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Thirdhand smoke: How aware are patients?

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Abstract:

BACKGROUND AND AIM: The use of tobacco and tobacco products is one of the biggest public health problems that continue to threaten human health worldwide. Thirdhand smoke (THS) is a new concept that emerges from tobacco use, and there are not enough studies on its effects on human health. Therefore, we aimed to determine the level of awareness of THS and the parameters affecting it in individuals who applied to a chest diseases hospital in Türkiye.

METHODS: A total of 400 volunteers who admitted to our hospital between February and March 2022 were literate and accepted to participate in the study were included. Volunteers were given a questionnaire including the demographic characteristics and Baths-T survey, which was used to determine the awareness of THS.

RESULTS: Of the 400 participants included in the study, 162 (40.5%) were females, 238 (59.5%) were males, and their mean age was 44.09 ± 12.75 years. In our study, the mean Baths-T score was 35.1 ± 6.74 . The mean score of persistence and health beliefs was 15.51 ± 3.54 and 19.58 ± 3.74 , respectively. It was determined that the total and two subdimension scores were statistically significantly higher in women than in men ($p=0.019$, 0.046 , and 0.011). Awareness was statistically significantly lower in smokers and those with low education levels ($p=0.001$ and 0.014).

CONCLUSIONS: We think that the male gender, low education level, and smokers, whose awareness level is low, should be the primary target group in informing about THS.

Keywords:

Baths-T, thirdhand smoke, tobacco

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Introduction

The use of tobacco and tobacco products is one of the biggest public health problems that threaten human health worldwide. According to the World Health Organization data, more

than 8 million people die annually from diseases caused by tobacco and tobacco products, and approximately 1 million are not active smokers. According to the Global Adult Tobacco Survey report, 30.5 million adults (59.7%) in Türkiye live in smoking households and approximately

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20 million of them are non-smokers. The report also stated that more than 10 million people live in houses with at least one smoker.^[1,2]

Tobacco smoke contains more than 7000 chemicals, most of which are toxic, and at least 70 have been found to cause cancer.^[1,3] Although studies on cigarette and secondhand smoke are very old, studies on thirdhand smoke (THS) first started in 2006. THS was named residual tobacco or stale tobacco in scientific studies over the years, and the concept of THS was decided after 2011.^[4,5]

According to Matt et al.,^[6] THS is defined as the rerelease of residual cigarette smoke pollutants remaining on surfaces and dust after smoking into the gas phase or reacting with oxidants or environmental compounds in the environment to form secondary pollutants.

The presence of THS components in the air, dust, and surfaces has resulted in various routes of exposure. While less volatile compounds are taken dermally and orally, volatile compounds released from the surfaces are taken into the body by inhalation.^[7,8] There have not been sufficient studies to fully demonstrate the health effects of THS. However, studies have found that many chemicals found in THS and stored on surfaces are group 1 carcinogens, and long-term exposure to low levels of these toxins has been reported to cause concern.^[8,9]

In *in vitro* experiments, it has been shown that THS delays wound healing by impairing DNA damage and fibroblast migration.^[10,11] In the study of Rehan et al.,^[12] it was determined that there was growth retardation in the respiratory system in the fetuses of pregnant mice exposed to THS.

In studies on secondhand cigarette smoke, it has been determined that people's knowledge and awareness about the harms of cigarette smoke are correlated with a decrease in smoking and the rate of quitting. There are very few studies on THS awareness in the literature.^[5,13] Therefore, in our study, we aimed to determine the THS awareness level and its parameters in people admitted to a chest diseases hospital in Türkiye.

Materials and Methods

A total of 400 volunteers who admitted to our hospital between February and March 2022 who were between the

ages of 18 and 65, able to read and write, and who agreed to the study at the end of the briefing were included in the study. The volunteers were asked about their demographic characteristics (age, gender, marital status, number of children, income status, and education level), the number of people living in their house, and smoking condition. If they smoke, whether they smoke at home, whether there are other smokers in the house, and whether there was smoking in the house they lived in during their childhood. A questionnaire containing the awareness scale^[14] validated for Türkiye was given. Volunteers filled out the questionnaire by reading it themselves.

The study was approved by the Süreyyapasa Chest Diseases and Chest Surgery Training and Research Hospital Ethics Committee 116.2017.R-241/03.02.2022. Completion of the questionnaire by the participants was deemed as informed consent to participate. The study was conducted following the principles and guidelines of the Declaration of Helsinki for medical research involving human subjects.

The Beliefs About Third Hand Smoke (Baths-T) Scale (Table 1), a standardized 9-item scale, was used to assess the patient's general beliefs about THS (referred to as THS total score). Moreover, of the nine items, five items (no.: 1, 2, 3, 7, and 8) were related to beliefs about THS impact on health (referred to as THS health beliefs score), and four items (no.: 4, 5, 6, and 9) were related to beliefs about THS persistence in the environment (referred to as THS persistence beliefs score). The THS total score, based on nine items, can range from 9 to 45. The THS health beliefs score, based on five items, can range from 5 to 25. The THS persistence beliefs score, based on four items, can range from 4 to 20. Higher scores indicate stronger beliefs about the harm and persistence of THS.

Statistical analysis

Descriptive statistics of the obtained data were calculated. The conformity of the numerical features to the normal distribution was examined using the Shapiro–Wilk test. The relationships between total score and two subdimension scores and other numerical characteristics were analyzed by Spearman's rank correlation analysis. The relationships between categorical features and scale scores were evaluated with the Mann–Whitney U test or the Kruskal–Wallis analysis. A value of $p < 0.05$ was accepted as a statistical significance level. SPSS 25.0 package program (SPSS, Inc., Armonk, NY, USA) was used in the calculations.

Table 1: Baths-T questionnaire

The next questions will ask for your opinions on the effects of smoking inside your home	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1. Breathing air in a room today where people smoked yesterday can harm the health of infants and children	1	2	3	4	5
2. Breathing air in a room today where people smoked yesterday can harm the health of adults	1	2	3	4	5
3. Particles in rooms where people smoked yesterday can cause cancer	1	2	3	4	5
4. Smoke particles can remain in a room for days	1	2	3	4	5
5. Smoke particles can remain in a room for weeks	1	2	3	4	5
6. Smoke particles get absorbed into furniture and walls	1	2	3	4	5
7. After smoking a cigarette, smoke particles on skin, hair, and clothing can be passed on to others through touch	1	2	3	4	5
8. After touching surfaces where cigarette smoke has settled particles can enter the body through the skin	1	2	3	4	5
9. Opening windows or using air conditioners does not eliminate all smoke particles in a room	1	2	3	4	5

Results

Of the 400 people included in the study, 162 (40.5%) were females, 238 (59.5%) were males, and their mean age was 44.09 ± 12.75 years. The demographic data of the volunteers are shown in Table 2. While 31.3% (125) of the volunteers were university graduates, 28.5% (114) were primary school graduates. Of the participants, 202 (50.5%) were smokers, while 198 (49.5%) had never smoked. Of the participants, 267 (66.8%) were exposed to cigarette smoke in the home environment as children.

When the demographic data between male and female genders were compared, no statistically significant difference was found between education levels ($p=0.102$). In contrast, smoking was statistically significantly higher in males ($p=0.001$). The mean smoking was 23.07 ± 14.72 p/year. Of the volunteers, 300 had children, and the education level of those who had children was statistically significantly lower than those who did not ($p=0.001$).

The answers given to the THS awareness scale, Baths-T scale, are shown in Figure 1. In our study, the mean total score was 35.1 ± 6.74 . The persistence beliefs mean score was 15.51 ± 3.54 , and the health beliefs mean score was 19.58 ± 3.74 (Table 3).

As a result of comparing the genders in terms of Baths-T total score and two subdimension scores, it was determined that both the total score and the two subdimension scores were statistically significantly higher in women than in men ($p=0.019$, 0.046 , and 0.011) (Table 4).

Table 2: Demographic characteristics of the volunteers

Characteristics	n	%
Gender		
Female	162	40.5
Male	238	59.5
Marital status		
Married	312	78.0
Not married	88	22.0
Education level		
Primary school	114	28.5
Middle school	43	10.8
High school	104	26.0
University	125	31.3
Master's degree	14	3.5
Smoking		
Yes	202	50.5
No	198	49.5
Does he/she smoke at home?		
Yes	76	37.6
No	126	62.4
Comorbid diseases		
N/A	186	46.5
Asthma bronchial	47	11.8
Hypertension	27	6.8
Chronic obstructive pulmonary disease	23	5.8
Atherosclerotic heart disease	14	3.5
Diabetes mellitus	13	3.3
Lung cancer	9	2.3
Other diseases ^a	81	20.3
Home smoke exposure in childhood		
Yes	267	66.7
No	133	33.3

^a: Other diseases include anemia, allergic rhinitis, depression, anxiety disorder, gastroesophageal reflux, gastritis, cerebrovascular accident, rheumatoid arthritis, and inflammatory bowel disease

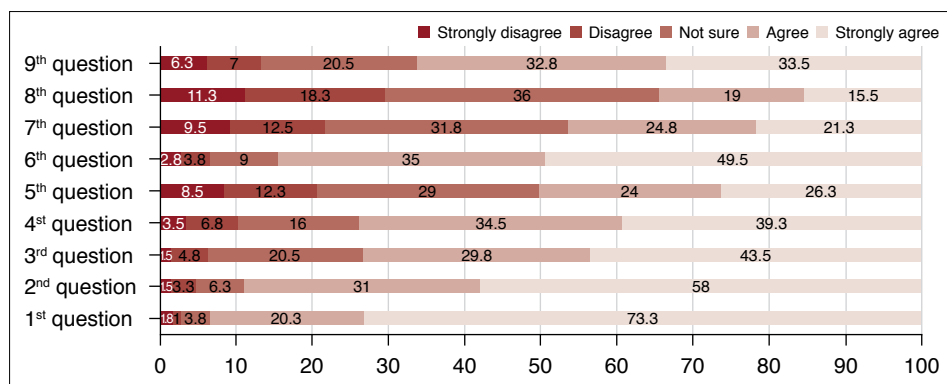


Figure 1: Distribution of the answers given to the questions asked on the Baths-T questionnaire

When the relationship between awareness and age is examined, a low but statistically significant negative correlation was found between the persistence beliefs score and age ($r=0.106$, $p=0.035$).

It was found that both total and two subdimension scores were statistically significantly higher in nonsmokers ($p=0.001$, 0.004 , and 0.001). There was no statistically significant difference between those who had exposure to cigarette smoke at home in childhood and those who did not ($p=0.578$, 0.960 , and 0.234).

While there was no statistically significant difference between those with and without children in terms of Baths-T total score and health beliefs score ($p=0.096$ and 0.609), it was observed that the persistence beliefs score was significantly higher in those without children ($p=0.006$) (Table 4).

Baths-T total score was statistically significantly lower in primary school graduates than in other education levels ($p=0.014$). While there was no significant difference between education levels in terms of the health beliefs score ($p=0.181$), the persistence beliefs score was statistically significantly lower in primary, secondary, and high school graduates than in other education levels ($p=0.002$) (Table 5). Baths-T total score was significantly higher in volunteers diagnosed with lung cancer than in the group diagnosed with chronic obstructive pulmonary disease (COPD), asthma bronchial, and hypertension ($p=0.045$). While the health beliefs score was significantly lower in volunteers diagnosed with COPD, asthma bronchial, and hypertension than in groups with lung cancer and other disease diagnoses ($p=0.034$), no statistically significant difference was found between disease groups in terms of persistence beliefs score ($p=0.113$).

Discussion

As a result of our study, the THS awareness level was found above the scale mean score. However, it was observed that the level of awareness was low in men, smokers, and primary school graduates.

These results show that the awareness of THS in volunteers is higher than that of the general population. We think their awareness is high because our hospital is a chest diseases branch hospital, and the education level of the participants is generally high.

In the study of Xie et al.,^[15] with the families of primary school children in Shanghai, while the awareness level in the Baths-T total score and health beliefs score was high in women, they found awareness in the persistence beliefs equal to that of men. Similarly, our study found that Baths-T total score and awareness level in both subdimensions were low in males. In addition, we found a negative correlation with age in the persistence beliefs scoring, and we found that awareness of persistence beliefs decreases at advanced ages. In the study of Haardörfer et al.,^[16] gender difference and age did not affect any subdimension scoring. The low awareness about persistence beliefs in advanced ages can be explained by the fact that the information on this issue is mostly through educational institutions and social media.

Table 3: Total mean scores of Baths-T, health, and persistence beliefs

Score	Mean±SD (n=400)
Baths-T score (max=45)	35.10±6.74
Health beliefs score (max=25)	19.58±3.74
Persistence beliefs score (max=20)	15.51±3.54

Table 4: Relationship of Baths-T and two subdimension scores with gender, smoking, being a parent, and childhood exposure to cigarette smoke

Characteristics	Health beliefs score (mean±SD)	Persistence beliefs score (mean±SD)	Baths-T score (mean±SD)
Gender			
Female (n=162)	20.07±3.35	16.09±3.27	36.15±5.95
Male (n=238)	19.26±3.96	15.13±3.68	34.38±7.17
p	0.046	0.011	0.019
Smoking			
Yes (n=202)	18.96±3.74	15.24±3.47	34.02±6.67
No (n=198)	20.23±3.65	15.79±3.61	36.02±6.72
p	0.001	0.004	0.001
Child			
Yes (n=300)	19.51±3.80	15.24±3.58	34.74±6.87
No (n=100)	19.82±3.58	16.35±3.31	36.17±6.30
p	0.609	0.006	0.096
Childhood cigarette smoke exposure			
Yes (n=267)	19.45±3.79	15.51±3.61	34.96±6.90
No (n=133)	19.86±3.64	15.53±3.42	35.38±6.45
p	0.234	0.960	0.578

In two studies conducted with 786 participants, one in Germany in 2017 and the other in Kuwait in 2021, the Baths total score and health beliefs mean score were lower in smokers compared with nonsmokers.^[16,17] In our study, THS awareness in smokers was statistically significantly lower in total score and both subdimensions, which explains the low level of awareness among men, because smoking in men was statistically significantly higher than in women.

Studies measuring parents' awareness of THS have shown that awareness is higher in those with higher education levels, and it has been found that these parents more strictly comply with smoking bans at home.^[5,17,18] In the scale studies of parents' awareness against the harms of cigarette smoke, it has been determined that those with higher education levels have more knowledge about the persistence of THS in the environment and its negative impact on health.^[19,20] In our current study, no statistically significant relationship was found between education level and awareness of health beliefs. In contrast, awareness of persistence beliefs was statistically significantly higher in those with university or higher education. Baths-T total score was significantly lower in primary school graduates, similar to previous studies.

The low level of awareness of the persistence beliefs among the volunteers who have children can be explained by our study's low level of education. These

results have shown that the main reason for increasing awareness of THS is the level of education.

Baths-T total score in the volunteers followed up for lung cancer was statistically significantly higher than the group with other diagnoses. There is no study in the literature to discuss these values. The high awareness of THS in cancer patients can be explained by the fact that lung cancer is a life-threatening disease. In COPD and asthma patients, the low awareness of health beliefs

Table 5: Comparison of education levels in terms of Baths-T and two sub-dimension scores

Score	Education level	n	Mean±SD	p
Baths-T score	Primary school ^a	114	33.89±6.77	0.014
	Middle school	43	34.56±6.98	
	High school	104	34.51±7.33	
	University	125	36.74±5.56	
	Master's degree	14	36.43±8.78	
Health beliefs score	Primary school	114	19.18±3.52	0.181
	Middle school	43	19.16±4.33	
	High school	104	19.35±4.17	
	University	125	20.30±3.04	
	Master's degree	14	19.57±5.37	
Persistence beliefs score	Primary school	114	14.71±3.82	0.002
	Middle school	43	15.40±3.18	
	High school	104	15.16±3.72	
	University ^b	125	16.43±3.01	
	Master's degree ^b	14	16.86±3.70	

^a: Baths-T score was lower in primary school graduates than in other education levels, ^b: Persistence beliefs score was higher in university and master's degree than in other education levels

shows that the harms of smoking are not adequately explained. Our results reveal that it is necessary to explain to this patient group that continuing to smoke is dangerous not only for themselves but also for the health of their relatives.

According to the global adult tobacco report, it has been shown that approximately 30.5 million (59.7%) people living in Türkiye live in smoking households.^[2] In the present study, exposure to cigarette smoke at home during childhood was 66.7%. However, contrary to expectations in our study, it was observed that THS awareness was not related to childhood exposure.

Conclusion

In general, it has been observed that high awareness of THS has been created in a society with training and programs about the harms of tobacco and tobacco products. However, awareness was low among men with low education levels and smokers. Therefore, we think this group should be the primary target audience for informing about THS.

Limitations

The volunteers were selected from the chest diseases branch hospital, which creates the limitation of this study.

Conflicts of interest

There are no conflicts of interest.

Ethics Committee Approval

The study was approved by the Süreyyapasa Chest Diseases and Chest Surgery Training and Research Hospital Ethics Committee (No: 116.2017.R-241, Date: 03/02/2022).

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Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept – M.Ö.A., D.E.; Design – M.Ö.A., Ü.A.A., Ö.S.; Supervision – M.Ö.A., D.E.; Funding – None; Materials – None; Data collection &/or processing – M.Ö.A., Ö.S., Ü.A.A.; Analysis and/or interpretation – M.Ö.A., Ü.A.A., D.E.; Literature search – M.Ö.A., D.E., Ü.A.A., Ö.S.; Writing – M.Ö.A., D.E., Ü.A.A., Ö.S.; Critical review – M.Ö.A., D.E., Ü.A.A., Ö.S.

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