Research Article

Secondhand Water-Pipe Smoking and its Association with Systemic Inflammation among Cafés Employees in Karachi, Pakistan

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Objective: The study was designed to determine the correlation of exposure to secondhand smoking (SHS) of Water pipe (WP) with Neutrophils to Lymphocytes ratio and Platelets to Lymphocytes ratio.

Material & Methods: A cross sectional survey was conducted among employees at cafes and restaurants of Karachi, where WPs were offered to customers. A total of 200 participants were selected through convenience sampling, out of which 181 consented to participate. Participants were divided into exposed (to SHS) and unexposed groups. Data were collected by using structured questionnaire, and blood samples were drawn to measure systemic inflammatory markers (Neutrophil to Lymphocyte ratio NLR, Platelet to Lymphocyte ratio PLR). Data was analyzed by using SPSS software.

Results: Among the included 181 participants, 48.1% (n = 87) were unexposed to SHS, 31.5% (n = 57) were exposed to SHS of WP and 20.4% (n = 37) were exposed to SHS of cigarette & WP. Mean NLR (P = 0.779) and mean PLR (P = 0.205) did not vary significantly according to exposure to SHS among participants. After adjusting for socio-demographic covariates, associated of NLR and PLR with exposure to SHS was also not found to have a statistical significance.

Conclusion: The study found no correlation between exposure to SHS of WP and systemic inflammation using different markers. However, the cross-sectional nature of data and uncontrolled confounding and relatively lower level of exposure in the study sites may potentially explain the overall findings of the study.

Keywords: Secondhand smoking, Waterpipe smoking, Cigarette, Systemic inflammation, Neutrophil to Lymphocyte ratio, Platelet to Lymphocyte ratio.

INTRODUCTION

Water-pipe (WP) smoking is one distinct genre of tobacco use with different names according to modifications including hookah, narghile, shisha, maassel, and hubble-bubble. It originated from the countries of southwest Asia and North Africa [1]. The term WP is used to refer to all kinds of instruments that involve passage of tobacco smoke through water before inhalation [1]. In modern WP, moistened tobacco is added with sweetener and flavorings of fruits and candy, producing an aromatic smoke that may particularly appeal to the users [2].

The prevalence of WP use is on the rise globally. According to a study, the highest prevalence of current WP smoking was among school going adolescents across different ethnic origins in the United States: especially among students having origins from Arab (12%-15%), the Arabic Gulf region (9%-16%), Estonia (21%), and Lebanon (25%) [3, 4]. In comparison, the prevalence of current WP smoking among adults is 6% in Pakistan, 4%-12% in Arabic Gulf region, 11% among Arab speaking adults in Australia, 9%-12% in Syria and 15% in Lebanon [5].

Smoke emitted from WP contains harmful substances and poses a threat to its voluntary as well as involuntarily users through Secondhand smoke (SHS) [3]. The likely association of SHS with diseases has been substantiated by a number of scientific studies, reports and reviews [6]. The studies have been carried out from molecular level to whole population and helped to point out relevant findings about the toxicology of active and SHS smoke [6]. The report from National toxicology program revealed that 250 compounds are present in SHS which are carcinogenic [7, 8]. Also, evidence suggests that the non-smokers when exposed to WP smoke can inhale about 71-81% of nicotine [9].

Policies to control SHS of tobacco products are being formulated but most of them are cigarette oriented and WP related policies remain neglected. However, in reality, a single WP smoke inhalation is equal to inhaling smoke from 200 cigarettes [10, 11]. Therefore, the present study was conducted to find out the SHS exposure of WP among café employees and its correlation with inflammatory indicators, neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR). The findings may help to design strategies to prevent SHS exposure of WP among café employees by highlighting the potential harm caused by this occupational hazard.

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MATERIAL & METHODS

A total of 200 participants were selected through convenience sampling. Employees who were users of any form of tobacco since one year i.e. cigarette, cigar, pipe, WP, *beedi*, vaporizer, *paan, mawa, gutka, paan masala* and *naswar*, had history of any non-communicable disease, were taking medications for any chronic condition or antibiotics for last 30 days or had fever in last one month were excluded.

Data was collected from individuals who were exposed to SHS of WP (cafés where WP was available) and individuals who were not exposed to SHS (cafés where WP was not available).A structured questionnaire was used for data collection and information related to exposure to SHS, frequency, duration and level of awareness was collected [12]. A complete medical history was also taken from the participants including their general condition, physical activity and current drug intake and blood samples were collected to be tested for complete blood count (CBC) to measure systemic inflammatory markers (NLR, PLR). A prior approval of Ethics Committee was obtained before conducting the study (Ref: IRB-564/DUHS/-15/51). Data was analyzed using SPSS 21, chi-square test, one way ANOVA and Multivariate regression analysis were run.

RESULTS

A total of 200 individuals were invited to participate in the study, out of which 181 participants consented to be a part of the study. (Response rate = 90.5%). Among the included participants, 94 (51.9%) were exposed to SHS and 87 (48.1%) were not exposed to SHS. The 94 exposed individuals were further divided into two groups; one group consisted of 57 (31.5%) participants who were exposed to SHS of WP only and 37 (20.4%) participants who were exposed to SHS of cigarette and WP both.

Socio-Demographic Characteristics of the Respondents

One hundred and seven (59.1%) participants were less than 25 years old and 74 (40.8%) were 25 years old or above. Among all participants, 95 (52.5%) were single and 86 (47.5%) were married. Overall, 16 (8.8%) participants were uneducated, 119 (65.7%) were educated up to secondary level and 46 (25.4%) were in higher education group. Total 76 (42%) participants had a monthly earning of equal to or less than PKR 16000 and 105 (58%) had a monthly earning of more than PKR 16000. One hundred and thirty-six (75.1%) participants were working less than 8 hours per day and 45 (24.8%) were working for more than 8 hours per day. Among all participants, 32 (17.6%) were physically active and 149 (82.3%) were physically inactive.

Socio-Demographic Characteristics in Correlation with Exposed and Unexposed Groups

The study findings indicated that correlation of age with exposure to SHS was statistically significant (P = 0.006). Participants who were less than 25 years old were less likely to be unexposed to SHS (38.3%), compared to those who were greater than 25 years old (62.2%). Monthly income and duration of working shift also showed statistically significant correlation with the exposure to SHS (P = < 0.001). It was recorded that participants who were earning PKR 16000 or less per month were very less likely to be unexposed to SHS (9.2%), in contrast to those who were earning more than PKR 16000 monthly (76.2%). Whereas participants whose working hours were 8 hours or less per day were more likely to be unexposed to SHS of cigarette and WP (59.6%), but those who were working for more than 8 hours per day were less likely to be unexposed to SHS (13.3%). Other demographic variables like marital status, education level and physical exercise were not statistically significantly associated with the exposure to SHS (P = > 0.05) (Table **1**).

Table 1. Baseline Characteristics of Participants Based on Exposure to SHS (n = 181).

Characteristics	Total	Unexposed to SHS (n = 87)	Exposed to SHS of WP (n = 57)	Exposed to SHS of Cigarette & WP (n = 37)	P-value
	n (%)	n (%)	n (%)	n (%)	
Age (years)					
≤ 25	107 (59.1)	41 (38.3)	41 (38.3)	25 (23.4)	0.006
> 25	74 (40.8)	46 (62.2)	16 (21.6)	12 (16.2)	
Marital Status					
Single	95 (52.4)	38 (40.0)	36 (37.9)	21 (22.1)	0.061
Married	86 (47.5)	49 (57.0)	21 (24.4)	16 (18.6)	
Education					
No Education	16 (8.8)	05 (31.2)	08 (50.0)	03 (18.8)	0.400
Up to Secondary	119 (65.7)	62 (52.1)	33 (27.7)	24 (20.2)	
Higher	46 (25.4)	20 (43.5)	16 (34.8)	10 (21.7)	

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Characteristics	Total	Unexposed to SHS (n = 87)	Exposed to SHS of WP (n = 57)	Exposed to SHS of Cigarette & WP (n = 37)	P-value
	n (%)	n (%)	n (%)	n (%)	
Monthly Income					
≤ 16000	76 (41.9)	07 (9.2)	43 (56.6)	26 (34.2)	< 0.001
> 16000	105 (58)	80 (76.2)	14 (13.3)	11 (10.5)	
Duration of Working Shift					
≤8 Hours	136 (75.1)	81 (59.6)	35 (25.7)	20 (14.7)	< 0.001
>8 Hours	45 (24.8)	06 (13.3)	22 (48.9)	17 (37.8)	
Physical Exercise					
No	149 (82.3)	71 (47.7)	47 (31.5)	31 (20.8)	0.958
Yes	32 (17.6)	16 (50.0)	10 (31.2)	06 (18.8)	

*p-value has been calculated using Chi square test.

Mean NLR and PLR according to Exposure to SHS

The average NLR was 1.74 for participants who were unexposed to SHS, 1.72 for those who were exposed to SHS of WP and 1.64 for those who were exposed to SHS of cigarette and WP both. The Mean PLR was 95.11 for unexposed participants, 101.16 for those who were exposed to SHS of WP, and 88.49 for those who were exposed to SHS of cigarette and WP both. There was no statistically significant mean differences in NLR and PLR among the three groups (P = > 0.05).

Hematological Profile according to Exposure to SHS

Hematological profile of participants from both exposed and unexposed groups showed a statistically significant mean difference of eosinophil (P = 0.043), platelet count (P = 0.021), red cell count (P = 0.004) and hematocrit (P = 0.020) among both the groups, as these were higher in participants exposed to SHS. However, other blood components of CBC showed no statistically significant mean differences among three groups (P = > 0.05) (Table **2**).

Table 2. Hematological Profile of the Study Participants (n = 181).

Characteristics	Unexposed to SHS	Exposed to SHS of WP	Exposed to SHS of Cigarette & WP	P-value
	(n = 87)	(n = 57)	(n = 37)	
	Mean ± SD	Mean ± SD	Mean ± SD	
Total Leukocyte Count (10^9/L)	7.98 ± 1.79	8.11 ± 2.18	7.72 ± 2.12	0.659
Neutrophil (10^9/L)	4.66 ± 1.42	4.69 ± 1.66	4.42 ± 1.76	0.664
Lymphocytes (10^9/L)	2.88 ± 0.85	2.89 ± 0.84	2.84 ± 0.71	0.945
Monocytes (10^9/L)	0.20 ± 0.19	0.19 ± 0.13	0.19 ± 0.11	0.893
Eosinophils (10^9/L)	0.21 ± 0.11	0.29 ± 0.25	0.28 ± 0.24	0.043
Platelet Count (10^9/L)	256.61 ± 56.84	271.58 ± 69.37	236.73 ± 43.42	0.021
Hemoglobin (gm/dl)	14.42 ± 1.08	14.34 ± 1.91	14.66 ± 1.29	0.556
Red Cell Count (10^{12}/L)	4.70 ± 0.46	4.82 ± 0.63	5.06 ± 0.60	0.004
HEMATOCRIT (%)	42.45 ± 3.24	42.39 ± 6.74	45.08 ± 5.69	0.020
M.C.V (fl)	85.98 ± 5.72	88.09 ± 9.77	88.57 ± 7.19	0.118
M.C.H (fl)	28.77 ± 2.44	29.26 ± 3.56	28.68 ± 2.93	0.534
M.C.H.C (pg)	33.17 ± 1.24	33.23 ± 2.05	32.73 ± 1.52	0.282

*p-value has been calculated using one-way ANOVA.

Correlation of Exposure to SHS with NLR (Tertiles) and PLR (Tertiles)

The NLR was also categorized into three tertiles, low (≤ 1.31) with 33.7% (n = 61) participants, middle (1.32-2.13) with 34.3% (n = 62) participants and high (≥ 2.14) with 32.0% (n = 58) participants. Number of participants who were unexposed to SHS was higher in high tertile of NLR (42.5%, n = 37), whereas the number of participants who were exposed to SHS of WP was higher in middle tertile (45.6%, n = 26) as compared to low and high tertile of NLR, and the participants who were exposed to SHS of cigarette & WP were mostly in low tertile of NLR (43.2%, n = 16). It was observed that correlation of exposure to SHS with NLR tertiles was statistically significant (P = 0.02). However, no statistical significance was found among the observed socio-demographic variables and NLR tertiles (P = > 0.05).

PLR was also categorized into low (≤ 78.38), middle (78.36-102.49) and high (≥ 102.50) groups, with participants 33.1% (n = 60), 33.7% (n = 61) and 33.1% (n = 60) respectively. Unexposed participants were equally present in three categories whereas the participants who were exposed to SHS of WP were mostly present in higher tertile (38.6%, n = 22) and participants who were exposed to SHS of both cigarette & WP mostly belonged to the middle tertile (40.5%, n = 15). However, there was no statistical significance found between PLR tertiles and these correlations (P = > 0.05) (Table **3**).

Table 3. Association between NLR (Tertile) and Exposure to SHS with other Demographic Variables (n = 181).

Characteristics	**Total**	**Low (≤ 1.31) n = 61**	**Middle (1.32 -2.13) n = 62**	**High (≥ 2.14) n = 58**	**P-value**
		n(%)	**n(%)**	**n(%)**	
Neutrophil Lymphocyts Ratio (Tertiles)					
Exposure to SHS					
Waterpipe	57	17 (29.8)	26 (45.6)	14 (24.6)	0.02
Unexposed	87	28 (32.2)	22 (25.3)	37 (42.5)	
Cigarette &WP	37	16 (43.2)	14 (37.8)	07 (18.9)	
Platelet Lymphocyte Ratio (Tertiles)					
	Total	**Low (≤ 1.31) n = 60**	**Middle (1.32 -2.13) n = 61**	**High (≥ 2.14) n = 60**	**P-value**
		n(%)	**n(%)**	**n(%)**	
Exposure to SHS					
Unexposed	87	29 (33.3)	29 (33.3)	29 (33.3)	0.692
Waterpipe	57	18 (31.6)	17 (29.8)	22 (38.6)	
Cigarette &WP	37	13 (35.1)	15 (40.5)	09 (24.3)	

*p-value has been calculated using Chi square test.

Association between Exposure to SHS and NLR (Tertiles) – Multinomial Logistic Regression

Univariate and multivariate analysis was carried out for middle and high NLR tertile using low tertile as reference group. Participants who were exposed to SHS of WP (Univariate analysis OR = 1.95, 95% CI [0.85 - 4.46], P = 0.115) (Multivariate analysis OR = 1.76, CI 95% [0.76 - 4.09], P = 0.190) and those who were exposed to SHS of cigarette and WP both (Univariate analysis OR = 1.11, 95%CI [0.45 - 2.76], P = 0.816) (Multivariate analysis OR = 1.03,95% CI [0.41 - 2.59], P =0.951) were present in higher proportion in middle tertile of NLR, compared to unexposed participants, however there was no statistical significance in this finding. A statistically significant negative correlation was found between exposure to SHS of cigarette and WP both and the higher tertile of NLR, in reference to unexposed participants (Univariate analysis OR = 0.33,95% CI [0.12 - 0.91], P = 0.033) (Multivariate analysis OR = 0.29,95% CI [0.10 - 0.82], P=0.019) (Table **4**).

Table 4. Odds Ratio of High NLR (Tertiles) with Exposure to SHS (Multinominal Logistic Regression).

Neutrophil Lymphocytes Ratio (compared to NLR ≤ 1.31)								
Characteristics	**Univariate analysis**				**Multivariate analysis**			
	OR[a] (95% CI)	**p-value**	**OR[a] (95% CI)**	**p-value**	**OR[b] (95% CI)**	**p-value**	**OR[b] (95% CI)**	**p-value**
	Middle (1.32 - 2.13)		**High (≥ 2.14)**		**Middle (1.32 - 2.13)**		**High (≥ 2.14)**	
Exposure to Secondhand Smoke								
Unexposed	Ref		Ref		Ref		Ref	
Waterpipe	1.95 (0.85 - 4.46)	0.115	0.62 (0.26 - 1.47)	0.282	1.76 (0.76 - 4.09)	0.190	0.53 (0.22 - 1.28)	0.158
Cigarette &WP	1.11 (0.45 - 2.76)	0.816	0.33 (0.12 - 0.91)	0.033	1.03 (0.41 - 2.59)	0.951	0.29 (0.10 - 0.82)	0.019
Age (years)								
≤ 25	Ref		Ref					
> 25	0.74 (0.36 - 1.53)	0.418	1.09 (0.53 - 2.26)	0.809	-		-	
Marital Status								
Single	Ref		Ref		Ref		Ref	
Married	0.57 (0.28 - 1.17)	0.126	0.52 (0.25 - 1.09)	0.082	0.62 (0.29 - 1.29)	0.199	0.45 (0.21 - 0.96)	0.039
Education								
No Education	Ref		Ref					
Up to Secondary	0.29 (0.06 - 1.51)	0.141	0.64 (0.10 - 4.00)	0.630	-		-	
Higher	0.40 (0.07 - 2.28)	0.302	0.58 (0.08 - 4.01)	0.579	-		-	
Monthly Income								
≤ 16000	Ref		Ref					
> 16000	1.10 (0.54 - 2.24)	0.793	1.49 (0.71 - 3.12)	0.284	-		-	
Physical Exercise								
No	Ref		Ref					
Yes	1.35 (0.54 - 3.37)	0.516	0.94 (0.35 - 2.50)	0.896	-		-	

OR[a] = Unadjusted odds ratio, OR[b] = Odds ratio adjusted for secondhand smoke exposure and marital status,
CI = Confidence interval.

Association between Exposure to SHS and PLR (Tertiles) – Multinomial Logistic Regression

Univariate and Multivariate analysis indicated that participants exposed to SHS of WP were more likely (Univariate analysis OR = 1.22, 95% CI [0.54 - 2.74], P = 0.626) (Multivariate analysis OR = 1.52, 95% CI [0.65 - 3.54], P = 0.332) to be in the higher tertile of PLR as compared to unexposed participants, while those who were exposed to SHS of cigarette & WP were (Univariate analysis OR = 1.15,95% CI [0.47 - 2.85], P = 0.756) (Multivariate analysis OR = 1.19,95% CI [0.48 - 2.99], P = 0.698) more likely to be in the middle tertile as compared to unexposed participants. However these associations were not statistically significant. In addition, participants who were greater than 25 years old were more likely to have high PLR (Univariate analysis OR = 2.14, 95% CI [1.02 - 4.47], P = 0.044) (Multivariate analysis OR = 2.29, 95% CI [1.06 - 4.93], P = 0.034) relative to those who aged less than 25 years (Table **5**).

Table 5. Odds Ratio of High PLR (Tertiles) with Exposure to SHS (Multinominal Logistic Regression).

Platelet Lymphocyte Ratio (compared to PLR ≤ 78.35)								
Characteristics	**Univariate analysis**				**Multivariate analysis**			
	OR[a] (95% CI)	**p-value**	**OR[a] (95% CI)**	**p-value**	**OR[b] (95% CI)**	**p-value**	**OR[b] (95% CI)**	**p-value**
	Middle (1.32 - 2.13)		**High (≥ 2.14)**		**Middle (1.32 - 2.13)**		**High (≥ 2.14)**	
Exposure to SHS								
Unexposed	Ref		Ref		Ref		Ref	
Waterpipe	0.94 (0.41 - 2.19)	0.894	1.22 (0.54 - 2.74)	0.626	0.99 (0.42 - 2.35)	0.987	1.52 (0.65 - 3.54)	0.332
Cigarette & WP	1.15 (0.47 - 2.85)	0.756	0.69 (0.26 - 1.87)	0.468	1.19 (0.48 - 2.99)	0.698	0.81 (0.29 - 2.25)	0.691
Age (years)								
≤ 25	Ref		Ref		Ref		Ref	
> 25	1.21 (0.57 - 2.56)	0.616	2.14 (1.02 - 4.47)	0.044	1.23 (0.57 - 2.64)	0.604	2.29 (1.06 - 4.93)	0.034
Marital Status								
Single	Ref		Ref					
Married	1.65 (0.80 - 3.38)	0.174	1.00 (0.49 - 2.06)	1.000	-		-	
Education								
No Education	Ref		Ref					
Up to Secondary	1.62 (0.36 - 7.27)	0.525	1.88 (0.42 - 8.35)	0.409	-		-	
Higher	2.11 (0.43 - 10.28)	0.355	1.33 (0.26 - 6.74)	0.728	-		-	
Monthly Income								
≤ 16000	Ref		Ref					
> 16000	0.79 (0.38 - 1.62)	0.512	1.00 (0.48 - 2.08)	1.000	-		-	
Physical Exercise								
No	Ref		Ref					
Yes	1.09 (0.44 - 2.71)	0.851	0.79 (0.30 - 2.06)	0.625	-		-	

OR[a] = Unadjusted odds ratio, OR[b] = Odds ratio adjusted for secondhand smoke exposure and age, CI = Confidence interval.

DISCUSSION

In the present study, no significant association was found between SHS and systemic inflammation. Findings of the study suggest that SHS of WP has no statistically significant effect on the hematological profile of the study participants. Mean NLR for exposed participants was lower than unexposed participants while mean PLR of exposed was slightly higher but not significant. After analyzing the data in a variety of different ways, no significant association between SHS and raised NLR was observed, however PLR as a continuous variable showed significant correlation with SHS of WP exposure.

Previously, a number of studies were done to find out the role of exposure to SHS of cigarette in systemic inflammation [9, 13] but only few studies discussed SHS of WP and its harmful effects. Also, NLR and PLR are not frequently utilized measures of inflammation.

A study conducted on active and passive WP smokers reported a significant increase in white blood cells (WBCs) for active smokers and no increase in those who were exposed to SHS of WP [14], similar to the findings from the present study. Another study conducted on mice, measured change in total leukocyte count (TLC) after acute exposure WP smoke and reported a significant increase in TLC [15]. However, in

the present study the included participants were exposed to SHS of WP for a period of at least six months, which may not have been a sufficient time period to observe manifest changes in systemic inflammation. A study based on self-reported exposure to SHS of cigarette showed increase in WBCs and CRP levels of participants exposed to SHS of cigarette for at least 3 days a week as compared to unexposed healthy individuals [16]. Similarly, participants from the current study who were exposed to SHS of WP, their mean TLC was slightly higher as compared to unexposed participants. Literature suggests that increased TLC might be due to nicotine-induced release of catecholamines, causing a rise in blood lymphocyte counts. Also, inflammation caused by the irritant effect of smoke on respiratory tree might be a contributory factor for the high TLC count [17].

Furthermore, one study conducted on 50 non-smoker young employees working in WP cafés and 48 non-smokers university students exposed to cigarette SHS in cafeteria measured the CO in their exhaled breath. Results indicated more chronic cough and elevated levels of CO in SHS of WP exposed participants as compared to those exposed to SHS of cigarette [18]. Another prospective observational study was conducted in Scotland, in which WBCs and neutrophil count of non-smoker bar workers was measured before and after introduction of smoke free laws. Participants were observed for two months after imposing the law. Findings of the study reported a significant decrease in WBCs and neutrophils indicating decrease in overall systemic inflammation [19]. However, results of the present study are fairly contrasting compared to the above mentioned studies.

In developed countries, policies to control SHS of tobacco products are being formulated but most of them are cigarette oriented and WP related policies remain neglected [20]. However, in developing countries there is a lack of regulation and enforcement of these policies leading to an increase in WP use [20].

Studies discussing SHS face the challenge of precise classification of SHS exposures and consequently the evidence on classification of SHS exposure is critical while studying the effects of SHS. The assessment of exposure includes factors like time and place of the exposure, cumulative exposures, exposure during a particular time, or a recent exposure [21, 22]. It is also challenging to assess the exposures because people go to a number of environments where exposures take place and the problem also arises in distinguishing the exposure in locations such as public places or workplaces [6] . The concentrations of SHS components in a space, depends on the number of smokers and the rate at which they are smoking, the volume into which the smoke is distributed, the rate at which the air in the space exchanges with uncontaminated air and the rate at which the smoke is removed from the air.

Despite the study limitations, there is enough evidence to suggest SHS of WP as a harmful practice which requires designing public health interventions and research work to fill in the gaps in knowledge on the health effects of SHS of WP.

CONCLUSION

In this study, we did not find any association between exposure to SHS of WP and systemic inflammation using different markers, which may be attributed to the different methodological limitations related to its cross-sectional design, weak sampling technique and uncontrolled confounders. Nonetheless, this study indicates the need of large, well-designed, prospective, longitudinal, community-based studies to better assess the long-term health risk among involuntary smokers exposed to SHS of WP. Additionally, future studies should account for the level of awareness regarding the ingredients and emissions of flavored tobacco products, puffing parameters and duration of smoking.

LIST OF ABBREVIATIONS

CO	Carbon Monoxide
CRP	C-reactive Protein
NLR	Neutrophil Lymphocyte Ratio
PLR	Platelet Lymphocyte Ratio
PPM	Parts Per Million
SHS	Secondhand Smoke
TLC	Total Leukocyte Count
TLV	Threshold Limit Value
WBCs	White Blood Cells
WP	Water-Pipe

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AUTHORS' CONTRIBUTION

Rabia Baloch and **Mehak Pervaiz** have contributed equally.

CONFLICT OF INTEREST

The authors declare that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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APPENDIX

HARMFUL EFFECTS OF SECOND HAND SMOKE

Note: Term "Shisha" is used instead of Waterpipe

Form ID #_____

Age: _____ Sex: _____

☐ Male

☐ Female

Marital status:

☐ Married

☐ Unmarried

Number of completed years of formal Education: _____

Occupation: _____

Residence: _____

Working Address: _____

Monthly Income PKR: _____

Blood pressure: _____ mmHg

Pulse: _____ /min

Waist circumference: _____ cms

Weight: _____ kgs

1. Do you work in an environment where shisha is served?
   ☐ Yes
   ☐ No
2. How long have you been working in such environment? _____ months
3. What is the duration of a typical working shift? _____ hours
4. Do you take shisha puffs?
   ☐ Yes
   ☐ No
5. Do you serve clients using Shisha pipes?
   ☐ Yes
   ☐ No
6. What is approximate duration of your exposure to shisha in a day?
   _____ Hours / day
7. Does anyone smoke shisha in your presence at home?
   ☐ Yes
   ☐ No
8. Does anyone smoke shisha in your presence at any other place?
   ☐ Yes
   ☐ No
9. Do you work in an environment where people smoke cigarettes?
   ☐ Yes
   ☐ No

10. Does anyone smoke cigarettes in your presence at home?
    - ☐ Yes
    - ☐ No
11. Does anyone smoke cigarettes in your presence at any other place?
    - ☐ Yes
    - ☐ No
12. What is approximate duration of your exposure to cigarette smoking in a day?
    _____ Hours/ day
13. Do you think smoking shisha is safe for your health?
    - ☐ Yes
    - ☐ No
14. Do you think that smoke released from shisha used by a person in your presence harms your health?
    - ☐ Yes
    - ☐ No
15. Has anyone ever discussed the harmful effects of smoking shisha with you?
    - ☐ Yes
    - ☐ No
16. Do you practice any sort of exercise like walk, jogging, gym, swimming, sports?
    - ☐ Yes
    - ☐ No
17. If yes then how often do you perform such exercise?
    - I. ≥ 5 day/week
    - II. 2-3 days/week
    - III. Once a week
    - IV. Once a month
18. During last 30 days did you suffer from fever or infection?
    - ☐ Yes
    - ☐ No

    Specify_____
19. Do you suffer from any of these diseases?
    - I. Diabetes
    - II. hypertension
    - III. cardiac disease
    - IV. lung disease
    - V. other_____
20. Do you feel any of the following symptoms?
    - I. Increased Heartbeat
    - II. Cough
    - III. Breathlessness
    - IV. Fatigue/Restlessness
21. Have you ever tried or experimented with cigarette smoking?
    - ☐ Yes
    - ☐ No

22. If yes, do you still smoke?
    - ☐ Yes
    - ☐ No
23. During the last 12 months (one year), did you use any form of smoked tobacco products other than cigarettes (e.g. cigars, water pipes cigarillos, little cigars, pipes)?
    - ☐ Yes
    - ☐ No
24. During the last 12 months (one year), did you use any form of smokeless tobacco products (e.g. chewing tobacco, snuff, dip)?
    - ☐ Yes
    - ☐ No
25. Has anyone ever discussed harmful effects of shisha smoke you inhale from other shisha smokers around you?
    - ☐ Yes
    - ☐ No
26. During the past 30 days (one month), have you seen or heard anti-shisha smoking media messages (e.g. television, radio, billboards, posters, newspapers, magazines, movies, drama)?
    - ☐ Yes
    - ☐ No
27. When you go to sports events, fairs, concerts, community events, or social gatherings, how often do you see anti-shisha smoking messages?
    - ☐ Yes
    - ☐ No
28. Are you in favor of banning shisha smoking in public places (such as in restaurants, cafés, bars)?
    - ☐ Yes
    - ☐ No