguards should wear appropriate uniforms that are quite distinct and easily recognizable by bathers. Generally, this would mean bathing suits of a solid, bright colour with a distinctive patch and shirt. The uniforms should be practical, culturally appropriate and durable (Mc Cloy & Dodson, 1980). A U. Navy study found that the mixture of yellow-red (orange) is most readily detectable. The redder the colour the better the visibility of the colour (Malone, Sexton, & Farnsworth, 1951). Although the study was related to lifesaving equipment and those who were swept overboard, and, therefore, is in the interest of beach lifeguards only, it seems reasonable to create a universal tradition in all the other lifeguard specialties (waterfront, pool and water parks). Therefore, for lifeguards to be more visible from a distance, they should wear red-yellow or orange coloured uniforms, hats, and swim hats.

4.3.11 Record-Keeping and Written Operating Procedures

Lifeguard services should design and implement a system of obtaining, storing and retrieving information on services rendered, special incidents, population served and other aspects of operations. Reports and record-keeping will provide a method of recall for testimony if litigation arises from actions performed
by lifeguards. The data derived from this system could also be used for research into the cause and prevention of injuries and fatalities at public open-water recreational beaches (McCloy & Dodson, 1980).

4.3.12 Ability to Perform Risk Assessment

All aquatic environments pose a safety risk to bathers. A fairly safe beach would be one that has full-time lifeguards, low wave energy, no rip currents, reefs, and cliffs, bathers who know swimming, know about tides and waves, have good common sense and are cautious. Possibly no such beach exists (Nietschman, 1997). Like beaches, all aquatic environments (lake, swimming pool, river etc.) could not be 100% safe.

The consequences and the severity of a risk in an aquatic environment vary. The consequence might be a minor or serious injury, death (Calland, 2000) or liability and litigation because the accident is perceived as someone’s fault, from whom compensation must be claimed (Thomas & Raymont, 1998). The severity of the risk ranges from very low to extremely high, from a reasonably safe to a really dangerous aquatic environment dependent on the prevalence and severity of hazards, the aquatic knowledge and experience of bathers, and the presence or not of professional lifeguards (see Chartered Institute of Environmental Health, n.d.).

Because the vast majority of all drownings are preventable (Bierens et al., 2002; Moon & Long, 2002) a risk assessment is vital. Risk assessment is the process by which hazards present in an activity are identified and an estimation is made of the extent of the involved risks (Thomas & Raymond, 1998). Risk assessment is central to the effective management of health and safety at any waterside environment. In order to carry this out effectively there must be a careful examination of the environment to determine what the hazard is and from that, the risk to which those who work or play at the waterside environment can be exposed (Mac Gregor, 2002). Conducting a risk assessment requires identification and evaluation of the risks, of those at risk, reasonable and practical action to anticipate such an event and recording of the assessment (Table 4.12; Whatling, 1994; Lifesaving Society, 1999b).
### Table 4.12: Beneficial Outcomes to Bathers’ Safety of the Successful Risk Assessments that Followed Big Aquatic Tragedies on Different Beaches.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Aquatic Area</th>
<th>Incident</th>
<th>Action Taken</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>American Beach (Nassau County), Florida</td>
<td>In 1989 NCC decides to eliminate lifeguards in order to safe money. Almost a year later, 5 people drowned and 20 near-drowned on memorial Day 1990, when rough ocean conditions and strong winds caused rip currents and dangerous conditions.</td>
<td>Local officials re-establish lifeguarding services.</td>
<td>In the 8 years since, no-one has drowned.</td>
</tr>
<tr>
<td>2</td>
<td>Keawaula Beach, Hawaii</td>
<td>The beach is exposed to high surf, strong shore break, and strong current. Very many people visit the beach. During 1985–1991, 2 people drowned and 40 near-drowned.</td>
<td>The State of Hawaii elected to place lifeguards in 1992.</td>
<td>Since then, no drowning has occurred at this beach.</td>
</tr>
<tr>
<td>3</td>
<td>Ocean Beach, San Francisco, California</td>
<td>Due to budgetary concerns, lifeguards for some beaches were gradually removed in the early 1990s. However, people continued to swim and drowning continued to occur. In 1998, there were 7 drownings at Ocean Beach, which exceeded the previous 6-year total. These generated extensive media attention.</td>
<td>GGNRA consulted with USLA to develop plans to employ, train and deploy aquatic rescue personnel at Ocean Beach. On-site lifeguard services began before the summer of 1999.</td>
<td>Since that time, no drowning has occurred at Ocean Beach.</td>
</tr>
<tr>
<td>4</td>
<td>Ocean Beach, San Diego, California</td>
<td>In 1918, 13 people drowned in rip currents in a single day while beach attendance was approximately 5,000.</td>
<td>City officials cited inadequate protection as a cause of tragedy. They initiated a municipal lifeguard service.</td>
<td>Despite the annual attendance of 15 million people and over 7,000 rescues, the average number of drownings is between 0 and 1 annually.</td>
</tr>
</tbody>
</table>

*Note: Last column’s outcome describes the circumstances that exist without defining the meaning of ‘since then’.*

*Taken from Branche et al. (2001).*

Although a risk management plan is unique for each aquatic area, some features are common (Manitoba Coordinating Committee on Recreational Water Safety, 1998). A hazard is something with the potential to cause harm and is always there. A risk is the likelihood (high or low) that the particular harm that
a hazard may cause will actually happen (CITB, 2002; Health & Safety Executive, 2002). The risk assessment should be reasonably practicable. This means that it’s a matter of balancing the level of risk against time, trouble, and cost of the precautions that are required to avoid it. The judgment should be driven by the risk and not the size of the financial cost (Health & Safety Executive, 1999). The aim is to make sure that no one gets hurt or becomes ill (Health & Safety Executive, 2002).

4.3.13 Ability to Deal as Educator

Nearly a century ago lifeguards might have been viewed as heroic aqua men and women; whereas today they are trained and encouraged to be systematic scanners and educators (Griffiths et al., 1996). In the recent past lifeguards were often highly skilful in swimming, performance of water safety skills, so comfortable and well trained, that they could not imagine someone else was getting into trouble in an aquatic environment, and so they never scanned the water appropriately (Griffiths, 1995; Griffiths et al., 1996). Therefore, the major problem with those talented lifeguards was that they simply did not watch the water because they were specifically trained to make rescues, not to prevent the need for them. They too often did not expect accidents to happen nor did they consider preventing them. Thus lifeguards must be water safety educators rather than simply water safety experts. They no longer are just authorities; they must become authoritative (Griffiths, 1995). Today, answering the question: ‘What exactly is a lifeguard?’, lifeguards responded considering themselves as supervisor, disciplinarian, public relations person, maintenance person, swimming teacher, baby-sitter, first-aider and swimming coach (Griffiths, 1995). This change in their role might be attributed to the fact that, today, water safety organizations have realized that prevention is more effective than rescue for decreasing the number of drowning incidents (Avramidis, 2008c) but also because most lifeguards today are not competent swimmers as in the past (see Wood, 1999; Brewster, 2007; Leclerc, 2007).

4.3.14 Ability to Recognize the Instinctive Drowning Response

The instinctive drowning response has four characteristics. The victim struggles to keep his or her face above the water in an effort to breathe. Unable to do this, he or she begins to suffocate. His or her arms are extended to the
side, pressing down for support while the legs cannot support by kicking. The victim has a vertical position in the water. Finally, the victim struggles at the surface unable to move forward about 20–60 sec before submersion (Pia, 1984; 2008; American Red Cross, 1995).

In a guarded aquatic area a drowning incident might occur due to the lifeguard’s failure to recognize a casualty’s instinctive drowning response. In 1984, Pia described the drowning incident of a young boy in a swimming pool, where three lifeguards were, at that time, on duty. The author concluded that the boy’s drowning was due to RID factor where ‘R’ stands for the first lifeguard’s failure to recognize the young boy’s struggle. In other words the lifeguard did not distinguish the difference between play in the water with the instinctive drowning response.

As mentioned previously, lifeguards of the past were often excellent swimmers or able to initiate a rescue procedure but fully unaware of how a drowning casualty might appear. Lack of data does not allow us to identify the number of drowning cases that occur due to this inability to recognize the instinctive drowning response. However, taking into account the numerous drowning incidents worldwide annually, we can assume that some lifeguards or bystanders could be unfamiliar with this drowning response.

4.3.15 Ability to Remain Alert

The lifeguard’s responsibility is visual scanning of areas where people are swimming above and under the water, but the ability to remain alert all the time is not possible for a number of reasons. Lifeguard vigilance can rarely be maintained at an optimum level for more than 30 minutes. At the same time, detection of critical environmental cues while engaged in lifeguarding vigilance tasks is never 100% (Coblentz, Mollard, & Cabon, 2001). The quality of visual scanning also decreases over the day as much as 45% when the temperature reaches 30°C (Fenner et al., 2006), or due to fatigue, monotony, stress, noise (Coblentz et al., 2001; Ellis and Associates & Poseidon Technologies, 2001), the number of children in the aquatic environment (Harrell, 1999), social distractions, schoolwork demands, ancillary maintenance duties, the degree of peer acceptance (Pia, 1984; Griffiths, 1998a, 2000a) and the length of the on-
duty periods. Finally, the bad quality of lifeguard scanning can be attributed to the limited amount of time spent on training surveillance compared to CPR, first aid and rescues during the lifeguard programmes (Sims, 2002) and to the lack of a keen work ethic due to the young age of most lifeguards (Griffiths, 1998a; 2000a).

Research studies examining the ability of the lifeguard to stay alert in open water and pool settings confirm that vigilance cannot stay constantly high. In open water, beach lifeguards (n=20) spent on average 5 minutes and 20 seconds looking at the swimming area for every 10 minutes they were observed, which means that 4 minutes and 40 seconds of every 10-minute interval were spent viewing other areas of interest (e.g. friends standing beside the lifeguard stand, surfers riding waves off other beaches and members of the opposite sex walking up and down the beach; Griffiths, 1986; Griffiths, Steel, & Vogel-song, 1999). In a swimming pool area, another study (n=500) revealed that lifeguards can not possibly see everything all of the time (Ellis and Associates & Poseidon Technologies, 2001). Finally, 55% of adult lifeguards (n=2,769) said they watched the water 100% of the time compared with 45% of teenagers claiming that they watched their zones 100% of their time (Griffiths et al., 1996; 1999).

The lifeguard literature reveals a number of non-scientifically tested strategies that have been proposed in order to help the lifeguards remain alert. The first strategy is recommending exercises of personal diligence (table 4.13; Ellis & White, 1994). Second, because the above strategy does not seem to be effective, the application of the ‘five-minute strategy’ has also been proposed (Griffiths, 2000b). Third, a frequent assessment (every 30 minutes) by the manager is likely to lead to more vigilant lifeguards (Griffiths, 2001b). However, the 5-minute scan has discriminability and internal consistency weaknesses that violate testable theory requirements because research supporting the theoretical basis for quadrant grouping and criteria for selecting a focal person within each quadrant (key issues in the 5-minute scanning strategies) has not been identified (Pia, 2007). From all the above it clearly seems that future research is needed in order to find ways that will help the lifeguards stay vigilant.
Table 4.13: Technique Recommended by Ellis & Associates for Making Lifeguards more Conscious about the Importance of Watching their Area.

<table>
<thead>
<tr>
<th>DISTRACTER ACTION TO BE TAKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch an empty pool with flat water</td>
</tr>
<tr>
<td>Between the pool and the roller coaster on the other side of the swimming pool area</td>
</tr>
<tr>
<td>A very attractive person of the opposite sex</td>
</tr>
<tr>
<td>Add crowd, noise, loud music</td>
</tr>
<tr>
<td>Bathers approach you complaining</td>
</tr>
<tr>
<td>Add warm weather and a dry throat</td>
</tr>
<tr>
<td>Keep your eyes on the water</td>
</tr>
</tbody>
</table>

Adapted from Ellis & White (1994).

4.3.16 Ability to Overcome Fear and Bystander’s Lack of Response

The anxiety of the rescuer and a bystander’s lack of response can prevent a rescue taking place. In terms of anxiety, in competitions, lifesavers (n=20) appear to have increased levels of somatic anxiety and decreased levels of self-confidence which can influence their performance and decision making (Avramidou, Avramidis, & Polman, 2007). On the other hand, in real situations, bystanders’ witnessing an emergency tend to avoid becoming involved (RLSS Australia, 2001a) for a number of reasons. This happens because first the bystanders must perceive the need to help (many people see no need to help someone in difficulties). Second, they must decide to take responsibility for offering help (in a large crowd of observers, the easiest thing for people to do is to avoid action). Third, they must weigh the costs of getting involved as opposed to doing nothing (helping someone might be dangerous, a waste of time or even an embarrassment if it turns out that the person wasn’t really in danger. On the other hand, the price of not helping might be guilt, blame of other people, loss of honour and self-esteem). Fourth, they must know how to help (people who finally take the initiative to help usually, but not necessarily, have got some training in rescuing others; Wade & Tavris, 1993).

Taking all the above into consideration it seems that altruism is not only a spontaneous or selfless expression of a desire to help. Some social conditions can make altruism more or less likely to occur (Wade & Tavris, 1993). Therefore, a crowd may cause a trained rescurer not to act quickly. The rescuer should overcome personal fear and nervousness. Therefore, the ability to recognize the emergency, a willingness to accept personal responsibility and
courage for overcoming fear are very important variables for initiating a rescue (RLSS Australia, 1992; 2001a).

4.3.17 Ability to Act as Leader in Managing Emergencies
The effectiveness of a lifeguard team is a multi-dimensional construct that depends on successful leadership, followership and the emergency situation (figure 4.4; Carron, 2003). Lifeguard leadership is the process of influencing an organized lifeguard team in accomplishing its goals (see Roach & Behling, 1984). Followers (e.g. lifeguards) are the head lifeguard’s allies or, in other words, the people who make the head lifeguard’s actions effective. Their role in the leadership equation is not very well appreciated (Hughes, Ginnett, & Gurphy, 1996). Despite the complexities of the head lifeguard (leader) and the followers (lifeguards), no factor in the international framework is as complex as the situation (e.g. the emergency situation; see Hughes et al., 1996).

Crisis (situation factor) can affect the leadership process. In those cases, the lifeguard team is expected to look to the leaders to identify the problem and then to develop and initiate the solution (Avramidis, 2009b). Therefore, lifeguards when facing strong aquatic emergencies generally will expect their head lifeguards to be assertive, directive and decisive (Mulder & Stemerding, 1963). The leader’s (head lifeguard’s) job at that moment is to estimate the
demands, constraints, and then the available choices in the situation. The demands are role expectations (e.g. regulations and policies for the operation of the aquatic area). The constraints are all those factors that limit a head lifeguard’s range of actions in a particular aquatic emergency (e.g. rough weather conditions, lack of appropriate equipment or specialized lifeguards etc.). The choices are the head lifeguard’s discretionary behaviours or, in other words, what finally he or she will decide to do (Steward, 1982).

4.4 Under Whatever Circumstances

The nature of the aquatic environment is multi-dimensional and various factors need to be considered. The following paragraphs will discuss the interrelationship amongst casualty and equipment involved in the aquatic activity, the risk as physical demand of aquatic activity, the presence or absence of others, the time of occurrence, and finally the aquatic activity (table 4.14).

<table>
<thead>
<tr>
<th>Table 4.14: The Circumstances of Occurrence of a Drowning Incident.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrelationship among casualty and equipment</td>
</tr>
<tr>
<td>Risk as physical demand of aquatic activity</td>
</tr>
<tr>
<td>Presence or absence of others</td>
</tr>
<tr>
<td>Time of the day</td>
</tr>
<tr>
<td>Weekend–Weekday</td>
</tr>
<tr>
<td>Month</td>
</tr>
<tr>
<td>Vacancy–Holiday</td>
</tr>
<tr>
<td>The aquatic activity</td>
</tr>
</tbody>
</table>

4.4.1 Interrelationships amongst Rescuer, Casualty and Equipment

This section will explain how the interrelationship between rescuer, casualty and equipment involved in the aquatic activity can enhance an aquatic accident or prevent drowning. Firefighters, police and military services are commonly seen improvising rescues in flooded water wearing their official uniforms. One wonders what the reaction would be if firefighters were to attack a fire wearing wetsuits or if police made arrests in lifejackets instead of bullet-proof vests (Ray, 2006b). The use of appropriate equipment is vital for the survival of both casualty and rescuer.
(1) Wet and Dry Suit
Research has taken place to identify which wet suit provides the highest protection against cold water (Hampton, n.d.). People entering cold water during the abandonment of a ship face a number of dangers that include the inhalation of water, the possibility of laryngeal spasm causing simply asphyxiation, drowning etc. Many of the above problems are overcome if people are dry next to the skin, having prepared themselves by wearing a sensible amount of clothing including an outside layer that is both windproof and waterproof, such as a well-designed survival suit (Cross, n.d.).

(2) Casual Clothes
People entering cold water should keep on their warm clothing under the life-jacket and should float and remain still rather than swim around (Keatinge, n.d.). It was shown that an Olympic level swimmer could not swim for much more than 10 minutes in a water temperature of 10°C fully clothed, and that at the time she could have drowned if she hadn’t been asked to leave the water (Cold Water Casualty, 1990). Although the information from the above experimental study is very important from an educational point of view (e.g. in order to make people more aware and safety conscious about the negative effects of cold water), it is only a case report of an elite swimmer, and thus, it does not represent what happens to an average survivor who is fighting to stay above the water surface. Several environmental or psychological factors might negatively affect the outcome of this fight to stay afloat (e.g. swimming in the dark, raining, distance from safety, the survivor is the only one from a group of people who drowned, fear, stress etc.). Therefore further research with more participants wearing clothes who are closer to the average person (instead of the elite swimmer) would be very useful in enabling more general conclusions to be made.

(3) Personal Flotation Device
Research suggests that not using a Personal Flotation Device (PFD) may increase the risk of drowning, but it is difficult to evaluate how many drownings were avoided by people wearing such devices (Hedberg et al., 1990). Sometimes the use of general flotation devices (e.g. kickboards, float belts, water wings, rafts, noodles, inner tubes) might present obstacles for lifeguards and
for this reason many facilities ban them (DeRosa, 2001). However, according to others, without floating aids, a subject generally drowns within minutes due to swimming failure in cold water, and therefore, life jackets should always be worn when immersion can occur, to prevent submersion at an early stage (Milton, 1990; Dorp, Knape, & Bierens, 2003). Indeed many people drown due to boating-related accidents each year in the United States (Table 4.15) while the use of a PFD could have increased the chances of survival (Avramidis, 1997a; 1998a; Treser, Trusty, & Yang, 1987, United States Coast Guard, 2001).

### Table 4.15: Number of Fatalities by Type of Vessel in the USA During 2001.

<table>
<thead>
<tr>
<th>BOAT TYPE</th>
<th>DROWNING</th>
<th>OTHER DEATH</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airboat</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Auxiliary sail</td>
<td>10</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Cabin motorboat</td>
<td>24</td>
<td>17</td>
<td>41</td>
</tr>
<tr>
<td>Canoe/Kayak</td>
<td>94</td>
<td>7</td>
<td>101</td>
</tr>
<tr>
<td>Houseboat</td>
<td>5</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Inflatable</td>
<td>14</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Open motorboat</td>
<td>256</td>
<td>96</td>
<td>352</td>
</tr>
<tr>
<td>Other*</td>
<td>11</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Personal watercraft</td>
<td>11</td>
<td>39</td>
<td>50</td>
</tr>
<tr>
<td>Pontoon boat</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Rowboat</td>
<td>47</td>
<td>2</td>
<td>49</td>
</tr>
<tr>
<td>Sail only</td>
<td>13</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Unknown</td>
<td>6</td>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>

Taken from United States Coast Guard (2001).

A number of epidemiologic characteristics seem to be linked with the drowning incidents of people who did not wear a PFD while engaged in an aquatic activity. In terms of age, the use of a PDF in boats decreased dramatically at the age of 15 years (Bennet, Quan, & Williams, 2002b). In another study (n=40), 83% of the drowning victims were 13–19 years old (Newman et al., 1998). In terms of gender, the majority of the drowned victims were males (Newman et al., 1998), possibly because females were more likely to wear a PFD than males (Quan et al., 1998). In terms of activity, those using motorboats (19%) were least likely to wear a PFD (n=4,181; Quan et al., 1998).

Taking together all of the above, it seems that most people who drowned during boating activities were not wearing a PFD properly or not wearing one at all (Newman et al., 1998; Morbidity and Mortality Weekly Report, 2001). Indeed many of the drowning deaths might have been prevented with the use of PFDs (Shatz et al., 1998). Finally, medical practitioners should encourage
PFD use and other protection for their patients who are known water enthusiasts (Branche, Conn, & Annest, 1998) or people with epilepsy (Ryan & Dowling, 1993).

(4) Quality of Materials
A number of studies show that the quality of the equipment used in an aquatic facility might be linked with drowning. First, subsistence fishermen are predominantly found in the poor countries around the world and use equipment that is minimal (Dorp, Knape, & Bierens, 2003). Second, abalone divers, who dive with hooker lines and compressors on boats for catching the sea harvest, often use poor equipment; the compressor is petrol-, or diesel-driven and the exhaust pipe is beside the air inlet pipe. Carbon monoxide, when compressed to 1–10 atm increases in solubility and even 0.1% in the air sent to the diver can be fatal within 10 minutes (Manock, 1973). Finally, in commercial diving fatalities, the rare accidents that do occur are often due to equipment malfunctions or unsafe work practices (Caruso, 2006). Although there is not enough evidence to support the claim that the quality of materials might lead to drowning, it is clearly important to research this variable further.

(5) Lifeguard Equipment
Although lifeguards still make up the primary unit in the operation of protective and rescue services, their effectiveness is significantly increased by the use of certain types of equipment and facilities. These devices are designed to assist the lifeguard in prevention, rescue and treatment, thereby allowing fewer guards to provide better services to aquatic users. There is considerable variation in the kinds of equipment assemblages and operating facilities used by lifeguard services. Often the kinds of equipment and type of facilities are characteristic of a region and are based on tradition or historical precedence. Although methods may vary, the basic premise remains that lifeguards must be provided with the necessary equipment to respond most efficiently and effectively to an emergency and to observe and provide warnings or other preventive measures to bathers (McCloy & Dodson, 1980).
Figure 4.5: Computed-Aided Casualty Detection System for Swimming Pools.

Note: The video cameras enable early and effective identification of a drowning casualty. The above water video cameras can be used to feedback pictures of view which would normally be obscure to a lifeguard as long as they can easily reach a particular area if required. Built in motion detect software, working in conjunction with the above water cameras can be set up to produce an alarm if there is intrusion into any particular area. The system is not designed to replace lifeguards. It is created with the purpose of assisting them to save lives.

Taken from Swimming Pool Safety Company (2009).

Lifeguard detection systems are important instrumentations because accidents happen when the guards are distracted or have failed to notice warning signs (Financial Times, 2001). These artificial intelligence systems sound the alarm when they ‘see’ someone in danger of drowning (figure 4.5; Marks, 2002). Such systems, have received international publicity (Preugshat, 2001; Uclic, 2001; Marks, 2002), acceptance from leading water safety organizations (Carrell, 2001) and has proved its efficacy by warning the lifeguards, successfully, about a drowning incident in a number of cases (e.g. Davies, 2001; Parents Online, 2001; Uclic, 2001; Aspen Publishers, 2002; Marks, 2002). Although only limited cases have been reported so far where people have been saved by such systems, they designed to assist the lifeguard and provide backup during moments of boredom, or distraction and also to be capable of detecting simulated casualties when lifeguards fail to do so.

The use of a rescue tube plays an important role in pool and water park rescue. A study (n=33, 15 certified lifeguards and 18 individuals who demonstrated the entry-level swimming skills necessary to enrol in a lifeguard-
training class) showed that despite the apparent benefit of using a rescue tube during a rescue, its use increased water resistance when it was positioned across the rescuer’s chest (Leclerc, 2007). The same author suggested that those participants who used the American Red Cross technique were slower than those using the YMCA technique. Therefore emphasis must be given, apart from whether or not this equipment is used during a rescue, to how it is used. As no other study has related drowning with the use of lifeguard equipment, research on that topic will be extremely relevant and interesting.

The use of fins plays an important role in open water rescue in terms of speed of action. When lifeguards (n=10) in a study carried a mannequin barefoot, they had significantly slower velocity than when they used fins. The decline in velocity across the 25 m tended to be greater when they did not use fins, and the slopes tended to be smoother when they used flexible fins. Also using fibre fins enabled lifeguards to maintain the same velocity from the beginning to the end of each trial (Abraldes et al., 2007). This study, therefore, demonstrated the importance of, not only using this equipment, but also the most appropriate type to use.

4.4.2 Risk as a Physical Demand of Aquatic Activity
The presence of risk from the physical demands of aquatic activity might lead to drowning. For example, sailing in rough weather with no obvious travel plan is a risky activity; two people were lost overboard from a sailing yacht, losing their lives in the water (Marine Accident Investigation Branch, 1996). A second example of risk as a physical demand of aquatic activity is the attempt to rescue others without having appropriate lifesaving skills (e.g. A.ST, 2003); in New Zealand 55 people lost their lives trying to save others between 1983 and 2002 (Water Safety New Zealand, 2002). Although the study does not explain clearly whether or not the cause of drowning was other factors (e.g. faulty equipment, poor training etc.), it is understandable that the decision to save someone always contains some degree of risk, especially if the people who initiate the rescue have not had proper lifesaving education.
4.4.3 The Presence or Absence of Others

Research seems to suggest that drowning incidents occurring in the presence of others have a favourable outcome as long as the witnesses are capable of recognizing the need for rescue. In one survey, 89% of all drowning victims (n=199) were not supervised (Quan et al., 1989). Similarly, others argue that the chances of drowning at a beach protected by lifeguards trained under United States Lifesaving Association standards is less than one in 18 million (Branche et al., 2001) underlying the importance of the lifeguard presence. Opposite findings, however, show that drowning incidents occur even where lifeguards are on duty (Royal Life Saving Society Australia, 1998; 1999; 2000; 2001a). One possible reason for that was found in an evidence-based observation study that examined several thousands of drowning incidents that occurred each summer on Orchard Beach (USA), revealing that people drown even in the presence of others due to the inability of bystanders, and occasionally lifeguards, to recognize the casualty’s instinctive drowning response (Pia, 1970). One might assume, therefore, that the presence of bystanders, lifeguards or parents can play a vital role in drowning prevention as long as they are able to recognize the casualty’s drowning pattern and consciously supervise the swimmers constantly.

4.4.4 Time of Day

Limited research has begun to link drowning episodes with the time of day. A retrospective study (n=90, age<12 years, between January 1991 and December 2000) of children admitted to hospital with a diagnosis of drowning, revealed that the time with the highest incidence of drowning was 12–6 pm (Tapadinhas et al., 2002). Another study that examined non-commercial accidental water transport (boating) fatalities in the period 1980–1984 (n=24), found that on most occasions (22, 95.7%) the cause was drowning and the time of occurrence was during afternoon in 15 (65.2%) of the cases (Copeland, 1986). From all the above it seems that further research on this aspect is clearly needed.

4.4.5 Weekend versus Weekday

The fact that drowning rates are higher during the weekend than during weekdays is supported by a number of studies (table 4.16; Greensher, 1984;
Moler, 1993; Pearn et al., 1976; Royal Life Saving Society Australia, 2001a). This can be explained by the fact that for many people, Saturday is the first non-working day of the week, and many children have the chance either to go swimming in a swimming pool or to go and play near the water unattended after the afternoon meal (between 3 and 6 pm). Another interesting statistic shows that most of the Australian male drownings occurred on public holidays while females drowned during school holidays (Australian Water Safety Council & University of New South Wales, 2000).

### Table 4.16: Immersion Accidents in Fresh Water by Day of the Week in Children Aged 0–15 Years (n=111).

<table>
<thead>
<tr>
<th>Day of Week</th>
<th>Survived</th>
<th>Died</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Tuesday</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Wednesday</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Thursday</td>
<td>9</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Friday</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Saturday</td>
<td>7</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Sunday</td>
<td>15</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

*Note:* Data are collected from City of Brisbane over the five year period 1971–1975. Taken from Pearn et al. (1976).

#### 4.4.6 Month of the Year

Deaths exhibit a seasonal pattern in most parts of the world (Becke & Weng, 1998; Avramidis & Butterly, 2009) occurring mostly during the warmer months of the year (Health Education Authority, 1996). A retrospective study between 1991 and 2000 with the diagnosis of drowning (n=90), revealed that the summer months had the highest rate of drowning for children below 12 years old (Tapadinhas et al., 2002). In another study that examined seasonal patterns of death in Matlab of Bangladesh (n=20,328 deaths) drowning deaths peaked in September (Becke & Weng, 1998). The reason for that difference may be that the first study focused specifically on children aged 12 years, who are on holiday during the summer, while in Matlab the researchers examined drowning deaths in all age groups. In Houston (USA) during the period 1970–1978, the peak month was May with 101 drownings; June and July followed with 97 and 92 drowning deaths respectively (McCloy & Dodson, 1984). This means that people drowned mainly at the beginning of the summer and carried on drown-
ing during the warm months. In the USA generally, 60% of all drownings occur in the summer months (Moller, 1993). In the countries of the United Kingdom, most drowning deaths occur during August (n=57) and the summer has the highest drowning rates (n=136). The second highest season was spring (n=115) and the second months were September and May (table 4.17; Royal Society for the Prevention of Accidents, 2001). This is likely to happen because those seasons and months are the next warmest after the summer; people participate in outdoor or other aquatic activities, eventually getting into difficulties. Similar findings came from a 5-year population study in Minnesota, where 286 drownings (n=404) occurred during the period May–September (Hedberg et al., 1990).

<table>
<thead>
<tr>
<th>Season</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Feb</td>
<td>1</td>
<td>10</td>
<td>3</td>
<td>28</td>
<td>27</td>
<td>4</td>
<td>4</td>
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<td>Mar</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Apr</td>
<td>3</td>
<td>38</td>
<td>24</td>
<td>37</td>
<td>34</td>
<td>27</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jun</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jul</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aug</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sep</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oct</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nov</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Dec</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Months</td>
<td>Scotland</td>
<td>England</td>
<td>C. Islands</td>
<td>N. Ireland</td>
<td>Wales</td>
<td>Totals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

4.4.7 Vacation–Holiday

Research shows that people drown while they are on holiday. In Greece, eight people drowned in different areas during the summer holiday of Holy Spirit day, within a 3-day period (Lambropoulos, 2003). In Australia, between 1 July 2000 and 30 June 2001, 21 people drowned during the school holiday period, 4 on public holidays, 9 on other non-holiday weekends and 11 on other non-holiday weekdays which shows that there is a slight increased rate during holidays (Royal Life Saving Society Australia, 2001c). From the above statistics, the high ratio in school holidays was, as expected, the period with the highest frequency, because it is the longest period (normally 3 months) and also the only time when most people go on holiday. In another study, overseas tourists (n=88, from 12 countries) drowned in Australia during the period 1992–1997. Tourist drowning comprised 4.7% of non-boating drowning, 18% of surf/ocean, 25% of scuba/snorkeling and 1.6% of boating drownings (Mackie, 1999). That shows that people drown not only while they are working...
(e.g. fishermen etc.), but also during leisure and recreation, when one imagines that everyone thinks they will have a pleasurable and safe experience near the water.

4.4.8 The Aquatic Activity

A number of research studies show that scuba diving can be a cause of drowning. First, an experienced diver drowned after a generalised seizure caused by \( \text{O}_2 \) toxicity during a 19-minute ‘technical’ dive to a depth of 47 m. He had used a 50% \( \text{O}_2/\text{Nitrogen} \) gas mixture inappropriately. This case illustrates the risk of oxygen toxicity from oxygen-enriched air during deep dives, the shortcomings of the diver's equipment, and the need to examine, with knowledge of diving physiology and practice, the use of the equipment (Lawrence, 1996). Second, in another study, two scuba divers nearly drowned during diving training in a swimming pool (Zwingelberg, Green, & Powers, 1986). Elliot and van Hulst, (2006) argued that between one-third and one-half of all diving deaths by drowning involve young, inexperienced male divers and another significant number involve scuba diving students. Third, only in the USA, from the 90 scuba diving fatalities that occur annually, drowning is reported as the leading cause of death. According to the same authors the reasons for that is entanglement, out-of-air emergencies at depth in cave and wreck diving, or even pulmonary barotraumas, cerebral arterial gas embolism and unconsciousness leading eventually to water aspiration and drowning.

Although the water birth is promoted as an improved and safe method of delivery, there is a possibility of drowning. Four drowning case studies of infants are not enough to say that water birth is a dangerous technique that should be avoided as it leads to drowning, but it highlights the need for more evidence on safety before it is offered routinely. It is finally recommended that water births should take part in audited institutions undertaking this obstetrics practice (Nguyem et al., 2002).

When reviewing the literature for identifying means of transportation, ships and airplanes were found to be problematic. Unsafe or overcrowded vessels (including refugee boats), are associated with large numbers of drownings annually (World Health Organization, n.d.). A large number of accidents and
shipwrecks at sea have occurred over the last 20 years with catastrophic consequences (Brandstrom, 2006) like the M/S Estonia, where 852 people died in the sea (Boesten, 2006). Also submersion and immersion accidents following aircraft crashes in water have been reported in Alaska, where, because the road system is minimal, much travel for recreation and business is conducted by air. In this area it is not uncommon to have one air crash a day in areas with a high volume of traffic, because of the weather (Nemiroff, 2006).

4.5 Where: The Environment in which Drowning takes Place

The question ‘where’ examines the environment in which drowning takes place. The environment in which one works or spends time during leisure has a major effect on the likelihood of accidents, because it can be unstable, but this may not be apparent (table 4.18; Calland, 2000).

<table>
<thead>
<tr>
<th>Table 4.18: Environmental Variables that can Enhance the Occurrence of a Drowning Incident.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific geographical characteristics of the country</td>
</tr>
<tr>
<td>Aquatic environment</td>
</tr>
<tr>
<td>Water depth</td>
</tr>
<tr>
<td>Water specific gravity</td>
</tr>
<tr>
<td>Length of supervised aquatic area</td>
</tr>
<tr>
<td>Ground gradient</td>
</tr>
<tr>
<td>Lighting</td>
</tr>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Waves</td>
</tr>
<tr>
<td>Tide</td>
</tr>
<tr>
<td>Currents</td>
</tr>
<tr>
<td>Pollution</td>
</tr>
<tr>
<td>Water temperature</td>
</tr>
<tr>
<td>Reflection</td>
</tr>
<tr>
<td>Off-shore winds</td>
</tr>
<tr>
<td>Weather</td>
</tr>
<tr>
<td>Psychological pressure because of the public presence in emergency</td>
</tr>
<tr>
<td>Influence of other parties that desire to go over their limits</td>
</tr>
<tr>
<td>Noise during lifeguard scanning</td>
</tr>
<tr>
<td>Preventive measures</td>
</tr>
<tr>
<td>Legislation</td>
</tr>
<tr>
<td>Morality of selling policy regarding equipment</td>
</tr>
</tbody>
</table>

4.5.1 The Aquatic Environment

The aquatic environment includes numerous areas. In many countries, drowning occurs around the home environment, whereas in others, drownings in public or private swimming pools, in open water, at sea, or on beaches are
frequent (table 4.19: Bierens et al., 2002). Below, a number of such aquatic environments will be presented.

Table 4.19: Relative Contribution of Various Submersion Media to Drowning Accidents.

<table>
<thead>
<tr>
<th>Body of water</th>
<th>Drowning (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt water</td>
<td>1–2</td>
</tr>
<tr>
<td>Fresh water</td>
<td>98</td>
</tr>
<tr>
<td>Swimming pool (private)</td>
<td>50</td>
</tr>
<tr>
<td>Swimming pool (public)</td>
<td>3</td>
</tr>
<tr>
<td>Lakes, rivers, streams, storm drain</td>
<td>20</td>
</tr>
<tr>
<td>Bathtub</td>
<td>15</td>
</tr>
<tr>
<td>Bucket of water</td>
<td>4</td>
</tr>
<tr>
<td>Fish tanks or ponds</td>
<td>4</td>
</tr>
<tr>
<td>Toilets</td>
<td>1</td>
</tr>
<tr>
<td>Washing machines</td>
<td>1</td>
</tr>
</tbody>
</table>

Taken from Orlowski (1987).

Drowning incidents have been reported in open water in a number of studies. In Australia during the period 1992–1997, most non-boating drowning (22%) occurred in ocean/estuary (tidal) sites (Mackie, 1999) possibly because the areas are wider and the participation of the public in recreational activities more extensive. In Canada, 153 people drowned during the period 1990–1998 (Lifesaving Society, 2000b). In New Zealand, 27 (22%) drowned in 2002 (Water Safety New Zealand, 2003). Considering the fact that the Canadian population is estimated to be 32,641,688 and New Zealand 4,150,650, the difference between the drowning incidents is expected (Statistics Canada, 2006; Statistics New Zealand, 2006). About 5% of all drowning incidents in the UK occur in docks (Eaton, 1995).

Drowning incidents have been reported in inland water in a number of studies. In New Zealand, 4 people drowned in 2002 (Water Safety New Zealand, 2003). In Pinellas County of Florida (USA) 26 people drowned during the period 1983–1987 (about 6 or 7 per year) (Nichter & Everett, 1989). In 1999–2001, 12 people drowned in Australia (RLSS Australia, 2001a). In Pinellas County of Florida (USA) 13 people drowned in canals, during 1983–1987 (3 per year) (Nichter & Everett, 1989). During the period 1971–1975, 13 children drowned (n=111) in the city of Brisbane in inland water (Pearn et al., 1976) possibly because it is the third largest city in Australia having a population of
over 1.6 million (Ourbrisbane.com, 2006). In a retrospective study of 125 submersion victims, 86 were found in ditch water (Bierens et al., 1996). In Ireland, 80% of swimming rescues (n= 2,000 incidents) by officers of the Republic of Ireland’s police service took place in rivers (Connolly, 2004b). Although some of the above studies report only a small number of drowning incidents, they clearly show that drowning is likely to occur at any inland aquatic environment.

<table>
<thead>
<tr>
<th>Means of access to pool</th>
<th>Fenced*</th>
<th>Unfenced</th>
<th>Unknown or unspecified</th>
</tr>
</thead>
<tbody>
<tr>
<td>With parent</td>
<td>9</td>
<td>–</td>
<td>10</td>
</tr>
<tr>
<td>With other child</td>
<td>3</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Lock broken</td>
<td>–</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Gate left open</td>
<td>3</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Through house door</td>
<td>2</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Climbed fence?</td>
<td>2</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Unfenced</td>
<td>–</td>
<td>19</td>
<td>–</td>
</tr>
<tr>
<td>Unknown</td>
<td>–</td>
<td>–</td>
<td>32</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>19</td>
<td>19</td>
<td>55</td>
</tr>
</tbody>
</table>

*Note: type unspecified.
Taken from Ross et al. (2003).

Drowning incidents have been reported in swimming pools in a number of studies. In a sample of 2,673 drowning deaths, 17% occurred in private swimming pools in Australia during 1992–1997 (Mackie, 1999). In 2001, about 874 successful rescues were reported in Wildwood two Raging Waters Waterparks of New Jersey in the USA (Raging Waters, 2001). The high number of incidents can be explained by the fact that many bathers were coloured (coming from law socio-economic background which means that do not have enough money for swimming lessons) or swim having consumed alcohol or food (E. Avramidou, personal communication, 2 September 2002). In 2002, in New Zealand 4 people drowned in home swimming pools and spas (Water Safety New Zealand, 2003). This number is small, but it is important to mention it as it shows that even in a place like spas that most private companies consider as safe, a drowning incident might occur. Most companies like hotels and water parks in countries with poor lifeguard legislation are allowed to operate spas by letting their users know that ‘there is no lifeguard on duty’ and that ‘you are swimming at your own risk’. In Victoria (Australia) there are about 55,000 in-ground swimming pools. No state law requires the owner to fence
them (table 4.20). During 1988–1990, 42 drownings of children were reported and one-third of those incidents took part in private swimming pools (Victorian Injury Surveillance System, 1990). Residential hot tubs, spas and whirlpools represent poorly recognized but high-risk drowning sites for young children. During 1960–1979, 74 drownings were reported (about 3 or 4 drownings per year) of children aged 10–41 months in California (Shinaberger et al., 1990). Two children drowned in 1998/1990, in Victorian spas (Routley & Ashby, 1997). During 1999–2001, 13 people drowned in home pools and spas in Australia (about 6.5 per year; RLSS Australia, 2001b). From all the above it is obvious that the place that is considered by most water safety organizations as safer, the pool, can lead to a fatality, when improper or unsupervised activity, especially of young children, takes part.

Drowning incidents have been reported in domestic water in a number of studies. Epidemiologic data from different countries, show that people have drowned in waterholes, dams and garden ponds (Pearn et al., 1976; Royal Society for the Prevention of Accidents, 2001). A second type of domestic water where drowning might occur is in a bucket. Children aged 8–18 months, attracted by the bubbles, objects on the surface or the water itself, lean forwards. As they are unable to get out, they either drown within a few minutes or inhale chemicals and die later from internal injuries (table 4.21; Department of Trade and Industry, 1996). Five gallon buckets and other large containers are dangerous for toddler drowning, because their head is the heaviest part of their body and can easily become trapped in such containers; when large containers are filled with liquid, they weigh more than the toddler and will not tip over to allow the child to escape (Petridou & Klimentopoulou, 2005). Finally, bathtub submersions or drowning were reported in numerous research studies related to young children and old people (Pearn et al., 1976; 1979; Quan et al., 1989; Routley & Ashby, 1997). Considering the relatively short time spent there, the bathroom is the most dangerous room in the house for children aged under 5 years (Pearn et al., 1976; Routley & Ashby, 1997; Mackie, 1999; Ross et al., 2003; Petridou & Klimentopoulou, 2005).
Table 4.21: Number of Childhood Drownings in 5-gallon Buckets in the USA.

<table>
<thead>
<tr>
<th>Year</th>
<th>No of reported deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>21</td>
</tr>
<tr>
<td>1985</td>
<td>21</td>
</tr>
<tr>
<td>1986</td>
<td>24</td>
</tr>
<tr>
<td>1987</td>
<td>24</td>
</tr>
<tr>
<td>1988</td>
<td>23</td>
</tr>
<tr>
<td>1989</td>
<td>24</td>
</tr>
<tr>
<td>1990</td>
<td>23</td>
</tr>
<tr>
<td>1991</td>
<td>33</td>
</tr>
<tr>
<td>1992</td>
<td>19</td>
</tr>
<tr>
<td>1993</td>
<td>18*</td>
</tr>
<tr>
<td>1994</td>
<td>17*</td>
</tr>
<tr>
<td>Total</td>
<td>247</td>
</tr>
</tbody>
</table>

*data are not complete.

Taken from Department of Trade and Industry (1996).

4.5.2 Specific Geographical Characteristics of the Country

It can be hypothesized that the more aquatic environments there are within a country the higher will be the chances of a drowning incident occurring. For example, countries such as New Zealand and Greece are surrounded by, and contain, a wide variety of aquatic environments that provide outstanding opportunities for recreational and sporting activities (Avramidis, 1998a; Water Safety New Zealand, 2000b). However, as no research has related drowning to the number of kilometres of a country’s coast line, the total circumference of all the lakes, and the total length of all the rivers, a future study based on that would be of interest.

4.5.3 Water Depth and Distance from Safety

Water depth and distance from safety are likely to play an important role in drowning incidents especially for the weak- or non-swimmer (Macdonald, 1999). In terms of water depth, it has been found that children can drown in 5 feet or less of water (Avramidis, 1998a; Griffiths, 2002) and drowning takes many people by surprise as it happens silently within seconds in as little as 2 cm of water (figure 4.6; Ridder et al., 2002). In terms of distance from safety, drowning rarely occurs at distances greater than 50 m from the beach (Surf Life Saving Association Australia (1985) and more precisely, 90% of all drowning deaths occur within 10 m of safety (Orlowski & Szpilman, 2001). More interestingly, studies from the United Kingdom confirm that 55% of drownings occur within 3 m of rescue and many in water only just deeper than the person’s height (Stallman, 2008).
Figure 4.6: The Water Depth of the River is one of the Variables that Constitute the General Drowning Trap Model in the Potomac River.

\[
\begin{align*}
\text{Depth of the River} & + \\
\text{Velocity} & + \\
\text{Deceptiveness} & = \\
\text{Drowning Trap} & \text{ (River Fatalities)}
\end{align*}
\]

Taken from Kauffman (1992).

4.5.4 Specific Gravity of Water

Although it seems logical to suppose that fewer drowning incidents should occur in very high density salty water due to its buoyancy, no study has correlated drowning rates with the specific gravity of water. On the other hand drownings occur even in the extremely buoyant Dead Sea (Yagil, Etzion, & Oren, 1983). Some statistics reveal that the majority of drowning incidents has taken part in fresh water (Orlowski, 1987; Lifesaving Society, 2000b), while others show a greater drowning rate in oceans/estuaries (Mackie, 1999). Therefore, it is not safe to suppose that where the water’s specific gravity is greater than 1.0 (salty water), people do not sink as easily as when it is not (e.g. in fresh water). Why people drown should be related mainly to how many people participate in a specific aquatic activity. The more people get involved doing something in, on, or around water seems far more important than the specific gravity of the water. Thus, this variable should be studied more in the future.

4.5.5 Beach Gradient

The beach gradient might be a contributing variable to drowning. A steep gradient allows access to deep water for weak or non-swimmers and it may also provide an unstable surface. A beach that is mostly considered ‘low risk’ may, on some occasions, be ‘high risk’. For example, Aberdeen beach has a shallow gradient throughout most of its tidal range so may be considered ‘low risk’. However, after certain storm conditions there can be a steep incline at the
high tide line. This configuration, along with a high tide and strong currents or large waves can elevate Aberdeen beach to ‘high risk’. During the summer for Aberdeen this can be something of a freak condition. If such a steep gradient is set up before the summer season it can persist until the winter storms (MacDonald, 1999).

4.5.6 Length of Supervised Aquatic Area
The length of the supervised area as a possible variable that might contribute to drowning seems to be neglected in the water safety literature. Analysis of a questionnaire suggested that the optimum width which is safe to scan was 106 m. The furthest distance from the water’s edge to the sea for best scanning was 98 m with the largest area safe to scan being 9.334 m². It was also found that the highest distance that could safely be scanned was up to 85 m (Fenner & Harrison, 2002). Although the authors did not provide a detailed description of the methodological process and the number of questionnaires that were given, it seems logical that the distances found should be used until fresh evidence either confirms these or finds new measures. In the year 2000, the Greek governing authority changed the legislation regarding the area to be supervised by individual lifeguards, from 300 m (FEK, 1976) to 600 m (Decree-Law 2000). Even if research has not correlated the high drowning rates that occur in Greece with the extremely big area that is required to be supervised by single lifeguards, it is natural to assume that the increasing number of deaths due to drowning could be related to the lifeguard’s inability to supervise such large areas (see Avramidis, 2003a; 2004b). Legislation should be a tool for assisting water safety personnel not for pushing them to be ‘Life-Gods’ instead of ‘Life-Guards’.

4.5.7 Shape of Supervised Aquatic Area
Although the shape and the size of swimming pools vary and are dependent on the owner or the designer, there is no evidence to suggest that those shapes are necessarily safe. Approximately 100,000 pools are designed and constructed annually worldwide in various shapes (table 4.22; Mittelstaedt, 1992). A pool shape can cause ‘blind spots’ for the lifeguard with all the consequences that this can produce (e.g. lack of supervision leading to accidents). As the above source did not specify which pool shape should or
shouldn’t be preferred for safety reasons, future research should focus on this particular issue.

Table 4.22: The Shape of Different Pools.

<table>
<thead>
<tr>
<th>Category</th>
<th>Shape</th>
<th>Category</th>
<th>Shape</th>
<th>Category</th>
<th>Shape</th>
<th>Category</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.</td>
<td></td>
<td>15.</td>
<td></td>
<td>16.</td>
<td></td>
<td>17.</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td></td>
<td>18.</td>
<td></td>
<td>18.</td>
<td></td>
<td>19.</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td>14.</td>
<td></td>
<td>15.</td>
<td></td>
<td>15.</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td></td>
<td>16.</td>
<td></td>
<td>17.</td>
<td></td>
<td>17.</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td></td>
<td>18.</td>
<td></td>
<td>19.</td>
<td></td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Taken from Mittelstaedt (1992).

4.5.8 Lighting

To date no study has related lighting as a contributing variable to drowning. However, it seems reasonable to hypothesize that poor lighting might negatively affect the quality of lifeguard surveillance and the detection of a drowning casualty from the lifeguard’s point of view, as well as the ability of the bathers to swim safely in the aquatic environment (Schwartz, 1998). As no study has yet related drowning to the available lighting around the aquatic environment it would be interesting to examine this variable as a possible contributing risk factor.

4.5.9 Water Clarity and Reflection

Water clarity and reflection might be contributing variables leading to drowning. Reduction in the clarity of swimming pool water can be risky because it prevents pool users from assessing the water depth and lifeguards from seeing a victim under the water, and therefore it should be minimized (Schwartz, 1998). Reflection is a big problem caused when the sun shines from the south in the afternoon; also glazing, artificial lighting, waves, rapids, jets or even falling water can produce turbulent water making lifeguards unable to see
(Brons, 2006). Although no-one has related drowning deaths to this variable, it is obvious that lifeguards cannot save what they cannot see.

4.5.10 Flood

Inland flooding is the number one weather-related killer worldwide affecting both aquatic civilians and rescue workers (see table 4.23; Ray, 2006a). For example, while the 1999 war in Yugoslavia resulted in less than 10,000 deaths, triggering international intervention, in Venezuela in the same year 50,000 people were killed by floods in that country alone. According to the USA State Department, terrorist groups killed fewer than 10,000 people worldwide over the period 1980–1999, while in 1998 alone, nearly 100,000 people perished in floods worldwide. Civilians drown while attempting to drive their vehicles through flooded roads, cross the border unlawfully to gain access to the USA, become stranded on small islands or washed downstream and others drown and are found days later in a decomposed state (Greenhalgh, 1997). On the other hand, it has been reported that firefighters, police and military services are commonly seen improvising rescues in flooded water wearing their official uniforms (Ray, 2006b). In the USA, 10% of the people who died (n=52) in flood fatalities were rescue workers, generally untrained (Greenhalgh, 1997; Jonkman, 2006; Ray, 2006a). Unfortunately, the extent of drowning has been underestimated because drownings resulting from floods and natural disasters are not coded as drownings but as natural disasters (Smith, 2006).
Table 4.23: Information About the Day, Location, the Number of People Killed or Injured and a Short Description of What Happened in Great Flood Disasters.

<table>
<thead>
<tr>
<th>A/A</th>
<th>Location, Day, No Drowned</th>
<th>Description of incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Earth, 1656 years after Adam's creation All inhabitants on earth except 8 people</td>
<td>Noah’s Flood: is described in the book of Genesis. The story portrays God’s deadly wrath against human wickedness. He created a 40-day flood, for destroying every living organism except Noah and his family. Water reached a level about 6.5 m higher than the highest mountain.</td>
</tr>
<tr>
<td>2.</td>
<td>Johnstown (USA), 1889 2,000 dead, 1,000 missing</td>
<td>Twenty million tons of water exploded through the South Fork Dam and into the valley, about 14 miles upstream from the city. It took an hour for the flood to reach the town. The relatively slow progress was that what was bearing down wasn’t only water but also a gigantic mix of people, animals, uprooted houses, schools, factories, bridges and trees.</td>
</tr>
<tr>
<td>3.</td>
<td>Japan, 1896 27,122 dead, 9,247 injured</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Mississippi (USA), 1927 500 drowned</td>
<td>Heavy rainfall over Mississippi.</td>
</tr>
<tr>
<td>5.</td>
<td>Florence (Italy), 1966 More than 100 drowned</td>
<td>In 48 hours, 19 inches of rain engulfed 750 villages as well as 3 cities.</td>
</tr>
<tr>
<td>6.</td>
<td>Mid-Atlantic Region (USA), 1972 122 dead</td>
<td>Agnes, a mammoth rainstorm poured about 28 trillion gallons of water into 4 rivers. This was the costliest storm ever in the USA.</td>
</tr>
<tr>
<td>7.</td>
<td>St. Petersburg (Russia), 1824 10,000 drowned</td>
<td>The Neva river overflowed.</td>
</tr>
<tr>
<td>8.</td>
<td>Dayton (USA), 1913 1,200 killed</td>
<td>Heavy rains and sudden spring thaw causes the Ohio river to overflow its banks.</td>
</tr>
<tr>
<td>9.</td>
<td>China, 1939 500,000 dead</td>
<td>All regions' rivers overflowed at once.</td>
</tr>
</tbody>
</table>

Adapted from Alberts et al. (1989).

4.5.11 Raining

Raining is related to flooding and therefore can kill many people at the same time. In the year 2000, 12 people died and 8,000 were forced to leave their homes in the USA as monsoon rains continued. Also rain can cause death if lightning strikes occur while people are swimming (Spina & Baldassarre, 1992; Dworkin, 1998). The results of such disasters are drowning or generally death, and loss of property (Avramidis, 2004c).
4.5.12 Warm Temperature

Heat has been found to negatively influence both bathers and lifeguards, increasing the chances of drowning. In particular, temperatures over 30°C significantly reduce lifeguard vigilance by about 45% with respect to optimal performance (see Coblentz et al., 2001). A high number of drowning incidents have been reported during the warm months (Royal Society for the Prevention of Accidents, 2001; Tapadinhas et al., 2002) when thousands of people go swimming.

4.5.13 Waves

Several case reports identify the variable ‘wave’ as a cause of death due to drowning (Mail Foreign Service, 2001). The water itself is an unstable environment, increasing the complexity of the rescue procedure (Ward et al., 1997), and because seas now cover 70.8% of the Earth (Gilluly, Water, & Woodford, 1968) a rescue is very likely to occur in open water environments. Lifesavers and lifeguards will frequently be called upon to initiate a rescue in a rough sea (Stockwell & Fussman, 1998), and, therefore, a basic understanding of how a wave works, is of paramount importance for the outcome of the rescue. At the shore the sea vigorously attacks the land (Gilluly et al., 1968), causing surf on the beaches, and pounds on the rocks (Hutchinson, 1979) sometimes with waves 6 m high, even during clear and calm weather (Sallenger et al., 1995) or with waves 30–40 m higher than sea level (Gilluly et al., 1968). The energy of the wave, the most important variable for the rescuer, depends on its length and height. Waves with high energy can do very much work in a given time (King, 1972) and therefore they constitute a reasonably important factor to be considered when developing the plan of action for a lifesaving (Royal Life Saving Society Australia, 2001a). In open water, waves are created by the wind and stronger winds give longer and higher waves (Bertin, 1961; Hutchinson, 1979; British Sub Aqua Club, 1985). All this is of considerable importance to everyone who is concerned with any coast (Gresswell, 1959a) such as the lifeguard.

A tsunami can be the cause of drowning deaths on a very large scale (table 4.24). Hence the Japanese name, which translates as tsu, ‘harbour’, and nami, ‘wave’. It originates beneath the ocean. Undersea earthquakes are the
principal cause as they create waves which sometimes reach speeds of 600 miles/hour. When waves approach the shallow waters of a coast, they slow down and vast quantities of water pile up in a huge fast-moving wave (Alberts et al., 1989). The earthquake of 2004 that generated the great Indian Ocean tsunami was estimated to have released the energy of 23,000 Hiroshima-type atomic bombs. Giant forces were released suddenly shaking the ground violently and unleashing a series of killer waves that sped across the Indian Ocean at the speed of a jet airliner. More than 150,000 people were dead or missing and millions more were homeless in 11 countries, making it perhaps the most destructive tsunami in history (National Geographic, 2005).

Table 4.24: Information about the Day, Location, the Number of People Killed or Injured and a Short Description of What Happened When Great Waves Appear in Coastal Areas.

<table>
<thead>
<tr>
<th>A/A</th>
<th>Location, Day</th>
<th>No of Drowned</th>
<th>Description of the incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sanriku (Japan), 1896</td>
<td>27,122 deaths, 9,247 injured</td>
<td>Tsunami enforces that the 30 miles of Japanese coastline were devoid of life, after the event.</td>
</tr>
<tr>
<td>2.</td>
<td>Sanriku (Japan), 1933</td>
<td>3,000 deaths</td>
<td>Tsunami that had waves as high as 75ft.</td>
</tr>
<tr>
<td>3.</td>
<td>Hawaii, 1946</td>
<td>96 drowned or killed by floating debris</td>
<td>Walls of water higher than 25 ft, that tsunami brought to Hilo, caused severe damage along the Hilo waterfront area.</td>
</tr>
<tr>
<td>4.</td>
<td>Colijnsplaat (Netherlands), 1953</td>
<td>1,850 deaths</td>
<td>About 800,000 acres of farmland were submerged for days in salt water due to wind, waves and high tide.</td>
</tr>
<tr>
<td>5.</td>
<td>Assam (India), 1950</td>
<td>1,500 deaths</td>
<td>A powerful quake raises the level of a river and kills many people.</td>
</tr>
</tbody>
</table>

Adapted from Alberts et al. (1989).

4.5.14 Tide

The magnetic attraction of the earth and the moon results in water on the earth’s surface moving, in patterns that are described as tides (Whatling, 1994). Seas generally reach their highest level on the shore twice a day, with an average interval between two successive high tides of 12 hours 25 minutes (Surf Life Saving Association Australia, 1998). However, tides do not occur at the same time each day. This is only one of the factors that make tide forecast extremely difficult. The estimation of the water depth must always take into account the high and the low tide, which both change the water depth
In some coastal areas of the Atlantic the difference can be 15 m (Papagrigorakis, 1994; Simeonidis, 1995) while in other seas the change in level of the tide is almost nil (Gresswell, 1959b). Although there are available published editions that determine the heights and times of tides (White, 1991; Lifesaving Society, 1999b), in tidal waters swimmers can underestimate the water depth (Lifesaving Society, 1999b). For example, at mid-tide the water level will be rising at its fastest, and could rise 1.5 m in 30 minutes, which would be critical for a small unattended child on the rocks at a beach (Whatling, 1994). Unsuspecting poor or weak swimmers can suddenly find themselves in difficulty in the same spot where earlier they had played safely. Also, bathers or waders enjoying the sea on the sandbar may find, when returning to shore, that the water between sandbars is beyond their depth (Lifesaving Society, 1999b).

4.5.15 Currents

Currents are hazardous to swimmers as they can move out faster than a swimmer can swim back in. A rip current is a body of water moving out to sea against the incoming waves. These currents are caused by the piling up of water on the beach during heavy surf conditions and the consequent retreat of water back down the beach in an attempt to find its own level (Macdonald, 1999). On Memorial Day 1990, 5 persons drowned and 20 others nearly drowned when rough ocean conditions and strong winds caused rip currents to form immediately offshore, making this one of the worst drowning episodes in Florida’s history (Branche et al., 2001).

4.5.16 Water Pollution

Considerable attention has been given to the topic of water quality in terms of drowning, since about 1970 (Espeseth, 1992). Many mysterious drownings are caused by carbon monoxide emissions from boat engines and generators. Since 1990, 482 boat-related carbon monoxide poisonings have occurred in 26 American states (94 died, 77 unconscious). This was the finding of a study conducted by the U.S. Centers for Disease Control and Prevention and the U.S. Department of the Interior. They suspected that the actual number of deaths should be much higher because drowning victims are not always tested for carbon monoxide. At high levels, the gas can cause convulsions and
seizures leading to coma or even heart attack (United Press International, 2003). Therefore, outdoor recreation can have negative impact not only upon the natural environment (Warren, 1992), but also on the health of those in the water. The findings of this study provide enough scientific evidence for charging pollution with drowning and therefore, boaters need to be made more aware of the consequences of their negative attitude towards the water.

4.5.17 Water Temperature

Cold water can hasten the process of drowning because it reduces the period for which a person is conscious (Groneng, 2006). More precisely, first of all cold water can cause a cold shock response (Golden & Tipton, 2002). In 10°C water temperature, Duncan Goodhew (gold Olympic medalist in swimming) could hold his breath under water for only about 10 seconds before starting to hyperventilate rapidly in an uncontrolled way (Cold Water Casualty, 1990). This cold shock response could cause drowning even for Olympic swimmers if they were not used to swimming in cold water within minutes of cold-water immersion (Golden & Hardcastle, 1982). Second, in 10°C water temperature, Sharon Davies (silver Olympic medalist in swimming) could only swim for approximately 10 minutes before symptoms of panic and distress appeared (Cold Water Casualty, 1990), an indication that many people die from swimming failure before hypothermia sets in (Brooks, Cornelissen, & Popp, 2006). Finally cold water can cause hypothermia leading to loss of consciousness and death from cardiac arrest (Golden, 1973). Although these are only two cases, an average person is likely to have less chance of survival than an Olympic level athlete in similar conditions. Furthermore, drowning is one of the obvious dangers that can be triggered by cold water, therefore, water temperature should be taken into consideration before engaging in aquatic activities.

4.5.18 Off-Shore Winds

Safety in recreational waters, in assessing and controlling related risks, includes the identification of the direction and speed of the wind (World Health Organization, 2003). Off-shore winds can, for example, drift away from the beach an inflatable with all its passengers (Avramidis, 1998a). Although no
study has related these winds to drowning, future research would be very interesting.

4.5.19 Influence of Other People who Desire to go Beyond their Limits

Often people start going beyond their personal limits when engaged in aquatic activities while being influenced by others. First, case reports show that people tend to initiate things that others ask them to do under social pressure (e.g. non-swimmers jump in the water from a height, unguarded children swim and race, etc.; SEGA lifeguard potential program, n.d.). Second, there are some activities that can become risky when people take part without appropriate preventative measures and without following recommended guidelines; all aquatic sports can be characterized as dangerous and risky when people do not follow the rules (table 4.25). For example, more people drown in Canadian boating incidents than in all other ‘in-water’ incidents combined (e.g. swimming, playing in the water, bathing, etc; Lifesaving Society, 2000b). Most fatal boating incidents occur during recreational activities. Finally, not knowing how to perform a rescue can be risky, as people have lost their lives trying to save others (Hedberg et al., 1990).

<table>
<thead>
<tr>
<th>Water Sport</th>
<th>No of drowning/submersion incidents</th>
<th>Country and year of occurrence</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powerboat, personal watercrafts, canoes, kayaks, sailboats, and rowboats</td>
<td>988</td>
<td>Canada 1994–1998</td>
<td>Lifesaving Society, 2000a</td>
</tr>
<tr>
<td>Boating incidents (author does not specify type)</td>
<td>292</td>
<td>Australia 1992–1997</td>
<td>Mackie, 1999</td>
</tr>
<tr>
<td>Submersion due to motor vehicle accident</td>
<td>244</td>
<td>Netherlands 1987–1993</td>
<td>Bierens et al., 1996</td>
</tr>
<tr>
<td>People drowned while attempting to rescue others</td>
<td>36</td>
<td>Australia 1992–1997</td>
<td>Mackie, 1999</td>
</tr>
<tr>
<td>Ignorance of warning signs</td>
<td>34</td>
<td>Aqaba 1999</td>
<td>Talafieh et al., 1999</td>
</tr>
<tr>
<td>Walk or ride vehicle on ice</td>
<td>58</td>
<td>Minnesota 1980–1985</td>
<td>Hedberg et al., 1990</td>
</tr>
</tbody>
</table>
4.5.20 Noise during Lifeguard Scanning
Noise during lifeguard scanning constitutes a distraction factor for lifeguards (Coblentz et al., 2001; Ellis and Associates & Poseidon Technologies, 2001). The problem becomes bigger in indoor aquatic environments, as the sound cannot escape. In an overcrowded and noisy swimming pool, the lifeguard becomes less effective. It is the responsibility of the employer, therefore, to prevent the lifeguard from potential hearing problems and also from being less vigilant. Employers should take precautions if noise levels exceed 85 decibels at any given time. Then the recommended action should be more frequent personnel changes at the poolside at busy times, or even immediate action to reduce the noise level (Health & Safety Executive, 2000; Institute of Sports and Recreation Management & Royal Life Saving Society UK, n.d.). Although no research has related drowning rates with levels of noise, it can be assumed that low levels of noise can play a major role in maintaining a high level of lifeguard alertness. Therefore more research is required.

4.5.21 Presence/Absence of Preventive Measures
A number of water safety measures seem to be related to drowning prevention. First, one measure is whether there are lifeguards available or not. In the USA several pools, water-parks and beaches have been forced to close their facilities due to the shortage of available lifeguards, while some pool management companies that provide guards ended their contracts on 15 August (Griffiths, 2001a).

A second measure is whether there is established legislation related to water safety (e.g. lifeguarding employment, personal protective equipment and pool fencing). Where lifeguards are required by law, then there is a duty to supply and supervise lifeguards, but at many aquatic facilities the law does not require guards (Griffiths, 2001a), therefore, more research is needed on the effectiveness of legislation and enforcement (Mackie, 2006). Also, whereas life jackets must be carried on civilian aircraft (Leese, n.d.) and cruises (Green, 1985), their use has not been described (Quan et al., 1998), nor does legislation require them to be worn while onboard (Leese, n.d.). Finally, because every year hundreds of children drown silently in residential swimming pools (American Academy of Pediatrics, 1993; United States Consumer Product
A third measure is whether there are safety signs and whether or not they are readable. Signs such as ‘Swim at Your own Risk’ have been shown to be ineffective. Some possible alternatives could be: ‘Parents; Please watch your children … it takes only seconds to drown!’; ‘Parents, if you’re more than an arm’s length away, you’ve gone too far’ (Griffiths, 2000a; 2002; International Life Saving Federation, 2007a). However, the problem remains of how to inform bathers of water conditions in relation to danger (figure 4.7). While the colours of traffic lights and other symbols are the same internationally, the flags to warn bathers of a phenomenon that can threaten their lives are not. Local water safety authorities, facility owners and others decide what they believe to be the best, but warning signs should be common to all. Also, warning signs should not be in words because they can then be of benefit only to those who speak the language of that country (Morizot, 2002a; Sims, 2006). Lack of international signs could, therefore, be a potential cause of unintentional drowning, mainly for foreigners.
Fourth, another measure is whether or not there is conscious surveillance of bathers within an aquatic environment. When a school or other organized group visits the swimming pool or the beach, instead of having double coverage for children, very often no teachers or parents actually supervise the children appropriately. This happens because the lifeguards mistakenly assume that the adults in attendance are responsible for watching their children, and therefore they can relax for a little while. Conversely, teachers, parents or adult volunteers, do not closely supervise the children because they perceive the lifeguards to be more experienced in water safety and rescue, and view them as babysitters for the day. Instead of having double coverage of lifeguards and adults, no-one ends up watching the children. It is vital therefore, that owners, supervisors, managers and lifeguards understand this hidden danger. Also, a written and enforced policy covering groups and private parties can be of great help in the prevention of drowning or other accidents (Griffiths, 1998b).

Figure 4.7: The Number of Beachgoers who did not Know the Meaning of each Warning Flag at a Public Beach in South Florida, USA (n=283).
Finally, another safety measure is whether there are pre-hospital emergency facilities located close to the aquatic facility. Those, so-called, Drowning-Resuscitation-Centers can reduce delay time and the need to refer the patient to a hospital. They provide a good link between hospital services and hospitals, and also an excellent back-up for the lifeguard (Szpilman et al., 2002). However, it is possible that this remarkable type of service is very rare. At the moment, there is a lack of data and information regarding the presence or absence of effective regulation, in some parts of the world, that would provide such establishments.

4.5.22 Morality of Selling Policy regarding used Equipment

Lack of morality in the selling policy for equipment related to aquatics might be a contributing variable to a drowning incident. Although the European Union prohibited the use and sales of some inflatables for young children, some local markets and beach-shops still do sell them (Adesmeftos Typos, 2002). According to research in European countries, other equipment (e.g. toys for children), represent a factor that could cause drowning (Apostolakis, 2002). Although the report of this research does not provide details of the nature of the equipment, it seems reasonable to assume that they could be buoyancy aids and other items that can be used in the water.

4.6 Summary

The aim of the present interdisciplinary review study was to identify variables that have been described in the water safety literature that relate to drowning from a social, psychological, or physiological perspective. It was found that there were variables like the rescuer, the casualty, the place and the circumstances of occurrence that are related to drowning. It was also suggested that if there is an aquatic environment and human activity in, on, under, or near the medium, liquid, a drowning incident might happen to any person, under whatever circumstances.
Chapter 5:
An Observational Content Analysis of Video Recorded Rescues
Chapter 5: An Observational Content Analysis of Video Recorded Rescues

5.1 Introduction
Epidemiologic data from the first review study shows that drowning is a leading cause of death worldwide with about one unintentional drowning incident every 70 seconds. This chapter contains the methodology, findings, discussion and conclusion of the content analysis that involved observing video recorded rescues. This involved procedures such as behavioural coding, aiming to abstract information from the videos, forming the basis of theory development. The analysis was performed to find key variables that appeared to be relevant, and could possibly be incorporated into the subsequent chapter (interview study). The process began with the formulation of research questions; then the development of data collection instrument, the data collection, the analysis of raw data and ended with conclusions and applications to accident prevention and safety promotion (Davies, 1997).

5.2 Method

5.2.1 Variables
The examined variables were those that were discussed in the literature review that might contribute to a drowning incident (e.g. who was the casualty, the rescuer, where, and under what circumstances the incident happened). A variable was defined as anything that was found to lead or might lead to a drowning incident. As one of the aims was to develop a new risk classification for drowning, there was a need to consider every potential contributing variable, even if only one author supported it. For a better understanding and analysis, the variables were grouped in 4 clusters of who is the casualty, who is the rescuer, under what circumstances and finally where the drowning incident occurred (table 5.1).
Table 5.1: The Variables that Were Examined in the Content Analysis.

<table>
<thead>
<tr>
<th>WHO1: The Casualty</th>
<th>WHO2: The Rescuer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Physical Water Fitness</td>
<td>(1) Age, (2) Sex, (3) Training, (4) Experience, (5) Expertise,</td>
</tr>
<tr>
<td>(3) Age</td>
<td>speed, (10) Knowledge of the particular dangers of the</td>
</tr>
<tr>
<td>(4) Sex</td>
<td>aquatic area, (7) Professionalism, (8) Ability to: Do risk</td>
</tr>
<tr>
<td>(5) Ethnicity</td>
<td>assessment, (9) Deal as educators, (10) Recognize</td>
</tr>
<tr>
<td>(5) Casualty Type</td>
<td>instinctive drowning response, (11) Remain alert, (12)</td>
</tr>
<tr>
<td>(6) Socio-economic background</td>
<td>React ignoring bystanders’ apathy, (12) Presence/ Absence</td>
</tr>
<tr>
<td>(7) Demographic Area of residence</td>
<td>of Others.</td>
</tr>
<tr>
<td>(8) No of family members</td>
<td></td>
</tr>
<tr>
<td>(9) Occupation</td>
<td></td>
</tr>
<tr>
<td>(10) Behaviour</td>
<td></td>
</tr>
</tbody>
</table>

Under WHATEVER Circumstances
(1) Interrelationship among casualty and equipment, (2) Risk as Physical demand of aquatic activity, (3) Time, (4) Day-Month, (5) The Aquatic Activity, (6) Type of Rescue.

WHEREVER

5.2.2 Sampling
During the year 2000 approximately 450,000 people drowned worldwide which means that approximately one person drowned per minute. Those drownings and submersions were unintentional (excluding cataclysms, transport and water transport accidents; World Health Organization, 2003). Relatively few incidents are video recorded and only by amateur camera operators or the emergency services. The median sample size, in qualitative studies that use software for data management, is about 40 (Kelle, 1997) because ‘representativeness’ is not the crucial purpose of the qualitative sampling. In the present study, a criterion sampling method was chosen, identifying videos that could demonstrate well the elements of drowning and answer the research questions. Video recorded drowning incidents (n=41) were obtained from various sources that were all available in the public domain. More precisely the study used 18 rescues from the videocassette ‘On drowning’, (1970), three rescues from the video cassette ‘The history of RNLI’, (1994), five rescues from the videocassette ‘Great Survivors; Witness Events of the 20th Century’, (1998), two rescues from the TV program ‘Animal Heroes; Real Life Rescues’, (2001), seven rescues from the TV program ‘When stands go wrong’, (2001), one rescue from the TV program ‘999’, (2000), and five rescues from various TV night newscasts (Batavanos nearly drowns, 2002; Children near drown in a frozen...
lake, 2001; Drowning in Patra, 2001; Near drowning of family in Indianapolis, 2001; Stowaways drown in river Rio Bravo, 2002).

To be included in the analysis, videos had to present either a drowning incident or a successful aquatic rescue. Those videos were selected because their content would allow the analysis of each emergency situation as it happened in the place. Ethical research has only two options for understanding drowning; it could either study animals or incidents that had already occurred involving humans. In the present study the episodes were real events of human drownings video recorded or reconstructed. The reconstructed ones were treated as if they were real. Also this enabled the identification of casualties' behaviours that might not be apparent to themselves. Finally, it allowed the identification of behaviours that under other circumstances, the rescued casualties may be unwilling to disclose or the drowned people would not be able to report because they would be dead.

In some observation content analysis, camera operators were trained in using the video camcorders (e.g. Rich & Chalfen, 1999; Rich, Lamola, Amory & Schneider, 2000). In the present study most of the videos were filmed by non professional camera operators. This means that the quality of the videos was sometimes patchy but the videos represent a first-hand raw documentation of the emergency experience that is remarkably useful for research (Rich & Patashnick, 2002) and understanding of the drowning process.

The literature review showed that drowning is a leading cause of death. Detailed knowledge will enable to understand why this happens. Humans perceive the environment almost completely by audio-visual means; as video captures audio-visual information it becomes extremely useful because it allows a detailed analysis and coding of the recorded data (Volkmer et al., n.d.). However, video recording is underused in improving safety (Mackenzie & Xiao, 2003), possibly because of the lack of suitable processing and communication supporting platforms that can decide which information should be extracted (Oliveira, Correia & Guimarães, n.d.). On the other hand, video records are a rich source of data for documenting performance which reveal safety, a powerful training tool and provides a reusable record of events that can be repeatedly reviewed and used as research data of critical events, trauma and resuscitation (Mackenzie & Xiao, 2003). By using observational methods the
research can focus on the content of communicative behaviour (Bowers & Courtright, 1984). A limited number of theses have used content analysis (e.g. Konger, 1996; Shaw, 2002) and even fewer have implemented observation content analysis (e.g. Hart, 1996) although it can be applied to examine any piece of recorded communication. In the present study it allowed the answering of questions based on real emergency aquatic incidents. Also it helped to analyze and interpret real incidents that describe attitudinal and behavioural elements of each individual (e.g. the disposition to do risky activities etc).

5.2.3 Data Collection

Using the observational method this study analyzed a total of 41 videos, with visual narratives ranging from 0.5-12 minutes (mean 345.0 seconds, SD=2.8). To analyze the video narratives, the visual data contained in the video were observed on a JVC TV (CM31720-003) using a Panasonic Video Cassette Recorder AG-MD830. One of the first things to establish was the length of each video narrative, as the aquatic emergencies were usually in video cassettes that contained other audiovisual narratives. Therefore, it was not always clear when each narrative started and ended. This had to be defined for guaranteeing reliable measurements during the test-retest. The reset time button of the recorder was pressed while the first visual or audio message that was related to the aquatic emergency was on the screen. For example, in some videos the audio narrative started before the actual visual video, while in other cases, the visual video started before the audio narrative. In both cases the actual start point of the video was either the very first visual scene or the first audio narrative of the video. However, in cases where the video was connected with transition effects with the next/previous video (e.g. fade in, etc), the starting/finishing points were those where the whole scene could cover the whole TV screen (figure 5.1).
As soon as the start and end points of the video were established, the video tapes were watched in real time like a movie, to get overall impressions of the aquatic emergency with the researcher making rough notes; then, the objective and subjective content of the video was recorded. **Objective content** was defined as the observations of audio or visual information upon which every person watching the video would agree (e.g. what type of rescue a lifeguard does, in which aquatic environment the casualty is drowning, what they say etc). Unsupported assumptions and editorial comments were avoided. An example of an objective description is this: ‘Mr L.H. was immersed in the river. Mrs L.McD. was shouting to him to hold on the collar of the dog that approached for rescuing him’. For objective description it was avoided to report that Mr L.H. could not hear Mrs L.McD. because he was deaf, or to say that the dog that rescued him was a Newfoundland until those were confirmed as such within the video. **Subjective content** of records was defined as the responsive interpretations of the psychosocial dynamics of the scene. Subjective content should be the same regardless of the number of times that the same researcher will observe the same video. An example of a subjective content is the interpretation of the same thing differently (e.g. ‘after saved by the dog, Mr HL was very scared’ and ‘after saved by the dog, Mr HL was very depressed’). A researcher’s observations would therefore be influenced by their personal age, gender, personal experience etc. The researcher could misunderstand what is being observed causing researcher error (Gratton & Jones, 2004).

As this study had only one researcher, to avoid this happening, a test-retest occurred for each story in random order within a period of 3 months. The in-
formation that was common in each observation was finally recorded and saved as the final narrative. During the test and retest each story had to be transcribed twice; first to analyse all the audio messages coming out of the video and second, to describe what could actually be seen. This ensured that enough information about each story would be available for analysis instead of relying completely on the narrator’s comments. Finally, each aquatic emergency narrative was divided into manageable sections (30 seconds long) so specific observations could precisely be located in the transcribed text. The procedure that was followed is described in the table 5.2.

Table 5.2: Procedure for the Observational Content Analysis.

1. selection of the video cassette
2. selection of the specific video narrative
3. selection of the start point of the video
4. visual observation of the video keeping rough notes
5. recording of objective and subjective audio content
6. recording of objective and subjective visual content
7. repetition of the steps 5-6 after three months (retest)

NVIVO (see next section: ‘instrument selection’) also allowed the exact localization of the coded text within the transcribed narrative by document number, paragraph and line (Rich & Chalfen, 1999). As the subjects of the present research were the casualties and the rescuers that were shown in the videos, there was no direct communication with the researcher and therefore, threats of reliability such as subject error and subject bias were not present (Gratton & Jones, 2004). The use of observational content analysis of video recorded incidents examined the drowning experience ‘from the inside out’. The objective data that the videos captured were enriched of information that other forms of data couldn’t duplicate; an example of this was the audiovisual record of a girl being submerged under the water for four minutes, wheezing and gasping for breath with her hair caught in the water suction valve of a whirlpool. The findings of this study have later been correlated with the interviews that will follow in the next chapter to ensure construct validity (Gratton & Jones, 2004). On the other hand, certain disadvantages had to be considered. The difficulty in data recording was overcome by their nature (video) that allowed repeated, careful and thorough observation before transcribing the narratives (Gratton & Jones, 2004) for content analysis. Content analysis was dependent on the careful observation of the videos, the categorization of the frequency and nature of the verbal interactions, the data analysis and the writing up of a brief report with recommendations for future practice (Booth, 1998).
5.2.4 Data Analysis

There is no instrumentation for analyzing extensive amounts of audiovisual information that document some type of human behaviour. While developing the analysis of the audiovisual material of this study, a search was undertaken of different software packages that deal with audiovisual data. Among those that were examined, the software Observer works better with limited data in extreme detail. Although it is ideal for working with data from control and standardized environment, in the present study neither the environment nor all the data were standardized. The software ATLASi enables working with large amounts of data but they have to be converted into memory consuming digital files. Once data coding has taken part ATLASi files cannot easily be altered or annotated (Rich & Patashnick, 2002). The software NVIVO (QSR International Pty Ltd) analyzes rich text data with no fixed units of analysis, edits document text without disrupting the coding, links to annotations and external files, links to editable and codable memo documents views and reports coding in many ways. NVIVO also browses and refines coding in a live node browser that provides access to context, stores demographics and other descriptive data, organizes and describes documents and nodes using sets, automatically codes sections and searches data for text patterns and auto-code keywords. Also, NVIVO integrates searching of coding, attributes and text patterns, searches a subset of data and spreads the coded results, cross-tabulates any nodes, attribute values and text patterns, and exports the table. Finally it conceptualizes the ideas in a graphical modeling tool that links back into the data. The program focuses not on the production of descriptive statistics but on description of the data themselves. NVIVO has fewer operating system problems than other programs because it was more recently produced than most of them. Because of all the above positive technical characteristics and capabilities it was decided to use NVIVO in the present study.

Once the transcriptions were complete, they were converted into Rich Text Format (.rtf) files and imported into NVivo. NVIVO and all the procedures that are required for making a project, creating a proxy document (with video data), making and managing nodes (codes), and reporting the results were used as instrumentation of the content analysis following the guidelines of the manufacturers (QSR, 2002). Node is the word that NVIVO uses for ‘code’ and it is intended to represent anything that project users may wish to refer to (Neuen-dorf, 2001). A data collection instrument (coding tree) was developed for de-
scribing different behaviours (Coleman, Stevenson & Wilson, 2000) based on Variables that were found in the literature review and seemed to contribute to a drowning incident (table 5.3).

<table>
<thead>
<tr>
<th>Table 5.3: The Nodes (Codes) that Were Used in the Content Analysis.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHO</strong>: The Casualty</td>
</tr>
<tr>
<td>Disability/Medical Problem (epilepsy, asthma, diabetes, none disabled), Age (youth, middle age, old age), Gender (male, female), Ethnicity (white, black), Casually Type (weak swimmer, non-swimmer, injured, unconscious, swimmer, multiple), Socio-economic background (rich, average, poor), Demographic Area of residence (resident, tourists), No of family members, Occupation, Behaviour</td>
</tr>
<tr>
<td><strong>Under Whatever Circumstances</strong></td>
</tr>
<tr>
<td>Wet and dry suit, Casual Clothes, Personal Flotation Device, Quality of materials, Lifeguard equipment, Presence of others, Time of occurrence, Day, Season, Vacation-Holiday-Normal day, The Aquatic Activity, Type of Rescue (shout/signal, reach, throw, wade, row, swim/aid, swim/ tow, combination)</td>
</tr>
</tbody>
</table>

NVIVO software allowed the examination of the coded text by using the coding stripes (a procedure of identifying differently coded sections visually) or using the Node Browser that compared internally all data that were similarly coded. Reviewing the coded text twice enabled the establishment of new relationships between nodes and structuring free nodes into tree nodes. As the coding procedure progressed, NVIVO was used to find areas in which themes overlapped by performing Boolean searches with matrix intersection to find the intersection of the 4 clusters. Once the nodes had been consolidated and structured using grounded theory, they were ready to be entered into the NVIVO Modeller for conceptual model building (Rich & Patashnick, 2002). Document Text Reports were made for each aquatic emergency including in-
5.3 Findings

5.3.1 Descriptive Statistics

This section discusses all the findings and contains the frequencies of the variables that describe who drowns, who rescues the drowned casualties, and finally where and under what circumstances the incident takes part.

Table 5.4: The Frequencies of the Sub-Variables that Constitute the Variable ‘Casualty’ in the Examined Sample (n=41).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sub-variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male: 26, 63.4%, Female: 15, 36.6%</td>
</tr>
<tr>
<td>Age</td>
<td>Young (below 16 years old) 19, 40.42%, Middle aged (between 16-40 years old) 23, 48.94%, Elderly (41+ years old) 5, 10.64%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>White 29, 70.7%, Non-white 12, 29.3%</td>
</tr>
<tr>
<td>Casualty type</td>
<td>Non-swimmer 9, 22%, Weak-swimmer 7, 17.1%, Injured swimmer 1, 2.4%, Unconscious casualty 3, 7.3%, Multiple casualties 21, 51.2%</td>
</tr>
</tbody>
</table>

Table 5.4 shows the findings that are related to the casualty. The present study shows that people experienced a drowning incident regardless of their age and gender. Male gender (26, 63.4%) was more vulnerable than female (15, 36.6%). Casualties were young (below 16 years old; 19, 40.42%), middle aged (between 16-40 years old; 23, 48.94%) and elderly (41+ years old; 5, 10.64%). Drowning happened to members of any ethnic group (whites, 29, 70.7% and non-white casualties 12, 29.3%). The entire casualty types were found to be involved in drowning incidents; non-swimmers (9, 22%), weak-swimmers (7, 17.1%), injured swimmers (1, 2.4%), unconscious casualties (3, 7.3%) and multiple casualties (21, 51.2%).
Table 5.5: The Frequencies of the Sub-Variables that Constitute the Variable ‘Rescuer’ in the Examined Sample (n=41).

<table>
<thead>
<tr>
<th>The Rescuer</th>
<th>Sub-variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male 36, 88%</td>
</tr>
<tr>
<td></td>
<td>Female 1, 2.4%</td>
</tr>
<tr>
<td></td>
<td>Animal rescuer 3, 7.3%</td>
</tr>
<tr>
<td></td>
<td>Unspecified 1, 2.4%</td>
</tr>
<tr>
<td>Age</td>
<td>Middle aged (20-30 years old) 26, 86.7%</td>
</tr>
<tr>
<td></td>
<td>Youth (below 20 years old) 4, 13.3%</td>
</tr>
<tr>
<td>Current Level of Experience</td>
<td>Experience 25, 61%</td>
</tr>
<tr>
<td></td>
<td>Expertise 7, 17%</td>
</tr>
<tr>
<td></td>
<td>Physical strength 20, 48.8%</td>
</tr>
<tr>
<td></td>
<td>Vision 10, 24.4%</td>
</tr>
<tr>
<td></td>
<td>Swimming speed 21, 51.2%</td>
</tr>
<tr>
<td>Knowledge of the dangers in the aquatic area they supervise</td>
<td>Dangers related to bathers 16, 39%</td>
</tr>
<tr>
<td></td>
<td>Dangers related to lifeguards 8, 19.5%</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Adequate number of Lifeguards and Surveillance 6, 14.6%</td>
</tr>
<tr>
<td></td>
<td>Visible appearance and clothing 3, 7.3%</td>
</tr>
<tr>
<td>Ability to</td>
<td>Do risk assessment 21, 51.2%</td>
</tr>
<tr>
<td></td>
<td>Recognize instinctive drowning response 13, 31.7%</td>
</tr>
<tr>
<td></td>
<td>Remain alert 29, 70.7%</td>
</tr>
<tr>
<td></td>
<td>React ignoring bystanders’ apathy 10, 24.4%</td>
</tr>
</tbody>
</table>

**Table 5.5** summarizes the findings of the study that are related to the rescuer. Rescuers were found to be represented by both genders and age groups. In terms of gender, male rescuers far outnumbered (37, 90.2%) the females (1, 2.4%). Also a small sample of animal rescuers was present (3, 7.4%). In terms of age, the majority of the rescuers was aged between 20–30 years old (26, 86.7%) and only a small percentage of them was below 20 years old (4, 13.3%). The current level of the rescuers on certain abilities necessary for the bather supervision and an effective rescue varied. For example while they were experienced in terms of working years (25, 61%) and remained alert in most cases (29, 70.7%), only in about half of the cases did they undertake the appropriate risk assessment (21, 51.2%), were physically strong (20, 48.8%), and fast swimmers (21, 51.2%). When evaluating their ability to visually detect the casualty (10, 24.4%), their professionalism (6, 14.6%), whether they were wearing visible and appropriate clothing (3, 7.3%), were able to recognize the drowning victim (13, 31.7%), and reacted ignoring the bystander’s apathy (10, 24.4%), we found the levels of appropriateness to be lower again.
Table 5.6: The Frequencies of the Sub-Variables that Constitute the Variable ‘Whatever Circumstances’ in the Examined Sample (n=41).

<table>
<thead>
<tr>
<th>Under Whatever Circumstances</th>
<th>Sub-variables</th>
</tr>
</thead>
</table>
| Rescue type                  | Reach 4, 10.5%  
|                              | Throw 5, 13%  
|                              | Wade 8, 21%  
|                              | Row 6, 15.8%  
|                              | Swim and tow 10, 26.3%  
|                              | Air rescue 2, 5.3%  
|                              | Combination 3, 7.9%                                                        |
| Interrelationship             | Wet and dry suit 3, 7.34%  
| among casualty and           | Casual Clothes 9, 21.9%  
| equipment                    | Personal Flotation Device 12, 29.3%  
|                              | Quality of materials 8, 19.5%  
|                              | Lifeguard/rescue equipment 11, 26.8%                                        |
| Risk as physical             | Presence or absence of others 12, 29.3%  
| demand of aquatic            | Time of occurrence: Day 40, 97.6%; Night 1, 2.4%  
| activity                    | Season: winter 5, 36%; autumn 2, 14%; spring 1, 7%; summer 6, 43%          |
| The type of activity         | Swimming 26, 63.4%  
|                              | Yachting/cruising 5, 12.2%  
|                              | Other aquatic activity (diving, snorkeling, stunt) 2, 4.8%  
|                              | Driving 3, 7.3%  
|                              | Air/Space travel 3, 7.3%  
|                              | Walking on frozen lake 2, 4.9%                                             |

Table 5.6 summarizes the findings of the study that are related to the circumstances of occurrence of a drowning incident. All types of rescue were initiated utilising various types of equipment in order to assist the drowning casualties. More precisely, single rescues such as reach (4, 10.5%), throw (5, 13%), wade (8, 21%), row (6, 15.8%), swim and tow (10, 26.3%), air rescue (2, 5.3%) or their combination (3, 7.9%) were initiated using quality materials (e.g. buoyant rings etc; 8, 19.5%), personal flotation devices (12, 29.3%), lifeguard/rescue aids (e.g. power boat, scuba diving equipment, rope, rocket thrust etc; 11, 26.8%), wet/dry suit used from either casualty or rescuer (3, 7.34%) for saving someone's life. Incidents occurred in all seasons of the year and at any time of the day. Most incidents occurred during the summer (6, 43%) and the winter (5, 36%), lees during the autumn (2, 14%) and in limited cases during the spring (1, 7%). Nearly all the incidents occurred during the day (40, 97.6%). Only one incident took part during the night (1, 2.4%). The type of activity in which the casualties were involved varied. People experienced a drowning incident or an aquatic emergency that could lead to drowning while they were swimming (26, 63.4%), doing other aquatic activities (div-
ing, snorkelling, stunt; 2, 4.8%) driving (3, 7.3%), yachting/cruising (5, 12.2%), air/space travel (3, 7.3%), and walking on a frozen lake (2, 4.9%). Other circumstances leading to a drowning incident involved the type of clothing that the casualty was wearing and whether or not the incident occurred in the presence of others. It was found that in some cases the casualties fell into the water whilst wearing casual clothes (9, 21.9%) in the presence of others (12, 29.3%).

**Table 5.7: The Frequencies of the Sub-Variables that Constitute the Factor ‘Wherever’ in the Examined Sample (n=41).**

<table>
<thead>
<tr>
<th>Aquatic Environment Specific</th>
<th>Sub-categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake</td>
<td>3, 7.31%</td>
</tr>
<tr>
<td>Sea</td>
<td>29, 70.73%</td>
</tr>
<tr>
<td>Swimming pool</td>
<td>1, 2.43%</td>
</tr>
<tr>
<td>River</td>
<td>5, 12.19%</td>
</tr>
<tr>
<td>Stream</td>
<td>1, 2.43%</td>
</tr>
<tr>
<td>Harbor</td>
<td>1, 2.43%</td>
</tr>
<tr>
<td>Domestic water</td>
<td>1, 2.43%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size/ Shape of working area</th>
<th>Water depth: casualty out of depth (22, 53.65%), standing up level (1, 2.43%), unspecified (18, 43.90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from safety</td>
<td>1-9m (14, 34.14%), 10-20m (5, 12.19%), 21-500m (3, 7.31%), 500m-ocean (6, 14.63%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outdoor</th>
<th>Flood 3, 11.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raining/snow</td>
<td>3, 11.5%</td>
</tr>
<tr>
<td>Waves</td>
<td>4, 15.4%</td>
</tr>
<tr>
<td>Currents</td>
<td>5, 19.2%</td>
</tr>
<tr>
<td>Off Shore Winds</td>
<td>3, 11.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social, Emotional</th>
<th>Psychological anxiety 7, 25.95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk taking behaviour</td>
<td>2, 7.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethical Issues</th>
<th>Preventive measures 13, 48.14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breach of law</td>
<td>3, 11.11%</td>
</tr>
<tr>
<td>Morality of selling policy</td>
<td>regarding equipment 2, 7.4%</td>
</tr>
</tbody>
</table>

**Table 5.7** summarizes the findings that are related to the place of occurrence of a drowning incident. It shows that drowning incidents were located in lakes (3, 7.31%), sea (29, 70.73%), swimming pool (1, 2.43%), rivers (5, 12.19%), stream (1, 2.43%), harbour (1, 2.43%), and domestic water (1, 2.43%). In terms of water depth, incidents occurred where the casualty was out of their depth (22, 95.6%) or in water, in which they could stand up (1, 4.3%) and at various distance from safety (ranging from 1 m up to the open ocean but it could not specify precisely through visual observation). When the ground gradient in the aquatic areas was downhill drowning incidents were also present (e.g. in Orchard beach of USA). Drowning incidents leading to survival oc-
curred in bad weather conditions like raining/snow (3, 11.5%), flood (3, 11.5%), off-shore winds (3, 11.5%), strong sea currents (5, 19.2%), waves (4, 15.4%) or in good environmental conditions (8, 30.7%). There was evidence of psychological anxiety (7, 25.92%) and risk taking behaviour (e.g. parachuting, illegal bungee jumping) in some cases (2, 7.4%). Preventative measures (13, 48.14%), the breach of law (3, 11.11%) and the lack of morality in selling equipment policy (2, 7.4%) were variables related to drowning.

5.3.2 The Contributing Variables of the 4W Model

Boolean search with matrix intersection with the 4 variables found 7560 possible combinations (table 5.8). More precisely it was found that variables relevant to the Casualty (Who1) related with the Rescuer’s variables (Who2) 303 times (out of 1584), with the place of occurrence (Wherever) 237 times (out of 1404) and with the circumstances under which the incident took part (Whatever circumstances) 104 times (out of 864). The rescuer (Who2) related with the place of occurrence (Wherever) 230 times (out of 1716) and with the circumstances of the aquatic incident (Whatever circumstances) 359 times (out of 1056). The place of occurrence (Wherever) and the circumstances (Whatever circumstances) under which the drowning incident occurred were related 192 times (out of 936).

<table>
<thead>
<tr>
<th></th>
<th>Who (Casualty)</th>
<th>Who (rescuer)</th>
<th>Whatever Circumstances</th>
<th>Wherever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who (Casualty)</td>
<td>-</td>
<td>303 (1584)</td>
<td>-</td>
<td>237 (1404)</td>
</tr>
<tr>
<td>Who (rescuer)</td>
<td>-</td>
<td>-</td>
<td>359 (1056)</td>
<td>230 (1716)</td>
</tr>
<tr>
<td>Whatever Circumstances</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>192 (936)</td>
</tr>
<tr>
<td>Wherever</td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 5.2 shows that there was an interrelationship between the 4 variables. Specifically it was found that from all the combinations only a small percentage (18.84%) was actual which means that only 1425 relationships were found between various sub-variables out of a total 7560.
Therefore, the rescuer and the circumstances under which each aquatic emergency took part was the most frequent pair of variables of the examined sample (359 interrelationships). The second most frequent combination of variables was the interrelationship between the casualty and the rescuer (303 interrelationships). The third combination was between the casualty and the place where the incident occurred (237 times). The fourth combination was between the casualty and the circumstances that exist during the aquatic emergency (230 interrelationships). The fifth was the interrelationship between the place of occurrence and the circumstances of the incident (192 interrelationships). Finally, the sixth was the interrelationship between the casualty and the circumstances under which the incident occurred (104 interrelationships).

5.3.3 The Single Variables of the 4W Model

Table 5.9 shows the frequency of occurrence of the four variables that constitute the 4W model of the examined sample. The rescuer (e.g. professional lifeguard or amateur lifesaver) was the most frequent variable related to drowning. The second most frequent variable is the casualty. Finally, the circumstances and the place of occurrence are variables nearly as frequent as the casualty. The following sections explain more detailed these relationships between the variables that constitute the 4W model.
Table 5.9: Single and Contributing Variables that Relate with Drowning.

<table>
<thead>
<tr>
<th>Ranked factor combinations</th>
<th>Observed interrelationships (n)</th>
<th>Rescuer</th>
<th>Casualty</th>
<th>Wherever</th>
<th>Whatever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Videos (n = 41)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Rescuer -Whatever</td>
<td>359</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>5 Rescuer - Casualty</td>
<td>303</td>
<td>5</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4 Casualty - Wherever</td>
<td>237</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>3 Rescuer - Wherever</td>
<td>230</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2 Wherever - Whatever</td>
<td>192</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 Casualty - Whatever</td>
<td>104</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1425</td>
<td>14</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Note. The first column contains the ranked variable combinations, the second column the observed interrelationships, and the remaining four the number of times these variables actually interrelated. The more times two variables interrelated, the higher rank have. The pair with the most relationships ranks 6 and the pair with the fewest relationships ranks 1. The variables (in order of higher frequency) that related with a drowning incident is the rescuer (14 points), the casualty (10 points), the place of occurrence (9 points) and the circumstances under which it will occur (9 points).

5.4 Discussion

5.4.1 Who (Casualty)–Who (Rescuer)
People had to be rescued from drowning either because they were working or performing another activity prior to the incident. Casualties who were on duty before experiencing drowning (e.g. milk-man, astronaut, sailor, airplane pilot) were rescued by middle-aged male rescuers with expertise and experience who knew the human related site-specific dangers that might exist. On the other hand, casualties who performed another type of activity before the drowning incident (e.g. walking alone on a frozen lake, swimming far from the shore, not supervising their children in an aquatic area, illegal crossing the borders, driving on a flooded road, etc.) were rescued by rescuers who reacted, ignoring the bystander’s lack of response and doing the appropriate risk assessment.

Regardless of their level of physical fitness, people experiencing a drowning incident were saved by rescuers or bystanders. Casualties with poor physical fitness depended on the rescuer’s speed of action. They were rescued by middle-aged male lifeguards and bystanders. These lifeguards demonstrated qualities of good vision, physical strength, expertise, ability to react ignoring the bystander’s lack of response and to recognize the instinctive drowning response. On the other hand, casualties with good physical fitness were saved by bystanders and rescuers. The rescuers had to act fast. This may mean that casualties needed immediate assistance in order to be rescued, not because
they were weak swimmers but because they engaged in advanced or risky activities that they could not control completely. Their rescuers needed to be able to remain alert in order to detect them, to do a risk assessment for the severity of the situation, and to know the particular dangers that might exist for everyone involved in the rescue (i.e. casualties, bystanders and rescuers).

Young and middle-aged casualties were saved in almost all drowning incidents by rescuers with the same characteristics. Specifically they were rescued by middle-aged males who detected them visually and had the physical strength and expertise to perform the rescue immediately. On some occasions, rescuers had to ignore the bystanders’ lack of response as most of them had not realized that someone was in difficulty. Before the rescue they had to remain alert, recognize the instinctive drowning response, do a risk assessment and be aware of the particular dangers that might exist in the area for bathers or the casualty. The rescuers of those two age groups had to have knowledge of the dangers that might exist for casualties and bystanders (e.g. the depth of the water and the ground gradient). Furthermore, the rescuers of the middle-aged group had to also have knowledge of dangers that might exist for themselves, because it can be more dangerous rescuing older casualties than rescuing young ones if they engage in extreme activities, as in the following cases.

‘Niagara falls for daredevils and stunt men is the ultimate challenge. For years it was the dream of stunt man Steve Trader and on a cold March morning his dream was about to become a reality. Equipped with a high tech version of an invented Niagara Falls barrel, Trader and his girl friend Lorry Martin take the plunge’.
(video narrative 2, 0:00:00-00:00:30)

‘A balloon with 5 people onboard drifts helplessly out to sea after being blown off course by unpredictable winds. What started out as a fun-filled pleasure flight is now a full-scale emergency. Rescue boats and helicopters manage to catch up with the balloon […] The balloon is running out of fuel. The last option is to ditch into the sea’.
(video narrative 5, 00:00:00-00:01:00)

Young and middle-aged casualties were saved in the presence of bystanders. When professional lifeguards rescued casualties of both age groups bystanders were present. In other incidents, middle-aged casualties were saved by amateur lifesavers in places where bystanders were present. This can be explained because middle-aged casualties tend to engage in aquatic activities
further away from the shore, alone, doing more advanced activities, and sometimes ignoring safety rules. The following example illustrates clearly that in remote aquatic areas, only amateur lifesavers and bystanders will be present and it will be hard to detect a casualty.

‘Seventy yards up the river, amateur prospector Link Hill was searching for gold in a stretch of dangerous rapids. In an instant, Link was fighting for his life. Although Lillian was unaware of Link’s desperate straggle, a sudden change in Bo’s behaviour caught her attention’
(video narrative 15, 00:01:00-00:01:30)

A casualty’s sex and ethnicity appeared to relate to almost the same rescuer characteristics. White and non-white casualties of both sexes needed rescuers who could detect them and react immediately, who were strong enough and had expertise in rescuing people. They also needed rescuers who could remain alert, recognize the instinctive drowning response, know the dangers that exist in the area, make the appropriate risk assessment and react ignoring the bystanders’ lack of response. During some emergencies with casualties of both ethnicities, bystanders were also present. However, because they could not recognize the instinctive drowning response of the casualty their presence did not affect the rescue. It is characteristic that some animals (as rescuers) were better able than people (bystanders) to recognize the urgency of the situation, as in the following example with a Newfoundland dog named Bo.

‘Although Lillian was unaware of Link’s desperate struggle, a sudden change in Bo’s behaviour caught her attention. Lillian says: ‘Suddenly he dropped the stick out of his mouth and immediately he looked up the river very focused. He was almost holding his breath’. Lillian searched for the cause of Bo’s odd behaviour. Lillian says: ‘I saw nothing except the white running water. I looked again and as I looked an arm came up […] He simply launched into that water. He scrambled over and he was totally focused’.
(video narrative 15, 00:01:00-00:02:00)

All types of casualties had to be rescued in the present sample. For example, characteristics of multiple casualties were related to all the examined rescuer characteristics except the rescuer’s ability to remain alert and have quality initial training. Depending on the emergency, usually 3-4 lifeguards were needed, because without enough lifeguards, it would be impossible to initiate
a mass rescue. Objective and subjective content of the video revealed the fol-
lowing.

‘Four middle-aged lifeguards are running fast towards them (the casual-
ties) one after the other. At the last moment they are making a surface
dive and they grab the casualties. Then they pull them back to the shallow-
er water [...] the lifeguards, having guaranteed the safety of the casual-
ties, are diving under the surface to ensure that no one has been left
under the water’.

(video narrative 41, 00:00:30-00:01:00)

Also non-swimmers were related to a number of rescuer characteristics except
to the lifeguard’s ability to do a risk assessment, remain alert, have good vi-
sion and initial training and co-operate with other lifeguards or other rescue
services. Finally, injured and unconscious casualties were both saved by
physically fit and fast rescuers, who reacted despite the bystander’s lack of
response, and had knowledge of the hazards of the area. Furthermore, not
surprisingly, the outcome of the treatment of unconscious casualties was also
dependent on quality initial training for the administration of resuscitation. The
narrator annotates.

‘(The lifeguards) needed all their skills and training that day. But it
needed two flashes of inspiration to save Hailey’s life’.

(video narrative 10, 00:00:30-00:01:00)

5.4.2 Who (Casualty)–Whatever Circumstances
The presence of rescue equipment alone or together with a wet or dry suit,
enabled a successful outcome after a drowning incident. Amateur prospectors,
fishermen, sailors and stuntmen who wore wet or dry suits during a drowning
incident could remain above the water surface and eventually be saved by
rescuers. On the other hand milk-men and stowaways, who experienced a
drowning incident while wearing casual clothes, were saved only in those
cases where a rescuer could effectively use some equipment during the res-
cue. In cases where wet/dry suit and rescue equipment were absent, a drown-
ing death occurred, as in the following narrative.

‘Three young stowaways are trying to cross the river that is the
pure border between Mexico and the USA. They are detected by
the border guards who are trying to stop them. Desperate, they
try to swim. The reporters are trying to help them by throwing ca-
bles of video cameras unsuccessfully. Eventually they drown’.

(video narrative 12, 00:00:00-00:00:30)
The circumstances of drowning were different for youths and for middle-aged victims. Middle-aged victims drowned during summer, autumn and winter. Their survival depended on the use of a PFD while they were in deep water and on a reach rescue while they were close to safety. On the other hand, youths drowned during spring, summer and winter. They were most commonly rescued with the use of rescue equipment or with a wade rescue.

The circumstances of drowning were different for male and female victims. Males drowned at any time during the day, and engaged in various activities in all seasons of the year (e.g. swimming, yachting, cruising, diving, snorkeling, stunt, driving, air/space travel, walking on a frozen lake). Females drowned while on vacation, holidays or normal working days, during the day-time. They were swimming, yachting, cruising, snorkeling, performing stunts and walking on a frozen lake. They were saved with the use of rescue equipment when the water was deep or with a wade rescue when the incident took part in shallow water.

The circumstances of a drowning incident varied between casualties with different ethnicities. In almost all cases, non-whites were involved in drowning incidents while swimming. Because their drowning occurred in the presence of bystanders and lifeguards they were successfully saved when a combination of rescue methods was used. On the other hand, whites experienced drowning while engaged in a variety of aquatic and non-aquatic activities (e.g. sailing, ice-skating, bungee jumping, walking, cruising etc.). Their rescue could be attributed to the presence of rescue equipment, PFDs, and the use of the wade- or the reach-rescue.

The circumstances of occurrence under which different casualty types experienced drowning varied. First, multiple victims were saved by combined rescue methods or with a swim/tow-rescue. During their rescue, quality equipment was used in some cases (e.g. PFD, wet or dry suit), which means that they were only occasionally prepared for the activity they undertook. In other cases they wore casual clothes during the drowning incident. Second, non-swimmers were saved with a wade-rescue. This was expected because people who do not know swimming cannot swim far from safety. However, when non-swimmers engaged in aquatic activities that involved some risk, they needed rescue equipment to be saved. Third, weak/tired swimmers were usually in the
water wearing casual clothes and their safety depended on the quality of materials used for the rescue. Finally, injured casualties were saved with a row-rescue. All the above casualties were undertaking an aquatic activity (snorkeling, swimming, bungee jump, yachting, sailing) or fell into the water by accident while they were walking, or driving a car, spaceship, airplane, and aerostat.

Casualties with low socio-economic status were involved in drowning incidents. These casualties fell into the water unintentionally in all cases and are mentioned below.

‘Eventually they (stowaways) drown trying to find a better future in another country’.
(video narrative 12, 00:00-00:30)

‘The young boy and all the rescuers are wearing clothes that show that the whole community is poor’.
(video narrative 18, 00:00:30-00:01:00)

‘A fishing boat with 3 crew members (fishermen) on board is sinking progressively in the sea’.
(video narrative 22, 00:00:00-00:00:30)

People experienced drowning regardless of their area of residence. Both residents and non-residents in the area of the accident, who undertook an aquatic activity, were involved in drowning episodes. When the drowning incident occurred in the presence of humans or even animals, then a successful rescue was performed.

5.4.3 Who (Casualty)–Wherever
The physical water fitness of the victim was related to the place of occurrence of the drowning episode. Not surprisingly, the physical water fitness of the casualty was related to the aquatic area, the currents, the depth of the water, and also with the way that some people are influenced by others to go beyond their limits. Regardless of how good swimmer a person is, it is almost certain that strong currents, deep water and the influence of people who overestimate their personal limits could jeopardize their safety. The following narrative demonstrates clearly the above statement.
‘A local family (father, mother, young boy), were in the car on a bridge that was above a river. Due to non-stop raining for days, the flood was very dangerous and the water level very high. While the car is starting to cross the bridge, the flood is causing it to drift under the bridge. The young boy is floating out of the car. The mother is managing to get out safely helped by bystanders. Reporters, bystanders and the father are starting an agonizing attempt to find and save the boy. Without a second thought the father is getting in the river again endangering himself trying to save his son’.  
(video narrative 14, 00:00:00-00:00:30) 

A number of occupations and casualty behaviour was related to the place of occurrence of a drowning incident. Amateur prospectors and stuntmen exhibited anxiety when engaged in risky aquatic activities that took part in seas and rivers. They were involved in drowning incidents when the ground gradient was slopping, the water deep or wavy, and the currents shifted them far from the shore, and when they were influenced by others to overestimate their limits. Finally, they disregarded the related safety legislation and did not take preventative measures.

In terms of casualty type, non-swimmers drowned in a number of different aquatic settings. Non-swimmers drowned at short distances from safety in seas and lakes where the ground gradient was downhill and the water deep. They also drowned when there were rough environmental conditions (e.g. waves, currents, raining, and snow), or where there was no legislation or preventative measures.

Youths and middle-aged victims almost always experienced drowning in the same aquatic settings. Both age groups were in danger when weather conditions were rough (e.g. raining, snowing, waves) in seas and lakes, when they were out of their depth and at a distance from safety, when the ground gradient was steep, and in the absence of appropriate legislation and preventative water safety measures. On the other hand, youths were also in danger when the equipment they used was poor quality, while victims aged 41 years and older were vulnerable in flood water.

Gender was related to the place of occurrence of a drowning incident. Both sexes were in danger when the ground gradient was steep, at any distance from safety, in shallow and deep water, and in the absence of preventative
measures in the aquatic area. Males drowned in coastal areas and lakes, when there were bad environmental conditions (e.g. waves, raining, snowing), and no related water safety legislation. Females drowned in coastal areas, rivers, floods and due to sellers’ immorality in selling quality personal protective equipment like life-jackets.

Ethnicity was related to the place of occurrence of a drowning episode. White casualties drowned in several locations like rivers, seas and lakes due to rough environmental conditions (e.g. raining, waves, snowing and flooding) and in the absence of water safety legislation. Non-white casualties drowned on steep beaches, a few metres away from safety and most often in water only a little deeper than their height.

The location of drowning incidents varied between different casualty types. Injured swimmers drowned in harbours due to the lack of related water safety legislation. Weak/tired-swimmers drowned at short distances away from safety when the sea was wavy or the ground gradient steep. Non-swimmers experienced drowning in water depths a little deeper than their height, at distances close to safety where the ground gradient was steep or when they were trapped in currents. Finally, multiple victims drowned in lakes when it was raining, snowing or there were no preventative measures and related safety legislation. Some of them also drowned in deep water in the open ocean or close to the beach when the seabed was declivitous. This can be explained because in cases where bathers do not know swimming, the seabed is declivitous and the equipment they use is not of good quality, then they rely completely on the buoyancy of the equipment.

‘In this case a collapsing tube was the cause of the double drowning. These girls depended on the tool for support. As the plastic ring deflates they also panic trapping one girl in the tube’.
(video narrative 37, 00:00:00-00:00:30)

The area of residence of the casualty was related to the place of occurrence of a drowning incident. Non-residents were usually in danger at sea when engaged in aquatic activities that involved psychological anxiety or risk, usually when legislation and preventative measures were absent, or present but ignored. On the other hand locals were in danger in an aquatic environment near their area of residence when the weather conditions were rough (e.g.
raining, snowing, floods). This difference is very important because it shows that non-residents usually seek pleasure from engagement in activities with risky settings while locals get into difficulties mainly due to accidents near their homes. The examples below illustrate this contradiction.

‘Jim and his dogs Tarry and Tara went for their daily walk near Jim’s lakeside cottage […] it started snowing and the visibility started getting bad. By then he realised that he was far further out than he normally went. Suddenly Jim and Tara were fighting for their lives trapped in freezing water’.  
(video narrative 7, 00:00:00-00:01:00)

‘In the history of Niagara Falls they (Steve and Lorry) have become only the 4th and 5th people to survive. But leaving through this amazing stunt only what Traders appetites for danger. His next challenge is a 400 foot pendulum swing from the highway long swing from Tampa Bay in Florida’.  
(video narrative 2, 00:00:30-00:01:00)

5.4.4 Who (Rescuer)–Whatever Circumstances
Rescuers performed a variety of drowning rescues. Middle-aged amateur lifesavers and professional lifeguards initiated swim-and-tow-rescue, wade-rescue, a combination of rescue methods, or used rescue equipment. They wore wet or dry suits for protection and the rescue took part in the presence of bystanders. Some of their rescues involved risk.

Male and female rescuers saved drowning victims under different circumstances. Although rescuers of both sexes responded to aquatic emergencies, males responded more frequently; in particular, male rescuers initiated rescues even when the casualty was doing something risky. They also used quality rescue equipment, wet or dry suits, or used the swim/tow-, wade- and reach-rescue for saving someone.

Various rescuer qualities were required in a number of drowning episodes. First, lifeguard or lifesaver expertise was evident in situations where the aquatic activity involved risk and when rescue equipment or various types of rescue had to be used. Second, rescuer speed of action was noted in all the sampled drowning episodes when quality rescue equipment was worn (e.g. PFD, wet, dry suit) and various rescue types were used (e.g. combination, swim-and-tow-, row-, wade-). Third, rescuer’s vision was noted in rescues that occurred during the day or night, while the rescuer performed rescues with
(e.g. swim/tow-, wade-rescue) or without rescue equipment (e.g. combined types of rescue). Fourth, the rescuer had to remain alert, to be able to recognize the instinctive drowning response of a non-swimmer and do the appropriate risk assessment, when there was risk involved in the aquatic activity. Fifth, the rescuers had to know the dangers that might exist for them, and use quality lifeguard rescue equipment (wet or dry suits), while performing drowning rescues (e.g. throw-, swim/tow-, wade-, reach-rescue or a combination of these). Sixth, physical strength of the rescuer was required in drownings where the casualty was at risk because of the nature of the activity and when the rescuer used equipment. It was required not only in the water but also on land-based rescues of casualties who had fallen accidentally into the water fully clothed. In those cases, the rescuer needed some minimum strength in the upper body to pull the casualty successfully, as illustrated in the following case.

‘Terry is immersed up to the waist in a frozen lake. The ice is broken at the point where he is. An arm is holding him from a higher level just 1.5 m high […] Bystanders are trying to pull him out of the cold water but the only thing they can actually do is to prevent him from sinking completely. Terrence is trying to climb out unsuccessfully […] The person who is holding him is trying to get a better grip on his wrist […] Three bystanders have made a human chain, by holding each others wrists in an attempt to hold Terrence above the water’.

(video narrative 9, 00:00:00-00:00:30)

A variety of aquatic and non-aquatic safety professionals performed different types of drowning rescues. First, lifeguards responded to drowning incidents with risk settings using rescue equipment or wade rescues. Second, amateur lifesavers rescued casualties using the swim-and-tow-, wade-, throw- or row-rescue. Third, emergency services personnel performed rescues (e.g. air-rescue, row-rescue or a combination of methods) using quality rescue equipment and wearing wet or dry suits. Finally, bystanders were able to initiate rescues using quality rescue equipment (e.g. PFD) or various rescue techniques (e.g. throw-, reach-rescue or a combination of rescue methods).

5.4.5 Who (Rescuer)–Wherever

Rescuers had to perform rescues under various circumstances. For example, middle-aged male rescuers responded to emergencies when casualties were
anxious or risk was involved during the aquatic activity. Also male rescuers responded to drowning incidents that occurred at some distance from safety in open water, on a downhill ground gradient, in water deeper than the casualty's height, and when the weather conditions were rough (e.g. waves, winds). Finally, a rescuer responded to emergencies either when related water safety legislation was breeched illegally (e.g. stowaways trying to cross the borders of a country, illegal bungee jumping from a bridge), or some regulation recommended a lifeguard presence at the place of the incident (e.g. the presence of lifeguards at the whirlpool who responded to the non-breathing girl).

Rescuer qualities were evident during certain circumstances in drowning incidents. First, lifeguards had to have good vision when initiating rescues at sea, at some distance from the beach. Second, lifeguards had to have physical strength in rescues on a downhill ground gradient and in water deeper than the casualty’s height. Third, rescuer expertise was required to perform a rescue at a relatively longer distance from safety. It was also required in those cases where rescuers had to save people in wavy water, while the lifeguard’s scanning was interrupted by noise and, finally, when the casualty who engaged in a risky activity was feeling very anxious.

Different types of aquatic safety professionals performed drowning rescues based on the level of their training. For example, untrained lifesavers responded to emergencies where the water was deeper than the casualty’s height. But professional lifeguards responded to casualties in more complicated aquatic emergencies where anxiety and risk was involved in wavy seas. It is seen, therefore, that a professional lifeguard responds to more immediate and demanding situations compared to a lifesaver whose abilities are limited. Finally, other emergency services (e.g. fire brigade, scuba divers, helicopter crew etc.) attempted rescues in harbours, rivers, and wavy waters, when the legislation and relevant preventative measures required their presence.

5.4.6 Whatever Circumstances–Wherever

A number of weather conditions were present during drowning incidents that occurred in certain aquatic environments. More precisely, drowning rescues occurred in streams, rivers, the sea, when the ground gradient was downhill, and regardless of water depth and distance from safety, and they happened
because of weather conditions like waves, currents, raining, snowing and flooding.

Use of equipment was evident during rescues in some aquatic environments, especially in cases where the casualty panicked. Rescue equipment, personal flotation devices and wet or dry suits were also used for rescues in deep water, at some distance from safety and in wavy conditions. The following two examples describe such cases.

‘The yacht disappears below the surface within seconds. One man is swimming front crawl with his head above water about 4 m away from the sunken yacht. People from the tanker are throwing 2 red lifejackets into the water. The crew member is swimming towards them and grabs one of them’.

(video narrative 4, 00:02:00-00:02:30)

‘All the passengers in the powerboat were wearing personal flotation devices’.

(video narrative 11, 00:00:00-00:00:30)

‘He (amateur prospector) is wearing a wet suit but not a personal flotation device’.

(video narrative 15, 00:01:00-00:01:30)

‘The two fighters fall unintentionally into the water. They are wearing protective clothing’.

(video narrative 8, 00:00:00-00:00:30)

‘A scuba diver with waterproof clothing is diving under the icy water of the lake in a desperate attempt to find the body of the young boy’.

(video narrative 9, 00:01:30-00:02:00)

Casual clothes were worn in a number of drowning incidents where unintentional submersion occurred, for example, when flooding had occurred or when the ice on a lake broke, as seen in the cases below.

‘The children (who have fallen in a lake because the ice broke) are wearing casual clothes but not personal flotation devices’.

(video narrative 8, 00:00-00:30)

‘While the car is starting to cross the bridge, it is drifting under the bridge because of the flood. The young boy is pulled out of the car by the current’.

(video narrative 14, 00:00-00:30)
The quality of equipment used during some drowning rescues was related to a number of variables. First, it was related to the need to maintain related legislation and preventative measures that will enforce such quality. Second, it was related to rescues taking part at a distance from safety and in flooded areas. The following narrative shows the importance of maintaining legislation and preventative measures for the quality of equipment that may be used during a rescue.

‘Her car has been swept along in a flash flood and she has no way of getting out. A group of quick-thinking locals are trying to get ropes around the car. One rope is attached but is not strong enough. […] Although the distance from safety is no more than 10 m, the flood water is very strong’.

(video narrative 13, 00:00:00-00:00:30)

Drowning incidents took place under different circumstances during different seasons. Incidents at sea occurred during summer, autumn, and winter (video narratives 16, 17, 19), in lakes they occurred during winter (video narratives 7, 9) and in rivers during spring (video narrative 15). In some cases, those drowning incidents occurred because there was anxiety or risk during the aquatic activity and absence of related legislation and preventative measures (video narratives 6, 10).

Various types of rescue occurred in different aquatic environments and circumstances. First, air-rescue was used in rivers, where it was difficult to cope with the strong currents. Second, row-rescue was the preferred type in harbours, in deep water and when there was appropriate legislation to foresee this need. Third, when the casualty was at some distance from safety a reach-, wade-, row-, swim/tow-rescue was used or a combination of different rescue types. Fourth, when the ground gradient was downhill a throw- or a combination of rescues was preferred. Fifth, when there were preventative measures established in coastal areas (e.g. lifeguard presence scanning the water from a high chair or equipped with a helicopter and power boat) the rescuers preferred to use row-, swim/tow-rescue or a rescue with multiple rescue means.
‘The balloon is running out of fuel. The last option is to ditch into the sea [...] The white police boat and the yellow rescue boat are trying to catch the balloon using a rope; but it doesn’t work as the balloon is blown away by the wind [...] The red-yellow helicopter is flying just above the balloon. The two power boats are standing very near the balloon’.

(video narrative 5, 00:00:30-00:01:30)

Anxiety and the risk during an aquatic activity were related to swim/tow- and row-rescues. This means that those engaged in aquatic activities that contained risk were either prepared for an accident, having a craft, and used swim/tow-rescue for approaching the boat, or they didn’t have a craft at all and, therefore, had to be rescued with the most difficult type of rescue which is the ‘swim/tow’.

‘The Dare Devils are floating in the water all together. Lora is unconscious with a broken neck and Geoff is not breathing with a broken neck as well. The power boat of the team is approaching them: The Dare Devils who are conscious and holding onto their injured partners, are shouting to the power boat seeking help. A second boat is very close to them. One man is doing rescue breathing with Lora, who is facing upwards, by using the mouth to mouth technique. The team is in the power boat that is travelling quickly’.

(video narrative 2, 00:02:30-00:03:30)

Free nodes were used to find under what circumstances drowning is likely to occur in certain aquatic environments. Interestingly, it was found that activities which might lead to a drowning incident were not only aquatics but also activities that take part on the ground (e.g. walking on a frozen lake, driving a car on the road near the water) or in the air (ditching of airplane, space ship and balloon). The following examples illustrate this quite clearly.

‘... we had decided that we are going to go diving or snorkelling’

(video narrative 1, 00:00)

‘In the whirlpool the water was moved round and round by pumps which continuously sucked the water in and blew it back out again. Hailey’s hairs were caught in the intake pump valve of the whirlpool and she was trying to free them. Pipa says: “I tried to pull her out. She would not budge”.

(video narrative 10, 00:03:00-00:03:30)

‘Culla Cuba is convinced she is about to die. Her car has been swept along in a flash flood in Istanbul and she has no way of getting out’.

(video narrative 13, 00:00:30:00)
5.4.7 Limitations

This study presented a few limitations. First, although in some studies that used NVIVO for observation content analysis of videos the cameramen were trained in using the video camcorders (e.g. Rich & Chalfen, 1999; Rich, Lamola, Amory & Schneider, 2000; Rich, Lamola, Gordon & Chalfen, 2000), in the present study most of the videos have been filmed by amateur cameramen. Because of that, some characteristics of the videos were not the same e.g. the duration of the available video of each emergency situation, the zoom, the sound, and demographic data of the casualty or the rescuer. Second, some videos provided both visual and audio outputs whereas others provided only visual. The third limitation was that the current sample didn’t provide evidence for all the nodes (variables) that constituted the noding tree possibly due to the limited number of video narratives that were analysed. It is believed that with a higher number of video narratives it would be possible to provide

‘Seventy yards up the river, amateur prospector Link Hill was searching for gold in a stretch of dangerous rapids. In an instant, Link was fighting for his life’.
(video narrative 15, 00:01:00-00:01:30)

‘Within 42 hours of the first fire alarm sounding on board the cruise liner “Achille Lauro” the boat was burning herself out in the Indian Ocean’.
(video narrative 17, 00:00:00-00:30:00)

‘When a hijacked Boeing 747 crashed off the Comoros islands the consequences were catastrophic and the battle for those who survived the initial impact was truly frightening [...] The pilot had the intelligence to ditch the plane. The plane had broken into 3 pieces and this resulted in 120 deaths. But the remarkable statistic was that 47 passengers and 3 crew members survived’.
(video narrative 19, 00:00:00-00:30:00)

‘A small chamber of the spaceship supported by 3 aerostats is flying down towards the sea. The chamber splashes onto the surface of the sea and remains there’.
(video narrative 20, 00:02:00-00:02:30)

‘Jim and his dogs went for their daily walk near Jim’s lake-side cottage [...] Suddenly, the ice of the frozen lake on which they were walking broke and Jim with Tara fell into the water fighting for their lives, trapped in freezing water.’.
(video narrative 7, 00:00:00-00:01:00)
evidence for all the reported in the literature review variables, generating the model even further.

5.4.8 Recommendations
Future study could possibly research the interrelationship between the 4 Variables that constitute the 4W model but with a more homogeneous sample where the rescuers will be only professional lifeguards. Also, the identification of the casualties that survived and the use of a semi-structured interview will allow to answering of questions that could not be answered in this study (e.g. day, month, time of occurrence etc).

5.5 Conclusions
This study shows that when there is a human activity in, on, above, under or near an aquatic environment, a drowning incident might happen to whomever, wherever and under whatever circumstances. It also shows that the four main Variables that constitute the 4W model of drowning and lifesaving (e.g. who drowns, who rescues, where an incident occurs and under what circumstances it occurs) influence the drowning process. The single most important factor that determines the outcome in an aquatic emergency was the rescuer and the casualty was the second. Survival after an aquatic emergency is not determined only by single but also from interrelated Variables. The most important interrelationship is between the rescuer and the circumstances that will need to cope in the aquatic area; the second is the way that the rescuer interrelates with the casualty. The circumstances under which the casualty will get into difficulties and the place where the casualty will be are the next most important Variables that determine the outcome of the rescue. As there is not ‘waterproof activity’ the presence of quality lifesavers, lifeguards, and the education of public members safety-wise will strengthen the two most important variables of the 4W model (rescuer and casualty), and increase the chances of survival after drowning incidents.
Chapter 6:
Semi Structured Interviews of Aquatic Professionals
Chapter 6: Semi Structured Interviews of Aquatic Professionals

6.1 Introduction

The previous chapter showed that when there is a human activity in, on, above, under or near an aquatic environment, a drowning incident might happen to whomever, wherever and under whatever circumstances. It also showed that the four main Variables that constitute the 4W model of drowning influence the drowning process. However, it didn't prove any relationships between certain Variables with drowning. This chapter aims to support most of the previous findings and also to identify those missing relationships investigating drowning and other aquatic emergencies through interviewing personnel with related experience.

6.2 Method

6.2.1 Oral Evidence

The use of a questionnaire based survey was thought to be inappropriate when related to events that possibly involve emotions. Also the time lapse which may have occurred would necessitate a very special approach and therefore, it was very important that the voices of the people themselves should be the key source of evidence for the aquatic emergencies that took part. Therefore, in this study it was decided to use semi-structured interviews. By interviewing people it was considered a good way to encourage memorizing, making interviewees able to document their experiences and perceptions that would then be related to the variables that constitute the 4W model.

6.2.2 Reliability and Validity

In order to establish validity, a series of measures were taken. First, feedback was solicited about the present research and coding from colleagues within the university (Weston et al., 2001). Some would argue that oral research would merely generate anecdotal information (Steele, 1995). This however would not cause a problem because anecdotal rescue stories were exactly what were needed in order to illustrate, in detail, aquatic emergencies. Second, to overcome the possibility of obtaining irrelevant information, the interviewer was prepared to guide the interview to the desired path by asking specific questions. Third, to establish the reliability of this part of the research,
substantial research and reading of related literature took place, in order to ensure that the interviewer was able to lead the conversation when needed to the correct path. Fourth, a standardized interview schedule, within a consistent interviewing environment was maintained. Fifth, the interviewee’s permission was obtained for the recording and the transcription of the interview was done straight after the interview (Gratton & Jones, 2004). Sixth, confidentiality and anonymity were maintained in order to establish validity (see below ethical issues). It was found though that people were more truthful when they had no worries about the immediate effect of what they were reporting for the casualties that were involved, a finding similar to what was reported by Lumnis, (1987). Also according to Seldon & Pappworth, (1983) oral history (or in our case the interview) may sometimes be more reliable after a period of time, because the mind is more detached and able to reconstruct the occurred events. Finally, interviewees were free to speak without hesitating to mention things that would show them in a negative light, without the need to please the interviewer (Dean & Whyte, 1978).

6.2.3 Sampling

The procedure of convenience and snowball sampling was used in the present study; an approach for locating information-rich key informants or critical cases (Patton, 1990). According to the same author several studies have used this sampling procedure successfully by accumulating new information rich-cases. More precisely, the sampling started by asking well-situated people in the aquatic industry the question: ‘who knows a lot about drowning and aquatic rescue incidents? Who should I talk to?’ By asking a number of people who else could give related information, the snowball got bigger, accumulating new information-rich cases. In an effort to keep the project within manageable proportions it was decided to concentrate the study on a reasonable sample taken from localities of different countries where the interviewer had access (e.g. Cyprus, Greece, UK, USA) meeting the sampling requirements. Demographics of the subjects that participated are described in table 6.1.
Table 6.1: Demographic Characteristics of the Respondents that Participated in the Semi-Structured Interview.

<table>
<thead>
<tr>
<th>No</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>34</td>
</tr>
<tr>
<td>Mean Age</td>
<td>31 years</td>
</tr>
<tr>
<td>Sex</td>
<td>Male 30 (88.2%), Female 4 (11.8%)</td>
</tr>
<tr>
<td>Nationality</td>
<td>Greek 25 (71.4%), English 2 (5.7%), American 1 (2.8%), Cypriot 6 (17.1%)</td>
</tr>
<tr>
<td>Area of the Incident</td>
<td>Sea (above the water surface) 23 (67.6%), Sea (below the water surface) 5 (14.7%), Lake 2 (5.9%), Pool/Waterpark 4 (11.8%)</td>
</tr>
</tbody>
</table>

6.2.4 Interview Preparation and Interviewer

A semi structured interview was used. A schedule of themes to be covered within each interview was utilized by the researcher and thus prompts were utilized accordingly. Particular attention needed to be given to any responses regarding specific incidents during collection to ensure that the interviewee were not becoming distressed and using identifiers instead of names during recording ensured that the interviewees all remained anonymous. This type of interview was used to ensure that important questions would be answered by the participants but also that they would be allowed to express their own experience in their own way, as each aquatic emergency is constituted by different characteristics that might not be possible to categorize. It is equally important to have standardized questions to make sure that the study will be able to make some conclusions but it is also important to allow the participants to talk about their experience. Those questions were open-ended, neutral, singular and clear in order to minimize imposition of predetermined responses when gathering the data, to avoid dichotomous response (e.g. 'yes' or 'no') that prevents the responder from in-depth talk, and to avoid tension and confusion because the interviewee doesn’t know what is being asked (Patton, 1990). The interview focused on the following themes (Table 6.2).
Table 6.2: The Interview Themes that Were Used in the Semi-Structured Interview.

<table>
<thead>
<tr>
<th>No</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The general background and experience of the rescuer.</td>
</tr>
<tr>
<td>2.</td>
<td>Their experiences of real-life rescuer situations type/ location/ timing/ season of rescue, nature of casualty, what both parties were doing prior to the incident. What help they received as a rescuer during and after the incident.</td>
</tr>
<tr>
<td>3.</td>
<td>Their views on what Variables tend to precipitate rescue situations and which Variables might be the most prevalent/important and why. This might relate to types of location, age/ sex/ number/ personality type of casualty.</td>
</tr>
<tr>
<td>4.</td>
<td>Major difficulties facing rescuers and how these may vary by location, rescuer experience, casualty number.</td>
</tr>
<tr>
<td>5.</td>
<td>Their views on risk taking behaviour in aquatic situations. The relative effectiveness of publicity/education/signage. Should certain groups be constrained from using specific locations such as marinas, lakes, bays etc?</td>
</tr>
<tr>
<td>6.</td>
<td>Their views on the quality and extent of their water safety education and water safety education in general. What more can be done?</td>
</tr>
<tr>
<td>7.</td>
<td>Their perceptions of water safety provision and practice. Their ideas on how improvements can be made.</td>
</tr>
<tr>
<td>8.</td>
<td>Their views on where the responsibilities for safe aquatic behaviour lie and why.</td>
</tr>
</tbody>
</table>

Questions were asked only in cases where the interviewee hadn’t reported them on their own within the interview. This was attempted in accordance to Seldon & Pappworth (1983) who stated ‘let the interview run; never attempt to dominate it; guide it and try to ask as few questions as possible; plenty of tape but only few questions’ (p. 73). The interviewer had a 3-year relevant previous work experience in two Greek aquatic magazines (Greek Diver and Under Water World), and therefore, the interviewing procedure, possible transcription difficulties and other related issues were not completely unknown.

6.2.5 Ethical Issues

Based on Patton, (1990) the ethical issues of promise and reciprocity, risk assessment, confidentiality, data access and ownership, interviewer mental health and advice were considered:

Promises and reciprocity: interviewees were told that they will be given on request a copy of the final study when it is eventually finished.

Risk assessment: Dealing with people who have experienced the death of a loved one, friend or acquaintance may lead to emotional upset. Questioning was sensitive. This also extended to those who were involved in the (at-
tempted) rescue. Any instruction given to potential participants was comprehensible. Each potential subject of the interviews was given a participant information sheet (see appendix 8) in order to be adequately informed of the aims, methods, anticipated benefits and potential hazards of the research and any discomfort it may entail. Potential participants were aware that they may discuss their involvement with an appropriately qualified, nominated, independent person. Subjects were advised of the possibility of trauma and advised that they could withdraw at any time, or refuse to answer any questions they felt were inappropriate, without having to specify a reason. They were also advised that in the unlikely event of their suffering psychological distress, then they should seek professional help. Research conformed with legislation relating to data protection. The risk to the researcher involved possible inappropriate behaviour of the interviewees. Thus, interviews were conducted in the presence of a third person, at a location deemed satisfactory by both researcher and interviewee. The researcher was a highly experienced lifeguard, instructor, and first aider with extensive experience of the aquatic environment and drowning incidents. He was therefore aware of the distress that these incidents cause and made every effort to ensure that the interviews were conducted in a professional yet empathetic and sensitive manner. The risk to the researcher might involve possible inappropriate behaviour of the interviewees.

Thus, interviews were conducted in the presence of a third person, who stayed close but was unable to hear the conversation, at a location deemed satisfactory by both researcher and interviewee. This could be at the interviewee’s workplace or a mutually agreeable place such as a café or public park. A follow up meeting took part in order to ensure that the interview was not affected the participant’s emotional health.

Confidentiality: Confidentiality and anonymity were maintained. As stated above, subjects were told that they could withdraw at any time, without having to offer an explanation. Similarly, they could opt not to answer individual questions, without having to justify themselves. In the interviews coding data with numbers instead of names were used to protect the identity of participants. Participant information sheet (appendix 8) was distributed, and informed consent form (appendix 7) was obtained from all the participants. Data were stored securely with restricted access; anonymity of participants, agencies and geographical settings in the publishing of reports were maintained. Hard copies of the data will be kept for two years after the thesis completion, in order to
facilitate journal article submission. Thereafter the data will be destroyed. Audio tapes were destroyed once transcription was complete and agreed as an accurate record by the participants.

Data access and ownership: Access to the data was open to only the researcher and the supervisory team. Care was also taken in securing individual confidentiality statements from all research personnel. The collection and storage of research data complied with the Data Protection Act of 1998 where appropriate (Leeds Metropolitan University, 2005).

Interviewer mental health: The interviewer had 3 years of experience in interviewing people in similar events, having written books and other material related to drowning and aquatic accidents issues. Therefore, his mental health was not felt to be in danger by contacting people that described aquatic emergencies.

Advice: The interviewer asked the supervisory team for assistance in matters of ethics and institutional approval was obtained from the faculty research ethics sub-committee.

6.2.6 The Recording
A SANYO M-1110C audio tape recorder and 2-hours Maxell cassettes were used to record the interview. Interviewees were assured before the interview that it would be confidential and anonymous, and that the tape recorder was only for allowing the researcher to maintain accurate and precise data. The tape recorder had a built-in microphone and was put on a table in between the interviewer and the interviewee on a stable surface. The recording system was always tested prior to the interview. Batteries were checked every time before the interview and spare batteries and cassettes were always available. During the recording the interviewer asked the questions (where necessary) speaking clearly and slowly, asking the interviewee to do the same. At the beginning of the interview, the interviewer checked if he could hear the interviewee’s voice, and then the interview continued. The table where the tape recorder was positioned was free of other items (e.g. bottles, papers etc). The tape recorder was stopped during irrelevant conversation. At the beginning and at the end of the interview, interviewer said ‘this is the beginning/end of the interview with … (name of interviewee)’ (Patton, 1990).
6.2.7 The Location

Although most aquatic or emergency personnel were available to be interviewed during their work, it was decided to interview them after their daily work at a pre-arranged time and place, to ensure that they would feel comfortable and relaxed. Also, in order to avoid noise from the external environment that might cause problems and misinterpretations during the transcription, a quiet place free of interruptions was always chosen for the interview.

6.2.8 Copying-Indexing-Transcribing

All cassettes were copied to avoid the risk of losing the data. Master copies were kept in a safe place. An indexing system was developed for the cassettes and the notes that were kept during the interview, in order to be more accessible (Wengraf, 2001). During the transcription, the following process was followed (Wengraf, 2001): The interviewer first, listened to each interview as a whole, without stopping the tape recorder. During the listening, the interviewer tried to remember the interview process as it happened for using some more qualitative data known as ‘hard data’ (e.g. how the interviewees were feeling during an important statement, how serious they were making the point that they made, were they trying to convince the interviewer about their beliefs? etc.). Those data would be possible to be extracted only if the first listening was careful. At the ‘Version zero’, a second listening of the interview took place. The transcription that followed was verbatim (unedited and complete) to assure that during analysing no data would be missed (e.g. hesitations, gaps, inconsequentialities etc). Notes with ‘hard data’ were added in brackets. Finally, at the ‘Clean up version’ language mistakes, gaps and other possible errors were corrected in order to make the text more readable and smooth.

6.2.9 Analysis

Once the transcriptions were complete, the ‘clean up version’ of each narrative was converted into Rich Text Format (.rtf) file and imported into NVIVO. NVIVO and all the procedures that were used in the previous chapter for making a project were followed (see chapter: an observational content analysis of video recorded rescues). Emerging variables were coded as free nodes.
6.3 Findings

6.3.1 Descriptive Statistics

This section discusses all the findings and contains the frequencies of the variables that describe who drowns, who rescues the drowned casualties, and finally where and under what circumstances the incident takes part.

Table 6.3: Frequencies of the Sub-Variables that Constitute the Factor ‘Casualty’ in the Examined Sample (n=34).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sub-scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male (30, 88.2%), Female (4, 11.8%)</td>
</tr>
<tr>
<td>Age</td>
<td>Below 19 years old, (11, 33.3%), Between 20-40 years old (16, 48.5%), 41+ years old (5, 15.1%), Unspecified (3, 8.57%).</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>White (34, 100%), Non-white (0, 0%)</td>
</tr>
<tr>
<td>Area of residence</td>
<td>Resident (10, 29.4%), No resident (19, 55.9%)</td>
</tr>
<tr>
<td>Casualty type</td>
<td>Non-Swimmer (7, 20.6%), Weak-Swimmer (4, 11.8%), Injured Swimmer (4, 11.8%), Unconscious Casualty (12, 35.2%), Multiple Casualties (7, 20.6%)</td>
</tr>
</tbody>
</table>

Table 6.3 shows the findings that are related to the casualty. The present study shows that drowning victims were represented by both sexes and age groups (males: 30, 88.2%, females: 4, 11.8%). The casualties were aged below 19 years old (11, 31.42%), between 20-40 years old (16, 45.71%) and people equal or older than 41 years of age (5, 14.28%). Only white casualties experienced drowning (whites, 34, 100%). Evidence of all the casualty types’ non-swimmers (7, 20.6%), weak-swimmers (4, 11.8%), injured swimmers (4, 11.8%), unconscious casualties (12, 35.2%) and multiple casualties (7, 20.6%) was present in this study. Both foreigners (19, 55.9%) and locals were involved in aquatic emergencies (10, 29.4%) which means that although there is a higher danger for strangers, unfortunately even the local citizens can get into difficulties, indication that the place of origin doesn’t provide guarantee or at least an absolute degree of water safety sense.
Table 6.4: Frequencies of the Sub-Variables that Constitute the Variable ‘Rescuer’ in the Examined Sample (n=34).

<table>
<thead>
<tr>
<th>The Rescuer</th>
<th>Sub-Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male 27, 92.1%</td>
</tr>
<tr>
<td></td>
<td>Female 2, 6.9%</td>
</tr>
<tr>
<td>Age</td>
<td>Below 20 years old 1, 3.3%</td>
</tr>
<tr>
<td></td>
<td>20-30 years old 28, 93.3%</td>
</tr>
<tr>
<td>Current Level of</td>
<td>Experience 17, 50%</td>
</tr>
<tr>
<td></td>
<td>Expertise 14, 41.2%</td>
</tr>
<tr>
<td></td>
<td>Physical fitness 14, 41.2%</td>
</tr>
<tr>
<td></td>
<td>Health 4, 11.8%</td>
</tr>
<tr>
<td></td>
<td>Vision 16, 47%</td>
</tr>
<tr>
<td></td>
<td>Swimming speed (of action) 19, 55.9%</td>
</tr>
<tr>
<td>Knowledge of the</td>
<td>Dangers related to bathers 13, 38.2%</td>
</tr>
<tr>
<td>aquatic area they</td>
<td>Dangers related to lifeguards 2, 5.9%</td>
</tr>
<tr>
<td>supervise</td>
<td></td>
</tr>
<tr>
<td>Professionalism</td>
<td>Adequate no of lifeguards and surveillance 13, 38.2%</td>
</tr>
<tr>
<td></td>
<td>Visible appearance and clothing 7, 20.6%</td>
</tr>
<tr>
<td></td>
<td>Record keeping and written operating procedures 4, 11.8%</td>
</tr>
<tr>
<td>Ability to …</td>
<td>Do risk assessment 5, 14.7%</td>
</tr>
<tr>
<td></td>
<td>Deal as educator 1, 3%</td>
</tr>
<tr>
<td></td>
<td>Recognize instinctive drowning response 9, 26.5%</td>
</tr>
<tr>
<td></td>
<td>Remain alert 22, 64.7%</td>
</tr>
<tr>
<td></td>
<td>React ignoring bystanders’ lack of response 14, 41.2%</td>
</tr>
</tbody>
</table>

Table 6.4 summarizes the frequencies of the variable ‘rescuer’. As in the first study, males dominated the lifeguard or rescuer profession (30, 88.24%), far outnumbering their females counterparts (4, 11.76%). In terms of age, most of the rescue workers and the lifeguards were between 20–30 years old (28, 93.3%) and only one case was below 20 years old (3.3%). The rescuers showed some variation with regard to experience, speed of swimming, visual detection capability, and vigilance. About half of the aquatic safety professionals were experienced (17, 50%) and were fast swimmers (19, 55.9%); slightly fewer could visually detect the victim (16, 47%) but more could remain alert while on duty (22, 64.7%). A lower percentage, however, was proficient in physical fitness (14, 41.2%) and had the ability to react, ignoring the bystander’s lack of response (14, 41.2%). Also the rescuers were more often aware about the dangers that were related to the bathers (13, 38.2%) and less often aware about the dangers that were related to themselves (2, 5.9%). In terms of professionalism, in some reported cases the number of the lifeguards on duty and the surveillance they maintained was adequate (13, 38.2%), they
wore visibly identifiable clothing (7, 20.6%) and kept records maintaining written operating procedures (4, 11.8%). Finally only in a few cases did lifeguards state that their health was important in allowing them to perform their job (4, 11.8%), that they did the appropriate risk assessments in their facilities (5, 14.7%), that they had to deal as educators (1, 3%), or that they were able to recognize a drowning casualty to perform a rescue (9, 26.5%).

Table 6.5: Frequencies of the Sub-Variables that Constitute the Factor ‘Whatever Circumstances’ in the Examined Sample (n=34).

<table>
<thead>
<tr>
<th>Under Whatever Circumstances</th>
<th>Sub-Scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rescue type</td>
<td>Reach 1, 3.2%</td>
</tr>
<tr>
<td></td>
<td>Wade 2, 6.4%</td>
</tr>
<tr>
<td></td>
<td>Row 4, 13%</td>
</tr>
<tr>
<td></td>
<td>Swim with aid 3, 9.7%</td>
</tr>
<tr>
<td></td>
<td>Swim and tow 17, 54.8%</td>
</tr>
<tr>
<td></td>
<td>Combination 4, 13%</td>
</tr>
<tr>
<td>Interrelationship among casualty and equipment</td>
<td>Wet and dry suit 4, 11.8%</td>
</tr>
<tr>
<td></td>
<td>Personal Flotation Device 2, 5.9%</td>
</tr>
<tr>
<td></td>
<td>Quality of materials 1, 3%</td>
</tr>
<tr>
<td></td>
<td>Lifeguard/rescue equipment 12, 35.3%</td>
</tr>
<tr>
<td>Risk as physical demand of aquatic activity</td>
<td>Presence of others 22, 64.7%</td>
</tr>
<tr>
<td></td>
<td>Time of occurrence: 10:00-18:00 (21, 72.4%), 18:00-02:00 (2, 6.9%), 02:00-10:00 (6, 20.7%)</td>
</tr>
<tr>
<td></td>
<td>Day: Weekend 16, 57.14%, Weekday 12, 42.86%</td>
</tr>
<tr>
<td></td>
<td>Season: Winter 3, 10%; Autumn 3, 10%; Spring 1, 3.3%; Summer 23, 76.7%</td>
</tr>
<tr>
<td></td>
<td>Holiday 13, 54.2% Normal Day 11, 45.8%</td>
</tr>
<tr>
<td>The type of activity</td>
<td>Swimming 16, 51.6%</td>
</tr>
<tr>
<td></td>
<td>Sailing 1, 3.2%</td>
</tr>
<tr>
<td></td>
<td>Other aquatic activity (scuba diving, snorkeling, jumping into the water, fishing, walking or playing in the water) 13, 42%</td>
</tr>
<tr>
<td></td>
<td>Walking on frozen lake 1, 3.2%</td>
</tr>
</tbody>
</table>

Table 6.5 summarizes the frequencies of the variable ‘whatever circumstances’. All types of rescue were used for assisting the drowning casualties using various types of equipment. More precisely single rescues such as reach (1, 3.2%), wade (2, 6.4%), row (4, 13%), swim with aid (3, 9.7%), swim and tow (17, 54.8) or their combination (4, 13%) were performed. During those rescues quality materials (e.g. scuba diving gear etc; 1, 3%), personal flotation devices (2, 5.9%), lifeguard/rescue aids (e.g. binoculars, oxygen, whistle, pocket mask, jet ski, power boat, scuba diving equipment, rescue can, and rescue tube; 12, 35.3%), and wet/dry suit were used from either the casualty
or the rescuer (4, 11.8%). Incidents occurred at any season of the year and at any time of the day. First, most of the drowning incidents occurred during the summer (summer 23, 76.7%), one tenth of the cases occurred during the autumn (3, 10%) and the winter (3, 10%) and occasionally during the spring (1, 3.3%). Second, although the most often time of occurrence within a day was between 10:00-18:00 (21, 72.4%), drowning incidents were also present between 18:00-02:00 (2, 6.9%) and 02:00-10:00 (6, 20.7%). Third, the aquatic emergencies occurred either while people were on holidays (13, 54.2%) or during normal working days (11, 45.8%). Finally, most of the cases 1 the casualties were in danger in the presence of others (22, 64.7%). The type of activity in which the casualties were involved varied. People experienced a drowning incident or an aquatic emergency that could lead to drowning while they were swimming (16, 51.6%), sailing (1, 3.2%), doing other aquatic activities (scuba diving, snorkeling, jumping into the water, fishing, walking or playing in the water; 13, 42%), and while walking on frozen lakes (1, 3.2%).

<table>
<thead>
<tr>
<th>Aquatic Environment Specific Geographical Characteristics of the country</th>
<th>Sub-categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake 2, 5.88%</td>
<td>Sea (beach) 23, 67.64%</td>
</tr>
<tr>
<td>Sea (under water) 5, 14.70%</td>
<td>Swimming pool 4, 11.76%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size and Shape of working area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water depth: casualty out of depth (27, 79.41%), standing up level (3, 8.82%), unspecified (4, 11.76%)</td>
</tr>
<tr>
<td>Distance from safety 1-9 m (8, 30.8%), 10-50 m (8, 30.8%), 51-200 m (9, 34.6%), 201 m-ocean (1, 3.8%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indoor-Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality 2, 5.9%</td>
</tr>
<tr>
<td>Lighting 3, 9%</td>
</tr>
<tr>
<td>Waves 7, 20.6%</td>
</tr>
<tr>
<td>Currents 3, 9%</td>
</tr>
<tr>
<td>Off Shore Winds 1, 2.9%</td>
</tr>
<tr>
<td>Water temperature: cold (4, 11.8%), warm (7, 20.6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social and Emotional Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk taking behaviour 9, 26.5%</td>
</tr>
<tr>
<td>Risk because of the presence of the public 1, 2.9%</td>
</tr>
<tr>
<td>Influence of others 2, 5.9%</td>
</tr>
<tr>
<td>Noise during lifeguard scanning 3, 9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethical Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventive measures 18, 53%</td>
</tr>
<tr>
<td>Morality of selling policy regarding equipment 2, 5.9%</td>
</tr>
</tbody>
</table>
Table 6.6 summarizes the frequencies of the variable ‘place of occurrence’. It shows that drowning incidents were located in lakes (2, 5.88%), in seas above the water (23, 67.64%), or under the water (scuba- and skin- diving; 5, 14.70%), and in swimming pools (4, 11.76%). Incidents occurred when the casualties were out of their depth (27, 79.41%), or in water, in which they could stand up (3, 8.82%) when the casualty had previous medical history (e.g. diabetic seizure, epilepsy, cardiac arrest). Most incidents (61.6%) occurred notN further than 50m from the safety e.g. 1-9m (8, 30.8%), and 10-50m (8, 30.8%). Only a few incidents occurred at distances between 51-200m (9, 34.6%), and only one at a distance greater than 201m (1, 8 3.8%). When the air in swimming pools was not clear (2, 5.9%), and the lighting poor (3, 9%) it was likely to have a drowning incident because the lifeguard was unable to detect a distressed person preventing the danger. Other well established in the lifesaving literature outdoor Variables such as off-shore winds (1, 2.9%), strong sea currents (3, 9%), and waves (7, 20.6%) contributed to drowning incident in beaches and lakes. Water temperature was either cold (4, 11.8%) or warm (7, 20.6%) during some of the incidents. In some cases the influence of others affected the people that were in danger (2, 5.9%). If they were alone in the aquatic environment, it is likely that they would not participate in the activity that jeopardized their safety. Noise while the lifeguards scanned the water (3, 9%) was also a factor that affected their quality leading to drowning. Preventative measures (18, 53%), and the lack of morality in selling appropriate equipment policy (2, 5.9%) were Variables that affect the outcome of drowning.

Table 6.7: The Free Nodes that Were Examined in an Effort to Adumbrate More Spherically the Casualty and the Rescuer of the Examined Sample (n=34).

<table>
<thead>
<tr>
<th>Casualty</th>
<th>Type of clothes</th>
<th>Weight 65.05kg± 19.83</th>
<th>Height 1.58m ± 0.28</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>swimwear 25, 81%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>wetsuit 5, 16.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>casual clothes 1, 3.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rescuer</th>
<th>Type of clothes</th>
<th>Weight 82.05kg ± 6.90</th>
<th>Height 1.79m ± 0.069</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>swim wear 14, 45.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lifeguard uniform 11, 35.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>specialized (scuba, neoprene, dry suit) 5, 16.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>casual clothes 1, 3.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the content analysis in Nvivo, emerging nodes were coded as ‘free nodes’ in an effort to better understand the casualty- rescuer relationship. Table 6.7 shows that, in general, the rescuers were always heavier and taller.
(82.05kg, 1.79m) than the casualties that they saved (65.05kg, 1.58m), an indication that explains, at least partially, why sometimes without proper life-guard equipment the rescuers felt confident and were able to successfully perform a rescue. Casualties were usually wearing their swimwear (25, 73.5%) or wetsuit (5, 15%), which means that they were engaged in simple (e.g. swimming, jumping from height etc.) or more advanced aquatic activities (e.g. sailing, scuba diving, skin diving); only occasionally had casualties fallen into the water wearing casual clothes (1, 3%). On the other hand, rescuers often wore professional uniform (t-shirt, shorts, and cap or hat; 11, 32.4%) but unfortunately most of the times they wore only swimwear (14, 41.2%). This happened mainly in the interviews that involved Greek lifeguards, an indication that there is a need for maintaining a professional attitude. In one case, the amateur lifesaver fell into the water in his clothes (1, 3%) drowning himself later on, as he was unable to cope with the waves and the strong sea current. Only in a few cases the rescuers wore specialized equipment (e.g. neoprene, scuba diving gear, and dry suits; 5, 15%) which means that professional rescuers are not usually present and therefore the public should be well educated in water safety, and always supervised by qualified personnel in organized aquatic areas.

6.3.2 The Contributing Variables of the 4W Model
Boolean search with matrix intersection with the variables of the 4 Variables found 2910 possible factorial combinations. More precisely it was found that variables relevant to the Casualty (Who\textsubscript{1}) related with the Rescuer's variables (Who\textsubscript{2}) 58 times (from a total of 420), with the place of occurrence (Wherever) 27 times (from a total of 416) and with the circumstances under which the incident took part (Whatever circumstances) 16 times (from a total of 320). The rescuer (Who\textsubscript{2}) related with the place of occurrence (Wherever) 58 times (from a total of 728) and with the circumstances of the aquatic incident (Whatever circumstances) 36 times (from a total of 532). The place of occurrence (Wherever) and the circumstances (Whatever circumstances) under which the drowning incident occurred were related 11 times (from a total of 494). Table 6.8 shows the contribution of each cluster in the interrelationships.
Table 6.8: Significant Interrelationships Between the 4 Variables and the Total Interrelationships that Were Examined in Brackets.

<table>
<thead>
<tr>
<th></th>
<th>Who (Casualty)</th>
<th>Who (rescuer)</th>
<th>Whatever Circumstances</th>
<th>Wherever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who (Casualty)</td>
<td>-</td>
<td>58 (420)</td>
<td>16 (320)</td>
<td>27 (416)</td>
</tr>
<tr>
<td>Who (rescuer)</td>
<td>-</td>
<td>-</td>
<td>36 (532)</td>
<td>58 (728)</td>
</tr>
<tr>
<td>Whatever Circumstances</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11 (494)</td>
</tr>
<tr>
<td>Wherever</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 6.1 shows that there was an interrelationship between the 4 Variables. Specifically it was found that from all the combinations only a small percentage (7.8%) was significant which means that only 206 relationships were significant between various variables (child nodes and sibling nodes in the node tree) out of a total 2910.

The combination of the Variables ‘rescuer’-‘wherever’ and ‘rescuer’-‘casualty’ played the major role in the outcome of the examined sample (both pairs had 58 interrelationships). The third important combination was between the rescuer and circumstances under which the incident occurred (36 interrelationships). The fourth combination was between the casualty and the place of occurrence (27 interrelationships). The fifth was the interrelationship between the casualty and the circumstances of the incident (16 interrelationships). The sixth was the interrelationship between the place and the circumstances under which the incident occurred (11 interrelationships).
6.3.4 The Single Variables of the 4W Model

As shown at the table 6.9, the rescuer (professional lifeguard or amateur lifesaver) is the single most determinant factor appearing in relationships with all the rest Variables. The casualty and the place of occurrence are the next most important single Variables. The less important factor in the 4W model is the circumstances under which a drowning incident might occur. The following sections explain more detailed the above relationships between the variables that constitute the 4W model that will then be discussed more extensively in the findings (section 6.4.1).

<table>
<thead>
<tr>
<th>Ranked factor combinations</th>
<th>Observed Interrelationships (n)</th>
<th>Rescuer</th>
<th>Casualty</th>
<th>Wherever</th>
<th>Whatever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews (n = 34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Rescuer-Wherever</td>
<td>58</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>5 Rescuer-Casualty</td>
<td>58</td>
<td>5</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4 Rescuer-Whatever</td>
<td>36</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>3 Casualty-Wherever</td>
<td>27</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2 Casualty-Whatever</td>
<td>16</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>1 Wherever-Whatever</td>
<td>11</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>206</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

Note. The first column contains the ranked factor combinations, the second column the observed interrelationships, and the rest four the number of times these Variables actually interrelated. The more times two Variables interrelated, the higher rank have. The pair with the most relationships ranks 6 and the pair with the less relationships ranks 1. The most important single factor for a successful outcome after a drowning incident is the rescuer (15 rankings), the casualty (10 rankings), the place of occurrence (10 rankings) and the circumstances under which it occurs (7 rankings).

6.4 Discussion

6.4.1 Who (Casualty)-Who (Rescuer)

This section aims to explain who rescued who from drowning in the examined sample of incidents. To be rescued, all casualty types needed rescuers with good vision, ability to remain alert, to react despite the bystander’s lack of response and with knowledge about any aquatic dangers that might exist. However, certain types of casualties also required rescuers to have some additional qualities. For example, injured swimmers were rescued by physically strong middle-aged rescuers. Unconscious casualties were saved by physically strong lifeguards or professional rescuers who performed the rescue and co-operated with the emergency services, as explained in the script below.
Some of our lifeguards quarrelled with them, pulling them to go away. One of ours pulled one so hard that he threw him to the ground. We hit him in the chest just in case his heart started. But no such luck. Fifty seconds later, the ambulance arrived. A male nurse started hitting him hard in the chest. We thought he was going to break his ribs. The nurse performed chest compressions and I supplied air with the pump. They brought the defibrillator. They shocked him 3 times but nothing happened.

(Interview 24, Section 0, Paragraph 6)

Multiple casualties needed their rescuer to be experienced and to detect the recognisable features of the IDR as in the following script.

The girl was a weak/tired swimmer and the man an injured swimmer. The French couple had abandoned their raft and were trying to swim to one of the buoys. The tired man grabbed onto one of the buoys. The buoy, however, was full of rust and shells from the weather. He scraped his chest badly. It was like he had been stabbed. He didn't have the strength to hold onto the buoy and started heading back. He could neither hold on nor swim back to shore. Thus, he started to drown 100m from the shore. The woman started swimming to save herself, without being able to help the man.

(Interview 18, Section 0, Paragraph 24)

Good swimmers had to be rescued by amateur lifesavers who acted quickly, doing a risk assessment before rescuing them. This happened because the good swimmers overestimated their abilities, swimming in unguarded remote aquatic areas where only amateur lifesavers were present. In the following script, the casualty knew how to swim but performed hyperventilation exercises unattended before he lost consciousness.

I think he knew swimming; most skin divers do, but in that case he hyperventilated; that is when the problems started.

(Interview 30, Section 0, Paragraph 6)

The casualty's physical fitness was related to a number of rescuer characteristics. Casualties with poor physical fitness and those who could not reach safety, needed a bystander to warn the lifeguard or professional rescuer who would then be able to recognize their IDR and initiate the rescue, as in the script below.
The man gestured and was showing us something under the water. He was pointing to a man who was underwater, holding a child, 9 years old in his arms.

(Interview 20, Section 0, Paragraph 6)

The gender of the casualty was related to the gender of the rescuer. White male casualties were often saved by people with good vision who were able to recognize the IDR and remain alert. Also male casualties were more likely to be saved by male rescuers.

A number of rescuer characteristics were related to the age of the casualty. First, rescuers had to be able to recognize the instinctive drowning response of middle-aged victims. Second, they had to be able to remain alert and have good vision to rescue young casualties. Finally, regardless of the age group of the casualty, rescuers had to react fast and use their expertise when the casualty was injured, unconscious or when more than one casualty was in danger, as in the extract below.

Because the conditions didn’t facilitate effective rescue breathing in the water, they discontinued their efforts and concentrated on getting him out of the water. They gave him mouth-to-mouth whenever they could. The lifeguard got him out. The time from when the man was spotted until he was removed from the water was about 10 min.

(Interview 11, Section 0, Paragraph 6)

6.4.2 Who (Casualty)—Wherever

This section aims to identify places where a casualty might be in danger. All casualties were found in difficulties some distance away from safety; the ones on the beach who didn’t have physical swimming strength were saved because of the existence of preventative measures (e.g. lifeguard presence and use of equipment, warning signs and staff training). Others who were physically strong swimmers were in danger because they were not spotted early due to the noise during lifeguard scanning, as in the following script.

He was swimming fine, backstroke with both hands. We watched him. We looked away for just a moment. When we looked back at him, less than a minute later, we saw his head in the water and arms stretched out on the surface.

(Interview 11, Section 0, Paragraph 6)
Casualties from different age groups demonstrated different attitude patterns. Young casualties exposed themselves to danger by swimming far from safety. Middle-aged casualties were in danger near the beach but they also engaged in aquatic activities that involved risk taking behaviour. Finally, older casualties were in danger in aquatic environments where preventative measures were present, an indication that the elderly were more predictable and mature about avoiding extreme situations that could intentionally jeopardize their safety.

Drowning incidents occurred in different places for male and female casualties. Female casualties were in danger only at sea. Males endangered themselves by swimming far away from safety at sea, waterparks and swimming pools and engaging in activities that involved risk. They were saved because of the existence of preventative measures.

Thinking retrospectively I would consider swimming on that day as a risky activity; we had set up the red flags indicating that swimming was dangerous. Nevertheless, the father with the child had possibly ignored them when getting in to the water.
(Interview 20, Section 0, Paragraph 8)

The type of casualty was related to the place of occurrence of the drowning incident. Surprisingly, non-swimmers were in danger a long way from safety but were saved because there were established preventative measures in the aquatic area. Those casualties participated in activities that did not require swimming ability prior to the moment of their unintentional submersion (e.g. walking on a frozen lake, sailing, jumping into the water from a cliff etc). Injured swimmers were also found to be in difficulties a long way from safety. Unconscious casualties engaged in activities that involved risk taking behaviour but were saved due to the presence of preventative measures, as seen in the script below.

A 21-year-old male white skin diver was performing non-stop (apnea) hyperventilation exercises over the underwater well. He was performing them, hyperventilating, without resting. He had done 2-3 times in the well. On the last dive he suffered hypoxia. Meanwhile, he had two people watching him on the surface. They were also skin divers. Because he was a long time coming out, one of them dived until the edge of the well at 11m and saw the shiny diver’s mask.
(Interview 31, Section 0, Paragraph 7)
The area of residence was related in some cases to the place of occurrence of the drowning incident. Locals faced drowning incidents in lakes, swimming pools or waterparks and when the length of the area supervised by the lifeguards was too long.

6.4.3 Who (Casualty)– Whatever Circumstances

This section aims to explain under what circumstances a casualty may experience a drowning incident. Casualties of different genders experienced drowning incidents under different circumstances. Young male casualties faced drowning incidents regardless of their physical fitness. Middle-aged females were involved in drownings only during lunch-time. Considering that women were risk takers only occasionally this means that they were in danger of drowning mainly while engaged in swimming activities.

Different casualty types were rescued from drowning in different ways. Weak or tired swimmers needed a combination of rescue methods to be saved. Unconscious casualties needed the use of PFD or other lifeguard and rescue equipment as well as the use of the ‘swimming with rescue aid’ technique usually in aquatic areas where other people were present.

There were about 60-70 athletes competing in this championship [...] While I was competing at Regatta Lazer Radial Europeans with 30 knots wind force I capsized and my mast touched the seabed and I was caged. Then I swam up to my centreboard. I was trying to pull my centreboard but of course I could not go up. I thought I was tired and too light to do this because I had not realized that the mast was attached to the seabed. My arms were getting tired and cold and I had no strength any more, although I consider myself a competent swimmer. It was also very cold because the temperature was 8ºC and it was drizzling. Finally I fainted but because I was wearing a lifejacket I remained at the water surface unconscious no more than a few minutes. The rescuers knew the dangers of the area for the athletes and apparently reacted quickly to get me out of the water. Then I woke up in a big orange rubber boat with scuba divers and I looked at my mast. It was bent. All my stuff was in the boat. Then I realized that I was stuck on the seabed. They left me at the race committee boat which on the beach and went straight in to assist other athletes who were in danger at the same time. (Interview 27, Section 0, Paragraph 6)

The area of residence of the casualty was related to the circumstances of occurrence of the drowning incident. Non-locals, who didn’t know the aquatic area, were saved because of the presence of others. They either did not know
which areas were lifeguarded or they preferred to swim in remote locations, where their only chance of survival relied completely on bystanders.

6.4.4 Who (Rescuer)–Wherever

This section aims to describe rescuer characteristics that are required during drowning rescues in various aquatic environments. First, in rescues taking place in open water and at some distance from safety, rescues, lifeguards, professional rescuers and amateur lifesavers had to visually spot the casualties, approach them fast and remain alert, reacting despite the bystanders’ lack of response. Also they had to cope with waves, strong winds, currents and psychological pressure when the rescue seemed to be a risky intervention. Second, in swimming pools, lifeguards were able to visually spot the person in distress when the air quality, lighting and water clarity was good despite the presence of noise during their scanning. The following script, describes such a situation.

A second later the boy dropped the rings and stopped swimming. His body dropped to the bottom. He was motionless! The air quality of the pool, the water clarity and the lighting enabled me to see him.

(Interview 34, Section 0, Paragraph 7)

Risk taking behaviour was related to open water drowning incidents with casualties and rescuers. Some casualties were risk takers engaging in various aquatic activities. The following scripts describe some of those risk takers.

Later on, they came to tell us they did an autopsy. He had epilepsy in the water. He had been dead for 2 hours since the moment we saw him. And that happened because he was fishing too deep alone. His friend who usually fished with him came and showed us the spot where they fished together. It was about 4 km from the beach.

(Interview 24, Section 0, Paragraph 6)

Shortly thereafter, I saw from the dive-computer that I was at 42 m and diving unchecked even deeper. Suddenly, as if I’d realized what I was about to do, I made an effort to find my partner. I didn’t see my buddy and I didn’t know why. Obviously I had lost my sense of orientation and I didn’t know what was happening to me. I was wrapped in a black evil. At some point I had no sense of orienting myself.

(Interview 29, Section 0, Paragraph 7)
I think it was risky for her to swim alone without a friend, knowing that she had heart problems. But her love for swimming made her go there often without proper supervision. Also, she should have let us know about her health condition, and should swim always in front of the lifeguard, not at the edge of the beach, or anywhere else.

(Interview 3, Section 0, Paragraph 6)

It was interesting to note that risk taking behaviour occurred not only to casualties but also to amateur lifesavers, as in the following script.

He approached the Englishman, who was conscious, and helped him get out of the current. The Englishman made his way out of the water. Neophytes, however, wasn’t able to follow him. He tried to get away from the rocks, but the waves wouldn’t let him [...] The Englishman is alive, while Neophytos is not.

(Interview 25, Section 0, Paragraph 6)

6.4.5 Who (Rescuer)—Whatever Circumstances

This section aims to explain under what circumstances a professional lifeguard or an amateur lifesaver may perform an aquatic rescue. The ability of a lifeguard to perform a drowning rescue was related to the need for retraining. Lifeguards commented in interviews that they often had to do staff training and renew their lifeguard qualification as part of their continuing professional development (e.g. attending regular courses for lifeguarding and first aid). The following scripts describe that this occurred with all participants except the interviewees from Greece, where most of the lifeguards never update their knowledge, because legally their qualification never expires.

We, as lifeguards and as a team, renew our lifeguard qualification every two years, and we do staff training 3 hours/week.

(Interview 34, Section 0, Paragraph 7)

I do regular training in my lifeguard team. We also care about continuing our professional development by updating our knowledge and even doing advanced courses.

(Interview 12, Section 0, Paragraph 9)

Rescuer expertise and physical strength were related to different types of rescue. Expert lifeguards, rescue divers, coast guard and fire brigade rescuers performed rescues using lifeguard or other rescue equipment. On the other hand, physically strong rescuers either used rescue equipment for performing rescues or swam and towed the casualty, relying on their own strength. Exper-
tise was not a variable that applied to them, possibly because the use of life-guard or other rescue equipment is considered in the contemporary water safety industry as a requirement and proof of quality services and professionalism. This contradiction in rescue methods used is illustrated clearly in the following scripts.

I blew my whistle, hit the emergency stop button and jumped into the water with my rescue tube. I placed it around his waist and with the ‘duck pluck’ technique I brought him unconscious, to the surface [...] and then towed him out. I called for the backboard. While I was getting him out of the water, my colleagues were approaching.

(Interview 33, Section 0, Paragraph 6)

I used the chest carry tow, which is a body contact rescue. I was tired from running. I dived in and approached him and said ‘turn around so I can pull you out’. ‘I cannot, I am exhausted’. There was a strong current and it was difficult. He was calm and I didn’t have to tell him anything to reassure him. It took me a long time to get him out.

(Interview 23, Section 0, Paragraph 34)

The use of a personal flotation device was associated with the speed of the rescuer. Although a PFD provides buoyancy, the rescuer’s speed of action was necessary especially in scuba diving and sailing accidents. This happens because a PDF cannot prevent heat loss and death due to heart failure or drowning due to the cold shock response when the person starts hyperventiliating, and inhaling water is likely.

It was also very cold because the temperature was 8°C and it was drizzling. Finally I fainted but because I was wearing a lifejacket I remained at the water surface unconscious no more than few minutes. The rescuers knew the dangers of the area for the athletes and apparently reacted quickly to get me out of the water. Then I woke up in a big orange rubber boat with scuba divers.

(Interview 27, Section 0, Paragraph 6)

Written operating procedures were related to the circumstances of occurrence of a rescue intervention. In well organized teams adequate numbers of life-guards observed the water, keeping records and maintaining written operating procedures. When interviewed, those lifeguards commented on how important it was for them that the performed rescue was part of their emergency action plan.
The circumstances of lifesaving interventions in drowning incidents were similar for different rescue services. Lifeguards, professional rescuers and emergency services performed rescues in the presence of bystanders, reacted despite their lack of response, remained alert, recognized the casualty’s IDR and did the appropriate risk assessment prior to the rescue. Furthermore, they used lifeguard or other rescue equipment during the ‘swimming with rescue aid’ technique or a combination of rescue methods adapted to the specific aquatic emergency, as seen in the following script.

_The other guard gave me his rescue can. I gave it to the man to hold on his right hand side. On my left, the woman had given me her hand and I was holding it with my left hand._

(Interview 14, Section 0, Paragraph 7)

6.4.6 Wherever–Whatever Circumstances

This section aims to explain where and under what circumstances a drowning incident might occur in different aquatic environments. Drowning incidents occurred at sea during a certain time of day (between 09:40 and 19:20) and any season (mainly during summer). On the other hand, in swimming pools and waterparks incidents occurred during holidays or on normal days.

The type of rescue used differed, based on the activity undertaken prior to drowning. When incidents took place at a relatively short distance from safety (e.g. 4-20 m) or in scuba diving activities, a ‘swim and tow’ rescue was used. On the other hand, when the sea was wavy, a lifeguard or other rescue equipment was used. This is understandable because in such environmental conditions it is safer to use equipment for the protection of both the rescuer and the casualty. This contradiction is illustrated in the following two scripts.

We also maintain records and written operating procedures that include normal operating procedures and an emergency action plan. In this action plan we included the case of recovering an unconscious non-breathing casualty from the pool bottom, so I was aware and trained for coping with this emergency.

(Interview 34, Section 0, Paragraph 7)
Further out, though, there were waves that pulled you even farther out to sea [...] We had realized that something was wrong and while we were waiting to see what would happen, we prepared the boat, loaded the engine, oars, life preservers.

(Interview 18, Section 0, Paragraph 6)

We towed him right away coming up to the surface using the chin tow body contact technique. His repeated efforts and the pressure caused him to lose consciousness and he started sinking. At that moment, one of our team was surfacing. We saw this man sinking and realized something was wrong from the posture of his body and his movement in the water. He was submersed for about 1-2 min. We towed him right away and we tore off his uniform immediately. The distance from safety was about 20 m. We then started CPR. He came round 2-3 minutes later.

(Interview 30, Section 0, Paragraph 36)

Water temperature was related to the type of rescue. In aquatic environments with moderate water temperatures (unspecified precisely but ranging from about 10-27°C) a swim and tow rescue technique was preferred by professional lifeguards, amateur lifesavers or rescue divers.

The morality of the policy for selling aquatic equipment was related to the quality of materials that were sold. In some cases the equipment that was sold for aquatic use was of good quality allowing an aquatic activity to occur safely or an aquatic emergency to have a successful outcome, as in the following scripts.

I started to inflate my jacket. Luckily my equipment worked very well. I don’t want to think what would have happened if my jacket could not inflate, or if my dive computer didn’t work showing the exact depth.

(Interview 29, Section 0, Paragraph 7)

We inflated an inflatable about 20 m long and 1.5 m wide and threw it in the water. The inflatable was good because sometimes you hear that in other places the inflatable deflated.

(Interview 35, Section 0, Paragraph 6)

However, in other cases the poor quality of the equipment could be fatal if the casualty was unable to self-manage the emergency situation he experienced. This case is described in the following script.
6.4.7 Limitations

Although a drowning incident was found to occur at any time of the day, most of the sample’s incidents (21, 72.4%) occurred between 10:00-18:00. This was because the majority of the interviewees were lifeguards and their rescues occurred during their daily duties. With a different sample or sampling method it is likely to see different breakdown of the time frequency within the day. On the other hand, it is needless to say that during this time, most of the people go swimming especially during the summer because it is warmer. The height and weight of the casualty were not measured. Both were rough perceptions of the interviewee who was in most of the cases the rescuer. Therefore it cannot be considered scientifically but it shows, generally, that casualties in average were smaller than their rescuers. Similarly, the distance from safety and the water depth where the casualty was found depended on the interviewees’
commends and not on a reliable measure, and therefore, further research is required for establishing more solid conclusions.

6.4.8 Recommendations
Future research might place video cameras in aquatic areas where many rescues take part (e.g. as in Orchard Beach with Frank Pia). This audio-visual material would facilitate the basis of further research that might be undertaken by interviewing casualties and rescuers straight after the incident. Although this seems to be unrealistic, even few case-rescue incidents supported by video and interviews will be invaluable recourse for excluding results.

6.5 Conclusions

The Variables that constitute the 4W model (e.g. who drowns, who rescues, where and under what circumstances a drowning takes part) interrelate and determine the outcome of an aquatic rescue. The outcome of the rescue depends primarily on where the professional lifeguard/amateur lifesaver will perform the rescue and who is the casualty that the rescuer will initiate to save. After that, the next most important interrelationships are under what circumstances the rescuer will perform the rescue, where and under what circumstances the casualty is experiencing difficulties and finally where and under what circumstances the drowning is taking place. From the above Variables, the rescuer plays the most dominant role, while the casualty and the place of occurrence seem to determine similarly the outcome. The circumstances under which the incident will occur are the less important factor.
Chapter 7:
Discussion and Conclusions
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7.1 Introduction

This research comprised three studies. The first study was a literature review, aiming to develop the theoretical framework of a 4W model of drowning. This model would contain all the variables that could possibly be present in a drowning incident (e.g. rescuer characteristics, casualty characteristics, place and circumstances of the occurrence of a drowning incident). The second study was based on observations of video-recorded rescues, aiming to assess the burden of drowning in a sample of aquatic episodes, and to establish single and combinations of variables which interrelated in each incident. The third study was based on interviews, aiming to assess the same issues but also to give insights into questions that were left unanswered in the second study. Furthermore, an overall discussion of the findings that were common to all three studies would give new insights (e.g. a set of water safety recommendations for governments, water safety organizations, aquatic safety professionals and the general public; the Haddon Matrix as a drowning prevention framework and the development of the 4W model of drowning).

Integrating the findings of the three studies yields important results. First, it was shown that the 400 m and the 50 m swim were not appropriate test criteria for beach and pool/water park lifeguard certification respectively. Instead, test criteria like a 100 m run–50 m swim–100 m run for open water and a 50 m run–20 m swim–50 m run for pool/water parks could be more useful for assessing speed combined with an ‘early approach’ to the victim. The ‘early approach’ criterion would be established to test the ability of the lifeguard to be able to remain alert, to have good vision, to recognize the casualty’s instinctive drowning response, to initiate a rescue ignoring the bystander’s lack of response and to reassure the drowning victim. Second, drowning incidents could occur not only to people engaged in swimming and other aquatic activities but also to those engaged in non-aquatic activities above and near the water like walking on frozen lakes, driving near the water or flying above an aquatic area. Third, from all four variables related to drowning the most salient were rescuer characteristics because the presence of a lifeguard acting preventatively would minimize the likelihood of a drowning incident. Fourth, from all possible paired combinations of the 4W variables, the pair ‘rescuer-casualty’
was the most salient in a drowning incident which means that, in a drowning incident, to know 'who rescues whom' may be more important than any other possible pair combination. Finally, the development of the 4W model of drowning may be used as a means of drowning prevention and safety promotion.

7.2 Who (Casualty)

7.2.1 Gender
The first review study of the existing literature identified that although both sexes experienced drowning, males far outnumbered females. The second and third video and interview studies supported these findings but more importantly they helped in understanding how and why this happened. Males were more likely to be involved in a drowning episode because they were more inclined to risk-taking behaviour, exposed themselves to the aquatic environment where immersion was possible more frequently and were also more likely to consume alcohol. Males also were more likely to swim irrespective of their capabilities without taking the necessary safety precautions (e.g. use of personal flotation device, wet suit etc.). Females in the examined sample were far less likely to exhibit risk-taking behaviour; those who did were usually under the influence of a group of males.

7.2.2 Age
Casualties of all age groups were reported to be involved in drowning incidents in the first review study. The second and the third study showed that drowning was attributed to different parameters for people in different age groups. Children were in danger when participating in activities that involved risk due to their immature or undeveloped co-ordination, skills and perception. Older children were in danger because they overestimated their physical abilities. Adolescents and young adults aged under 25 years were at risk because their peer group considered their risky behaviour as normal, their attitudes and beliefs demonstrated a lack of awareness, their familial engagement in risk behaviour, and their lack of skills to resist engagement.

7.2.3 Ethnicity
All examined ethnicities were found to be involved in drowning incidents in the first review study. The second and third video and interview studies supported this finding but, more importantly, helped in the understanding of how and why
this happened. In these two studies, non-whites drowned because they were less likely to be proficient at swimming, participating only in swimming activities near the shore, in water just deeper than their height. On the other hand most of the examined recreational activities in the two samples were more expensive than swimming (e.g. sailing, scuba diving, skin diving, fishing, yachting etc.). In those cases the drowning victims were always white. This means that in the examined sample, ethnicity was related to socio-economic differences.

7.2.4 Casualty Type
All examined casualty types were involved in drowning incidents in the first review study. The second and third video and interview analyses supported this finding and helped in understanding how and why this happened. First, although there is no clear evidence that drowning rates are higher in poor swimmers, in the second and third studies, people who found themselves in aquatic difficulties were, indeed, more likely to be non-swimmers and unconscious victims. Non-swimmers drowned because they fell unintentionally into the water while engaged in non-aquatic activities (e.g. walking on frozen lakes, driving in flood water etc.) or because they swam on sloping beaches and suddenly found themselves out of their depth. Others often inclined were people who fell into unconsciousness while engaged in aquatic activities due to a heart attack, hypoxia, hypothermia, or engagement in sporting activities (e.g. sailing, snorkelling) and swimming in shallow water.

Second, swimming ability did not guarantee immunity from drowning in any of the two sampled studies. Drowning did not correspond with reported swimming ability, which means that superiority in physiological parameters developed through regular swimming training could not guarantee survival for the sampled victims. They experienced a drowning incident because they spent more time in the water, engaged in risky activities, consumed alcohol, overestimated their swimming abilities and developed rapid hypothermia after they were submerged in cold water that changed the physiological parameters of their body.

Finally, multiple victims of the same type, or combination of casualty types were also in danger in the video and interview analyses. This was evident in various emergencies where people experienced an unintentional submersion
(e.g. shipwreck, airplane ditching, flooding) or as part of voluntary participation in an activity above or near the water through risk-taking behaviour (e.g. a group of people initiating a bungee jump from a bridge).

7.2.5 Area of Residence
The first review study of the existing literature identified that although people drown regardless of their area of residence, non-residents drown slightly more often than locals. In the same review study, epidemiological research showed that ocean drowning was more likely for people who lived inland or who were tourists. In the videos and interviews of the present sample, people visiting aquatic environments while residing in other areas of the same country or in a different country were involved in a drowning incident because they were unaware of the dangers of the specific aquatic environment and because they initiated risky activities. Therefore part of the problem of those drowning incidents could be attributed to the unfamiliarity with the specific characteristics of the aquatic environment. On the other hand, the reason why locals were involved in drowning incidents was attributed to two reasons: first, because they had more frequent exposure to the aquatic environment, and second, because this high exposure made them underestimate possible aquatic dangers by overestimating their capabilities for dealing with them.

7.3 Who (Rescuer)

7.3.1 Gender
Although females work as lifeguards, lifeguarding and other rescue services were male-dominated professions in the first review study. In the video and interview studies this male domination was also evident for a number of reasons. First, in cases where the professional rescuer was male, this was due to lack of lifeguard equipment or written operating procedures to recommend their use in the aquatic facilities. Lack of equipment made lifeguard rescue a demanding process requiring physical strength not usually possessed by a female rescuer when compared to her male counterpart. Therefore, many rescue services that did not use such equipment (because either they did not have enough funds to buy it or this was their rescue philosophy), choose to employ males rather than females as rescue workers. Second, where the rescue was performed by male amateur lifesavers, this was the result of coinci-
dence, of male superiority in terms of physical strength, or due to the inclination of males to take risks. More precisely, coincidence occurred in cases where bystanders who were present at the drowning episode were males, and inevitably, they were the only ones who could respond. Male amateur rescuer intervention was also evident in cases where bystanders from both sexes were present, but only the males attempted physically demanding rescues that required strength. Furthermore, amateur male rescuers attempted risk-taking rescues, jeopardizing their lives in the hypothermic water of wavy seas or in rivers with strong currents, without doing a risk assessment. Finally, female lifeguard presence was evident only in rescues occurring in swimming pools, whirlpools, jacuzzis and water parks. In those aquatic environments the use of lifeguard equipment that could make up for lack of physical strength was either established with written policies or unnecessary because the demands of the rescue were not high due to the nature of the aquatic environment (e.g. a short distance from the poolside and water depth at height level).

7.3.2 Animal Rescuers

The involvement of animal rescuers in saving distressed people was well-documented in the first review study. In the video and interview studies, trained and untrained animal rescuers like dolphins or dogs appeared to perform rescues. Consideration of this finding suggests that animals played a vital role during drowning rescues in the two studies for a number of reasons. First, their involvement was important because, as the only witnesses of the drowning incident occurring in a remote area, they were the only ones that could respond. In some cases the dog ‘rescuer’ belonged to the drowning victim while in others a group of dolphins or a dog happened to be present at the place where the drowning incident occurred. Second, their involvement was important because on some occasions their senses (hearing and visual acuity), swimming speed and physical strength were superior to those of human bystanders, and as a result, again they were the only ones who detected a drowning struggle and also had the ability to perform an effective water rescue. Bystanders who accompanied dogs admitted that they would never be able to hear or see drowning casualties at such distance from the edge of the river, nor would they be able to swim and tow them back to safety. Similarly, in cases where dolphins performed the rescue, a human intervention would have had difficulty in being successful as the casualties had been swept far from the
7.3.3 Age
The first review study showed that half of the lifeguards were aged 19 years or under and worked mainly in pools and water parks. In the video and interview studies most lifeguards and rescuers were between 20 and 30 years of age. Also most of the drowning incidents in the sample of those two studies occurred in open water (e.g. beach, lake, river, stream, harbour). This showed that lifeguards choosing to work in open water were usually older, compared with their young pool/water park counterparts who choose to work in less demanding conditions and environments. The reason behind this was that the certification criteria were less demanding for pool/water parks than for open water, and therefore more accessible to young people seeking seasonal employment without previous related work experience, physical strength and swimming ability. Lifeguards and rescuers much younger than 20 years lacked experienced and expertise. On the other hand, those much older than 30 years experienced a natural decline in their physical attributes due to their age. Therefore, approximately 30 years was shown to be the optimum age at which one could balance the necessary psychological and mental capabilities (i.e. maturity, experience and expertise) with the physiological attributes (i.e. physical strength and visual acuity etc.) that each rescuer needs to have in certain aquatic emergencies.

7.3.4 Level of Experience and Expertise
Experience and expertise were reported in the first review study to be important attributes for lifeguards/rescuers who are dealing with drowning. The video and interview studies involved lifeguards/rescuers who could be labelled ‘experienced’ in terms of years of employment. These aquatic professionals were usually between 20 and 30 years of age, which again, as shown above, means that age could be a rough guide indicating optimum levels of experience and expertise counter balanced with physical strength. Indeed in those cases where older lifeguards and other professional rescuers attempted a drowning rescue, the demands in terms of experience and expertise were higher (i.e. use of complicated rescue equipment like helicopters, ships and fire brigade instrumentation; attempt a mass rescue of many victims; or cope with dangerous conditions like low water temperatures, high waves and strong
currents that required a thorough risk assessment prior to the rescue attempt). In those cases, it was shown that the more years the aquatic professionals had worked the more expert they were, because mastery of the skills and aquatic readiness in cases of emergency were built through re-training and re-qualification that required a number of years of employment.

7.3.5 Early Approach

A crucial finding of this research was that when approaching the drowning victim early approach was required by amateur and professional rescuers in the video and interview samples. The review study revealed that emphasis was given by most organizations worldwide, not on early approach but on a 400 m timed swim as a test requirement for certifying beach lifeguards. Also many organizations across the world often linked the early approach to the drowning victim with the swimming speed that a lifeguard should have. However, many of the incidents in the two qualitative studies requiring lifeguard intervention were less than 10 m from safety but also in water depths little deeper than the victim’s height. This shows that early approach was needed for a rescue and, therefore, this element should have been tested in lifeguard certifications instead of swimming stamina. Furthermore, in most rescues it was shown that the lifeguard did not need to be a competent swimmer as the approach to the casualty required only a few arm strokes. To be able to approach a drowning victim quickly, it was more important to remain alert, have good vision, recognize the casualty’s instinctive drowning response, run up to the point on land that would allow the shortest swimming distance or wade approach and initiate a rescue ignoring the bystander’s lack of response. Therefore, the term ‘early approach’ seemed to be a more valid and multi-dimensional test requirement than the 400 m timed swim in the two studies. This is because it seems that it should be based not only on speed of swimming but on the speed that could be achieved in all the previously described elements that occurred, from the moment the casualty was spotted until the moment they were approached at distances up to 50 m. When the distance was greater than 50 m, a different rescue method may be used (e.g. rescue board or power boat) rather than a swimming approach. Consequently, if the time testing requirements were less demanding, more candidates would have passed the exams and be entitled to work, thus increasing accident prevention. This was very important considering that in some drowning episodes presently sampled there was a shortage of lifeguards. It also highlighted an almost universal contradiction in rescue
philosophy: most organizations around the world claim that the lifeguard’s responsibility should mainly be focusing on prevention, but instead of making the certification criteria for the time-swim easier in order to have more lifeguards on duty who will work preventatively, they keep them traditionally relatively ‘difficult’ for most lifeguard candidates, emphasising their ability in swimming.

7.3.6 Knowledge of Local Hazards

In the video and interview studies rescuers were only occasionally aware of the hazards that existed in the aquatic area (e.g. sloping beach, cold water, holes, dangerous underwater life, sea currents, waves, tide); this finding has a three-fold interpretation. First, when rescuers were aware of the hazards, this knowledge made them more careful, in order to avoid the risks and stay safe. For example, bystanders, fire brigade members and professional rescuers used a human chain, ladder, or rocket thrust for saving drowning casualties instead of getting into the cold water or rough sea. Second, when rescuers knew the hazards and initiated a rescue, these could still have fatal outcomes because they were amateur lifesavers, they did not have, or know how to use, rescue equipment and because the hazards were beyond their personal abilities. Third, when rescuers were unaware and unprepared for the hazards that they would face, this was because not all cases in the examined samples of the videos and interviews involved professional lifeguards. Indeed, more than half of the incidents occurred in areas without lifeguards, where amateur lifesavers, fire brigade and rescue divers performed the rescue; thus it was not always possible to know the hazards of the area. On the other hand, this was discouraging because it shows that safety professionals initiated rescues without perhaps being able to do the appropriate risk assessment, thus endangering their safety and the safety of the casualties.

7.3.7 Number of Rescuers

The first review study suggested that in given aquatic emergencies a certain number of professional rescue workers were needed for a successful rescue intervention. In the video and interview analyses the number of aquatic safety professionals was not always enough for performing a rescue. When the number of rescuers was adequate, this was due to appropriate water safety legislation and thorough written operating procedures that recommended a certain number of lifeguards for meeting the needs of a given aquatic environment. On the other hand, when the number of lifeguards was not enough
this was due to a serious lifeguard shortage in the industry for several reasons: it has arisen because people choose to work in other financially more attractive jobs, the legislation did not require lifeguard presence, the local authorities did not enforce regulations or the recommended number of lifeguards were, by law, not enough. Furthermore, in those cases the certification criteria for someone to qualify as a lifeguard were mainly based on examining physical strength and swimming stamina which means that only a limited number of lifeguard candidates could pass the test criteria, and, therefore, the number of qualified aquatic safety professionals available to work would be less than the number needed. Therefore, one possible action plan that could have been implemented by the understaffed aquatic facilities of the present sample could have been to select areas with fewer aquatic dangers (e.g. currents, cliffs, marine life etc.) at the facility and peak times of the day, to place the few available lifeguards. Also, when insufficient number of amateurs had to attempt a rescue, a counter-balancing between a thorough risk assessment of success versus failure and jeopardizing their own safety was vital. Collectively, all the above considerations suggested that the bottom line for each attempted drowning rescue in the examined sample, was the need for a thorough risk assessment on how and when to place the available human resources in an organized place to act preventatively, and how and when amateur lifesavers could attempt a rescue with the least possible fatal consequences.

7.3.8 Rescuer Visibility

According to research reported in the first study, lifeguards may wear uniforms in red, yellow or orange colours to be detectable while on duty. It is necessary to be more easily visible, so that whoever spots a drowning victim can quickly and easily detect the rescuer and report it. This means that the rescue intervention will start without unnecessary delay. However, lifeguards wore high-visibility uniforms in only a few cases in the second and third studies. There are numerous reasons for this. First, a large proportion of the sample was from America in the 1970s (video study) and Greece (interview study) where lifeguards were not wearing clothes at all. Apart from being seen, another reason for an aquatic safety professional to wear clothes while on duty was in order to be protected from the sun. However, in the 1970s, sun exposure was not as dangerous as it is today (and therefore, it can be assumed, there was less public health awareness on that matter). On the other hand, in Greece, aquatic safety professionals’ cultural trends encouraged body exposure to the
sun to give a nice suntan. Second, while for most participants who were examined in the interviews there was legislation requiring the use of those colours in lifeguard uniforms, no suggestion was made that this uniform should be worn at all times while on duty. Therefore, it seemed that legislation requiring a number of measures could not be effective if it was not accompanied by written operating procedures to enforce the application of these rules. Indeed, in cases where lifeguard uniforms were not worn while on duty, the lifeguards reported an absence of written operating procedures at the workplace. Third, some lifeguards wore other colours (e.g. white, green and blue) because they were working in pools and water parks where the lifeguard was visible even without wearing the colours reported in the first study. Finally, the reason why not all rescuers wore high visibility colours in the two studies was simply by chance: some of them were either bystanders or amateur lifesavers who were present at the scene when the incident occurred and attempted to rescue the drowning victim, or they belonged to other rescue services that do not need to use such colours (e.g. scuba divers, helicopter crew members etc.). Collectively, the findings of the two examined studies suggested that although the use of detectable colours was not applicable in some cases and made no difference when rescuers spotted the victim, in other cases where a third person informed the lifeguard about the emergency, their use enhanced the speed of the attempted rescue.

7.3.9 The Ability to Recognize a Drowning Victim

The first review study showed that aquatic safety professionals and bystanders were often unaware of the outward behaviour of drowning casualties. The second and third video and interview studies supported this finding but more importantly helped in understanding how and why this happened. More specifically, even though the majority of lifeguards in the video and interview analyses remained alert while on duty, only some of them were able to recognize that someone was drowning. This happened because the rest of the lifeguards had not been trained in detecting the critical signals of the drowning pattern. Therefore, these findings suggested that part of the inability of the lifeguards to detect the drowning victim early, as reported in the two studies, resulted from ineffective education in the first place and lack of staff training that would have taught lifeguards how to recognize someone who is drowning.
7.3.10 The Ability to React Despite the Bystanders’ Lack of Response

In the first review study it was noted that it is important for lifeguards and rescuers to be able to react to a drowning incident despite the bystanders’ lack of response. In the video and interview studies this did not always happen for two reasons. First, because the crowd caused a trained rescuer not to react quickly. To save a drowning victim, the rescuer needed to be able to recognize the emergency, have a willingness to accept personal responsibility, and courage to overcome fear and nervousness before and during the rescue attempt. The casualties were eventually saved in most cases because a number of other parameters related to drowning were not demanding (e.g. drowning occurred at a short distance from safety, the water was not very deep, absence of waves and currents etc.). Second, a lack of response from untrained people was understandable and more-or-less expected. On the other hand, although even experienced professionals were likely to show hesitation in an emergency, in contrast to amateurs they had the opportunity to improve this particular attribute through up-to-date quality education that involved simulated rescue incidents. In the videos and interviews, such measures for decreasing the chance of hesitation in an emergency were not evident. Therefore, aquatic safety professionals (especially those interviewed from Greece whose qualification never expired) needed to have higher quality initial training, regular and repeated staff training and re-certification every 1–2 years from the first award, as is good practice already established in well-developed countries like the USA and the UK.

7.3.11 The Ability to be an Educator

In the first review study lifeguards considered themselves educators that were trained to act mainly preventatively. In the second study that analysed video-recorded incidents, the limitations of the methodological procedure did not allow for an examination of whether or not an educator’s role had been performed. In the interview study a limited number of cases were evident due to different pedagogical systems in the countries of those interviewed. For example, those from the USA and the UK acted as educators because they were trained by their lifeguard organizations to emphasise prevention. On the other hand, most of those interviewed were from Greece and Cyprus, countries that do not include prevention strategies to the same extent within their lifeguard training programme, and therefore, their lifeguards were trained only to rescue people and not to act as educators.
7.3.12 Maintaining Written Operating Procedures

In the first review study it was shown that written operating procedures constitute an important component of each aquatic facility for drowning prevention, rescue and treatment. In the video-recorded rescues, although it was methodologically impossible to identify whether or not such procedures were maintained, this evidence was indirect. There were other variables present that constituted the written operating procedures (e.g. numerical ability of the lifeguards on duty, visible clothes and the ability to visually detect the casualty). On the other hand, in the third interview study lifeguards commented that during demanding rescues they were successful because they knew what to do due to presence of normal operating procedures and emergency action plans (e.g. the two components of written operating procedures). These findings suggested the importance of advanced safety procedures and implementation of a system for obtaining and retrieving information on the services rendered, special incidents and other aspects of lifeguarding operations.

7.3.13 The Ability to Visually Detect the Casualty

The first review study showed that the ability to visually detect a casualty was important as most of the information that a lifeguard receives from the environment is visual, but only some were able to do so. The second and third video and interview studies supported this finding but more importantly they helped in understanding how and why this happened. In cases where lifeguards and rescuers were able to detect the drowning victim, this happened for a number of reasons. First, because they were either trained or able to detect the casualty’s instinctive drowning response, remained alert, were scanning the water and did not engage in other activities that could distract their attention (e.g. extensive conversations with bathers, renting umbrellas etc.). Second, because they avoided monotony and fatigue with frequent rotations. Third, because they scanned professionally the ‘water’ and not the ‘people’ in their area of responsibility. Finally, because the area they had to supervise was not very long, it was possible for them to scan effectively. However, in some other incidents visual detection was irrelevant due to the all-too-obvious nature of the incident (e.g. aircraft crash, shipwrecks etc.). In those cases other types of communication were used such as electronic or auditory signaling. Therefore, it is understandable why not all the rescuers reported that they visually detected the emergency: they either were made aware by bystanders
about the urgency of the situation or realized it through other means of communication.

7.3.14 Health

Health as a rescuer characteristic has been neglected in the aquatic safety literature that was reviewed in the first study. On the other hand, variables emerging from the video and interview studies showed that in some cases the health status of a lifeguard/rescuer was reported to be important in performing a rescue. Particularly, some of the interviewees commented that they were healthy and strong during the rescue. Also the lifeguards interviewed from Greece reported that after they received a qualification from a lifeguard organization, they needed to pass medical examinations by a cardiologist before they could get a license to work.

7.4 Under Whatever Circumstances

7.4.1 Rescue Type

The first review study showed that a number of rescue types could be attempted in a drowning episode. All rescue types were also examined in the video and interview studies. First, the technique most represented was the swim-and-tow. In the video sample, it was used because most of the incidents occurred in shallow water and, therefore, the lifeguard did not need rescue equipment or more complicated types of rescue to be successful. In the interview sample, in the rescues on Greek and Cypriot beaches no rescue tube was used, because there was a long history in those two countries of emphasising body contact rescue techniques even in rescues occurring at longer distances and deeper water. Therefore, part of the reasons why this rescue method was chosen so often, was attributed to the education that the lifeguards received in the first place and also to the lack of written operating procedures that would recommend the use of equipment for ensuring safety for both rescuer and victim. On the other hand, some of the lifeguards that attempted body contact rescue tows relied on their swimming ability because they were skilful swimmers and members of the national water polo team.

Second, land-based and wade rescues were also used by professional lifeguards, emergency services, or amateur lifesavers when the distances from
the victim were short but the rescuers decided not to risk their safety by getting into the cold, flooded or wavy aquatic environment. This finding was very encouraging as those types of rescue were recommended as the safest because they did not require body contact and the rescuer could remain out of the water. Also it shows that the rescuers made the appropriate risk assessment prior to the rescue and were aware of the dangers that might exist for themselves and the victims. Third, a row rescue and a swim-with-aid rescue were used in few cases, which means that long-distance rescues were rare but also that related legislation and written operating procedures were established in some aquatic environments. Finally, more complicated rescues like air rescue, or even a combination of the previous methods, were used for saving multiple victims in bad environmental conditions (e.g. raining, waves) and when the rescue took place at great distances from the shore.

7.4.2 Interrelationship of Casualty, Rescuer and Equipment
The quality of materials used during a rescue by the rescuer or the casualty has been neglected in the aquatic safety literature that was reviewed in the first study. On the other hand, emerging variables in the two qualitative studies showed that in some cases the quality of materials was reported to be important in performing a rescue. During aquatic emergencies in the videos and interviews, either rescuers or casualties wore wet and dry suits, an indication that they were well prepared or that the activity was not just swimming across the beach but a more complex one (e.g. scuba diving, spear-gun fishing, snorkelling in areas with sharks, underwater search and rescue, searching for gold across a river etc.). Personal flotation devices were also worn in other cases. Casualties or rescuers wore casual clothes during some emergencies, because they had fallen, unprepared and unintentionally, into the water. An exception to this was those cases where lifeguards, professionally clothed, had to jump into the water in their official uniform without hesitation.

7.4.3 Presence and Absence of Bystanders and Lifeguards
The first review study showed that people were more likely to drown while engaged in aquatic activities alone. The second and third video and interview studies supported this finding but more importantly they helped in understanding how and why this happened. Drowning incidents occurred in the absence of lifeguards and bystanders when people engaged in aquatic activities far from the shore that involved risk (e.g. sailing in rough weather, searching for
gold in remote areas etc.), without wearing personal flotation devices and disregarding environmental conditions (e.g. waves, currents, tide, snow etc.). On the other hand, drowning incidents also occurred in the presence of lifeguards and bystanders because they were untrained in detecting critical signals of the instinctive drowning response of the victim or were engaged in other activities that distracted their attention (e.g. parents sunbathing instead of supervising their children etc.). Trained lifeguards could also miss a drowning incident due to noise at the workplace, heat, monotony, the number of bathers and the whole expanse of aquatic area they had to supervise. This means that when a lifeguard was not supported by related legislation and normal operating procedures that required frequent rotation and enough lifeguards, then it was more likely that a drowning episode would go unnoticed while lifeguards were on duty.

### 7.4.4 Weekend vs. Weekday

The first review study showed that drowning rates were higher during the weekend than on weekdays. In the second study which analysed video-recorded incidents, the methodological procedure did not allow for an examination of whether drowning occurred more often during weekend or weekdays. The interview analysis showed that drowning incidents occurred at any time. When drownings occurred at weekends, this was because people did not work and visited aquatic areas for leisure. They were aware of the dangers of drowning and because of that, on some occasions they had taken the necessary precautions (e.g. use of PDF, wet-suit etc.). On the other hand, people were also involved in drowning during weekdays while they were working on land or at sea and were trapped in floods or storms. In these cases, this was due to unexpected circumstances over which they could not possibly always have personal control or taken the necessary preparation. Although the opposite would be expected, even risk takers, who participated in stunts that they personally organized outside their work duties at any time of the week, were found ill-prepared for coping with drowning.

### 7.4.5 Season

The first review study showed that drowning deaths exhibited a seasonal pattern in most parts of the world with most of them occurring at the beginning of the summer and continuing throughout the warm months. In the video and interview studies drowning occurred in any season but was more likely during
the summer. For example, in countries where most incidents took place during the summer, there was a tradition of aquatic recreational activities and a long coastline (e.g. Australia and USA in the video study and Greece and Cyprus in the interview study). Although the type of aquatic activity in those cases varied (e.g. snorkelling, scuba diving etc.), it was mainly swimming. Drowning occurred also during winter, autumn and spring due to engagement in aquatic and non-aquatic activities above or around the water (e.g. airplane flight, sailing, driving or walking near a river or lake, etc.). As shown in the introduction to this thesis, those episodes that occurred during non-aquatic activities would not be coded in injury epidemiology statistics as drowning but under a different code. However, as we were interested not in the way an incident was coded but on whether or not it could lead to drowning due to immersion or submersion in a liquid, they were analysed in the video study. Collectively, the above findings suggested that drowning incidents exhibited a seasonal pattern attributed to social trends and demographics of each country of the assessed sample.

7.4.6 Holiday–Normal Day
The first review study showed that male drowning tended to occur on public holidays while females drowned during school holidays. In the video and interview analyses people drowned slightly more often while on holiday than on a normal day. From an epidemiological point of view, this showed that people were in danger at any time in the two studies. The people involved in drowning while on holiday were engaged in recreational aquatic activities during leisure time (i.e. swimming, yachting, scuba diving, snorkelling etc.). However, those who drowned during normal days were engaged not only in aquatic but also in non-aquatic activities taking part near or above an aquatic environment (i.e. driving, walking, or flying). The first category of people relied on lifeguard intervention while the second, on the intervention of other professional emergency services that had to go to the scene of the drowning incident later (e.g. scuba diving search and rescue team, fire brigade, coast guard etc.). This may mean that those in danger outside a lifeguarded area, may have delayed or fewer opportunities of being rescued. Furthermore, given that very often rescue services lacked time in the two studies, they were not always able to do the appropriate risk assessment or to know the hazards that might exist in the aquatic area.
7.4.7 Type of Activity

An important finding of the present thesis was that although swimming was the most common recreational aquatic activity, involvement in other aquatic and non-aquatic activities also led to drowning. From those activities some were well established in injury epidemiology statistics presented in the first review study because they were coded as drownings while others were not because they were drownings ‘hidden’ under different codes. In the second and third video and interview studies the victims walked on frozen lakes, were driving in flood water, were involved in boat-related incidents (e.g. sailing, yachting, and cruising), and participated in other aquatic activities (diving, snorkelling, performing stunts, scuba diving, jumping into the water, fishing, walking or playing in the water). Finally, activities took place above the water (e.g. bungee jump, airplane, balloon and space ship travel) leading to aquatic emergencies and drowning.

7.4.8 Time of Occurrence

In the first review study it was found that the peak time of occurrence of drowning was between 15:00 and 18:00. In the video and interview studies, drowning took place more often between 10:00 and 18:00. The only exception to that could be in cruising that could take place during the night or in non-aquatic activities, and could lead to an aquatic emergency (e.g. a flight that crashed in the water). From a lifeguarding perspective, because local authorities and aquatic facilities could not feasibly maintain lifeguards everywhere and at all times, there was a need to note when the peaks occurred and allocate resources accordingly.

7.5 Wherever

7.5.1 Specific Geographical Characteristics of the Country

A wide range of aquatic environments was well documented in the related literature in the first study as places of occurrence of drowning. In the video and interview studies, the most common place of occurrence of a drowning incident was the sea when people engaged not only in pure aquatic activities (i.e. skin diving, scuba diving, swimming and yachting) but also in non-aquatic activities (i.e. parachute and bungee jump, airplane and aerostat flight etc.). In a number of those activities, the reasons why people became victims were risky
behaviour, overestimation of personal ability and failure to appreciate their limits, lack of risk assessment of the undertaken activity or even mechanical failure of the instrumentation used (e.g. scuba diving cylinder, malfunction of airplane or space ship instruments etc.). Second, people drowned in swimming pools and water parks due to mechanical failure of the equipment used, inability of written operating procedures to foresee and prevent specific aquatic emergencies or overestimation of the pool bathers’ limits that led them to disregard the instructions from the lifeguard and the pool regulations. Third, people also drowned in lakes, rivers, and streams due to unexpected flooding or breaking of the ice on which they walked. Finally young children drowned in domestic water in a drainage pipe when their parents left them unattended at the house.

7.5.2 Depth of Water Area
Research presented in the first review study showed that drowning could occur in shallow water. The methodological procedure followed in the two qualitative studies showed that people were in difficulties both while out of their depth and when they could stand up in the water. This was likely to occur not because the people in difficulties were necessarily non-swimmers but because they had a previous medical history (e.g. diabetes, epilepsy, or heart disease). Therefore, water depth was the most important consideration for weak or non-swimmers and those with disabilities and medical problems, in those sampled in the videos and interviews, because if they fell unconscious face down in shallow water that would have prevented air from entering their lungs.

7.5.3 Distance from Safety
The video and interview analyses showed that the distance from safety was a component of each drowning incident. In particular, it was shown that the distance of drowning episodes from safety ranged from 1-9 m up to many miles. Considering that distance from safety is one of the components that affected the speed of rescue and also that speed equals time, then there was a need to locate spatially the activity prior to the incident and the location of drowning to understand its antecedents. Consequently, depicting a drowning victim in a geometric model at the centre of 3-dimensional space yielded crucial findings (figure 7.1). As shown previously in this discussion, drowning was the outcome not only of engagement in aquatic activities (e.g. swimming, boating, scuba diving etc.) but also of activities occurring in the air (e.g. parachute and
bungee jumps, air and space flights above the sea etc.) and on land (e.g. driving or walking in flooded areas or frozen lakes). Therefore, in the examined sample in terms of distance, the drowning problem as well as the consequent rescue intervention, were not 1-dimensional but rather 3-dimensional problem and task respectively (e.g. length, height or depth and width).

Figure 7.1: Depiction of Drowning on a Geometric Model of 3-Dimensional Space of the Physical Universe.

Note. The three dimensions that are commonly called length, width, and depth (or height), here are represented by drowning incidents occurring after engagement in activities taking part on water, in the air and on land.

Drowning incidents in the video and interview studies occurred in all 3-dimensions. The first dimension of length represented the distance between the location of drowning and the shore or the poolside of such activities as swimming, boating, sailing etc. The second dimension of height or depth represented the distance between the location of drowning from the water surface of such activities as air flight, space ship mission, parachute and bungee jump, as well as scuba diving, spear fishing and snorkelling respectively. The third dimension of width represented the distance between the location of drowning in inland water from the land in such activities as walking or driving in flooded areas and frozen lakes etc. In other words, this showed that lifeguards, professional rescuers and amateur lifesavers had to respond to drowning episodes whose starting point was one of the previously described dimensions at various distances from safety. Therefore, people became drowning victims regardless of whether or not the distance of their undertaken activity was far from the water.

A rescue intervention in the videos and interviews was a 3-dimensional task. Rescues rarely occurred exactly in front of the eyes of the rescuer on a per-
pendicular plane to allow a 1-dimensional intervention. For example, the interviewee lifeguards from Greece who supervised 600 m and were positioned in the middle of a beach, had to run across the beach a number of metres (e.g. dimension of width), attempt a swimming approach from the shortest distance (e.g. dimension of length) and possibly continue with an underwater search for the unconscious submerged drowning victim (e.g. dimension of depth). Similarly, in other rescues from the video analysis a rescuer had to run to the place where the helicopter was parked (e.g. dimension of width), fly to the place where the victim was drowning (e.g. dimension of length) and attempt a rescue which required the rescue swimmer jumping into the water and the eventual lift, together with the victim, into the helicopter (e.g. dimension of height). This showed that lifeguards, professional rescuers and amateur lifesavers had to respond to drowning episodes covering a distance from safety to the place of the event in more than one dimension.

All these points suggested that perceiving drowning and the consequent attempted rescue as a 3-dimensional problem and task respectively had a number of implications. First, it revealed a number of ‘hidden’ drowning incidents that contemporary injury epidemiology would classify under different codes, underestimating the burden of drowning and therefore the magnitude of the problem, with negative consequences when decision making to fund research and education in terms of prevention, rescue and treatment. Second, it stressed the need, from an educational point of view, for better public awareness regarding water safety prevention in people who engaged not only in aquatic activities but also in non-aquatics in, on or around the water, for them to know how to swim and be able to survive in an aquatic emergency. Third, it showed that the 400 m swim for open water rescue and the 50 m swim for pool/water park rescue on their own were not adequate test requirements to ensure a speedy approach because they assessed speed in only one dimension. Instead, test criteria like a 100 m run–50 m swim–100 m run for open water and a 50 m run–20 m swim–50 m run for pool/water parks could be more useful for assessing speed in relation to distance. Finally, the presence of each dimension and the number of metres between the rescuer and the casualty of each of those dimensions posed an additional number of obstacles that had to be overcome. For example, a lifeguard who attempted a 1-dimensional rescue at a certain distance from safety was concerned with fewer variables (e.g. distance from safety, weather and environmental conditions etc.) than a
rescuer who attempted a 3-dimensional rescue who was concerned with all variables related to width (e.g. run, likelihood of getting injured), length (e.g. swim, need to fuel and operate a power boat or a helicopter etc.) and possibly height (e.g. knowledge of handling a specialized rescue, concern about weather conditions etc.) or depth (e.g. knowledge about marine life dangers, underwater currents, water temperature etc.). Therefore, this stressed the need for further education from the rescuer’s point of view.

7.5.4 Indoor–Outdoor Factors

In the first study a number of indoor and outdoor variables were reported to play a role in drowning rescues. In the video and interview studies they also appeared to be present in drowning incidents but more importantly they helped in understanding how and why this happened. The first variable was glare: it was essential in water surveillance that glare should be minimized and lighting maximized so that a swimmer could be seen on the bottom of the pool. Failure to do this might result in a drowning death due to delayed detection of the casualty and recognition of the need to attempt a rescue. Second, waves, currents, and off-shore winds were present when people faced a drowning incident in open water emergencies. In fact, in some of the drowning episodes those variables were the main reasons that not only caused the drowning episode but also placed the lifeguards or other professional rescue services in danger, making the rescue process more difficult.

Variables like flooding and rain led inhabitants and rescuers to drown. Flooding and rain were related to non-aquatic activities that led to drowning (e.g. driving and walking near a river). Those two variables could possibly be considered more dangerous than others because they placed people in danger unexpectedly during their daily routine and not when engaged in aquatics. Furthermore, because of their magnitude, large numbers of people were placed at risk in any given emergency. The contemporary injury epidemiology statistics understands drowning as a 1-dimensional problem that occurs only after immersion or submersion in a liquid, and therefore, considers as drowning only incidents involving immersion or submersion in a liquid. However, by placing 'drowning' in the video and interview analyses in the 3-dimensional space of the physical universe where people live and die, it is understood that drowning could possibly occur not only in an aquatic environment but even on land in areas not considered aquatic, but which could suddenly be filled with water
due to a flood or tsunami. Therefore by classifying those incidents as 'disasters', not 'drownings', the only thing that could be achieved is an underestimation of the problem.

Finally, temperature was related to drowning. When the water was warm many people participated in aquatic activities, increasing the possibility of a drowning incident (e.g. during the warm months of the year). On the other hand, when the water was cold, people in the two qualitative studies were in danger of experiencing death within minutes of cold-water immersion after an unintentional fall (e.g. breaking the ice on a frozen lake, etc.). Collectively, the above findings of the video and interview analyses suggested the need for a higher quality lifeguard service on duty at times of peak temperatures during the day and year. Also it suggested the need for more effective public awareness on the dangers of an unintentional fall into cold water.

7.5.5 Social–Emotional Environment

Risk-taking behaviour was a cause of drowning in the first review study. This was an important finding from this study because risk taking is a personality trait with limited scientific attention in relation to drowning. The results of the second and third video and interview studies supported this finding but more importantly they helped in understanding how and why this happened. Therefore, a number of psychological perspectives need to be addressed in relation to the risk-taking behavior that was exhibited in the video and interview studies.

First in terms of age, in the two qualitative studies older children performed risk-taking activities because they overestimated their physical abilities and participated in activities that required higher ability, physical strength and experience. On the other hand, some adult risk takers had a lifetime history of risky behaviour. Another reason why adults performed risky activities was because they perceived aquatic activities as being less dangerous when intoxicated than when sober. In some cases, the effect of alcohol or drugs reduced their belief that there could be negative consequences, thus increasing their risk-taking behaviour. Even swimming in a controlled lifeguarded environment needs to be recognized as risk-taking behaviour when following a heavy meal and alcohol consumption. This led to the conclusion that, in the present sample, risk takers were not only those who seek pleasure from activities that con-
tain some degree of risk but also those who disregarded safety rules and prohibitions in an aquatic area.

Second, in the videos and interviews it was shown that sporting risk takers tended to be very confident that they could manage the risks involved. More precisely, they took physical risks to trigger the 'fight or flight' response. The sampled drowning victims wanted to experience high arousal as excitement rather than fear, believing themselves to be in control of the risks. This gave them feelings of satisfaction derived from the exercise of control in dangerous circumstances that they perceived to be challenging rather than threatening. Also they enjoyed the dangers of their risky activity as pleasant because they had (or thought they had) the necessary preparation that would allow them to have personal control in risk taking. Risk takers in the videos and interviews were also unrealistically optimistic expecting that misfortunes would happen to others and, because of that, they ignored every prohibition about their action that was not consistent with their behaviour.

Third, the casualties of the video and interview studies participated in risky activities in or around an aquatic environment on a voluntary basis and influenced by their group. It was also shown that risky behaviour was an effective symbol when it was recognized as risky by others who also participated voluntarily in the same aquatic or non-aquatic activities near or above the water. Therefore, part of the problem of risk-taking behaviour in the examined sample relied on the relationship between individuals and their social groups, the relational context in which a person's action had meaning and conferred status.

Finally, it was shown that in the videos and interviews, risk takers were triggered by aquatic adventures that were considered as rewarding, exciting, fun and exhilarating. Risk takers were highly skilled people, who did not experience a high level of fear, feeling self-satisfaction by behaving riskily and getting involved in activities that required developed coping skills in the face of uncertainty. Unfortunately for them, risk takers do not always have control of their risky actions.
7.5.6 Noise during Lifeguard Scanning

The first review study showed that appropriate actions should be taken to decrease levels of noise at the aquatic environment. In the interview and video studies, noise was related to drowning in two ways. First, noise distracted lifeguards and caused fatigue when scanning, thus not allowing quality observation of the bathers. The lifeguards reported in the interviews that this fatigue was more evident as the lifeguard daily duty was nearing the end, and therefore, the more hours they had worked in a noisy aquatic environment, the less likely they felt able to hear a shout for help. Second, when victims and bystanders were shouting for help, lifeguards were unable to hear them due to the noise made by other bathers. Consequently, lifeguard rescue attempts were delayed because lifeguards did not detect drowning victims early. This was evident on overcrowded beaches and indoor swimming pools where many people swam and played noisily around a drowning victim or where the music from the facility’s megaphones was loud.

7.5.7 Socio-Political Issues

Socio-political issues were identified which affected the outcome of drowning incidents in the first review study. In the video and interview studies such socio-political issues were related to drowning. The first issue identified was the presence of preventative measures in the aquatic environment where the incident occurred (i.e. warning signs and labels, water depth markers, flags limiting the lifeguarded area, lifeguard presence etc.). In those drowning incidents a successful rescue took place. The presence of such measures was essential for ensuring that drowning would be avoided. The second issue was breaching the law. Some people sampled in the videos and interviews breached the law while engaged in illegal aquatic activities. When rescuers were amateur lifesavers, the drowning was fatal. When rescuers were professionals, the victims survived. In other words, this shows that breaching the law may not necessarily have led to drowning in all cases, if there were other preventative measures that could provide professional rescue intervention. The final issue was the morality of the sales policy regarding equipment. The quality of some equipment was the cause of drowning in a number of cases examined in the two qualitative studies; people engaged in aquatic activities were sometimes in difficulties when their equipment (i.e. scuba diving tank, inflatable etc.) did not work properly.
7.6 The Single Variables of the 4W Model

Clearly there is causality in every incident but analysis of the interaction between the four elements using videos and interviews identified the rescuer as the primary focus, followed by the casualty, the place of occurrence and finally the circumstances of occurrence of a drowning episode (see chapters 5, 6 and appendix 7).

The variable that appeared to be most significant in drowning episodes was the rescuer. Based on findings from the video and interview analyses rescuers were mainly, but not exclusively, males aged between 20 and 30 years, physically strong and fit, with good vision and swimming ability. They tended to hold an updated lifeguard qualification and had previous work experience as a lifeguard. They knew the dangers of the specific aquatic area. Most of them worked as a member of a lifeguard team rather than as a solo amateur lifesaver and they tended to co-operate with other emergency services. Finally, most rescuers were able to visually detect the casualty, they recognized various signals indicating a drowning, and reacted fast despite the lack of response by bystanders.

The second variable that appeared in the drowning episodes was the casualty. Based on findings from the video and interview analyses a human activity in, on, above or around an aquatic environment could lead to drowning regardless of the casualty’s type, gender, age, ethnicity, ability or disability, and area of residence. Although casualties of both sexes experienced drowning incidents, males far outnumbered females. The younger a person was the more likely he or she was to drown. Due to socio-economic differences non-white people were likely to drown more often, while white people drowned in aquatic activities in which non-white people could not afford to participate. Non-swimmers, unconscious casualties and non-residents of an aquatic environment were the ones in greatest danger. Unfamiliarity with the aquatic environment led to a higher drowning rate for non-residents. The rescuer could drown too. Finally, the casualties were often visiting the aquatic area for the first time, engaging in risky activities, not wearing a personal flotation device and sometimes were submerged unintentionally fully clothed.
The third variable that appeared in the drowning episodes was place of occurrence. Based on the findings of the video and interview analyses it was suggested that drowning incidents could occur in any aquatic environment with a water depth that allows immersion or submersion, in a variety of environmental conditions, where the ground was sloping, and at any distance from safety. Drowning could also occur in the absence of safety regulations, when the law was breached and where risk-taking behaviour could be triggered and psychological anxiety caused by the undertaken activity.

The fourth variable appearing in the drowning episodes was circumstances of occurrence. Based on findings from the video and interview analyses it was suggested that drowning incidents might occur at any time but mainly during the day time in all seasons, after engagement in any human activity taking part in, on, near, above or under the surface of liquid, due to poor quality or absence of rescue and personal protective equipment. Also, any risky activity that does not comply with safety procedures might lead to drowning and various types of rescue might be used.

7.7 The Interrelated Contributing Variables of the 4W Model

As the 4W model is composed of four variables, there are six possible combinations of pairs which link the four variables with each other (i.e. rescuer–wherever, rescuer–casualty, rescuer–whatever, casualty–wherever, casualty–whatever and wherever–whatever). From these, only the variables that constituted the pair ‘rescuer–casualty’ were present most often in the drowning episodes of the video-recorded rescues and the interviews (appendix 8) which means that to get an insight into how a rescue occurred, it is important to know ‘who’ rescued ‘whom’. For example, a professional lifeguard with good visual acuity, ability to remain alert and react despite the bystanders’ lack of response, attempting a risk assessment and an early approach, having knowledge about the dangers that might exist, may have a good chance of rescuing a casualty who fell unintentionally into the water wearing a PFD, is a weak swimmer and has the strength to shout for help. On the other hand, an amateur lifesaver who is unable to recognize the Instinctive Drowning Response, might be less able to successfully perform a rescue for a non-swimmer who will soon become unconscious and a non-breathing casualty; the same might
happen to an amateur lifesaver who does not have rescue equipment and the necessary training.

7.8 The Theoretical Framework of the 4W Model

So far there is no universal risk classification reporting system worldwide, and as a result, the burden of drowning is underestimated significantly because of the way that the statistics are presented (see Connolly, 2008; Langley & Smith, n.d.). Therefore, to quantify the global burden of drowning and to report the causes of drowning, in a standardized system (e.g. information about the rescuer, the casualty, the place and the circumstances of occurrence) a systematic, consistent, valid and reliable system of reporting drowning incidents is needed. To construct such a system, a model needed first to be hypothesised upon which the risk classification could be built (see figures 5.2, 6.1 and appendix 9). The 4W model was created based on a literature review study of possible variables that might contribute to drowning, and two further studies (of video-recorded rescues and interviews) were used, to achieve triangulation of the data and give new insights about the antecedents of drowning. Those studies would confirm if the model is valid (theoretically, conceptually, hypothetically) and if it could be used. The first review study provided externally generalizable data by identifying a broad range of variables related to drowning from the literature. The two studies of the videos and interviews provided internal credibility and in-depth understanding of what actually happened in each drowning episode. All three studies together provided consistency, validity and reliability, and constituted the 4W model that was based on variables common to all three studies.

The results of the present thesis suggested that the rescuer, the casualty, the place and the circumstances of occurrence were variables that were involved in a drowning incident when there was human activity in, above, under or around an aquatic environment. The variables with the highest frequency were, in order of significance, rescuer characteristics (Who1), casualty characteristics (Who2), location (Wherever), and general circumstances (Whatever). The most consistent and seemingly important interrelationship was between the rescuer and the casualty. The RID factor (Pia, 1984) and the 5-minute scanning strategy (Griffiths, 2000a) are useful to lifeguards, though have lim-
The C-zones (Connolly, 2004) help both lifeguards and the general public to understand the drowning process, though in a relatively limited capacity. The 4W model offers a far broader and more detailed model of drowning incidents. For example, the 4W variables give insight into the antecedents of drowning incidents and the model applies to a wide range of human activities, including those that occur in, above and around an aquatic environment. Those involved in water safety education should therefore consider using the 4W model to educate others about the factors that lead to drowning incidents and determine their outcome.

Professional involvement in the aquatic safety industry for an individual could be at any of the three stages ‘prevention – rescue – treatment’. Failure in achieving prevention leads to the need for performing a rescue, and failure in initiating a rescue when the victim is conscious leads to the need for successful treatment. The unsuccessful intervention in terms of rescue and treatment has a number of negative psychological, sociological and societal consequences that were described in the introduction (e.g. post traumatic stress disorder, distressing near-death experiences, high costs, divorces, litigation, etc.; see Borta, 1991; Kozlowski, 1992; Bouwer & Stein, 1997; Chemtob et al., 1998; Alonzo, 2000; Grosse, 2001; Barss & Gagnon, 2002; Avramidis, Holden & Clark Sharp, 2007; Holden, 2008). In some cases, even a successful intervention might lead to some of those consequences (e.g. post traumatic stress disorder because of feelings of guilt or terror; Riggs, Cahill & Foa, 2006). Therefore there is an obvious need for successful prevention. Because the role of a lifeguard is mainly preventative and also a successful prevention erases the need for the next two stages (i.e. rescue and treatment) the use of this model as an educational tool could play a vital role in accident prevention and safety promotion. Educators, lifeguard trainers and water safety instructors can prepare their aquatic professionals and the general public by informing them that no human activity that takes part in, on, under or around an aquatic environment could be safe if appropriate prior safety measures have not been taken.
Table 7.1: Framework for Drowning Prevention Interventions based on the Haddon Matrix

<table>
<thead>
<tr>
<th>Rescuer</th>
<th>Casualty</th>
<th>Place of Occurrence</th>
<th>Circumstances of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level of visual acuity</td>
<td>Most often male gender</td>
<td>Slipping ground</td>
<td>Daytime</td>
</tr>
<tr>
<td>Inability to remain alert</td>
<td>Most often young age</td>
<td>Any distance from safety</td>
<td>All seasons</td>
</tr>
<tr>
<td>Inability to detect the victim</td>
<td>Unfamiliarity with the aquatic environment</td>
<td>Water depth that allows immersion or submersion</td>
<td>Lack of quality or absence of rescue and personal protective equipment</td>
</tr>
<tr>
<td>Expired lifeguard qualification</td>
<td>Non-resident</td>
<td>Absence of safety regulations</td>
<td></td>
</tr>
<tr>
<td>No previous work experience as a lifeguard</td>
<td>First visit to the aquatic area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of formal lifesaving training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physically unfit</td>
<td>No use of personal flotation device</td>
<td>Breached law</td>
<td></td>
</tr>
<tr>
<td>Delayed response</td>
<td>Non-swimmer</td>
<td>Lack of preventive measures</td>
<td></td>
</tr>
<tr>
<td>Fails to recognize various signals indicating a drowning</td>
<td>Fell in the water fully clothed</td>
<td>Lack of morality in selling equipment policy</td>
<td></td>
</tr>
<tr>
<td>Hesitates to react fast influenced by the bystanders’ lack of response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inability to perform risk assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of debriefing of the rescue team</td>
<td>Lack of effective treatment (e.g., basic and advanced life support)</td>
<td>No action taken to establish preventive measures</td>
<td></td>
</tr>
<tr>
<td>No re-evaluation of the written operating procedures</td>
<td>No warning signs were placed to prevent future drowning.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Adapted from Haddon, (1980).
7.10 Recommendations

The final aim of the thesis was to provide a number of recommendations, which, based on the current findings, outline necessary actions to be taken by governments, local authorities, water safety organizations and the general public. The ability and degree of application of the findings from the thesis to target groups will prove the efficacy of the 4W model and its impact on society in terms of drowning prevention.

Governments need to take a series of actions. First of all, new legislation needs to be put in place for water safety signs, pool fencing, and qualifying criteria for a lifeguard, instructor or director of a water safety authority. Also other legislation needs to be put in place that will require re-training of rescuers every one or two years, staff training on a weekly basis at the workplace, offering the necessary equipment according to international recommendations, development of national standards on aquatic safety (guidelines, common manual and syllabus for all independent aquatic safety authorities). Furthermore, governments need to set up regulations that will include requirements for enhanced passenger briefings before flights, life preservers and helicopter floats for particular above-water operations, helicopter performance proposals (Federal Aviation Administration, 2007), ships and cruises.

Second, because there is no laboratory test that can identify a young person at risk, it would be desirable to discuss certain risk factors such as lack of safe procedures during childhood (Irwin, 1989), and, therefore, water safety and swimming lessons may be included in the physical education national curriculum of primary schools. Third, it would be useful if emergency services such as the fire brigade and the police had the appropriate equipment (e.g. rocket thrust, rescue tube, first aid kit, automated external defibrillator, oxygen and pocket mask), a basic level of swimming (i.e. be able to swim competently fully clothed a certain distance), first aid skills, and lifesaving, as they often are the first people on the scene. Fourth, the penalties for breaching the law about water safety need to be reviewed to assess whether they are strict enough to discourage people from risking their, or others’, lives when performing risk-taking behaviour around the water.
Fifth, it would be useful if the Ministries of Health and Education could work co-operatively to produce TV spots that will encourage safe behaviour in, above or around the water. The Ministry of Media could discourage magazines, journals, TV, serial and film producers from producing material in which inappropriate risky behaviour in or around the water is shown, and at the same time encourage them to formulate programmes that would promote safe behaviour and increase the knowledge and understanding of the audience and participants (e.g. awarding ceremonies for ‘Rescue of the Year’ similar to that of the Oscar Awards; TV programme ‘The Rescuers’ like ‘Big Brother’ or ‘Survivor’; films like ‘The Guardian’; TV series like ‘Baywatch’ or ‘Casualty’ and ‘999’; home video games consoles like ‘Wii’ or interactive on-line first aid courses like ‘BBC health’).

Sixth, the lifeguard presence in aquatic areas and implementation of cardio-pulmonary resuscitation training courses for the public are significant preventative measures for the reduction of drowning (Spyridopoulos et al., 2004), but could still be improved. Thus, it would be useful if the Medical and Sport Science Department of all universities could establish mandatory courses of ‘first aid’ and ‘lifesaving’ and specialties of ‘lifeguarding’ for arming university students with academic and practical knowledge about lifesaving, lifeguarding and first aid. However, to reduce the number of drowning deaths, it is important for not only university students, but also parents, teachers and doctors to learn facts and statistics. It would, therefore, be vital to improve health education, including a drowning prevention curriculum in co-operation with various health specialties, to create a healthy school environment for students (Ishii et al., 2002). For example, each hospital could regularly incorporate into its activities some basic life support or first aid courses that will be advertised on-line at a central base of the Ministry of Health, with posters at various places in the hospital.

Seventh, as the adverse climate conditions substantially increase the likelihood of drowning, it would be useful for Civil Protection to undertake a leading role in organizing frequent sessions to educate and train the public and other specialized teams on how to cope with aquatic emergencies that are likely to take place (e.g. flooding, tsunami, shipwreck etc.). Finally, it would be useful if the government increased funding for research and education on prevention, rescue and treatment of drowning and other related aquatic emergencies, be-
cause it will be cheaper to spend money preventatively rather than on hospitalizing drowning casualties.

Local authorities would need to take a series of actions. First, they would need to take responsibility for making funding available where possible for additional professional lifeguards in an attempt to provide more quality lifeguard surveillance. Second, there would need to be frequent assessment of the maintenance of the procedures and the penalties for those not following the legislation would need to be stricter, in order to discourage people and organizations from declining to follow national standards. National standards would need to meet at least the standards of the International Life Saving Federation. Third, it would be useful if every activity that takes place in, under, around or near an aquatic environment had written operating procedures, including normal operating procedures and emergency action plans. Fourth, because risk takers are unlikely to behave safely, it would be helpful if local authorities gave them the opportunity to practise their risky behaviour in an environment with as little extraneous danger as possible. Organizing extreme games is likely to engage the interest of those risk takers who need publicity and adventure to fulfil their needs. Therefore local authorities could give them the opportunity to actually behave riskily in a controlled and safe environment (e.g. bungee jumping or stunt shows in a lifeguarded area with ambulance cover etc.).

As the present findings stress the importance of professionalism in lifeguarding, it would be useful if a series of actions was taken by water safety organizations. First, organizations located in high-income countries could provide, whenever possible, assistance to lower-income countries (International Life Saving Federation, 2007b). Second, water safety organizations could improve the structure of training and maintain high certification standards. Third, regular staff training at the workplace (at least three hours/week) and qualification renewal from the water safety agencies (every year) is vital for professional lifeguards and rescuers.

Fourth, organizations that give qualifications for, or employ, professionals for activities taking part above, on, under or near the water may adopt a policy that will require teaching swimming, personal survival and lifesaving as part of their education and emergency action plans respectively. Fifth, lifeguard and other rescue equipment (e.g. rescue tubes, rocket thrusts, pocket masks, spi-
nal boards, cervical collars, gloves, oxygen, defibrillators, power boats, surf boards, and jet skis) are recommended for use. Sixth, effective surveillance and rescue intervention depends on several factors (levels of attention, boredom, equipment, training, scanning techniques etc.) but it would be useful to maintain at least one lifeguard every 300 m during busy days and peak times of the day, especially in countries like Greece where currently they maintain one lifeguard for 600 m of beach.

Seventh, when drowning incidents occur the 4W model and the Haddon matrix can provide, for those organizations, a useful lens through which to examine the antecedent and situational factors that led to the accident. This will form a picture of what the victim experiences and what elements are missing which put the person in danger. These missing elements are what may be taught (Stallman, 2008). This process may be useful for identifying cases of negligence and teaching valuable lessons in order to minimize the number of future drowning incidents.

Eighth, the organization that awards beaches with the ‘Blue Flag’ would need to be stricter in ensuring quality lifeguard services. Also it would be useful if the International Life Saving Federation created an award, similar to the ‘Blue Flag’, for the safety services of all aquatic environments (e.g. swimming pools, beaches, rivers, lakes etc.) and facilities (e.g. hotels, summer camps, aquatic sport clubs etc.) that will both increase the Federation’s income for funding various projects (research, education, etc.) and force local communities to meet internationally approved safety and rescue standards (e.g. water safety signs and flags, minimum number of lifeguards per given dimensions of aquatic environment, minimum equipment, staff training, re-certification etc.). Ninth, water safety organizations should include in their syllabus, profiles of ‘at risk people’ so that lifeguards or rescuers will be able to recognize and prevent particular sets of behaviour in guarded aquatic environments.

Tenth, the creation of new publications needs to be based on research findings. Finally, organizations that are involved in water safety, injury prevention and rely on statistics to create their policy and claim government funding based on facts, need to stop underselling themselves by interpreting drowning statistics incorrectly (Connolly, 2008); they need, rather, to rely on the description of the death instead of the code, as there are hidden ‘drowning’ incidents
in the E codes of the ICD system (Langley & Smith, n.d.). The International Life Saving Federation, should publish a position statement explaining the way that drowning deaths need be reported, in order to provide a better estimation of the drowning problem, and therefore be in a better position for claiming funding for prevention, rescue and treatment. Also on-line brainstorming, fostering and disseminating research, and addressing issues that have been dictated by tradition, will help ensure that vital water safety issues will be addressed and exchanged through the lifesaving scientific community (Stallman & Kjendlie, 2008).

Eleventh, because the lifeguard profession has core similarities with public health, safety and security-based jobs (e.g. police, fire, ambulance, rescue teams), it may reasonably be expected that screening procedures on their physical and psychological health need to be established by the water safety organizations. This may be implemented by establishing tests for visual acuity (Seiller, 1996, 1997), pathological and cardiological problems (Decree Law, 2000) and for early identification of pre-existing risk factors, to provide effective prevention for candidate lifeguards who are at risk of developing trauma-related disorders and psychopathological symptoms after trauma exposure (Heinrichs et al., 2005).

The general public would need to take care of several issues. First, anyone engaged in an activity taking part in, above, under and around the water needs to consider the risks to which they are exposed. Risky activities near, above, in or under an aquatic environment and overestimation of personal limits are dangerous practices that need to be avoided. Second, people participating in activities that seem to be non-aquatic, but take place above or around the water (e.g. astronauts, pilots, fishermen, drivers, etc.) need to know how to swim.

Third, as the presence of lifeguards and their interaction with other factors is clearly important, people would need to engage in aquatic activities supervised by lifeguards where possible. People would also need to participate in activities that are set up by authorities with established emergency action plans for aquatic emergencies and avoid going into places that do not offer quality safety services. Fourth, parents should always supervise their children, especially those under 5 years old.
Fifth, despite apparent differences and drowning patterns between genders, age groups, ethnicities, occupations, behaviour, place of occurrence, activities, areas of residence, distance of the activity from the aquatic location, time of day, day of the week, and month, it would be useful for all people to pay attention to the safety measures of the undertaken activity, even when drowning seems unlikely (e.g. safety measures on board an airplane before take-off above the sea etc.). Finally it is hoped that the findings of this study will be used as new information about drowning (Myntti et al., 1991) because it has previously been found that the value of accident research and the implementation of research findings usually results in a downturn in drowning (Wiggleworth, 2001).

As the present thesis constituted a mixed methods approach of three studies, two more future studies are suggested to supplement the present findings. A quantitative research study, using the same sample, could link the examined variables with the outcome of drowning (either death or survival) to identify which variables (from those assessed presently) lead to a drowning death and/or survival and to what degree (i.e. no rescuer may lead to death, amateur lifesaver may lead to higher chances of survival, professional lifeguard may lead to high chances of survival etc.). Also, a second study with a bigger sample and an epidemiological quantitative approach, could relate the risk factors with the outcome of the incident. After conducting such a study it would be possible to integrate a risk classification system, to formulate a drowning rescue report and be able to maintain reliable data through its worldwide distribution by major organizations like the World Health Organization and the International Life Saving Federation. The benefit of that would possibly be significant as it would enable aquatic professionals to measure the effectiveness of a lifeguard/rescue team, the adequacy of an aquatic facility in terms of safety, the degree of risk of a given activity in terms of drowning, and it would enable the appropriate organizations to keep records and conduct research using drowning statistics with cross-cultural comparisons.
7.11 Limitations

The current findings are subject to a number of different sources of potential bias. The first limitation is that the first study used only literature that was based in English and Greek languages and therefore might have neglected important findings of research conducted in other languages. A second limitation is that considerable time may have passed between the drowning incident and the interview. Therefore, those interviewed may have struggled to remember specific details about the drowning incident, and their perceptions are likely to have been influenced by the stressful nature of the situation. A third limitation is that in some cases the methodological procedure left cases unspecified (e.g. in the video analysis in some cases, for example, shipwrecks, it was impossible to define precisely the demographics of the casualties, and in some interviews, participants could not give precise answers about the size or shape of the area, etc.).

A fourth limitation is that some of the examined variables were not precisely measured but were only rough perceptions of the interviewees (i.e. distance from safety, the casualty’s height and weight). For other variables that could have been affected because of the time lapse between the interview and the incident (i.e. time, day, and month) modifications were proposed for reliable data collection (Williamson & Gilchrist, 2006). For example, to overcome this obstacle, participants were asked not to give the exact day or time the incident happened as this would not be accurate, but instead, to give an approximate indication such as: ‘the incident happened either during the day or during the night and either during a weekday or during a weekend’. To establish the 4W model, it was important to see not exactly, but roughly, when a drowning incident occurred. Although one might argue that oral research could lead to mistakes because of the time lapse between the incident and the interview, this was not the case in this study because interviewed people were truthful, having no worries about the immediate effect of what they reported for the casualties who were involved, in a similar way to research reported by Lunnis, (1987). They were asked to report only those things for which they had confidence in the answer. Finally interviewees spoke freely with no hesitation in mentioning things that would show them in a negative light, and without feeling the need to please the interviewer (Dean & Whyte, 1978) because the inter-
viewer had established confidentiality and a friendly approach (Thomas & Nelson, 2003).

A fifth limitation was that the Global Burden of Disease and specific country data excluded drowning deaths due to water or other transport accidents, cataclysms and intentional injury, from their official statistics on drowning (World Health Organization, n.d.), therefore, it was not always possible to estimate and compare similar situations in other countries and answer related sociological questions (e.g. 'why do we have different drowning rates in Australia and New Zealand while those countries have geographic and recreational similarities?').

The final limitation was that the way that rescuer characteristics interrelated with the place and circumstances of occurrence of the drowning incident was not established. In contrast to the pair ‘rescuer–casualty’, place and circumstances of occurrence appeared more often in one study but less often in the other. However, given the fact that the rescuer plays the dominant role within all the linkages of the 4W model, a further examination of how it interrelates with the other variables will enhance understanding and effectiveness of rescue procedures for the benefit of both casualty and rescuer. Therefore, further research is required to replicate the current findings and examine the utility of the 4W model in other contexts.

7.12 Conclusions

The most important finding of the present thesis was that when there is human activity in (e.g. swimming, sailing, cruising), under (e.g. scuba diving), on (e.g. walking on a frozen lake), around (e.g. driving and walking) and above (e.g. air flight with airplane or parachute, bungee, space ship mission etc.) an aquatic environment, then a drowning incident might happen to whomever (due to victim’s or rescuer’s mistake), wherever and under whatever circumstances. Unlike previous researches who have addressed drowning in a mechanical uni-dimensional manner this thesis has stressed the multi-dimensionality of drowning and the need to use a multi-disciplinary approach in order to understand the processes involved. To do this, attempts were made to break the problem down into its basic building blocks and then reassemble them into the
4W model. Using novel approaches that incorporated video analysis and interviews with lifesaving experts and aquatic professionals to examine the 'construction' of drowning incidents indicated that the most important consideration was the characteristics of the rescuer followed by the characteristics of the casualty, the place and the circumstances of occurrence of a drowning incident. The pairing 'rescuer-casualty' contributed the most to the understanding of how such incidents are constructed. In conclusion, the 4W model is a promising tool for lifesaving and lifeguarding training, as well as for understanding the dynamics of drowning for accident prevention and safety promotion by governments, local authorities, water safety organizations, and the general public.
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Y

Z
Appendices
Appendices

1. Appendix: Sample of Video Narratives that were used for Content Analysis

Table contains the video recorded drowning incidents that were analyzed in this study.

<table>
<thead>
<tr>
<th>Incident</th>
<th>Incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dorris Svorinic *</td>
<td>22. Waymouth **</td>
</tr>
<tr>
<td>2. Steve Trader **</td>
<td>23. Adolftotis II **</td>
</tr>
<tr>
<td>3. Batavano **</td>
<td>24. Pia 1 **</td>
</tr>
<tr>
<td>4. Olby Adams **</td>
<td>25. Pia 2 **</td>
</tr>
<tr>
<td>5. Judith Cooper **</td>
<td>26. Pia 3 **</td>
</tr>
<tr>
<td>6. Ron Royals **</td>
<td>27. Pia 4 **</td>
</tr>
<tr>
<td>7. Jim Gilchrist</td>
<td>28. Pia 5 **</td>
</tr>
<tr>
<td>8. Five children in frozen pond **</td>
<td>29. Pia 6 **</td>
</tr>
<tr>
<td>9. Terrence **</td>
<td>30. Pia 7 **</td>
</tr>
<tr>
<td>10. Haily Roggers **</td>
<td>31. Pia 8 **</td>
</tr>
<tr>
<td>11. Indianapolis **</td>
<td>32. Pia 9 **</td>
</tr>
<tr>
<td>12. Rio Bravo **</td>
<td>33. Pia 10 **</td>
</tr>
<tr>
<td>13. Culla Cuba **</td>
<td>34. Pia 11 **</td>
</tr>
<tr>
<td>14. Patra **</td>
<td>35. Pia 12 **</td>
</tr>
<tr>
<td>15. Lillian McDermont **</td>
<td>36. Pia 13 **</td>
</tr>
<tr>
<td>16. Tony Bullimore **</td>
<td>37. Pia 14 **</td>
</tr>
<tr>
<td>17. Achille Lauro **</td>
<td>38. Pia 15 **</td>
</tr>
<tr>
<td>18. Tsent Saw **</td>
<td>39. Pia 16 **</td>
</tr>
<tr>
<td>19. Comoros **</td>
<td>40. Pia 17 **</td>
</tr>
<tr>
<td>20. Appolion **</td>
<td>41. Pia 18 **</td>
</tr>
<tr>
<td>21. Yarmouth **</td>
<td></td>
</tr>
</tbody>
</table>

Rescues are taken from the following sources: 1, 2, 4-6, 9, 13 (When stands go wrong, 2001), 3, (Batavano nearly drowns, 2002), 10 (999, 2000), 11 (Near drowning of family in Indianapolis, 2001), 8 (Children near drown in a frozen lake, 2001), 12, (Stowaways drown in river Rio Bravo, 2002), 7, 15 (Animal Heroes; Real Life Rescues, 2001), 14 (Drowning in Patra, 2001), 16-20 (Great Survivors; Witness Events of the 20th Century, 1998), 21-23 (The history of RNLI, 1994), and 24-41 (On drowning, 1970).

*: simulated incident, **: real incident
Appendices

2. Appendix: Sample of transcribed audio visual narrative with observational content analysis.

The italic text represents the visual narrative while the normal text represents only the audio narrative (usually is the narrator or other voices that can be heard in the video).

<table>
<thead>
<tr>
<th>Incident 1: Accompanied Rescue by Dolphins</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00-00:00:30: On of this incredible animal rescues occurred on 19/04/97. Doris Svorinic and her friend Mark planned to spend their day swimming off the shores of a beach near their homes in Durbin of South Africa. Doris says: “It was perfect weather and we had decided that we are going to go diving or snorkeling; Mark had decided that he was going to go spear fishing, and so we went down to the beach”. [Doris and his friend Mark are sitting on the sandy beach close to their home. They are preparing themselves for swimming wearing their wet suit that was covering all their body. They got into the sea wearing mask, snorkel, fins and a wet suit that was having cup. Mark was also holding a spear-gun and a buoy].</td>
</tr>
<tr>
<td>00:00:30-00:01:00: As they swam Doris and Mark did not realize that they were been swept further and further out to sea by unusual side currents. Doris says: “We carried on swimming and carried on swimming and look further and further out. At one point I said ‘look I have had enough; I am going back’. I started swimming and at one split of second I thought maybe this is [Doris and Mark are swimming together further out to the sea. At some point Doris decides that they have swum enough and that they would need to start going back].</td>
</tr>
<tr>
<td>00:01:00-00:01:30: stupid to swim back. I got look up briefly and Mark was absolutely not inside, no inside at all”. Suddenly Doris found herself alone nearly half a mile from shore in an area where sharks were known to exist. “I got drained to the side current; you know just swam and swam and I just couldn’t get anyway. [Doris started looking after Mark but she could not find him, so she realized that she was alone. Then she started treading the water].</td>
</tr>
<tr>
<td>00:01:30-00:02:00: I got really really tired. Of course the panic started sitting slowly but surly. There are very very many sharks in this area, which can get quit aggressive especially if you are floating; which I had to do and of course their floating made me panic even more. It is just so easy for a shark to take you then you know, you are weak, you are floating, [Doris laid on her back to rest but she was thinking that every movement she was doing could attract sharks. This made her panic even more].</td>
</tr>
<tr>
<td>00:02:00-00:02:30: you know they will come up and get you. ‘A whole part of water went down to my snorkel and I actually chocked. I thought to myself this is it, this is it. I am going to drown actually because I don’t have the strength or the energy to swim back. I almost was surrendering myself, because I was in such state”. Doris had all been given up [Doris chocked when amount of water entered into her snorkel. She has started giving up].</td>
</tr>
</tbody>
</table>
| 00:02:30-00:03:00: of hope of reaching shore when she noticed shadows swimming shifty towards her. In an instance, Doris was surrounded by a group of dolphins. “I immediately recognized that they were dolphins because really God send; and relieved me beyond words. It was like a whole lot of
good friends just saying ‘Hi Doris [Doris in a moment is noticing shadows and realized that she was surrounding by a group of dolphins. They relieved Doris].

00:03:00-00:03:30: what’s going on with you don’t give up; let’s go; Pull yourself together; we’ll wait for you; float a bit, you know, you will be fine’." A gentle wave of calm washed over Doris. Her tiredness was replaced by a new strength. “They kindly made this protection circle around me. Perhaps they show me as another dolphin. ..... we have got to escort this creature back to the shoreline. [Dolphins started swimming around Doris making her to find the strength to start swimming back to the shore].

00:03:30-00:04:00: And I was able to start swimming then without too much panic because of the protection of these dolphins to give my breath back and then just to carry on. Once I got to the white water, this dolphin just leaped over my head; it was like saying ‘OK man [Once they reached the white water the dolphins left].

00:04:00-00:04:30: you are all right now’. After more than an hour Doris finally made it to safety. But tragically her companion Mark was not as fortunate. The intense currents that day were too powerful for him to fight. His body was recovered five days later. What is the difference between life and death for Doris? Some psychic connection she shared with the dolphins. [Doris got out of the water holding her fins. Her companion Mark was not with her. Then Doris is standing up and starts walking on the beach].

00:04:30-00:05:00: ‘I was given so much strength from these animals it was just the fact that I show the dolphins around me just relieved me to much that I was actually all right then. The heroes of the day were definitely the dolphins that have been back with me, without any doubt’. Dr Horace Dobbs says: ‘They have been a lot of examples of dolphins rescuing people and I think that humans have a special relationship with dolphins; [She laid on the sand to rest, gasping wheezing. Doris is smiling afterwards giving an interview and she is giving credits to the dolphins for saving her life. Dr Horace Dobbs (International Dolphin Watch) is talking about dolphins].

00:05:00-00:05:30: and this is partly related to the fact that their brains are as big as ours so there is a mental connection if you like between humans and dolphins’. For the past 24 years Dr Horace Dobbs has been contacting research into the unique relationship between humans and dolphins. His work has laid him to conclude that we often communicate with these gentle creatures through a variety of non verbal methods. [Scuba divers are diving with video cameras and underwater cameras in between dolphins exploring them].

00:05:30-00:06:00: ‘I am quiet convinced that dolphins do have a sense of what human beings are doing in the water; and if they need help they may give them. ... the energy to help them survive. I have had the privilege of swimming with dozens of dolphins. Meeting a dolphin is a very emotional experience and it is different for every body; and it depends upon your state of mind. [One skin diver is clapping his fingers in front the face of a dolphin while the dolphin is observing him. Two scuba divers are staying in front of one dolphin].

00:06:00-00:06:30: I have studied and gathered evidence that dolphins can
have an up lifting effect on the human spirit to such extent that they can help people with depression. Now why should they do that? I think is because they are on the same emotional level as the person who is suffering. If you go down and you look in to the eye of a dolphin under the sea you are aware that there is intelligence there, there is a relationship there, and there is an emotion there. [Dr Horace Dobbs is explaining smiling his theories about dolphins. Two scuba divers are near the surface next to a dolphin].

Incident 1: Accompanied Rescue by Dolphins

- 00:00:00-00:00:30: One of the incredible animal rescue stories and her friend Mark planned to spend their day swimming off the coast of Durban, South Africa. Doris says, “It was perfect weather and we decided to go swimming in the sea.”

- 00:00:30-00:00:00: As they swam, Doris and Mark did not realize that they were swimming in the company of dolphins. Doris saw something unusual and called Mark.

- 00:00:30-00:00:30: As they swam, Doris and Mark did not realize that they were swimming in the company of dolphins. Doris saw something unusual and called Mark. Doris turned and looked back and saw that a large group of dolphins was following them. Mark was also holding a camera and started filming the scene. Mark realized that they were alone and asked Doris to start going back. Doris started swimming towards the surface, but they were followed by a group of dolphins. The dolphins were swimming near them, and they were both amazed by the presence of these beautiful creatures.

- 00:00:30-00:00:30: As they swam, Doris and Mark did not realize that they were swimming in the company of dolphins. Doris saw something unusual and called Mark.

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- 00:00:30-00:00:30: As they swam, Doris and Mark did not realize that they were swimming in the company of dolphins. Doris saw something unusual and called Mark.
3. Appendix: Sample of the search results for the *aquatic environment’s* child node ‘river’.

<table>
<thead>
<tr>
<th>Doc 'video narrative 11', 1 passage, 127 characters. Section 0, Paragraph 3, 127 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A helicopter emergency team came to rescue a family. An entire family was trapped in Indianapolis’ river for nearly two hours.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doc 'video narrative 12', 1 passages, 99 characters. Section 0, Paragraph 3, 99 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three young stowaways are trying to pass the river that is the pure border between Mexico and USA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doc 'video narrative 13', 1 passages, 147 characters. Section 0, Paragraph 3, 147 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>During a day the face of a middle aged lady appears behind the slightly opened window of an almost upside down car in a flooded river in Istanbul.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doc 'video narrative 14', 1 passages, 229 characters. Section 0, Paragraph 3, 229 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A local family constituted by white father, mother and the young son, were in the car on a bridge that was above a river. Due to the non-stop for days raining, the flood was becoming very dangerous and the water level very high.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doc 'video narrative 15', 1 passages, 80 characters. Section 0, Paragraph 5, 80 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seventy yards up the river, amateur prospector Link Hill was searching for gold</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doc 'video narrative 2', 1 passages, 121 characters. Section 0, Paragraph 3, 121 characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Trader is getting in a specialized barrel that is left in the water in then it is falling from the Niagara’s Falls.</td>
</tr>
</tbody>
</table>
4. Appendix: Informed Consent Form

| Study title: 'The 4W model of drowning for lifesaving of non-aquatic & swimming activities' |
| Name of Researcher: Stathis Avramidis | Type of Research: Interview |

1. Please tick (√) all boxes and date and sign twice, where indicated below (X):

| A. | I confirm that I have read and understood the information sheet for the above study and understand what is expected of me………………………… |
| B. | I understand that my participation is voluntary. I also understand that I am free to withdraw at any time, without affecting my involvement on the expedition, legal rights, medical care or any aspect of my employment …… |
| C. | I understand that my employer will not be made party to any personal contribution that I make to interviews. I also agree that any written record of my contribution(s) will be anonymised by use of a false name …………… |
| D. | I confirm that I have been given the opportunity to ask questions regarding the study and, if asked, my questions were answered adequately and to my full satisfaction ……………………………………………………………………… |
| E. | I give my consent to the audio-taping of the interviews ………………… |
| F. | I agree to take part in the above study and to check that the typed versions of my contributions are accurate ………………………………………………………… |

Your name (PRINT) Date Signature: 

Researcher’s name (PRINT) Date Signature: 

Data Protection Act
I understand that data collected about me during my participation in this study will be stored on computer, and that any files containing information about me will be made anonymous.

I agree to the Leeds Metropolitan University recording and processing this information about my experiences. I understand that this information will be used only for the purpose of this study and my consent is conditional upon the University complying with its duties and obligations under the Data Protection Act.

Signature: X ……………………………………… Date: …………………
Witness: X ……………………………………… Date: …………………
5. Appendix: Participant Information Sheet

<table>
<thead>
<tr>
<th>PARTICIPANT INFORMATION SHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher: Stathis Avramidis</td>
</tr>
</tbody>
</table>

**Study Title**
The 4W model of drowning for lifesaving of non-aquatic & swimming activities

**Invitation to Participate**
You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask Stathis Avramidis (contact details on the last page) if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

**Purpose of the Study**
Drowning is a leading cause of death worldwide often occurring even in life guarded aquatic areas. The project is aimed to locate aquatic professionals, like you, who have faced aquatic emergencies in order to develop a risk classification for drowning and to investigate which risk factors and combination of factors contribute to drowning.

**Why have I been invited?**
You have been invited to participate to be interviewed because you are an aquatic professional and you have to describe a drowning incident. We expect to be talking to other aquatic professionals as well (hopefully up to 50 from various aquatic environments like sea, swimming pool, lake and water park).

**Do I have to take part?**
It is up to you to decide whether or not to take part in this research. If you do decide to take part you will be given this information sheet to keep and be asked to sign the enclosed Consent Form (you will be given a copy for your records). If you decide to take part, you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part or not answer a question, without giving a reason will not affect you in any way.

**What will happen to me if I take part?**
This study is based on what we call 'qualitative research'. This involves talking with people, and understanding how they feel and think. To do this, we need to talk to you and ask questions related to drowning, particularly any you have witnessed or experienced. This interview should last 40-60 minutes and will take place in a neutral venue, one where you feel comfortable and are able to express your opinions and feelings.

The interview will be tape-recorded. Once we have finished our interview, the interviewer will type the interview, which will be anonymised so you will not be identifiable from the typed sheets. At a subsequent meeting you will be asked to check the transcript for any inaccuracies, which will be amended to your approval. You will then be asked to sign the transcript to show it is a true record. Afterwards, the interview tape will be destroyed using the formal procedure set out by Leeds Metropolitan University.
What happens if I withdraw from the research?
If you decide to withdraw from the research, there are two options. The first is that any comments or details about you will not be included. The second is that you make no further contributions. You decide the level of your withdrawal. In the second option, existing contributions will be used in the analysis, but your name will not be included.

What do I have to do?
Other than talking to the researchers about your experiences, nothing else will be involved for you such as medical or lifestyle restrictions.

What are the possible disadvantages and risks of taking part?
There should be no disadvantages for you in taking part in this research except for the time taken to complete the interviews. The interview will last about one hour or so but we can take longer if you find it helpful to talk about your experiences. The interview style is designed to be supportive. It is not expected that you will discuss disturbing experiences, but this would be your choice.

What are the possible benefits of taking part?
The benefit for you to participate in this study is that you will be given an opportunity to talk about your experiences and concerns. Other than this, you will not receive any other direct benefit by taking part. The biggest benefit of the study is to help the development of a model for risk assessment and lifesaving education on drowning. Your anonymised interview will contribute to that model.

What happens when the research study stops?
I can send you a summary of the findings, if you are interested. Please ask me about how you can receive a copy at the end of the interview.

What happens when the research goes wrong?
No treatment is being given so nothing should go wrong.

What happens if I don’t wish to answer any question during the interview?
Simple. You don’t have to. You do not have to give any reason for this.

Will my taking part in this study be kept confidential?
All information, which is collected about you during the course of the research, will be kept strictly confidential. What you say will remain confidential and will not be disclosed to others so you can be linked to the comments.

What will happen to the results of the research study?
The results of this study will be stored at Leeds Metropolitan University. Research papers will be published in academic journals. All data will be held by the researcher, Stathis Avramidis, and kept secure in a locked filing cabinet. Once the data are all analysed and the thesis completed, all records will be deleted.

What do I do if I have a complaint about this research?
You can contact Professor Carlton Cooke, who is independent to the project but who is a member of the university should you wish to do so for any reason. You can contact him at the Leeds Metropolitan University, Carnegie Faculty of Sports and Education, Headingley Campus, LEEDS, LS6 3QS. England. Tel +442832600, Email: C.Cooke@leedsmet.ac.uk
### Who has reviewed the study?
The Carnegie Faculty Research Ethics Committee of Leeds Metropolitan University has reviewed this study.

### Contact details for further information and what happens now?
Stathis Avramidis (telephone +30 210-4123323, El. Venizelou 125a, Kastella Pireas 18533, Greece, S.Avramidis@leedsmet.ac.uk) would be happy to discuss and try and solve any problems which you might have with this research.

### What next?
We will contact you about 2 weeks after you receive this. That will give you time to read through this information and think again about whether you would like to participate. Please feel free to discuss any questions or concerns, which you might have. At this time, please return the enclosed Consent Form (after you have signed and dated it) in the enclosed self-addressed envelope. At your first interview, your interviewer will give you a copy of the Consent Form (after they have signed it). You can keep this copy for your records. Once we have your signed Consent Form we can organize interview times at the place of your choice. Thank you for reading this information and hopefully taking part in this exciting project that will allow us to extract useful information about aquatic emergencies.
6. Appendix: Pen Portraits

Below there is a brief description of the interviewee people that participated in the semi-structured interview. This section was included in an effort to describe more comprehensively the background of the participants. Interviewees have been referred similarly in another study (Dart, 2001). The identifiers have changed in order to maintain confidentiality and anonymity.

**Interviewee #1**: He is a volunteer first aider that prides himself for his long services in the Rescue Corps. He has attended only a 16-hour theoretical water safety program, where he learned the water safety code. His age, doesn’t allow him to participate in activities that require physical fitness and strength.

**Interviewee #2**: He is a professional beach lifeguard having worked many years as volunteer. He is national champion and member of the national water polo team in young age groups. He tries to update his knowledge and is keen in learning about lifeguarding. He has experiences from two countries.

**Interviewee #3**: He is not a skillful lifeguard neither a very good swimmer. However he has many years of working experience as beach lifeguard and has saved many people.

**Interviewee #4**: He is a part time scuba diving instructor without many experiences in rescue.

**Interviewee #5**: He has 6 years of experience in three countries as lifeguard instructor, lifeguard and author. He has worked in waterparks and swimming pools, rivers, and a beach.

**Interviewee #6**: He is a Dive Master scuba diver and has done many dives in the past. He knows all the safety rules but he is not very competent swimmer.

**Interviewee #7**: He is a very qualified person but not so very knowledgeable. He works as a beach or waterpark lifeguard mainly for financial reasons and not full time. He has education from instructors from two different countries. He has few years of work experience and a number of rescue stories to tell.

**Interviewee #8**: He is qualified from organizations in two different countries as beach lifeguard. He maintains a very healthy lifestyle, although he needs to work after his duty as beach lifeguard in a restaurant. He exercises regularly in the gym, but he lacks swimming skills and speed. He wants to prove that he is capable in doing things and dealing with issues related to his beach lifeguard position. He never had the chance to do staff training at the workplace but he is retrained every 2 years for renewing his qualification.

**Interviewee #9**: He is a no educated person, who works as beach lifeguard during the summer for few years, but he doesn’t have fundamental knowledge in rescue and first aid techniques.

**Interviewee #10**: He is a very experienced, mature beach lifeguard having worked for over 20 years. He is not competent swimmer, his body is not fit, and in fact he has some extra weight but he is able to prevent accidents before they happen. He never had the chance to do staff training at his workplace during each summer season but he is retrained every two years for renewing his qualification. He has faced many
aquatic emergencies and is able to teach the younger lifeguards of his team using his experiences.

**Interviewee #11**: She is a very clever person having worked many years as beach lifeguard. However, she is not qualified properly from a recognized lifeguard agency.

**Interviewee #12**: She is a professional beach lifeguard and physiotherapist. She has saved, during her 8 years work experience, over 80 people in the sea. She prides to be vigilant although she was not very well trained before she becomes qualified. She never had the chance to do staff training at her workplace.

**Interviewee #13**: Although he holds an advanced certificate in beach lifeguarding and teaching, having also work experienced at the beach and in a waterpark, he is not a very dedicated 'lifesaving person'.

**Interviewee #14**: He is a very clever and competent waterpark lifeguard with 5 years work experience in two countries. He is excellent swimmer up to national level in his country, and has done many times staff training, and qualification updates.

**Interviewee #15**: He never had the chance to do staff training at her workplace. He is a beach lifeguard with not so quality training from the organization that certified him. Most of his knowledge comes from his work experience.

**Interviewee #16**: He never had the chance to do staff training at her workplace. Although he works as beach lifeguard for few years, he is not a qualified lifeguard.

**Interviewee #17**: He never had the chance to do staff training at his workplace. He is very poorly trained from the awarding body that qualified him as beach lifeguard. Lifeguarding is his second profession; his main profession is delivery boy in take away food.

**Interviewee #18**: He is a Dive Master scuba diver that likes to go diving quit often joining his local scuba diving school. He works as bus driver

**Interviewee #19**: He is a very experienced swimming tutor and swimming club coach. Although he was never a swimmer himself, he has develop through the years a very positive attitude, talent and expertise in swimming teaching.

**Interviewee #20**: He is assistant manager and qualified pool lifeguard having worked few years in the indoor aquatic industry of his country. He has developed water safety since but he is not very much competent in swimming. He could be considered as average swimmer and definitely no competitive.

**Interviewee #21**: He is a very experienced scuba diver for many years. He is nationally known for his scuba diving expertise and owns a very successful scuba diving school.

**Interviewee #22**: He is a professional doctor and amateur scuba diver. He is a very accurate person in his descriptions.

**Interviewee #23**: She is the owner of a scuba diving school. She has seen a lot of training sessions in scuba diving, taking part and also is conscious about water safety prevention. She is not qualified neither have the aquatic skills to help someone into difficulties into the water.
Interviewee #24: He is a very experienced, mature person having many years of work experience as beach lifeguard. He has dealt with many aquatic emergencies either successfully or unsuccessfully.

Interviewee #25: He is young but has experiences either personally or through his father. He is responsible and shows maturity in water safety issues. He has worked only 1 summer as waterpark lifeguard.

Interviewee #26: He has 1 year of work experience as waterpark lifeguard, is not competent swimmer and not very knowledgeable but he has been involved in several emergencies because a member of his family is chief lifeguard in his town.

Interviewee #27: She has few years of experience as athlete of sailing a little while before the incident that she described. She has a brilliant sporting career as athlete having won several international championships. She is a respected and good person in character keen to help others.

Interviewee #28: He is a very strong person having worked at the beach for quite few years. He had many incidents in his carrier, although he is not a very good in first aid and rescue.

Interviewee #29: He has 6 years of experience as lifeguard instructor, lifeguard and author. He has worked in waterparks and swimming pools. He likes being professional and believes that 'lifeguarding is something very important'.

Interviewee #30: He is a volunteer beach lifeguard with many years of work experience. He is an excellent swimmer.

Interviewee #31: He has learned beach lifeguarding from two countries, and plays competitive water polo.

Interviewee #32: He is a very competent swimmer, beach lifeguard and seeks to always update his knowledge in lifeguarding.

Interviewee #33: He is a very modest person and an excellent swimmer. He studies Sport Science and Physical Education and has few years of work experience as beach lifeguard in coastal areas of the island where he comes from.

Interviewee #34: He is a very clever person that loves aquatic activities. He was a very competitive swimmer and member of the Men’s water polo team in his area. He works on volunteer basis as a beach lifeguard every summer.

The first column contains the ranked factor combinations, the second column the observed interrelationships, and the rest four the number of times these factors actually interrelated. The more times two factors interrelated, the higher rank have. The pair with the most relationships ranks 6 and the pair with the less relationships ranks 1. The factors (in order of significance) that determine the outcome of a drowning incident is the rescuer (29 rankings), the casualty (20 rankings), the place of occurrence (19 rankings) and the circumstances under which it will occur (16 rankings). The results come from the videos (upper scale) and the interviews (lower scale).

<table>
<thead>
<tr>
<th>Ranked factor combinations</th>
<th>Observed interrelationships (n)</th>
<th>Rescuer</th>
<th>Casualty</th>
<th>Wherever</th>
<th>Whatever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Videos (n = 41)</td>
<td></td>
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<td></td>
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<tr>
<td>6 Rescuer-Whatever</td>
<td>359</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>5 Rescuer-Casualty</td>
<td>303</td>
<td>5</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4 Casualty-Wherever</td>
<td>237</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>3 Rescuer-Wherever</td>
<td>230</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2 Wherever-Whatever</td>
<td>192</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 Casualty-Whatever</td>
<td>104</td>
<td>-</td>
<td>1</td>
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<td>1</td>
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<tr>
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<td>1425</td>
<td>14</td>
<td>10</td>
<td>9</td>
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<tr>
<td>Interviews (n = 34)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Rescuer-Wherever</td>
<td>58</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>5 Rescuer-Casualty</td>
<td>58</td>
<td>5</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4 Rescuer-Whatever</td>
<td>36</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>3 Casualty-Wherever</td>
<td>27</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
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<tr>
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<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>1 Wherever-Whatever</td>
<td>11</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Total</td>
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<td>15</td>
<td>10</td>
<td>10</td>
<td>7</td>
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<tr>
<td>Grand Total</td>
<td>1631</td>
<td>29</td>
<td>20</td>
<td>19</td>
<td>16</td>
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</table>

From the above table the following pairs (in order of significance) appear to contribute to the drowning incident:

1. ranking 5: ‘rescuer-casualty’;
2. ranking 6: ‘rescuer—whatever’ and ‘rescuer—wherever’;
3. ranking 4: ‘casualty—wherever’ and ‘rescuer—whatever’;
4. ranking 3: ‘rescuer wherever’ and ‘casualty—wherever’;
5. ranking 2: ‘wherever—whatever’ and ‘casualty—whatever’;
6. ranking 1: ‘casualty—whatever’ and ‘wherever—whatever’.

The pairs of factors ‘rescuer—whatever’ and ‘rescuer—wherever’ got 6 rankings (with 359 and 58 relationships from the videos and the interviews respectively), making their interrelationship the second most important after the pair ‘rescuer-casualty’ (5 rankings in both studies, 303 and 58 interrelationships in videos and interviews).
respectively). However, the pair ‘rescuer–whatever’ reappears in the third place (4 rankings, 36 interrelationships in the interviews) and the pair ‘rescuer-wherever’ reappears in the fourth place (3 rankings, 230 interrelationships in the videos). Similarly, the pair ‘wherever-whatever’ appears in the fifth place (2 rankings, 192 interrelationships in the videos) and in the sixth place (1 point, 11 interrelationships in the interviews). The pair ‘casualty- whatever’ appears in the fifth place (2 rankings, 16 interrelationships in the interviews) and in the sixth place (1 point, 104 interrelationships in the videos). From all the above it seems that apart of the pair ‘rescuer- casualty’ all the rest pairs, do not provide enough evidence, at least in the current two samples, for establishing them as the next most important contributing factors for the outcome of a drowning incident. Therefore further research is required.

The only well established relationship among the factors was between the rescuer and the casualty ranking always highly in the above list (getting 5 rankings in both studies). This means that in an aquatic emergency, it is important to consider ‘who’ is going to save ‘whom’.

The next two important interrelationships in the above list have the same degree of importance (getting 6 rankings) but each of them appeared to be important only in one study and not in both (e.g. videos and interviews) like the pair rescuer-casualty. This means that further research is required. The first shows that it is vital to know under what circumstances the rescuer will perform the rescue. For example a professional lifeguard, armed with equipment, detection systems, or trained in recognizing the Instinctive Drowning Response is more likely to safe a drowning casualty who is in difficulties. On the other hand, an amateur lifesaver might not see a non-swimmer drowning during a weekday night, because he cannot detect the casualty who is unable to shout for help and none will be present to inform him about the emergency.

The final pair of contributing factors (getting 6 rankings) shows that the aquatic environment where the rescuer will perform the rescue can determine the outcome of the drowning. For example if a person drowns in shallow water, then it is more likely that someone, even an untrained bystander might be able to perform a successful rescue. On the other hand, if the rescue takes place during raining in a wavy sea and the rescuer is not well equipped, then, it is more likely that drowning will lead to a fatality.
8. Appendix: The Interrelated Variables of the pair ‘Rescuer – Casualty’, Explain what Characteristics had to Have the Rescuer to Perform a Rescue to a Casualty with Certain Other Characteristics.

<table>
<thead>
<tr>
<th>Casualty</th>
<th>Multi-ethnic</th>
<th>Unconscious</th>
<th>Injured</th>
<th>Weak</th>
<th>Non-swim</th>
<th>Casualty Type</th>
<th>Risky Behaviour</th>
<th>Occupation</th>
<th>Non-residence</th>
<th>Residence</th>
<th>Background</th>
<th>Ethnic</th>
<th>Female</th>
<th>Male</th>
<th>Elderly</th>
<th>Middle Aged</th>
<th>Young</th>
<th>Disabled</th>
<th>Water Fitness</th>
<th>Bad Physical Fitness</th>
<th>Good Physical Fitness</th>
<th>Rescuer</th>
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<tbody>
<tr>
<td>Young</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Middle Aged</td>
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9. Appendix: The relationships between the variables of the 4W model.

The variables that constitute the 4W model are the rescuer, the casualty, the place of occurrence, and the circumstances under which the drowning incident might take part. All variables interrelated, an indication that to understand drowning, and to avoid or cope with an aquatic emergency is a complex task. The numbers are based on the sample that was used in the videos and the interviews chapters (n=75).

![Diagram showing the relationships between the variables of the 4W model]