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Original investigation

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Prevalence and Determinants of Secondhand Smoke Exposure Among Women in Bangladesh, 2011

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Abstract

Background and Objectives: The population of Bangladesh is highly susceptible to secondhand smoke (SHS) exposure due to high smoking rates and low awareness about the harmful effects of SHS. This study aims to determine the prevalence of SHS exposure and highlight the essential determinants in developing successful strategies to prevent adverse health effects in Bangladesh.

Methods: The analysis is based on the Bangladesh Demographic Health Survey 2011, in which 17,749 women in the reproductive age group (12–49 years) were included. The information regarding SHS exposure at home was derived from the question: "How often does anyone smoke inside your house?" The variable was recoded into 3 groups: daily exposure, low exposure (exposed weekly, monthly, or less than monthly), and no SHS exposure. We performed descriptive and bivariable analyses and multinomial logistic regression.

Results: A total of 46.7% of the women reported high exposure to SHS at home. According to the multinomial logistic regression model, relatively lower education and lower wealth index were significantly associated with daily SHS exposure at home. The exposure differed significantly between the divisions of Bangladesh. Having children at home (vs. not) and being Islamic (compared to other religious affiliations) were protective factors.

Conclusions: The study indicates that women from socioeconomically disadvantaged households are more likely to experience daily exposure to SHS at home. Therefore, especially these groups have to be targeted to reduce tobacco consumption. In addition to aspects of legislation, future strategies need to focus educational aspects to improve the population's health status in Bangladesh.

Introduction

Nearly 80% of the world's 1 billion smokers live in low- and middle-income countries, which are characterized by substantial population growth.[1] Globally, more than 5 million deaths are attributable to direct tobacco use annually, while more than 600,000 are the result of exposure to secondhand smoke (SHS).[1] SHS exposure is expressed as the "sum of exposures in the multiple microenvironments where a person spends time".[2(p156)] The indoor SHS concentration depends on the number of tobacco products smoked during a period of time, the volume of the room, the ventilation rate, and other processes that might eliminate pollutants.[3] The exposure mainly consists of the smoke released from the burning end of a smouldering cigarette, pipe, or cigar ("side-stream smoke," 85%) and, to a lesser extent, the

smoke exhaled from the lungs of an active smoker nearby ("mainstream smoke," 15%).[4]

SHS exposure may cause the same complications as active smoking. Accordingly, SHS may cause both acute and chronic diseases,[4,5] which are especially harmful to children, because they are more vulnerable to the adverse health effects.[6–9] Chronic exposure to SHS is suggested to be, on average, 80%–90% as harmful as chronic active smoking.[5,10] Scientific evidence has confirmed a dose–response relationship with no risk-free level of exposure (threshold dose).[11]

SHS is increasingly recognized as a major public health concern in Bangladesh, one of the most densely populated countries in the world. Currently, Bangladesh faces the challenges of both demographic and epidemiological transition, characterized by an aging population and the increasing relevance of chronic diseases caused by several risk factors, including smoking. The age-standardized smoking prevalence rate for the entire population is 23.4% and for men it is 44.4% in Bangladesh. In comparison, globally the prevalence is 18.7% and for men 31.1%.[12] Results of the Global Burden of Disease study 2010 indicate that smoking is a highly relevant risk factor in Bangladesh, leading to the largest number of disability-adjusted life years (DALYs). Smoking is ranked three in the list of the most important risk factors globally.[13] The World Health Organization (WHO) calculated the impact of tobacco-related illnesses in Bangladesh in 2004. According to these results, tobacco-related illnesses accounted for 16% of all deaths among people aged 30 years and above. SHS caused direct and indirect costs of about 5.8 billion Taka (US$75 million) per year.[14]

A total of 55% of Bangladeshi adults reported exposure to SHS at home within the previous month.[15] The results of the Global Adult Tobacco Survey (GATS) indicated comparable rates for women in Bangladesh regarding SHS exposure at home, with much higher rates for women aged 15–49 years with no formal education (60.0%) compared to women who had completed college (26.1%).[16] Smoking is the result of several determinants related to individual characteristics and the physical, social, political, and legal environment. Associations between high SHS exposure at home and low socioeconomic status[15,17,18] and low level of education[19–21] were found. In addition, health behavior and health knowledge are confirmed as relevant factors influencing exposure to SHS.[15] Awareness of the harmful effects of SHS exposure may result in smoking bans at home because family members aim to protect themselves or their relatives. Additionally, concerns about harming others can motivate smokers in their attempts to quit and thereby decrease smoking rates.[22,23] Furthermore, larger household size was confirmed to increase the risk of SHS exposure.[24]

The home is becoming a predominant source of exposure to SHS because it is the location where the majority of women and their children spend most of their time during an average day. Therefore, this study aims to examine the prevalence and the most important determinants of SHS exposure among women of reproductive age in Bangladesh at home. In order to assess multiple domains associated with SHS exposure at home, we used variables relating to regional aspects (urban vs. rural, divisions), socioeconomic factors, and information on the household structure. Furthermore, information about religion and variables on health behavior and health knowledge are included in our analysis because they were not examined in GATS, and models of health behavior are highly relevant for the development of successful strategies to reduce SHS exposure. The results on the prevalence of SHS exposure in different subgroups will be compared to the results of the GATS. Our study allows for further insights into determinants of SHS exposure because several independent variables were included in the analysis that were not considered in GATS.

Methods

Data Source

The analysis is based on the Bangladesh Demographic Health Survey (BDHS) 2011. BDHS used standard questionnaires from the MEASURE DHS+ model questionnaire. The detailed methodology, including the data collection method, validation, and reliability assessment, is explained elsewhere.[25] The BDHS 2011 is based on a two-stage stratified nationally representative sample of households. Interviews were successfully completed in 17,151 households, which represents a response rate of 98%. A total of 18,222 ever-married women aged 12–49 years were identified in these households and 17,842 were interviewed, yielding a response rate of again 98%. In addition to this household survey, in which only women were interviewed, ever-married men aged 15–54 years were selected and interviewed in a subsample of one third of the households.[26] Only the data from the household survey are used in this analysis. The data were weighted to make the estimates nationally representative. Therefore, the effective sample size was 17,749 women of reproductive age (12–49 years).

Variables Selected for Analysis

The dependent variable taken as a proxy for SHS exposure in this analysis was the question: "How often does anyone smoke inside your house?" The values for this variable were "daily," "weekly," "monthly," "less than monthly," and "never." Because most respondents (93.2%) answered either "daily" or "never," the values "weekly," "monthly," and "less than monthly" were categorized as low exposure. The question and values were the same as in GATS,[27] but in this study, three different levels of SHS exposure were considered (daily, low, and no exposure), because adverse health effects are more likely to occur in frequently exposed people.

The selection of independent variables as potential determinants of SHS exposure was literature based. In PubMed, a search of recent literature on tobacco exposure and its determinants was performed, including particularly (systematic) reviews and meta-analyses. Categorical variables were used from the large dataset by recoding or computing most of them. Age was categorized in 10-year age groups. The wealth index was already calculated and provided within the BDHS. It serves as an indicator of household-level wealth and is classified in wealth quintiles (from lowest to highest).[26] We recoded the two lower quintiles as "poor," the two higher quintiles as "rich," and kept the medium quintile as "middle." Education was classified into four groups ("no education," "primary," "secondary," and "higher education"). Information as to whether the women were currently employed ("yes" or "no") was taken directly from the dataset. We used place of residence ("rural" or "urban"), the seven divisions of Bangladesh and recoded the values for religion to "Islam" and "others." We used some variables on the household structure. The number of household members was grouped ("1–3," "4–6," "7–9," or "10+"). The number of children was calculated by adding the number of sons and daughters at home and also grouping these sums afterward ("none," "1," "2," or "3+").

Recodings were also performed for three other variables that were used as proxies for health behavior and health knowledge: Concerns about water safety ("concerns" or "no concerns") were used as a proxy for health behavior in general, decisions on health

care ("respondent," "respondent and other," or "other") as a sign of empowerment, and frequency of watching television ("at least once a week," "less than once a week," or "not at all") for access to health information. All transformations were checked using plausibility controls (e.g., cross tables).

Statistical Analysis

All statistical analyses were performed using the statistical software package IBM SPSS Statistics 21. A weighting factor was used in descriptive, bivariable, and multivariable analysis to take account of the complex sampling. Firstly, frequency runs were explored to present descriptive information about the sample (including percentages and means). Normal distribution was checked using histograms and by testing the goodness of fit (Kolmogorov–Smirnov test) to gain a first insight into the data. The p value of the Kolmogorov–Smirnov test showed highly significant results ($p < .001$) for all selected variables. The equality of distributions was tested (Mann–Whitney U test and Kruskal–Wallis test). The results were significant ($p < .05$) for all selected (independent) variables using SHS exposure as the test variable (results not shown).

In the bivariable analysis, cross tables between the dependent variable and all independent variables were performed to explore the associations between SHS exposure and nominal- or ordinal-scaled independent variables. We used the chi-square test of independence to analyze the associations between two variables with multiple categories. All tests were two sided, and statistical significance was based on an alpha level of .05. Afterward, correlations between all the selected variables and the variance inflation factor (VIF) were calculated in order to test multicollinearity.

Finally, a multinomial logistic regression was conducted to determine the degree of association between SHS exposure and several independent variables. Only the independent variables that were statistically significant ($p < .05$) in the bivariable analysis were employed, which led to the exclusion of "age." We calculated odds ratios (OR) and 95% confidence intervals (CIs) for high SHS exposure. We compared high exposure and low exposure with no exposure. Nagelkerke's R^2 (.107) was calculated to provide an overview of the percentage of the dependent variable that may be accounted for by all the selected independent variables.

Results

Descriptive Analysis

The characteristics of the sample are described in Table 1. The mean age of the women interviewed was 30.7 years. The largest proportion of women belongs to the group classified as rich in the wealth index (41.9%). The educational level was primary education or below for 57.5% of the women in the sample. The majority of women lived in rural areas (71.0%) (Table 1).

The prevalence of daily exposure to SHS at home was 46.7%. The original values of weekly (2.8%), monthly (1.1%), and less than monthly (2.8%) exposure were combined as low exposure (6.8%) in further analyses.

Bivariable Analysis

The results of the bivariable analysis are presented in Table 2. Daily exposure to SHS was found to be highest in the group of women aged 12–19 years (51.9%). Exposure in the other three age groups was about five percentage points lower. Exposure was significantly related to the wealth index and education, indicating that people with poor socioeconomic status were more likely to be exposed daily than rich people, and women with no education were 2.3 times more likely to be exposed daily than those with higher education (24.6%; $p < .001$). Women who were currently employed were less likely to be exposed to SHS than women who were unemployed. The exposure was higher for women living in rural than in urban areas.

Table 1. Sociodemographic and Socioeconomic Characteristics of the Sample, Bangladesh 2011

Characteristics	n[a]	%
Age in years		
12–19	1,970	11.1
20–29	6,908	38.9
30–39	4,900	27.6
40–49	3,971	22.4
Age (mean)	30.7	
Place of residence		
Urban	4,619	26.0
Rural	13,130	74.0
Division		
Barisal	1,002	5.6
Chittagong	3,222	18.2
Dhaka	5,736	32.3
Khulna	2,139	12.0
Rajshahi	2,646	14.9
Rangpur	2,039	11.5
Sylhet	967	5.4
Wealth index		
Poor	6,737	38.0
Middle	3,567	20.1
Rich	7,445	41.9
Educational level		
No education	4,932	27.8
Primary	5,271	29.7
Secondary	6,235	35.1
Higher	1,311	7.4
Currently employed		
No	15,220	85.8
Yes	2,513	14.2

[a]Sample sizes may not add up to 17,749 due to missing values; weighted results.

The variables of health behavior indicated that women who were concerned about their health status (represented by concerns about water safety) showed significantly lower rates of exposure (33.2%) than those women without any concerns (48.4%; $p < .001$). If the women were allowed to make decisions about health care on their own, this led to lower rates of SHS exposure. High frequency of watching television was associated with a lower likelihood of being exposed to SHS compared to those women who did not watch television.

Correlations between the dependent variable "exposure to SHS at home" and the independent variables are significant for all variables except age, although very slight. Overall, the relationships between all variables presented by correlations are mainly low or moderate. Therefore, multicollinearity seems to be no problem in the following study. To confirm this, the VIF was taken into consideration. It showed only small intercorrelations among the independent variables selected for the multinomial logistic regression model (range: 1.02–1.89).

Multivariable Analysis

In Table 3, the results of the multinomial logistic regression model are provided in two sets of coefficients: (a) daily exposure versus no exposure and (b) low exposure versus no exposure. For the

Table 2. Prevalence of Secondhand Smoke (SHS) Exposure by Respondent Characteristics, Bangladesh 2011

	SHS exposure						
	Daily		Low		Never		
Determinants	*n*[a]	%	*n*[a]	%	*n*[a]	%	*p*[b]
Age, years							
12–19	1,020	51.9	135	6.9	812	41.3	<.001
20–29	3,142	45.6	480	7.0	3,269	47.4	
30–39	2,247	45.9	333	6.8	2,314	47.3	
40–49	1,872	47.2	251	6.3	1,844	46.5	
Place of residence							
Urban	1,905	41.3	338	7.3	2,366	51.3	<.001
Rural	6,376	48.6	862	6.6	5,874	44.8	
Division							
Barisal	322	32.2	41	4.1	638	63.7	<.001
Chittagong	1,465	45.6	219	6.8	1,529	47.6	
Dhaka	2,815	49.1	356	6.2	2,562	44.7	
Khulna	900	42.3	197	9.2	1,033	48.5	
Rajshahi	1,267	47.9	159	6.0	1,217	46.0	
Rangpur	985	48.4	174	8.5	878	43.1	
Sylhet	528	54.8	53	5.5	383	39.7	
Religion							
Islam	7,415	46.5	1,070	6.7	7,467	46.8	.041
Others	866	49.0	130	7.3	773	43.7	
Wealth index							
Poor	3,761	55.9	433	6.4	2,539	37.7	<.001
Middle	1,711	48.0	227	6.4	1,626	45.6	
Rich	2,810	37.8	540	7.3	4,076	54.9	
Educational level							
No education	2,805	57.0	284	5.8	1,834	37.3	<.001
Primary	2,674	50.8	358	6.8	2,235	42.4	
Secondary	2,479	39.9	477	7.7	3,264	52.5	
Higher	323	24.6	81	6.2	907	69.2	
Currently employed							
No	7,180	47.2	1,012	6.7	7,006	46.1	.003
Yes	1,095	43.7	186	7.4	1,227	48.9	
Household members							
1–3	1,189	37.8	230	7.3	1,729	54.9	<.001
4–6	4,705	47.0	682	6.8	4,627	46.2	
7–9	1,702	51.8	208	6.3	1,373	41.8	
10+	685	53.7	79	6.2	512	40.1	
Children at home							
None	1,151	46.0	151	6.0	1,200	48.0	<.001
1	2,292	44.7	380	7.4	2,457	47.9	
2	2,471	45.6	368	6.8	2,582	47.6	
3+	2,368	50.7	301	6.4	2,002	42.9	
Concerns about water safety							
No concerns	7,629	48.4	1,043	6.6	7,083	45.0	<.001
Concerns	652	33.2	156	7.9	1,155	58.8	
Decisions on health care							
Respondent	787	36.6	172	8.0	1,191	55.4	<.001
Respondent and other	4,080	49.0	581	7.0	3,663	44.0	
Other	3,107	51.1	373	6.1	2,601	42.8	
Frequency of watching TV							
Not at all	3,580	51.4	391	5.6			<.001
Less than once a week	1,038	47.5	185	8.5			
At least once a week	3,362	42.7	621	7.2			

[a]Sample sizes may not add up to 17,749 due to missing values (high n = 8,281; low n = 1,199; never n = 8,240); weighted results.
[b]p value (two sided) based on Pearson's χ^2 test.

comparison between low exposure and no exposure, only education (all categories), wealth index ("poor" vs. "rich"), frequency of watching TV ("not at all" vs. "at least once a week"), and the region ("Barisal" vs. "Sylhet") revealed significant results. Therefore, and because high SHS exposure is more harmful than low exposure, we concentrate on the comparison between daily exposure and no

Table 3. Multinomial Logistic Regression: Odds Ratios (ORs) and 95% Confidence Intervals (CI) of Daily and Low Secondhand Smoke Exposure, Bangladesh 2011

	Daily exposure		Low exposure	
Variable	OR (95% CI)	*p*	OR (95% CI)	*p*
Place of residence (ref.: rural)				
Urban	1.16 (1.03–1.27)	.001	1.14 (0.96–1.35)	.125
Region (ref.: Sylhet)				
Barisal	0.36 (0.29–0.44)	<.001	0.44 (0.28–0.68)	<.001
Chittagong	0.74 (0.63–0.88)	<.001	1.00 (0.71–1.40)	.994
Dhaka	0.92 (0.79–1.08)	.324	1.00 (0.72–1.39)	.991
Khulna	0.69 (0.58–0.82)	<.001	1.33 (0.94–1.88)	.111
Rajshahi	0.73 (0.62–0.87)	<.001	0.91 (0.64–1.29)	.581
Rangpur	0.72 (0.60–0.86)	<.001	1.33 (0.93–1.89)	.115
Religion (ref.: other)				
Islam	0.82 (0.73–0.92)	.001	0.91 (0.74–1.12)	.369
Wealth index (ref.: rich)				
Poor	2.08 (1.88–2.30)	<.001	1.50 (1.24–1.82)	<.001
Middle	1.44 (1.31–1.59)	<.001	1.10 (0.91–1.34)	.327
Educational level (ref.: higher)				
No education	3.93 (3.34–4.61)	<.001	1.84 (1.37–2.47)	<.001
Primary	2.96 (2.54–3.45)	<.001	1.84 (1.39–2.43)	<.001
Secondary	1.93 (1.67–2.23)	<.001	1.69 (1.30–2.19)	<.001
Currently employed (ref.: yes)				
No	0.87 (0.78–0.96)	.006	0.87 (0.72–1.05)	.154
Household members (ref.: 10+)				
1–3	0.41 (0.35–0.48)	<.001	0.78 (0.57–1.07)	.119
4–6	0.63 (0.55–0.72)	<.001	0.87 (0.66–1.14)	.300
7–9	0.80 (0.69–0.93)	.003	0.91 (0.68–1.22)	.535
Children at home (ref.: 3+)				
None	1.36 (1.20–1.54)	<.001	0.91 (0.71–1.67)	.460
1	1.33 (1.20–1.47)	<.001	1.14 (0.94–1.39)	.180
2	1.05 (0.96–1.15)	.252	0.96 (0.81–1.14)	.648
Concerns about water safety (ref.: concerns)				
No concerns	1.40 (1.24–1.58)	<.001	0.95 (0.77–1.17)	.626
Decisions on health care (ref.: other)				
Respondent	0.63 (0.56–0.70)	<.001	1.03 (0.85–1.26)	.752
Respondent and other	1.05 (0.97–1.13)	.206	1.10 (0.95–1.26)	.192
Frequency of watching TV (ref.: at least once a week)				
Not at all	0.83 (0.76–0.90)	<.001	0.75 (0.63–0.89)	.001
Less than once a week	0.91 (0.81–1.02)	.092	1.13 (0.93–1.38)	.218

Reference category = no exposure (n = 16,536); weighted results.

exposure in the following description of the results of the multivariable analysis.

The results indicate that education and wealth index had the highest impact on SHS exposure at home. The likelihood of reporting daily SHS exposure among women with no education was 3.93 (95% CI = 3.34–4.61; $p < .001$) times that of the women with higher education. The *OR* decreased with higher levels of education. The likelihood of being exposed daily to SHS in the sample of poor women was twice that of women representing the rich population.

The likelihood of daily SHS exposure for women living in urban areas was 1.16 (95% CI = 1.03–1.27; $p = .001$) times that of women living in rural areas. SHS exposure also depends significantly on the division. Using Sylhet, the division with the highest rates of SHS exposure, as reference category, Barisal showed a strong protective effect (*OR* = 0.36; 95% CI = 0.29–0.44; $p < .001$). The *OR* for Chittagong, Khulna, Rajshahi, and Rangur were comparable at around 0.7, while in Dhaka, the *OR* was not significantly different from the reference division (*OR* = 0.92; 95% CI = 0.79–1.08; $p = .324$).

The fewer people who lived in one household, the lower were the odds of being daily exposed to SHS. The *OR* for households with 1–3 people was 0.41 (95% CI = 0.35–0.48; $p < .001$) and this increased consistently with growing household size until an *OR* of 0.80 (95% CI = 0.69–0.93; $p = .003$) was reached for 7–9 people in the household compared to the reference category of more than 10 people. However, there is an exception if children are living in the household: No or fewer children living in the household led to a higher likelihood of being exposed daily to SHS. The regression indicates an *OR* of 0.87 (95% CI = 0.78–0.96; $p = .006$) for women who were currently unemployed compared to employed women.

Women with no concerns about water safety, which was used as a proxy variable for good health behavior, were more likely to be daily exposed to SHS at home. The *OR* for daily SHS exposure was 0.63 (95% CI = 0.56–0.70; $p < .001$) for all women who were able to make decisions regarding health care on their own compared to the reference group of women who were passive in the process of decision making. The results indicate that the likelihood of daily SHS exposure decreases when women watch less television.

The *OR* for women who do not watch television at all was 0.83 (95% CI = 0.76–0.90; $p < .001$) compared to those who watch at least once a week, whereas the *OR* was a bit higher (*OR* = 0.91; 95% CI = 0.81–1.02; $p = .092$) for those who reported watching less than once a week.

Discussion

In this study, the overall prevalence of SHS exposure at home in Bangladesh was 53.5%, comparable to the results from GATS, which indicated a prevalence of 52.0%.[16] The prevalence is lower than in Vietnam (72.3%) and China (65.1%) but higher than in India (39.3%) and Thailand (29.8%).[16] Several factors were significantly associated with SHS exposure. Among them, socioeconomically disadvantaged households in terms of education and wealth index need to be especially highlighted due to their highly significant and strong associations with SHS exposure. These determinants are highly relevant, particularly in a country such as Bangladesh where smoking is barely perceived as a risk factor for health.[20,28] The observed associations between SHS exposure and education are comparable to the results of GATS[27] and to the Asian countries mentioned above.[16]

Since high SHS exposure is associated with low socioeconomic status and low levels of education, greater efforts to educate smokers about the health risks associated with SHS for themselves as well as for their family members are necessary.[17] Women need to be informed about and made aware of the negative consequences of SHS exposure and should be encouraged to make their households more smoke free.[29] The empowerment and education of women, therefore, plays a key role in enabling them to protect themselves, their children, and other family members.[18]

Health information can be disseminated by the use of mass media and suitable campaigns to promote the relevant knowledge, and this already takes place in Bangladesh.[27] Therefore, a higher frequency of watching TV might improve health knowledge and lead to more proactive health behavior in Bangladesh. A study from Bangladesh and other low- and middle-income countries indicated that information on the serious harms of tobacco use provided by television are effective.[30] Nevertheless, watching TV may not only serve as a proxy for access to health information but may also generate concerns because smoking in films was also described as a common reason for smoking initiation.[21] All health information messages have to be tailored to the needs of the recipients in order to increase the likelihood of success. Until now, only textual warnings on cigarette packets have been provided to raise awareness about the health effects of tobacco consumption and SHS exposure. However, graphical warning labels on tobacco products may be more successful in reaching illiterate populations.[19,27] Advertisements and the promotion of tobacco products should be forbidden, and the risks of smoking should be included in the school curriculum.[31]

Although the bivariable analysis showed a higher prevalence of SHS exposure in rural areas, the results of the multinomial logistic regression indicated that the urban population is more exposed to SHS than the rural population. The same is true for the variable regarding watching TV, which indicates a higher SHS exposure in rural areas in the bivariable analysis but a higher *OR* for daily SHS exposure in the multivariable analysis. The reason for these inconsistencies between bivariable and multivariable analysis is the fact that we have controlled for several variables in the multivariable analysis. In particular, the inclusion of the wealth index variable led to the inversion of the *OR* for place of residence and frequency of watching TV. Nevertheless, a higher likelihood of being exposed daily to SHS in urban areas is a public health concern because the prevalence of smoking bidis is higher in urban slums than in rural areas. Bidis are more harmful to health due to their higher concentrations of tar and nicotine.[28]

The study indicated that Islamic religion had a slightly protective effect compared to other religions, which were mainly represented by Hinduism (9.5%), Buddhism, and Christianity (each 0.2%). Imams, for example, could advise people about the risks associated with smoking and SHS exposure.[32] However, it might not be the religion itself that determines SHS exposure, but rather active religious participation and religiosity,[33] which was not assessed in the BDHS. In a prospective cohort study (n = 4,569) conducted in the United States, a higher frequency of attendance at religious services was associated with a lower probability of current smoking as well as smoking initiation during a 3-year follow-up.[34]

Smoke-free laws may successfully lower the risk of SHS exposure. They need to consider public places, the occupational setting, and the home in order to reduce the number of new tobacco users, to support people who want to quit smoking, and to protect people from SHS exposure.[15,28] The WHO has recommended that various smoke-free indoor public environments are enforced through national legislation, and furthermore, educational strategies are pursued to reduce SHS exposure at home.[6] Bangladesh ratified the WHO Framework Convention on Tobacco Control in 2004 and several laws were passed in line with this convention.[15] Until now, smoke-free regulations have been in operation more in urban centers, and rural regions have been neglected in most countries of the Southeast Asian region.[18] Although Bangladesh has established smoking prevention initiatives such as tax policies, banned smoking in selected public places, and prohibited tobacco advertisements and sponsorship, the prevalence of tobacco use is still high.[31] Because the home as a private space is not included in these policy initiatives, a combination of policy regulations and the promotion of awareness as well as education is necessary.[17] Several studies, for example, from the United States, indicate that a combination of these factors may lead to voluntarily smoke-free homes.[35,36] Studies focusing on low- and middle-income countries, also in Southeast Asia, indicate that being employed in a smoke-free workplace is associated with living in a smoke-free home.[37,38] There is evidence from Taiwan showing that a smoke-free policy reduced the odds of SHS exposure both in the workplace and at home.[39]

The results and determinants of SHS exposure provide an adequate overview of SHS determinants. Because the data were collected at a household level, they are transferable to a large population. The large sample size and highly prevalent risk factor of SHS exposure positively influences the reliability of the model. The results based on BDHS 2011 data regarding the overall prevalence of SHS are comparable with the results from GATS. Data from both studies confirm the significant relevance of education. According to this study, the risk of SHS exposure is higher in urban than in rural areas, which is inconsistent with the results of GATS. Furthermore, our study highlights further determinants of SHS exposure, which were not assessed in GATS. As well as religion, the variables used as proxies for health behavior and health knowledge (concerns about water safety, decisions about health care, and frequency of watching TV) were also significantly associated with SHS exposure. This confirms the conclusion that education and information need to be strengthened in order to reduce SHS exposure and its adverse health effects. Additionally, the distinction between daily and low SHS exposure

compared to no exposure indicated that most determinants revealed significant results only for the daily exposure. This might be because the statistical power for the group with low exposure is less. Most people who were exposed to SHS at home experienced it on a daily basis (46.7%) and only a minority reported low exposure (6.8%). Nevertheless, this emphasizes the need to develop and implement successful strategies to reduce SHS exposure.

Limitations

The interpretation of these results faces certain limitations. Firstly, independent and dependent variables were measured at a single point in time because of the cross-sectional study design. Secondly, all selected variables were self-reported, which may lead to misclassifications due to recall and reporting bias. The self-reporting may lead to an underestimation of exposure and, therefore, bias the risk estimate of the effects of SHS.[4] Several studies have confirmed that pregnant women in particular tend to underreport their own consumption of tobacco as well as their SHS exposure owing to social desirability response or to avoid criticism from health professionals.[40] To assess the reliability of self-reporting in this context, validation studies using biomarkers are necessary. A valid and reliable measurement of the outcome or risk factor is fundamental in epidemiological studies. In particular, in the context of a person's SHS exposure, a more objective and accurate measurement by biomarker validation is recommended to confirm the results.[2,17] Nevertheless, even though the results might be biased, they are more likely to result in underreporting than overreporting.

Several other factors not assessed in the current study are obviously relevant to SHS exposure as well. Therefore, potential biases due to unmeasured variables are important. For example, questions regarding their own smoking status or the smoking status of family members were not included, which limited the results, because we suppose that female smokers are more likely to be exposed to SHS at home.

It has to be mentioned that this study concentrated on SHS exposure at home. Other settings, such as public places, workplaces, restaurants, and bars, are not taken into account, because no information was available in the dataset, although they can be prominent locations for SHS exposure. For example, employed women might be exposed at their workplace if it is not regulated by smoke-free policies. For nonemployed women, who are the majority (85.8%) in this study, the household is the most critical venue for SHS exposure because they are likely to spend most of their time at home. Hence, our measure is likely to provide a reasonable estimate of SHS exposure among unemployed women although our assessment, by focusing on household SHS exposure only, is likely to have underestimated overall SHS exposure.

Conclusions and Implications

The public health relevance of SHS exposure was addressed in this article. Measures to reduce SHS exposure, particularly at home, are scarce. Therefore, future research should investigate how this exposure can be lowered, smoking initiation prevented, and smoking cessation facilitated. This study examined the determinants of SHS exposure in Bangladesh in order to present some essential areas of interest that offer options for action to reduce SHS exposure. Those actions should include, in addition to laws on tobacco control, mass health communication programs and more attention paid to health-related topics during education. The study highlighted the relevance of education and wealth index in particular and also of individual health knowledge and behavior, apart from the household structure, as the most important determinants of SHS exposure. Therefore, more public health attention is needed to prioritize education advising people in terms of health and reducing social disparities, which will improve the population's health status in Bangladesh.

Declaration of Interests

None declared.

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