

## **Are Sociodemographic Characteristics and Experiences Associated to Behaviours on Residential Fires? A Young Adult Sample**

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### **Abstract**

This study aimed to determine the role of behaviors and factors associated to reduction of fire risks among university students. This cross-sectional study was conducted in a vocational higher education school (N=3886 students). Single stage systematic random sampling technique was used to select the participants from the population and data of the study was collected by face to face interviews. We interviewed 661 students. The mean age of the students was 20.1±2.3 years and 68.2% were male. It was found that 15.9% of participants had an experience in any type of fire, also 21.2% of the students had a training about fire. Although 85.8% stated that they were keeping children away from flammable materials, only 19.7% had a fire action plan to escape in their living places where they lived in. Students living in the dormitory (OR: 1.63), who had any education on fire (OR: 1.46), and who received first aid training (OR: 1.37) had more positive fire-related behavior. To reduce the risk of mortality, morbidity and economic burden of fires in countries and increase the level of readiness to fire where prevention and intervention services are limited, trainings on fire prevention, early intervention skills and basic first aid training for fires are needed among young people. Higher education period is appropriate for those trainings.

**Keywords:** Behaviour, Experience, Residential Fire, Sociodemographic Characteristics, Young Adult

## **Sosyodemografik Özellikler ve Deneyimler Konut Yangınları Davranışları ile İlişkili Midir? Bir Genç Yetişkin Örneklemi**

### **Özet**

Bu çalışma üniversite öğrencileri arasındaki yangın risklerini azaltma ile ilişkili davranışların ve faktörlerin rollerini belirlemeyi amaçlamıştır. Bu kesitsel çalışma bir meslek yüksekokulunda yürütüldü (N=3886 öğrenci). Popülasyondan katılımcıları seçmek için tek aşamalı sistematik

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Bu makaleye atıf yapmak için- *To cite this article*

İnal, E., Kaya, E., Metin, B. C. and Paksoy Erbaydar, N. (2020). Are Sociodemographic Characteristics and Experiences Associated to Behaviours on Residential Fires? A Young Adult Sample. *Journal of Disaster and Risk*, 3(2), 159-168.

rastlantısal örnekleme tekniği kullanıldı ve çalışmanın verisi yüz yüze görüşmeler şeklinde toplandı. Çalışma sürecinde 661 öğrenci ile görüşüldü. Katılımcıların konut yangınları davranışları sosyodemografik özelliklerine ve deneyimlerine göre karşılaştırıldı. Öğrencilerin yaş ortalaması  $20.1 \pm 2.3$  ve %68,2'si erkekti. Katılımcıların %15,9'unun herhangi bir yangını deneyimledikleri ve ayrıca %21,2'sinin yangınla ilgili bir eğitime sahip oldukları saptanmıştır. %85,8'i çocukları yanabilir materyallerden uzak tuttuklarını belirtmesine rağmen, yalnızca %19,7'sinin yaşadıkları yerlerde bir yangın kaçış planına sahip oldukları saptanmıştır. Yurtta yaşayan (OR:1.63), yangın konusunda herhangi bir eğitime sahip olan (OR:1.46) ve ilk yardım eğitimi alan (OR:1.37) öğrencilerin yangınla ilgili davranışları daha olumluydu. Ülkelerin yangınların ölüm, hastalık risklerini ve ekonomik yükünü azaltmak için önleme müdahale hizmetlerinin yetersiz olduğu yerlerde yangına hazırlık düzeyini artırmak için üniversite öğrencileri arasında yangın önleme eğitimleri, erken müdahale ve yangınlar için basit ilk yardım eğitimlerine ihtiyaç duyulmaktadır. Üniversite eğitimi süreci bu eğitimler için uygun olabilmektedir.

**Anahtar Kelimeler:** Davranış, Deneyim, Konut Yangını, Sosyodemografik Özellikler, Genç Yetişkin

## 1. INTRODUCTION

Residential fires are one of the most common disasters and important cause of accidental death in the world and in developing countries. The National Fire Protection Association (NFPA) reported that average number of residential fires were 358 500 per year during 2011-2015 in USA. These fires caused an average of 2 510 deaths, 12 300 injuries, and approximately 6.7 Billion Dollars indirect property lose per year (Ahrens, 2017). A study conducted in United Arab Emirates, found that 5 490 fire incidents occurred between the periods of 2006–2013. Residential fires were responsible of about 28% of all fires (Alqassim and Daeid, 2014). Another study from Jordan found that annual average of fires was 8 198 between 2000-2004 period, and residential fires were account of 20% of all fires. The authors stated that the fire frequency was increasing sharply over the period of 1999–2004 (Sweis, 2006). A comprehensive study conducted in Turkey revealed that one million fire cases lived between 1988 and 2008. It has also been observed that there has been a significant increase in fire numbers over the years, and fire numbers increased from 20 000 in 1998 to 90 000 in 2008 (Bekem, Cavus, Demirel, 2011).

The residential fires are responsible of majority and severe form of fatal burn injuries (Mallonee et al., 1996). Injuries and deaths resulting from residential fires are an important public health problem especially in developing countries because of limited preventive interventions and rescue services (Jonsson et al., 2017). In low and middle-income countries death rate was eleven times higher than in high-income countries death rate (Peden, 2008), and over 90% of fatal fire-related burns occur in developing countries (Murray et al., 1996). According to WHO statistics, 310 000 people died as a result of fire related burns every year, of whom 96 000 were under the age of 20 (Murray et al., 1996). Based on the Characteristics of Home Fire Victims Survey, children under the age of five were one and a half times as likely as the general population to die in a home fire. Youth are also at the greatest risk of death in fire at home structure (Hall, 2005). Furthermore, the report indicated that people ages 20-49 faced the highest risk of non-fatal injury from home fires. Also, injury risk for adults between the ages of 20 and 34 was 30 percent higher than the average person (Hall, 2005).

To prevent residential fires and reduce fire related deaths and injuries; besides technological interventions such as smoke alarms, sprinklers, child resistant lighters and fire safe cigarettes, it is important to focus on understanding and changing negative human behaviors which are responsible of fires (Warda and Ballesteros, 2008). Negative human behaviors can include a wide variety of behavioral and psychological factors and these behaviors contributes to fire setting

behavior (Bowling, Merrick and Omar, 2013). Also, it is known that using technological material like smoke alarms and sprinkler was very low in Turkey and in other developing countries because of unawareness of the effectiveness of these practices among people (Forjuoh, 2006). In developing countries, personal behavior is critical as fire prevention services are not satisfactory. Since Turkey is a developing country, people's behaviors gain importance towards fire prevention services. Young people should be in the target groups who can gain positive behaviors related to fire due to their dynamic structure and being open to change.

Few published studies evaluated the behaviors of people related to residential fires. According to Second Injury Control and Risk Survey (ICARIS-2) 52% of household reported had a fire escape plan and only 16% of them with an escape plan reported practicing it every six months in USA (Ballesteros, Kresnow, 2007). In Sweden, Ploubidis and colleagues measured self-reported behaviors which may form elements of a plan for escaping from a house fire. According to the study, 32% of participants reported having a torch next to the bed, 79% reported having kept their escape routes visible, 86% recorded having external door keys, 36% strongly agreed or agreed that, in the case of a fire, their child could be hiding under the bed and 35% might be hiding in a cupboard or wardrobe (Ploubidis et al., 2015). Keeping children from flammable materials (lighters, matches, etc.) is also an important behavior for preventing fires. Playing of children with flammable materials (lighters, matches, etc.) is responsible for approximately 5% of residential fires, but those fires are related to a greater proportion of deaths. A study conducted in Dallas, USA show that fire play accounts for around 42% of deaths of children in residential fire (Istre et al., 2002).

Positive behaviors such as having a fire action plan to escape, keeping children away from flammable materials, saving emergency numbers in the phonebook, not doing electrical repairs by themselves, leaving the keys on the entrance door play an important role for prevent residential fires and death and injuries related it. The main aim of this study was to evaluate the behaviors which are effective to prevent residential fires and associated factors among young adults.

## **2. METHOD**

### ***2.1. Study Design and Setting***

After the ethical approval, which was obtained by the institutional review board, this cross-sectional study was conducted in Yalova Vocational School. The school is an associate degree and offer education in a wide range of fields such as textile technology, electric and energy, marketing and advertising and computer technology. There were 3,886 students in the school at the 2017-2018 academic year (Yalova University).

### ***2.2. Participants***

The inclusion criteria of the study was being a student at the school at the 2017-2018 academic year. The exclusion criteria was attending to the Civil Defense and Firefighting Program (CDFP) because of having formal education on nature, causes, prevention and intervention on fires. Of the students, 80 were excluded to because of attending to the CDFP.

### ***2.3. Data and Variables***

Data was gathered with a 14-question survey by face to face interview with participants between 01 and 10 May 2018. Five interviewers who were trained had the interviews. On the questionnaire, four questions were about sociodemographic characteristics; three were about the experiences, and seven were about the behaviors of the students on residential fires. Age was categorized to two groups (19 years and younger and 20 years and older) for comparing the

behavioral scores. The behaviors of the participants on fires were evaluated through seven items which could be answered as “yes” or “no”. According to the behavioral scoring system the maximum score was 16 points (Having an emergency assembly point outside the living place in case of fire took one point, having a fire action plan, saving emergency numbers in the phonebook and leaving the keys on the entrance door took two point, and keeping children away from flammable materials, not doing electrical repairs by themselves and not using more than one multiple adapter in power outlets took three points).

#### **2.4. Sample Size**

For the population of 3 806 students, minimum required sample size was calculated as 650 with an effect size of (d) 0.2, an  $\alpha$  of 0.05, and a power of 0.80, using G Power version 3.1.9.2. Finally, the target sample size was identified as 715 by increasing the minimum required sample size by 10%, considering possible refusals. Single stage systematic random sampling technique was used to select the participants from the population.

#### **2.5. Statistical Analysis**

Statistical analysis was performed using SPSS for Windows version 23. Kolmogorov-Smirnov test was used for evaluating the distribution of continuous data. Descriptive statistics were shown as mean  $\pm$  standard deviation (SD) for normally distributed data, median with interquartile range (IQR) for quantitative discrete data, and frequency (n) and percentage (%) for categorical variables. Mann-Whitney U test and Kruskal-Wallis test were used for univariate analyses of behavioral score according to the characteristics of the participants. Dunn’s test with Bonferroni correction was used for posthoc pairwise comparisons of the participants’ living places. Multivariate ordinal regression was used to examine the association of the characteristics of the participants with behavioral score of the participants. In univariate analyzes were included all independent variables with  $p < 0.20$  in the multivariate model and  $p < 0.05$  was defined as statistically significance level.

### **3. RESULTS**

Of the 715 students, 23 students could not be reached, and 31 students refused to participate. We interviewed with 661 students who accepted to participate in the study. All the questions asked in the questionnaire were answered completely by the participants. The mean age of the students was  $20.1 \pm 2.3$  years and 68.2% (CI: 64.9%-71.3%) were male. Of the 661 participants, 45.7% (CI: 42.3%-49.2%) were living in a dorm, 29.7% (CI: 26.6%-32.9%) in a house without family and 24.6% (CI: 21.8%-27.8%) were living with their family. Only 20.7% (CI: 18.1%-23.7%) of them were the owner of their residence (Table 1).

Of the participants, 15.9% (CI: 13.6%-18.6%) had an experience in any type of fire, and 21.2% (18.6%-24.2%) had a training on any topic of fire. On the other hand, nearly half of them (46.9%, CI: 43.5%-50.4%) had a basic first aid knowledge (Table 2). The mean total behavioral score was 8.17 with a standard deviation of 2.87 (not shown in the table).

The behaviors of the students about the residential fires were found different levels. Although 19.7% (CI: 17.1%-22.6%) of the participants had a fire action plan to escape in their living places, 85.8% (CI: 83.2%-88.0%) stated that they were keeping children away from flammable materials. Of the students, 21.6% (CI: 19.0%-24.7%) reported that they had an emergency assembly point outside the living place in case of fire; 27.1% (CI: 24.1%-30.3%) saved emergency numbers in the phonebook (to remember in case of panic); 79.9% (CI: 76.9%-82.5%) did not do electrical repairs by themselves; 36.8% (CI: 33.5%-40.2%) did not use more than one multiple adapter in power outlets; and 47.2% (43.8%-50.7%) left the keys on the entrance door (Table 3).

Table 1. Sociodemographic Characteristics of the Participants

Characteristics	n	% (95% CI)
Age (years)		
≤18	97	14.7 (12.4-17.3)
19	200	30.3 (27.2-33.6)
20	167	25.3 (22.4-28.4)
21	104	15.7 (13.4-18.5)
≥22	93	14.1 (11.9-16.7)
Mean±SD= 20.1±2.3		
Sex		
Male	451	68.2 (64.9-71.3)
Female	210	31.8 (28.7-35.1)
Residence		
Dorm	302	45.7 (42.3-49.2)
House without family	196	29.7 (26.6-32.9)
House with family	163	24.6 (21.8-27.8)
Ownership of the residence		
Owner	137	20.7 (18.1-23.7)
Not owner	524	79.3 (76.3-81.9)

Note: CI: confidence interval

Table 2. Experiences of the Students About Fire and First Aid

Experiences	n	% (95% CI)
Having experience in any type of fire		
Yes	105	15.9 (13.6-18.6)
No	556	84.1 (81.4-86.5)
Having training about fire		
Yes	140	21.2 (18.6-24.2)
No	521	78.8 (75.8-81.5)
Having basic first aid knowledge		
Yes	310	46.9 (43.5-50.4)
No	351	53.1 (49.6-56.5)

Table 3. Behaviors of Participants on Residential Fires

Behaviors	n	% (95% CI)
Having a fire action plan to escape in the living place	130	19.7 (17.1-22.6)
Keeping children away from flammable materials (lighters, matches, etc.)	567	85.8 (83.2-88.0)
Having an emergency assembly point outside the living place in case of fire	143	21.6 (19.0-24.7)
Saving emergency numbers in the phonebook (to remember in case of panic)	179	27.1 (24.1-30.3)
Not doing electrical repairs by themselves	528	79.9 (76.9-82.5)
Not using more than one multiple adapter in power outlets	243	36.8 (33.5-40.2)
Leaving the keys on the entrance door	312	47.2 (43.8-50.7)

In univariate analysis, we found that the behavioral scores of participants was associated with the type of living place, having training on any topic about fire and having basic first aid training ( $p=0.005$ ,  $p=0.001$ ,  $p=0.002$ ). There was no significant association between the behavioral scores of participants and age, sex, ownership of residence or having experience in any type of fire. (Table 4). In the multivariate analysis, we found that the behavioral score of students was significantly

associated with living place, having training about fire and having basic first aid knowledge.). Students living in the dormitory (OR: 1.63), who had any education on fire (OR: 1.46), and who received first aid training (OR: 1.37) were more positive fire-related behavior (Table 4).

Table 4. Behavioral Scores of The Participants According The Characteristics And Experiences

Characteristics/Experiences	Univariate Analysis			Multivariate Analysis		
	OR	95% CI	p*	OR	95% CI	p**
Age (years)						
≤19	ref			ref		
>19	0.79	0.60-1.03	0.084	1.19	0.90-1.56	0.222
Sex						
Male	ref			-		
Female	1.09	0.82-1.45	0.554	-		
Living place						
House without family	ref			ref		
House with family	1.57	1.09-2.27	<b>0.015</b>	1.19	0.74-1.91	0.475
Dorm	1.66	1.21-2.28	<b>0.002</b>	1.63	1.18-2.25	<b>0.003</b>
Ownership of the residence						
Not owner	ref			ref		
Owner	1.32	0.94-1.86	0.104	1.44	0.88-2.36	0.152
Having experience in any type of fire						
No	ref			-		
Yes	0.99	0.68-1.42	0.936	-		
Having training about fire						
No	ref			ref		
Yes	1.70	1.23-2.36	<b>0.001</b>	1.46	1.02-2.32	<b>0.037</b>
Having basic first aid knowledge						
No	ref			ref		
Yes	1.55	1.18-2.02	<b>0.002</b>	1.36	1.01-1.81	<b>0.041</b>

#### 4. DISCUSSION AND CONCLUSION

Burn injuries related to fires continue to be one of the main causes of unintentional death and injury (Peden, 2008). For fires, Global Burden of Disease 2017 recorded heat, hot substance and fire injuries in 360 000 (313 000–380 000). Furthermore, WHO had similar estimates as 410 000 burn injuries (Spencer et al., 2018). Furthermore, fire-related burns in low- and middle-income countries were among the leading causes of disability-adjusted life-years (DALYs) (Peden, 2008).

A variety of risk factors were reported for the fatal residential fires (Doll et al., 2007). These include employment, grade education, rural residence, disability of physical and mental, male gender, and home-related factors such as home ownership and form of housing (Warda, Tenenbein and Moffatt, 1999). However, behavioural factors of residential fire injury and its prevention were not well documented in current literature on the research (Warda, Tenenbein and Moffatt, 1999). These behaviours include daily practices, such as safe cooking behaviours and location of space heaters, principles of applied behavioural analysis, modelling of evacuation, factors influencing fire risk perception, visual exposure, and concepts of residential design (Doll et al., 2007). A collection of main factors for predicting and explaining behavioural changes affecting many health issues have been identified, including three variables deemed appropriate and adequate intentions, environmental barriers and skills and five variables that can affect the intensity and direction of intentions or directly affect behavioral expectations, social norms, self-standards (Fishbein et al., 2001).

Behaviours as having a fire action plan, keeping children away from flammable materials, saving emergency numbers in the phonebook, not doing electrical repairs by themselves, leaving the keys on the entrance door were just examined in this study. These behaviour determinants are important to improve positive behaviour. Among the factors as housing type, in this study, the status of having positive behaviour on house fires is significantly higher in participants lived in a dorm than living in family residence and living alone. This can be explained that there are encouraging factors such as controlling and supporting peer to have positive behaviour. However, in Turkey, there are many problems with fire services (Yentürk et al., 2002; Uygun and Inal, 2019). The firefighting services are not well developed, fire brigade approaches and services are old and inadequate, the fire precautions of many buildings are not sufficient, the building load is excessive. In these circumstances individual protective behaviours gain importance. In a study reporting the development and testing of a building evaluating parental fire safety behaviors for planning escape from a house fire, the best fit for the data was given with a two-class model, combining responses to five fire safety planning behaviors, and corresponding probabilities were identified for each fire safety variable for both classes. It was reported that the group who were more fire safety behaviour to escape from a house fire comprised 86 percent of participants most likely to have a torch, be aware of how their smoke alarm sounds, have accessible external door and window keys, and exit clear. The group that had less fire safety behaviors to escape from a house fire included 14% of participants who were less likely to report these five behaviors. Furthermore, in stated study, participants assigned to fire safety behaviour to escape from a house fire group were 2.5 times more likely to submit an escape strategy (OR 2.48; 95 % CI 1.59–3.86) than those with less fire safety behaviors to escape from a house fire group (Ploubidis et al., 2015). In the study, positive behaviours on residential fires was found higher in the students stated that training about fire than the students who did not. The result of this study revealed that training about the prevention of fire has been quite effective in increasing the awareness of young people about residential fires. However, earthquake comes to mind firstly within disaster groups in Turkey, whereas fires are very common which mostly affects younger age groups (Ersoy, Kocak, 2016). However, modern individual prevention approaches to fires are not taught in schools (Ersoy, Kocak, 2016). Information and trainings on residential fire should be given to all people especially to young individuals in the community.

The mean age of the participants in the study was  $20.1 \pm 2.3$  years and they were the risk group for house fires. Young age and low socioeconomic status are among common risk factors for residential fire death in urban paediatric emergency department patients (Wood et al., 2016). Close to 75% of young children's burns came from hot liquid, heated tap water or steam. The burns they experienced are typically the result of hot drink scalds or touch burns from radiators or hot water pipes (Agran et al., 2003). In Finland, an 11-years study found that 50 percent of burns were due to electricity in the 11–16-year group, while the other 50 percent were due to fire and flames (Peden, 2008). Smoking was the major cause of fatal fires in residential areas (Hall, 2004).

Haddon Matrix is suggested to analyse and prevent injury of all types. The matrix as a framework summarizes the risk and protective factors, and sets out the various preventive approaches, both effective and promising. It is suggested for fire related burns among children that on the pre-event phase, lack of information about the risks of fire at home, sex, household storage of flammable objects, matches or lighters available to children are the important factors. For on the event phase, unmaintained smoke alarms and sprinkler systems, poor knowledge about evacuation procedures, lack of access to telephone to call for help were risk factors (Peden, 2008). This study showed that 79.9% of the participants did not do electrical repairs by themselves; 36.8% did not use more than one multiple adapter in power outlets and 27.1% save emergency numbers in the phonebook (to remember in case of panic). These are important behaviours to prevent residential fires. This result reveals that fire prevention behaviour was quite prevalent among the young, also, a great number of students did not save emergency numbers in the phonebook to remember in

case of panic. Thus, it is very important to give a point of view about these behaviours' necessity and importance in the schools. In a prospective, quasi randomized controlled study determined the effect of community based fire prevention interventions on the awareness and actions of fire protection in primary school was described as a modest increase in fire safety actions among children whose families received a fire prevention indicating a shift in household fire safety practices, but no substantial change was observed in fire safety knowledge among groups (Hwang et al., 2006). Sex is an important factor on fire safety in some studies (Jonsson et al., 2017; Xiong, Bruck and Ball, 2015). Girls' fire-related death rate was 4.9 per 100,000 population, compared with 3.0 per 100,000 for boys (Peden, 2008). The difference was especially marked in infants and adolescents aged 15 to 19 years (Peden, 2008). The age of this group had greater exposure, experimentation and risk taking (Peden, 2008). In this study, there was no statistically significant difference in behavioural status between the different categories of participants' age and sex. In a survey conducted in Sweden, it was reported that male sex, old age, smoking, and alcohol were identified as risk factors (Jonsson et al., 2017).

The study had some limitations. The study sample size was restricted to a group comprising of a vocational school, not to students of all higher education programs of the country. Therefore, the findings of this study can not be generalized to all young adults in Turkey. Furthermore, there are very few researches studied in this area. Furthermore, fire-setting behavior can be seen in association with various psychiatric and behavioral disorders in childhood, adolescence, and adulthood. Within the scope of the study, no evaluation was made for this group.

This study showed that positive behavioral status on residential fires was associated with the place where the participant lives in and having training about fire. Interventions aimed to increase positive behaviors on residential fire should include the young people who live in family house or who live alone in a house. Therefore, young people need to train on fire prevention, early response and basic first aid for fire to reduce the risk of mortality and morbidity and the economic burden of fire. Period of university education may be appropriate for those trainings. This study has evaluated the behaviors of university students in Turkey related to residential fires. There are few published studies on this subject so this study is very important in terms of prioritizing intervention studies to be carried out.

## **Acknowledgements**

This study was presented as a poster in 2nd International and 20th National Public Health Congress, 2018.

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