



## Retrospective Evaluation of Forensic Medicolegal Childhood Deaths Among Children Aged 0-6 Years

Ali Yıldırım\*, Erdoğan Polater, Celal Bütün

**Abstract:** **Objective:** The aim of this study was to analyze the epidemiological pattern and characteristics of forensic cases resulting in death among children aged 0-6 years and to discuss the solution offers in order to prevent such events that may result in death in 0-6 years of childhood.

**Materials and Methods:** 73 cases of medicolegal childhood death among children aged 0-6 years whose post-mortem examinations, dead body examinations and/or autopsies were performed at the morgue of the Cumhuriyet University Hospital in a 8-year period between January 1, 2008 and December 31, 2016 were included in the study group and retrospectively analyzed. In all statistics, the SPSS v.20 statistical software was used, and a p value of <0.05 was accepted as statistically significant.

**Results:** The study included 73 forensic cases resulted in death whose dead body examinations and autopsies were performed. Of the cases, 52.1% (n:38) were female and 47.9% (n:35) were male. When the age groups were compared, it was found that the highest mortality rate was in the 0-1 age group with 65.8%. When the manner of death was compared by age groups after autopsy and toxicology/histopathological examinations performed, it was found that the majority of deaths among children aged 0-1 years was due to sudden infant death syndrome with 35.4% (n:17), drowning in water was the most common cause of death between 2-3 years of age with 35% (n:7), followed by accidental deaths due to fall with 30% (n:6), and the deaths among children aged 4-6 years was due to traffic accident with 100% (n:5).

**Conclusion:** Since a considerable portion of deaths were due to preventable and/or treatable causes such as sudden infant death syndrome (SIDS), disease and traffic accidents in conclusion of our study, it is thought that putting legal sanctions regarding these causes into effect, taking preventive and therapeutic health measures, as well as developing awareness policies with education will significantly reduce the rate of childhood deaths.

**Keywords:** Forensic Medicine, Pediatric Deaths, Epidemiological Pattern, Cause of Death

**Öz:** **Amaç:** Bu çalışmada 0-6 yaş grubu çocukluk çağı ölümlerine ilişkin adli olguların epidemiyolojik paterninin ve özelliklerinin analizini ve 0-6 yaş arası çocukluk çağında ölümlerine ilişkin sonuçlanabilen bu tür olayların meydana gelmesini önlemek amacıyla çözüm önerilerinin tartışılmasını amaçladık.

**Gereç ve yöntem:** Çalışma Cumhuriyet Üniversitesi Hastanesi morgunda 01.01.2008-31.12.2016 tarihleri arasındaki 8 yıllık sürede postmortem incelemeleri, ölü muayene ve/veya otopsi yapılan 0-6 yaşlar arası 73 çocukluk çağı medikolegal ölüm olgusu çalışma grubuna dahil edilerek olgular retrospektif olarak incelenmiştir. Tüm istatistiklerde SPSS V.20 istatistik programı kullanılarak p<0.05 değeri anlamlı olarak kabul edilmiştir.

**Bulgular:** Çalışmaya ölü muayene ve otopsi yapılan ölümlerine ilişkin 73 adli olgu alındı. Olguların %52.1'i (n:38) kız, %47.9'u (n:35) erkek grubunda idi. Yaş grupları arasında karşılaştırma yapıldığında en fazla ölümlerine ilişkin olguların %65.8 ile 0-1 yaş grubunda olduğu saptandı. Ölüm şekli yaş gruplarına göre karşılaştırıldığında yapılan otopsi ve toksikolojik-histopatolojik incelemeleri sonrası 0-1 yaş arası ölümlerin büyük bölümünün %35.4 (n:17) ile ani bebek ölümü sendromuna bağlı olduğu, 2-3 yaş arası ölümlerde %35 suda boğulma (n:7) en sık ölüm sebebi olduğu, bunu %30 ile düşmeye (n:6) bağlı kaza sonucu ölümlerin takip ettiği, 4-6 yaş ölümlerinin ise %100 (n:5) trafik kazası sonucu olduğu saptanmıştır.

**Sonuç:** Bu çalışmamızda ölümlerin önemli bir bölümünün ani bebek ölümü sendromu (ABÖS), hastalık kaynaklı ve trafik kazası gibi önlenemez ve/veya tedavi edilebilir nedenlerden oluşması nedeniyle bunlara yönelik yasal yaptırımların uygulamaya geçirilmesi, koruyucu ve tedavi edici sağlık önlemlerinin alınması, ayrıca eğitim ile farkındalık politikalarının geliştirilmesi için çocukluk çağı ölümlerinin önemli ölçüde azaltacağı düşünülmektedir.

**Anahtar Kelimeler:** Adli Tıp, Pediatric Ölümler, Epidemiyolojik Pattern, Ölüm Sebebi

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### Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article.

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### Ethical Declaration

The principles outlined in the Declaration of Helsinki were followed in our study, and since this is a retrospective research, no ethics committee approval was obtained.

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## 1. Introduction

Childhood death is one of the most important criteria showing a healthy physiological, psychological and social development of children growing up in the society, as well as one of the components showing whether the individuals who are the future of societies are provided with special care and protection needs according to the Declaration of the Rights of the Child (1). It is necessary to determine the epidemiological pattern and characteristics of childhood deaths in order to better understand childhood deaths, to reduce the rate of these deaths which are a social tragedy and public health problem, to increase the measures for these deaths and to strengthen new policies. Trauma is one of the most important etiological factors responsible for childhood and adolescent deaths and is the primary cause of approximately 15000 deaths in the United States each year, more than 50% of which are pediatric deaths (2-3). In pediatric deaths, children become more vulnerable to traumas due to their poor physical structure and durability, small body volumes, lack of awareness of dangers, being exposed to environmental risks, being curious about finding and learning and deaths due to severe traumas occur more commonly (4). Especially children in the age group 0-6 years are more susceptible to events that may result in injury, especially trauma, than adults since they still do not possess sufficient developmental characteristic to protect themselves and have not yet completed their physical development (5). Therefore, pediatric forensic deaths represent a specific group in terms of their management and processes. In a study conducted in our country, it was indicated that the cause of death was an accident in a considerable portion of forensic deaths among children aged 0-18 years; traffic accidents ranked first among deaths due to accidents, followed by traumatic events such as falls, drowning in water, burns, poisonings and firearm injuries, although the order may vary (6-7). In the United States, accidents rank first in the etiology of childhood deaths, followed by drowning in water, burns, although the order may vary (8-9). In numerous studies, it has been observed that males are at a higher risk for trauma than females, and in terms of childhood, the age group 0-4 years and adolescent males aged 15-18 years are at a higher risk of trauma (10-11). Another specific group in childhood deaths is the cases of unexpected sudden infant death syndrome (SIDS), which usually occurs in infants with normal development aged between 1 week and 1 year, the rate of which is unknown in our country and which continues to be one of the most important

problems in forensic medicine. SIDS is not a specific disease, but is a diagnosis made as a result of excluding the causes that are difficult to detect, such as metabolic diseases; however, it is difficult to exclude intentional and accidental deaths in this diagnosis, even if all conditions are met. The cause cannot be figured out in about 80% of unexpected sudden infant deaths under 1 year of age (12-13); however, mechanical asphyxia is known to be the most important cause of preventable deaths under 1 year of age (4).

In this study, it was attempted to explain the epidemiological pattern of pediatric medicolegal deaths in the 0-6 age group, risk factors associated with deaths, accidents that have an important place in childhood deaths and what can be done to reduce the rate of childhood deaths occurring due to preventable causes, such as unexpected sudden infant death syndrome, and the importance of raising awareness about this issue through preventive and interventionist education policies.

## 2. Materials and Methods

In this cross-sectional study, the cases of forensic childhood death occurred in the city center and whose postmortem examinations were performed, were retrospectively investigated. The postmortem examination of all cases was carried out by the chief public prosecutor's office at the morgue of the Cumhuriyet University, Faculty of Medicine Hospital with reference to a protocol between the Ministry of Justice and our university. After analyzing the forensic files along with dead body examination and autopsy reports of the forensic cases (n:73) aged 0-6 years whose dead body examinations and autopsies were performed by the Department of Forensic Medicine at the morgue of the Cumhuriyet University Hospital between 01.01.2008 and 31.12.2016, these cases were evaluated in terms of data such as gender, age, year, season, month, referred place, place of death, incident scene evidence, manner of death, cause of death, tests performed, manner of accident, site of injury and type of injury. The study groups were divided into 3 groups as 0-1, 2-3 and 4-6 years of age.

The data obtained from our study were loaded in the SPSS (version 22.0) software, and in the analysis of the data, the chi-square test was used for multi-way contingency table analysis, when the assumptions of the chi-square distribution could not be met in multi-way contingency table analysis, the chi-square value was calculated by Monte Carlo model from the chi-square exact tests and the margin of error was taken as 0.05. The data are presented as numbers and percentages.

### Ethical Declaration

The principles outlined in the Declaration of Helsinki were followed in our study, and since this is a retrospective research, no ethics committee approval was not obtained.

### 3. Results

73 cases of medicolegal childhood death among children aged 0-6 years whose post-mortem examinations, dead body examinations and/or autopsies were performed in a 8-year period between 2008 and 2016 were included in the study group and retrospectively analyzed. When 73 pediatric deaths forming the study group were analyzed by years and gender, it was observed that the deaths most commonly occurred in 2009 and 2013, and of the deaths, 52.1% were female (n:38) and 47.9% (n:35) were male (Figure 1).

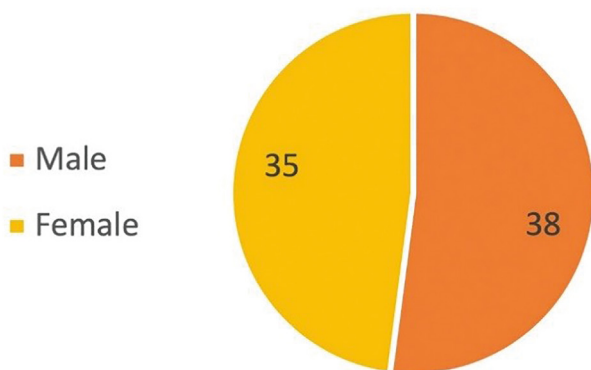


Figure 1. Distribution of pediatric deaths by gender

The male to female ratio was found as M/F: 1.08, and there was no significant difference in terms of gender distribution. When the distribution of pediatric death cases was analyzed by age range, it was found that the majority of cases were between 0-1 years of age with 65.8% (n:48), between 2-3 years of age with 27.4% (n:20), and between 4-6 years of age with 6.8% (n:5). When the manner of death was compared by age groups after autopsy and toxicology/histopathological examinations performed, it was found that the majority of deaths in children aged 0-1 years was due to sudden infant death syndrome with 35.4% (n:17), drowning in water was the most common cause of death among children aged 2-3 years with 35% (n:7), followed by accidental deaths due to fall with 30% (n:6), and the deaths among children aged 4-6 years was due to traffic accident with 100% (n:5). Figure 2 shows the distribution of pediatric deaths by age groups and manner of death. When the deaths were compared in terms of seasonal frequency, it was found that of the deaths, 20.3%

occurred in winter, 33.8% in autumn, 32.4% in summer and 13.5% in spring; when compared by months, it was found that deaths most commonly occurred in September with 17.6%, in July with 14.9%, in August with 10.8% and in October with 10.8%. In conclusion, it was found that deaths more commonly occurred during the summer-autumn transition period. When compared in terms of location, the majority of deaths were found to be at home with 52.7% (n:39), followed by on the motorway with 12.2% (n: 9). Figure 3 shows the distribution of pediatric deaths by location.

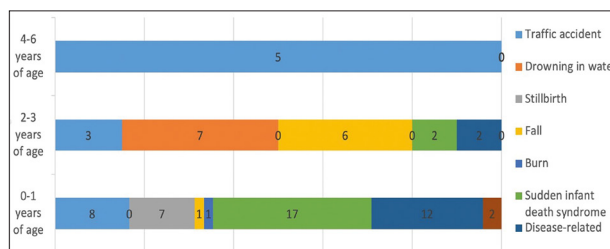


Figure 2. Cause of death and distribution by ages

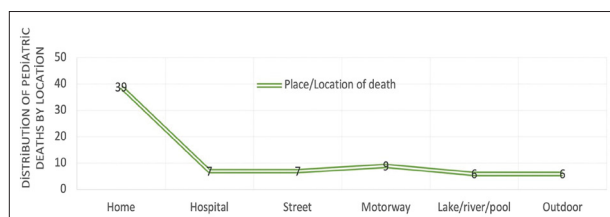
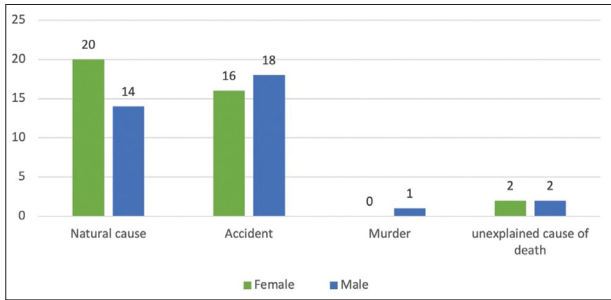


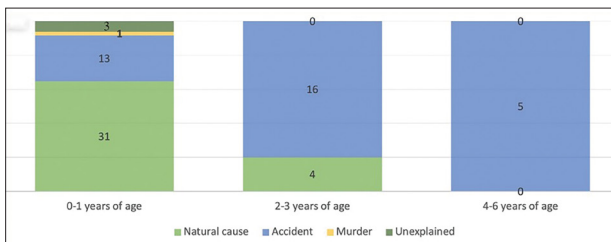
Figure 3. Place/Location of death and number of deaths

In the comparison of deaths by age range regarding the most common season, it was found that the deaths among children aged 1-3 years most commonly occurred in the summer and the deaths among children aged 0-1 years most commonly occurred in the winter months. In the statistical analysis conducted on whether there is any trauma finding in the death cases, it was found that there were no (could not be found any) trauma finding in 79.2% of deaths in the 0-1 age group, trauma findings were found in 50% of deaths in the 2-3 age group, and trauma findings were observed in all cases in the 4-6 age group. Figure 6 shows the presence of trauma finding by age groups. When the rates of ordering test to determine the cause of death were compared by age groups, toxicology and histopathology tests were ordered in all cases in the 0-1 age group, as the cause of death could not be found in the external examination and autopsy series, while no test was performed in the 2-6 age group since the cause of death was obvious. When the causes of death were compared by age groups, the majority of deaths among children aged 0-1 years were due to natural causes with 64.6% (n:31), and the deaths among children aged

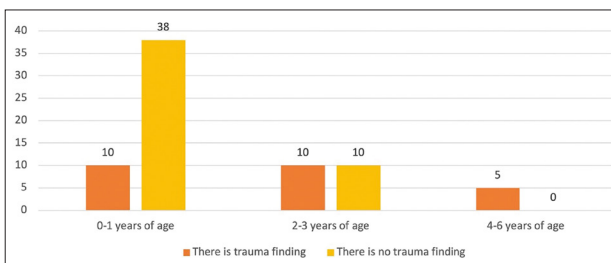
2-6 years were due to unnatural causes/forced deaths caused by trauma-accident. Figure 4-5 shows the causes of deaths and the distribution by age and gender groups.



**Figure 4.** Cause of death and distribution by gender



**Figure 5.** Cause of death and distribution by age groups



**Figure 6.** Presence of trauma finding in pediatric deaths

#### 4. Discussion

According to the State of the World’s Children 2016 report of UNICEF, it is seen that 16 thousand children under 5 years of age still die every year, and that these deaths are one of the most important indicators of the welfare status of the children and their future generations. According to the same report, there are 6 million 821 thousand children under 5 years of age in Turkey with a population of 78 million 666 thousand, and 19 of every 1,000 children dying annually in Turkey were determined to be children under 5 years of age (14). According to the UNICEF, the death rate among children under 5 years of age in 2015 was determined as 14%, and according to the Turkish Statistical Institute, the death rate among children under 5 years of age between 2011-2016 was 12.1%,

while this rate was found to be 10.8% in the Central Anatolia (15).

Autopsy is one of the gold standard tools to determine the cause of childhood death and postmortem examinations have an important place in pediatric deaths, especially in the 0-6 age group. In our study, it was found that of the 73 autopsied pediatric cases, 65.8% (n:48) were 0-1 years old, 27.4% (n:20) were 2-3 years old and 6.8% (n:5) were 4-6 years old. It was found that the majority of deaths among children aged 0-1 years was due to sudden infant death syndrome with 35.4% (n:17), the most common cause of death in children aged 2-3 years was drowning in water with 35% (n:7), followed by deaths resulted from accidents due to fall with 30% (n:6), and deaths among children aged 4-6 years was due to traffic accident with 100% (n:5). In our study, deaths by natural causes were classified as disease-related, prematurity- and SIDS-related. Although SIDS-related deaths (n:17) are common among deaths among children aged 0-1 years, it is seen that this is followed by disease-related deaths (n:12) and prematurity- or maternal disease-related stillbirths (n:7). As is consistent with our region, in a study of 642 cases conducted by Demirci et al. regarding childhood deaths, it was reported that 35% of the deaths occurred between 0-4 years of age, and that there was no sudden infant death syndrome (SIDS)-related death in this age group (16); in another study included 178 cases conducted by Tokdemir et al., it was reported that 38.2% of the deaths were between 0-5 years of age, and that infectious diseases and their complications and cardiac anomalies were at the forefront in sudden deaths due to pathological causes among children aged 1-4 years. (6) Compared to the international literature, the most common causes of death are seen to be SIDS due to mechanical asphyxia following falls from height. (8-17) We think that the reason for the significantly higher incidence of deaths due to SIDS caused by preventable mechanical asphyxia in the 0-1 age group in our study compared to the national and/or international studies (6,8,16,17,18) is due to the fact that the risk factors are unknown to the locals. In a study of 207 cases without trauma finding and unknown cause of death by postmortem examinations conducted by Pakis et al. regarding SIDS-related deaths among children aged 1 week-1 year between 2000 and 2006, later detection of SIDS in 52 cases shows how it is extremely difficult to find the cause of death among children aged 1-2 years. (19). The most important reason for the higher incidence of deaths at home in the comparison of location-related deaths in our study is common SIDS deaths resulted from preventable mechanical asphyxia due to lying in the wrong position (positional

asphyxia). We are of the opinion that determination of risk factors, such as face-down lying position, use of soft beds, sharing the same bed with the mother, and raising awareness of the locals about this issue have an important role in reducing and preventing the cases in this age group. Again, disease-related deaths were most commonly encountered in the 0-1 age range in our study, and it is seen that how this age range is susceptible to deaths by natural causes due to insufficient development of respiratory system. In a study of 140 cases conducted by Okoye et al. regarding the epidemiological pattern of childhood deaths, the fact that 30% of the cases (42/140) were disease-related or sudden infant death syndrome-related is consistent with our study and demonstrates that child deaths in this period are generally deaths by natural causes due to insufficient development of respiratory organs and muscles (20). The classification of deaths by natural causes between 0-1 years of age, which is the

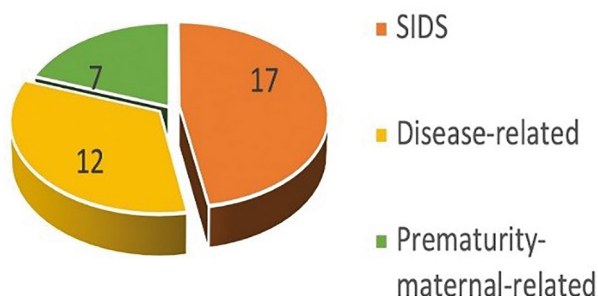


Figure 7. Natural cause of death

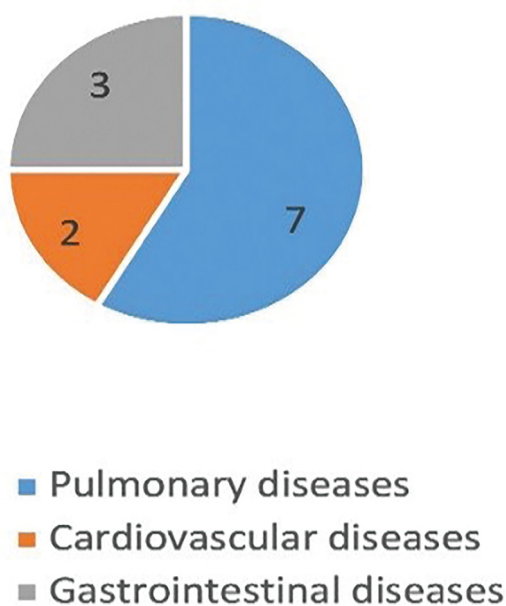
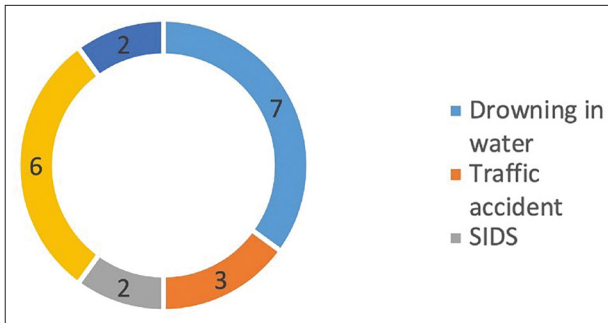


Figure 8. Disease-related deaths

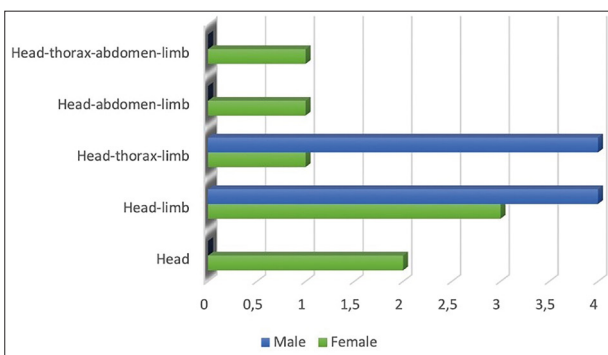
subject of our study, is presented in Figure 7. Another important point to note is that SIDS- and prematurity-related deaths among deaths by natural causes between 0-1 years of age secondary to SIDS, disease and prematurity due to environmental stress occur more commonly in males (21), whereas deaths by natural causes more commonly occurred in females in our study. The reason for this is that deaths due to disease are more common among females. Again, in line with the literature (6), it was seen that infectious deaths caused by pneumonia and gastroenteritis were the most common among the disease-related deaths, followed by cardiac anomalies. Figure 8 presents the classification of disease-related deaths.

Accidental deaths continue to be a serious public health problem that may lead to disability and/or death for growing children worldwide. In numerous international statistical studies published in the literature, it is seen that childhood accidents continue to be one of the most important causes of death (22-25). In our study of 73 cases, it is seen that deaths were mostly due to forced and/or accidental causes, deaths secondary to SIDS due to mechanical asphyxia resulted from accident were remarkable in deaths among children aged 0-1 years (n:17), drowning- (n:7) and fall-related (n:6) deaths resulted from accident were common in deaths among children aged 2-3 years, and all deaths among children aged 4-6 years (n:5) were due to traffic accidents. Deaths due to drowning in water are the second most common cause of deaths in infants and children following traffic accidents in the USA and Australia (26,27). In numerous autopsy series, it was observed that males were at a greater risk than girls during childhood in terms of childhood deaths in addition to pre-school children aged 0-4 years (10,11). In the national literature, in a study of 301 cases conducted by Aydın et al. regarding medicolegal childhood deaths in Samsun, it was reported that drowning in water (n:33) was remarkable as the most common cause of death following traffic accidents (n:112) and falls (n:34) (28); again, in a study by Tokdemir et al., it was reported that deaths among children aged 0-5 years were due to drowning in water (6). The high incidence of deaths due to drowning in water and falls among pre-school children aged 2-3 years in our study was observed to be consistent with the national and international literature. We are of the opinion that the primary cause of these deaths is the presence of natural water sources, such as river, stream, dam water, or irrigation canals close to settlements in our region, and that children swim unawares in these waters without knowing the depth and characteristics of water, and that children tend to be more accident-prone since they cannot gain motor skills in this period. Figure 9 presents the most common causes of death among children aged 2-3 years.



**Figure 9.** Deaths among children aged 2-3 years

Although the most common cause of death is accidental injury among children, the rate of deaths due to traffic accidents especially increases when children are in play age and commonly play in areas open to motorized traffic and start cycling. In our study, it was observed that especially all of children in the 4-6 age group died due to traffic accident. The fact that the most common cause of deaths due to accidents in childhood is motor vehicle accidents in many studies shows that children are more prone to accidents in this period since their cognitive functions have not fully developed and they have not gain avoidance skills, and that accidents result in death in this period when they are vulnerable. Considering the most common injury site in traffic accidents, it was found to be head and limb. Figure 10 shows the distribution of injury sites.



**Figure 10.** Injury sites due to traffic accidents

In conclusion, sudden and unexpected asphyxial deaths can be severely traumatic for families. In numerous studies, infants' sleep environments have been found to be the most important factor regarding sudden and unexpected deaths. Parents or childminders should keep clothes, toys that may be potential suffocation items for infants or objects that may lead to asphyxia away from the cradles or sleep environments of infants, as well as should prevent children from lying in positions that may lead to positional suffocations such as face-down lying

(prone) position. The American Academy of Pediatrics and NBSC (National Back To Sleep Campaign) suggest that avoidance of prone/face-down sleeping position in children will provide an about 40% reduction in SIDS-related deaths (33). Again, sharing the same bed should be avoided as families' or other children's sharing the same bed with infants may present a potential danger that could lead to accidental suffocations. Another important point is the deaths and/or injuries that occur in environments where there is insufficient environmental measures such as traffic accidents, falls, drowning in water, especially for children who are in pre-school age and who want freedom of play. In order to reduce the rate of childhood deaths, first of all, studies requiring multi-disciplinary approach should be conducted on a national scale rather than local scale to determine why children die and how their deaths can be prevented. Statistical studies from the autopsy series that forensic medicine specialists perform frequently regarding the causes why children die each year should be taken into consideration, and precautions should be taken by the relevant institutions in line with these results. Community health, family health and public health physicians, non-governmental organizations and the relevant units of the government should come together with regard to child health and discuss the measures to reduce the rate of child deaths according to the statistics determined and should get into the act. International data should be compared and the measures taken to reduce deaths in countries where child deaths are common should be evaluated and the conclusions obtained should be shared with the community. We are of the opinion that creating awareness campaigns in this regard, informing and enlightening the community about this issue, and implementing legally preventive measures and deterrent penalties will reduce the rate of childhood deaths.

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