

Prevalence of tandoor smoke exposure in female patients with asthma: A cross-sectional study from the East of Turkey

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Abstract

Aim: The aim of this study was to evaluate the use of cow dung cake (cdc) for heating, cooking and baking in female patients (pts) with asthma.

Material and Methods: This cross-sectional study was conducted between January 2016 and 2018. The study included 522 female pts with asthma. Pts were divided into three groups based on using cdc (for heating, cooking and baking). Secondly, the pts who used cdc in tandoor for baking were evaluated and these pts were divided into three groups based on exposure to tandoor smoke [a) currently using, b) previously used, c) never used]. Age, BMI, comorbidity, the place where pts live, educational status, occupation, smoking status, pulmonary functions and complete blood counts of all pts were evaluated. All statistical calculations were performed with SPSS 23.0.

Results: 219 (42%) of all pts were using the cdc, 165 (31.7%) pts were using tandoor, 106 (20.4%) pts had previously used tandoor. The pts who exposed to tandoor smoke previously were significantly older and these pts had higher BMIs. The incidence of comorbidities, the place where pts live, occupation and educational status were significantly different between tandoor smoke exposure groups. The pts who were currently using tandoor for baking lived in villages. In all three groups, most of the women were housewives and most of them who were exposed to tandoor smoke were illiterate. Hemoglobin levels of the pts who were exposed to tandoor smoke were higher. The pts who were currently using tandoor for baking had significantly lower MPV and pulmonary function tests such as FEV1, FVC, PEF and FEF 25% levels.

Conclusion: The women with asthma who exposed to tandoor smoke are older, overweight, rural housewife people and they have comorbidities. The pulmonary functions and hemoglobin of them may be affected by exposure to tandoor smoke.

Keywords: Female; asthma; biomass; tandoor smoke

INTRODUCTION

Asthma is one of the most common chronic diseases in the world, with increasing prevalence and resulting in a substantial worldwide burden (1). Reasons for asthma are unclear, but risk factors for this disease including tobacco smoke exposure, dust mites, indoor moistness and mold, domestic animals, lifestyle changes and environmental exposures such as traffic-related pollution have been concerned (2). In low- and middle-income countries, exposure of household air pollution from the use of biomass for cooking is an increasing distinguished risk factor for asthma and other chronic respiratory diseases

(2). Worldwide, about 2.4 billion people commonly use cheap and widely available biomass substances such as dried woods, crop residues and animal dung cakes to supply household energy particularly in rural areas of low- and middle-income countries, including sub-Saharan Africa, South-East Asia and the Western Pacific region (3, 4). Biomass substances are typically burned on a simple cook-stove within a house lacking enough outdoor ventilation and toxic gases such as nitrogen oxides, carbon monoxide, methane, benzene, aldehydes and polycyclic aromatic hydrocarbons are released from this combustion (3, 4). The burning light materials are solid particles and gases with size of <2.5 microns and they can remain in the

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air for longer times (3, 4). These particles can penetrate the lungs deeply and they can damage to respiratory system with oxidative stress and chronic inflammation (3, 4). In most cultures of low- and middle-income countries, women play an active role in cooking in the family and some of them start to help their mothers at young ages (5). Hereby, women may be exposed to biomass substances for a long time starting from their childhood periods (5).

Tandoor, in eastern Turkey, used for baking bread, or made of clay, having a thickness of 5-6 cm, upwardly tapering, is a kind of buried cylindrical furnace on earth (6, 7). In our country, particularly the use of cow dung cake (cdc) in the household tandoor is common in cities such as Kars where cattle breeding is widespread (8). Rural and poor areas in eastern Turkey, women are generally responsible for house works such as heating, cooking and baking bread (8). In these areas, women are more heavily exposed to tandoor smoke in the indoor environment because they burn cdc for baking bread in tandoor. For many years, these women are exposed to tandoor smoke for an average of 4-5 times and several hours per month (9). Prolonged exposure to tandoor smoke in women, indoor environment, caused by the burning of the cdc, can lead to chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD), chronic bronchitis, asthma and some type of cancers (8).

In this study, our aim was to evaluate the use of cdc for heating, cooking and baking bread in female patients (pts) with asthma. We especially focused on the pts who used the cdc in the tandoor for baking bread.

MATERIAL and METHODS

Design and Assessment

This epidemiological cross-sectional study was conducted with the approval of a university hospital entitled Kafkas University Medical Faculty ethics committee between January 2016 and January 2018 in Kars city, the east of Turkey. The study included 522 female pts with Asthma Disease who admitted to Pulmonology Department. All female pts who were admitted to our hospital due to various reasons and diagnosed with asthma or diagnosed as a new asthma were included in the study. Firstly, all of the pts were divided into three groups based on using cdc (for heating, cooking and baking bread). Secondly, the pts who used the cdc in the tandoor for baking bread were evaluated as a sub-group. These sub-group pts were divided into three groups based on exposure to tandoor smoke [a) currently using, b) previously used, c) never used]. Age, body mass index (BMI), comorbidity, the place where pts live, educational status, occupation, smoking status (smoker, ex-smoker, never smoker), expose to passive smoke, pulmonary function tests and complete blood count parameters of all pts were evaluated. Pulmonary function tests were measured at baseline using a spirometer (Spirolab III-MIR, Italy). All pts were informed and verbal consent was obtained for the study.

Blood samples

All blood samples were drawn from the vein in the forearm and collected into 2 mL Lavender (EDTA) top tube and

were analyzed with Pentra DF Nexus, Horiba Medical, Japan with Automated Cell Counter Methodology. The blood samples were stabilized optimally when run within in 4 hours of collection, stable for 24 hours at room temperature, and stable for 36 hours at 2 – 8 degrees C.

Statistical Analysis

All statistical calculations were performed with SPSS 23.0 (SPSS for Windows, Chicago, IL, SA). All continuous variables were expressed as mean±standard deviation; categorical variables were defined as percentages (%). The categorical parameters were compared with Chi Square test and Fischer's exact test. The normal distribution was determined by histogram and Kolmogorov-Smirnov test. The non-parametric tests were performed because they did not conform the normal distribution. Mean values of continuous variables were compared between the groups using Mann-Whitney U test. The statistical significance level was $p < 0.05$.

RESULTS

Of 522 pts with asthma, 219 (42%) were using the cdc for various purposes. 148 (28.3%) pts were using the cdc for both heating, cooking and baking bread.

Table 1. Clinical features of all pts included in the study

	All patients	The use of cow dung cake		P
		Exist	Absent	
		Mean±sd / n (%)		
Age	45±11.9	48±10.4	42.8±12.5	<0.001
Length (meter)	1.6±0	1.6±0.1	1.6±0	0.012
Weight (kg)	77.2±14.1	78.5±13.5	76.3±14.5	NS
BMI (kg/m ²)	29.5±5.6	30.2±5.3	29±5.8	0.015
Comorbidity	172 (32.9%)	74 (33.8%)	97 (32%)	NS
HT	128 (24.5%)	61 (27.9%)	66 (21.8%)	NS
DM	34 (6.5%)	7 (3.2%)	27 (8.9%)	0.009
CAD	10 (1.9%)	6 (2.7%)	4 (1.3%)	NS
Depression	12 (2.3%)	5 (2.3%)	7 (2.3%)	NS
Hypothyroidism	17 (3.3%)	8 (3.7%)	9 (3%)	NS
Hyperlipidemia	2 (0.4%)	1 (0.5%)	1 (0.3%)	NS
Rheumatoid Arthritis	2 (0.4%)	1 (0.5%)	1 (0.3%)	NS

Continuous variables are expressed as mean ± standard deviation; BMI, body mass index; HT, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; NS, non-significant

102 (19.5%) pts were smoker, 58 (11.1%) pts were ex-smoker and 362 (69.3%) pts were never smoker. 242 (46.4%) pts had exposure to passive cigarette smoke. 165 (31.7%) pts were currently using the tandoor, 106 (20.4%) pts had previously used a tandoor and 249 (47.9%) pts had never used it. Two pts could not be informed about exposure to tandoor smoke. Clinical features of all pts included in the study are presented in Table 1. The age of the pts who used the cdc was significantly greater ($p < 0.001$) and the BMIs of these pts were higher. The number of pts with diabetes mellitus (DM) was significantly higher in the group who did not use the cdc.

Table 2. The place where pts live, occupation and educational status of all pts included in the study

	All patients	The use of cow dung cake		P
		Exist	Absent	
		n (%)		
The place where pts live				
Village	229 (43.8%)	179 (81.7%)	50 (16.5%)	
County	45 (8.6%)	13 (5.9%)	32 (10.6%)	<0.001
City center	249 (47.6%)	27 (12.3%)	221 (72.9%)	
Occupation				
Housewife	459 (87.8%)	216 (98.6%)	242 (79.9%)	
Civil servant	37 (7.1%)	-	37 (12.2%)	<0.001
Student	19 (3.6%)	-	19 (6.3%)	
Employee	8 (1.5%)	3 (1.4%)	5 (1.7%)	
Educational status				
Illiterate	139 (26.6%)	97 (44.5%)	42 (13.9%)	
Literate	85 (16.3%)	42 (19.3%)	43 (14.2%)	
Primary school	174 (33.3%)	66 (30.3%)	107 (35.3%)	<0.001
Secondary school	39 (7.5%)	11 (5%)	28 (9.2%)	
High school	44 (8.4%)	2 (0.9%)	42 (13.9%)	
University	41 (7.9%)	-	41 (13.5%)	

Continuous variables are expressed as mean ± standard deviation; NS, non-significant; pts, patients

Living places, occupations and educational status of all pts included in the study are given in Table 2. The differences between the groups in terms of living places, occupations and educational status were significant ($p < 0.001$). 81.7% (179) of the pts who used the cdc were living in the village. 72.9% (221) of the pts who did not use the cdc were living in the city center. In both groups, most of the pts were housewives (87.8%; 98.6%). 44.5% (97) of the pts who

used the cdc were illiterate and 35.3% (107) of the pts who did not use it were primary school graduate. Complete blood count of all pts included in the study are presented in Table 3. Hemoglobin was higher in pts who used the cdc. MPV was higher in pts who did not use the cdc.

Pulmonary function tests of all pts included in the study are presented in Table 4. FEV1, FVC and FEF 25% were significantly higher in pts who did not the use cdc.

Table 3. Complete blood count parameters of all pts included in the study

	All patients	The use of cow dung cake		P
		Exist	Absent	
		Mean±sd		
Hemoglobin	13.94±1.38	14.13±1.28	13.81±1.44	0.025
Hematocrit	41.8±4.3	42.1±4.2	41.6±4.4	NS
WBC (x10 ³)	7.69±2.08	7.6±2.13	7.76±2.03	NS
MPV	8.74±0.96	8.54±0.9	8.89±0.98	<0.001
RDW	15.3±2.5	15.2±2.1	15.5±2.7	NS
PCT	0.63±8.11	1.13±12.3	0.24±0.06	NS
Platelet (x10 ³)	280±68.4	283.5±68.5	277.5±68.3	NS
Lymphocyte count	2.27±1.13	2.31±1.5	2.23±0.73	NS
Lymphocyte (%)	29.4±8.1	29.9±7.9	29.1±8.3	NS
Platelet/Lymphocyte ratio	140.1±74.2	140.3±60.2	140±83.9	NS
Neutrophil count	4.87±2.93	4.94±4.01	4.8±1.79	NS
Neutrophil (%)	60.3±26.7	58.2±12.3	61.8±33.5	NS
Neutrophil/Lymphocyte ratio	2.46±2.13	2.38±1.93	2.51±2.27	NS
Eosinophil count	0.19±0.14	0.18±0.11	0.2±0.16	NS
Eosinophil (%)	2.5±1.8	2.5±1.6	2.6±1.9	NS

Continuous variables are expressed as mean ± standard deviation; WBC, white blood cell; MPV, mean platelet volume; RDW, red cell distribution width; PCT, plateletcrit; NS, non-significant

Clinical features of pts according to exposure to tandoor smoke are presented in Table 5. The women exposed to tandoor smoke previously were significantly older ($p < 0.001$) and these pts had higher BMIs compared to other groups (currently using; never used). The incidence of hypertension (HT) and DM were significantly different between three groups (currently using; previously used; never used). Hypothyroidism was higher in pts in previously used group ($p = 0.0016$).

Living places, occupations and educational status of pts according to exposure to tandoor smoke are presented in Table 6. The differences between the groups in terms of

Table 4. Pulmonary function tests of all pts included in the study

	All patients	The use of cow dung cake		P
		Exist	Absent	
		Mean±sd		
FEV1	72.9±16.3	70.2±17.1	74.9±15.4	0.003
FVC	68.3±15	65.3±16.1	70.5±13.8	<0.001
PEF	53.4±17.8	51.5±17.7	54.9±17.8	NS
FEF 25-75%	72.9±23	71.4±22.7	74.1±23.1	NS
FEF 25%	56.3±19.4	53.9±19	58±19.5	0.047
FEF 50%	63.9±21.3	61.7±20.8	65.6±21.6	NS
FEF 75%	88±54.9	86.4±27.7	89.3±68.1	NS

Continuous variables are expressed as mean ± standard deviation; FEV1, forced expiratory volume in second one; FVC, forced vital capacity; PEF, peak expiratory flow; FEF, forced expiratory flow; NS, non-significant

living places, occupations and educational status were significant ($p < 0.001$). The women in going on tandoor smoke exposure group were living in villages significantly ($p < 0.001$). The women in never tandoor smoke exposure group were living in city center significantly ($p < 0.001$). In all three groups, most of the women were housewives (currently using, 98.2%; previously used 100%; never used, 75.9%). Most of the women exposed to tandoor smoke were illiterate (currently using, 44.8%; previously used, 42.9%). Most of the women in never tandoor smoke exposure group were primary school graduate (37.8%).

Complete blood count parameters of pts according to exposure to tandoor smoke are presented in Table 7. Hemoglobin levels of the pts who exposed to tandoor smoke currently or previously were higher. The women in going on and previously tandoor smoke exposure groups had significantly higher hemoglobin levels compared to women in never tandoor smoke exposure group ($p = 0.042$; $p = 0.0169$). The women in going on tandoor smoke exposure group had significantly lower MPV levels compared to women in never tandoor smoke exposure group ($p < 0.001$).

Pulmonary function tests of pts according to exposure to tandoor smoke are presented in Table 8. The women in going on tandoor smoke exposure group had significantly lower FEV1, FVC, PEF and FEF 25% levels compared to women in never exposure to tandoor smoke ($p < 0.005$).

Table 5. Clinical features of pts based on exposure to tandoor smoke (currently using, previously used and never used)

	Tandoor smoke exposure			P		
	Currently using	Previously used	Never used	Currently using/ Previously used	Currently using/ Never used	Previously used/ Never used
	Mean±sd / n (%)					
Age	47±10.5	51.9±8.6	40.7±12.4	<0.001	<0.001	<0.001
Length	1.6±0.1	1.6±0	1.6±0	NS	0.007	<0.001
Weight (kg)	78.4±13.2	81±14.6	74.9±14.2	NS	0.010	0.001
BMI (kg/m ²)	30.1±5	31.6±5.9	28.3±5.5	0.044	0.001	<0.001
Comorbidity	50 (30.3%)	56 (52.8%)	65 (26.1%)	<0.001	NS	<0.001
HT	44 (26.7%)	43 (40.6%)	40 (16.1%)	0.017	0.009	<0.001
DM	2 (1.2%)	14 (13.2%)	18 (7.2%)	<0.001	0.005	<0.001
CAD	5 (3%)	1 (0.9%)	4 (1.6%)	NS	NS	NS
Depression	4 (2.4%)	1 (0.9%)	7 (2.8%)	NS	NS	NS
Hypothyroidism	2 (1.2%)	7 (6.6%)	8 (3.2%)	0.016	NS	NS
Hyperlipidemia	1 (0.6%)	-	1 (0.4%)	NS	NS	NS
Rheumatoid Arthritis	-	1 (0.9%)	1 (0.4%)	NS	NS	NS

Continuous variables are expressed as mean ± standard deviation; BMI, body mass index; HT, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; NS, non-significant

Table 6. The place where pts live, occupation and educational status of pts based on exposure to tandoor smoke (currently using, previously used and never used)

	Tandoor smoke exposure			P		
	Currently using	Previously used	Never used	Currently using/ Previously used	Currently using/ Never used	Previously used/ Never used
	n (%)					
The place where pts live						
Village	138 (83.6%)	59 (55.7%)	32 (12.9%)			
County	7 (4.2%)	13 (12.3%)	25 (10%)	<0.001	<0.001	<0.001
City center	20 (12.1%)	34 (32.1%)	192 (77.1%)			
Occupation						
Housewife	162 (98.2%)	106 (100%)	189 (75.9%)			
Civil servant	-	-	36 (14.5%)	NS	<0.001	<0.001
Student	-	-	19 (7.6%)			
Employee	3 (1.8%)	-	5 (2%)			
Educational status						
Illiterate	74 (44.8%)	45 (42.9%)	20 (8%)			
Literate	31 (18.8%)	25 (23.8%)	28 (11.2%)			
Primary school	49 (29.7%)	31 (29.5%)	94 (37.8%)	NS	<0.001	<0.001
Secondary school	10 (6.1%)	3 (2.9%)	26 (10.4%)			
High school	1 (0.6%)	1 (1%)	41 (16.5%)			
University	-	-	40 (16.1%)			

NS, non-significant

Table 7. The place where pts live, occupation and educational status of pts based on exposure to tandoor smoke (currently using, previously used and never used)

	Tandoor smoke exposure			P		
	Currently using	Previously used	Never used	Currently using/ Previously used	Currently using/ Never used	Previously used/ Never used
	Mean±sd					
Hemoglobin	14.07±1.3	14.12±1.34	13.76±1.44	NS	0.042	0.016
Hematocrit	41.9±4.3	42.5±3.8	41.4±4.6	NS	NS	0.022
WBC (x10³)	7.64±2.11	7.5±1.97	7.83±2.1	NS	NS	NS
MPV	8.54±0.9	8.82±1.09	8.85±0.92	NS	0.001	NS
RDW	15±1.7	15.7±3	15.4±2.6	NS	NS	NS
PCT	1.42±14.11	0.24±0.05	0.24±0.06	NS	NS	NS
Platelet (x10³)	284.2±65.9	284.4±73.8	275.1±67.4	NS	NS	NS
Lymphocyte count	2.3±1.67	2.26±0.78	2.24±0.7	NS	NS	NS
Lymphocyte (%)	29.3±7.8	30.8±8.8	28.8±8.1	NS	NS	NS
Platelet/Lymphocyte ratio	144±64.2	145.5±113.8	134.9±55.7	NS	NS	NS
Neutrophil count	5.1±4.47	4.53±1.67	4.86±1.85	NS	NS	NS
Neutrophil (%)	59.3±11.5	57.9±12.5	62.2±37.1	NS	NS	NS
Neutrophil/Lymphocyte ratio	2.5±2.14	2.49±3.27	2.42±1.34	NS	NS	NS
Eosinophil count	0.17±0.1	0.21±0.16	0.19±0.15	NS	NS	NS
Eosinophil (%)	2.4±1.6	2.8±2	2.4±1.8	NS	NS	NS

Continuous variables are expressed as mean ± standard deviation; WBC, white blood cell; MPV, mean platelet volume; RDW, red cell distribution width; PCT, plateletcrit; NS, non-significant.

Table 8. Pulmonary function tests of pts based on exposure to tandoor smoke (currently using, previously used and never used)

	Tandoor smoke exposure			Currently using/ Previously used	P	
	Currently using	Previously used	Never used		Currently using/ Never used	Previously used/ Never used
	Mean±sd					
FEV1	69.8±17.1	72±17	75.4±15	NS	0.002	NS
FVC	64.6±16	67.3±15.1	71.1±13.6	NS	<0.001	0.009
PEF	50.7±17.7	52.6±16.8	55.5±17.9	NS	0.012	NS
FEF 25-75%	70.9±22.4	72.6±24.6	74.3±22.4	NS	NS	NS
FEF 25%	53.4±19.2	54.6±17.8	59±19.7	NS	0.013	NS
FEF 50%	61.3±20.5	62.6±21.7	66.2±21.4	NS	NS	NS
FEF 75%	86.3±27.9	86.5±29.3	89.7±73.8	NS	NS	NS

Continuous variables are expressed as mean ± standard deviation; FEV1, forced expiratory volume in second one; FVC, forced vital capacity; PEF, peak expiratory flow; FEF, forced expiratory flow; NS, non-significant

DISCUSSION

In the study, all of the pts were female with asthma, and some of these pts were using cdc, a biomass variant in their daily lives. More than half of our pts had been exposed to tandoor smoke at any time in their lives. Environmental biomass smoke exposures for heating and cooking have been associated with different chronic lung diseases such as COPD, asthma, bronchitis and interstitial lung disease by chronic inflammation (10). In Asian and African countries, biomass exposure is high and exposure to biomass substances is one of the risk factors for asthma and COPD (10). Kars is one of the cities of Turkey where biomass substances such as dried animal dung cakes are widely used for heating, cooking and baking bread. The traditional tandoor for baking bread is used by women in indoor places where intense exposure to biomass smoke occurs. In our study, the use of tandoor for baking in pts with asthma is not low. Therefore, we think that the tandoor for baking bread is a serious risk factor for asthma in women living in rural areas.

In the study, age and BMI were higher in pts who used the cdc and who used tandoor previously. The oldest and the highest overweight women were in pts who used tandoor previously and this group had the most common incidence of comorbidity such as HT and DM compared to other groups (currently using and never used groups). High BMI and poverty are paradox terms for countries with lower socioeconomic status such as Middle-East, Asia and Africa (11, 12). Low fat protein sources such as pulses and poultry, edible oil consumption, easily available and low costs of highly processed foods including empty calories are reason of obesity in countries with lower socioeconomic status (11, 12). In developing countries, older women born and live in rural areas and physical activity rates are lower for them (13, 14). Women living in these areas have a higher biomass exposure and accessing to health care services for these women is difficult (13). HT and DM have similar pathophysiologic

mechanisms such as oxidative stress related to reactive oxygen species, increased sympathetic nervous activation, impaired immunity response, impaired insulin-related vasodilation, improper activation of the renin angiotensin aldosterone system and chronic low-grade inflammation (15). Obesity and raised visceral adiposity are risk factors for coexistence of HT and DM (15). Chronic inflammation is a typical finding of aging and aging is an important risk factor for HT, DM and cardiovascular diseases (15, 16). The women who used tandoor were living in villages and they were also overweight. So, they had higher comorbidities. These findings were expected for them.

Most of the women who used the cdc were living in the village and also most of the women who used tandoor currently or previously were living in villages. The number of pts living in county and city center were higher in pts who used tandoor previously compared to currently using group. Worldwide, about 50% of the population and 90% of the rural population living in developing countries use biomass substances as a unique source of fuel (17). In low outcome countries, people living in rural areas are commonly poor and biomass substances are cheap or free of cost and easily available for these people (18). Biomass substances such as dried animal dung are the easiest and cheapest sources of energy for people living in rural areas, as in our pts.

Most of all pts and all the pts who used tandoor were housewives. The rate of illiterates was higher among pts who used the cdc and pts who used tandoor. The rate of primary school graduate was higher among pts who did not use cdc and pts who never used tandoor. None of the pts who used tandoor were university degree graduate. The term of gender means that femaleness and maleness are learnt models which are established by culture (19). After acceptance of Islamism, especially Turkish-Islamic states, the education of women with the reference of religion began to get behind (20). Throughout this process, women often began to tend towards housework (20).

In Turkey, 6 years and older illiteracy rate in women 6% and 1.7% in men and eight out of ten illiterate people are women (19). The main reasons for illiteracy rate for women include early marriage, negative traditional prejudices, the idea that sending girls to school is redundant and the idea of seeing girls like helper of mother serving the family (19). The women who live in Turkey, rate of illiteracy increases from younger to older, from western to eastern and from urban to rural areas (19). In Kars city we planned the study, the east of Turkey, where there is a low literacy rate among women.

The hemoglobin level was higher among pts who used the cdc and pts who used tandoor. MPV levels were higher in pts who did not use the cdc and pts who never used tandoor. Carbon monoxide (CO) is one of the gases produced when using biomass substances (3, 4). CO shows 210 times greater affinity for hemoglobin compared to oxygen and small changes of CO concentration in room air increases blood level of carboxyhemoglobin (COHb) (21, 22). After CO binds to hemoglobin, the oxygen-hemoglobin dissociation curve shifts to left and oxygen release reduces (21). In smokers, increased red cell mass, increased erythropoietin and increased hemoglobin levels are associated with increased COHb concentration (23, 24). Thus, increased COHb and hemoglobin concentration is an expected finding for women who exposed to indoor biomass smoke exposure (22). Behera et al., found that COHb levels were two or five times higher in women exposed to biomass smoke for cooking than healthy subjects (25). In their study, COHb concentrations of these pts were like chronic smokers (25). In Kars, where the study carried out, the altitude in the city center reaches about 1750 m and in the villages, it reaches to 2000 m (26). Moreover, living in high altitude as well as biomass smoke may cause hypobaric hypoxia and increased COHb levels (22). Increased MPV means enlarged agreeable platelets, which are more active than normal platelets metabolically and increased MPV indicates platelet size affected by systemic inflammation (27, 28). MPV is an important predictor of the efficacy of anti-inflammatory treatment and inflammation in chronic inflammatory diseases (27). It has been shown that increased MPV is associated with HT and DM (29, 30). In this study, we were expecting an increased MPV level in the women who exposed to tandoor smoke and who used the cdc due to excess of inflammatory processes such as long-term biomass exposure, older age, obesity, HT and DM. But on the contrary, there are also studies showing that COHb does not affect MPV or alter the MPV daily (31, 32). These studies show that MPV is not correlated with hemoglobin (31, 32). We could not measure the inflammation quantitatively. In the other group of our study, although the inflammatory risk factors are less, the total inflammatory load may be higher and therefore MPV may be higher in that group.

FEV1, FVC and FEF 25% were significantly higher in pts who did not the use cdc and FEV1, FVC, PEF and FEF 25% levels were higher in pts who never exposed to tandoor smoke. Asthma is one of the chronic inflammatory small

airway diseases and FEF 25-75% of the FVC is commonly used spirometric parameter to measure small airway lung pathology (33). FEV1 and FVC have also been shown to decrease in small airway diseases such as asthma (34, 35). Exposure to biomass combustion substances may reduce pulmonary function tests by chronic irritation (36). The pts we included in the study were diagnosed with asthma. However, not all spirometric parameters changed to the same extent. Pts' ability to perform spirometry with sufficient accuracy may affect the results.

Limitations of the study

The most important limitations of the study are inability to quantify tandoor smoke exposure and inflammation degree quantitatively in pts. Despite the large number of pts, there were difficulties in accessing information about pts.

CONCLUSION

This study is important because it gives information about the prevalence of a biomass type called tandoor smoke in asthmatic pts. In addition, basic demographic information such as the place where pts live, occupation, educational status about women living in the east of Turkey are presented. In conclusion, women with asthma who use tandoor are older and overweight and these women are housewives, they live in rural areas and they have high rate of comorbidities such as HT and DM. The pulmonary functions and hemoglobin of these women may be affected by exposure to tandoor smoke.

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