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RESEARCH

## FACTORS AFFECTING DROWNING-RELATED MORTALITY OF ELDERLY FOREIGNERS ACCORDING TO AUTOPSY RESULTS

### ABSTRACT

**Introduction:** We aimed to determine age-related factors associated with fatal drowning by analyzing the demographic data of drowning victims. In addition, we discuss possible measures to reduce drowning-associated deaths.

**Materials and Method:** We retrospectively reviewed autopsy reports of foreign tourists, who died due to drowning, and then, whose autopsy and pathological sampling were carried out in Antalya Forensic Medicine Institution. The included cases were divided into two groups; Group I comprised cases who were  $\geq 65$  years at the time of death, and Group II comprised cases  $< 65$  years. The groups were compared with respect to demographic data, water source from which they were taken out, season, narcotics, alcohol level and presence of coronary artery diseases.

**Results:** 48 of 89 cases that we included in the study account for Group I while the rest, 41 cases, account for Group II. Statistically significant difference was determined between the groups with respect to nationality, season, water source from which they were taken out, alcohol levels and coronary artery diseases ( $p < 0.05$ ). No statistically significant difference was determined between the groups with respect to gender, narcotics and BMI ( $p > 0.05$ ).

**Conclusion:** We therefore recommend that people, particularly those with CAD, choose mornings and afternoons for swimming, thereby avoiding the midday hours in which temperature and humidity are high. Furthermore, they should not strain their effort capacity and should avoid imbibing alcoholic drinks before swimming.

**Key Words:** Drowning; Aged; Autopsy; Mortality.



ARAŞTIRMA

## BOĞULMA NEDENİ İLE OTOPSİ YAPILAN YAŞLI YABANCI OLGULARINDA MORTALİTEYİ ETKİLEYEN FAKTÖRLER

### Öz

**Giriş:** Bu çalışmada suda boğulma vakalarında yaşla birlikte ortaya çıkan önlenebilir nedenleri belirleyerek ölümlerin azaltılması için alınması gereken önlemlerin tartışılması amaçlanmıştır.

**Gereç ve Yöntem:** Suda boğulma nedeni ile ölen ve Antalya adli tıp kurumunda açık otopsi ve patolojik örnekleme yapılan yabancı uyruklu turistlere ait otopsi raporları geriye dönük incelendi. Çalışmaya dahil edilen olgular 65 yaş ve üstü Grup I, 65 yaş altı olgular ise Grup II olarak iki gruba ayrıldı. gruplar demografik veriler, çıkarıldıkları su kaynağı, mevsim, uyuşturucu madde, alkol düzeyleri ve koroner arter hastalığı varlığı yönünden karşılaştırıldı.

**Bulgular:** Çalışmaya aldığımız 89 olgunun 48'i Grup I, 41'i Grup II'yi oluşturmuştur. Gruplar arasında uyruk, mevsimsel, çıkarıldıkları su kaynakları, alkol düzeyleri, koroner arter hastalığı yönünden istatistiksel olarak anlamlı fark tespit edildi ( $p < 0,05$ ). Cinsiyet, uyuşturucu madde ve BMI yönünden her iki grup arasında istatistiksel olarak anlamlı fark tespit edilmedi ( $p > 0,05$ ).

**Sonuç:** Özellikle yaşla birlikte termoregülatuar kapasitenin azalması ve komorbid hastalıkların eşlik etmesi nedeni ile yaşlı nüfusun, nemin ve sıcaklığın yüksek olduğu öğlen saatleri yerine sabah ve öğleden sonra suya girmeleri, efor kapasitelerini zorlamamaları ve suya girmeden önce alkol almamaları önerilmektedir.

**Anahtar Sözcükler:** Boğulma; Yaşlılık; Otopsi; Mortalite.



## INTRODUCTION

Drowning is ranked as the third most common cause of accidental death among all age groups combined. Approximately 500,000 drowning-related deaths per year occur worldwide (1). The World Health Organization defines old age as age  $\geq 65$  years. Currently, more than 10% of the population of developed countries comprises people  $\geq 65$  years of age. As age increases, there is a significant increase in the presence of chronic disease. In particular, the incidence of coronary artery disease (CAD) and cerebrovascular disease increases with age. It has been reported that cardiovascular disease and malignancy are the primary causes of death in old age but the incidence of death due to accident has decreased (2).

Antalya, a Mediterranean city in Turkey, is one of the most popular travel destinations in the world and is visited annually by over 10 million people, of which the majority are  $\geq 65$  years of age. In the present study, we aimed to determine age-related factors associated with fatal drowning in Antalya by analyzing the demographic data of drowning victims. In addition, we discuss possible measures to reduce drowning-associated deaths.

## MATERIALS AND METHOD

In the present study, autopsy reports of foreign individuals  $\geq 18$  years of age who died because of drowning between January 2012 and December 2014 and were autopsied at the Antalya Forensic Medicine Institution were reviewed retrospectively.

The included cases were divided into two groups; Group I comprised cases who were  $\geq 65$  years at the time of death, and Group II comprised cases  $< 65$  years. For each case, age, sex, nationality, weight, height, site of drowning (body of water), season, narcotic level, alcohol level, and presence of CAD were recorded. For CAD, pathology reports were reviewed for the presence of medium or advanced obstruction in the coronary arteries or the presence of cardiac scar tissue; the presence of either was considered to be CAD. Cases in which the manner of death was determined to be suicide or in which accidents were caused by water sports were excluded from the study.

## Statistical Analysis

Data were evaluated using the Statistical Package for the Social Sciences (SPSS) version 21 (IBM, USA). Frequency, mean  $\pm$  standard deviation, and percentages were calculated. The

chi-square test was used for comparisons. A  $p$ -value  $< 0.05$  was considered statistically significant in the chi-square test.

## RESULTS

Of the 89 cases included in the present study, 48 were in Group I and 41 were in Group II. The mean age in Group I and Group II was  $74.35 \pm 6.41$  years and  $45.95 \pm 14.02$  years, respectively. Group I was composed of 37 men (77.1%) and 11 women (22.9%), and Group II was composed of 32 men (78%) and 9 women (22%). There was no statistically significant difference between the groups with respect to sex ( $p > 0.05$ ).

With respect to season, in Group I, 26 cases drowned in the fall, 14 in the summer, and 8 in the spring; in Group II, 20 cases drowned in the summer, 11 in the spring, 9 in the fall, and 1 in the winter. A statistically significant difference was discovered between groups with respect to season ( $p < 0.05$ ) (Figure 1).

Time of death was significantly different ( $p = 0.038$ ) between groups; in Group I, 87.5% of cases ( $n = 42$ ) cases drowned around midday compared with 65.9% ( $n = 27$ ) in Group II.

With respect to the body of water, 47 cases in Group I drowned in the sea (97.9%), whereas only 30 cases in Group II drowned in the sea (73.1%). This difference was statistically significant ( $p = 0.008$ ) (Figure 2).

There was a statistically significant difference ( $p = 0.025$ ) between the groups with respect to nationality; 19 cases (39.5%) were German and 13 cases (27%) were Russian in

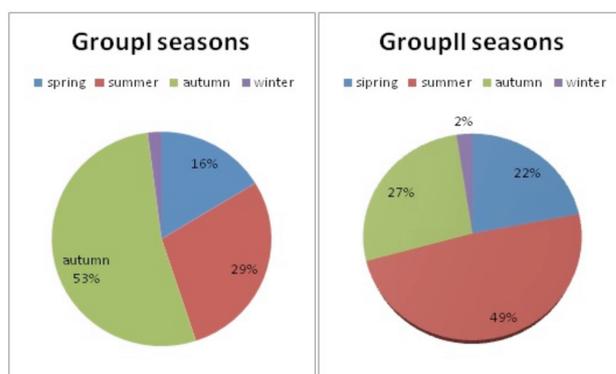


Figure 1— Distribution of cases depending on seasons.

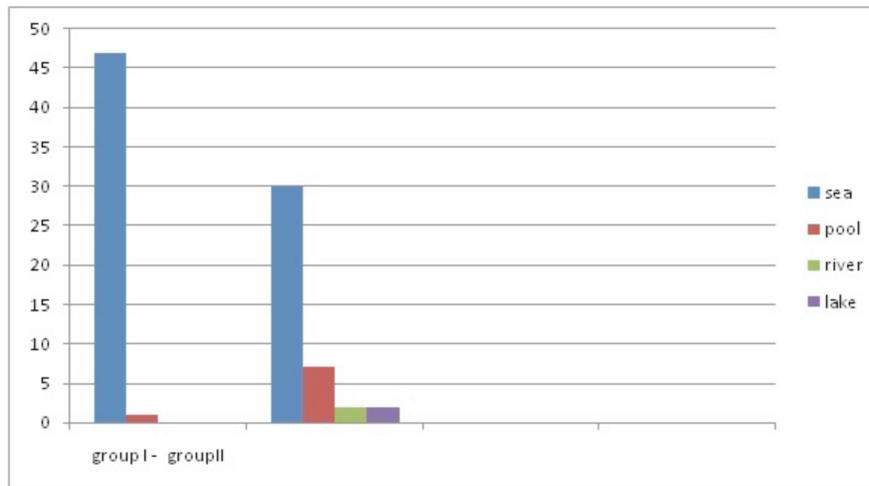


Figure 2— The place at which the cases happened.

Group I, whereas 14 cases (34.1%) were Russian, 7 cases (17%) were German, and 4 cases (9.7%) were Ukrainian in Group II (Table 1).

Significant differences were discovered between the groups with respect to the presence of alcohol ( $p=0.035$ ), blood alcohol level ( $p=0.02$ ), and CAD ( $p=0.01$ ) whereas no significant difference was found between the groups with respect to the use of narcotics ( $p=0.235$ ) and body mass index (BMI) ( $p=0.637$ ) (Table 2).

## DISCUSSION

Ageing is generally characterized as being in decline both physically and mentally. People at an older age are more susceptible to trauma because of the presence of chronic disease, which worsens with increasing age, and old age physiology (3).

Although most cases of accidental drowning in water are preventable, drowning is still the third most common cause of accidental death in all age groups combined. According to data from the 2010 Global Burden of Disease Study, the mean number of cases of drowning at an advanced age worldwide is 39.732 per year (4). Many studies in the literature emphasize childhood in cases of drowning (5,9); however, the elderly population is increasing, particularly in developed countries, and we must shift our attention to this demographic as well.

Studies have reported higher mortality rates for drowning in males across every age group. This is because male individuals

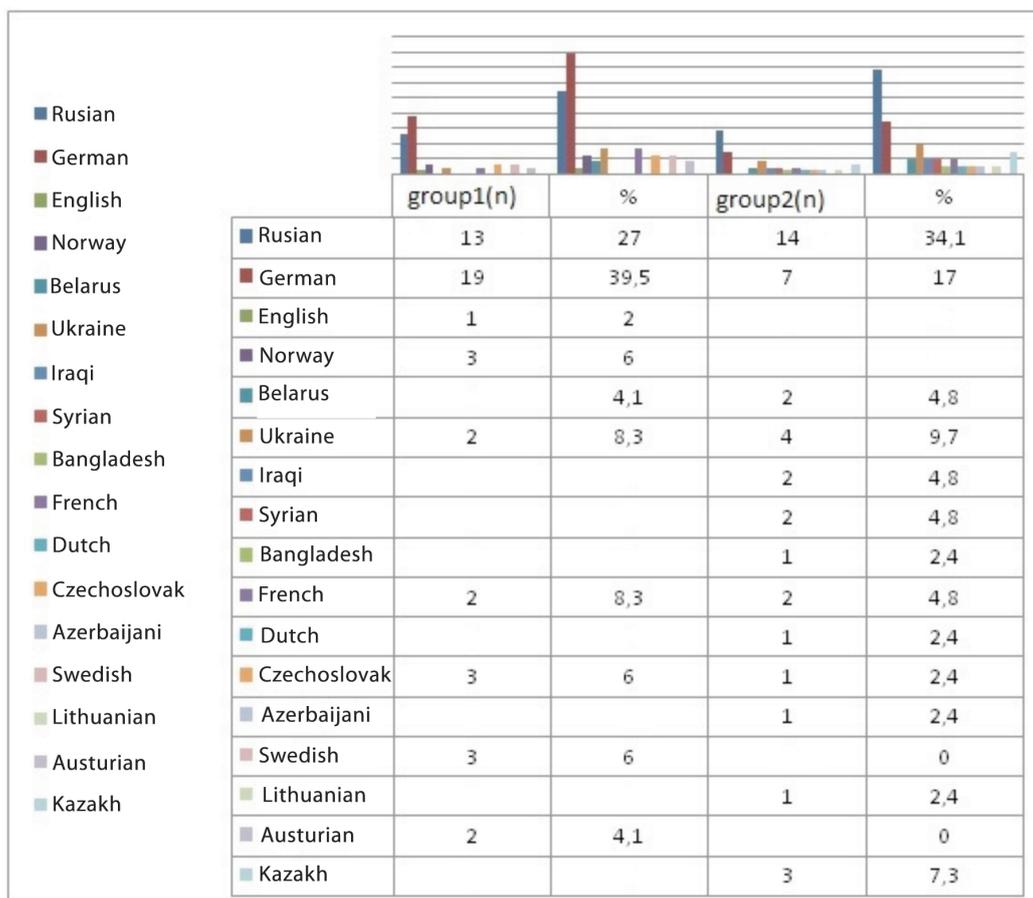
are more active in daily life, are involved in dangerous and/or high-risk activities, are encouraged to show unnecessary bravery, and particularly, they imbibe greater amounts of alcohol (1,6,7,8). Consistent with the literature, men in both groups of our study were more likely to drown than women.

In tourist destinations, particularly in the summer, drowning cases increase significantly because of the increase in swimming and sea activities (1,9,10). Although any study may report drowning in fresh water, drowning more frequently occurs in the sea in coastal destinations (11-13). Antalya, the source of the present study data, is a coastal town that is a particular popular global tourist destination. Drowning cases frequently occurred in the sea for both of the groups in our study. However, comparing the groups, 97.9% of the cases in Group I ( $n = 47$ ) versus 73.1% ( $n = 30$ ) of the cases in Group II occurred in the sea. We have associated this significant difference between the groups with the fact that elderly people are less active compared with the young, and they may avoid activities that require more courage and fitness, such as swimming in rivers and pools.

Temperature is the most important climatic element having an effect on almost every kind of human activity. When certain thresholds are exceeded, temperature affects the physical, physiological, and psychological conditions in humans. One study has reported that ambient temperature should be maintained between 16.7°C and 24.7°C for comfort with respect to climate for humans (14). In particular, because thermoregulatory capacity decreases in elderly people, excessive



**Table 1—** Distribution of The Groups Versus Nationality



temperature may cause an exacerbation of cardiovascular and cerebrovascular diseases (15). In our study, more drowning cases occurred during midday hours, when the sunlight is at a high angle, in both groups but particularly in Group I. In our region, the average temperature is much higher than is comfortable for many people, particularly during the summer and it often feels much hotter than the reported temperature because of the high humidity (16). We believe that the high temperature affects the individual's physical and physiological balance and causes drowning.

Regarding seasonality, in our study, most of the cases in Group I drowned in the fall followed by the summer, whereas the cases in Group II drowned mostly in the summer. We believe that the difference between the groups with respect to seasons is that the younger population prefer summers for vacation involving entertainment and intense activities, where-

as elderly people prefer fall vacations for peace and rest.

According to the data from the Antalya Culture and Tourism Directorate, the city was visited by an average of 10,976,075 foreign tourists every year between the years 2012 and 2014. Of these, 29.07% were Russian and 26.48% were German (17). In our study, drowning cases consisted of mostly German and Russian tourists. Most cases in Group I were German, and most cases in Group II were Russian. We have associated this with the fact that young people from Russia prefer our country for vacation compared with most older Germans.

Alcohol disturbs cognitive functions and causes problems with balance, and high alcohol intake is one of the most important preventable risks for drowning. In one study, it was reported that presence of alcohol in the blood was found in approximately 30%–40% of deaths resulting from drowning



**Table 2—** Comparison of The Groups With Respect to Alcohol, Narcotics, CAD and BMI

	Group I n: 48	Group II n: 41	p
Alcohol positivity	n: 11 (%23)	n: 18 (%44)	0.035
Promille (median±sd)	0.42±0.50.204	1.73±1.08.867	0.002
Narcotics positivity	n: 1 (%2)	n: 3 (%7)	0.235
CAD presence	n: 39 (%81.2)	n: 18 (%44)	0.001
BMI (median±sd)	30.3±5.3	30.1±5.7	0.637

(18). In a study conducted in New Zealand, alcohol was associated with 7.1% of drowning-related deaths in subjects older than 65 years versus 20.1% of cases for those 18–65 years of age (19). In our study, alcohol was present in 23% of Group I cases and 44% of Group II cases, which is consistent with the literature. The high blood alcohol level found in Group II was also significant between the young and old age groups.

Elderly persons' lesser alcohol intake, compared with the young, may be explained by the fact that they lead more sedentary lives and do not attend parties as often as young people do. Although alcohol was detected in a large proportion (23%) of the geriatric age group, the mean blood alcohol level of 0.42 permille (parts per 1000) was unlikely to cause serious cognitive disturbance and imbalance. However, it is a preventable risk.

The use of narcotics is associated with drowning-related mortality (20). In our study, non-narcotic drug use was found in three people in Group II: tetrahydrocannabinol was reported in two, and benzodiazepine use was reported in one. Benzodiazepine use was reported in one case in Group I.

Aging is associated with serious increases in cardiovascular, cerebrovascular, and respiratory diseases; in addition, because of the decrease in thermoregulatory capacity at older ages, the severity of comorbid disease is increased in the summer (15). Because such persons' effort capacity is reduced and swimming requires high effort, comorbid disease in association with the effect of high temperature and humidity is a serious risk factor. According to a study conducted in Japan, most of the drowning cases, particularly in the geriatric age group, occurred in bath tubs, and cardiovascular and cerebrovascular disease was frequently encountered during autopsy (21). In our study, CAD was found in 81.2% of cases in the geriatric age group, confirming that the presence of CAD is a serious risk factor for drowning.

Two-thirds of the adult population in the United States and at least half of the population of many other developed co-

untries are currently overweight or obese (22). A high BMI (calculated as the weight in kilograms divided by the square of the height in meters) is associated with increased mortality from heart disease, stroke, and many specific cancers, but the precise relationship between BMI and all-cause mortality remains uncertain (23). In our study, BMI was found to be at the threshold of obesity in both groups. Obesity may be a significant risk factor in drowning at any age because obesity decreases motion capacity and increases the risk of heart disease and stroke.

A limiting factor in our study is that only drowning cases involving foreign persons were included. This is because there is a legal requirement for autopsy in every case involving the death of a foreigner, whereas only external examination is required for Turkish citizens; thus, autopsy results and pathological and toxicological evaluation are not available in every case.

As conclusion; in the present study, drowning rates increase in the fall and summer, particularly during midday hours, during which time the increase in temperature and humidity lowers the thermoregulatory capacity of elderly people. Furthermore, additional comorbid diseases in the elderly, particularly the presence of CAD, as well as alcohol intake and obesity were discovered to be preventable serious risks. We therefore recommend that people, particularly those with CAD, choose mornings and afternoons for swimming, thereby avoiding the midday hours in which temperature and humidity are high. Furthermore, they should not strain their effort capacity and should avoid imbibing alcoholic drinks before swimming.

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a contribution to conception and design of article, GT is responsible of analyzing the data, BMS has a contribution of drafting the article, İK has a contribution to data acquisition.

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