Epidemiological Analysis of Drowning Deaths Among Different Groups in Jordan - a Retrospective Study (2015-2019)

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ABSTRACT

Background: According to the World Health Organization (WHO), drowning is globally considered as one of the leading causes of injury related deaths. Defined as the process of experiencing respiratory impairment from submersion in a liquid medium. Drowning is a public health concern in Jordan. This study aimed to investigate drowning incident data from the Forensic Medicine Teaching Centre in the North of Jordan for the purpose of defining high risk groups and circumstances around drowning fatalities which suffered an attention deficit. Objective: The study aims to describe the rate of fatal drowning in North of Jordan and to properly understand the risk factors associated with it. Methods: The present study is retrospective, based on investigating 2808 autopsy reports and selecting only 85 drowning related death reports conducted through a 5 year period (2015-2019) in the Forensic Medicine Teaching Centre which serves Northern Jordan including Irbid, Jarash, Ajloun, and Al-Mafraq. The statistical analysis of fatal drowning cases included the following risk variables: Age, gender, month, year, nationality, address, alcohol and drug consumption. Results: 15 variables were consistent and analyzed across the database of this study. The high risk groups and patterns were identified and the majority of fatal drowning cases were related to males (80.4%). Age group from (2 to 27 years of age were included in the high-risk groups with (88.2%) of all cases. Specifically, the age 2 had the highest occurring frequency. While (17.6%) of drowning fatalities occurred in August. Alcohol and drugs had no significant impact on increasing drowning rates. The dominant manner of death among all cases was accidental (95.3%). Fatal drowning rates were decreasing throughout the years of (2015-2019). Conclusion: Defining drowning high risk groups and its epidemiology helps to overcome this preventable cause of death. The current study highlights the necessity for the need of further interventions to be actively fixed into policies and educational programs and emphasize safety precautions during water activities and to improve the dataset collection for better planning of prevention strategies. Keywords: Drowning, Froth, Alcohol, Drug, Fatal, Jordan.

1. BACKGROUND

Drowning is the process of respiratory impairment by submersion of water or any other fluid medium with asphyxial basis (1). A study held by Kumar A et al. (2019) stated that according to the World Health Organization (WHO) drowning is considered as one of the leading causes of death related to injury (2). Investigation of drowned bodies is an important part of specific medico-legal requests which could be a very challenging issue (3), for there is no ideal diagnostic test to prove drowning as the definite cause of death (4), several tests and methods need to be established and investigated such as death circumstances, postmortem external examination of drowned bodies, investigation of autopsy findings through microscopic, toxicological and histological findings (4, 5).

To help in understanding the scope of this issue, focus should be placed on defining the major risk factors contributing to drowning (6). With an overview to the potential risk factors associated with fatal drowning, several retrospective studies were established to help in increasing awareness of the issue and to prevent it (7).
2. OBJECTIVE
This study aims to describe rates of fatal drownings in the North of Jordan, proper understanding of risk factors helps to guide identification of the best practice for the purpose of minimizing the lethal exposure to drowning.

3. MATERIALS AND METHODS

Study Design, sample and variables:
For the retrospective analysis proposed, a study was conducted in the Forensic Medicine Teaching Centre, Irbid, Jordan for a 5-years period (2015-2019). This center serves Northern Jordan including Irbid, Jarash, Ajloun, and Al-Mafraq. 2808 autopsy reports were assessed, and only drowning-related death cases were selected. The cases were evaluated according to Age, gender, month, year, manner of death, postmortem changes, nationality, address, mouth froth, lung froth, lung weight, the existence of rib markings and external signs of injury, alcohol and drug consumption.

Study procedure:
We obtained ethical approval from IRB at Faculty of medicine, Jordan University of science and technology, Irbid, Jordan. The data were collected from autopsy reports of all drowning related deaths in Northern Jordan from January 1, 2015 to December 31, 2019. The data were analyzed using SPSS version 25 and Microsoft Excel 2016. Descriptive statistics were used to describe study variables using frequencies, percentages, means, and standard deviations.

4. RESULTS
Over the 5-year span from 2015-2019, 85 drowning cases were admitted to the Forensic Medicine Teaching Centre, Irbid, Jordan. Autopsy protocols and death scene reports were available for all 85 drowning cases identified, along with pathological and toxicological findings which were carried out when needed.

Out of 15 variables were available for this study, most of them were consistent across the database. Collected data of variables included: Age, gender, month, year, manner of death, postmortem changes, nationality, address, mouth froth, lung froth, lung weight, the existence of rib markings and external signs of injury, and alcohol and drug consumption.

Drowning cases during the period of 2015-2019 (shown in table1) were classified in this study according to their association with risk factors.

When the manner of drowning deaths was tracked down among all 85 cases in this study, the majority of cases was found to be accidental with 81 cases out of 85, whereas both suicidal and homicidal cases reported only 2 cases for each of them.

Among drowning victims, there were 70 (80.4 %) male victims and 15 (17.6%) females. Regarding the total number of deaths caused by drowning, males accounted for the majority of cases. The age of victims ranged between 1 and 69 years old (mean 14.19 years), which clarifies that the most frequently involved age group with the highest risk to get drowned falls between the ages of (2 to 27 years 88.2%). The age 2 (9.4% of cases), showed the highest occurring frequency among all ages mentioned in this study. Followed by the age of 4 and 7 with a percentage of 7.1% for each, then the ages of 5 and 13 with a percentage of 5.9%. The least age group involved in drowning deaths was 1 year old and the age group of more than 53 years old with a percentage of only 1.2% for each (Figure 1).

When the month of drowning incidence was taken into consideration, the highest number of drowning cases occurred in August with 15 cases that make 17.6% of all cases. Followed by July with 13 cases and a percentage of 15.3%. The least commonly involved season was found to be December with only 2 cases that account for 2.4% of all cases. All of the 15 cases occurred in August were related to male victims. In July 11 cases out of 13 were related to male victims (84.6%) and only 2 cases belonged to females (15.4%), as shown in (Figure 2).

Between 2015 and 2019, 77 cases (90.6%) of all drowning deaths were related to Jordanians, followed by Syrians with 6 cases (7.1%) of all 85 cases, then Palestinians and Pakistanis with 1 case (1.2%) for each of them. 62 cases of 77 which belonged to Jordanians were males (80.5%), and 15 cases (19.5%) for females. Immigrants accounted for (9.4%), all of them were males (100%) (Figure 3).

Most of drowning fatalities took place in Irbid, 66 cases out of 85 (77.6%), followed by Mafraq with 15 cases (17.6%), Ajloun 3 cases (3.5%) and just one case in Jarash (1.2%).

Number of 5 cases out of 66 cases that occurred in Irbid (5.9%) showed signs of external injury during P.M. examination of drowned bodies, 2 of them (40%) were
males and 3 (60%) were females. No signs of external injury were present in the other locations where drowning cases took place.

When frothy fluids and external foam were looked for and classified during examination, the following observations were found: mouth froth was found in 63 cases out of 85 (74.1%) and absent in 22 (25.9%). Where lung froth data was found in 56 cases out of 68 (82.4%), absent in 12 (17.6%) and reported as not available in 17 cases. 56 cases out of 85 (82.4%) were found to have both lung and mouth froth.

Early signs of putrefaction were present in only 3 cases of all 85 cases which took place in the Al-Aghwar region, while the rest of 82 cases had an early postmortem change.

In this study, lung weight was measured in 30 cases with regard to age and gender only. Out of 27 cases out of 30 (90%) showed increase in lung weight, only 3 cases (10%) were recorded a value that falls in the normal range.

This study shows that among 67 cases; 53 (62.4%) of them had rib markings. 14 cases (16.5%) showed no rib markings.

Blood Alcohol Concentration (BAC) was measured in 45 cases out of 85 (52.9%) by analyzing a femoral vein sample and found positive in 5 cases (5.9%), negative in 40 cases (47.1%). None of the five positive cases had a concentration higher than 80mg/dL, the highest recorded was 52 mg/dL which had no contribution in drowning occurrence.

Victims who had BAC test positive fell in the age range of (18-34), two cases were related to males in the age of 24. 3 out of 5 cases (60%) which tested positive were related to male victims and 2 cases (40%) belonged to females, (Figure 4).

Number of 45 cases out of the total number of autopsies were tested for drug involvement, only one case reported positive for Carbamazepine, the detection of only one case has no statistical value.

Drowning rates are decreasing throughout the years, with 24 cases which make up 28.2% of all cases reported among the 5 years of study (2015-2019), where 2019 recorded a much lower rate with 12 drowning cases (14.1%).

5. DISCUSSION

In this study children were in the high-risk group, and the highest frequency referred to two-year-old children. Almost similar results were found in a study held in Ireland by Davey et al. showed that the majority of drowning cases affected children between the ages of 1-4 (8), other studies held by Evans et al. (9), Denny et al. (10), Wang et al. (11), and Raess et al. (12) showed that drowning mostly affected children under the age of 5 which comes in agreement with our findings. This result may have been caused by the absence of children strict supervision.

When gender variables were taken into consideration, this study showed that the majority of cases were related to male victims with 80% of all incidents which could be explained due to their increased exposure to water with the tend to act in a much riskier behavior like swimming alone. For the fact that other separate studies which were conducted in Australia by Wallis et al. (13), Staines & Smith (14), Cenderadewi et al. (15), and a study which was performed among Asian and African populations by Tyler et al. (16) showed that males were at a much higher risk to get drowned than females, and also a study conducted in china by Wang et al. (17) suggested the same results as found in this study and proved that males are at higher risk than females to get drowned.

With reference to the time of year that drowning deaths are most likely to occur, in this study when month incidence was observed through the 5-year period of study, it was found that August had the highest number of drowning fatalities. The least commonly involved season was December. This result is caused mainly because of swimming activities held during summer time with the lack of swimming ability among certain age groups. Several studies conducted in Ireland, France, Australia and china by Davey et al. (8), Bessereau et al. (18), Leavy et al. (19) and Liu et al. (20) respectively, together with a study held by Loux et al. (21) revealed that summer was the season with the highest percentage in regards to risk factors associated with fatal drownings compared to other months of the year which came out with agreement with the results of this study.
When the manner of drowning deaths was tracked down among all 85 cases in this study, the majority of cases was found to be accidental with 81 cases out of 85, whereas both suicidal and homicidal cases reported only 2 cases for each of them. Several studies held by Oshima et al. (40), Cenderadewi et al. (15), Chang and Smith (41) and Xu (42) found out that accidental drowning incidents had the highest percentage of occurrence compared to other modes of death as homicide and suicide.

As there is a unique challenge to calculate drowning rates among refugees and immigrants worldwide. This study showed that 77 cases (90.6%) of all drowning deaths were related to Jordanians, immigrants accounted for (9.4%). Only 8 cases (9.4%) of drowning cases belonged to nationalities other than Jordanians, 6 of them belonged to Syrians, and 2 other cases which belonged to a Palestinian and a Pakistani immigrant. All 8 cases represent drowning incidents related to working immigrant victims who constitute a minority among the Jordanian population. This group of immigrants tend to work in the industrial estate in Irbid. Where in other studies held by Gallinger et al. (22), Pidgeon et al. (23, 24), Bona et al. (25), and Zhu et al. (26) demonstrated that immigrants had a high risk of drowning among original citizens.

Alcohol as a well-known risk factor to drowning increases the chances of fatal drowning cases when present in a concentration that is higher than the legal dose (BAC ≥ 80 mg/dL) for its participation in hampering the ability of the victims to swim through the negative impact it has on vision and balance (27-29).

Several studies were performed on Alcohol abuse regarding drowning deaths as it plays a significant role in the participation of increasing drowning mortality rate. In this study routine toxicological analysis was carried out on each drowning case to determine BAC level, only 5 cases (5.9%) out of 45 were found positive for alcohol. This result is believed to be at this low value because of strong religious commitments and beliefs among Jordanian population. Where in contrast with our result in other studies carried out by Pajunen et al. (30), Peden et al. (31,32), Calverly et al. (33) and Craft& Button (34) discovered that BAC high values contributed magnificently in drowning deaths where Alcohol was found positive in a much higher percentages in their studies.

Putrefaction can complicate the ability of forensic experts to determine the mode and cause of death (35). Early signs of putrefaction were present in only 3 cases of all 85 cases which took place in the Al-Aghwar region which is considered as the lowest elevation in the world with extremely hot weather during summer that makes a suitable environment for putrefaction phenomenon to occur. Along with the fact that many of those cases suffered a delay in recovering the drowned body from water, almost until it floats to the surface of water to get noticed. This result of putrefaction phenomenon taking place in water environments and interrupting the determination of the cause of death as in drowning came with agreement with other studies made by Byard (35), Fortes et al. (36), Caruso (37), Wangl (38), and Stephenson et al. (39).

6. CONCLUSION

The rate of drowning cases is decreasing through the years, while the majority of victims are males and children. Focus should be put on prevention strategies like paying close, constant attention and supervision of children, improving swimming skills and providing physical barriers where drowning is likely to occur. Drowning can be avoided through following several interventions and strategies such as teaching swimming skills and water safety to school age children and teenagers. Providing safe recreations for local people away from water sources with children supervision, then providing awareness lectures to the local people and communities with high vulnerability to drowning.

• Acknowledgments: We thank Jordan University of Science and Technology for the funding support.
• Authors Contribution: A.M.S and M.H. gave substantial contributions to conception and design of the study. All the authors had a part in acquisition of data, or analysis and interpretation of data. All the authors had a part in article preparing for drafting or revising it critically for important intellectual content. All the authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
• Conflict of Interest: The authors declare no conflict of interest.
• Financial support and sponsorship: Jordan University of Science and Technology.

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