

# Study of water drowning death patients on clinical care and prevention

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## 수중익사 사망 환자의 임상 치료 및 예방에 대한 연구

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**Abstract** The purpose of this study was to investigate drowning death patients on clinical care and prevention. Drowning accidents that occurred in the Republic of Korea were identified by using the Emergency Activity Daily Report Data from the National Emergency Management Agency (NEMA). The age of drowning accidents was 20-29 years (25.4%). Drowning cases for the months of August was 17.6%. The main circumstance involved in the drowning cases was swimming (45.0%). Half of swimming incidents related the drowning accidents of people attempting to save a life of a family member or friend from the water. The most common location was at a lake or reservoir (40.2%). Drowning is a main cause of accidents in the Republic of Korea. Preventive strategies that may be beneficial for persons contain life jackets or life rings supply, upgrading swimming ability, placing lifeguards based on public education activities.

**Key Words** : Prevention, Clinical, Care, Drowning, NEMA

요 약 본 연구의 목적은 수중익사 사망 환자의 임상 치료 및 예방을 알아보고자 하였다. 수중 익사 사고는 소방 방재청에서 사용한 구급 활동 일일 보고서 데이터를 사용하여 확인 하였다. 소방 방재청 통계에서 익사 사고의 특성을 확인했다. 익사 사고의 나이, 날짜, 원인, 위치, 시간 및 사례 조사 하였다. 또한, 검색은 자연적인 원인과 사례를 찾고 NEMA 웹 사이트의 수집했다. 익사 사고의 나이는 20~29년 (25.4 %)이었다. 8월 익사의 경우는 17.6 %였다. 7, 8월 즉 여름에 익사 사고의 약 30%가 발생했다. 물에 빠진 경우에 수영과 관련된 사고가 45.0 %이었다. 수영과 우발적 사고의 절반은 물에서 가족이나 친구를 구출하려고 시도하는 사람의 익사 사고를 포함되었다. 가장 일반적인 위치는 호수나 저수지에서 40.2%이었다. 호수와 해변에 있는 사람들에 대한 인명 구조, 장비 또는 구명조끼가 없었다. 익사 사고는 14시-18시 사이에 가장 많이 발생했다. 익사는 한국의 상해와 관련된 사고의 주요 원인이다. 대한 민국에서 익사의 특성을 이해하는 것은 예방 전략을 개발하는 것이 필요하다. 예방 전략으로 구명조끼 및 구명기 설치 의무화, 안전교육 활성화, 수영 능력 향상, 인명구조인력 배치 증가 등이 있다.

주제어 : 수중익사, 사망 환자, 임상 치료, 예방, 소방 방재청

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## 1. Introduction

Drowning accidents have steadily increased every year and is the second cause of unintentional injury or death globally after traffic accidents and fall injuries [1, 2]. An estimated 449,000 people drowned worldwide [3]. Strategies to prevent these accidents rely on features of the victim and the specific circumstances, which may be different by country. For example, drowning accidents in the pool are an important cause among toddlers in many developed countries. Four-sided pool fencing, which isolates a pool from the home, is an effective prevention strategy. But, fencing did not help preventing the drownings frequency, primarily in those situations which the pool can be accessed by toddlers without authorization. Disposing lifeguards is a good strategy for older age groups, however, it is impossible for lifeguards to deal with everyone all the times [4].

A preventive strategy that should be very helpful for people of all ages and under almost all kind of circumstances, is developing swimming ability. However, a definite relationship between increased swimming ability and decreased risk of drowning has never been proved. According to data, lots of drowning victims could swim [5]. As evidenced by the shortage of patents citations, most of researchers rarely use a few patent databases. Therefore, significant potential methods to prevent drowning could be ignored. Thus, this study seeks to report the current evidence using the data from the National Emergency Management Agency (NEMA) about the incidence and characteristics of drowning with regard to the preventive strategies and accidents of drowning in Republic of Korea.

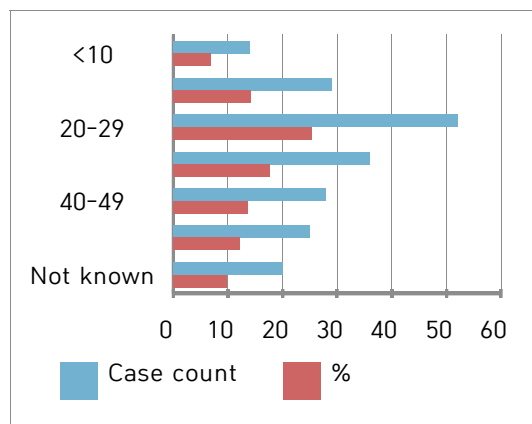
## 2. Methods

This study focused its search on the clinical care, subjects' age, accidental month, cause of drowning, location of drowning, and time of drowning. The factor

of clinical care included the drowning time, the CPR time, initial body temperature and the patient transport time. In this research a study used the Republic of Korea with the Emergency Activity Daily Report Data from the NEMA. Drowning accidents occurred from first of January to thirty-first of December in 2014. The NEMA records were searched to identify drowning accidents including any of the mechanisms including age, weather, date, cause, location and time. For each of the drowning cases that was closed, the unit record file on the NEMA website was inspected. This information was coded and entered into an Excel file, which was then combined with the Statistical Package for the Social Science WIN version 13 (SPSS) file based on the original information obtained from NEMA. NEMA statistics information indicates that 204 drowning accidents occurred in Korea during 2014[6].

The files were then imported into SPSS and analyzed, primarily using frequency tables, cross tabulations and text searching.

## 3. Results



The number of drowning victims was total 204.

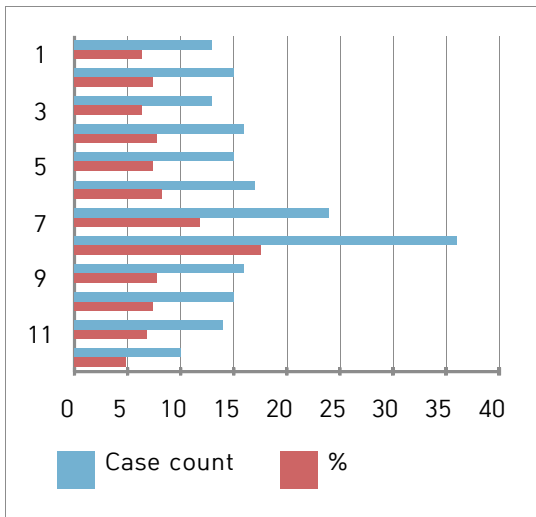
The number of drowning victims under age 10 was 14 (6.8%) with a lack of risk factor recognition. The age of drowning accidents for victims aged 20-29 was

25.4%, and for victims aged 30-39 years, 17.6%. [Fig. 1].

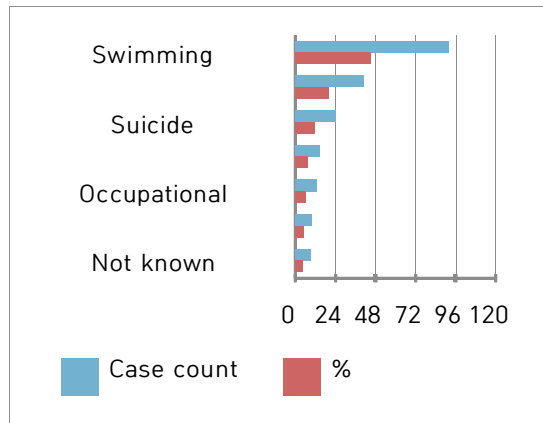
<Table 1> The clinical care record of the drowning deaths

Categories	M(SD)
Drowning time	9.4(4.23)
CPR time	7.6(1.94)
Body temperature (°C)	12.1(4.30)
Transport time	38.6(6.65)

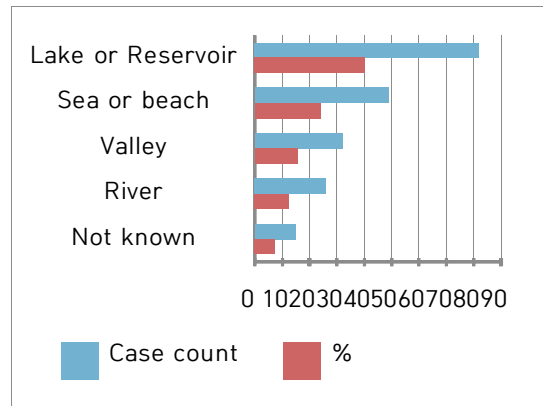
There is the clinical care record of the drowning deaths. The drowning time is  $25.3 \pm 7.34$  min. The CPR time is  $25.8 \pm 8.76$  min, initial body temperature is  $33.2 \pm 5.72$  (°C), The patient transport time is  $9.31 \pm 3.54$  min <Table 1>.



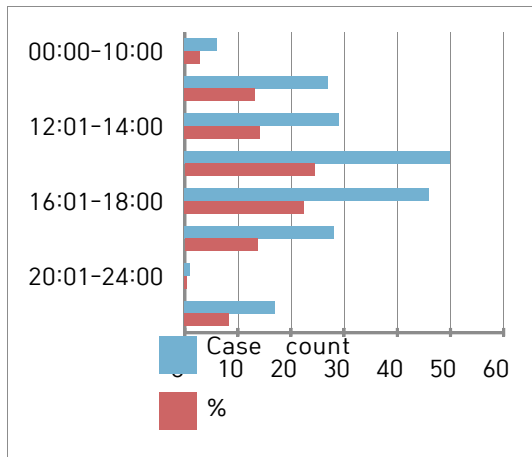
Two hundred and four accidents were identified in NEMA that were due to drowning. The months with the most drowning cases were June(8.3%), July(11.8%), August(17.6%), and September (7.8%). Nearly half (45.5%) of the drowning accidents occurred during summer [Fig. 2].



The main factor involved in the drowning cases were swimming (45.0%), incidental (20.1%), suicide (11.8%), water-related activity (7.4%), occupational (6.4%), alcohol( 4.9%), not known (4.4%). Alcohol factors of causes meant situation that people lost their judgment and acting power. Half of swimming and incidental drownings involved reports of the drowning of people attempting to rescue family or friend in the water. Almost half of the drowning accidents came out during recreational swimming activities [Fig. 3].



The most common locations were at or near a lake or reservoir (40.2%), sea or beach (24.0%), valley (15.7%), river (12.7%) [Fig. 4].



More drowning occurred between 12:00-18:00. In the morning, the quantity of life guards can be reduced. Swimming after 18:00 is the period when more drowning occur due to carelessness [Fig. 5].

#### 4. Discussion

Strategic safety facilities need to be put in place to reduce drowning. The estimated contribution was highest for people engaged in swimming (45%) and lowest in drowning due to occupation (12%). Also, Driscoll reported that none of the occupationally related drowning accidents were associated with alcohol. but there were only seven such cases and only three with valid blood alcohol measurements. So, this study didn't show the association of alcohol with occupation drowning accidents. But some studies reported that a contribution from alcohol has been estimated to occur between 25% to 50% of unintentional drowning accidents [7, 8, 9]. A widely used Australian assessment of drug-caused mortality and morbidity attributes about one-third of 'accidental drowning' accidents to alcohol [10]. This attributed fraction was based on information judged by those authors to provide sufficient evidence that alcohol is a risk factor for drowning, but insufficient to quantify the elevation

of drowning risk in relation to alcohol level. There is a lack of sufficient data concerning the involvement of alcohol as a risk factor for drowning.

Most drowning cases might come out in sunny warm weather. Almost half of drowning accidents came out during summer season [Fig. 2]. When developing preventive strategies, we must consider staffing requirements, lifeguards or public education regarding these important factors. The main circumstance types in the drowning accidents, that included people attempting to rescue a family or friend were swimming (45.0%), and incidental (20.1%). The new preventive strategies should consider the recreational swimmers because a large number of cases involve recreational swimming activities. In addition, the large numbers of people attempting to rescue others suggest that preventive strategies should be targeted at rescuers of drownings. Also, safety legislation or safety regulations about drowning accidents such as compulsory safety equipment and devices at every swimming areas might be potential solutions. [11, 12] Occupationally related drowning accounted for only 6.4% of drowning cases, but one would expect nearly all of these cases to be preventable. These cases resulted from persons working in or near a body of water and fell into the water and drowned. Prevention strategies of such occupational drowning would seem easily accomplished with a requirement for life preservers for workers operating in or near bodies of water.

Almost half of drowning accidents occurred during swimming and most commonly in lakes or reservoirs (40.2%), seas or beaches (24.0%), valleys (15.7%), and rivers (12.7%) [Fig. 4]. The facts that there are no lifeguards and rescue equipments at lakes or beaches are important. So, providing lifesaving equipment at every swimming areas might reduce the mortality[11, 12].

The detection of a person approaching, entering or becoming distressed in a body of water and providing an alarm has been the objective of a large number of

inventions. Pool door alarms, pool perimeter intrusion detection systems, pool alarms that detect changes in water level, pressure, etc. and wearable immersion alarms have been patented. One of the most advanced inventions among these is a system commercialized under the name Poseidon, which uses video monitoring and image processing technology to automatically recognize a swimmer in distress in a pool. It alerts lifeguards and pinpoints the victim's location on a monitor [13, 14]. Increasing swimming ability is not easy. But if it is possible, it should be effective in both developed and developing countries. It could reduce drowning risks in many situations for all age groups [15, 16, 17, 18]. Thus various strategies and interventions should be demanded to decrease the incidence of drowning accidents in Korea. The analysis presented here was based only on closed cases in NEMA. Regretfully, NEMA data were imperfect in partial information involving weather statistics and causes. So, we could not use roughly 50 cases. Finally, this study is based on the 204 cases with perfect informations.

## 5. Conclusion

Drowning is one major cause of injury related accidents in the Republic of Korea[16]. Comprehension of the features of drowning accidents in Korea is the first step to develop preventive strategies. Preventive strategies available for all ages' people under almost all circumstances are disposing lifeguards, providing life jackets or life rings and invigorating public education on the basis of developing swimming ability.

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