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The analysis of medico-legal deaths in adolescents and teenagers in Izmir (Turkey)

İzmir (Türkiye)'de ergen ve gençlerde mediko-legal ölümlerin analizi

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Summary

Aim: In this study, we aimed to analyze the medico-legal deaths of teenagers aged 10-19 years which occurred in Izmir (Turkey) and the causes of death.

Materials and Methods: In this study, we retrospectively reviewed autopsy reports for 232 medico-legal deaths of the ages of teenages aged 10-19 years over three years (from January 01, 2010 to December 31, 2012) logged by the Izmir Morgue Department of the Council of Forensic Medicine (Turkey). The cases were evaluated according to age, sex, the manner of death, the cause of death and findings of toxicological analysis. Data was classified and statistically analyzed.

Results: 75.4% of cases were males. The vast majority of deaths were related to external causes (91.8%), especially road traffic accidents and accidents at home, followed by suicides (24.6%) and homicides (13.4%). The majority of suicides were committed by hanging (59.6%) and most of the homicides by firearms (51.6%). Natural death accounted for only 7.3% of all deaths and 41.2% of them were related to acute myocardial infarction.

Conclusion: The vast majority of deaths were found to be related to external causes, in particular unintentional causes. Considering the role of traffic accidents and home accidents among unintentional deaths, efforts to prevent traffic accidents and accidents at home could significantly reduce mortality in this age group. Additionally, we think that the expansion of free youth counseling centers to provide psychological support for adolescents and teenagers will reduce mortality in this age group.

Key Words: adolescents, teenagers, suicide, homicide, accidents.

Özet

Amaç: *Bu çalışmada, İzmir (Türkiye)'de meydana gelmiş 10-19 yaş arası mediko-legal ölümlerin ölüm sebeplerine göre analizini yapmayı amaçladık.*

Gereç ve Yöntem: *Bu çalışmada, Adli Tıp Kurumu İzmir Morg İhtisas Dairesi'nde, 1 Ocak 2010-31 Aralık 2012 arasındaki üç yıllık dönemde otopsisi yapılmış 10-19 yaş arasındaki 232 mediko-legal ölüme ait otopsi raporları retrospektif olarak gözden geçirildi. Olgular, yaş, cinsiyet, ölüm sebepleri, ölümün orijinleri ve toksikolojik analiz bulguları yönünden değerlendirildi. Elde edilen veriler sınıflandırıldı ve istatistiksel olarak analiz edildi.*
Bulgular: *Olguların %75.4'ü erkekti. Ölümlerin büyük çoğunluğu (%91.8) dış nedenler, özellikle trafik kazaları ve ev kazaları ile ilişkili olup; bunu intiharlar (%24.6) ve cinayetler (%13.4) izlemekteydi. İntiharların çoğu (%59.6) ası şeklinde uygulanmış; cinayetlerin çoğu (%51.6) ateşli silahlar ile gerçekleşmişti. Doğal ölümler, tüm ölümlerin yalnızca %7.3'ü olup, onların %41.2'si akut myokard enfarktüsüne bağlı idi.*

Sonuç: *Ölümlerin büyük çoğunluğu dış nedenler ve özellikle taksirli (kaza kaynaklı) ölümler ile ilişkili bulundu. Kazi ölümler içersinde trafik kazaları ve ev kazalarının rolü değerlendirildiğinde, trafik kazaları ve ev kazalarının önlenmesi için çalışmaların önemli ölçüde bu yaş grubundaki ölümleri azaltacağı söylenebilir. Ayrıca, ergenler ve gençler için psikolojik destek sağlamak için kurulmuş ücretsiz gençlik danışma merkezlerinin sayısının arttırılmasının bu yaş grubunda ölümleri azaltacağını düşünüyoruz.*

Anahtar Sözcükler: *Ergenler, gençler, intihar, cinayet, kazalar.*

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Introduction

A human develops; stops and collapses in several periods from birth until death. These periods are known as childhood, puberty, adolescence, youth, maturity and senility. Each of them includes distinctive and significant psychological and social characteristics. These periods cannot be separated from each other by clear boundaries. The periods of puberty and adolescence among these periods have a special importance because they are the most beautiful, the most powerful and the most hopeful periods of human life (1). It is defined that adolescence is the process of 10-15 years including biological, psychological and psycho-social alterations, whilst puberty is the process of 3-5 years including development of secondary sex characteristics (2). In the history, the term "adolescent" was first used in 15th century. The terminology of puberty and adolescence and age boundaries between these periods vary by several factors including national, territories, social, cultural and individual characteristics (3). However, the adolescent period is generally used for defining the persons between 10-19 years of age (4). The adolescent and teenager periods of life are more prone to the dangers of life and humans are more vulnerable in the face of events. These characteristics can lead to death (1).

According to the data of Turkish Statistical Institute, 1.3% of all deaths occurred between the ages of 10 and 19 years (5). Minino reported that (6) 68% of all deaths from 1999 to 2006 were between the ages of 12-19 years in the United States. The five leading causes of death among teenagers are accidents (unintentional injuries), homicide, suicide, cancer, and heart disease. Accidents account for nearly one-half of all teenage deaths. The mortality rates in 2005 were described as 18.0 per 100,000 people between ages of 10-14 years and 65.1 per 100,000 people between ages of 15-19 years in the United States (7). According to a study which included the statistics of 187 countries and was reported by Lazano et al. (8), unintentional injuries including road traffic accidents were defined as the primary reason of death among those aged 10-19 years.

In this study, we aimed to analyze the medico-legal deaths among those aged 10-19 years which occurred in Izmir (Turkey) according to the cause of death. The data obtained in this study will shed light on future studies in order to prevent deaths occurring in the second decade of life.

Materials and Methods

In this study we retrospectively reviewed autopsy reports for medico-legal deaths of the ages of 10-19 for three years (from January 01, 2010 to December 31, 2012) of the Izmir Morgue Department of the Council of Forensic Medicine (Turkey). Then, the crime scene investigation data and knowledge obtained from eyewitnesses were reviewed for additional information which was not recorded in the autopsy reports.

The cases were evaluated according to age, sex, the manner of death, the cause of death and findings of toxicological analysis. Ages and sex were correlated with the manner of death and the cause of death. The determination of manner of death was applied according to the crime scene investigation reports.

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All statistical analyses were performed with *qui-square test*. A "*p*" value less than 0.05 was considered as statistically significant.

Results

In the period between 2010 and 2012, totally 6174 medico-legal autopsies were performed in the Izmir Morgue Department of the Council of Forensic Medicine (Turkey). 3.8 percent (n=232) of them was between the ages of 10 and 19. Of 232 victims, 175 (75.4%) were males and 57 (24.6%) were females ($p<0.005$). The mean age of all the victims was 15.8±2.7 (median: 16). The mean ages of the male and female victims were 16±2.5 (median: 16) and 15±3 (median: 15) respectively. Of the cases 29.7% (n=69) was between the age of 10-14, 70.3% (n=163) was between the age of 15-19 ($p<0.005$) (Figure-1). Table-1 shows the death rates for every 100,000 populations and percentage according to number of annually medico-legal autopsies.

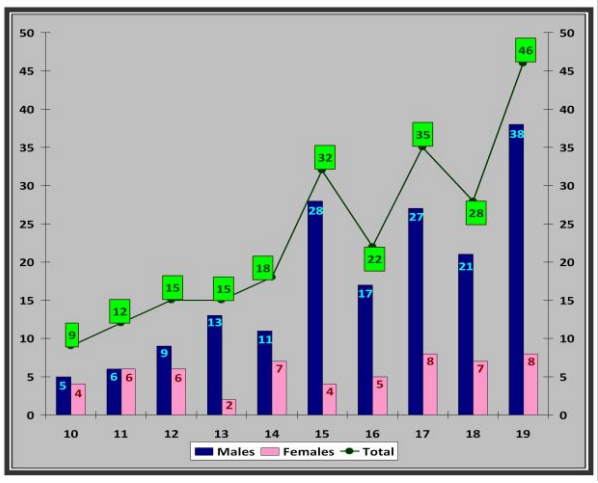

Figure-1. The distribution of 232 deaths of adolescents and teenagers according to age and sex.

The vast majority of deaths were related to external causes in the total (n=213; 91.8%; p<0.005) and both sexes (n=161; 92%; p<0.005 for males and n=52; 91.2%; p<0.005 for females) (Figure-2). External causes reached to the highest value at the age of 19 (n=43; 20.2%) whilst natural deaths were at the age of 16 (n=4; 23.5%) (Figure-3).

Table-1. Death Rates According to Years.

DEATH RATES ACCORDING TO YEARS	AGE GROUPS		
	10-14	15-19	Overall
2010			
Total population	279,181	289,282	586,463
Number of deaths	20	47	67
Death rate for every 100,000 population	7.2	16.2	11.4
Percentage of death among deaths autopsied in all ages (total autopsy n=1872)	1.1	2.5	3.6
2011			
Total population	277,685	286,362	564,047
Number of deaths	22	56	78
Death rate for every 100,000 population	7.9	19.6	13.8
Percentage of death among deaths autopsied in all ages (total autopsy n=2078)	1.1	2.7	3.8
2012			
Total population	269,659	286,600	556,259
Number of deaths	27	60	87
Death rate for every 100,000 population	10.0	20.9	15.6
Percentage of death among deaths autopsied in all ages (total autopsy n=2224)	1.2	2.7	3.9
TOTAL			
Average population	275,508	287,415	562,923
Total number of deaths	69	163	232
Average number of deaths	23	54	77
Average death rate for every 100,000 population	8.3	18.8	13.7
Percentage of death among deaths autopsied in all ages (total autopsy n=6174)	1.1	2.6	3.8

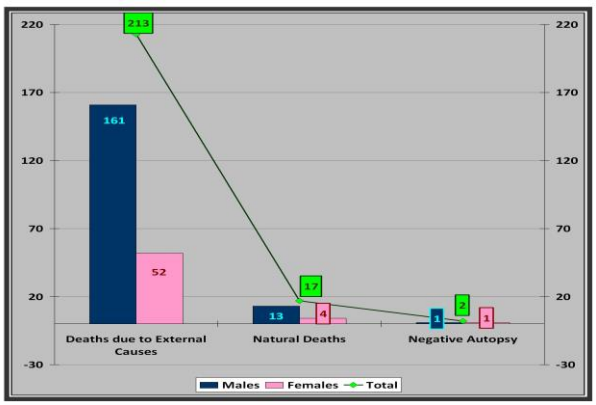

Figure-2. The distribution of 232 deaths of adolescents and teenagers according to type of death.

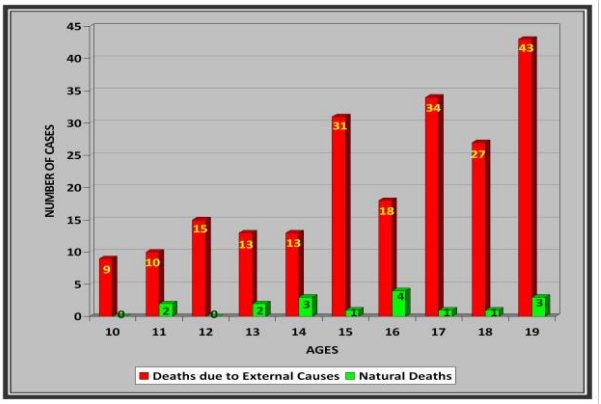

Figure-3. Comparison of deaths due to external causes and natural deaths on the basis of age.

A) External Causes

In the classification of deaths due to external causes, unintentional deaths were the primary causes in total (n=125; 58.7%) and males (n=101; 63.4%) whilst suicides in females (n=24; 46.2%) (Figure-4). Unintentional deaths reached to the highest value in total and females at the age of 18 (n=20; 16%; p>0.005 for total and n=5; 21.7%; p>0.005 for females) whilst at the age of 17 in males (n=17; 16.7%; p>0.005) (Figure-5).

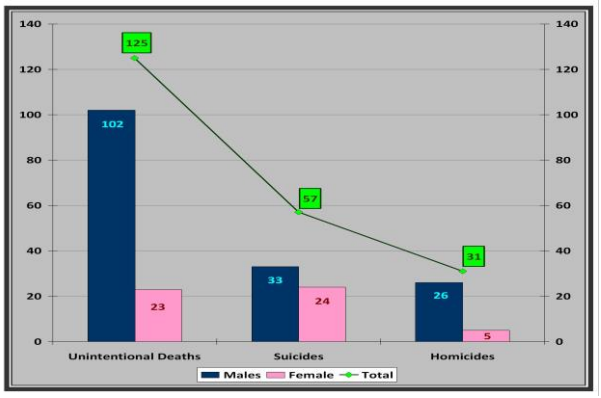

Figure-4. The distribution of external causes according to manner of death and sex.

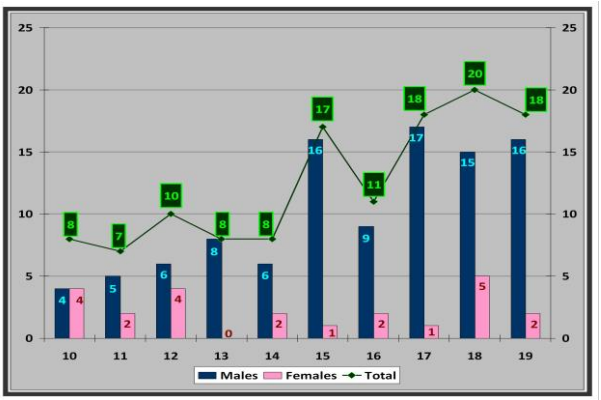

Figure-5: The distribution of unintentional deaths according to age and sex.

1) Unintentional deaths

Among unintentional deaths, the road traffic accidents (n=44; 35.2%) and drowning (n=37; 29.6%) were in the first two places. In females, the number of drowning (n=9) was more than twice of the traffic accidents (n=4). The distribution of unintentional deaths according to age groups, sex and cause of death was shown in Table-2.

Table-2: Causes of Unintentional Deaths.

CAUSE OF DEATH	AGE GROUPS								
	10-14			15-19			Overall		
	M	F	T	M	F	T	M	F	T
Road traffic accidents	10	0	10	30	4	34	40	4	44
Drowning	11	7	18	17	2	19	28	9	37
Falls from heights	4	2	6	3	1	4	7	3	10
Electrocution	1	0	1	9	0	9	10	0	10
Remaining below of an object (or dent in one case)	0	0	0	4	1	5	4	1	5
Carbon-monoxide poisoning	0	2	2	1	2	3	1	4	5
Fires	0	1	1	3	1	4	3	2	5
Compression between two objects	1	0	1	2	0	2	3	0	3
Accidental firearm injuries	1	0	1	0	1	1	1	1	2
Object falling on decedent	1	0	1	1	0	1	2	0	2
Struck by train	0	0	0	1	0	1	1	0	1
Accidental intake of the overdose of amphetamine	0	0	0	1	0	1	1	0	1
TOTAL	**29**	**12**	**41**	**73**	**12**	**84**	**101**	**24**	**125**

(M: males, F: females, T: total)

Table-3: Methods of Suicides.

METHOD OF SUICIDE	AGE GROUPS								
	10-14			15-19			Overall		
	M	F	T	M	F	T	M	F	T
Hanging	6	4	10	16	8	18	22	12	34
Firearms	0	1	1	7	1	8	7	2	9
Jumping from heights	0	2	2	2	3	5	2	5	7
Drugs	0	0	0	1	5	6	1	5	6
Jumping in front of a train	0	0	0	1	0	1	1	0	1
TOTAL	**6**	**7**	**13**	**27**	**17**	**44**	**33**	**24**	**57**

(M: males, F: females, T: total)

Table-4: Methods of Homicides.

METHOD OF HOMICIDE	AGE GROUPS								
	10-14			15-19			Overall		
	M	F	T	M	F	T	M	F	T
Firearms	2	2	4	10	2	12	12	4	16
Sharp force	2	0	2	9	1	10	11	1	12
Homicidal strangulation	0	0	0	1	0	1	1	0	1
Blunt force	0	0	0	1	0	1	1	0	1
Terrorism (Bomb explosion)	0	0	0	1	0	1	1	0	1
TOTAL	**4**	**2**	**6**	**22**	**3**	**25**	**26**	**5**	**31**

(M: males, F: females, T: total)

Table-5: Causes of Natural Deaths.

METHOD OF HOMICIDE	AGE GROUPS								
	10-14			15-19			Overall		
	M	F	T	M	F	T	M	F	T
Acute Myocardial Infarction	1	0	1	6	0	6	7	0	7
Pericarditis	0	1	1	1	0	1	1	1	2
Epilepsy	0	1	1	1	0	1	1	1	2
Pneumonia	0	1	1	0	0	0	0	1	1
Meningitis	1	0	1	0	0	0	1	0	1
Pathological Brain Hemorrhage	1	0	1	0	0	0	1	0	1
Cardiac Anomalia	1	0	1	0	0	0	1	0	1
Peritonitis	0	0	0	1	0	1	1	0	1
Astma	0	0	0	1	0	1	1	0	1
TOTAL	**4**	**3**	**7**	**10**	**0**	**10**	**14**	**3**	**17**

(M: males, F: females, T: total)

41 of unintentional deaths (32.8%) were found related to home accidents, whilst 24 (19.2%) were related to occupational accidents and 16 (12.8%) were related to other environmental factors and non-traffic accidents. In 14 cases, ethyl alcohol was detected in the blood between 0.19 g/l and 1.51 g/l. THC was found in the urine of one case. MDMA was found in the blood of one case. Additionally, there were some drugs related to medical treatment in the samples of four cases.

2) Suicides

The littlest victim of suicides was a male aged 11 who hanged himself. In the classification of suicidal deaths, the deaths related to hanging was the primary method of suicides in total (n=34; 59.6%; p<0.005), both sexes (n=22; 66.7%; p<0.005 for males and n=12; 50%; p<0.005 for females) and both age groups (n=10; 76.9%; p<0.005 for aged 10-14 and n=18; 40.9%; p<0.005 for aged 15-19) (Table-3). In 4 cases, ethyl alcohol was detected in the blood between 0.31 g/l and 2.71 g/l. THC was found in the blood of one case. Benzodiazepines were found in the samples of one hanging case. In samples of six suicide cases by drugs, there were tricyclic antidepressants (n=3), antipsychotic drugs (n=2), benzodiazepines (n=1) and pesticide (n=1). Additionally, there were some drugs related to medical treatment in the samples of two cases.

3) Homicides

The littlest victim of homicides was a male aged 13 who was injured by firearm. The majority of homicides were committed by firearms in total (n=16; 51.6%; p<0.005), both sexes (n=12; 46%; p<0.005 for males and n=4; 80%; p<0.005 for females) and both age groups (n=4; 66.7%; p<0.005 for aged 10-14 and n=12; 48%; p<0.005 for aged 15-19) (Table-4). In 4 cases, ethyl alcohol was detected in the blood between 0.66 g/l and 2.11 g/l. THC was found in the samples of two cases.

B) Natural Deaths

Eighty-two point four percent of natural deaths occurred in males (n=14). In males, half of the natural deaths (n=7) was related to acute myocardial infarctions (p<0.005). All causes of natural deaths were shown Table-5. In one case, ethyl alcohol was detected in the blood 0.11 g/l. MDMA was found in the blood of one case. Additionally, there were some drugs related to medical treatment in the samples of six cases.

C) Negative Autopsies

A 15-year-old female and a 15-year-old male were found dead in their houses. No macroscopical pathology was found in their autopsies. In toxicological analysis and microscopical investigation the cause of their death was not revealed.

Discussion

In the two studies applied in Istanbul-Turkey (1989-1993) (1) and Konya-Turkey (1991-2000) (9), the share of deaths occurred between the ages of 10-19 among all autopsied deaths were reported as 9.2% and 13.9% respectively. However, this rate in the present study (3.8%) was found to be much lower than the previous studies, the results in Table-1 showed that the death rates of ages of 11-20 increased from 2010 to 2012 in Izmir. Whereas the mortality rate (per 100,000) for ages 10 to 24 decreased from 76.1 in 1990 to 60.3 in 2005 in the Unites States (7).

In this study, the number of male cases was four times that of females although the death rate of male/female

was reported as 1.7/1 in Izmir in the data of Turkish Statistical Institute (5). This result reveals the difference between deaths rates and medico-legal death rates. However, males were reported to have a higher mortality rate than females in previous studies. The death rate of male/female was defined as 9.3/1 by Asirdizer et al (1). Minino reported that male teenagers are more likely to die than female teenagers at every single year of age from 12 to 19 years, and older teenagers are at higher risk of dying than younger teenagers (6). This result was confirmed in the present study (Figure-1).

Although it has been stated in the classical education of forensic medicine that deaths of young people are suspicious and they are medico-legal cases, unfortunately, many deaths of young people are unreported due to several factors. In the present study, the small number of natural deaths (n=17, 7.3%) (Figure-2) supports the thesis above mentioned.

The rate of deaths between the ages of 15-19 was 2.4 times more than the ages of 10-14. This rate was reported as 1.7 by Wong and Sun (4), 3.8 by Asirdizer et al (1), and 6.4 by Heninger and Hanzlink (10).

Unfortunately, the fact that adolescents become more educated and autonomous with age does not seem protective against other risk factors for unnatural death (10). In Switzerland, more than 50% deaths were due to external causes (4). The death toll of adolescents due to external causes was about 3 times of that due to natural causes in the United States (11). Seventy-two percent of deaths between the ages of 10-24 in the Unites States between 1999 and 2006 were unnatural deaths (12). In the present study, the rate of deaths due to external causes was 91.8%. The rates of deaths due to external causes were reported as 92% in Elazığ, Turkey (13), 90% in Istanbul, Turkey (1), 75% in Finland (14). For external causes, age group of 15-19 was more risky than the age group of 15-19 (Figure-3) similar to results of previous studies (1,4,10).

In this study, unintentional deaths (n=102; 63.4% of external causes), especially in road traffic accidents (n=40; 24.8% of external causes, 39.2% of unintentional deaths) were the most important external causes for deaths of males (Figure-4, Table-2). In general, unintentional deaths were found as the primary external cause (n=125; 58.7% of external causes), especially in the road traffic accidents (n=44; 20.7% of external causes, 35.2% of unintentional deaths) (Figure-4, Table-2). According to the 2008 data of Turkish Statistical Institute 9% of deaths between the ages of 10-19 was related to road traffic accidents in Turkey (5). However, the traffic accident was defined as the major external cause of deaths of children and adolescents in the world, accounting for 27.4% between 1986 and 1990, and 21.4% between 1996 and 2000 in Hong Kong (4); 30% in Georgia (1985-2004) (10); 32.7% in Diyarbakir, Turkey (2000-2003) (15); 35% in the United States (12); 36% in Switzerland (1969-1997) (11). Gunaydin et al reported that 84.1% of deaths in childhood were unintentional in Konya, Turkey (9). The rate of unintentional deaths among all deaths was found to be 53.9% in the present study where they reached to the highest value in total and females at the age of 18 whilst at the age of 17 in males (Figure-5). Drowning (29.6%) was the second cause of unintentional deaths. Also the number of other unintentional deaths (n=44, 25.2% of unintentional deaths, 19% of all deaths) was too many to be ignored (Table-2). Asirdizer et al reported that unintentional deaths in the house of infants and adolescents were major public health problem and 26% of deaths under the age of 18 was related to home accidents (16). In the present study, 32.8% of unintentional deaths and 17.7% of all deaths was related home accidents. Also it was reported that an average of 2822 (55%) of 5103 annual unintentional deaths in US children between 1985 and 1997 with a known location of injury took place in the home environment (17).

Wong et al reported that suicide had overtaken traffic accidents as the leading cause of external death for males aged 15 to 19 in the 1996-2000 periods (4). In the present study, suicides (n=24; 46.2%) were the primary cause of deaths due to external causes for females (Figure-4). The rates of suicides among external causes were reported as 32% in Switzerland (1969-1997) (11); 18% in Istanbul, Turkey (1989-1993) (1); 7.8% between 1986 and 1990, and 14.9% between 1996 and 2000 in Hong Kong (4). Suicide has been reported as the second or third most common cause of death in children and adolescents all over the world (18, 19). The rate of suicides among all deaths was found as 24.5% in this study. Suicides including 3.9% of all child deaths in Konya, Turkey (9); 6% of unnatural deaths of children under the age of 19 in the United Kingdom (20); 7.7% of all deaths between the ages 0 and 18 in Istanbul, Turkey (2001-2005) (19); 7.1% and 11% of all deaths in the United States (7, 12); 12% of unnatural deaths in Georgia (1985-2004) (10).

The suicidal method is a major factor, which determines suicidal behavior's fatality (21, 22). Guns are used in approximately two-thirds of all suicides in the United States (21). In other parts of the world, hanging is more common, followed by guns, jumping from a high place, and drowning. In Northern India and China, intoxications are the most common methods (21, 23, 24). In Turkey, hanging was reported as the most often-preferred suicide method (44.8%), followed by firearms (22.2%), medical intake (16.3%) and jumping from a high place

(10.3%) (22). Hanging (59.6%) was the primary suicide method, followed by firearms (15.8%), jumping from a high place (12.3%) and drug intake (10.5%) in the present study (Table-3). Asirdizer et al stated that the methods of suicide varied by genders and age (22). Also, it is possible to see this variability in (Table-3).

Homicide was reported as the most common manner of unnatural deaths of adolescents in Georgia, accounting for 48% of unnatural deaths (10). In our study, the rates of homicides were found as 13.4% among all deaths and 24.8% among external causes (Figure-4). Homicides included 2.7% between 1986 and 1990, and 2.4% between 1996 and 2000 in Hong Kong (4); 3.4% of unnatural deaths of children under the age of 19 in the United Kingdom (20); 4.2% of all child deaths in Konya, Turkey (9); and 9% and 13% of all deaths and of in the United States (7, 12).

Firearm (51.6%) was the primary homicide method, followed by sharp force (38.7%), and others (9.7%) in the present study (Table-4). In the study of Haninger and Hanzlick, homicides were committed by firearms in 88.2%, by sharp force in 6% and by other methods in 5.8% (10). In contrast, homicides by cutting and piercing instruments and hanging and strangulation each accounted for 19% of homicides in the United Kingdom, followed by child battering and other maltreatment (12%). Firearms accounted for 6% of homicides (20). Roberts and Barker stated that the methods of homicide varied by genders and age (20). Also, it is possible to see this variability in (Table-4).

Acute myocardial infarctions (n=7; 41.2%) is the primary cause of natural deaths (Table-5), parallel to the results of the study of Asirdizer et al (1). Zheng et al reported that the increased trend in mortality from “out-of-hospital cardiac deaths” among the U.S. adolescents and young adults indicates an urgent need for public health initiatives to promote heart-healthy lifestyle choices in childhood and to support heart-healthy policies and environments for the community (25).

Roberts et al reported that surveys in secondary schools over the past 25 years have shown large increase in the number of teenagers exposed to drugs (26). In the present study, the rate of overdose was only 3% (7 total; 1 unintentional, 6 suicidal) although there were alcohol in 26 cases (11.2%) and some drugs which were not used in the medical treatment in 12 cases (5.2%).

Conclusion

In this study, the vast majority of deaths were found to be related to external causes, especially in unintentional causes. Considering the role of traffic accidents and home accidents among unintentional deaths, efforts for the prevention of traffic accidents and home accidents can be said to significantly reduce mortality in this age group. Additionally, we think that the expansion of free youth counseling centers to provide psychological support for adolescents and teenagers will reduce mortality in this age group, even if suicides and homicides were related to a wide variety of factors.

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