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# The Bulletin of Legal Medicine

## Adli Tıp Bülteni

### EDITORIAL

The difficult times have been experienced all over the world due to the coronavirus epidemic, which is declared as a pandemic by the World Health Organization. We are all witnessing an extraordinary period humanity has lived. In the process accompanied by neoliberalism and globalization, we are all responsible for making the world uninhabitable, from the administrative manners of countries regarding industrialization, concretion, global warming, melting glaciers, decreased groundwater resources, plastic and chemical waste, nuclear power plants, armament, to individual practices such as spitting on the streets, polluting the environment with wastes, or producing agricultural products with more chemicals in villages. In the times of Corona, we are in a period where we are responsible for questioning everything. As the American Indian proverb says, “We do not inherit the Earth from our ancestors; we borrow it from our children.”

These days have once again demonstrated the importance of science. As Atatürk emphasized in his promise that he left us as his legacy, “Science is the most real guide for civilization, for life, for success in the world. To search for a guide other than science is absurdity, ignorance, and heresy.”

Meanwhile, The Bulletin of Legal Medicine is quietly celebrating its 25th anniversary. We would like to thank the editors, editorial boards, authors, and consultants who contributed to our journal, especially The Association of Forensic Medicine Specialists. We are here with breakthroughs in our journal. We are here with our journal, which will be published by Akademisyen Publishing House, an international publishing house, introducing both recent innovations and full-text articles in Turkish and English. It is our greatest wish that our journal is indexed by well-recognized international databases and that its impact factor increase.

We hope to increase the scientific quality of our journal together with the awareness that science and merit are the only truth in building the forensic sciences of the future, and that the scientific nature of our journal will continue to establish a common platform for sharing the most up-to-date scientific studies in the field of Forensic Medicine and Forensic Sciences.

Prof. Dr. Halis Dokgöz  
Editor





# The Bulletin of Legal Medicine

## Adli Tıp Bülteni

Research Article

### Evaluation of Publication Rate of Forensic Medicine Specialty Theses in Turkey

#### Türkiye’de Adli Tıp Alanında Yapılmış Uzmanlık Tezlerinin Bilimsel Yayına Dönüştürülme Oranının Değerlendirilmesi

Derya Çağlayan, Cemil Çelik, Ahsen Kaya\*, Ekin Özgür Aktaş

**Abstract: Objective:** The present study aims to investigate the publication rate of Forensic Medicine specialty theses in national and international journals. **Materials and Methods:** The Council of Higher Education Thesis Centre Database was searched for medical specialty theses written between 1983-2016. Another screening was carried out using the resident and mentor names, as well as thesis title on Ulakbim, Türk Medline, Google Scholar, Web of Science, PubMed databases. The years that the theses were written and the articles were published, the database of the journal, resident’s name order, type of research, thesis subjects were recorded. **Results:** The findings showed that 77 (32.6%) out of a total of 236 theses written between 1983-2016 were published. Fifteen-point two percent of these theses were published in Science Citation Index-Expanded/Social Sciences Citation Index, 11.9% were published in international and 5.5% in national indexed journals. The mean publication time was 2.95±2.49 years. It was found that the resident was the first author in 85.7% of the articles, and 53.2% of the published theses were prospective studies. Most frequently article subjects were in the fields of Forensic Pathology (26%) and Psychiatry (23.4%). **Conclusion:** Publishing rate of the theses in Forensic Medicine was similar to the data regarding publication rates of theses in different medical specialty fields in our country and abroad; however, it is below the level desired. It is of utmost importance to find solutions to facilitate the process, including but not limited to mentors that are encouraging and instructive, foreign language support, time and funding.

**Keywords:** Forensic Medicine, Publication, Specialty, Theses

**Öz: Amaç:** Adli Tıp alanında yapılmış tıpta uzmanlık tezlerinin ulusal ve uluslararası dergilerde yayına dönüştürülme oranının incelenmesidir. **Gereç ve Yöntem:** Yüksek Öğretim Kurulu Tez Merkezi veri tabanından 1983-2016 yılları arasında yapılan uzmanlık tezleri taranmıştır. Ulaşılan tezlerin yazar ve danışman adı ile tez başlığı kullanılarak Ulakbim, Türk Medline, Google Scholar, Web of Science, Pubmed veri tabanları taranmıştır. Yayına dönüştürülmüş tezlerin yapıldığı yıl, makalenin yayınlandığı yıl, derginin veri tabanı, uzmanlık öğrencisinin yazar sıralaması, araştırma tipi, tez konuları ana başlıklar halinde kaydedilmiştir. **Bulgular:** Tarama sonucunda 1983-2016 yılları arasında ait 236 tezdən 77’sinin (%32.6) yayına dönüştürüldüğü saptanmıştır. Bu tezlerin %15.2’si Science Citation Index/Science Citation Index Expanded, %11.9’u uluslararası, %5.5’i ulusal indeksli dergilerde yayınlanmıştır. Tezin makale olarak yayınlama süresi ortalama 2.95±2.49 yıl olarak bulunmuştur. Tezi yapan uzmanlık öğrencisinin makalelerin %85.7’sinde birinci yazar olduğu saptanmıştır. Yayına dönüştürülmüş tezlerin %53.2’sinin prospektif çalışma olduğu ve en sık Adli Patoloji (%26) ile Adli Psikiyatri (%23.4) alanlarında yapıldığı saptanmıştır. **Sonuç:** Adli Tıp alanında tezlerin yayına dönüştürülme oranı ülkemiz ve yurtdışında farklı uzmanlık alanlarında yapılmış olan çalışmaların verileri ile benzer bulunmuştur ancak olması gereken seviyenin altındadır. Tez danışmanının teşvik edici ve eğitici olması, yabancı dil desteğinin verilmesi, zaman ve maddi kaynağın sağlanması gibi süreci kolaylaştıran çözümlerin üretilmesi önem taşımaktadır.

**Anahtar kelimeler:** Adli Tıp, Tez, Uzmanlık, Yayın

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

#### Ethical Declaration

The principles outlined in the Declaration of Helsinki were followed in our study, and since our paper was a review article on theses and publications, ethics committee approval was not obtained.

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## 1. Introduction

In our country, Turkey, thesis preparation is a requirement for the completion of a specialty in medicine. This process is intended to ensure that residents acquire the necessary skills to conduct original research and to introduce innovation to the science through sharing the acquired knowledge. However, publishing theses in the form of scientific articles is problematic both in our country and across the world (1,2). According to the studies conducted in developed, as well as developing countries, the publication rate of the theses is low, varying between 1.2 to 52.3% (3). Theses cannot be converted into scientific publications because of various reasons, such as the mentors' not being encouraging and instructing, the content of the study not being original, or due to a lack of proficiency in foreign languages, lack of time and funds (4,5).

In recent years, the number of studies on the publishing rate of theses in different medical specialties has been increasing. This retrospective study aims to investigate the publication rate of specialty theses in Forensic Medicine in national and international journals.

## 2. Materials and Methods

On 23 August 2018, screening was carried out on the Council of Higher Education Thesis Centre Database (<https://tez.yok.gov.tr/UlusalTezMerkezi/tarama.jsp>), selecting "Forensic Medicine Department" from among departments, "Ministry of Justice" as university and "Specialty in Medicine" from among thesis types. Masters theses and doctoral dissertations were not evaluated in this study. Considering the publication process, theses dated 2017-2018, as well as the theses that do not belong to the Forensic Medicine Department, were excluded from this study. In case of theses that were uploaded to the database in multiple numbers, only one thesis was included in this study. With using the resident and mentor names, as well as titles of the theses, were included in this study, databases of Ulakbim (Turkish Academic Network and Information Center), Türk Medline (<http://www.turkmedline.net/>), Google Scholar, Web of Science and PubMed were screened between 23-27 August 2018. A comparison was made of the abstract sections of the articles that were electronically available and abstract sections of the relevant theses to assess the publication rate. The years in which the theses were written and the articles were published, database of the journal [national, international and Science Citation Index (SCI)/Science Citation Index Expanded (SCI-E)/Social Sciences Citation Index (SSCI)], resident's order among the authors, type of

research (prospective-retrospective-animal experiment studies) were recorded. Subjects of all theses, published or not published, were categorized under main themes per area of thesis. The statistical analysis was conducted using the chi-square test and Fisher's Exact test, using SPSS 15.0 package software. *P*-value was considered significant at  $< 0.05$ .

## Ethical Declaration

The principles outlined in the Declaration of Helsinki were followed in our study, and since our paper was a review article on theses and publications, ethics committee approval was not obtained.

## 3. Results

The screening resulted in 270 theses that belonged to Departments of Forensic Medicine and the Ministry of Justice between 1983 and 2018. Out of a total of 236 theses dated 1983-2016, 77 (32.6%) of them were published. Fifteen-point two percent (n:36) of these theses were published in SCI/SCI-E/SSCI, 11.9% (n:28) were published in international, and 5.5% (n:13) in national indexed journals.

The mean publication time of theses as articles was  $2.95 \pm 2.49$  (min:-1, max:10) years, which was  $3.03 \pm 2.52$  years on average for SCI/SCI-E/SSCI journals, and  $2.88 \pm 2.49$  years for other national/international journals ( $p=0.79$ ).

Upon an assessment of the authorship order of articles, we found that residents were the first author in 66 publications (85.7%), second author in eight publications (10.4%), and third author in three publications (3.9%). The rate of residents appearing as the first authors was 77.8% for studies published in SCI/SCI-E/SSCI journals, and 92.7% for studies published in other journals; however, no statistically significant difference between the two was identified ( $p=0.09$ ).

The academic status of the residents after specialization education was also evaluated, the findings showed that 50.6% of the 77 physicians who published their theses and 27% of the 159 physicians who did not publish their theses had an academic career ( $p<0.05$ ).

Distribution rates of published theses by year of article and database of the journal in which they were published are presented in Table 1. An increase was noted in the number of articles after the year 2009 ( $p<0.05$ ). Thirty-eight percent of articles published before 2009 and 50% of the articles published in and after 2009 were published in the SCI/SCI-E/SSCI journals, with no statistically significant difference between the two groups ( $p=0.44$ ).

**Table 1. Distribution of published theses by year of article and journal database.**

Years	Articles in SCI/SCI-E/SSCI journals		Articles in international journals		Articles in national journals		Total number of the articles	
	n	%	n	%	n	%	n	%
1994-1998*	0	0	2	2.6	1	1.3	3	3.9
1999-2003	5	6.5	2	2.6	2	2.6	9	11.7
2004-2008	3	3.9	4	5.2	2	2.6	9	11.7
2009-2013	14	18.2	9	11.7	5	6.5	28	36.4
2014-2018	14	18.2	11	14.3	3	3.9	28	36.4
Total	36	46.8	28	36.4	13	16.9	77	100

\*The first article that was electronically available was dated 1996.

When the theses were evaluated according to the type of study, the findings showed that 53.2% (n:41) were prospective, 28.6% (n:22) retrospective, 14.3% (n:11) animal experiment studies, and 3.9% (n:3) other (such as a review). Publishing rate of animal experiments, prospective and retrospective studies in SCI/SCI-E/SSCI journals were 72.7%, 56%, 22.7%, respectively (p=0.009).

An analysis of the distribution of the articles according to their topics revealed the most frequent area of study to be Forensic Pathology (n:20) and Forensic Psychiatry (n:18). The highest publishing rates in SCI/SCI-E/SSCI journals were found in the areas of Forensic Genetics (100%) and Forensic Toxicology (67%). Table 2 shows the subjects of the articles, as well as their publishing rate in SCI/SCI-E/SSCI journals. One hundred and fifty-nine theses that were written in 1983-2016 without being published focused on Forensic Pathology (n:33), Forensic Psychiatry (n:27), Forensic Traumatology (n:20), Forensic Radiology (n:17), Forensic Chemistry (n:16), medical malpractice studies (n:9), Forensic Genetics

(n:6), Forensic Toxicology (n:5), Forensic Biology (n:5), Forensic Anthropology (n:3), Ballistics (n:2), other (n:16), respectively.

#### 4. Discussion

The findings obtained in this study showed that the publishing rate of theses written in Forensic Medicine was at the country average levels and similar to other countries' data. However, the current rate is still below the desired and required levels. An assessment of studies conducted in different medical specialty fields in our country revealed the publishing rate of theses in national and international/SCI-E journals was as follows: 35.6% in Otorhinolaryngology (6), 50% in Eye Diseases (7), 49.7% in Urology (8); and exclusively for the SCI/SCI-E journals: 18% in Neurosurgery (9), 10.2% in Infectious Diseases and Clinical Microbiology (1), 12.3% in Orthopedics (10). An assessment of studies carried out in other countries revealed the following rates: 35.3% in Radiology (11), 27.9% in Pediatrics in France (12), which

**Table 2. Subjects of the articles and publishing rates in SCI/SCI-E/SSCI journals**

Subject of the articles	Distribution of the articles		Publishing rate in the SCI/SCI-E/SSCI journals	
	n	%	n	(%)
Forensic Pathology	20	26.0	12	60.0
Forensic Psychiatry	18	23.4	6	33.3
Forensic Traumatology	8	10.3	2	25.0
Forensic Biology	7	9.0	4	57.1
Forensic Toxicology	6	7.8	4	66.6
Forensic Radiology	5	6.5	1	20.0
Forensic Genetics	4	5.2	4	100.0
Forensic Chemistry	3	3.9	1	33.3
Ballistics	3	3.9	1	33.3
Other	3	3.9	1	33.3

presents that the issues in publishing theses are not unique to our country.

Various studies are available investigating the factors that complicate the publication process of scientific researches. Major barriers and challenges identified by two surveys conducted among faculty members were listed as follows: lack of sufficient instructions on how to write an article at graduate programs, lack of proficiency in foreign languages, lack of regulations that promote publishing, lack of sufficient guidance of the thesis mentor, studies lacking in terms of their scientific levels, lack of coercive factors for publishing, journals requiring fees, lacks of funding and time, and also negative or non-original conclusions (4,5). However, “without publication research is sterile” (13) and studies that take intensive efforts should be published to contribute to the literature.

Although the time to publish an article from a thesis is variable, previous studies reported that the average being 2.8 years, it could take up to seven years (2,8,14). The results of our study indicated the mean publication time to be in line with the literature. An extension of the admission and publication process, rejection due to various reasons of the article, particularly in high-impact factor journals, may have a negative impact on the author (15). However, in our study, the findings showed that the publication time in SCI/SCI-E/SSCI journals and non-SCI/SCI-E/SSCI journals to be similar, along the lines of the Mayir et al.’s (14) study. Delays in the publishing process may also result in the publication of similar studies from different centers (2). Consequently, efforts, such as foreign language support, training on how to write scientific articles from theses and on the selection of journals, are required to facilitate publication process (1).

Studies conducted in our country and abroad reported that the rate of residents appearing as the first author varies between 54% and 84% (2,6,8,11). In general, the first author in articles obtained from theses is the resident. However, if the idea belongs to the mentor, the article has been written with analysis, and the majority of the study has been conducted by the mentor, then the resident becomes the co-author (16). Although our study does not analyze the reasons thereof, the findings showed that the rate of the first authorship of residents in SCI/SCI-E/SSCI journals to be low similarly a study carried out in the field of General Surgery (14). This may be associated with academic promotion criteria that were applicable in our country until 2016, as stated in the Sipahi et al.’s study (3). Given that studies conducted apart from the thesis were considered to be publication in line with these criteria and the idea that the first authorship would not contribute to the resident may have resulted in the mentors

reporting themselves as the first author (3). The impacts of the change of criteria in 2016 and scoring points for studies relevant to theses on the publication rate can be assessed in the upcoming process. Another possible reason could be the idea that the study can be published in a high-impact journal if the content thereof is thought to be original. Therefore, denying the resident’s right to the first authorship could be demotivational.

In recent years, the competition among authors to publish studies has been severe in the world of science (13). When analyzed the distribution of articles by years, an increase is identified in 2009 and thereafter. This increase may be due to the aspiration to be appointed to academic staff positions and the desire to increase the number of publications as a performance indicator. Sayek et al. reported that the publishing rate of theses by individual pursuing an academic career was 82.4%, while this rate among persons with no academic expectations was at 57.1% (17). Similarly, the academic career rate of physicians who published their theses was found to be higher in our study. Another possible explanation for lower publication rates before 2009 may be the articles becoming not accessible on electronic media in the past years.

Prospective studies are desirable because of various reasons, such as the student having sufficient time for thesis studies, resource materials being more abundant and accessible. A scientific study will be of higher quality and have a greater probability of being published if it is designed prospectively (6). Previous studies reported that prospective theses were published more than retrospective ones (6,8). When evaluated concerning animal experiments, on the other hand, the desire to publish and rate of admission as article are higher because such studies provide access to information using experiments that cannot be carried out on humans and are precursors of studies to be conducted on humans. As expected, our study found the publishing rate of prospective theses and animal experiment studies in SCI/SCI-E/SSCI journals to be high as well. It was observed that the most common study areas among all theses conducted between 1983 and 2016 were Forensic Pathology, Forensic Psychiatry and Forensic Traumatology, which led to the conclusion that more theses would be published in these areas. However, it is striking that theses on Forensic Anthropology and theses analyzing medical malpractices, which have become a particularly frequent agenda topic in our country in recent years, were not published. Rate of publication in the fields of Forensic Genetics and Forensic Toxicology in SCI/SCI-E journals may have been found to be high because of being up-to-date and their contribution to the literature by constantly acquiring new data.

Limitation of our study is that only six of the theses belonging to the Council of Forensic Medicine, which works under the Ministry of Justice and trains a great number of residents in Forensic Medicine besides universities, were uploaded to the Thesis Centre database and that theses written in the Council could not be analyzed. If the theses that could not have been analyzed could have been reached, a more accurate conclusion would have been reached. For this aim, all theses which are written in the Council of Forensic Medicine should be compulsorily uploaded into the thesis database of the Council of Higher Education and a substructure should be created for this. Another limitation is that theses dating back to the period when uploading to the database were not mandatory could not be accessed; thus, their publishing rate could not be assessed.

In conclusion, the publishing rate of theses in Forensic Medicine specialty is low, although found to be similar when compared to studies conducted in different specialties in our country and across the world. Publishing rate of theses in indexed journals is an important indicator of scientific achievements of individuals, academic institutions and countries; thus, necessary adjustments should be made to ensure more effective use of such a resource (7). However, the theses should not be written only for academic apprehension. In medicine, which is a profession that requires conducting lifelong research, reading continuously and following the developments, the theses should be seen as an opportunity where the merits of the medicine would be learned in the best way. Incentives should be given for theses with high scientific quality, as well as any support to ensure their publication, such as necessary time, financial support and training. Publication of the thesis may be introduced as a requirement for the completion of specialty training, as is the case in academic applications (1). Further studies investigating the reasons for and proposing solutions for unpublished theses of persons who completed their specialty training may help to increase this rate.

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## Comparison of the Greulich-Pyle and Tanner-Whitehouse Methods for the Detection of Bone Age

### Kemik Yaşı Tayininde Kullanılan Greulich-Pyle ve Tanner-Whitehouse Yöntemlerinin Karşılaştırılması

Atilla Kaplan\*, Hakan Yılmaz

**Abstract:** **Aim:** The aim of this study is to compare the most commonly used Greulich-Pyle atlas and Tanner-Whitehouse methods in the evaluation of left wrist radiography for bone age determination due to its medical and forensic importance in the pediatric period. **Materials and Methods:** For this study, 150 girls between 11-16 years of age and 210 boys between 11-18 years of age are chosen. A total of 360 cases are separated into 12 groups according to their sex and age. The left wrist radiographs of the cases are evaluated retrospectively. The bone age in these cases is determined with the GP atlas, the TW2 and TW3 methods. RUS scores that are mostly applied in TW methods are used. The relation between methods and chronological age, difference and usability are researched. **Results:** In general, TW2 overestimated and TW3 underestimated the ages. In GP method, the differences between chronological age and bone age are not significant whereas in TW3 method the differences are significant. **Conclusion:** According to the results, the GP atlas was the more applicable method for the age groups included in this study.

**Keywords:** Chronological Age, bone age, hand and wrist radiograph, Greulich-Pyle atlas, Tanner-Whitehouse method

**Öz:** **Amaç:** Pediatrik dönemde tıbbi ve adli açıdan önemi nedeniyle kemik yaşı tayini için çekilen sol el bileği grafisini değerlendirmede en çok kullanılan Greulich-Pyle atlası ve Tanner-Whitehouse yöntemlerinin karşılaştırılması amaçlanmıştır. **Gereç ve Yöntem:** Bu çalışmada kronolojik yaşları 11-16 arasında değişen 150 kız olgu ve 11-18 arasında değişen 210 erkek olgu incelenmiştir. Toplamda 360 olgu yıllara ve cinsiyete göre 12 gruba ayrılmıştır. Tüm olguların sol el bilek grafileri retrospektif olarak değerlendirilmiştir. Olguların kemik yaşı tespiti GP atlası, TW2 ve TW3 yöntemlerine göre yapılmıştır. TW yönteminde en çok kabul gören RUS skorları kullanılmıştır. Yöntemler ile kronolojik yaş arasında ilişki, fark ve kullanılabilirlik araştırılmıştır. **Bulgular:** Genelde TW2 yöntemi olguların yaşını daha büyük, TW3 yöntemi ise küçük göstermektedir. Kronolojik yaş ile kemik yaşı arasındaki farklar GP yönteminde anlamlı bulunmamış, TW3 yönteminde anlamlı bulunmuştur. **Sonuç:** Çalışmaya dâhil edilen yaş gruplarında GP atlasının daha kullanılabilir olduğu görülmüştür.

**Anahtar kelimeler:** Kronolojik yaş, kemik yaşı, el bilek radyografisi, Greulich-Pyle atlası, Tanner-Whitehouse metodu

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## 1. Introduction

Maturation varies according to hereditary, personal, sexual and socioeconomic status. Bone age shows the maturation of the bone. Bone age assessment is necessary for the diagnosis and follow-up treatment of some endocrine diseases. Age determination is important in terms of forensic purposes and it is required by the judicial authorities in many legal situations in our country such as the assessment of the criminal liability of a suspect and, age correction (1). In age determination, histological, morphological and radiological methods are used. The radiological examination of the bones and their adaptation to the existing atlases comes to fore as the method that is mostly used in the clinic for age determination and as the method, the most accurate values are obtained (2). The basic method of measuring bone age is to examine the maturation criteria such as seeing and fusing ossification centers by taking radiographs of regions suitable for the chronological age of the person (1). Hand and wrist are the appropriate regions with the necessary conditions for the radiographic examinations used to determine the skeletal maturation periods during the growth process. The most preferred bone age detection methods in hand and wrist radiography are Greulich-Pyle atlas (GP) and Tanner-Whitehouse (TW) methods (3,4). However, GP and TW methods do not give equivalent bone age results (3). For this reason, in our study, it was aimed to determine which method is more available by comparing chronological age with GP and TW methods.

## 2. Material and Method

In this study, left hand wrist radiographs of 210 (58.4%) boys aged between 11 and 18 and 150 (41.6%) girls aged between 11 and 16 years were evaluated retrospectively. A total of 360 individuals were included in the study (Table 1). Suitable cases were selected for our study among the cases archived in a computer environment

**Table 1. Distribution of cases by chronological age and gender**

Chronological age	Boy	Girl	Total
11 (132-143 month)	30	30	60
12 (144-145 month)	30	30	60
13(156-167 month)	30	30	60
14 (168-179 month)	30	30	60
15(180-191 month)	30	30	60
16(192-203 month)	30		60
17(204-215 month)	30		60
Total	210	150	360

in the Department of Pediatric Radiology of Istanbul Medical Faculty. The birth dates of the cases were recorded in the computer by determining them in the information obtained from the identity card and information taken from their families and by examining the clinical files.

The cases with incomplete and suspicious information were not included in our study. Patients with normal growth and development, those who are in good condition mentally and physically, were included in the study. Cases with endocrine and metabolic disease history and skeletal dysplasia that may affect bone development were not included in the study as well. Imaging involving pathologies that complicate radiographic evaluation in the hand-wrist region are also not included. Technically inappropriate shots were not included. Left hand wrist radiographs were analyzed digitally from PACS (Picture Archiving and Communication Systems).

There is no pregnancy and birth history in the cases included in the study in girls groups. The first groups of girls and boys have been formed from those who have turned the age of 11 and have not yet reached the age of 12. A total of five groups have been established of girls who turned the age of 15 and reached the age of 16 in days (11, 12, 13, 14 and 15 age groups). Of boys, a total of 7 groups were created, ranging from those who turned the age of 17 and got to the age of 18 (11, 12, 13, 14, 15, 16 and 17 age groups).

As the TW system does not provide information for girls older than 16, 16 and 17 age groups are created for boys only. The groups were selected from the months that were distributed to represent their age group as much as possible. The chronological age (CA: Chronological Age) of each case was calculated from the difference between the date of birth and the radiographic screening dates. TW2 and TW3 bone age values to be used in our study were calculated for all cases. In this method, the most accepted RUS (Radius, Ulna, Short bone) scores were used. In addition, the x-ray film of each case was matched with suitable photographs in GP atlas according to gender and bone ages were found according to this method.

Since the results are found as decimal in TW method, the parts the values after the comma of bone age values found as a result of GP method are converted to decimal values by simple mathematical calculation for compatibility. Similarly, this method was used in calculating the chronological age.

All data were transferred to the computer environment and statistical evaluation was done with SPSS 21.0 (Statistical Package for the Social Sciences) program. Values with and without normal distribution were analyzed with Kolmogorov-Smirnov and Shapiro-Wilk



**Table 2. Chronological age and bone age mean values and standard deviation**

	CA		GP		TW2		TW3	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total	13.95	1.82	13.90	1.99	14.2	2.0	13.1	2.1
B	14.35	1.96	14.26	2.10	14.7	2.1	13.5	2.2
G	13.39	1.45	13.40	1.70	13.5	1.6	12.5	1.6
11B	11.45	0.28	11.16	0.83	11.2	1.0	10.4	0.7
11G	11.36	0.30	11.48	1.06	11.8	1.0	10.8	1.0
12B	12.46	0.29	12.58	0.79	12.9	0.8	11.6	0.6
12G	12.48	0.30	12.28	1.04	12.2	0.9	11.2	0.9
13B	13.33	0.26	13.39	0.90	13.9	0.7	12.2	2.2
13G	13.31	0.32	13.42	1.10	13.6	1.0	12.6	1.0
14B	14.39	0.24	14.39	0.87	15.1	0.4	13.9	0.5
14G	14.39	0.26	14.62	0.94	14.7	0.6	13.8	0.7
15B	15.25	0.24	14.98	1.05	15.6	0.7	14.5	0.8
15G	15.40	0.26	15.18	0.82	15.2	0.5	14.4	0.5
16B	16.24	0.22	16.49	0.72	16.7	0.4	15.8	0.4
17B	17.32	0.26	16.81	1.15	17.3	0.6	16.2	0.6

SD: Standart Deviation, CA: Chronological age GP: Greulich-Pyle, TW: Tanner-Whitehouse, B: Boy, G: Girl

tests. In our study, 12-year-old boy and 14-year-old boy groups showed normal distribution, while other groups did not. To determine the relationship between methods and chronological age; the Parametric Pearson test was applied to these two groups with normal distribution and Spearman's rho test, which is a nonparametric test, was applied to the other groups. The p-value below 0.05 was found significant.

Correlation coefficients (ICC: Intraclass Correlation Coefficient) were calculated by making intraclass correlation analysis in terms of availability or reliability between methods according to chronological age. Wilcoxon Signed Ranks test was used to evaluate the meaning of the difference between the chronological age and the three methods. In addition to that, standard deviation and mean values were calculated. The difference between the chronological age and the bone age values resulting from the methods was calculated with Excel program formulas. In addition, the differences between the average values found as a result of statistical evaluation were assessed according to age groups and gender. Corresponding month values were found as a result of simple mathematical calculations from the differences.

### Ethical Declaration

This study was produced from the first author's medical specialty thesis conducted at the Istanbul Medical

Faculty of Istanbul University in 2014. Ethics committee approval was received from Istanbul Medical Faculty (File No: 2014/1474, number: 1570, approval date 26.09.2014).

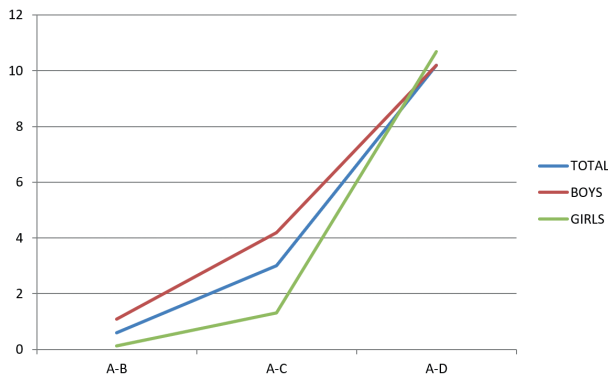
### 3. Results

As all the cases were evaluated together, mean CA  $13.95 \pm 1.82$ , GP bone age  $13.90 \pm 1.99$ , TW2 bone age  $14.2 \pm 2.0$  and TW3 bone age were calculated as  $13.1 \pm 2.1$  years. When gender discrimination was made, the total age of TW2 bone was the highest average value for boys and girls (Table 2). These values were observed as  $14.7 \pm 2.1$  for boys and  $13.5 \pm 1.6$  for girls. The mean values for GP atlas in total were smaller than the chronological age, the difference was measured about 0.6 months and compared to other methods smaller difference was observed. Although TW2 mean values are bigger than chronological age, the difference was calculated as 3 months. The biggest difference in all cases was found between TW3 and chronological age with a value of 10.2 months. TW3 mean was observed as lower than the chronological age. Considering the total values by gender; the least difference was between chronological age and GP atlas, and it was measured as 1.08 months for boys and 0.12 months for girls (Table 3, Figure 1).

**Table 3. Differences between chronological age and bone age in mean values. Values are calculated in months.**

Groups	CA-GP	CA-TW2	CA-TW3
Total	0.6	3	10.2
Boy	1.08	4.2	10.2
Girl	0.12	1.32	10.68
11 B	3.48	3	12.6
11 G	1.44	5.28	6.72
12 B	1.44	5.28	10.32
12 G	2.4	3.36	15.36
13 B	0.72	6.84	13.56
13 G	1.32	3.48	8.52
14 B	0	8.52	5.88
14 G	2.76	3.72	7.08
15 B	3.24	4.2	9
15 G	2.64	2.4	12
16 B	3	5.52	5.28
17 B	6.12	0.24	13.44

CA: Chronological age, GP: Greulich-Pyle, TW: Tanner-Whitehouse, B: Boy, G: Girl

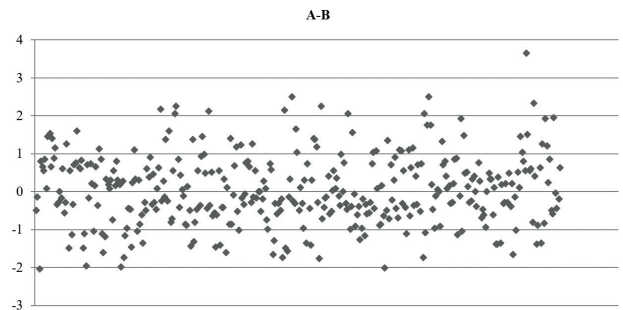


**Figure 1.** The differences in the mean of the chronological age and bone age values are shown. The numbers on the Y-axis represent the differences in months. A = CA, B = GP, C = TW2 and D = TW3

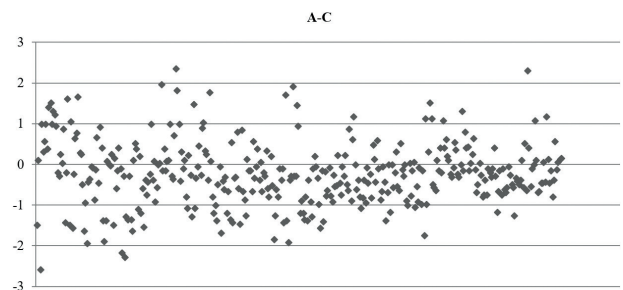
According to GP atlas, the cases are observed as more advanced and this situation changes in terms of gender and age. In 11,14,15,17 boy age groups, the relationship between GP and chronological age is observed as similar. In other age groups, the chronological age is observed as back compared to the GP atlas, and this generally the case in the girls' age groups (Figure 2). In TW2 method, bone age is advanced compared to chronological age. In terms of gender and age, this situation is similar, except for 11 boys, 12 girls, 15 girls and 17 boys' groups (Figure 3). When all cases and gender-based subgroups are examined in the TW3 method, bone age is observed back from the chronological age (Graph4). The difference between

TW3 and chronological age is calculated as 10.2 months in total over average values. The highest difference is observed in the 12-year-old girl group as 15.36 months.

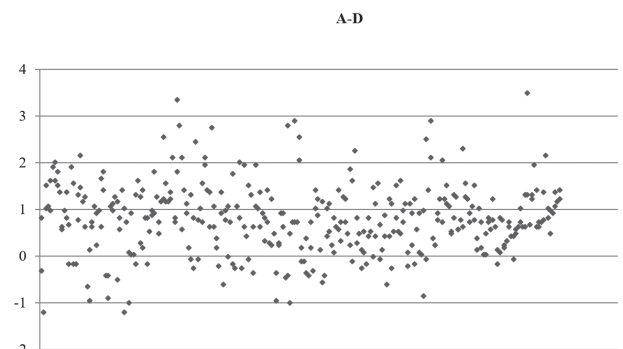
When the statistical relationship between chronological age and bone age estimation methods is analyzed and all groups are evaluated together regardless of gender; a significant correlation was observed between CA and three methods (GP, TW2 and TW3) ( $p < 0.001$ ). There was a significant correlation between the methods, and a



**Figure 2.** The numerical difference between the chronological age and GP bone age skin is shown in all cases. The numerical difference of values on the Y-axis is shown. The X-axis starts from the 11-12 age group, and the boy-girls position is in the 17-18 age group, respectively. A = CA, B = GP



**Figure 3.** The numerical difference between chronological age and TW2 bone age values is shown in all cases. The numerical difference of values on the Y axis is shown. The X-axis starts from the 11-12 age group, and the boy-girl position is in the 17-18 age group, respectively. A = CA, C = TW2



**Figure 4.** The numerical difference between the chronological age and TW3 bone age skin is shown in all cases. The numerical difference of values on the Y-axis is shown. The X-axis starts from the 11-12 age group, and the boy-girl position is in the 17-18 age group, respectively. A = CA, D = TW3

**Table 4. Correlation between chronological age and bone ages**

	Number	CA-GP		CA-TW2		CA-TW3	
		r	p	r	p	r	p
Boy	210	0,904	0,0001	0,945	0,0001	0,940	0,0001
Girl	150	0,843	0,0001	0,873	0,0001	0,875	0,0001
Total	360	0,891	0,0001	0,925	0,0001	0,923	0,0001

CA: Chronological age, GP: Greulich-Pyle, TW: Tanner-Whitehouse

**Table 5. Correlation between chronological age and bone age in age groups and gender discrimination**

Age Group	Gender	Correlation					
		CA-GP		CA-TW2		CA-TW3	
		r	p	r	p	r	p
11	Boy	-0,097	0,609	-0,044	0,819	-0,045	0,814
	Girl	0,625	0,001	0,682	0,001	0,675	0,001
12	Boy	-0,114	0,547	-0,155	0,415	-0,167	0,377
	Girl	0,189	0,317	0,290	0,120	0,292	0,117
13	Boy	0,339	0,067	0,338	0,068	0,253	0,177
	Girl	0,357	0,053	0,342	0,064	0,336	0,070
14	Boy	0,072	0,704	-0,053	0,780	-0,069	0,717
	Girl	0,310	0,096	0,270	0,150	0,282	0,131
15	Boy	0,126	0,506	0,139	0,463	0,149	0,431
	Girl	0,302	0,105	0,216	0,252	0,207	0,271
16	Boy	0,525	0,003	0,474	0,008	0,435	0,016
17	Boy	0,189	0,316	0,040	0,833	-0,064	0,735

CA: Chronological age, GP: Greulich-Pyle, TW: Tanner-Whitehouse

higher correlation was observed especially between TW2 and TW3. As gender discrimination was made and total data by gender were taken into consideration a similar result was observed (Table 4). When gender and group were differentiation was made, a significant correlation was observed in 11-year-old girls and 16-year-old boys. But the weak correlation was observed in 13-year-old boys and girls. TW2 method showed the highest correlation between CA and methods in the 11-year-old girl group which showed a significant correlation. In the age group of 16, GP showed the highest correlation. Whereas, in the age group of 13, which showed a weak correlation, GP method was showed the highest correlation with CA. No significant correlation was observed in other groups (Table 5).

In the intraclass correlation analysis, all three methods were found reliable. When age and gender were

differentiation was made, reliability was found significant in the GP method in the 11-year-old girl group, and in the TW2 and TW3 methods in the 11-year-old girl and 16-year-old boys (Table 6). Considering the statistical difference between chronological age and methods (Table 7); in total, a significant difference is observed between CA and TW2 and TW3 methods, while no significant difference is observed with GP method. When gender discrimination is made, similar results are observed in boys only. There is a significant difference only with TW3 in girls in general. When gender and age are differentiation was made, the groups where only the difference between TW3 and CA is significant are 11 age boy-girl, 12 age boy-girl, 13 age girl, 14 age girl, 15 age boy-girl, and 17 age boy groups. Results in other groups are followed similarly to the general.

**Table 6. Intraclass correlation**

Method	GP		TW2		TW3	
	ICC	C.I.95%	ICC	C.I.95%	ICC	C.I.95%
Total	0,937	(0,922-0,949)	0,952	(0,935-0,964)	0,917	(0,454-0,970)
Boy	0,945	(0,927-0,958)	0,957	(0,932-0,972)	0,935	(0,497-0,978)
Girl	0,905	(0,869-0,931)	0,923	(0,894-0,944)	0,855	(0,282-0,945)
11B	0,097	(1,137-0,457)	0,088	(1,213-0,474)	0,047	(0,308-0,262)
11G	0,501	(0,53-0,763)	0,496	(0,01-0,754)	0,464	(0,70-0,739)
12B	0,162	(1,495-0,452)	0,185	(0,359-0,259)	0,109	(0,452-0,265)
12G	0,163	(0,744-0,600)	0,274	(0,474-0,648)	0,116	(0,172-0,419)
13B	0,339	(0,416-0,688)	0,257	(0,244-0,597)	0,249	(0,226-0,588)
13G	0,333	(0,424-0,685)	0,322	(0,370-0,671)	0,230	(0,274-0,580)
14B	0,073	(1,019-0,566)	0,033	(0,289-0,270)	0,065	(0,570-0,364)
14G	0,312	(0,399-0,668)	0,356	(0,212-0,675)	0,254	(0,233-0,593)
15B	0,203	(0,616-0,614)	0,242	(0,395-0,613)	0,152	(0,272-0,502)
15G	0,299	(0,417-0,660)	0,385	(0,221-0,699)	0,119	(0,129-0,408)
16B	0,394	(0,184-0,701)	0,298	(0,213-0,638)	0,275	(0,209-0,619)
17B	0,127	(0,599-0,554)	0,133	(0,881-0,593)	0,024	(0,120-0,232)

GP: Greulich-Pyle, TW: Tanner-Whitehouse B: Boy, G: Girl

**Table 7. Meaning of the difference between bone age and chronological age according to methods (p-values)**

Age Groups	Gender	Wilcoxon Signed Ranks Test		
		GP	TW2	TW3
11	Boy	0,037	0,086	0,000
	Girl	0,845	0,009	0,001
12	Boy	0,382	0,012	0,000
	Girl	0,365	0,323	0,000
13	Boy	0,658	0,001	0,000
	Girl	0,344	0,041	0,001
14	Boy	0,773	0,000	0,001
	Girl	0,090	0,014	0,000
15	Boy	0,136	0,011	0,000
	Girl	0,198	0,123	0,000
16	Boy	0,088	0,000	0,000
	-	-	-	-
17	Boy	0,028	0,294	0,000
	-	-	-	-
Total	Boy	0,232	0,000	0,000
	Girl	0,613	0,023	0,000

GP: Greulich-Pyle TW: Tanner-Whitehouse

## 4. Discussion

Bone age assessment plays an important role in investigating whether bone maturity occurs in clinical practice at a rate compatible with chronological age. In this context, bone age assessment is useful in the diagnosis and follow-up of children with skeletal dysplasia and endocrine disorders as well as in the planning of orthopedic procedures (5). In addition, one of the important subjects of forensic science is age determination (6). In his study, Çöloğlu (7) stated that the results of age determination from x-ray films in forensic medicine can be affected by various metabolic and hormonal disorders and vitamin-mineral deficiencies. He emphasized that in order to avoid mistakes, the clinical examination of individuals should be paid attention to. In this study, it was stated that the factors affecting bone age were gender, race, endocrine disorders, nutritional disorders, syndromes (such as Turner and Marfan syndrome). In a study conducted by Baransel et al. (8), he emphasized that hypogonadotropic hypogonadism disease should be considered in bone age determination cases. In addition, being in a high socioeconomic status provides easy access to health services, adequate food intake and exercise, and access to more growth potential (9).

In many regions of the world, judicial authorities frequently require forensic medicine experts to make age determinations for the purpose of solving many legal and social problems, as well as for reasons such as inadequate population records, immigration, illegal multiple identity possession. Requests for age determination are more frequent in ages such as 12, 15, 18, 21, 25, which are important in the determination of criminal liability and legal responsibility (10,11). The most preferred bone age detection methods in hand-wrist radiographs are GP atlas and TW methods (3,4). These methods are widely used in the world (12). In the Greulich-Pyle (13) method, evaluation is made by comparing the images of the standard of which was stated one by one and hand and wrist radiographs in the boys and girls up to the age of 18, Tanner-Whitehouse method (14,15) is based on left hand and left wrist radiograph. Since the injury of the right hand is more than the left hand, more confident measurements are obtained with the use of the left wrist (16). In TW method, scoring is done by examination of the maturation of the pineal glands in 20 bones in the hand and wrist. For each bone evaluated, the total score is obtained from the scores received according to the stage of maturation. Considering the gender discrimination, age determination is made in the existing tables of the method according to the total score.

In our study, GP atlas, TW2 and TW3 methods are discussed. The last and previous editions of the TW method were evaluated as separate methods and bone age was calculated according to the RUS scores. A statistical comparison of the chronological age and the three methods in total was conducted. The data obtained in our study conclude that all three methods are applicable for age detection in cases. However, according to chronological age, TW3 shows maturation more backwards while TW2 does more advanced. Although the maturation in GP atlas changes descending to the subgroups, it generally falls behind according to the chronological age. While reliability is generally significant, it decreases with the exception of a few groups when we move down to sub-groups. It seems more appropriate to use GP atlas in the age groups examined in our study. TW2 method revealed the bone age of the cases rather bigger. Albeit with less difference than TW2, the GP method tends to make the age older in some groups, this situation may lead to errors especially in judicial cases. The TW3 method has shown maturation backwards. We think that the use of TW3 is not suitable because more than one-year difference is observed in some age groups and this difference is statistically significant. There are few studies where GP, TW2 and TW3 methods were compared in the same cases. However, in various regions of Turkey and in other countries many studies have been conducted examining the availability of GP, TW and other methods in determination of bone age.

Determination of age in Turkey is being widely used in forensic medicine departments "Gök Atlas", are made with GP TW2 and on atlases designed according to the standards of the western society (10) In a study conducted using the method of Gök Atlas, GP and TW3 (17), the roentgenograms of 333 healthy children (164 girls, 169 boys) of the left hand and wrists, elbows, shoulders and pelvis were examined. It was concluded that the TW3 (for girls) and GP (for boys) methods showed that they were more suitable for predicting bone age than "Gök atlas".

In a study on the adequacy of GP method for Turkish children in the forensic age determination (18), left hand wrist radiographs of 241 girls aged 11 to 18 years and 251 boys aged 11 to 19 years were examined. It was emphasized that the method can be used technically by clinicians, but as the standard deviation in some age groups (12,15 in girls and 12,15,18 in boys) is more than the year it is ethically unacceptable and that this method should be used with caution in criminal liability cases. In a different study (19), bone ages of 757 cases were examined from the left wrist radiograph according to GP atlas and it was stated that the mean differences between bone age and

chronological age were too low to be of practical significance. In a study conducted in the Mediterranean region (20), the left hand wrist graphs of 535 patients were examined using the GP atlas. In this study, for southern Turkey, the difference between chronological age and bone age was found to be statistically significant. Bone age was observed smaller in boys aged 10-15 years and bigger in girls aged 10-18 years. It is said that the use of GP method is suitable for South Turkish children. However, it is stated that revision is needed to get better results and to minimize errors.

In another study conducted in our country (21), left hand wrist radiographs of 225 healthy cases between 7 and 17 years of age were examined according to GP atlas. As a result of the study, it was stated that during adolescence, Turkish boys may have a skeletal maturation pace different from that of the boys of America where GP standards are derived. Therefore, GP Atlas is not entirely feasible for Turkish boys, but it has been concluded that with some modification it could be available. In another study (22), hand and wrist radiographs of 324 children were evaluated and it was reported that there was a high correlation between the mean chronological age and bone age. In this study, it is thought that the TW3 atlas can be used for Turkish children in the forensic age determination until a new atlas is published according to the results of the studies to be carried out nationwide. However, in our study, we observed that the TW3 method was not suitable. In another study (23), it was reported that GP and TW methods do not consistent with Turkish society. In a study conducted in the Central and Eastern Anatolian regions (24), the left hand wrist radiographs of 849 (375 boys, 574 girls) between the ages of 9 and 17 were examined according to the GP method and it was stated that bone development was earlier in the adolescents living in Malatya compared to those in Sivas.

A study comparing both methods has been conducted in the UK (3). In this study, the bone age of patients between the ages of 2 and 18 was evaluated using GP and TW2 methods. It was stated that the two methods used in the evaluation of bone age in clinical practice do not give equivalent bone age estimates and that only one method should be used when making serial measurements on the patient and TW2 method is more repeatable than GP atlas. In a study conducted in Italy (25), it was concluded that TW2 method is not reliable in studies conducted for forensic purposes. It is stated that the TW2 method tends to overestimate the real age. GP and TW3 methods have proven to be reliable in boys. It is stated that the best method for girls is TW3, and it is recommended to use GP and TW3 methods by associating them with each

other while making forensic age estimates around the age of 14. In our study, it is observed that the TW2 method generally tends to overestimate the real age. GP method was found appropriate. However, the TW3 method tends to make it appear smaller than its age.

In a study in which 1390 healthy cases between the ages of 1 and 18 were evaluated by the GP method of left hand wrist radiography (26); It is stated that genetic differences, diet and nutrition can affect the differences in bone growth pattern. These questions the applicability of the Greulich-Pyle atlas as a reference for children of different races. According to the results of this study, it was emphasized that bone age assessment can be improved by considering the ethnic population. In a study on the applicability of two commonly used bone age (GP and TW3) assessment methods to children of the twenty-first century in England (27), 392 patients with trauma were evaluated. It was observed that there was no significant difference between bone age and chronological age when using GP atlas in the study population. TW3 bone age was statistically significantly lower in girls at low and medium socioeconomic levels compared to chronological age. It was stated that secular change did not lead to significant progress in terms of skeletal maturation in the population in which the study was performed.

In a study (28), 36 studies in which GP method was used from the literature were sampled and compared with economic and demographic data. It was observed that high economic progress and modernization level were associated with advanced maturation and low levels were associated with the delay of bone development. In an article (29) evaluating the studies examining the relationship between GP atlas and chronological age, it is stated that the average differences by age group and gender rarely exceeded one year. It is said that there is still a good relationship between GP skeletal age and mean chronological age in modern populations. However, the individual variation of development within a population and heterogeneities between studies have been noted to be very important.

In a study (30) in which 300 cases were examined between the ages of 10-20 in Italy, it was stated that GP atlas provided a good match with the chronological age and did not show a statistically significant difference. In the study, which included 150 cases between the ages of 5 and 18 who investigated the applicability of the GP atlas for the Brazilian population (31), the chronological age and bone age were compared. As a result of the study, it was stated that bone age is often older than the chronological age in the girl age group, but this method is reliable in the staging of development. In a study conducted in Thailand

(32), the left wrist radiographs of 365 patients between the ages of 8 and 20 were evaluated retrospectively and bone ages were calculated according to GP, TW3 and Fishman methods. According to other methods, there was no significant difference between TW3 and chronological age. In a study for the South African population (33), 102 cases were evaluated retrospectively according to the GP method, and it was suggested that this method shows bone age younger for both genders and additional methods should be used.

The standards of GP and TW methods used to assess skeletal maturity apply to white Americans and North and Central Europeans. The applicability of these standards to different ethnic group members than the reference population has been the subject of controversy (34). Studies regarding the bone age determination methods used in the left hand wrist radiography and described above do not yield similar results. There are results that overlap with our study as well as the results where significant differences are observed. In the studies conducted in our country and other countries it was shown that there may be significant differences between our people and the communities referenced. In addition, in studies related to bone age detection methods. it has been observed that there are different results between regions in our country

## 5. Conclusion

As a result of the study, the TW3 method generally shows the maturation in the chronological ages between 132-191 months and the boys between 132-215 months backward, while the TW2 method is more advanced. In total, the GP method results did not produce a statistically significant difference with the chronological age. In the age groups discussed in our study, it seems more appropriate to use the GP atlas, one of the methods included in the study. The use of TW3 method has not been found appropriate. It is thought that in methods the use of TW2 is more appropriate in some age groups than TW3. The tendency of the TW2 method and the GP method in some age groups to show cases older, and the TW3 method to show cases younger, may lead to errors, especially in forensic cases.

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## Can Planktonic Organisms be Useful for Determining the Drowning Depth in Fatal Diving Accidents?

### Ölümcül Dalış Kazalarında Boğulma Derinliğinin Belirlenmesinde Planktonik Organizmalar Yardımcı Olabilir mi?

Ahmet Höbek\*, Akın Savaş Toklu, Neslihan Balkis-Ozdelice, Benin Toklu Alıçlı

**Abstract: Objective:** Although the triggering factors are various, most of the fatal diving accidents result in drowning. If drowning depth is known, it will contribute the clarification of underlying reasons of the accidents. In this experimental study, it has been investigated whether planktonic organisms can be used to determine the drowning depth in diving accidents. **Materials and Methods:** Planktonic organisms in water samples taken from the surface and 30 meters depth of Marmara Sea were investigated. In addition, rats in one of the two groups of 8 Wistar Albino species were drowned in the water sample obtained from surface and rats in the second group were drowned in the water sample obtained from 30 meters depth at a pressure of 4 ATA in a hyperbaric chamber and planktonic organism was investigated in the lungs of drowned rats. **Results:** In the autopsies planktonic organism was not found in the lungs of rats. It was observed that the lungs of the rats that drowned at 4 ATA were more bulging and bleeding. The absence of a planktonic organism in the lungs was thought to be due to the fact that the rats aspirated a very small amount of water and the plankton density in the samples was low. **Conclusion:** The determination of seasonal and daily migration of planktonic organisms to particular depths at dive sites can help to determine the depth of drowning in fatal diving accidents. However, in this experimental study, no planktonic organism was detected in the lungs of drowned rats.

**Keywords:** Diurnal Migration, Diving Accidents, Drowning, Planktonic Organisms.

**Öz: Amaç:** Tetikleyici neden farklı olsa da ölümcül dalış kazalarının büyük bir bölümü boğulma ile sonuçlanmaktadır. Boğulmanın gerçekleştiği derinliği bilmek, kaza nedenlerinin aydınlatılmasına önemli katkıda bulunabilir. Bu deneysel çalışmada, ölümcül dalış kazalarında, boğulma derinliğinin tespitinde planktonik organizmaların kullanılıp kullanılmayacağına tespiti amaçlanmıştır. **Gereç ve Yöntem:** Bunun için Marmara Denizi'nde yüzeyden ve 30 metre derinlikten alınan su örneklerindeki planktonik organizmalar incelenmiştir. Ayrıca Wistar Albino türü 8 bireyden oluşan iki gruptan ilkinde bulunan sıçanların yüzeyden alınan su örneği içinde ve diğer grupta bulunan sıçanların ise 30 metre derinlikten alınmış su örneği içinde, bir basınç odasında 4 ATA basınç altında boğulmaları sağlanmış ve boğulan sıçanların akciğerlerinde planktonik organizmalar araştırılmıştır. **Bulgular:** Sıçanların boğulma sonrası yapılan otopsielerde akciğerlerinde planktonik organizmaya rastlanmamış, 4 ATA basınç altında boğulan gruptaki sıçanların akciğerlerinin daha şişkin ve kanamalı olduğu gözlemlenmiştir. Akciğerlerde planktonik organizmaya rastlanmaması, sıçanların çok az miktarda sıvı aspire etmesinden ve örnekteki plankton yoğunluğunun düşüklüğünden kaynaklanmış olabileceği düşünülmüştür. **Sonuç:** Dalış bölgelerindeki planktonik organizmaların, belirli derinliklere yaptıkları mevsimsel ve günlük göçlerinin belirlenmesi, ölümle sonuçlanan dalış kazalarında boğulma derinliğinin tespitine yardımcı olabilir. Ancak bu deneysel çalışmada boğulan sıçanların akciğerlerinde planktonik organizma tespit edilememiştir.

**Anahtar kelimeler:** Diurnal Göç, Dalış Kazası, Boğulma, Planktonik Organizmalar.

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#### Ethical Declaration

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## 1. Introduction

The first dives date back as far as 5000 years from today, although it is not known for certain when humankind first dived into the water holding its breath. It is known that the first diving trials were conducted for the purpose of extracting high commercial value goods such as pearls, sponges and coral from shallow waters. The Greek historian Herodotus mentions that Xerxes, King of Persia, commissioned a father-daughter diver named Scyllias and Cyana to find a sunken treasure in the fifth century BC (1). Today, it is possible to dive for military or professional purposes up to 300-400 meters with suitable gas mixtures, methods and equipment (2).

According to World Health Organization data, 9% of all injured accidents worldwide are caused by drowning, among the top ten causes of death in the 1-24 age range, and 372,000 people drown each year (3). Because diving activity takes place in a different environment than physiological conditions, events resulting in injury or death occur, although the causes leading to the event are a wide variety, in most of the accidents the ultimate cause of death is stated to be drowning (4). In a study conducted in our country, drowning was reported as the most common cause of death in fatal diving accidents (5).

Drowning begins with involuntary breathing following a period of breatholding while in the water. Following this, when the fluid reaches the oropharynx or larynx, laryngospasm develops reflexively. However, if the person wants to breathe, either only a small amount of fluid is aspirated into the lungs due to laryngospasm, or there is no fluid passage to the lungs at all. As a result of the respiratory failure, while the oxygen levels in the alveoli and blood drop and hypoxemia develop, carbon dioxide levels rise and hypercarbia and acidosis develop. Although there is a significant increase in respiratory movements over time, ventilation cannot occur due to obstruction at larynx level and being in water environment. Due to the falling oxygen level in the blood, the oxygen going to the larynx muscles is also reduced and energy production in the muscles cannot take place. Therefore, laryngospasm is eliminated and some fluid begins to enter the person's lung after a while (6).

In a fatal diving accident, having an idea of the depth at which the drowning took place can give valuable clues as to the manner and cause of the accident. In diving accidents, identifying the cause of the accident may contribute to improving diving safety by providing additional information to existing information in terms of diving safety. The depth at which the body was found may not

be the depth at which the death event occurred, which developed by drowning in majority of the accidents. In 85-90% of drowning cases some fluid aspiration to the lungs is mentioned, but there is no aspiration in 10-15% of cases, the amount of fluid aspirated to the respiratory tract and lungs is known to differ from one person to another (7, 8, 9). Diatoms may be one of the most important diagnostic tools used in the cases of drowning (10, 11). Planktonic organisms detected in internal organs can provide valuable clues as to whether the cause of death of bodies found in water was drowning, the site and depth of drowning, and are used by experts to elucidate death and its mechanism (12, 13, 14, 15, 16).

In this study, the presence of planktonic organisms in the lungs of rats drowning at surface and at a depth of 30 meters was investigated and its value in determining the depth of drowning was discussed.

## 2. Materials and Methods

The preliminary study was conducted using samples taken from Kaşıkçı Island Region, and the main study was conducted with samples taken from the Tuzla Coast, in the Marmara Sea. Two liters of seawater from the surface and 30 meters depth were taken for preliminary study and 60 liters of seawater were taken from the surface and 30 meters depth for the study using Nansen bottle (Figure 1). Lugol solution was added to the water samples to increase the visibility of chloroplasts (17, 18).

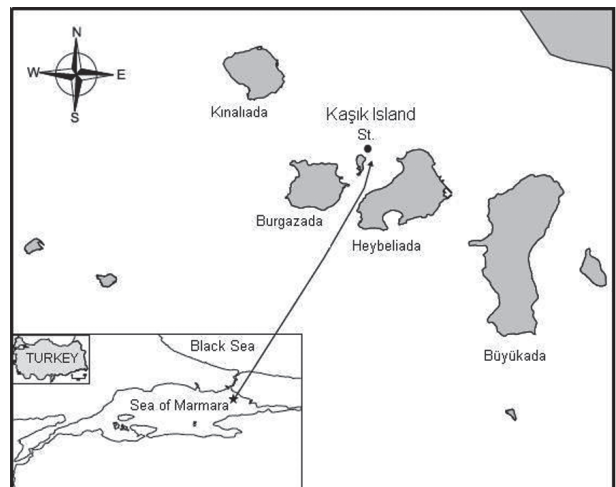


Figure 1. Sampling station in the Marmara Sea

16 Wistar Albino rats were divided into two groups as Group-1 and Group-2 and each group included eight rats. The rats in Group-1 and Group-2 were suffocated in 38x25x15 cm size plastic cages by being submerged in a plastic container with the size of 60x40x24 cm. containing

seawater sample taken from the surface at 1ATA pressure (to simulate the conditions of liquid aspiration occurring at 1 ATA environmental pressure at surface) and seawater sample taken from the depth of 30 meters at 4ATA pressure (to simulate the conditions of liquid aspiration at 4 ATA environmental pressure at the depth of 30 meters) respectively. The pressurized environment was provided in the double lock multiplace chamber at the Department of Undersea and Hyperbaric Medicine, Istanbul Faculty of Medicine, Istanbul University.

An autopsy was performed on the rats about two hours after the drowning. The abdomen of the rats was fully opened, with the incision opening just below the xiphoid in the supine position, widening to both sides. The skin incision is extended upwards, with the skin grazed on both sides in the thoracic and cervical areas. The diaphragm was cut from the rib compound so that both lung bases were protected and the thorax cavity was reached from the bottom. The sternal lid was then removed, including the manubrium sternum, by cutting through both parasternal lines with scissors. The amount of fluid in both chest cavities was evaluated as macroscopically and the trachea separated from the esophagus by blunt dissection was connected at 2 levels over 0.5 cm of bifurcation and cut between the connecting points and separated from the larynx. Blunt dissection was continued and the lungs were enclosed in a clean petri dish along with the trachea. After macroscopic examination, each lung tissue was separated into small particles (approximately 0,5x0,5 mm) with the help of a dermatome knife and put into bottles containing 2 cc 10% formaldehyde solution with a volume of 10 ml.

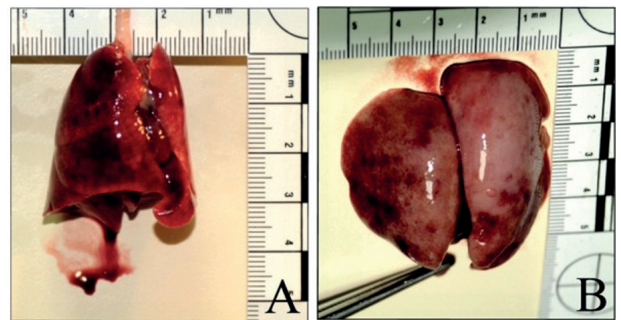
The lung tissue, which was cut into pieces and preserved in 10% formaldehyde, was examined in the plankton research laboratory of the Department of Hydrobiology, Department of Biology, Faculty of Science, Istanbul University. The seawater samples to be examined was subjected to a process of precipitation for a week, then the excess water at surface was removed by siphoning. 4% formaldehyde was added to the part at the bottom that was thought to be rich by planktonic organisms. The identification of the species was made under a phase-contrast inverted microscope.

### Ethical Declaration

This article was composed by reorganization of the specialty thesis entitled as “Farklı Derinliklerde Boğulan Sıçanların Akciğerlerde Tespit Edilen Planktonik Organizmalar Yardımıyla Boğulma Derinliği Tespit edilebilir mi?”

### 3. Results

Rats in both groups drowned about 3 minutes after immersion. During the autopsy performed two hours after the drowning, macroscopic examinations showed that the lungs of rats drowned at 4 ATA pressure had a greater volume and there were hemorrhaging foci on the surface of the lung. In rats drowned at 1 ATA pressure had smaller lungs in volume compared to the other group and there were petechial hemorrhages present on the lung surface (Figure 2).



**Figure 2.** The lungs of rats drowned at 1 ATA (A) and 4 ATA (B) pressures.

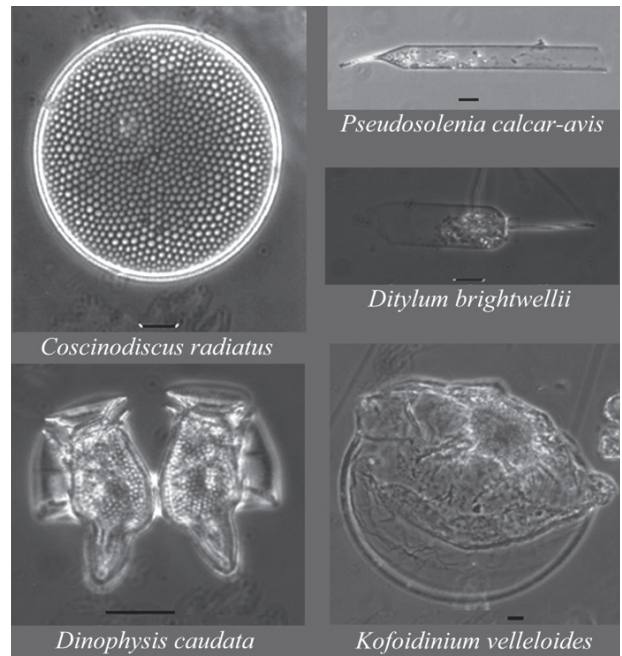
22 phytoplankton (Figure 3) and 5 zoo planktonic taxa were identified in the seawater sampled from the surface, while only 7 phytoplankton taxa were found in the seawater sample taken from 30 meters depth. Three of the diatoms detected were found in both seawater samples (Table 1). As a result of the examination of the fragmented lungs stored in formaldehyde solution, no plankton species were found.

**Table 1. Planktonic organisms detected in the seawater samples taken in the preliminary and main study.**

Taxa	Surface	30 m depth
<b>PYHTOPLANKTON</b>		
<b>Dinophyceae</b>		
<i>Alexandrium minutum</i> Halim, 1960	*	
<i>Dinophysis caudata</i> Saville-Kent, 1881	*	
<i>Kofoidinium velleoides</i> Pavillard, 1929	*	
<i>Noctiluca scintillans</i> (Macartney) Kofoid and Swezy, 1921	*	
<i>Phalacroma rotundatum</i> (Claparéde and Lachmann) Kofoid & Michener, 1911 and Michener	*	
<i>Prorocentrum micans</i> Ehrenberg, 1834	*	

(Continuing)

<i>Protopteridinium divergens</i> (Ehrenberg) Balech, 1974	*	
<i>Triplos fusus</i> (Ehrenberg) F.Gómez, 2013	*	
<b>Bacillariophyceae</b>		
<i>Cerataulina pelagica</i> (Cleve) Hendey, 1937	*	
<i>Chaetoceros</i> sp.	*	*
<i>Coscinodiscus radiatus</i> Ehrenberg, 1840	*	
<i>Coscinodiscus</i> sp.	*	
<i>Cylindrotheca closterium</i> (Ehrenberg) Reimann & J.C.Lewin, 1964	*	
<i>Dactylioselen fragilissimus</i> (Bergon) Hasle, 1996	*	
<i>Ditylum brightwellii</i> (T.West) Grunow, 1885	*	
<i>Guinardia flaccida</i> (Castracane) H.Peragallo, 1892	*	
<i>Hemialus hauckii</i> Grunow ex Van Heurck, 1882		*
<i>Leptocylindrus danicus</i> Cleve, 1889	*	
<i>Proboscia alata</i> (Brightwell) Sundström, 1986	*	*
<i>Pseudo-nitzschia pungens</i> (Grunow ex Cleve) G.R. Hasle, 1993	*	
<i>Pseudosolenia calcar-avis</i> (Schultze) B.G. Sundström, 1986 (= <i>Rhizosolenia calcar-avis</i> Schultze)		*
<i>Rhizosolenia hebetata</i> Bailey, 1856		*
<i>Rhizosolenia setigera</i> Brightwell, 1858	*	*
<i>Skeletonema costatum</i> (Greville) Cleve, 1873		*
<i>Thalassiosira</i> sp.	*	
<b>Euglenophyceae</b>		
<i>Eutreptiella</i> sp.	*	
<b>ZOOPLANKTON</b>		
<b>Ciliophora</b>		
Ciliate	*	
<i>Amphorellopsis tetragona</i> (Jørgensen) Kofoid and Campbell, 1929	*	
<b>Cladocera</b>		
<i>Penilia avirostris</i> Dana, 1949	*	
<b>Apendicularia</b>		
<i>Oikopleura</i> sp.	*	
<b>Copepoda</b>		
Copepoda nauplii	*	



**Figure 3.** Some phytoplankton species found in seawater samples (scale=20 µm)

#### 4. Discussion

Crime scene investigation, witness statements, macroscopic findings detected in autopsy, biological evidence and detailed toxicological analysis are utilized in forensic investigations and planktonic organisms contribute significantly to the clarification of the cause and mechanism of death in bodies recovered from water (13, 19).

Diatom detection has been used for over 50 years in the diagnosis of drowning (20). In a study conducted in Canada, 771 cases of drowning were retrospectively examined. 738 of these cases were drowned in fresh water and 205 of these cases had diatoms detected in the bone marrow and there was a correlation between the diatom intensity in the drowning environment and the results of the diatom test that increased the reliability of the diatom test (21). In another study, 81 out of 133 cases drowning were examined by sampling from the water where drowning occurred, and diatoms were found in 70 samples. However, of the 70 patients who drowned in the water sample with diatoms, it was not possible to detect diatoms in the blood and tissues of 51 cases, while it was possible in 19 cases. (22). When investigating a drowning incident, the greater the concentration of plankton in the event zone, the more likely the diatom test will be positive.

In a study of our country, a diatom examination carried out during an autopsy on one of the three diving accidents that resulted in death brought to the mortuary department of Istanbul Forensic Medicine Institute, more

than 20 diatoms in the lungs, 1-2 diatoms in the liver, 1-2 diatoms in the brain and 3-4 diatoms in the bone marrow have been detected. It was concluded that diver died as a result of liquid aspiration due to the characteristic similarity of diatoms in lung tissue preparations and in other tissue preparations (23).

Within a 5-year period covering 2003-2007 in the mortuary department of Forensic Medicine, diatom analysis yielded negative results in 300 of the 433 drowning cases that were autopsied in Istanbul and the negative rate was found to be around 70% in total. This rate was found to be higher in sea water cases (72.5%) than in freshwater cases (58.1%) (24).

Water samples should be taken immediately after the accident while the planktonic organisms are investigated to give an idea of the depth at which the drowning occurred. If water samples are taken at different times, or if the body is displaced for any reason after drowning, it should be kept in mind that the planktonic organisms that will be found in the lungs may not be similar to the planktonic organisms in the water sample.

In this study, no samples of plankton were found in the lungs of rats that were drowned in water samples taken from different depths. This can be attributed to the low density of plankton. In addition, the duration of immersion can also be considered as an important factor. In this experimental study, drowning occurred within about 3 minutes and the duration of immersion of rats is limited. In many cases of drowning, a long time passes until the body is found. In addition, when compared to the small lung capacity of rats, it is obvious that both the amount of water aspirated and the planktonic organism would be much more likely to enter the lungs in a person with a very large lung capacity.

It is possible to determine whether planktonic organisms that migrate to different depths at different times of the day can be used in determining the depth at which the drowning occurs, by finding out whether different species live at different depths. For this purpose, it is important to have a database of planktonic organisms in samples taken from different depths at different times in the regions to be examined.

Although the diatom test may be controversial, the most important issue is whether diatoms reach the organs in bodies that remain in water postmortem or not. In a study conducted in Eskişehir, one of the 10 rats who died out of water and were kept in water postmortem for 24 hours, 7 diatoms in the lung of 1 rat, 1 diatom in the lung of 1 rat, 1 diatom in bone marrow of 1 rat were detected, while no diatom was detected in the remaining 7 rats. In the lungs of 4 of the 10 rats that were kept in water postmortem for 72 hours, 1, 7, 9 and 10 diatoms were

detected, while there is no diatoms were detected in any organ of the remaining 6 rats. However, diatoms were detected in the lungs and other tissues of all 10 rats that were drowned, and the number of diatoms were higher in the lungs of these rats than in other groups. As a result of this study, it was stated that the diatoms detected in the organs of drowning cases were numerically greater than the diatoms detected in bodies that remained in water postmortem, and diatoms could be found in more organs (25).

Diatoms are photosynthetic algae that are of great importance in biological, ecological and economic terms and can live in any kind of aquatic environment. The most typical feature of the diatom cell is that it has a box-like exoskeleton called frustule=theca, made of more or less durable, hydrated silicate. The fragile yet durable structure of the silica skeleton allows it to be fossilized, and because of this silica wall, it has been known for many years that they make remains in sea sediments (26, 27). Although dinoflagellates are dominant in terms of species diversity in the seas, diatoms are more preferred in forensic studies than other groups in cadavers due to their durable structure due to their silica walls.

All these evaluations mentioned above require a multidisciplinary approach involving various experts. Such a team should include experts with technical knowledge who can evaluate the body and the outbuildings of the body in detail, police divers who will conduct criminal investigation at the crime scene, forensic experts, pathologists, toxicologists and hydrobiologists who will provide some laboratory supports to examine the body.

## 5. Conclusion

Although detection is not possible in every case, diatoms in organs is a valuable finding for the diagnosis of cause of deaths in drowning. Knowing the depth at which the drowning occurred will contribute significantly to the determination of the manner in which the diving accident occurred. Comparing the diatoms found in water samples taken from certain depths at the time of the accident with the diatoms found in the lungs of the casualty may give an idea of the depth of drowning. A database to be created on the daily and seasonal distribution of the depth of diatoms in the seas and inland waters may help determining the depth of drowning if there are diatoms in the organs.

## Limitations of the Study:

The study should be tested using different extraction methods for the detection of planktonic organisms in aspiration fluid and lung tissue and planktonic organism content dense waters. Detection of planktonic organisms in water samples will increase the reliability of the experiment by repeating it before the experiment

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### Screening of Physical and Emotional Abuse Risk and Protective Factors in a Group of High School Students

#### Bir Grup Lise Öğrencisinde Fiziksel ve Duygusal İstismar Risk ve Koruyucu Faktörlerinin Taranması

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**Abstract:** **Objectives:** Child abuse is a multidimensional phenomenon. Thus, planning prevention strategies and risk/protective factors should be obtained in a multilayered manner concerning the individual, family, school, environment, and policies. This study aims to investigate these factors among high school students. **Materials and Methods:** The participants' mean age was 15.69 (Sd = .96) and 53.4% (n=353) of them were female. The Rathus assertiveness inventory and the questionnaire included variables related to demographics, school and neighborhood, risky behaviors, family relationships/lifestyle, risky thinking styles, abuse experience in the immediate environment. **Findings:** The findings showed that 95.5% of the students (n=631) were living with their families and their perceived economic status was moderate/below (51.1%, n=337). In this study, 59 (9.6%) mothers and 104 (16.2%) fathers were university graduates. 397 (60.1%) participants come to the school by public transport and 39.5% (n=261) had no-one to accompany. Having a violent school-mate rate was 40.7% (n=269). Assertiveness did not differ by gender and class. Families' child-rearing practices were harder for the upper-class boys than for the girls; the boys find their families' expectations too much and felt less appreciated. 284 (43%) participants had three or more children who abused emotionally (n=284, 43%) and physically (n=135, 20.4%). **Conclusion:** Class and gender may affect substance use, truancy, neighborhood safety and school violence victimization. When abuse cannot be questioned directly, abuse can be guiding to examine whether students escape from school, whether there are close violent friends and whether they feel friends' support.

**Keywords:** decision tree, neglect, ecological theory, prevention, child abuse

**Öz:** **Amaç:** Çocuk istismarı, çok boyutlu bir olgu olduğundan önleme çalışmaları planlanırken, risk ve koruyucu faktörler bireyle, aileyle, okulla, yaşanan çevreyle ve politikalarla ilgili olmak üzere çok katmanlı biçimde elde edilmelidir. Bu çalışmada amaç, lise öğrencilerinde, istismarla ilişkili bu faktörleri betimlemektir. **Gereç ve Yöntem:** Katılımcıların yaş ortalaması 15.69 (Ss=.96) olup, %53.4'ü (n=353) kızdır. Rathus atılganlık envanterine ilaveten kullanılan anket demografik veriler, okul ve yaşanan çevre, riskli davranışlar, aile ilişkileri/yaşantı tarzı, istismara açık kılan düşünce yapısı ve yakın çevrede istismar gözlemiyle ilgili sorular içermektedir. **Bulgular:** Öğrencilerin %95.5'i (n=631) ailesiyle birlikte yaşamakta, %51.1'i (n=337) ekonomik durumunu orta/altı olarak nitelendirmektedir. Annelerin %9.6'sı (n=59) ve babaların %16.2 (n=104) üniversite mezunudur. Katılımcıların %60.1'i (n=397) okula toplu taşıma kullanarak geldiğini, %39.5'i (n=261) okula giderken kendisine kimsenin eşlik etmediğini bildirmiştir. Okul arkadaşlarından en az birkaç defa şiddet gördüğünü bildirenlerin oranı %40.7'dir (n=269). Atılganlık cinsiyet ve sınıfa göre farklılaşmamıştır. Ailenin terbiye yöntemleri, üst sınıflardaki erkeklere, kızlara göre daha sert gelmekte, erkekler ailelerinin beklentilerini fazla bulmakta ve daha az takdir edildiklerini hissetmektedirler. Katılımcıların %43'ü (n=284) yakın çevrelerinde duygusal istismara uğrayan çocuk sayısını üç ve daha fazla olarak tahmin etmiştir. Aynı tahmin, fiziksel istismar için %20.4'tür (n=135). **Sonuç:** Sağlığa zarar verici madde kullanımı, okuldan kaçma davranışı, yaşanan mahallede güvende hissetme durumu, okulda şiddete maruz kalma gibi faktörler sınıf ve cinsiyetten etkilenebilmektedir. İstismarın varlığının doğrudan sorgulanamayacağı durumlarda, katılımcıların fiziksel/duygusal istismara uğrayan çocukların olduğu bir çevrede bulunup bulunmadığını anlamada okuldan kaçma davranışları, şiddet gösteren yakın arkadaşların bulunup bulunmadığı ve kişinin algıladığı arkadaş desteği değişkenlerinin incelenmesi yol gösterici olabilir.

**Anahtar kelimeler:** karar ağacı, ihmal, ekolojik teori, önleme, çocuk istismarı

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#### Ethical Declaration

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## 1. Introduction

The emergence of child abuse is associated with many and varying variables. While some of these variables are related to the person's past, other variables may be related to the behaviors of the child during the abuse, cultural characteristics, and parents' perception of the child or certain personality traits of the children (1).

Using the approach of ecological theory, which includes the assessment of risk and protective factors together and in multiple dimensions, may be important in understanding the variables associated with the emergence of child abuse and neglect. The pursuit of this theory requires that the relevant factors be treated in multiple layers. That is, the situation is examined by looking at different levels, such as individual, family (structure/history), peer, school and neighborhood (2, 3). Each of these factors varies within itself and interacts with each other.

When investigating abuse and neglect cases or the possibility of abuse/neglect, there are some advantages in evaluating risk and protective factors in each of the specified layers. First of all, identifying these factors in early stages in development, such as adolescence, narrows the focus of the studies that aimed to determine the risk factors which have causal effects in the occurrence of abuse. Thus, layers, risk and protection concepts provide focus. It becomes easier to identify other factors that interact with these factors. In the ecological approach, as summarized by Saraw (4), the relevant assessment can be made at four levels: the first level microsystem includes the immediate environment surrounding the person (e.g., family members, peers). The second level, mesosystem, includes the relationships within the microsystem (such as the family support network). The third layer, egzo-system, describes structures, such as neighborhood and a school environment, which may not directly affect the person but still have influence. The macrosystem refers to the much wider social and political norm and judicial structure in which all systems are housed.

This multi-layered assessment can reveal how the adolescent is shaped not only by his personal characteristics but also by his environment, and in this sense, how he is strengthened or how he becomes vulnerable. One advantage of multi-faceted evaluation is that it helps to identify the accumulated risk, which is related to child abuse strongly (5, 6).

The present study aims to describe some risk and protective factors that may be associated with abuse in high school students in the Maltepe district of Istanbul at the levels of individual, micro, meso and ecosystems.

## 2. Methods

### 2.1 Participants

The research universe in this study consisted of Anatolian High Schools and Anatolian Vocational Technical High Schools in Maltepe District. The school type was also limited to this group not to act as a confounding factor and to investigate the risk and protective factors in a homogeneous population. Eleven of all these high schools were selected with the convenience sampling method. In this study, the research population was 9193 people, and the sample size was determined with the condition of 99% confidence level and 5% confidence interval was 621 people.

The average age of the participants in this study was 15.69 (Sd = .96). 53.4% (n=353) of 661 volunteer high school students were girls. The distribution of students by class was 46.6% (n=308) for the 9th grade, 32.7% (n=216) for the 10th grade and 20.7% (n=137) for the 11th grade.

### 2.2. Questionnaire, Procedures and Permissions

In this study, a questionnaire with 63 questions, written by the first author in this research article, was used to evaluate risk and protective factors. The survey was based on observations and experiences, as well as studies on risk and protective factors related to abuse (7-10). The survey contained the following sections: demographics (20 questions), school and living environment (8 questions), risky behaviors (4 questions), family relationships (6 questions), family lifestyle (8 questions) and abuse observation in the immediate environment (2 questions). In addition, questions were asked on some issues that were the focus of prevention work (14 questions). These issues were as follows: owning your own body, detecting the difference between good and bad touch, knowledge of special areas of the body, distinguishing between the foreign and familiar, and secrets that may be dangerous to hide (11).

The questionnaire underwent changes in the process of obtaining the permission of the Provincial Directorate of National Education of the Ministry of National Education (MoNE). MoNE asked that questions about behaviors that put health at risk be asked in more general terms and not to mention the names of the substances in the questions.

Another demand was that students should not be asked directly about their abuse experience. Therefore, the relevant questions asked as "Have you ever used a



substance harmful to health?”, “When you think about the children in your immediate environment, how many of these people do you think, in their families, often experience things like offensive words, humiliation, and excessive criticism?”, and “When you think about the children in your neighborhood, how many of them do you think are exposed to physically harmful behaviors within their families?”. Questions about abuse are sensitive questions. The answers to such questions include content that individuals may want to keep confidential and may not want to be exposed to the harmful effects of remembering the abusive experience. Participants do not want to be the subject of discrimination or judgment due to their answers (12). Questions involving the observations about the person’s environment indirectly about the traumatic life are informative about the way the subject of the research is seen in the environment where the person lives.

The 30-question Rathus Assertiveness Inventory was used to assess assertiveness to describe students’ strengths. The validity and reliability study of the scale were carried out by Voltan (13). Scores vary between -90 and +90. Minus points indicate unassertiveness, plus points indicate assertiveness.

### Ethical Declaration

This study was conducted after obtaining approval from the Marmara University Medical School Clinical Research Ethics Committee. The Ministry of National Education (MoNE) also approved the data collection in 2015-2016. In practice, the Helsinki Declaration rules were followed to conduct this study.

A research plan was prepared by contacting the principals, deputy principals, or guidance counselors of the relevant schools a few days before the survey was distributed. On the agreed day, the questionnaires were distributed to the students during the lesson, and they were asked to fill them out.

### 2.3. Analyzes

In the evaluation of the data, the average was taken and the frequency and percentage were calculated.

The data distribution was evaluated with methods, such as Kolmogorov-Smirnov test, and histogram, density graph, Mann-Whitney U test, were used for binary group (gender) comparisons and Kruskal-Wallis test for triple group (class) comparisons. Answers to Likert-type questions were given in the tables as percentages, but comparisons were made by accepting these variables as continuous variables (14). In the findings part, the data belonging to the whole group were firstly described, and

then, the data were examined whether gender made any difference for each class. In the case where gender made a difference, the results of the relevant variable were shared.

Finally, a decision tree model based on the CRT (Classification and Regression Tree) algorithm established to reveal factors related to the presence of physical abuse in the immediate environment (nobody or one-two people and more than two people) and to obtain the severity of the factors (15).

Since abuse is a multi-dimensional concept, abuse is influenced by various variables. In the questionnaire, the explanatory variables that significantly affect the dependent variable (how many people have been abused in its close circle) were determined by the chi-square test. By comparing the available data with the literature information, it is determined which variables would be added to the model. Accordingly, in the model for the dependent variable, whether there was a child exposed to abuse in the close circle, the explanatory variables were whether the friends were close/supportive, whether there was a feeling of trust in the neighborhood where they lived, whether a close friend shows violence, perceived economic situation, escaping from school, and gender.

All explanatory variables were coded as binary classes, risky and non-risky situations, and 1 was for the situation that would pose a risk. For example, code 0 was used if the participant never escaped from school and 1 if the participant escaped.

In order for the predicted tree to be more generalizable, it was pruned by taking a maximum depth of 5 as the growth criteria of the tree. In addition, the tree was grown until the explanatory variables decreased the homogeneity measured by the Gini coefficient by less than 0.0001. Due to the second criterion, the tree obtained was a 3-depth tree (see Figure 1 and Figure 3). The correct classification rate of the model and additional 10-fold cross validity values were given in the relevant section in the findings section (Table 11, Table 13).

In all analyzes,  $p < 0.05$  value was considered statistically significant. IBM SPSS 22.0 was used in the analysis.

## 3. Findings

In addition to the data in Table 1, 95.5% of the students ( $n=631$ ) were living with their family, and 51.1% ( $n=337$ ) described their economic status as medium and lower. An average of 4.5 ( $Sd = 1.23$ ) people lived at home. 9.6% ( $n=59$ ) of the mothers and 16.2% ( $n=104$ ) of the fathers were university graduates. Almost all of the parents were married (92.1%,  $n=605$ ).

**Table 1. Demographic information of the participants**

	yes		no		N*
	n	%	n	%	
Failed at a class	38	5.7	623	94.3	661
Health problem	93	14.1	567	85.9	661
Mother alive	658	99.5	3	.5	661
Father alive	650	98.3	11	1.7	661
Have a private room at home	425	64.5	234	35.5	659
Mother is working	235	35.6	426	64.4	661
Father is working	600	91.3	57	8.7	657
Physical or speech handicap	103	15.6	558	84.4	661

\* The numbers show the total number of participants who answered that question.

One-hundred-ninety-three (29.4%) participants (n=193) reported that if their family had difficulties in life, there was no one to support them or they were not sure whether they were. %22.5 (n=148) described their health as moderate and poor.

### 3.1. School, Immediate Environment, Some Risk Behaviors and Assertiveness Scores

Table 2 summarizes how the participants feel in their neighborhood and school.

In this study, 60.1% (n=397) of the participants reported that they came to the school using public transport, and 39.5% (n=261) reported that nobody accompanied them on their way to school.

The rate of the participants who reported that they experienced physical or emotional harmful behavior from their schoolmates a few times or more is 40.7% (n=269). It is 289 people (44.1%) who stated that there was a place where they could play safely in the neighborhood where their home is located.

Considering the data in Table 2 as a continuous variable, it was found that none of them showed normal distribution (p=.000). Therefore, non-parametric Mann-Whitney U test was used for each comparison by gender.

Accordingly, for the 10th grade only, the feeling of security in the neighborhood (median=3 for girls, 4 = for boys, U= 4055.00, p= .000, r = -. 25) and for the sense of belonging to school (median=3 for girls, boys for = 4, U= 4574.00, p= .011, r= -. 17) gender difference appeared: Both feelings were lower for girls than for boys.

The way of getting to school also showed a differentiation related to gender only in 9th grades (X<sup>2</sup>(3, N=208)=14.80, p=.001) (Table 3).

**Table 3. Distribution of 9th grade students' way to school by gender**

	School bus		Public transport		Private car		On foot		N	
	n	%	n	%	n	%	n	%	n	%
Girls	48	33.3	77	53.5	4	2.8	15	10.4	144	100
Boys	25	15.2	104	63.4	9	5.5	26	15.9	164	100

Being exposed to physical/emotional violence from a school friend showed a different gender distribution for grade 10 only. (X<sup>2</sup>(2, N=216)=5.49, p=.031) (Table 4).

**Table 4. Distribution of emotional/physical violence status of 10th grade from schoolmates by gender**

	No		Several times		Numerous		N	
	n	%	n	%	n	%	n	%
Girls	79	63.2	38	30.4	8	6.4	125	100
Boys	43	47.3	39	42.9	9	9.9	91	100

Half of the participants (49.9%, n=330) had some or more difficulties in complying with the school rules. Participants mostly (80.2%, n=529) had used harmful substances at least a few times.

At least one school escape rate was 32.4% (n=214), and 240 participants (36.4%) reported that they had at least one close friend who shows violent behaviors.

Only in 9th grades, there was a relationship between having difficulty in complying with school rules and gender (X<sup>2</sup>(2, N=308)=8.06, p=.018) (Table 5).

**Table 2. Variables related to the school and its immediate surroundings of the participants**

	No		Somewhat		Moderate		Much		Very much		N
	n	%	n	%	n	%	n	%	n	%	
Feeling safe in the neighborhood	28	4.2	61	9.2	180	27.3	212	32.1	179	27.1	660
Feeling belonging to the school	55	8.3	90	13.6	212	32.1	202	30.6	102	15.4	661
Seeing teachers close & supportive	29	4.4	105	15.9	253	38.3	209	31.6	65	9.8	661
Seeing schoolmates close & supportive	20	3.0	46	7.0	159	24.1	257	38.9	179	27.1	661

**Table 5. The distribution of the difficulty in adaptation to school rules in the 9th grade by gender**

	Very difficult		Somewhat difficult		Not difficult		N	%
	n	%	n	%	n	%		
Girls	14	9.7	67	46.5	63	43.8	144	100
Boys	8	4.9	59	36.0	97	59.1	164	100

Only in the 11th grades, the distribution of using health hazardous substance use ( $X^2(2, N=137)=10.42, p=.001$ ) and escaping from school significantly varied by gender (Table 6).

**Table 6. Use of the harmful substances by gender and absence from school in 11th grades**

Escaping from school								
	No		Several times		Numerous		N	
	n	%	n	%	n	%	n	%
Girls	14	16.7	69	82.1	1	1.2	84	100
Boys	22	41.5	31	58.5	0	0	53	100
Escaping from school								
Girls	54	64.3	22	26.2	8	9.5	84	100
Boys	18	34	18	34	17	32.1	53	100

Kolmogorov-Smirnov test showed that scores from Rathus Assertiveness inventory were not normally distributed ( $D=610=0.986, p=.011$ ). Mann-Whitney U Test did not indicate a gender difference for assertiveness score (*median for girls*=0.00 (min=-81, max=56), *for boys*=-2.00 (min=-90, max=43),  $p=.266$ ). The change that the assertiveness score can show by classes was evaluated using

the Kruskal-Wallis test, and no difference was found (*median for 9th grades*=-2.00 (min=-90, max=44), *median for 10th grades*=3.00 (min=-71, max=56), *median for 11th grades*=-1.00 (min=-54, max=44),  $p=.052$ ).

### 3.2. Family Relationships and Family Life

The responses of the participants, including their feelings and thoughts about family members, can be seen in Table 7.

The data in Table 7 were taken as a continuous variable, and we investigated whether there was a gender difference in each class. The sense of being understood in the family was lower for girls than boys both in 9th grades (*median for girls*=3, *for boys*=4,  $U=9504.00, p=.003, r=-.16$ ) and in the 10th grades (*median for girls*=3, *for boys*=3,  $U=4736.00, p=.037, r=-.14$ ).

The data in Table 8 were taken as continuous variables, and gender differences in each class were examined. Accordingly, it was observed that boys in the 9th grade perceived their family lives more regularly than girls (*median for girls*=3, *for boys*=5,  $U=9116.50, p=.000, r=-.20$ ). It was observed that the men in the 10th (*median for girls*=2, *for boys*=3,  $U=4695.50, p=.024, r=-.15$ ) and 11th grades (*median for girls*=2, *for boys*=3,  $T=1430.5, p=.000, r=-.30$ ) found more expectations from their families than the girls.

In the 11th grades, boys thought that they were less appreciated than girls (*median for girls*=4, *for boys*=3,  $U=1742.5, p=.026, r=-.18$ ) and it was found that the upbringing method of parents was harsh on them in comparison with girls (*median for girls*=1, *for boys*=2,  $U=1808.00, p=.044, r=-.17$ ).

**Table 7. Variables related to the family relations of the participants**

	No		Somewhat		Moderate		Much		Very much		N
	n	%	n	%	n	%	n	%	n	%	
Feeling loved in the family	11	1.7	32	4.8	94	14.2	166	25.1	358	54.2	661
Feeling understood in the family	39	5.9	89	13.5	223	33.9	167	25.4	140	21.3	658
Parent conflict frequency	166	25.1	332	51.1	84	12.9	40	6.2	28	4.3	650
Parent conflict severity	279	42.8	228	35.0	107	16.4	23	3.5	15	2.3	652
Frequency of conflict with parents	95	14.4	305	46.3	154	23.4	68	10.3	37	5.6	659
Severity of conflict with parents	239	36.3	251	38.1	118	17.9	37	5.6	14	2.1	659

**Table 8. Variables related to the family life of the participants**

	Never		Somewhat disagree		Neither agree nor disagree		Agree		Strongly agree		N
	n	%	n	%	n	%	n	%	n	%	
I cannot predict how some people in my family will behave.	257	39	223	33.8	110	16.7	44	6.7	25	3.8	659
We generally have a regular family life.	22	3,3	55	8.3	119	18	210	31.8	254	38.4	660
Our house is generally clean and tidy.	5	0,8	13	2.0	63	9.5	193	29.2	387	58.5	661
The methods used by some people in my family to nurture me feel harsh to me.	353	53,4	159	24.1	71	10.7	45	6.8	33	5.0	661
Some people in my family recognize my positive behavior and appreciate me enough for that.	34	5,2	82	12.5	130	19.8	189	28.7	223	33.9	658
I think my family has many expectations from me and it has exceeded my limits.	190	28,7	152	23.0	143	21.6	102	15.4	74	11.2	661
People in my family are good at dealing with life challenges.	11	1.7	28	4.2	95	14.4	208	31.5	319	48.3	661

**Table 9. Thoughts and behaviors that may leave participants open to abuse**

	Not suit me at all		Not suit me much		Not suit me		Suits me a little		Suits me a lot		Suits me extremely		N
	n	%	n	%	n	%	n	%	n	%	n	%	
1. I have to do everything adults say to me	120	18.2	115	17.5	136	20.6	161	24.4	76	11.5	51	7.7	659
2. If I open an account on the Internet or register to play a game, I will share my real name.	144	21.9	83	12.6	101	15.3	102	15.5	107	16.2	122	18.5	659
3. Sometimes it is appropriate to say "no" to an adult.	46	7.0	49	7.4	74	11.2	143	21.7	126	19.1	221	33.5	659
4. I can get in the car even of people I don't know very well.	434	65.7	95	14.4	44	6.7	41	6.2	18	2.7	29	4.4	661
5. Secrets must always be kept.	41	6.2	41	6.2	49	7.4	57	8.6	121	18.3	352	53.3	661
6. If a friend tells me that if I don't do what s/he wants, s/he won't talk to me again, I will do what he wants.	277	42.0	119	18.0	117	17.7	69	10.5	38	5.8	40	6.1	660
7. Foreigners also look like ordinary people.	95	14.5	74	11.3	134	20.4	113	17.2	96	14.6	144	22.0	656
8. If I have an incident that I will be very afraid or embarrassed, I have an adult acquaintance that I can tell about this incident.	99	15.0	63	9.6	64	9.7	75	11.4	107	16.3	250	38.0	658
9. I can share some secrets with people I trust for my own good.	66	10.0	51	7.7	70	10.6	121	18.3	141	21.4	211	32.0	660
10. I can report this to my relatives when I feel unsafe.	52	7.9	62	9.4	78	11.8	95	14.4	144	21.8	229	34.7	660
11. I trust people that I haven't actually seen but I only know from the internet.	353	53.4	115	17.4	80	12.1	62	9.4	25	3.8	26	3.9	661
12. Even if I love or like someone, s/he has no right to treat me in a way I don't like.	56	8.5	41	6.2	62	9.4	56	8.5	100	15.2	344	52.2	659
13. If a bad boy/girl at school orders me to do something, I better do what s/he wants.	509	77.2	58	8.8	33	5.0	23	3.5	24	3.6	12	1.8	659
14. Although someone says he knows you, he may still be a stranger	110	16.6	69	10.4	74	11.2	54	8.2	87	13.2	267	40.4	661

**Table 10. Comparison of the thoughts and behaviors that may leave participants vulnerable to abuse by gender**

	9th grade					10th grade					11th grade				
	Girls		Boys		Mann-Whitney U test	Girls		Boys		Mann-Whitney U test	Girls		Boys		Mann-Whitney U test
	mdn	n	mdn	n		mdn	n	mdn	n		mdn	n	mdn	n	
I can get in the car even of people I don't know very well.	1.0	144	1.0	164	$U=9199.5, p=.000, r=-.22$	1.0	125	1.0	91	$U=4414.5, p=.001, r=-.35$	1.0	84	2.0	53	$U=1311.0, p=.000, r=-.38$
Secrets must always be kept.	6.0	144	5.0	164	$U=9908.5, p=.009, r=-.14$	6.0	125	6.0	91	$P=.925$	6.0	84	6.0	53	$P=.148$
If a friend tells me that if I don't do what s/he wants, s/he won't talk to me again, I will do what he wants.	1.0	143	2.0	164	$U=9348.0, p=.001, r=-.18$	2.0	125	2.0	91	$P=.169$	1.0	84	2.0	53	$U=1746.5, p=.024, r=-.19$
I can report this to my relatives when I feel unsafe.	5.0	144	4.0	163	$U=8808.0, p=.000, r=-.22$	5.0	125	5.0	91	$U=4774.5, p=.037, r=-.21$	5.0	84	4.0	53	$P=.081$
Even if I love or like someone, s/he has no right to treat me in a way I don't like.	6.0	143	5.0	164	$U=9458.0, p=.002, r=-.17$	6.0	124	5.0	91	$U=4436.0, p=.004, r=-.30$	6.0	84	5.0	53	$U=1495.0, p=.000, r=-.30$
If a bad boy/girl at school orders me to do something, I better do what s/he wants.	1.0	144	1.0	163	$U=9850.5, p=.001, r=-.18$	1.0	125	1.0	91	$P=.166$	1.0	83	1.0	53	$U=1644.0, p=.001, r=-.28$
If I have an incident that I will be very afraid or embarrassed, I have an adult acquaintance that I can tell about this incident.	5.0	143	4.0	163	$p=.078$	5.0	124	5.0	91	$P=.337$	5.0	84	3.0	53	$U=1386.0, p=.000, r=-.32$
I trust people that I haven't actually seen but I only know from the internet.	1.0	144	2.0	164	$p=.059$	1.0	125	2.0	91	$P=.227$	1.0	84	2.0	53	$U=1590.5, p=.00, r=-.26$

In this study, 43% of the participants (n=284) estimated the number of children who had been emotionally abused in their close circle as 3 or more. The same estimate was 20.4% for physical abuse (n=135).

Looking at the decision tree, individuals who were unsafe in the neighborhood environment, perceive their economic situation as worse than their counterparts, and who tended to escape from school were likely to experience emotional abuse. In addition, individuals who had close friends who harmed animals or people in their environment, even if their neighborhood was safe, reported a

child who was emotionally abused in their close environment, especially when they lacked friend support.

Again, because s/he felt safe in his neighborhood and did not have any risk-taking behaviors, given that s/he was generally deprived of love and support increased the likelihood of someone who was subjected to emotional abuse in his immediate environment. Among the participants who did not feel safe in the neighborhood and had a violent close friend, the rate of reporting of emotionally abused friends was higher (Figure 1).

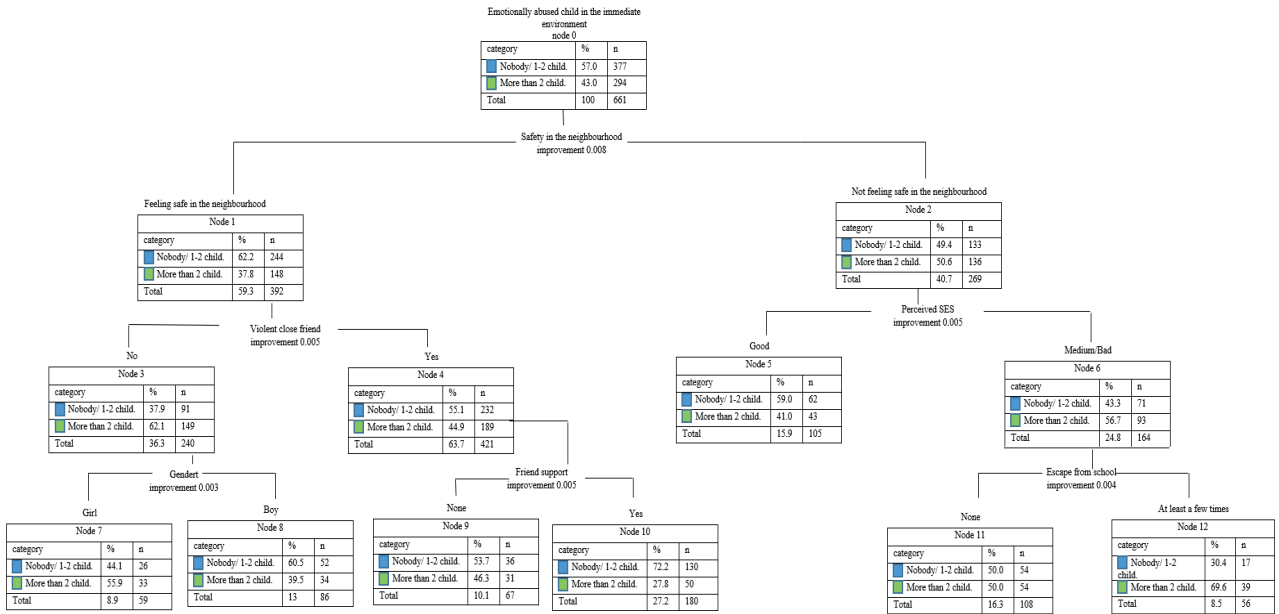


Figure 1. Decision tree made for the notification of emotional abuse in the close circle

Table 11. Decision tree cross-validity value for emotional abuse

Risk		
	Prediction	Standard error
Method		
Resubstitution	.386	.019
Cross-validity	.463	.019

Growing method: CRT  
 Dependent variable: Child who is emotionally abused near/ none or more than two

The ten-fold cross-validity coefficient was found to be .433.

Table 12. Decision tree contingency table for emotional abuse

Classification			
		Predicted	
Observed	No one or 1-2 people	More than 2 people	Percent correct
	No one or 1-2 people	334	
More than 2 people	212	72	25.4%
	82.6%	17.4%	61.4%

Growing method: CRT  
 Dependent variable: Child who is emotionally abused near/ none or more than two

When classifying the dependent variable (emotionally abused child in a person’s close circle), these variables are important: whether a participant had support from a friend, whether s/he escaped from the school or not, feeling safe in the neighborhood or not and whether had a violent friend (Figure 2).

If the participant did not have a violent friend but escaped from school without informing anyone, the rate of reporting that there were children who were physically abused in the immediate vicinity was high. If the person lacked support from close friends, having a close violent friend increased the rate of reporting that a participant had physically abused children in a close circle, although s/he did not escape from the school (Figure 3, 4).

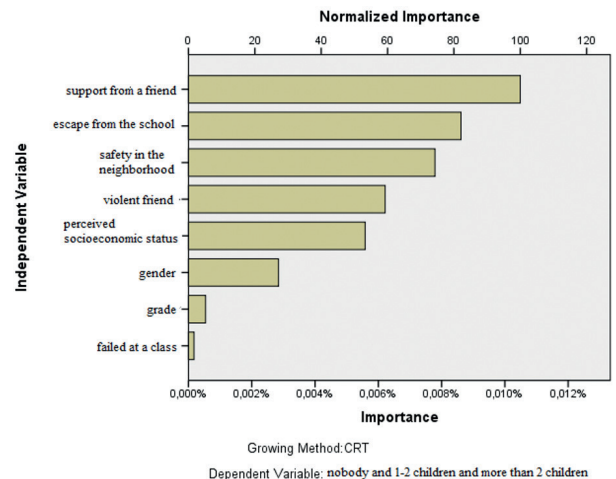


Figure 2. Normalized variable importance for the variable of being an emotionally abused friend in the immediate environment.

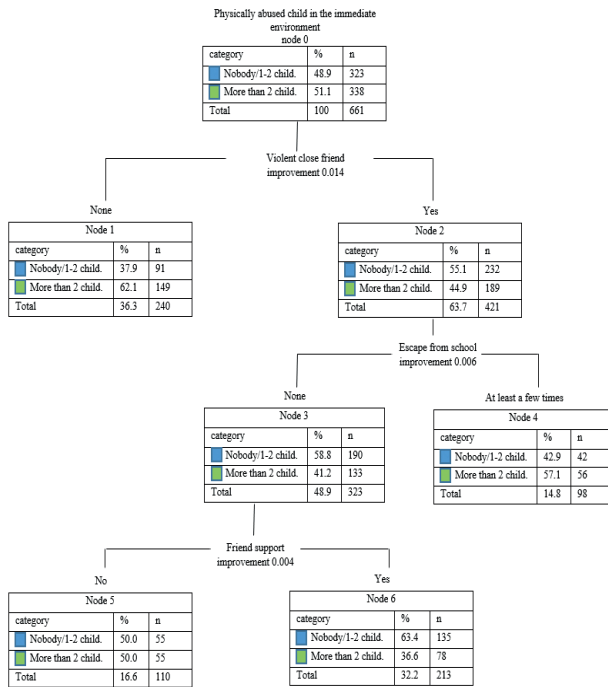


Figure 3. Decision tree made for the notification of physical abuse in the immediate environment

**Table 13. Decision tree cross-validity value for physical abuse**

Risk		
	Prediction	Standard error
Method		
Resubstitution	.402	.019
Cross-validity	.448	.019

Growing method: CRT  
 Dependent variable: Child who has been subjected to physical abuse at all/no one or more than two in a close circle

**Table 14. Contingency table for physical abuse**

Classification			
Predicted			
Observed	No one or 1-2 people	More than 2 people	Percent correct
No one or 1-2 people	135	188	% 41.8
More than 2 people	78	260	%76.9
	% 32.2	%67.8	59.8%

Growing method: CRT  
 Dependent variable: Child who has been physically abused (none/one or more than two)

When classifying having physically abused children in a close circle, the most prominent variables are escaping from the school, having a violent close friend and having a support from a friend (Figure 4).

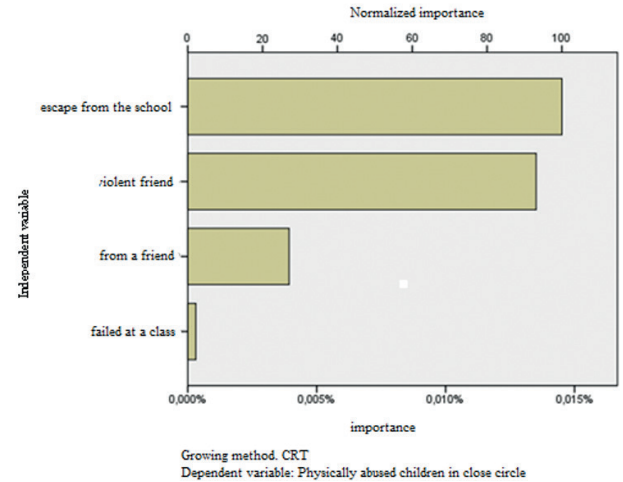


Figure 4. Normalized variable importance for having a friend who is physically abused in the close circle

## 4. Discussion

### 4.1. Demographic Information and Possibility of Abuse

The review and meta-analyzes examining the risks and protective factors associated with abuse and neglect report that various demographic data contribute to different degrees of abuse or neglect. Stith et al. (18) associated the lack of social support, unemployment, low socio-economic level, and being a single parent in the family with physical abuse. While the low level of education of parents is associated with physical abuse, neglect and emotional neglect, the gender of the child is related to both sexual and emotional abuse (18, 19). The sex of the child may cause parents to develop different expectations from girls and boys according to their gender roles, and therefore react differently to the child's behavior. This may be related to the different abuse experiences of children of different genders (20). The high number of children in the family also seems to be related to neglect (17, 21). Because the majority of the parents of the participants in this study are alive and married and that almost all the fathers have jobs can be described as protective. On the other hand, given that approximately one-third of the participants reported that they were not sure whether or not they could get support if their family had difficulties in life suggests that they may be at risk for social support.

## 4.2. Risk-Taking Behaviors, Thinking Style That Facilitates Abuse and Assertiveness

It is reported that there is a correlation between adolescent behaviors that endanger his/her health and safety and past abuse experience. For example, it has been observed that the externalizing psychological problems that arise in the child after the abuse has made it easier for the person to show risk behaviors related to substance use and sexual intercourse (22). Certain risk behaviors, such as becoming pregnant at a young age and having sexual intercourse at an earlier age than their peers, may increase in people who have been abused (23). Being abused in childhood is one of the variables that predict both girls' and boys' regular smoking and drinking (24) and excessive alcohol intake behavior at once (25). In this study, most of the students reported that they used health hazardous substance (such as alcohol and substance) at least several times. In the upper classes, this risk behavior was observed more frequent in girls than boys were. Being a girl, having a history of abuse, especially emotional abuse, and having deviant friends are important in predicting dangerous behavior (26). Simantov, Schoen and Klein (24) also confirm that there is a higher rate of abuse, domestic violence, negative life event reporting in people who regularly show smoking and drinking behavior, and the use of alcohol and substances in the upper classes (11th and 12th grades) is smaller than those (7 and 8th grade).

One of the risk behaviors questioned in this study was school escaping. Adolescents who are abused in the early period are more likely to escape from the school. They are less likely to continue higher education and show many psychological symptoms (27). Hagborg, Berglund and Fahlke (28) also reported that among students who escaped from school, students who were abused were high, nearly all of them had more than one type of abuse, more mental health disorders, and their relationship with their teachers was impaired. In this study, students who say that they have fled the school at least a few times made up about a third of the participants, and in the upper classes, the behavior of boys to escape from school was more common than girls.

Assertiveness is among the recommended skills to be developed in prevention programs (29). This skill can be developed to prevent a particular type of abuse, such as concerning sexual abuse, such as being able to say no to unwanted touch. Or it can be acquired as a general skill (30) and developed to be used in every stage of life (31). In this study, assertiveness levels did not make a significant difference according to gender and class.

In child abuse prevention, it is aimed to change the target audience's thoughts, approaches and behaviors through many concepts. Some of the concepts that can be targeted are the possession of the body, the distinction between good and bad touch, special parts of the body, keeping secrets, recognizing strangers, methods of fooling the attacker, denouncing existing abuse, and an acceptable and unacceptable touch of acquaintances (11). It is important to know the knowledge and attitudes of children in these areas that may make them vulnerable to exploitation before the prevention program is developed. Obtaining this data will also help in determining whether the targeted benefits have been achieved after the program.

Many things affect whether or not children express their abuse. Some of these are the relationship with the aggressor, the methods used by the attacker to silence the child, the child's perceived responsibility for the event, the guilt the child feels about the event, child's expectations about what will happen to their family, the attacker when they reveal the event. (32).

In this study, considering the responses of the participants in Table 9, the issues of being able to say "no" to adults or their peers and approach to keeping secrets seem to be the subjects that can be focused on in a prevention study. In addition, participants' knowledge and approach to safe internet use can be another focus. Studies show that risky internet use behaviors are strongly related to online victimization (33).

## 4.3. Family, School, Close Environment Life and Possibility of Abuse

Family members' understanding, love and acceptance of each other as well as adolescents are essential conditions for healthy psychological functioning. The nature and severity of conflicts that inevitably arise in family relationships and the ways the family members' coping with these are important for the healthy development of the person in adolescence. Concerning physical abuse, family conflict and cohesion in the family have a high effect size, and for neglect, the quality of the parent-child relationship has a high effect size (17). Tian, Liu and Shan (34) showed that parental support positively affects the psychological resilience of the adolescent both directly and by increasing self-esteem. How family functions are evaluated by adolescents are among the variables that predict physical or emotional abuse. The closeness and trust of family members to each other, whether they behave in consideration of all family members in their behaviors, predicted the physical abuse score and communication problems in the family predicted the emotional



abuse score (35). In families with abuse, for example, the presence of emotional abuse predicted the child's problem behaviors both directly and through self-efficacy and psychological resilience variables (36).

Conflicts between parents and adolescents indicate that not only disagreement but both sides frame the events in different ways. While the issues discussed are evaluated by the parent concerning right-wrong and/or morale, these issues can be seen as a personal choice for the adolescent (37). In this study, the vast majority of participants felt they were loved by their parents, but almost a fifth thought that they were not understood by them. The sense of understanding in the family in the 9th and 10th grades was significantly lower in girls than in boys. Nearly three-quarters found their family highly/almost highly enough to deal with difficulties.

The general flow of family life, how daily tasks are organized, and routines at home informs about the quality of the family's organization and predictability of family life. In this study, about one-tenth of the respondents reported that they could not predict the way some of the family members, and they did not have a regular family life. Regulating the conditions at home in the daily life stream is also considered among parenting skills, and parents are also supported in prevention programs.

Parenting styles are also a variable studied in the literature of abuse. The values the parents use while raising the child, the emotional tone of their upbringing, and the reward-punishment system they use determine many things. In our study, approximately one-tenth of the participants reported that the method of raising used in the family was harsh on him/her, and about one-fifth reported that his/her positive behaviors were not noticed and appreciated.

Hard discipline methods can be associated with behavioral problems in children. The presence of a positive attitude in the parent-child relationship (such as a parent's warm approach) may cause a buffer effect that will reduce the effects of harsh physical discipline (38). Dysfunctional parenting styles, such as overreaction to the child, and being authoritarian towards him, are associated with the potential for emotional and physical abuse of the child (39).

In this study, about a quarter of the participants reported that the expectations of the family members were higher than their own and exceeded their limits. Some studies point out that high parental expectations also increase the likelihood of criticizing the child (40, 41). The expectation of the parent should not be understood only as a variable with negative results. This variable, for example, causes the student to increase the emphasis on

academic achievement; on the other hand, it may develop his depressive mood (42). In this study, the opinions of the participants about parental expectations differed by class and gender. Generally, males found their family members' expectations much higher, thought that they were not appreciated enough and find their upbringing methods harsh.

The variables, such as the social organization of the neighborhood in which the person lives, the demographic characteristics of the people living in the environment, general human mobility are in line with the changes in the official abuse reports.

If social control and organization problems are observed in the living environment, the rate of abuse is related to this (43, 44). The high level of social cohesion in the neighborhood can be associated with the reduction of neglect cases in that neighborhood (45). For example, keeping an eye on each other's children and being able to act together in meeting the basic needs of children may reduce negligence. At the individual level, the negative perception of the social processes in the living environment may affect the stress that parents experience about parenting and mediate the emergence of physical abuse and neglect (46). In neighborhoods where collective impact, social networks are strong, and irregularity is low, rates of neglect, physical and sexual abuse are low (47). The feeling of belonging to the environment in which the person lives and feeling safe, there can also be considered as an indicator of how this environment is evaluated by him. The disruptive effects of abuse on the sense of belonging are reported: social loyalty and belonging are fully mediated in the relationship between psychological abuse and psychological resilience (48).

Up to three-fifths of the participants in this study reported feeling very/very safe in their environment. In the tenth grades, the sense of security in the neighborhood and the sense of belonging to the school showed a significant difference between the genders. Both feelings are lower in girls.

The way students go to school can be important in predicting the risks students might face. For example, dropping out of school by a parent or service may reduce the likelihood of absenteeism, hitchhiking, or more risky behaviors than going to school alone or with friends. Indeed, when individuals go to school alone, they feel less secure, while the presence of an adult can increase their sense of confidence (49).

Being abused is among the variables that can predict a decrease in self-esteem and deterioration of relationships with friends, depending on the type of abuse (50). Chronic abuse is associated with rejection by friends. Among the

things that facilitate this relationship are the aggressive behaviors shown by the victim. Victim children's social withdrawal is also associated with their rejection by their friends (51). In addition, having a history of abuse increases the likelihood of violence against schoolmates (52). In this study, approximately two-fifths of the respondents reported that they experienced physical or emotional harm at least a few times from their friends at school. This was more common among 9th-grade students, and girls were less likely to experience violence than boys.

## 5. Conclusion

The findings obtained in this study suggest that because parents are alive and married and that almost all of the fathers have a job are protective factors concerning abuse or neglect and failure to find someone to support if the family is in a difficult situation appears to be a risk factor. The participants mostly find their family sufficient to deal with the difficulties in life.

Most of the students have used harmful substances at least a few times, and girls in the upper classes have shown this behavior at a higher rate than boys.

Those who say that they have escaped from school at least a few times make up about a third of the participants. In upper classes (11th grade), boys have higher school absenteeism than girls.

Although the participants mostly feel that they are loved by their parents, they think that they are not understood by them, and this sense of understanding is lower in girls than in boys.

Approximately one-tenth of the participants reported that the method of upbringing used in the family was harsh to him, and about one-fifth of them reported that his positive behavior was noticed or not appreciated. The participants also reported that the family had many expectations from them and exceeded their limits. Especially males in the 10th and 11th grades find the expectations from their families more, find the upbringing methods hard, and thought that they were not appreciated enough. More than half of the participants reported that they felt very/very safe in their environment. In the tenth grade, the sense of security in the neighborhood and the sense of belonging to the school were lower in girls.

About half of the participants reported that they had experienced physical or emotional harm at least a few times from their friends at school. This was more common among 9th-grade students, and girls were less likely to experience violence than males.

Based on these results reported above, being able to say no to friends, i.e., refuse to smoke, increasing the parent-child interaction, realizing the effects of parenting

styles of children on the development of children, and using safe internet, can be chosen as the target of a prevention program that can be carried out in the region where this study has been conducted.

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### Childhood Deaths Due to Firearm Injuries in Izmir and Nearby Cities

## İzmir ve Çevre İllerde Meydana Gelen Ateşli Silah Yaralanmasına Bağlı Çocukluk Çağı Ölümleri

Faruk Aydın\*, Mehmet Sunay Yavuz

**Abstract:** **Objective:** Childhood deaths due to the firearm injuries are rising in our country and worldwide. In this study, our aim was to examine the childhood deaths related to firearm injuries in İzmir and neighboring provinces between 01.01.2006 and 31.12.2015 and the information such as sociodemographic aspects, the types of the firearms, origin, region of injury, place of death, shooting distance, and the owner of the firearm. **Materials and Methods:** In our study, autopsy report and forensic investigation files of childhood deaths related to firearm injuries in and around İzmir were retrospectively reviewed. The data were evaluated using SPSS version 22 program. **Results:** 79 (69,3%) of the cases were male, mean age is 14,04±4,23, and male / female ratio was 2,25. Guns and shotguns were used in 39 cases (34,2%) and in 75 cases (65,8%) respectively. When the cases were evaluated corresponding to their origins; homicide was the first with 37 cases (32,5%). It was found that deaths occurred most frequently in winter (n: 32,28.1%). Most of the cases occurred in rural areas such as villages and towns (n=48,42.1%) and the incidence mostly took place within houses (n=54,47.4%). In 35 cases (30,7%) the owner of the weapon was the father of the victim. **Discussion and Conclusion:** We think that if children reach the firearms easily, the injuries and the deaths are likely to occur therefore firearms shouldn't be kept in the residences with children if possible and children are not encouraged to use weapons even if they are toys.

**Keywords:** Child, Firearm, Death, Forensic Autopsy

**Öz:** **Amaç:** Ateşli silah yaralanmalarına bağlı çocukluk çağında meydana gelen ölümler ülkemizde ve yurt dışında giderek artmaktadır. Bu çalışmada 01.01.2006-31.12.2015 tarihleri arasında İzmir ili ve çevre illerde çocukluk çağında meydana gelen ateşli silah yaralanmasına bağlı ölüm olgularında sosyodemografik özellikler, kullanılan silah türü, orijin, yaralanan bölge, olay yeri, ölüm yeri, atış mesafesi, silahın ait olduğu kişi gibi verilerin değerlendirilmesi amaçlanmıştır. **Gereç ve Yöntem:** Çalışmamızda İzmir ve çevresinde meydana gelen ateşli silah yaralanmasına bağlı çocuk ölüm olgularının otopsi raporları ve adli tahkikat dosyaları retrospektif olarak taranmıştır. Veriler SPSS versiyon 22 programı kullanılarak değerlendirilmiştir. **Bulgular:** 79 (%69,3) olgu erkek, yaş ortalaması 14,04 ± 4,23, erkek/kadın oranı 2,25 bulundu. 39 olguda (%34,2) kısa namlulu, 75 olguda (%65,8) uzun namlulu silah kullanıldığı tespit edildi. Orijinlere bakıldığında; 37 olgu (%32,5) ile cinayetin ilk sırada yer aldığı görüldü. Ölümün en sık kış mevsiminde (n:32, %28,1) olduğu tespit edildi. Olguların en fazla (n:48, %42,1) köy/kasaba gibi kırsal bölgelerde ve olayın gerçekleştiği yer olarak en fazla (n:54, %47,4) evde meydana geldiği bulundu. Otuz beş olguda (%30,7) olayda kullanılan silahın küçüğün babasına ait olduğu görüldü. **Tartışma ve Sonuç:** Çocukların ateşli silahlara kolayca ulaşmaları halinde yaralanma ve ölüm olaylarının kolayca meydana gelebileceği, bu nedenle çocuklu evlerde mümkün olduğunca ateşli silah bulundurulmaması gerektiği, çocukların oyuncak dahi olsa silahlara özendirilmesinin bu konuda faydalı olacağı sonucuna varıldı.

**Anahtar Kelimeler:** Çocuk, Ateşli Silah, Ölüm, Adli Otopsi

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#### Ethical Declaration

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## 1. Introduction

Deaths from firearm injuries show different demographics that vary according to many factors. The number of deaths depending on a firearm injury shows a rapid increase in many countries that their legal mechanisms are slow or not sufficiently functioning, it is easy to access to the weapon and an important place of it in sociocultural structure, without strict legal practices restricting the possession and use of weapons (1).

It is stated that our country ranks fourteenth in the world in terms of armament, on average 3,000 people per year die by firearms in our country, and the most common cause of homicidal deaths is deaths that develop as a result of firearm injury (2). According to the 2003 reports of the National Trauma Data Bank of the United States (3), It is stated that approximately 20% of all deaths occurred as a result of firearm injuries in cases under the age of 19 (3). In an autopsy study in Konya, which evaluated 985 cases in the 18 and under age group during the period between 1999 and 2007, it is reported that 5,1% of cases that were found to have died as a result of firearm injuries were in the 18 and under age group (4). In another autopsy study conducted in Erzurum, it is stated that 18,9% of deaths related to firearm injuries during the two-year period were deaths under the age of 18 (5).

A study in the USA reported that most cases of children with firearms and resulting in death were male, and that the incident usually occurred either as a result of the accidental firing of the weapon by the deceased child himself or a family member or close friend of the deceased (6). Similarly, a study in our country shows that the majority of childhood deaths with firearms are from suicide and accident (4). It is stated that children's easy access to firearms and the use of guns as a result which can cause accidents are the basis of the main problem in these deaths (7).

Both in our country and in the world, autopsy cases related to firearm injury deaths are in the first place. In addition to the cause of death, the autopsy also attempts to obtain information about the origin of the incident (murder-suicide-accident) in light of the evidence obtained. Examination of firearm entry and exit wound characteristics and clothing can also provide important information about the origin (8). The post-mortem examination will contribute to the full details of the incident.

Our aim in the study was to examine the sociodemographic characteristics of the deaths related to firearm

injury in the 18 and under age group occurring in Izmir province and nearby cities, to compare the data obtained with similar studies conducted in our country and around the world, to draw attention to death events due to injuries caused by firearms in childhood and to increase the sensitivity of the society on this issue.

## 2. Materials and Methods

Autopsy reports and forensic investigation files of 114 deaths related to firearm injuries in the adolescent, child and infant age group of 18 years and younger, which occurred in Izmir and the surrounding provinces, were carried out by the Specialized Mortuary Department of Izmir Forensic Medicine Group Presidency in a total period of 10 years between 2006-2015; it has been evaluated in terms of characteristics such as location and time of death, gender, age, origin, type of gun, shooting distance, the structure of the bullet core, the entry point of the bullet, who owned the gun used in the incident, toxicological results of samples taken, cause of death and who the perpetrator is.

The data was evaluated using IBM SPSS version 22, using percentage, ratio and chi-square statistics in the data analysis,  $p < 0,05$  accepted as an indicator of significant difference and the data are presented in tables and graphs.

## Ethical Declaration

This study was conducted after obtaining approval letter from the Manisa Celal Bayar University Faculty of Medicine Clinical Research Ethics Committee numbered 20.478.486-320 and dated 28.09.2016 together with Forensic Medicine Institute Scientific Work Permit Board numbered 21589509 and dated 31.01.2017.

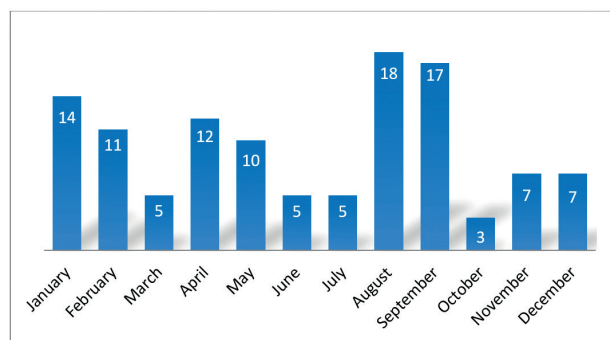
## 3. Results

It has been observed that a total of 1,876 cases of firearm injury-related deaths that were autopsied between 2006 and 2015, 114 (6,07%) were in the age group aged 18 and below. Looking at the distribution of cases by gender; of the 114 cases, 79 (69,3%) were male and 35 (30,7%) were female, and the M/F rate was 2,25. The average age of cases was detected as  $14,04 \pm 4,23$  (1-18) years. Looking at the distribution of cases according to age groups, 74 cases (64,9%) were found to be in the 15-18 age group in the first place (Table 1). There was no significant difference when comparing gender and age distribution ( $p > 0,05$ ).

**Table 1. Distribution of cases by age groups and gender**

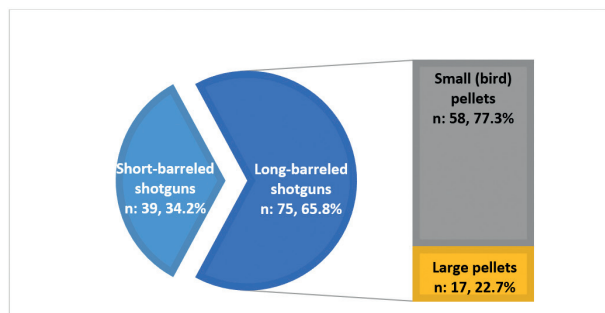
Age (Year)	Male		Female		Total	
	n	%	n	%	n	%
1-4	5	6,3	1	2,9	6	5,3
5-9	7	8,9	5	14,3	12	10,5
10-14	15	19	7	20	22	19,2
15-18	52	65,8	22	62,8	74	64,9
Total	79	100	35	100	114	100

When it was looked at the distribution of cases according to the years in which the event occurred, it was found that deaths occurred most frequently in 2007 with 22 cases (19,3%). When the distribution of the cases according to months is evaluated, the highest number of deaths was found to have occurred in August with 18 deaths (15,8%) and the fewest deaths occurred in October with 3 cases (2,6%) (Figure 1). In the distribution of deaths by seasons; 32 the most common cases (28,1%) occurred in the winter season, then in the summer season with 28 cases (24,6%) and in the spring and autumn seasons with 27 cases (23,7%) respectively.

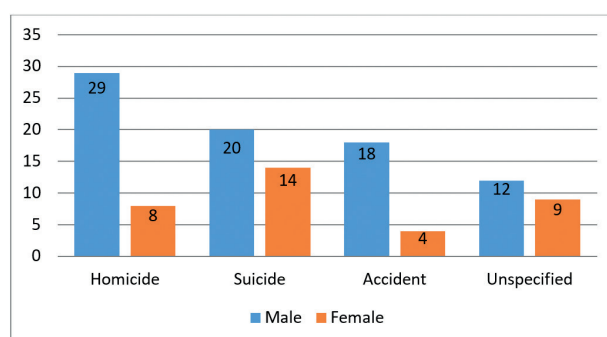
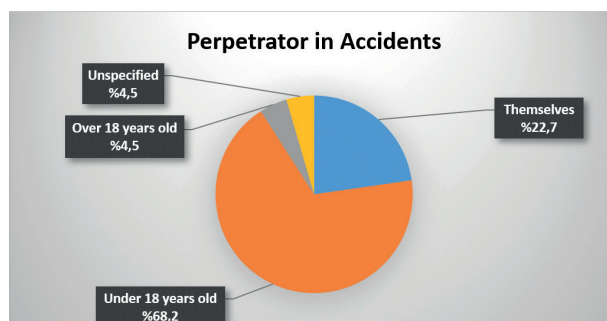
**Figure 1.** Distribution of cases by months of occurrence

Cases are evaluated by the type of firearm used; it was found that 39 cases (34,2%) had short-barreled guns and 75 cases (65,8%) had long-barreled guns (shotguns). In 58 (77,3%) of the cases where the shotgun was used, small (bird) pellets were used, and in 17 (22,7%) large pellets were used. (Figure 2).

Looking at origin distribution; while homicide ranks first with 37 cases (32,5%), in 34 cases (29,8%) suicide, in 22 cases (19,3%) accidental death was observed; on the other hand, in 21 cases (18,4%), no information about the origin was found in the forensic investigation file. The origin was most common in males (n: 29, 36,7%) and

**Figure 2.** Distribution of the cases according to the type of firearms used in the event

most common in females (n:14, 40%) was suicide (Figure 3). In 39 cases (34,2%) the injury was carried out by the minor themselves, in 11 cases (9,6%) the perpetrator was the father of the deceased, in 11 cases (9,6%) their sibling, in 12 cases (10,5%) their friend. The origin of the incident was stated as an accident when 22 cases were examined; five of them (22,7%) who pulling the trigger of a firearm causing their own death, in 15 cases (68,2%), people who pulling the trigger, was found to be less than 18 years old (Figure 4). Six of the suicide cases (17,6%) caused because of separating from their boyfriend/girlfriend, two (5,9%) committed suicide as a result of an argument with their family, two (5,9%) had a known severe psychiatric illness in their story, and one (2,9%) committed suicide due to bad report cards. In all cases where the

**Figure 3.** Distribution of cases by origin and gender**Figure 4.** Distribution of persons performing injury in cases with origin accident

origin was suicide, the shooting was done at adjacent or at closest distance, the most cases with accident origin (five cases) were from an adjacent and far distance, while the most cases with murder origin (14 cases) were from far distance.

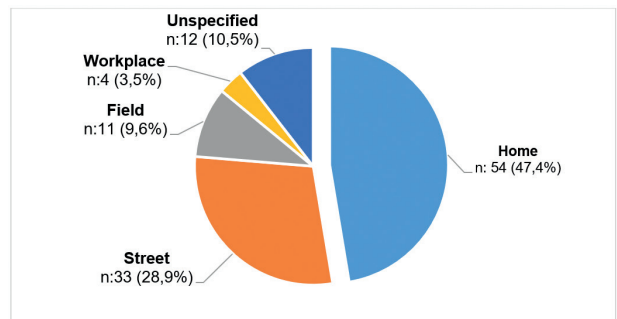
In fifty-three cases (46,5%), injuries in the head region, 20 cases (17,5%) in the abdomen region, 17 cases (14,9%) in the chest region, and 7 cases (6,1%) in the neck region were detected (Table 2). Other body injuries of the head region in cases whose origin is a suicide, there was a significant difference in the advanced level compared to the area injuries ( $p < 0,001$ ). Besides, there were observed that there was skull fracture and brain tissue destruction in 56 cases (49,1%), internal organ injury and large vessel destruction in 27 cases (23,7%), and in 22 cases (19,3%) death occurred as a result of internal organ injury. The single gunshot entry wound was found in all cases of suicide (n: 34) and accident (n: 22), and in 21 (56,8%) cases of homicide (n: 37).

Evaluating by the residential areas where the incident took place; 48 cases (42,1%) were found to have occurred in rural areas such as villages/towns, 37 cases (32,5%) were in the county center and 29 cases (25,4%) were in the provincial center. It was found that 17 (58,6%) of the fatalities reported to occur in the provincial center were short-barreled, 12 (41,4%) used long-barreled weapons (shotguns), while 39 (81,3%) of the fatalities in rural areas such as villages/towns were shotguns and 9 (18,8%) were short-barreled guns (Table 3). Short-barreled weapons were used in the provincial center and long-barreled weapons were used more in rural areas such as villages/towns. This difference was found to be statistically significant. ( $p < 0,05$ ). The majority of accidental deaths (72,7%) occurred in rural areas such as villages/towns, while there were almost none in provincial centers (4,5%) and there was a statistically significant difference ( $p < 0,05$ ).

**Table 3. Distribution of the cases according to the location of the incident and the firearm used in the incident and the origin**

	Provincial Center	Villages/ towns	County Center
<b>Firearm Type</b>			
-Short-barreled shotguns	17	9	13
-Long-barreled shotguns	12	39	24
<b>Origin</b>			
-Suicide	9	14	11
-Accident	1	16	5
-Homicide	12	16	9
-Unspecified	7	2	12
Total	29 (%25,4)	48 (%42,1)	37 (%32,5)

Fifty-four deaths (47,4%) occurred at home, 33 deaths (28,9%) occurred on the street, 11 deaths (9,6%) occurred in the field, and 4 deaths (3,5%) occurred at work. (Figure 5). Suicide (n:25, 73,5%) and accident (n:10, 45,5%) cases occurred in the home and homicide cases occurred in the street (n:16%, 43,2%) were the most.



**Figure 5.** Distribution of cases according to the location of the event

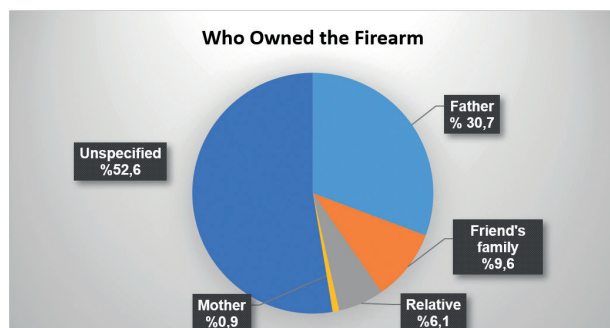
**Table 2. Distribution of cases by origin and injured body area**

Body Area	Suicide		Accident		Homicide		Unspecified		Total**	
	n	%	n	%	n	%	n	%	n	%
Head	21	61,8	9	40,9	14	37,8	9	42,9	53	46,5
Abdomen	7	20,6	8	36,4	4	10,8	1	4,8	20	17,5
Chest	2	5,9	1	4,5	8	21,6	6	28,6	17	14,9
Multiple body areas	3	8,8	1	4,5	9	24,4	3	14,2	16	14,1
Neck	1	2,9	3	13,6	2	5,4	1	4,8	7	6,1
Extremity	0	0	0	0	0	0	1	4,8	1	0,9
Total*	34	100	22	100	37	100	21	100	114	100

\*: Rates by origin      \*\*: Proportions within body regions



Looking at who owned the firearm used in the incident; it was observed that in 35 cases (30,7%) the gun belonged to the father of the deceased, in 11 cases (9,6%) to the family of the friend, in 7 cases (6,1%) to the relative and in 1 case (0,9%) to the mother, in 60 cases (52,6%) it was not stated who owned the gun (Figure 6).



**Figure 6.** Distribution of the firearms used in the incident by whom they belong

Of the 101 cases analyzed by toxicological analysis, 81 (71,1%) were negative, 20 (17,5%) were positive, the toxicological results were positive and eight cases were the first among the 14 cases whose origin was determined.

#### 4. Discussion

It has been observed that a total of 1,876 cases of firearm injury-related deaths that were autopsied between 2006 and 2015, 114 (6,07%) were at the age group 18 and below. When similar studies were examined; in the study conducted in Erzurum (5), 18,9% of all firearm injury related death cases between 2008 and 2009 were under the age of 19. While the study conducted in Diyarbakir (9), between 2009 and 2014, this ratio was 33% in the group under the age of 20, the study conducted in Eskisehir (2), this ratio was 16,3% in the group under the age of 20 between 1999 and 2008. In the study (10) conducted in the USA between 2000 and 2014, this ratio was reported as 7,3% in the group 17 years and under, and in the study (11) conducted in Canada between 1999-2003, it was reported as 15% in the group under 19 years. The proportion of children and adolescents in firearm injury related deaths in all age groups in our study, it appears to be lower compared to similar studies both national and foreign. We believe that this result is due to the fact that people living in Izmir and the surrounding provinces are more sensitive to hiding firearms from minors by taking security measures.

Our study showed that out of 114 cases, 79 (69,3%) were male and 35 (30,7%) were female. The proportion of men in the study, which included all age groups and

examined deaths that developed as a result of a firearm injury; 91,8% of Cingöz's (12) study in Aydın, The studies of Şam and et al. (13) in Istanbul, it was determined as 87 %, Demirci et al. (4) in Konya, the proportion of men in the study who evaluated firearm deaths under the age of 18 was 68% while Dowd and et al (14) study in the USA, it was reported that this rate is 90,4% for firearm injuries aged 14 and under. Studies conducted both in our country and abroad showed that the proportion of men in all age groups and child and adolescent age groups was significantly higher than that of women. (Table 1).

In our study, the cases were evaluated according to the seasons in which the incident occurred; the highest number of deaths occurred during the winter season with 32 cases (28,1%) (Figure 1). In studies conducted in our country and involving all age groups; These results were stated that; According to Bozkurt's study (9), fatalities occurred in Diyarbakir most during the summer season (32,7%) and least during the winter season (18,1%), according to Türkoğlu and et al, occurred (15) most in summer season in Elazığ (30,8%), according to Aydın and Çolak (16), it was most in summer season in Samsun (28,3) and least during winter season (20,9), and for Cingöz (12), the most occurred during the fall season (28,1%) and the least occurred during the winter season (21,2%). Although deaths from firearm injuries in all age groups are most likely to occur in the summer season, deaths in patients at the age of 18 and below in our study were most common in winter. It was suggested that children who were unable to get out of the house much in the cold weather and had to play their toys at home were more likely to spend time in the home environment where firearms were kept.

When the cases were evaluated according to the type of firearm in our study; 39 cases (34,2%) of short-barreled guns, 75 cases (65,8%) of long-barreled guns (shotguns) were recorded (Figure 2). Deaths from firearm injuries involving all age groups; it was stated that 71,4% of pistols were used in Bozkurt's study (9), in the study conducted by Türkoğlu et al. (15), 60% of pistols were used, 77% of pistols were used in the study of Aydın and Çolak (16).

Studies assessing firearm deaths under 18; Choi et al. (17) stated that shotguns were used in 51,6% of death cases while Demirci et al. (4) stated in their study that the use of shotguns was 66% and the use of handguns was 34%. Our study found that greater use of shotguns was in line with other studies that assessed firearm deaths under the age of 18. Although guns are easy to carry and can be kept on the person without attracting attention in daily life and it is seen that there are many deaths occurring with such weapons in all age groups, it was conducted

that the use of hunting rifle is higher in the group aged 18 and below because pistols are usually kept in houses and children are partially prevented from reaching these weapons while rifles are hung on the walls of the house especially in the countryside, it's bigger than pistols even if it's hidden and it is easily found by children.

When the cases are evaluated according to their origin (Figures 3 and 4), it was observed in the study that homicide was the first in 37 cases (32,5%), suicide was the first in 34 cases (29,8%), and accidental deaths were the first in 22 cases (19,3%). In other studies, all age groups in Turkey and abroad were examined for deaths with firearms; In the study of Gören and et al (18), 66,7% of cases were murder, 27% were suicide, 6,3% were accidents, In Toka's (2) study, 55,3% of cases were homicide, 37,6% were suicide, 5,7% were accidents; and also the study conducted by Solarino et al (19) found that 88,4% of cases were homicide, 11,5% were suicide, 0,1% were accidents. Compared all age groups and deaths as a result of firearm injuries in the 18-year-old and under age group in our study; the origin of murder ranks first in both groups, and as with all age groups, the tendency to commit murder with firearms is more likely in childhood age groups. When we look at all age groups From the studies we have analyzed in the literature, the highest rate of accident origin deaths was 6,3%, while firearm deaths under the age of 18 were assessed and also in the other studies; When Demirci and et al (4) stated accident origin rate as 34 %, Eber and et al (20) stated 20,7% in the group aged 14 and under. In our study, the rate of accidental deaths was 19,3%. These results show that accidental deaths from firearms increased noticeably in the group aged 18 and under. In our study, it was observed that the perpetrator was still at the age of 18 and below (68,2%) in the majority of accidental deaths, and 22,7% of the perpetrators pressed the trigger themselves as a result of playing with a firearm. Having a high rate of accidents in child and adolescent firearm deaths in the age group, it has been suggested that children in this age group are treated as toys by their parents because of toy guns, children's perception of firearms as toys and use them in their games cause fatal injuries to both themselves and other children.

When the cases in our study are evaluated according to origin and area of injured body (Table 2); of the 34 cases whose origin was determined to be suicide, the maximum number of injuries was found in the head region (n:21, 61,8%) and the second most frequent in the abdomen region (n:7, 20,6%). Most studies with cases of suicide by firearm, head and neck injuries ranging from 50,5% to 81% were reported (21-24). In our study, it was found that the highest proportion of suicide-related deaths

carried out by firearm was in the head and neck region. In preference to the head-and-neck area of those who commit suicide with a firearm, we believe that it is easier to hold a firearm, especially in the neck area. In addition, we believe that the head region is the riskier region for fatal injuries and that it is known that deaths from brain damage among people are definite and rapid and that it is effective for suicides to choose this region.

When the cases in our study are evaluated according to the residential areas where the incident occurred (Table 3); it was determined that 48 cases (42,1%) occurred in rural areas such as villages/towns, 37 cases (32,5%) occurred in the district center, and 29 cases (25,4%) occurred in the provincial center. Our study showed that the highest proportion of all three deaths due to firearm injury occurred in rural areas such as villages/towns. We think that all three origin deaths occur mostly in rural areas, due to the fact that those living in rural areas are easier to reach for shotguns due to both traditional and lack of supervision than those living in urban centers. In our study, it was observed that only one of the accidental deaths occurred in the city center. We believe that the reason why accident origin deaths are rarer in the city center that handguns are the most common type of firearm in provincial centers, so they are more difficult to find by children than long-barreled guns from hiding, and they are more conscious about the storage of weapons by taking security measures because the population in the provincial centers has higher socioeconomic and educational levels than in rural areas.

When the cases in our study are evaluated according to where the incident took place (Figure 5); there were 54 deaths (47,4%) at home, 33 deaths (28,9%) on the street, 11 deaths (9,6%) in the farm, and four deaths (3,5%) at work. When the cases are evaluated according to the place and origin of the incident; suicide (n:25, 73,5%) and accident (n:10, 45,5%) cases occurred in the home and homicide cases occurred in the street (n:16, 43,2%). The data we obtained in our study have been found to be consistent with the literature. (4, 17, 20, 25). In particular, possession of firearms in the home reduces the use of drugs, gas and other methods that are less likely to result in death in childhood suicides, and increases the likelihood that suicide will result in death (26).

In our study, the distribution of 54 cases according to the origin of the firearm used in the case can be determined (Figure 6); the highest proportion of all origins was found to be deaths from a father's firearm. It is reported that cases of accidental origin occurring with firearms at early age are usually caused by the curious individual

playing with a weapon that is not properly maintained by one of the family members in their own home (6).

In the world, the number of deaths related to firearm injury in the age group of 18 years and below is increasing, both legally and illegally, and individual armament is increasing. It is thought that multiple factors, such as the easy reach of children, contribute as a result of not keeping the guns in the home well. We believe that storing firearms in empty lockers in separate places from bullets and firecrackers will reduce the access of children to these weapons and thus prevent the injuries and deaths caused by firearms.

In our country, families to choose toys for their children to buy guns and the use of firearms in family TV series is very frequent in children's interest in guns is increasing; therefore, it leads to the perception of the gun as a toy. This results in accidental death as a result of the child playing with a firearm found in the home. We believe that not choosing guns when buying toys for children, and more careful selection of series and films watched with children will reduce the deaths caused by firearm injuries in this age group. As a result, in our world where individual armament is increasing, it is observed that firearms kept in homes lead to childhood deaths.

We think our community needs to be educated about that incident of injury and death can easily occur if children have easy access to firearms; therefore, homes with children should not have firearms as much as possible, if it is necessary, firearms should be to keep in high places beyond the reach of children, it is necessary to store them in empty lockers in separate places from projectiles and flares by taking safety precautions.

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## A Forensic Glance to Children's Virtual Privacy in Web 3.0

### Web 3.0'da Çocukların Sanal Mahremiyetine Adli Bir Bakış

Mehmet Aykut Erk, Sunay Fırat\*

**Abstract:** With the social media era considering as a turning point for communication age sharing has become unlimited. Many families have chosen technological devices rather than a safe play area for their children. It has been considered that children hang by a thread regarding easily accessibility and personal info via YouTube which is considered the biggest video sharing platform and another recent micro-film application which is popular with children.

It is necessary that children and adolescents to get connect with their peers. The children and adolescents who are lurking in online world without any guidance may join social media movements so called "trends".

The other thread which children and adolescents could face is the video-sharing sites which turned into trading sector. While children are online, their parents who have an urge to get goods from those sites give their children a chief part in those videos.

Another negativity for children who have a role in these videos is destructive comments that are typed under videos. Some comments which are filled with jealousy and anger can be labeled as "cyber-bullying"

Consequently, when the severe usage of YouTube and video-sharing sites considered, it has been a necessity to protect children' personal information and their privacy. The harm which is stemmed from sales policy has to be spoken by experts. If there are some platforms which are harmful for children by the meaning of sexual and economical abuse have to be warned.

**Keywords:** YouTube, TikTok, Child, Adolescent, Neglect, Abuse

**Öz:** Haberleşme ve iletişim çağının dönüm noktalarından biri olan sosyal medya dönemi ile iletişim ve paylaşım sınırsız hale gelmiştir. Birçok aile eskiden olduğu gibi çocuklarına oyun ortamı sağlamak yerine teknolojik araçlara başvurmayı tercih eder hale gelmiştir. En büyük video paylaşım platformu olarak kabul edilen YouTube ve son dönemde çocukların bir diğer uğrak noktası olan mikro-film uygulamaları yoluyla milyonların beğenisine çıkan çocukların, akıllı telefon ve tabletler aracılığıyla kolay ulaşılabilirlik ve kişisel bilgilerinin gizliliği bakımından tehdit altında oldukları düşünülmektedir.

Çocukların/ergenlerin akranlarıyla iletişim kurmaları olumlu kimlik gelişimleri için gereklidir. Çevrimiçi dünyada herhangi bir rehberi olmadan kendi başına hareket eden çocuk veya gençler bu kimlik arayışı sırasında akranlarıncı kabul görmek adına "trend" olan sosyal medya akımlarına katılabilmektedirler.

Çocukların/gençlerin karşılaşabileceği bir başka tehlike ise video-paylaşım sitelerinin artık birer ticaret unsuru haline gelmesinden kaynaklı olabilmektedir. Bu kazançtan pay almak isteyen içerik üretici aileler ise artık kendi çocuklarını da videoların başrolü haline getirmeye başlamışlardır. Bu sitelerdeki videolarda rol alan çocuklar için bir diğer olumsuzluk ise çocukların erişimi sınırsız olan bu videolara yapılan yorumlara maruz kalmalarıdır. Kimi yorumcunun kıskançlık ve öfke duyduğu bu yorumlar bir çeşit "siber zorbalık" olarak nitelendirilebilmektedir.

Sonuç olarak, YouTube ya da video-platform sitelerinin yaygın olarak kullanımı göz önünde bulundurulduğunda çocukların kişisel bilgilerinin ve mahremiyetinin titiz bir biçimde korunması gerektiği anlaşılmaktadır. Çocuklar üzerinden güdülen satış politikalarının çocuğun ruhsal gelişimine zarar verdiği uzmanlarca dile getirilmeli, çocukların ekonomik ve cinsel olarak istismar ve ihmal edildiği düşünülen platformlar yasal kanallarla uyarılmalıdır.

**Anahtar kelimeler:** YouTube, TikTok, Çocuk, Ergen, İhmal, İstismar

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## 1. Introduction

Along with the social media period which is one of the milestones of the communication era, communication and sharing have now become almost indefinite. In this virtual world, ever-changing with the current information technologies which bring us new terms such as anonymization, cyberbullying, etc., children cover one of the third of the total amount of internet users (1). With the change from Web 2.0 to Web 3.0, the possibility of sharing social media and private life has made it necessary for children to be observed in video sharing platforms.

## 2. YouTube Video Sharing Platform

Considered as the biggest video sharing platform, YouTube, with the chance of access from 88 countries with 76 languages, has more than 1 million users (2). This platform, used frequently by children under the age of 13, and seen as the primary amusement way, by the ones age of 8, enables its users to create their own content and share their personal information with anonymous viewers (3-5). Via YouTube Partner Programme, YouTube has developed a system that enables its content creator users to have financial gain, as advertisement gain. In this way, video creators are not only getting sponsor share thanks to the products, such as toys, candy, video games, etc., that they have promoted in their own videos, but they also gain certain amounts of money from the views and likes, determined in the YouTube's mentioned program (6). In 2018, to be able to participate in the Partner Programme, one needed to have 4000 hours of views and 1000 subscribers in the last 12 months (7). YouTube's economic incentives with the purpose of turning its users into "creative content creators" caused YouTube to become a platform that people get ambitious about being famous (9). Thus, young users have started to show some parts of their personal lives, scripted or unscripted, to the public to get a "micro-fame".

### 2.1. Privacy of Child in Microfilm Practices

Lately, children under the age of 18 have been involved mostly in microfilm practices (10). Children, who can be seen by millions and liked by them with very short-time videos formed as playback, are under threat, in regards to accessibility and confidentiality of personal information, via smartphones and tablet computers (11). In this respect, microfilm sharing practices, such as TikTok, Musically, etc., have been fined 5.7 million dollars for the claim for recording children's information without the allowance of their legal guardians and the use of this information by the third persons (12).

One of the most important developmental tasks of childhood is the ability to building suggestive social relations. However, modern life has altered the playgrounds and social interaction spaces of young ones. Many families now enable their children to access technological devices easily, instead of organizing a playground as it was before (13).

### 2.2. Traumatic Effects of Video Sharing Sites and Microfilm Practices on Children

One of the most important steps of the identity development of children, especially adolescents, is the quality of the relationship with their peers. Revealing oneself or self-presentation refers to the children's choice of an image or an identity to show the others. During this period, the child opens up in the context of their thoughts, feelings, and behaviors. Their self-expression and how they presented themselves to their peers affect identity development. Thus, it can be deduced that the children who use these kinds of video sharing channels or microfilm practices can face various troubles in that of this identity task (14).

Children or adolescents who go through online without any parental guidance may follow social media trends in order to be accepted by their peers. One of these trends is the one that is some kind of show of strength, called "choking challenge." According to a study, attracted by adolescents since the time YouTube was established, 2005, with the choking challenge, peers try to experience the "euphoria" by choking themselves with or without an instrument and stop the action right before passing out. This behavior is thought to be a show of strength and proving oneself to others. According to a study based on abroad, the frequency rate of this challenge among adolescents is in the range of 6%-12% (15).

Another YouTube "trend" that affects the children and adolescents is the videos of "hurting themselves" without suicide. This behavior's frequency rate among adolescents is in the range of 14%-21% (16). In the event of the repetition of the mentioned harmful behavior, which appeared again as a trend, it can cause children and adolescents to have interpersonal communication problems, increasing psychological symptoms and completed suicide attempts (17). It is considered that it poses a treat for the audience, children and adolescents, and it can affect their development negatively.

Another threat that children and adolescents can face is derived from the fact that video-sharing websites have now become commercial. In the event of finding a sponsor in a direct way or in a roundabout way, content creators whose videos are broadcasted on YouTube can gain

certain amounts of money (18). This new feature directly affects especially children and adolescents that cover a wide range of internet users. In fact, video games, toys, kids' games, and all the materials appealing to children are among the most "clicked" videos. 21 of 100 channels, whose users are from Turkey and total views are in the range of 27,839,567,985 and 567,171,174, are detected channels themed as toys, video games, cartoons and children's games (19).

It is observed that in many videos offered to the audience, there are elements that are thought to be harmful to children's mental health. In some videos that contain a lot of expressions such as blood and death, "fake" games of children recorded by their parents can make children feel troubled and as if they were in a la-la-land. The rating of this kind of "real life" themed videos is quite high among children. These kinds of videos are thought to cause bad behaviors (21). Even the children in the videos seem like they are doing the action and having fun, they are still directed by their parents and act as their parents want. Moreover in some of these videos, children are even forced by their parents or producing companies to act in a way that does not good for their mental or physical development. It can be clearly seen that in some videos that the child's right to privacy is ignored and their whole day is presented to the audience, the child leading is doing makeup or dying their hair to different colours, just like adults (21,22). Another negative effect of these videos for the children in it is that they are exposed to the comments made for these videos with unlimited access. Some comments can be considered as a kind of cyberbullying for showing the jealousy and anger of the person who makes the comment. A little child at the developmental stage might have to face comments filled with jealousy, anger, mockery, and hatred, addressing their physical appearance, voice, characteristic features, written by their peers, and therefore, their mental health might be affected negatively (21).

Moreover, economical abuse of the children who are the actor or the viewer of these videos is also at the agenda. Channel owner parents, firms that placed an ad into the video and video-sharing platforms take advantage of the contents that children spent time and energy on. To make this income permanent, parents might feel like they have to create new content all the time and they record and broadcast videos consistently in order not to lose their subscribers. These obligations are believed to take the children out of the playground and turn them into some kind of "virtual workers" (21,23).

### 3. Digital Footprints and the Child's Virtual Privacy

The anonymous environment in the social sharing websites and apps does not provide information on who has the children's personal information or images (24). Thus, it is claimed that children's personal information and images can be used for visual arousal by anonymous persons (24, 25). Therefore, according to a project supported by the European Union, it is discovered that 22% of children who spend time on access environments such as internet and social media have exposed to sexually explicit messages (26).

Changed with Web 3.0, the virtual security concept has gained even more attention especially with easier access of children to the web. This brings the necessity to argue on this in order for the protection of children from neglect and abuse. In this study, three primary topics on the virtual security of children have been determined. These topics are "digital footprints" that children leave after every single activity he performed, "discernment" which is the source of child's reactions to various types of situations, and "informed consent" which should be taken as a legal basis for the social media or for every website that the child is the user.

One of the most critical problems related to the virtual world and children is the possibility of the stream of digital identities of child users in the digital world for a lifetime. This digital identity, defined as the whole of online platforms and social media equipment, has started to take more place in the modern world with the popularisation of information technologies (27).

Written or visual contents shared by individuals or child users are effective for these individuals or child users in the virtual world, other than their real environment. Considered from this perspective, it can be said that no matter how cautious the individuals are on their personal data, sharing networks have bigger effects on these digital identities (28). Thus, social media service which hosts the digital identity can mostly use data for economical reasons.

Obtained by social media sites and firms, these digital identities might change hands without the knowledge of individuals, in that case children, and might be used a virtual identity completely unrelated to its real owner. On the other hand, these data may be obtained not only to be used in social media but also by other digital service providers trading data. In this respect, it can be said that when the number of these data-collecting organizations increases, the control of children and their parents on this data will disappear. This may be thought some kind of neglect caused by parents (29).

As Boyd stated (2008), data collected online become perpetual when it is automatically recorded and saved (30). Perpetuity of this data collected from various channels brings ethical problems for children. Therefore, the fact that these data become permanent and their long-term effects and consequences make it even a bigger problem (31).

With the rapid improvement in technology, the anonymization of data has now become another problem. This problem is caused because of the lack of privacy with the aggregation and anonymization of data in the digital world (32). Even these data, anonymized in the virtual environment, is a secured argument for the third-party software developers or service providers, it is still possible, using various technics, to remove the anonymity of these data (30, 33). Reverting the child's digital identity into a real one might lead to adverse outcomes in their life. This lack of privacy on their real identity will harm their future social, work and personal lives and will cause them to face discrimination (28).

However, as people started to gain from platforms such as Youtube, content creator parents who would like to get a share of the cake has pushed their own children to be the lead in the videos. Nevertheless, this poses a problem. According to UNICEF Data Research and Policy Department, children constantly leave digital footprints on online platforms. Thus, it is emphasized that these footprints are followed and abused by malicious people, and therefore, it is strongly recommended the necessity of precautions that will cover the digital footprints of children (20).

#### 4. Discernment of Child

When it is generally thought that children use technology effectively, it is still accepted they are not fully aware of the internet terms such as cookies that copy personal data and offer them to the third-party software (35). Therefore, it must be recognized that children's forward-looking discernment is still progressing on the decision-making mechanism (36). Also, when it is considered the fact that adolescents who are 12-14 can mostly act impulsively, it is thought that they are even more careless about personal data (37).

#### 5. Informed Consent

In cases as giving credentials for signing up to social media sites or complete a buying on various websites, "informed consent" becomes a necessity, especially for securing the data. Another ethical problem is children's consent without the knowledge of their parents (38). According to research on informed consent in 2005, it was

understood that none of the websites designed especially for children had clear instructions. Therefore, "terms of use" which must be included in informed consent, was written in a quite formal way (39). On the other hand, the "terms of use" option push children and parents to make a choice between complicated provisions and giving up the service they want to acquire. Hereby, these websites claim that they secure the data themselves. Nevertheless, these websites expect their visitors to give consent to a statement that is not clear and understandable.

#### 6. Conclusion

The problems encountered should be evaluated in the legal framework of the articles on the protection of personal rights placed in the Turkish Civil Code and the Turkish Republic Constitution Articles 20 and 41. The Turkish Republic Constitution Articles 24, 25 and 26 intended the retention of legal personality. According to these articles, one's name, honor, material and nonmaterial integrity are legally protected and it can be initiated legal action for those who cause harm on mentioned legal principles (40). In this respect, it is possible to damage nonmaterial integrity.

However, it is stated in the Turkish Republic Constitution Articles 20 that; "Everyone has the right to respect for his private and family life, his home and his correspondence. There shall be no interference on the right of privacy and family life." Again, the Turkish Republic Constitution Article 41 is on the protection of family and child rights, and it declared that the state shall take necessary precautions against all kinds of abuse or violence.

There are lots of children monetized by their parents who have a reputation on YouTube or other social media platforms. The parent, who should be the one to protect the child from various harm and abuse, has become the one who abuses their own children economically and causes the violation of their right of privacy, consciously or unconsciously, by exposing the child (41).

It is an undeniable fact that social media or other applications and virtual services that children frequently use obtain some personal information. However, this case can also be in favor of children. These data collected may be turned into vital maps for children with the help of adequate analysis (42). Thanks to this map, children in a difficult situation who are in need of vital necessities can be located and helped with these necessities to be covered.

The data collectors ought to offer solutions especially on social media platforms where children accept "the terms of use" without the recognition of the system and share their data. At the present time, with the spreading of



smartphones, developments in technology cause security measures to be varied. It is now possible to detect the age of the user using iris or facial recognition (43). In the event that the one who accepts to share their “data” by signing up is recognized as a child according to the national and international legal regulations, then the sharing of the data may not be approved. On the other hand, when a child, who wants to be involved in the system with the help of their parents, inform them, it will be possible to protect the child’s privacy.

Eventually, when it is considered the frequency of occurrence of informative technologies, spreading of internet and evergrowing and ever-changing system of social platforms, it is clearly understood that children’s personal information and privacy must be guarded carefully. Families must set up a rule on the duration of the use of smartphones, tablet computers etc. for their children and observe them during the use of these devices. Experts must reflect that economic reasons and sales policies conducted on children are harmful to their mental development. Also, platforms, which are thought to be the reason for children to face abuse and neglect, must be legally warned. These platforms must offer solutions against abuse and neglect, and make these solutions permanent.

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## Legal Cannabis, and Then...

### Kannabis Yasal, Ya Sonra...

Hadiye Bostancı Demirci, Sevda Acar, Serap Annette Akgür\*

**Abstract:** Recently, it is seen that the regulations regarding the use of psychoactive substances such as cannabis are considered just as a public security problem in specific periods and it is expected to be controlled by legal precautions. However, with the realization that the problem of substance use and addiction is not a mere public security problem, treatment and prevention activities have started to be given importance. In recent years, it has been observed that people who both regulate medical treatment, and work on the legal framework and related to the psychosocial dimension of the incident, have been working sensitively on legal regulations and new developments. From now on the substance use is evaluated within “public health and society safety”, and along with this, especially cannabis regulations are being changed rapidly and the issue is still being discussed in many countries. It is thought that it will be difficult to predict the long-term consequences of these practices as the basis of both individual and societal in terms of public health and public safety. This article is written in order to summarize the individual and social consequences that may arise if the use of recreational cannabis is allowed by compiling the studies regarding the subject.

**Keywords:** cannabis, recreational use, medical use

**Öz:** Yakın tarihe baktığımızda kannabis gibi psikoaktif etkili maddelerin kullanımını ile ilgili düzenlemelerin belirli dönemlerde sadece bir asayiş sorunu olarak değerlendirilerek, yasal tedbirlerle kontrol edilmek istendiği görülmüştür. Ancak, madde kullanımı ve bağımlılığı sorununun, zamanla sadece bir asayiş sorunu olmadığına farkına varılmasıyla, tedavi ve önleme faaliyetlerine de önem verilmeye başlanmıştır. Son yıllarda ise, tıbbi tedaviyi düzenleyen, yasal çerçeve konusunda çalışan ve olayın psikososyal boyutu ile ilgili kişilerin yasal düzenlemeler ve yeni gelişmeler konusunda hassasiyet ile birlikte çalıştığı görülmektedir. Madde kullanımının artık “halk sağlığı ve toplum güvenliği sorunu” olarak beraber değerlendirilmesi ile birlikte, son dönemlerde özellikle kannabise ilişkin düzenlemeler hızla değiştirilmekte, konu birçok ülkede hala tartışılmaktadır. Bu uygulamaların birey ve toplum bazında halk sağlığı ve toplum güvenliği açısından uzun vadede ortaya çıkacak sonuçlarının öngörülmesinin zor olacağı düşünülmektedir. Bu makale, konuya ilişkin yapılan çalışmaların derlenerek özellikle eğlence amaçlı (rekreasyonel) kannabis kullanımına izin verilmesi durumunda doğabilecek bireysel ve toplumsal sonuçları özetlemek amacıyla yazılmıştır.

**Anahtar Kelimeler;** kannabis, rekreasyonel kullanım, tıbbi kullanım

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## 1. Introduction

Cannabis, known as one of the oldest psychoactive substances; is among the plants used in different fields such as medical, industrial and food (1,2). Cannabis plant is identified with different names according to type and purpose of use. These names may be listed as; Cannabis, Indian hemp, hemp, and marijuana. For example; while as it comes to fiber production hemp was used for expression, the same plant is defined as hemp seeds as a source of seed oil. The plant Cannabis appears itself with the names of Cannabis and Marijuana in its illegal use (3). The increase in the use of cannabis, which has been using for medical, industrial, cultural and ceremonial purposes during the historical period for recreational reasons over time, and along with this increase, the emergence of various results such as (safety, health, perceived risk, etc.) influence the decisions taken on the production and use of cannabis. It should not be ignored that the use of cannabis is threatening the public health and safety by the way of causing situations such as creating addiction, facilitating access to other stimulants and drugs and their access, generating income through illegal trafficking, triggering criminal behaviors of those seeking access to these illegal substances (4).

Cannabis, which has been used for various purposes for thousands of years, was considered illegal in the United States in 1923 as its potential for abuse increased. It was described as “narcotic” in 1924 and it was decided to take under strict control (5,6). The use of Cannabis was banned in England in 1928 and it was declared as illegal substance in 1941. Within the scope of the Turkish Penal Code, which was entered into force in 1926 in Turkey (TCK), Cannabis has taken place among the controlled substances. With the “1961 Single Convention on Narcotic Drugs”, cannabis has become a substance cultivation, sale and possession of which were prohibited in our country as well (7).

As can be said that the Opium Act of the Netherlands, which took effect in the 1970s, has become effective especially in Europe and all over the world. Opium Act; is a law that defines the sale of substances, classification, cultivation, production, transportation and criminal acts and regulations related to them, and it includes regulations concerning the discrimination of the sale and use of cannabis within the framework of certain laws and special conditions (eg coffee shop). In recent years with the emergence of discussions over the legalization of cannabis use, new decisions have been taken by some countries to bend the current ban policy on both medical and recreational use.

Although cannabis has been among the banned substances since 1923 (USA), the opposite policies have been developing in the last 20 years in the United States (8,9). As of May 2018, 29 states in the USA have made medical use of cannabis and 8 states made recreational use of cannabis legal (10). Some states in the USA have made critical decisions and started to implement them on the use of cannabis for entertainment purposes since 2014. In addition to these states, similar steps have been taken to legalize in countries such as Canada, Uruguay, Spain and Portugal since 2018.

It is observed that the new policies are mostly related to medical and recreational use. At this point, it is important to have information about different usage definitions related to cannabis use. Recreational use; is the use that includes purposes such as enjoying, relaxing, changing perception and emotions, having fun in night life (11). As far as the medical use concerned; it includes the use depending on various legal regulations for therapeutic purposes in medical conditions such as neuropathic pain, Multiple Sclerosis, cancer, epilepsy (12).

In the recent period, movements to legalize the use of cannabis for recreational use especially in the European countries and in the American continent (food and other forms) and their attitudes on this issue are carefully monitored by other countries. Within the scope of this new approach, while some of the society benefits from the use of cannabis for recreational use, another part is concerned about the potential increases within the adolescent population, other negative consequences and addiction (13,14). Although the perception of cannabis as a harmless natural product is increasingly becoming more and more visible, the existence of concerns such as the legal spread of cannabis use and the effects of cannabis-related negative consequences on social structuring should not be ignored (15–18).

## 2. The Perception of the Society Regarding Cannabis-related Regulations

### 2.1. Demographical Factors

Various studies have been conducted on the characteristics of individuals who support / do not support the legalization of cannabis use. According to researches conducted on adults, in male gender, being a minority, race / ethnic status, having children, using cannabis have been associated with supporting the legal authorization of recreational use. However, it has been reported that people who think that cannabis use is risky for people with a higher average age, and female participants give lower

support for the legal use of cannabis for recreational purposes (9,19–25). Considering the variety of factors mentioned above in the process of making such decisions that may affect the society, it is observed that the variables capable of affecting the referendum and similar initiatives should be handled very carefully.

## 2.2. Perception of Risk

Risk is part of modern life. Modern life constitutes a social class that can make personal decisions in terms of thinking on and evaluating risk (26). Legalization of cannabis can affect social norms and risk perceptions arising from cannabis use, whether for medical or recreational use (8,9). Studies show the importance of perceived risk in supporting the legalization of cannabis, and provide evidence that those who support legalization or those who are hesitant perceive the risk of using cannabis lower than those who oppose it (24). In this context, with the legalization of the cannabis, if there will be a possible increase in use among young people; approaches are encountered to this increase may be related to the decrease in perceived risk and the increase in opinions about the social acceptability of use (27,28).

Epidemiological data in the USA supporting this prediction reveal that there is a negative relationship between the prevalence of cannabis use and the risk of perceived harm about its use (29). Doomfully, the perceived risk of using cannabis has been significantly reduced in the past two decades (30,31). In a study on young people, a significant decrease in the risk perception of cannabis use among young individuals was reported. Another part of the participants in the same research reports that cannabis use is risky. But this rate decreased from 54% in 2013 to 48% in 2015 (32).

According to these information, it seems possible to have a mutual relationship between the change in the perception of risk related to cannabis and its legality. It is considered that with the widespread use of cannabis, will bring the possibility of causing harm in health and psychosocial terms (17,33,34).

## 3. Biopsychosocial Results Related to Cannabis Use

There is a limited amount of research examining the changes that can be brought about by the use of cannabis for the recreational use, since it is a relatively recent development. However, since the states that constitute the USA adopt different cannabis policies and changing developments in cannabis use elicit problems in reaching healthy monitoring data, a complex picture regarding the results of cannabis use appears (35).

## 3.1. Use of Cannabis and Addiction

It has been thought that cannabis use is not addictive for many years. However, cannabis use was included in substance use disorders as cannabis use disorder with the regulation made in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) in 2013 (4,36). The withdrawal symptoms we encounter after regular cannabis use is stopped is only one of the effects of cannabis (37–39). The problems experienced by the person during the withdrawal period are listed as physical symptoms such as irritability, agitation / anxiety, sleep disorders, decreased appetite or weight loss, depressive symptoms, abdominal pain, chills, sweating, fever, cold or headaches (4). In general, cannabis use has been associated with a variety of short-term and long-term undesirable consequences such as addiction, short-term memory, motor coordination, judgment, brain development loss, impairment in brain development, acute paranoia, psychosis, and chronic psychotic disorder (16,17,40). These findings provide data, contrary to the opinion suggesting that cannabis use is not addictive.

## 3.2. Cannabis use and Periods of Development

Individual cannabis use is considered to be more harmful in some developmental periods. It has been reported that cannabis use harms the fetus during pregnancy and elicits prolonged neuropsychological decline and intellectual dysfunction when used regularly by adolescents (41,42). The data showing that the magnitude of the neuropsychological deterioration and the degree of continuance after withdrawal; may depend on the frequency and duration of cannabis use, the length of withdrawal and age of onset (43). Similar studies have shown a correlation between early onset of cannabis use and increased neuropsychological deterioration (44,45). In a longitudinal study supporting this finding, it was reported that participants who started using cannabis before puberty showed neuropsychological decline between the ages of 13-38 (42). Especially for the adolescent population, the function of the cannabis as switching to other stimulants and drugs and as facilitating access is another point to be considered.

## 3.3. Cannabis Use and Traffic Safety

It has been reported that cannabis use leads to psychomotor disorders that can cause accidents and deaths in traffic; it is also reported that it has been detected as an important factor in accidents caused by situations such as not wearing seat belts and violations of traffic laws (46,47). In European countries, cannabis comes first

among accidents that result in serious injury or death. Indeed, Masten and Guenzburger (2014) report that in some states (California, Hawaii, and Washington) where the medical use of cannabis has been legalized, the percentage of has increased in cannabinoid screening tests (48). The drivers were increased in the accidents resulted in death. There are many studies showing that the rate of drivers who drive vehicles and get involved in the accident is quite high, and that cannabis use influence driving ability (49). Whereas conducting a statistical risk assessment is not as easy as in alcohol. The first challenge for those working in this field is to put together a control group composed of those use substances but did not involve in an accident and the second is that the effects of cannabis on behaviors and its findings in the blood can not certainly be revealed (50,51).

When all relevant studies are examined, similarities are detected between cannabis and alcohol use when it comes to using a vehicle or machine; such as prolonged reaction time and impaired psychomotor coordination (43,52,53).

### **3.4. Cannabis Use and Unintentional Pediatric Exposure**

One of the negative consequences resulting from the legalization of cannabis is stated as unintentional pediatric exposure to cannabis products. Unintentional pediatric exposure is caused by inhalation of smoke without smoking cannabis as well as by direct contact to contaminated objects (54). In parallel with the increase in the legal use, availability and sales, unintentional pediatric exposure increases as a result of passive smoking and cannabis mixed –added foodstuffs. In the last 10 years, the increase in cannabis cultivation in indoor places has also increased the knowledge and materials related to cultivation in various sales places and on the internet (55,56).

Cases from 2009 to 2017 were examined in a study conducted to investigate unintentional pediatric exposure in the State of Colorado, which was the first state accepted the use of cannabis in the United States as legal. As a result of the research, it has been reported that there has been an increase in the number of applications made to pediatric hospitals and the District Poison Center following the legalization of medical use and sale of cannabis in Colorado. Despite the public health interventions made in the legislation after 2014, it was observed that the frequency of applications related to unintentional pediatric exposure to the child hospitals and the District Poison Center doubled in 2017 in Colorado. Despite the versatile measures taken, unintentional pediatric exposure continues to increase 4 years after the legalisation of the use

for recreational use in Colorado. It is thought that it is important to continue monitoring about the unintentional pediatric exposure in the child population and to examine the evaluations on public health, especially in this period when more governments and the state started to legalize the cannabis (10).

### **3.5. Cannabis Use and Normalization**

Parker et al. (2002) list the factors that underpin the normalization of cannabis use; as the increase in access to illicit substances, the prevalence of cannabis use and the tendency to tolerate cannabis use, cultural acceptance of the media productions produced, and the establishment of liberal policies that paved the way for cannabis use (57). In addition to these factors, it is thought that the use of cannabis will gain a new momentum through the legalization process, the widespread of edible products, allowing the cultivation of plants at home for medical and entertainment purposes, smoking in designated places such as (social clubs, coffee shops and homes) and related marketing strategies. The fact that everything can be marketed in the globalizing world adds a different dimension to perception studies related to the marketed product. The marketing process of cannabis related products has an important role in determining the social norms regarding the use of cannabis. It is obvious that polishing of cannabis containing cosmetics (hand creams containing cannabis, body oils, etc.), food (gum containing cannabis, cakes, sugar, teas, coffees, etc.) and cannabinoid drops and similar products sold outside the pharmacy will change the social consumption behavior. In this context, to examine the concept of perception management is of paramount importance.

Perception management can be explained as spreading or ignoring various information in order to affect people's feelings, motivations and judgments (58). In the relationship of the individual with the environment, a thinking process begins regarding the events he perceives, as a result of which meaning emerges in his mind. The fact that this process takes place in a continuity forms the basis of the individual's perception system in the society (59). There are some factors that are important for perception management and affect it. These factors can be classified as; the characteristics of perceiving person and of the perceived object and of the perception environment (60). In this context, effective marketing strategies; can be defined as exposure to commercial advertisements and promotions, demonstration of use in the media (modeling), advertising and packaging for sale (61–63). Effective marketing strategies, attitude, belief, expectation and usage towards starting and maintaining

use; it is thought that it provides in particular adolescents to normalize cannabis (64–66). Adolescents are particularly sensitive and attractive targets for such strategies. In the literature, it is reported that the age of early use is a risk factor that increases the use of tobacco, alcohol, and cannabis and causes use disorders (40,67–73).

#### 4. Conclusion and Recommendations

It can be claimed that it will take time to evaluate the biopsychosocial and other unpredictable results that will arise as a result of the legalization of the use of cannabis for recreational use.

There is evidence that the legalization of cannabis has brought the age of starting cannabis to higher limits, but this evidence alone is not considered sufficient. When Cannabis is legalized for recreational use; it is evident that the use will not be limited to adults only. As a matter of fact, although alcohol and tobacco use is restricted to certain legal frameworks in many countries around the world, it is reported that the use has become widespread and its use has started before the limits of legal age (74). In studies related to problematic behaviors, it is reported that adolescence is the highest period of substance use. Problematic behaviors, including cannabis use, are mostly exhibited for purposes such as gaining the trust of the adolescent's peer groups and being accepted by peer groups, declaring their freedom by getting away from the family, coping with stress and getting rid of pressure (75). These factors cause more contact with the substance during adolescence. This contact appears to cause addiction in early and mid term-adolescence, deterioration in brain development and many other negative consequences (17,76). As adolescents' cannabis use has negative results in terms of biological, social and psychological aspects, it can be said that academic research and field studies related to these risk factors are required.

In this context, in the researches to be conducted on the effects of cannabis use, especially adolescents in the society; the examination of the regular cannabis use rates in deaths and injuries in traffic accidents, emergency applications, applications to addiction treatment services, of individuals who benefit from mental health services and justice system (probation) can be recommended.

Within the context of practical applications, it is stated to be important in minimizing losses in the process of designing and implementing public policies that protect public health and public safety, educating the public about the negative consequences of cannabis origin (15). It is not clear in which direction will the social order and the safety of society be affected by the legalization of the use of cannabis. In this context, it is important that

individual, social and institutional training are carried out by experts about the harm that may result from the use of cannabis, especially in cooperation with all public institutions that have more contact with children, adolescents, and young adults.

Finally, in case that cannabis use becomes legal; it is suggested that a new control system can be created in terms of crime, crime rates can be reduced, and it will contribute to the economic process of the states by the way taxation. In addition, there are defenses in this legalization process that the workload of the institutions such as law enforcement and probation will decrease. Rather than these defenses, the critical point is thought to be biopsychosocial damages that cannabis use will create on the basis of society and individuals.

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### Suicide with Potassium Cyanide Bought on The Internet: A Case Report

#### İnternet Üzerinden Alınan Potasyum Siyanür İle İntihar: Olgu Sunumu

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**Abstract:** Cyanide is one of the most toxic substances known. Although acute intoxication isn't common, suicide with cyanide often results in death. In this study, it was present a 27-year-old man who suicide by buying potassium cyanide from the Internet. A cup with white contamination was found at the scene and an invoice and a credit card payment slip documenting that he had purchased 1 kg of potassium cyanide from a company selling chemical materials over the internet. In autopsy, nonspecific findings such as submucosal congestion and focal fresh bleeding areas and severe hyperemia in other tissues were found and the toxicological examination revealed that he died of oral cyanide poisoning. This study is presented in order to draw attention to the fact that cyanide, which is the most toxic substance known, can easily be bought over the internet and to emphasize that access to these substances should be strictly controlled.

**Keywords:** Cyanide, poisoning, suicide, internet, autopsy

**Öz:** Siyanür bilinen en toksik maddelerden birisidir. Akut zehirlenmelerine sık rastlanmamakla birlikte siyanürle intiharlar sıklıkla ölümle sonuçlanır. Bu çalışmada; internet aracılığı ile alınan potasyum siyanür ile intihar eden 27 yaşındaki bir erkek olgu sunulmuştur. Olay yerinde beyaz renkli madde ile bulaşıklı bir adet su bardağı, internet üzerinden kimyasal malzemeler satan bir firmadan 1 kg potasyum siyanür satın aldığını belgeleyen fatura ve kredi kartı ödeme fişi bulunmuştur. Otopside özefagusta submukozal konjesyon ve fokal taze kanama alanları, diğer dokularda ağır hiperemi gibi nonspesifik bulgular olduğu görülmüş ve toksikolojik incelemede ağız yoluyla alınan akut siyanür zehirlenmesi nedeniyle öldüğü saptanmıştır. Bu olgu, bilinen en toksik madde olan siyanürün internet üzerinden kolaylıkla alınabilmesine dikkat çekmek ve bu maddelere erişimin sıkı bir şekilde denetlenmesi gerektiğini vurgulamak amacıyla sunulmuştur.

**Anahtar Kelimeler:** Siyanür, zehirlenme, intihar, internet, otopsi

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#### Conflict of Interest

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

#### Ethical Declaration

Helsinki Declaration rules were followed to conduct this study and no ethical approval is need for this study.

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## 1. Introduction

Cyanide is a lethal and destructive poison, and has been defined by the Environmental Protection Agency (EPA) as the most toxic known substance (1, 2). Cyanide is an anionic poisonous chemical consisting of one C atom and one N atom joined with a triple bond. It forms salts with alkali cations, and ionic complexes with various metal cations (3). Its poisonous effects have been known in nature for a long time, although hydrogen cyanide was not isolated from Prussian blue until 1786 (4). It has solid, liquid and gaseous forms. Hydrogen cyanide (HCN) is colorless, and can take either a gaseous or liquid state. The salts of sodium, potassium and calcium cyanide are white in color (5). Cyanide is lighter than water and highly volatile in hot, dry temperatures, and has a boiling point of 26°C. It is easily diffused since it has a low molecular weight and is a volatile compound (4). Cyanide compounds have an odor resembling bitter almond, which can be detected at the threshold of 0.2–0.5 ppm (6), yet only 60% of the population can detect such an odor genetically (5).

Cyanide and cyanide salts are commonly used in a number of industrial processes, such as in the metal and plastic sectors, and in mining, gold extraction, painting and photography. Although it is a highly toxic and commonly used chemical, acute poisoning is rare, occurring when a cyanide-containing substance is ingested, inhaled or dermally absorbed. In humans, inhalation of 300 mg/m<sup>3</sup> cyanide is instantly fatal, while the inhalation of 120–150 mg/m<sup>3</sup> cyanide can lead to death within a few hours (2). A lethal dose for ingestion of KCN and NaCN compounds is 0.5–3.5 mg/kg (2). The lethal dose for transdermal exposures, in turn, is 100 mg/kg (7).

Cyanide-related deaths can result from accidents, suicide and even homicide. Accidental or industrial poisoning is possible, especially among those working in the metal and plastic industries, and in mining, gold extraction, painting, photography and agriculture. Suicide-related acute cyanide poisoning occurs typically through the ingestion of sodium cyanide or potassium cyanide (8). This study presents a case of suicide with potassium cyanide, which is easy to find and obtain online, and compares the findings with literature.

## 2. Case

### History

Our case was a 27-year old male who was a final year civil engineering student. It was ascertained during the judicial investigation that he was living in accommodation

with four friends, and was working part-time at a Turkish wrap (durum) restaurant due to financial troubles. His relationship with his family was poor, and he had been displaying symptoms of depression for a long time. He had mentioned suicide to his friends about 3 months previously, but had not sought medical treatment. On the day of the event, he told his flatmate that he had drunk cyanide 1 minute previously; he started to vomit and then had a seizure. He was taken to the hospital in a neighbor's vehicle, but was exitus at admission.

The crime scene investigation revealed a water glass contaminated with a white substance on the table in his room, along with a nearby teaspoon and a piece of paper saying "I AM TIRED". His wallet contained an invoice and credit card receipt indicating the purchase of 1 kg of potassium cyanide from an online chemical substances company.

### Autopsy Findings

An external examination revealed pink-purple livor mortis on the back of the body in the supine position. There was a light red, diffuse fluid of a serohemorrhagic nature coming out of the mouth and nose. There were no signs of trauma on the body. Macroscopically, there were petechiae and a light red appearance on the scalp and on all serous membranes, petechiae on the brain and cerebellar tissues, erosion and a bleeding-related dark red-black color on the mucosa of the tongue, tongue base, uvula, epiglottis and esophagus, diffuse edema fluid in the trachea and main bronchi, and congestion and edema in the lungs (the left lung was 560 g and the right lung was 610 g). The blood was light red in color and liquid. Microscopically, there was submucosal congestion and areas of focal fresh bleeding in the esophagus, intraalveolar fresh bleeding and severe hyperemia in the lungs, severe hyperemia in the heart, and hyperemia in the liver, kidney, spleen and pancreas. A toxicological analysis using the HS/GC/MS method revealed 11.59 mg/l cyanide in the blood. Cyanide was identified in the intraocular fluid and lung tissue, and in the toxicological analysis performed on the sheet of paper, the water glass washing fluid and in the white crystal powder from the crime scene. Additionally, 51 ml/l ethanol, 22 ng/ml paracetamol and 7 ng/ml lidocaine were identified. Considering the crime scene investigation and postmortem macroscopic, microscopic and toxicological examination findings together, it was concluded that the person had died from acute cyanide poisoning through ingestion. An investigation of the case at the Public Prosecution Office resulted in a verdict of non-prosecution due to suicide-origin death.

## Ethical Declaration

Helsinki Declaration rules were followed to conduct this study and no ethical approval is need for this study.

## 3. Discussion

Cyanide can lead to poisoning as a result of intravenous injection, dermal absorption, inhalation or ingestion. Cyanide poisoning is associated, fundamentally, with the failure of oxygen use by tissues, although normal oxygen may reach the tissues, and the occurrence of cellular hypoxia. Cyanide binds to the ferric ( $\text{Fe}^{+3}$ ) form of iron found in the structure of the mitochondrial cytochrome oxidase enzyme (cytochrome a3), and thereby inhibits this enzyme. The inhibition of the cytochrome oxidase enzyme ceases the reduction of oxygen to water, and thereby, the mitochondrial transport chain is blocked, in turn resulting in cellular hypoxia and ATP depletion. As a result, metabolic acidosis with an increased anion gap occurs, despite the normal partial pressure of oxygen in the blood. Respiratory and circulatory functions are impaired, resulting in death (2, 4, 9-11). Cyanide is metabolically inactivated primarily (about 80%) through the formation of thiocyanate catalyzed by the rhodanase enzyme in the liver, and thiocyanate is then passed in the urine (2).

The emergence of the clinical signs of cyanide-induced poisoning varies in accordance with the type, amount and method of cyanide used. It leads to death within seconds following inhalation or intravenous injection, within minutes following ingestion, and within a few hours following dermal absorption. Cyanide poisoning by inhalation is the most dangerous route due to its rapid absorption from the bronchial mucosa and alveoli. Ingested cyanide salts react with hydrochloric acid in the stomach and form HCN, and are quickly absorbed via the gastrointestinal tract. Upon absorption, cyanide spreads to all organs. In deaths from cyanide poisoning, the highest concentrations are in the liver, lungs, blood, spleen and brain (2, 9). The association between the blood concentrations of cyanide and the severity of symptoms have been defined as mild for 0.5–1 mg/l, moderate for 1–2 mg/l, severe for 2–3 mg/l and lethal for over 3 mg/l (12). The central nervous system is first to be affected. Main symptoms of mild cyanide poisoning include mental confusion, nausea, headache, dizziness, anxiety, perspiration and skin redness. For moderate poisoning, early symptoms include tachycardia, reflex bradycardia, tachypnea and dyspnea, while late symptoms include stupor and seizure. Severe poisoning symptoms, in turn, include paralysis, coma, hypotension, respiratory depression, mydriasis, S-T changes, ventricular fibrillation and asystole (5,

13). Among the lethal cases in literature, blood cyanide concentrations have been reported to be 3.0–80.9 mg/l in the five-case series by Musshoff et al., 5.3 mg/l in another study by Musshoff et al., 72 mg/l in a study by Le Graff et al., and >2 mg/l in a study by Koçak et al. (6, 13–15). In our case, the blood concentration of cyanide was 11.59 mg/l, detected in the toxicological analysis, which was observed to be lethal.

Our case died after he had told his friend that he had drunk cyanide 1 minute previously. For lethal cyanide dose intakes, and especially in forensic cases, knowledge of the ability and duration of movement is highly important for the crime scene re-enactment and the decision on origin. In most cases, the duration of mobility following cyanide ingestion is reported to be few seconds to 1 or 2 minutes, although there have been some cases with a mobility duration of 5–10 minutes (6, 16).

In cyanide poisoning cases, autopsy findings are typically non-specific, with the most specific finding during autopsies being a bitter almond odor. Nevertheless, the absence of such odor does not mean that death is not caused by cyanide poisoning, as the ability to detect such an odor differs from person to person due to genetic causes (5). Livor mortis and blood color may be light-bright red due to the excess oxygen in the circulating blood. Such a finding, however, is not specific to cyanide poisoning, and may not be always observed in deaths from cyanide (5). The most common autopsy findings include congested visceral tissue, congested and edematous lungs, and erosion, ulceration, and bleeding in the esophageal and gastric mucosa if the cyanide has been ingested (15). The microscopic findings observed in cyanide cases are ischemic changes in the brain, and particularly in the globus pallidus, intraalveolar fresh bleeding areas in the lungs, fresh bleeding areas in the myocardium, and parenchymatous changes in the liver and kidneys (5). The study by Koçak et al. reported extreme edema in the brain and punctual bleeding foci in white matter, extreme edema in both lungs and intraparenchymal bleeding in the upper lobe of the right lung (13). The study by Karadeniz et al. reported a diffuse edema and congestion, and a light pink appearance in lungs; a diffuse erosive appearance in the stomach, along with histopathological examination findings of generalized hyperemia in all visceral organs; acute swelling and intraalveolar fresh bleeding areas in the lungs; and diffuse fresh bleeding in the myocardium (4). No bright red color in the skin was observed in the said case, although the blood was observed to be light red in color and liquid. Only one of the autopsy team stated the detection of a mild bitter almond odor. There were congested and edematous lungs, and congestion and

hyperemia in the other visceral organs. Due to the ingestion of cyanide, erosion and bleeding was noted in the buccal and esophageal mucosa. A microscopic examination revealed no particular findings in the brain, although fresh bleeding areas were noted in the lung and hyperemia in the heart. Overall, the autopsy findings of the said case were found to be consistent with the non-specific findings defined for cyanide poisoning (4, 8, 13, 15).

A review of previous retrospective studies revealed few cases of cyanide use for suicide (17-19). Zhang et al. identified cyanide poisoning in only 15 of 565 autopsies conducted between 2000 and 2010 (17). Likewise, Gallagher et al. found cyanide poisoning to be rare, other than from occupational exposure (18). Liang et al. stated that the number of cyanide poisoning cases was very low compared to other types of poisoning (19). The intake of cyanide in suicide attempts may occur more frequently in people with easy access to cyanide, such as healthcare and laboratory personnel. The study by Musshoff et al. reported a 38-year-old male case ingesting cyanide in an attempt to commit suicide who was employed as a jeweler (6). The same study identified a 71-year-old physician together with their spouse, a 70-year-old person with a chemist spouse, and a 29-year-old laboratory technician who ingested cyanide in a suicide attempt (6). The study by Koçak et al. established that a 60-year-old male jeweler had died due to the accidental ingestion of cyanide (13). The use of cyanide in suicide attempts may also involve injection or inhalation, although these routes are more uncommon. A study by Musshoff et al. reported that a 48-year-old case was found dead in his car after being exposed to cyanide by inhalation, with a suicide verdict recorded (14). Another study reported that a 91-year-old male used cyanide through subcutaneous injection in a suicide attempt (20). Likewise, Prieto et al. reported a 30-year-old female case with a history of depression who committed suicide by subcutaneously injecting cyanide (21). The National Forensic Service (NFS) in Seoul, Republic of Korea, made a retrospective investigation of 255 cyanide poisoning cases between 2005 and 2010, and different from other studies, found that the most common cause of cyanide poisoning in the Republic of Korea was suicide, the vast majority (98.8%) of which involved ingestion. The same study determined that the mean age was  $41.88 \pm 13.09$  years, the number of male cases was higher and place of residence was the most common location of suicides (22).

The present study reports on a case who committed suicide after gaining easy access to a large amount (1 kg) of potassium cyanide online. As exemplified in the present case, the Internet has become a source for the purchase

of almost anything, including controlled toxic chemical substances. It is understood that individuals with no knowledge of chemical substances can easily access online information, and can obtain the necessary substances and use them to commit suicide (14). Literature contains two cases of suicide in which cyanide was bought online, one from a dark web source (15, 23). Applying controls to the sale and procurement of cyanide, which is a highly toxic substance with potential for use in both individual and mass deaths, through legal purchases has been regarded necessary. In our country, a legal framework has been established for the trade of chemical substances like cyanide under the “Regulation on Controlled Chemical Substances”, published in the Official Gazette dated 16/06/2004 and No. 25494. This regulation was entered into effect to identify the distribution channels and the end user, to understand for what purposes such controlled chemical substances that involve multiple domestic stages of sale are used and to prevent their illegal use. Under the Regulation, the purchaser must to complete a “Customer/End User Declaration” form prior to the procurement of any chemical substance, requiring such information as the intended purpose of use and the quantity of the chemical substance to be purchased, as well as a valid address. That said, it is believed that stricter rules should be applied for cyanide purchases, with strict supervision needed to ensure the rules are followed as a means of preventing abuse and poisoning.

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