RESEARCH ARTICLE

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Changes in Prevalence of Childhood Exposure to Secondhand Smoke in India: A Secondary Analysis of GATS Survey (2009-2017)

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Abstract

Background: Children are susceptible to early life inequalities stemming from their limited control over their environment and their physical incapability to handle the health and developmental consequences of smoke exposure. Additionally, their lack of awareness regarding the detrimental effects of secondhand smoke (SHS) exposure on their well-being emphasizes the crucial need to comprehend the extent of SHS exposure among the younger population. **Objective:** The study aims to analyze the magnitude and factors influencing SHS exposure among children under 15 years, along with the shifts in SHS exposure in India and its states between 2009-10 and 2016-17. **Methods:** The study utilized two rounds of the nationally representative cross-sectional Global Adult Tobacco Survey (GATS) conducted in 2009-10 and 2016-17, respectively. The study included a total of 47,494 households with 108,814 children under 15 years of age for GATS1 and 46,874 households with 1,000,167 children under 15 years of age for GATS2. Bivariate analysis and Multivariable logistic regression was employed. **Results:** Forty-five percent of children experienced SHS exposure at home. Although most states saw a reduction in exposure rates, Jammu and Kashmir, Punjab, and Tamil Nadu exhibited increases between 2009-10 and 2016-17. Multivariate analysis revealed that children from the North-Eastern (OR = 6.51, CI = (5.93-7.15)) and North (OR = 7.51, CI = 6.88-8.19)) regions, rural areas (OR = 1.45, CI = (1.37-1.52)), Scheduled Tribes (OR = 1.76, CI = (1.63-1.90)), and those with household adults lacking knowledge of SHS's harmful health effects on children (OR = 1.15, CI = (1.04-1.27)) were more likely to be exposed to SHS at home. **Conclusion:** India has made strides in reducing child SHS exposure, yet challenges persist in rural and impoverished homes. Comprehensive tobacco control measures can break the cycle of poverty driven by smoking-related expenses, fostering a tobacco-free generation.

Keywords: Secondhand smoke- child health- public health- India

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Introduction

Secondhand smoke (SHS) exposure is defined as the inhalation of tobacco smoke by non-smokers against their will or as involuntary exposure to tobacco smoke [1]. SHS, also called environmental tobacco smoke, involuntary smoking or passive smoking,is an intricate mixture of over 4,000 chemicals formed during combustion, including nicotine, carcinogens and toxins [2]. SHS exposure is a significant public health problem and is associated with respiratory infections, asthmatic exacerbations, mental health disorders, cardiovascular disorders, sleep disorders, cognitive dysfunction, lung cancer, and other forms of cancer [3]. Globally, 1.3 million premature and preventable deaths occur every year due to SHS exposure among non-smokers [4]. Globally, 40% of the children were exposed to SHS, which was higher than SHS exposure among non-smoking men (33%) and women (35%). Globally, 28% of the mortality due to SHS exposure was concentrated among children less than 15 years of age. The disability-adjusted life-years (DALYs) due to SHS exposure was 10.9 million, of which 6% were among children [5]. The Section 4 of the Cigarettes and Other Tobacco Products Act (COTPA),2003 prohibits smoking in public places. These rules were amended in 2009 and 2017 for better implementation and control of SHS exposure in public places [6]. However, smoking in non-prohibited areas such as homes and cars does not come under the ambit of COTPA. In private settings, primarily non-smoking adults and children are exposed to SHS [7]. Even transient exposure to SHS can lead to life-threatening diseases as there is no safe level of exposure to tobacco smoke [1, 8, 9].

The major source of SHS exposure among children is at home, as they spend most of their time at home. Children do not have any control over SHS exposure at

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home, and they even lack knowledge about the harmful health effects of SHS exposure [10]. Infants and young children have higher breath rates, and their vital body parts are undergoing development. During this phase of development, children exposed to SHS are more likely to develop the risk of multiple infectious diseases such as respiratory infections, meningococcal, asthma, ear infections, and sudden infant death syndrome [8, 9, 11]. In the year 2017, the annual cost of diseases attributed to SHS exposure among adults 15 years and above in India comes to around INR 566.7 billion (USD 8.7 billion) [12]. There is a need for further investigation on children under 15 years exposed to SHS in Indian homes as the inclusion may surge the cost of the disease attributed to SHS exposure. The World Health Organization's (WHO) thematic brief titled "Tobacco Control for Enhancing Child Health and Development" delves into the detrimental impact of SHS exposure on the nurturing care provided to children. Such exposure poses significant risks to children's well-being, physical health, nutrition, safety, security, responsive caregiving, and access to early learning opportunities. These crucial components of nurturing care are pivotal in enabling children to survive, thrive, and reach their full potential. Children are particularly vulnerable to early life inequalities stemming from their limited control over their environment and their physical incapability to cope with the health and developmental repercussions of smoke exposure. Therefore, addressing tobacco-related pitfalls becomes imperative in safeguarding the health and development of the young generation [13].

In high-income countries, biochemically validated measures of cotinine, carbon monoxide, or air particulate from home were measured to comprehend the trend and predictors of children's SHS exposure at home [14, 15]. However, In India, the data on SHS exposure among children is limited. Against this background, the study aims to capture the pattern, determinants, and changes in SHS exposure among children in India and its states between 2009-10 and 2016-17. To investigate the magnitude of SHS exposure among children (below 15 years) in India, the study has utilized both rounds of the GATS India data. The study aims at examining the changes in SHS exposure among children in India at the state and national level and determining the predictors of SHS exposure among children in India.

Materials and Methods

Data source

GATS 1(2009-10) and GATS 2(2016-17) were utilized to conduct the secondary data analyses. GATS is a nationally representative household survey of individuals aged 15 years or above. GATS survey uses consistent and standard protocol across countries, including India. GATS is conducted to measure and monitor the prevalence of tobacco use, exposure to SHS, as well as the impact of tobacco control measures across several socio-demographic variables. A multi-stage sampling procedure was adopted independently in each state, and within the states, three- and two-stage sampling was used independently for urban and rural areas. The first round of GATS was conducted in 2009-10, and the second round was conducted in 2016-17. International Institute for Population Sciences (IIPS), Mumbai, India, and Tata Institute of Social Sciences (TISS), Mumbai, India, were the nodal agencies for implementing GATS 1 and GATS2, respectively. The detailed methodology of GATS 1 and 2 was published earlier. GATS1, India, was carried out in 29 states and two Union Territories, with 69,296 completed interviews of individuals aged 15 years and above. In the second round of the GATS India survey, 74,037 adult interviews were completed in 30 states and two Union territories, with a response rate of 92.9 percent [16, 17].

Analytical sample

There were two study aspects for understanding the household and individual levels of SHS exposure among children. At the household level, the proportion of households with children under 15 years exposed to SHS at home and at an individual level, the proportion of children less than 15 years exposed to SHS at home was computed using GATS 1 and GATS 2 data. For SHS exposure at the household level, all households with children less than 15 years were selected (GATS1= 49,028 and GATS2 = 47,351 households). Out of these sampled households, 1,534 and 477 households from GATS 1 and GATS 2 did not have information on SHS exposure. After excluding the households with missing information on SHS, the sample size used for analysis was reduced to 47,494 and 46,874 households with children less than 15 years old for GATS 1 and GATS 2, respectively. For the second study aspect of the proportion of children <15 years exposed to SHS at home, the total number of children exposed to SHS was computed by using custom tables syntax of SPSS 20 software. The total number of children less than 15 years old in the sampled households were 1,12,435 and 1,01,199, respectively. For the purpose of analysis, the children who belong to households with missing information on SHS were excluded. After exclusion criteria, the total number of children included in the study were 1,08,814 and 10,00,167 for GATS1 and GATS2, respectively (Supplementary Figure 1).

Outcome variables

The outcome variables for the study were SHS exposure in households with children (below 15 years old). Two measures were used to form the dependent variable for the study.

Number of children and households with children aged less than 15 years

There are two questions for collecting information on the number of people in the household -In total, how many persons are living in this household?, and "How many of these household members are 15 years of age or older?". Using the two questions, the number of children younger than 15 years in each household was computed by subtracting the number of adults 15 years of age or older from the total number of household members. If the number of children in the household is zero, it indicates the household is without any children. All the households with children less than 15 years old formed the sample

for the study.

SHS exposure at home

The first question regarding SHS exposure at home asked to the respondent is, "Which of the following best describes the practices about smoking inside of your home?" The responses were "allowed", "not allowed, but exceptions", "never allowed", and "no rules". Respondents who responded that smoking was never allowed inside their homes were considered to be living in SHS-free homes. Those who indicated that smoking was allowed inside their home or allowed exceptionally were then further asked, "How often does anyone smoke inside your home?" The responses were "daily, weekly", "monthly", "less than monthly", and "never". Those who responded "never" were considered as living in SHS free home, and those who indicated "daily", "weekly", "monthly", and "less than monthly" were considered to have been exposed to SHS at home at any time. Using these questions, the variable of SHS exposure at home was constructed.

Exposure variables

This study used a set of socioeconomic and demographic variables, including place of residence (rural, urban), wealth quintile (poorest, poorer, middle, rich, richest), caste (Scheduled Castes(SC), Scheduled Tribes (ST), Other Backward Class (OBC), Others), religion (Hindu, Muslim, Christian, Others), region of residence (North, Central, East, Northeast, West and South), number of children in the households (Less than three and three or greater), presence of adult smoker at home (yes, no), knowledge/awareness about the harmful effects of SHS on children (yes, no) and noticed any anti-tobacco message in mass media (yes, no). The wealth index was computed using principal component analysis based on the ownership of the household's assets [18]. Some explanatory variables were unavailable in GATS 1 data and introduced in GATS 2, such as religion, caste, knowledge/awareness about the harmful effects of SHS on children and noticed any anti-tobacco message in mass media.

Statistical analysis

Data was analyzed using STATA version 16.0 (STATA Corp., Texas). Descriptive statistics using bivariate analysis were used to examine the prevalence of SHS exposure at home by the socio-demographic characteristics. Multivariate logistic regression was applied to examine the factors that predict SHS exposure at home. All analyses were appropriately weighted and adjusted for complex survey design.

Results

Descriptive statistics

A total of 47,494 households in GATS 1 and 46,874 in GATS 2 had children under 15 years formed the study sample. GATS 1 lacked data on religion, caste, and anti-tobacco messages. In GATS 1, 37.6% of households were urban, with two-thirds having fewer than three children and one-fifth having an adult smoker. GATS 2 had 71% Hindu households, over one-third from OBC and two-thirds rural. Fourteen percent had an adult smoker. Almost all were aware of the health effects of SHS, but only 40% noticed media messages in the last 30 days (Supplementary Table 1).

Socioeconomic disparity in SHS exposure among children

During GATS 1, 55.6% of households with children were exposed to secondhand smoke (SHS) at home. Rural areas had higher exposure (60.5%) than urban areas (41.7%), and the poorest wealth quintile households (66.7%) had more exposure than the richest quintile households (33.3%). The central region (68.1%) had the highest exposure, while the Western region had the lowest (45.4%). Homes with more than three children had a higher SHS exposure (66.7%) than those with fewer children (50%). Additionally, over four-fifths of households with children had an adult smoker. SHS exposure at home decreased by 13.5 percentage points from GATS 1 (55.6%) to GATS 2 (42.1%). GATS 2 maintained a similar pattern of SHS exposure across socio-demographic characteristics as in GATS 1. During GATS 2, higher exposure was observed in Muslim (47.2%) and ST (53.4%) households. Concerningly, awareness of SHS's adverse effects on children was low, with only 42% of adults being aware. Additionally, just over one-third (34.2%) had noticed information on the dangers of SHS in the mass media in the past 30 days.Though the proportion of the households with an adult smoking member had come down from GATS 1 to GATS 2 yet, more than two-thirds of the households with children (72.2%) had an adult smoking member in the family in GATS 2 (Table 1).

Over the time period between GATS 1 and GATS 2, there was a decrease in the percentage of adults reporting that smoking is allowed at home, as well as a decrease in the percentage of children exposed to SHS at home. An overwhelming fifty-two percent of the adults from the households who had children in GATS 1 reported that smoking is allowed at home. Discouragingly, this percentage registered only a slight decline in GATS 2 (48.8%). In GATS 1 (2009-10), 59.1% of children were exposed to SHS at home. In GATS 2, there was a decrease in the percentage of children were exposed to SHS at home to 44.7%. Notably, rural areas consistently showed higher percentages of smoking allowance at home and children exposed to SHS compared to urban areas for both rounds of the GATS India survey (Supplementary Figure 2).

Regional disparity and changes in SHS exposure at home among children

There were notable state-wise disparities in SHS exposure at home among children, with northeastern India showing exceptionally high rates. In Mizoram during 2016-17, over four-fifths of children were exposed to SHS at home, the highest in India. Following Mizoram, Meghalaya, Manipur, Jammu and Kashmir, Tripura, and Nagaland had over three-fifths of children exposed to SHS. Over half of the children were exposed in Arunachal Pradesh, West Bengal, Uttar Pradesh, Uttarakhand, Madhya Pradesh, and Haryana in 2016-17. The lowest

Table 1. Proportion of Households with Children Aged Less than 15 Years Exposed to SHS at Homes in India by Socio-Demographic Characteristics, India, 2009-10 and 2016-17

Background characteristics	GATS I (2009–10) Number of households with children exposed to SHS at home	(%)	GATS 2 (2016–17) Number of households with children exposed to SHS at home	Households with children exposed to SHS at home(%)
Religion				
Hindu	NA	NA	13,505	41.8
Muslim	NA	NA	3,325	47.2
Christian	NA	NA	2,924	34.8
Others	NA	NA	994	28.4
Caste				
Scheduled Caste	NA	NA	4,025	48.1
Scheduled Tribe	NA	NA	5,231	53.4
Other Backward Caste	NA	NA	6,138	40.2
Others	NA	NA	5,174	36.3
Place of residence				
Urban	8,058	41.7	5,010	30.2
Rural	18,405	60.5	15,739	47.5
Wealth				
Poorest	6,838	66.4	6,112	54.4
Second	7,183	59.5	5,935	43.8
Middle	4,426	53.5	2,966	39.5
Fourth	4,584	46.1	3,560	35.3
Richest	3,432	32.3	2,176	26.7
Region				
North	6,217	56.4	5,356	51.6
Central	4,808	68.1	4,346	57
East	4,232	61.6	2,886	43.1
North East	7,177	57.8	5,837	51.8
South	1,714	31.2	1,091	17.5
West	2,315	45.4	1,233	27.9
Number of children in the household				
Less than 3	16,272	50.8	13,838	38.7
≥ 3	10,191	62.9	6,911	49.3
Knowledge among adults about the harmful health effects of SHS on children				
Yes	NA	NA	19,141	41.6
No	NA	NA	1,037	47.2
Adult smoker in home				
Yes	7,065	81.1	4,892	72.2
No	19,398	51.3	15,857	38.4
Noticed information in media about dangers of SHS during last 30 days				
Yes	NA	NA	7,128	34.2
No	NA	NA	13,023	46.2
Overall	26,463	55.6	20,749	42.1

exposure was in Puducherry (4.6%), while Goa, Andhra Pradesh, Kerala, and Tamil Nadu had a prevalence below 20%.

Between 2009-10 and 2016-17, 28 states and Union Territories recorded a decline in the proportion of children exposed to SHS at home. There was a relative decline of 24.4 percentage points at the national level. Interstate variations in the relative change in the SHS exposure at home during the two rounds of the GATS survey reveal distinct patterns. The changes are categorized into

Table 2. State-Wise Percentage of Children Younger than 15 Years Exposed to SHS at Home, India, 2009-10 and 2016-17

State/UT	GATS1 (2009-10)	GATS2 (2016-17)	Absolute change (T2-T1)	Relative change (T2-T1)/T1
India	59.1	44.7	-14.4	-24.4
Jammu & Kashmir	69.5	78.9	9.4	13.5
Himachal Pradesh	82.1	34.9	-47.2	-57.5
Punjab	33.5	36.6	3.1	9.2
Chandigarh	43.9	31.7	-12.2	-27.8
Uttarakhand	89.9	64.2	-25.6	-28.5
Haryana	73.6	68.2	-5.4	-7.3
Delhi	65.6	45.5	-20.1	-30.7
Rajasthan	78.1	43.8	-34.3	-43.9
Uttar Pradesh	65	63.4	-1.6	-2.5
Chhattisgarh	70.1	38.9	-31.2	-44.5
Madhya Pradesh	74.6	67.4	-7.3	-9.7
West Bengal	66.5	59.2	-7.3	-11
Jharkhand	58.2	33.3	-24.9	-42.8
Odisha	61.9	29.2	-32.7	-52.8
Bihar	62.1	41	-21.2	-34.1
Sikkim	45	17.5	-27.5	-61.1
Arunachal Pradesh	53.6	52.2	-1.4	-2.7
Nagaland	81	73.7	-7.3	-9
Manipur	78.4	79.6	1.1	1.4
Mizoram	97.5	86.7	-10.8	-11.1
Tripura	77.2	76.8	-0.4	-0.5
Meghalaya	77.4	82.3	4.9	6.3
Assam	54.2	47.2	-7	-13
Gujarat	63.4	45.3	-18.1	-28.5
Maharashtra	39	21.3	-17.7	-45.4
Goa	27.3	16.1	-11.2	-41
Andhra Pradesh	34.7	15.4	-19.3	-55.6
Karnataka	52.8	29.4	-23.4	-44.3
Kerala	41.3	14.7	-26.7	-64.5
Tamil Nadu	11	11.7	0.7	6.6
Puducherry	11.1	4.6	-6.5	-58.3

Note: *Andra Pradesh and Telangana state combined as Telangana state formed in 2014. Hence, for GATS 1, data for Telangana state is not available, and prevalence is the same for Andhra Pradesh and Telangana state in GATS2

five groups: ≥0.0% increase, -20% to 0.0% decrease, -40% to -20% decrease, -60% to -40% decrease, and <-60% decrease. Jammu and Kashmir (13.5%), Punjab (9%), Meghalaya (6.3%), Manipur (1.4%), and Tamil Nadu (6.6%) experienced an increase. Kerala stood out with a significant decline of -64.5%, while several states, including Himachal Pradesh, Rajasthan, Maharashtra, Telangana, Chhattisgarh, Jharkhand, Odisha, Andhra Pradesh, and Karnataka, had declines between -40% and -60%. Uttarakhand, Gujarat, and Bihar showed declines between -20% and -40%, while Haryana, Uttar Pradesh, Madhya Pradesh, West Bengal, and Northeastern states (except Meghalaya and Manipur) had declines below -20% (Table 2 and Supplementary Figure 3).

Determinants of SHS exposure at home among children

Binary logistic regression analyses were conducted separately for GATS 1 and GATS 2. In GATS 2, religion and caste emerged as significant determinants of SHS exposure among children. Children from Hindu (OR = 1.96, CI = 1.78 – 2.16), Muslim (OR = 3.13, CI = 2.79 - 3.49), and Christian (OR = 2.83, CI = 2.51 – 3.19) households were more likely to be exposed to SHS at home compared to those from other religious groups. Similarly, children from SC (OR = 1.40, CI = 1.31 – 1.49), ST (OR = 1.76, CI = 1.63 - 1.90), and OBC (OR = 1.06, CI = 0.99 - 1.12) households were more likely to be exposed compared to those from other caste groups. Rural households were significantly more likely to have SHS exposure compared to urban households in both GATS 1 and GATS 2. Compared to the richest

Table 3. Odds Ratio for Exposure of SHS at Home among Households with Children by Background Characteristics, India, 2009-10 and 2016-17

Background characteristics	Adjusted odds ratio (95% CI)	
	GATS 1 (2009-10)	GATS 2 (2016-17)
Religion		
Others		1.00 (Reference)
Hindu		1.96 (1.78-2.16)
Muslim		3.13 (2.79-3.49)
Christian		2.83 (2.51-3.19)
Caste		
Others		1.00 (Reference)
Scheduled Caste		1.40 (1.31-1.49)
Scheduled Tribe		1.76 (1.63-1.90)
Other Backward Caste		1.06 (0.99-1.12)
Place of residence		
Urban	1.00 (Reference)	1.00 (Reference)
Rural	1.43 (1.42-1.43)	1.45 (1.37-1.52)
Wealth quintile		
Richest	1.00 (Reference)	1.00 (Reference)
Poorest	2.44 (2.43-2.44)	2.14 (1.96-2.32)
Second	2.39 (2.39-2.39)	1.95 (1.81-2.10)
Middle	2.17 (2.16-2.18)	1.67 (1.54-1.82)
Fourth	1.65 (1.64-1.65)	1.51 (1.40-1.62)
Region		
South	1.00 (Reference)	1.00 (Reference)
North	3.56 (3.55-3.57)	7.51 (6.88-8.19)
Central	4.16 (4.15-4.16)	5.87 (5.37- 6.42)
East	3.06 (3.05-3.06)	3.34 (3.05-3.67)
North East	2.75 (2.74-2.75)	6.51 (5.93-7.15)
West	2.09 (2.09-2.09)	2.37 (2.14-2.62)
Number of children in the household		
<3	1.00 (Reference)	1.00 (Reference)
≥3	1.24 (1.23-1.24)	1.17 (1.11-1.22)
Knowledge among adults about the harmful health effects of SHS on children		
Yes		1.00 (Reference)
No		1.15 (1.04-1.27)
Adult smoker in home		
No	1.00 (Reference)	1.00 (Reference)
Yes	4.24 (4.24-4.25)	4.53(4.23- 4.86)
An adult member of household noticed information in media about dangers of SHS in last 30 days		
Yes		1.00 (Reference)
No		1.01 (0.96-1.06)

wealth quintile households, the households belonging to the other wealth quintiles were significantly more likely to be exposed to SHS at home for both periods. Compared to the households from the Southern Region, the households from all the other five regions had significantly higher exposure to SHS at home for both GATS 1 and GATS 2. Households with adults lacking knowledge about the harmful effects of SHS on children were more likely to have SHS exposure (OR = 1.15, CI = 1.04 – 1.27) in GATS 2. The presence of an adult smoker at home significantly increased the likelihood of SHS exposure in both GATS 1 (OR = 4.24, CI = 4.24 - 4.25) and GATS 2 (OR = 4.53, CI = 4.23 - 4.86). Furthermore, households where adults had not noticed anti-smoking messages in the mass media were more likely to have SHS exposure (OR = 1.01, CI = 0.964 - 1.06) compared to those where adults had noticed such messages (Table 3).

Discussion

Children are the primary sufferers of SHS at home as they generally spend a substantial amount of time at home [19], and they have limited or no say on smoking at home [1, 20]. Children are predominantly susceptible to the adverse effects of SHS because of the smaller, immature and developing organs. SHS exposure among children is well associated with a range of detrimental health effects [21] and are at risk of preventable morbidities and premature mortality [22, 23]. Providing a safe and secure environment during the developmental phase of children at home will lead to achieving sustainable development goals of good health and well-being and reducing inequality within and among countries [12]. Based on the GATS1 and GATS2, the study provides the proportion of children (under 15 years of age) exposed to SHS at home in India and its states, along with the change in the percentage of children exposed to SHS at home over the period of 8 years. At the national level, there is a relative decrease of 24 percentage points in the children exposed to SHS at home. Despite the substantial decline still, 45% of the children below 15 years remain exposed to SHS at home. The Ministry of Health and Family Welfare developed the anti-tobacco health spot of 'Child' and 'Dhuan' for "Tobacco-free film rules" under COTPA in 2013, which have been dubbed in 16 Indian languages for a pan India coverage to notify about the health cost of smoking, SHS and the penalties to be faced by violating the smoke-free law [24]. Some studies have evaluated this intervention, they concluded the advertisement broadcasted in the cinema hall was easily recalled by the respondents, which achieved a high level of public awareness and respondents intended to quit smoking. Hence, the media campaign also brings significant long-term benefits in the reduction of smoking [25, 26]. The WHO's report on smoke-free movies (2016) praised India for successfully carrying out the intervention [27].

Regional differences were noted in the proportion of children exposed to SHS at home. Kerala and Himachal Pradesh witnessed the highest relative decrease in the percentage of children exposed to SHS. Conversely, Meghalaya and Manipur in the Northeast, Jammu and Kashmir and Punjab in the North, and Tamil Nadu in the South observed an increase in the percentage of children exposed to SHS at home from GATS1 (2009-10) to GATS2 (2016-17). Over eight years, SHS exposure at home remains almost the same in India's rural, poorest households in the Northeast, North, and Central regions. The results were echoing with previous studies [28, 29]. The variation in the prevalence of SHS exposure at home across the states of India could be coexisting with the socio-cultural geographic diversity. Even the disparities in healthcare infrastructure and behaviour norms could mark the variability among the states. Efforts are required to reduce adult smoking at home through providing integrated tobacco cessation with uninterrupted follow-up sessions by healthcare providers to avoid relapses. However, some other studies have also observed an encouraging reverse trend for adopting smoke-free homes, which facilitates cessation, reduces cigarette consumption, and increases quit attempts. Smoke-free home interventions are viewed by smokers as less threatening than cessation interventions, yet with guaranteed benefits on cessation that accomplish the same goal. Consequently, there is a need to provide constant assistance and different approaches to quit smoking by trained health personnel [28, 30, 31]. A study on the linkages between smoke-free policies at the workplaces and smoke-free homes in India has found that individuals with smoke-free workplaces were more likely to have smoke-free homes [32]. The government should make efforts for the stringent implementation of the no-smoke policy at the workplace which in turn would lead increasing the proportion of smoke free homes in India.

The results highlighted that the households with children were less exposed to SHS at home if an adult member of the household noticed the information about the dangers of SHS in the media and had awareness about the harmful effects of SHS exposure on children. In the United Kingdom, The Roy Castle Lung Cancer Foundation initiated a training program to help health professionals discuss SHS exposure with parents and provide interventions to control SHS at home [33]. The education department in Guangdong province of China used the innovative thought of inserting "smoke-free family creation" in teaching materials and requested primary school students to help their parents create smoke-free homes [34]. Such methodical implementation of awareness programs in India by health care providers on smoke-free environments in private settings among adults, school children, and adolescents will go a long way in reducing SHS exposure and boosting children's well-being and overall development.

The study finding also adds that there is a significant association between the prevalence of SHS exposure in the household and the prevalence of tobacco use, either smoking or smokeless form, among adolescents aged 15 to 19 years. The SHS-exposed households, apart from exposing the children to the health hazards of SHS exposure, are also at risk of having potential adolescent (15 to 19 years) smokers and smokeless tobacco users (Supplementary Table 2). Several studies have found an intergenerational association between parental tobacco use and teenage/adolescent tobacco use [35-38], thus compounding the hazards of childhood SHS exposure with personal smoking in adulthood. A child's exposure to SHS causes harm that follows into adulthood. Children are nevertheless more likely to have persistent respiratory issues into adulthood even if they do not take after their parents' smoking habits and lead smoke-free lives [39]. A study from Germany suggested targeting a group of children whose parents smoke and belong to socially disadvantaged families for the implementation of future tobacco control measures [40]. Along with smoke-free home interventions, tobacco-free generations will help to combat the health and development hazards among children [41].

The study findings underscore the critical need for a comprehensive, multifaceted approach and targeted policy approach to address and reduce SHS exposure among children at home in India. Awareness generation

campaigns emerge as a fundamental component, with a focus on tailoring messages to the high focus groups. Prioritizing rural areas, where awareness is lower, is vital for reaching a broader population. Additionally, recognizing and addressing economic disparities and implementing household smoking restrictions are crucial steps in creating a smoke-free home environment. School and community programs engaging various stakeholders can play a pivotal role in instilling anti-smoking education from an early age. The government should take the initiative to organize tobacco awareness programs at the community level, especially in the high focused states, to raise awareness of the harms of SHS exposure to the general population and children in particular. State-specific strategies, informed by local data, are indispensable for tailoring interventions to unique challenges and trends within each state. A robust monitoring and evaluation system is critical to assess the effectiveness of implemented policies over time, allowing for continuous adaptation based on emerging challenges. Supporting smoking cessation efforts is crucial to break the cycle of exposure. Lastly, inter-sectoral collaboration is emphasized as a linchpin for success. A unified effort involving government agencies, healthcare providers, educational institutions, community leaders, and non-governmental organizations is necessary to implement these recommendations comprehensively. Regular assessments and adaptations to the policy framework will be vital to ensure sustained progress in reducing SHS exposure among children in India. By adopting this multifaceted and collaborative approach, India can strive towards creating a healthier, smoke-free home environment forthe future generations.

Limitations of the Study

The study has limitations due to its cross-sectional nature, impeding the analysis of temporal trends and hindering the quantification of the impact of government interventions to reduce SHS exposure. The use of self-reported data as a proxy for SHS exposure may not accurately reflect the actual exposure. The study focused on a calculative approach to assess smoke exposure among children, capturing only the household, community, and knowledge perspectives of adults aged 15 years and older.

Author Contribution Statement

MB, AG and NK contributed to the planning of the study. MB and AG carried out statistical analysis and drafted the manuscript. MB, AG and NK reviewed the manuscript and approved the final manuscript.

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Approval

This study was used secondary data and no primary data collection was involved. Hence there is no approval required from the institutional review board.

Ethics statement

The GATS India data sets is available in the public domain from CDC and are de-identified. All the Global Adult Tobacco Surveys were approved by ethical boards of survey countries and CDC, Atlanta. Study protocols and survey materials for GATS 1 were approved by the Ethics Review Committee and Institutional Review Board (IRB) of the International Institute for Population Sciences, Mumbai. Study protocols and survey materials for GATS 2 were approved by the Ethics Review Committee and IRB of Tata Institute of Social Sciences, Mumbai. Consent was obtained from all participants. Parent or guardian consent was obtained for interviews of minors aged 15–17 years

Data Availability

The study used secondary data which is available in the public domain at https://nccd.cdc.gov/GTSSDataSurveyResources/Ancillary/DataReports.aspx?Country=180&CAID=2&Survey=4&WHORegion=2&Site=3840002016.

Conflict of Interest

The authors have no conflicts of interests to declare.

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