






RESEARCH ARTICLE

REVISED Trends and correlates of hardcore smoking in India: findings from the Global Adult Tobacco Surveys 1 & 2 [version 2; peer review: 1 approved, 1 approved with reservations]

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Abstract




Background: Data on prevalence of hardcore smoking (HCS) among different socioeconomic status (SES) groups in low- and middle-income countries are limited. We looked at the prevalence and pattern of HCS in India with the following objectives: 1) to analyse the association between SES and HCS, 2) to find trends in HCS in different SES groups and 3) to find state-wide variations in hardcore smoking.

Methods: Data of individuals aged ≥ 25 years from the Global Adult Tobacco Survey (GATS) India 2009-10 (N= 9223) and 2016-17 (N= 7647) were used for this study. If an individual met all the following criteria: (1) current smoker, (2) smokes 10 or more cigarettes/day, (3) smokes first puff within 30 minutes after waking up, (4) no quit attempt in last 12 months, (5) no intention to quit at all or in the next 12 months, (6) lack of knowledge of harmful effect of smoking, s/he was identified as a hardcore smoker. Multiple regression analysis was done to find the factors associated with HCS.

Results: Prevalence of HCS decreased from 2.5% in GATS 1 to 1.9% in GATS 2: males from 6.2% to 3.9% and females from 0.3% to 0.2%. Compared to the richest group the poorest, poor and those who belonged to the middle-income group were more likely to report HCS in GATS 1 and 2. However, only in the poorest SES group there was an increase in the proportion of hardcore smokers in GATS 2 compared to GATS 1. Other factors that were significantly associated with HCS in both surveys were male gender, working adults, those with lower education, early initiation of smoking and households without any rules for smoking inside the home.

Conclusions: Tobacco control and cessation efforts need to focus on individuals of poor SES groups particularly in the high prevalence Indian states.

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Hardcore smokers, Socioeconomic position, tobacco control, India



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REVISED Amendments from Version 1

In the revised version, we have included the trend in hardcore smoking across socio-economic groups and the unadjusted odds ratio is reported (Table 5 and Table 6). We have also added a new table (Table 7) replacing Figure 2 on the change in proportion of hardcore smokers among current daily smokers aged ≥ 25 years between GATS-1 and GATS-2.

Any further responses from the reviewers can be found at the end of the article

Introduction

There were more than one billion smokers globally in the year 2019 consuming 7.4 trillion cigarettes¹. Smoking was attributed to 7.7 million deaths and 200 million disability adjusted life years (DALYs) and was the leading risk factor for death among males in that year¹. Smoking prevalence in India decreased from 13.9% to 10.7% (males 24.3% to 19.0%, females 2.9% to 1.9%) during the period 2010 to 2017². Despite this decrease, there were 130.9 million smokers (116 million males and 14.9 million females) in India in 2019¹. In 2019, total deaths attributed to smoking in India were 1.01 million (845,000 males, 169,000 females) which was 10.8% of total deaths; 16.9% among male deaths and 3.85% of female deaths¹.

There is an argument that when smoking prevalence decreases a greater proportion of the remaining smokers are likely to be hardcore smokers (HCS). However, the recent editorial in the journal *Tobacco Control* stated that this argument is not supported by evidence. As per this editorial, softening (when smoking prevalence decreases, a greater proportion of the remaining smokers are likely to be non-HCS) was happening instead of hardening³. In high income countries, most evidence point towards softening rather than hardening^{4,5}. Although the definition of hardcore smoking varies across different studies, the common hardening indicators include measures of nicotine dependence and quitting behavior such as past experience of quitting and intention to quit. Even in low- and middle-income countries, a recent study reported a reduction of hard-core smokers in seven of the 10 countries included in the study and no change in one country (Mexico)². In the remaining two countries (China and Turkey) hardcore smoking increased. In India, hardcore smoking decreased from 2.5% to 1.6% as per the above study². Another study from low- and middle-income countries reported that the proportion of hardcore smokers varies from country to country and comprehensive and efficient implementation of the current tobacco control policies are likely to reduce the number of hardcore smokers⁶. A recent systematic review on hardcore smoking argued that there was no evidence for the occurrence of hardening (i.e. when smoking prevalence decreases, the remaining smokers likely to be HCS), and tobacco control policies based on hardening should be challenged⁷. A study from Australia reported that there was a greater accumulation of hardcore smokers in the low socioeconomic status group compared to the high socioeconomic status group indicating that hardcore smokers in low SES groups are less likely to quit⁸. Data on the prevalence of hardcore smokers among different

socioeconomic status groups in low- and middle-income countries are limited. In order to address this issue, we looked at the change in hardcore smoking during the period from 2010 to 2017 using the Global Adult Tobacco Survey (GATS) data in India with the following objectives: 1) to look at the association between socioeconomic status (SES) and HCS in India. 2) to find out the trend in HCS in different SES groups in India and 3) to find state-wide variations in hardcore smoking in India.

Methods**Survey**

The Global Adult Tobacco Survey (GATS) monitors tobacco use (smoking and smokeless) among adults and traces key tobacco control indicators consistently in GATS countries. The GATS is a cross-sectional household survey publicly available from the [Centers for Disease Control and Prevention \(CDC\)](#). In India, the initial round of GATS was conducted in 2009–10, which included all 29 states and a couple of Union Territories of Chandigarh and Pondicherry, forming about 99.9% of the Indian population. The second round was implemented in 2016–17 (GATS 2) in all 30 states of India and two Union territories (UTs). In GATS 1, 69,296 individuals, aged 15 years and above, were interviewed, among which 33,767 were males and 35,529 were females. In GATS 2 a total of 74,037 individuals aged 15 years and above were interviewed including 33,772 males and 40,265 females.

Study design and participants

GATS India was the first nationally representative survey in which electronic handheld devices were used as survey instruments. A stratified multistage probability sampling technique was used in GATS and a standardized questionnaire was used for the survey. Households were selected randomly from selected locations and within household eligible persons were interviewed randomly. Privacy was maintained during the interview. The survey method and survey instrument are described in detail elsewhere⁹. To identify the hardcore smokers and factors associated with hardcore smoking in India, GATS India survey data of 2009–10 and 2016–17 were used. The data for GATS 1 & 2 surveys in India were accessed from CDC's GATS survey data [webpage](#). We included smokers aged 25 years and above because majority of the studies on hardcore smoking included smokers aged 25 years and above and, in many studies, hardcore smoking definition included at least 5-6 years of smoking history⁷. Data from individuals aged 25 years and above (GATS 1= 56006, GATS 2= 60837) from both GATS India surveys were extracted to be included in the study¹⁰.

Variables in the study

Hardcore smoking was the outcome variable, and it was defined using several indicators based on previous studies^{11,12}. An individual was categorized as a Hardcore smoker based on following criteria: (1) current smoker, (2) smokes 10 or more cigarettes/day, (3) smokes first puff within 30 minutes after waking up, (4) no quit attempt in last 12 months, (5) no intention to quit at all or in the next 12 months, (6) lack of knowledge of harmful effect of smoking. Several other researchers have used all six criteria or a few out of the six to define hardcore

smoking^{11,12}. All six indicators are captured as individual variables in GATS 1 & 2 datasets. In our study, we considered hardcore smoking if the individuals met all six criteria. Interviewees who answered 'yes' to the question that smoking causes serious illnesses (e.g., heart attack, lung cancer, stroke) were considered as knowing the harmful effect of smoking. Those who answered 'no' or 'don't know' were defined as not having knowledge on harmful effects of smoking.

The other variables included in the analyses were: gender (male or female), type of residence (urban or rural), marital status (separated/divorced, single, married, widowed), occupation (not working, working), education (no formal schooling, education up to higher secondary, graduation and above), age group in years (25–35, 36–45, > 45years), caste (scheduled caste, scheduled tribe, other backward caste, others), age of smoking initiation (<20 years, ≥20 years), smoking practices inside home (no rules, allowed, not allowed but exceptions, never allowed) and wealth index. The wealth index was calculated as a composite index of household's ownership of assets such as television, radio, refrigerator, fixed telephone, cell phone, flush toilet, car, scooter/moped/motorcycle, washing machine, computer/laptop etc¹³. Based on wealth index the sample was divided into five quintiles (poorest, poor, middle, rich and richest)¹⁴. As self-reported income is not a reliable indicator, wealth index calculated based on asset ownership is used as a proxy indicator for economic status¹⁵.

Statistical analysis

IBM SPSS Statistics for Windows, Version 25.0 Armonk, NY: IBM Corp was used for data cleaning, preparation, and analysis. State-wise prevalence of current daily smokers and hardcore smokers was calculated from GATS 1 and 2 datasets using univariate analysis. Country sample weights were applied to balance for the complex sampling design adopted in GATS, to approximate prevalence rates and 95% confidence intervals (95% CI). Percentage distribution of hardcore and non-hardcore smokers among the survey population was analyzed using frequency tables. Binary logistic regression analysis was done to find the factors associated with hardcore smoking. The significance level in this study was fixed at $p\text{-value} < 0.05$

Results

The sample characteristics for the first and second rounds of the GATS in India are described in [Table 1](#). The proportion of adults aged more than 45 years was more in GATS 2 compared to GATS 1. Marital status and caste data were available only in GATS 2.

Change in current daily smoking and hardcore smoking prevalence between GATS 1 and GATS 2 in different states of India are given in [Table 2](#). For India as a whole, current daily smoking decreased from 13.9% to 11.0% and hardcore smoking decreased from 2.5% to 1.9%. The relative reduction of hardcore smokers was 24% compared to 20.9% in current daily smokers. Current daily smoking prevalence in GATS 1 was highest in

Mizoram (39.1%) and lowest in Goa (5.3%) while in GATS 2 the highest prevalence was in Mizoram (33.9%) and Meghalaya (32.4%) and the lowest in Goa (2.1%). Hardcore smoking prevalence in GATS 1 was highest in Mizoram (19.6%) and lowest in Goa (0%) whereas in GATS 2 the highest prevalence was in Meghalaya (4.9%) and the lowest in Goa (0%) and Sikkim (0%).

Change in current daily smoking and hardcore smoking prevalence between GATS 1 and GATS 2 among males are given in [Table 3](#). Current daily smoking prevalence among males in India decreased from 23.9% in GATS 1 to 19.6% in GATS 2 and that of hardcore smoking from 4.7% to 3.6%. Relative reduction of current daily smokers was 18% and that of hardcore smokers was 23.4%. Current daily smoking prevalence among males in GATS 1 was highest in Meghalaya (64.7%) and lowest in Jharkhand (6.3%) and Goa (8.2%). In GATS 2 also the highest and lowest prevalence was in the states Meghalaya (58.3%) and Goa (4.3%), albeit decreased rates in both states. In GATS 1 the highest prevalence of hardcore smoking among males was in Mizoram (37.5%) and lowest was in Goa (0%) while in GATS 2 the highest prevalence was in Meghalaya (9.9%) and lowest in Goa (0%).

Change in current daily smoking and hard-core smoking prevalence between GATS 1 and GATS 2 among females is given in [Table 4](#). Current daily smoking prevalence among females in India decreased from 3.3% in GATS 1 to 2.2% in GATS 2. The hardcore smoking among females aged 25 years and above at the national level remained unchanged standing at 0.2% to 0.2%. Relative reduction was 33% for current daily smokers. Current daily smoking prevalence among females in GATS 1 was highest in Mizoram (19.0%) and lowest in states like Kerala (0.0%), Maharashtra (0.0%) and Puducherry (0.0%). In GATS 2 the highest prevalence of current daily smoking was in Mizoram (12.9%) and lowest prevalence of 0.0% was reported from Chandigarh. In GATS 1 the highest prevalence of hardcore smoking among females was in Mizoram (4.3%) and hardcore smoking was not reported from 20 states and union territories, while in GATS 2 the highest prevalence was in Mizoram (3.2%) and hardcore smoking was not reported from 18 states and union territories.

Factors associated with hardcore smoking in India based on regression analysis of GATS 1 data are presented in [Table 5](#). Males, rural residents, working adults and those without any formal schooling were more likely to report hardcore smoking compared to their counterparts. Compared to those aged 25–35 years, those aged 36–45 years were more likely to report hardcore smoking. Compared to the richest group as per the wealth index all other categories were more likely to report hardcore smoking. Adults who initiated smoking below 20 years were more likely to report hardcore smoking compared to those who initiated after 20 years. With regard to smoking practices inside the home, those who did not have any rules and those allowed smoking inside the home were more likely to report hardcore smoking.

Table 1. Characteristics of individuals aged 25 and above included in the study.

Variables	GATS-1			GATS-2		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
Age group						
25–35 years	11425(20.4)	11369(20.3)	22794(40.7)	11559(19.0)	11194(18.4)	22753(37.4)
36–45 years	7561(13.5)	6721(12.0)	14282(25.5)	7605(12.5)	7604(12.5)	15209(25.0)
>45 years	9689(17.3)	9241(16.5)	18930(33.8)	11620(19.1)	11255(18.5)	22875(37.6)
Residence						
Urban	8737(15.6)	7897(14.1)	16634(29.7)	11011(18.1)	10464(17.2)	21475(35.3)
Rural	19938(35.6)	19434 (34.7)	39372(70.3)	19712(32.4)	19650(32.3)	39362(64.7)
Marital status						
Married	No data available			27194(44.7)	24700(40.6)	51894(85.3)
Single				2677(4.4)	669 (1.1)	3346 (5.5)
Separated/Divorced				183(0.3)	425(0.7)	608(1.0)
Widowed				730(1.2)	4259(7.0)	4989 (8.2)
Occupation						
Not working	3416(6.1)	19042(34.0)	22458(40.1)	3711(6.1)	21171(34.8)	24882(40.9)
Working	25259(45.1)	8289(14.8)	33548(59.9)	27073(44.5)	8882(14.6)	35955(59.1)
Education						
Graduation and above	3192(5.7)	1513(2.7)	4705(8.4)	4076(6.7)	2312(3.8)	6388(10.5)
Education up to Higher secondary	18314(32.7)	11537(20.6)	29851(53.3)	20259(33.3)	14114(23.2)	34373(56.5)
No formal schooling	7169(12.8)	14281(25.5)	21450(38.3)	6388(10.5)	13688(22.5)	20076(33.0)
Caste						
Others	No data available			8578(14.1)	7909(13.0)	16487(27.1)
Scheduled Caste				5718(9.4)	5780(9.5)	11498(18.9)
Scheduled Tribe				2738(4.5)	2920(4.8)	5658(9.3)
Other Backward Caste				13749(22.6)	13445(22.1)	27194(44.7)
Smoking-related factors						
<i>Age of daily smoking initiation (daily smokers-10680(GATS-1),8834(GATS-2))</i>						
< 20 years	5863(54.9)	545(5.1)	6408(60.0)	4673 (52.9)	336 (3.8)	5009(56.7)
>=20 years	3706(34.7)	566(5.3)	4272(40.0)	3366 (38.1)	459(5.2)	3825(43.3)
Environmental factors						
<i>Smoking practices inside home</i>						
Never allowed	10977(19.6)	10921(19.5)	21898(39.1)	15939(26.2)	15331(25.2)	31270(51.4)
Allowed	7729(13.8)	8787(15.6)	16466(29.4)	5840(9.6)	7362(12.1)	13202(21.7)
Not allowed but Exceptions	4705(8.4)	4424(7.9)	9129(16.3)	5292(8.7)	3529(5.8)	8821(14.5)
No Rules	5209(9.3)	3304(5.9)	8513(15.2)	3711(6.1)	3833(6.3)	7544(12.4)
Wealth Index						
Poorest	3305(5.8)	3360(6.0)	6665(11.8)	4563(7.5)	4381(7.3)	9004(14.8)
Poor	4425(8.0)	4256(7.6)	8681(15.6)	3224(5.3)	3164(5.2)	6388(10.5)
Middle	3808(6.8)	3808(6.8)	7616(13.6)	4441(7.3)	4441(7.3)	8882(14.6)
Rich	8625(15.4)	8009(14.3)	16634(29.7)	5475(9.0)	4927(8.0)	10342(17.0)
Richest	8513(15.2)	7897(14.1)	16410(29.3)	13384(22.0)	12837(21.1)	26221(43.1)

*The percentages are frequencies are derived after applying Sample Weights for GATS. GATS=Global Adult Tobacco Survey.

Table 2. Change in current daily smoking and hard-core smoking between GATS 1 and GATS 2.

States	Current daily smoking (%)			Hardcore Smoking (%)		
	GATS-1	GATS-2	Absolute Change	GATS-1	GATS-2	Absolute Change
J&K	25.4	23.0	-2.4	1.8	4.6	2.8
HP	19.8	14.5	-5.3	3.4	2.1	-1.3
Punjab	6.3	7.2	0.9	1.9	0.5	-1.4
Chandigarh	11.4	8.2	-3.2	4.3	1.4	-2.9
Uttarakhand	27.9	20.9	-7.0	3.8	4.0	0.2
Haryana	24.6	22.8	-1.8	6.8	3.6	-3.2
Delhi	19.3	9.6	-9.7	8.0	1.8	-6.2
Rajasthan	21.3	15.2	-6.1	7.2	2.4	-4.8
UP	17.4	14.4	-3.0	2.7	3.0	0.3
Chhattisgarh	10.0	5.1	-4.9	1.4	1.2	-0.2
MP	15.3	10.7	-4.6	1.4	1.8	0.4
WB	20.1	17.8	-2.3	6.4	4.4	-2.0
Jharkhand	3.6	7.2	3.6	0.4	0.2	-0.2
Odisha	9.7	5.7	-4.0	1.3	0.8	-0.5
Bihar	10.6	5.7	-4.9	0.9	0.9	0.0
Sikkim	20.7	10.8	-9.9	3.3	0.0	-3.3
Arunachal	25.5	17.8	-7.7	3.6	1.4	-2.2
Nagaland	31.9	10.7	-21.2	3.2	1.0	-2.2
Manipur	21.4	17.6	-3.8	3.4	2.4	-1.0
Mizoram	39.1	33.9	-5.2	19.6	4.8	-14.8
Tripura	29.9	24.4	-5.5	6.9	4.5	-2.4
Meghalaya	35.0	32.4	-2.6	13.0	4.9	-8.1
Assam	13.3	11.3	-2.0	1.5	3.0	1.5
Gujarat	12.8	8.9	-3.9	1.4	2.1	0.7
Maharashtra	6.8	3.5	-3.3	0.7	0.3	-0.4
Goa	5.3	2.1	-3.2	0.0	0.0	0.0
AP	19.3	16.5	-2.8	2.5	1.2	-1.3
Telangana		9.2			1.2	
Karnataka	13.3	8.4	-4.9	2.6	0.9	-1.7
Kerala	10.1	8.0	-2.1	1.7	1.4	-0.3
Tamil Nadu	9.0	10.9	1.9	1.9	1.7	-0.2
Puducherry	9.2	7.5	-1.7	1.3	1.2	-0.1
India	13.9	11.0	-2.9	2.5	1.9	-0.6

*The percentages are derived after applying sample weights. GATS=Global Adult Tobacco Survey.

Table 3. Change in daily smoking and Hardcore smoking between GATS 1 and GATS 2- Males.

States	Current daily smoking (%)			Hardcore Smoking (%)		
	GATS-1	GATS-2	Absolute Change	GATS-1	GATS-2	Absolute Change
J&K	40.1	38.8	-1.3	3.4	8.1	4.7
HP	36	27.7	-8.3	6.3	3.8	-2.5
Punjab	11.8	13.6	1.8	3.7	0.8	-2.9
Chandigarh	20	15.0	-5.0	7.5	2.5	-5.0
Uttarakhand	39.7	35.0	-4.7	5.8	7.3	1.5
Haryana	41.9	39.3	-2.6	12.9	6.7	-6.2
Delhi	32.7	16.4	-16.3	14.3	3.2	-11.1
Rajasthan	36.1	25.7	-10.4	13.6	4.4	-9.2
UP	27.6	24.8	-2.8	4.8	5.2	0.4
Chhattisgarh	15.4	10.4	-5.0	2.3	2.5	0.2
MP	27.4	20.0	-7.4	2.5	3.5	1.0
WB	36.7	33.7	-3.0	12	8.5	-3.5
Jharkhand	6.3	12.8	6.5	0.7	0.5	-0.2
Odisha	18.5	11.0	-7.5	2.5	1.7	-0.8
Bihar	11.9	7.1	-4.8	1	1.3	0.3
Sikkim	25	15.0	-10.0	0	0	0.0
Arunachal	39.3	28.9	-10.4	6.9	2.6	-4.3
Nagaland	47.1	20.8	-26.3	5.9	1.9	-4.0
Manipur	29.3	29.3	0.0	5.2	4.9	-0.3
Mizoram	58.3	51.6	-6.7	37.5	9.4	-28.1
Tripura	45.1	39.3	-5.8	12.1	8.1	-4.0
Meghalaya	64.7	58.3	-6.4	25	9.9	-15.1
Assam	24	21.3	-2.7	2.9	5.3	2.4
Gujarat	23.8	16.5	-7.3	2.7	3.9	1.2
Maharashtra	12.6	5.3	-7.3	1.3	0.6	-0.7
Goa	8.2	4.3	-3.9	0.0	0.0	0.0
AP	33.9	27.7	-6.2	5.2	2.4	-2.8
Telangana		17.2			2.4	
Karnataka	26.3	15.9	-10.4	5.2	1.7	-3.5
Kerala	21.4	17.2	-4.2	3.6	3.0	-0.6
Tamil Nadu	17.9	22.0	4.1	3.8	3.5	-0.3
Puduchery	18.4	13.2	-5.2	2.6	2.6	0.0
India	23.9	19.6	-4.3	4.7	3.6	-1.1

*The percentages are derived after applying sample weights. GATS= Global Adult Tobacco Survey; HCS= Hardcore smoking; J&K= Jammu and Kashmir; HP= Himachal Pradesh; UP= Uttar Pradesh; MP= Madhya Pradesh; WB= West Bengal; AP= Andhra Pradesh

Table 4. Change in current daily smoking and hard-core smoking between GATS 1 and GATS 2 – Females.

States	Current daily smoking (%)			Hardcore Smoking (%)		
	GATS-1	GATS-2	Absolute Change	GATS-1	GATS-2	Absolute Change
J&K	8.9	5.4	-3.5	0.0	0.6	0.6
HP	4.0	1.9	-2.1	0.6	0.5	-0.1
Punjab	0.4	0.4	0.0	0.0	0.1	0.1
Chandigarh	0.0	0.0	0.0	0.0	0.0	0.0
Uttarakhand	5.0	7.1	2.1	0.0	0.7	0.7
Haryana	5.5	5.3	-0.2	0.0	0.1	0.1
Delhi	2.6	2.1	-0.5	0.0	0.2	0.2
Rajasthan	5.9	4.2	-1.7	0.6	0.2	-0.4
UP	6.3	3.6	-2.7	0.4	0.6	0.2
Chhattisgarh	4.1	0.1	-4.0	0.4	0.0	-0.4
MP	2.4	1.0	-1.4	0.2	0.0	-0.2
WB	2.4	1.1	-1.3	0.4	0.1	-0.3
Jharkhand	0.9	1.5	0.6	0.0	0.0	0.0
Odisha	1.0	0.1	-0.9	0.1	0.0	-0.1
Bihar	9.3	4.3	-5.0	0.8	0.5	-0.3
Sikkim	14.3	5.9	-8.4	0.0	0.0	0.0
Arunachal	11.1	5.7	-5.4	0.0	0.0	0.0
Nagaland	13.3	0.0	-13.3	0.0	0.0	0.0
Manipur	13.8	6.0	-7.8	1.7	0.0	-1.7
Mizoram	19.0	12.9	-6.1	4.3	3.2	-1.1
Tripura	13.3	9.9	-3.4	1.2	0.9	-0.3
Meghalaya	4.1	5.7	1.6	0.0	0.0	0.0
Assam	1.6	1.0	-0.6	0.0	0.6	0.6
Gujarat	1.1	0.7	-0.4	0.0	0.1	0.1
Maharashtra	0.0	1.6	1.6	0.0	0.0	0.0
Goa	0.0	0.0	0.0	0.0	0.0	0.0
AP	5.3	5.8	0.5	0.0	0.0	0.0
Telangana		1.7			0.0	
Karnataka	0.3	0.9	0.6	0.0	0.0	0.0
Kerala	0.0	0.3	0.3	0.0	0.0	0.0
Tamil Nadu	0.1	0.1	0.0	0.0	0.0	0.0
Puduchery	0.0	0.0	0.0	0.0	0.0	0.0
India	3.3	2.2	-1.1	0.2	0.2	0.0

*The percentages are derived after applying sample weights.

GATS= Global Adult Tobacco Survey; HCS= Hardcore smoking; J&K= Jammu and Kashmir; HP= Himachal Pradesh; UP= Uttar Pradesh; MP= Madhya Pradesh; WB= West Bengal; AP= Andhra Pradesh

Table 5. Factors associated with HCS in GATS 1: Results of Binary logistic regression analysis (N= 56006).

Factors	Hard-core smokers (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p value
1. Socio-demographic characteristics				
<i>A. Gender</i>				
Female	0.2	Reference	Reference	
Male	4.7	2.83(2.19-3.66)	2.57(1.92-3.45)	<0.001
<i>B. Type of residence</i>				
Urban	1.9	Reference	Reference	
Rural	2.8	1.04(0.91-1.19)	1.23(1.06-1.44)	0.008
<i>C. Occupation</i>				
Not working	0.8	Reference	Reference	
Working	3.7	1.68(1.42-1.99)	1.37(1.12-1.67)	0.002
<i>D. Education</i>				
Graduation and above	0.8	Reference	Reference	
Education up to Higher secondary	2.6	2.02(1.45-2.83)	1.33(0.92-1.92)	0.129
No formal schooling	2.7	2.11(1.51-2.97)	1.34(0.91-1.96)	0.134
<i>E. Age group in years</i>				
25–35 years	1.5	Reference	Reference	
36–45 years	3.1	1.45(1.25-1.68)	1.30(1.11-1.54)	0.001
45 years and above	3.2	1.33(1.16-1.54)	1.35(1.15-1.57)	<0.001
<i>F. Wealth index</i>				
Richest	1.4	Reference	Reference	
Poorest	2.7	1.29(1.05-1.59)	1.29(1.01-1.65)	0.043
Poor	3.2	1.55(1.29-1.87)	1.51(1.21-1.89)	<0.001
Middle	3.4	1.85(1.53-2.24)	1.86(1.49-2.32)	<0.001
Rich	2.8	1.58(1.34-1.87)	1.51(1.24-1.82)	<0.001
2. Smoking related factors (n=10680)				
<i>Age of smoking initiation</i>				
20 years and above	15.2	Reference	Reference	
Below 20 years	20.3	1.42(1.26-1.61)	1.35(1.19-1.54)	<0.001
3. Environmental factors				
<i>A. Second-hand smoke exposure</i>				
<i>1. Smoking practices inside home</i>				
Never allowed	0.4	Reference	Reference	
Allowed	5.9	4.16(3.29-5.27)	2.86(2.23-3.68)	<0.001
Not allowed but exceptions	1.0	1.61(1.84-2.19)	1.53(1.11-2.12)	0.010
No Rules	2.9	2.52(1.94-3.27)	2.09(1.58-2.76)	<0.001

GATS= Global Adult Tobacco Survey; HCS= Hardcore smoking; OR= odds ratio; CI= confidence interval.

Factors associated with hardcore smoking in India based on regression analysis of GATS 2 data are presented in [Table 6](#). Males, working adults and those without any formal schooling were more likely to report hardcore smoking compared to their counterparts similar to GATS 1. However, the rural urban difference in hardcore smoking was not significant in GATS 2. With regard to the age group, those who were in the

age group of more than 45 years reported hardcore smoking more than those in the age group of 25–35 years. Regarding the wealth index categories, those who belonged to the poorest, poor and the middle group categories were more likely to report hardcore smoking compared to the richest wealth index group. Adults who initiated smoking below 20 years were more likely to report hardcore smoking compared to those

Table 6. Factors associated with HCS among individuals aged 25 years and above in GATS 2 (N=60837).

Factors	Hardcore smokers (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p value
1.Socio-demographic Characteristics				
<i>A. Gender</i>				
Female	0.2	Reference	Reference	
Male	3.6	2.27(1.75-2.96)	3.04(2.19-4.22)	<0.001
<i>B. Type of residence</i>				
Urban	1.3	Reference	Reference	
Rural	2.2	1.19(1.03-1.36)	1.16(0.98-1.35)	0.073
<i>C. Occupation</i>				
Not working	0.6	Reference	Reference	
Working	2.8	1.25(1.06-1.49)	1.22(1.01-1.22)	0.050
<i>D. Education</i>				
Graduation and above	0.3	Reference	Reference	
Education up to Higher secondary	1.9	2.86(1.86-4.41)	1.76(1.12-2.77)	0.014
No formal schooling	2.4	3.54(2.29-5.46)	1.94(1.22-3.08)	0.005
<i>E. Age group in years</i>				
25–35 years	1.0	Reference	Reference	
36–45 years	1.8	1.26(1.06-1.50)	1.11(0.92-1.34)	0.261
45 years and above	2.9	1.67(1.44-1.95)	1.54(1.31-1.83)	<0.001
<i>F. Wealth index</i>				
Richest	1.2	Reference	Reference	
Poorest	3.0	1.45(1.23-1.72)	1.39(1.14-1.69)	0.001
Poor	2.7	1.42(1.17-1.72)	1.36(1.10-1.69)	0.005
Middle	2.6	1.48(1.24-1.76)	1.31(1.08-1.58)	0.006
Rich	1.8	1.17(0.97-1.41)	1.12(0.92-1.37)	0.241
2.Smoking related factors (n=8834)				
<i>Age of smoking initiation</i>				
20 years and above	14.7	Reference	Reference	
Below 20 years	19.4	1.39(1.23-1.58)	1.33(1.17-1.52)	<0.001
3.Environmental factors				
<i>A. Second-hand smoke exposure</i>				
<i>1.Smoking practices inside home</i>				
Never allowed	0.5	Reference	Reference	
Allowed	5.4	2.87(2.40-3.43)	2.26(1.87-2.72)	<0.001
Not allowed but exceptions	1.3	1.08(0.85-1.38)	0.98(0.76-1.25)	0.849
No Rules	2.5	2.21(1.78-2.75)	1.92(1.52-2.41)	<0.001

GATS= Global Adult Tobacco Survey; HCS= Hardcore smoking; OR= odds ratio; CI= confidence interval.

who initiated after 20 years. With regard to smoking practices inside the home, those who did not have any rules and those who allowed smoking inside their home were more likely to report hardcore smoking similar to GATS 1.

The percentage of hardcore smokers across wealth quintiles among individuals aged 25 years and above in GATS 1 and

GATS 2 is given in [Figure 1](#). Only in the poorest wealth quintile was there an increase in the proportion of hardcore smokers in GATS 2 compared to GATS 1.

The proportion of hardcore smokers among current daily smokers and the changes between GATS 1 and GATS 2 are given in [Table 7](#). There was an overall reduction of 0.8% in

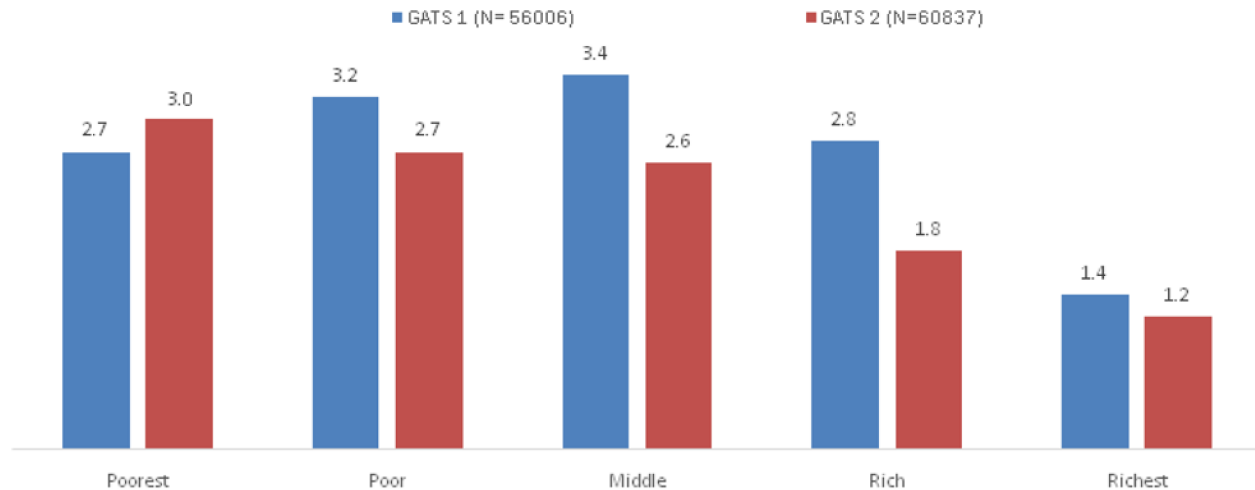


Figure 1. Percentage of hardcore smokers across wealth quintiles among individuals aged 25 years and above in GATS 1 and GATS 2. *The percentages are derived after applying sample weights. GATS= Global Adult Tobacco Survey.

the percentage of hardcore smokers among current daily smokers in India in GATS 2 compared to GATS 1. In 11 states and union territories there was increase in the proportion of hardcore smokers ranging from 0.5% in Kerala to 15% in Assam. In all other states and union territories there was decrease in the proportion of hardcore smoking. In Goa the proportion of hardcore smokers remained zero in both GATS 1 and 2.

Discussion

There were reductions in the prevalence of current daily smoking and hardcore smoking in India during the period between GATS 1 and GATS 2. A relative reduction of hardcore smoking prevalence of 24% was more than the 20.9% reduction in current daily smoking indicating softening of smoking rather than hardening during the period from GATS 1 to GATS 2. Compared to the GATS 1 data hardcore smoking increased only in the poorest wealth group in GATS 2 while in all the other wealth groups, hardcore smoking decreased demonstrating a greater accumulation of hardcore smokers in the poorest group as reported from Australia⁸. Current smoking prevalence was also reported to be highest among the poorest groups in India¹⁴. While the proportion of hardcore smokers in the poorest group remained high after a period of seven years between GATS 1 and GATS 2, in all the other wealth groups, there was a decline. Tobacco control measures need to focus on people belonging to the poorest group and offer them help to quit tobacco since they are likely to be more resistant to comply as reported recently in a US study¹⁶.

In GATS 1 the association between hardcore smoking and the wealth groups did not show a gradient. Compared to the richest wealth group those belonging to the middle wealth group showed the highest odds of reporting hardcore smoking whereas in GATS 2 the odds of reporting hardcore smoking increased with decreasing wealth index. The accumulation of hardcore smokers was gradually shifting to the poorest group

in GATS 2. While there was an overall decrease in hardcore smoking some population groups such as those belonging to the poorest section of the society seem to continue hardcore smoking. It may be important to initiate tailor made tobacco cessation efforts for smokers in the low SES groups.

While majority of the Indian states reported reduction in hardcore smokers a few states such as Jammu and Kashmir, UP, Bihar, Chhattisgarh, MP, Uttarakhand, Assam and Gujarat reported an increase in the prevalence of hardcore smokers. Respondents from the state of Goa did not report hardcore smoking in both the surveys, and there was a reduction in the current daily smoking prevalence. This highlights the importance of implementation of Cigarettes and Other Tobacco Products Act (COTPA) in all states particularly those where there was increase in hardcore smoking. In the states where there was an increase in hardcore smoking there was reduction in current daily smoking during the same period. In Odisha and Kerala, interesting findings were observed. Both the states had an overall reduction in the current smokers and hardcore smokers as a percentage among total sample ≥ 25 years. However, the percentage of hardcore smokers within current smokers from GATS 1 to GATS 2 has grown in Odisha and Kerala with a relative increase of 9.6% and 3.0%, respectively. This could be due to the accumulation of hardcore smokers when the overall prevalence of smoking reduced as reported in the Australian study⁸. Only three states reported an increase in current daily smoking: Punjab, Jharkhand and Tamil Nadu. In all these three states there was reduction in hardcore smoking.

Since smoking in India and most south Asian countries is predominantly a male behavior it is important to see the trends in hardcore smoking among males. Among the states where there was increase in hardcore smoking in the total population, Jammu & Kashmir, Chhattisgarh, Uttar Pradesh and Bihar etc.,

Table 7. Change in proportion of hardcore smokers among current daily smokers aged >= 25 years between GATS-1 and GATS-2.

States	GATS-1		GATS-2		% Change in Hardcore smokers among current daily smokers from GATS 1 to GATS 2
	% of Current Daily Smokers among adults ≥ 25 years	% of Hardcore smokers among current daily smokers	% of Current Daily Smokers among adults ≥ 25 years	% of Hardcore smokers among current daily smokers	
J&K	25.4	7.2	23	20	12.8
HP	19.8	17.4	14.5	14.5	-2.9
Punjab	6.3	30.3	7.2	6.5	-23.8
Chandigarh	11.4	37.5	8.2	14.3	-23.2
Uttarakhand	27.9	13.7	20.9	19	5.3
Haryana	24.6	27.6	22.8	15.7	-11.9
Delhi	19.3	41.2	9.6	18.5	-22.7
Rajasthan	21.3	33.8	15.2	15.7	-18.1
UP	17.4	15.6	14.4	20.5	4.9
Chhattisgarh	10	14.1	5.1	23.9	9.8
MP	15.3	9.3	10.7	16.4	7.1
WB	20.1	31.8	17.8	24.9	-6.9
Jharkhand	3.6	10.4	7.2	3.2	-7.2
Odisha	9.7	13.5	5.7	14.8	1.3
Bihar	10.6	8.5	5.7	16.1	7.6
Sikkim	20.7	14.3	10.8	0.0	-14.3
Arunachal	25.5	14.3	17.8	7.7	-6.6
Nagaland	31.9	9.7	10.7	9.1	-0.6
Manipur	21.4	16	17.6	13.8	-2.2
Mizoram	39.1	50	33.9	15.0	-35
Tripura	29.9	23.1	24.4	18.5	-4.6
Meghalaya	35	37.1	32.4	15.2	-21.9
Assam	13.3	11.3	11.3	26.3	15
Gujarat	12.8	10.7	8.9	23.4	12.7
Maharashtra	6.8	10.1	3.5	8.7	-1.4
Goa	5.3	0.0	2.1	0.0	0
AP	19.3	13.1	16.5	7.2	-5.9
Telangana	NA	NA	9.2	12.8	NA
Karnataka	13.3	19.7	8.4	10.2	-9.5
Kerala	10.1	16.7	8	17.2	0.5
Tamil Nadu	9	21.12	10.9	15.8	-5.4
Puducherry	9.2	12.5	7.5	16.7	4.2
India	13.9	18	11	17.2	-0.8

*The percentages are derived after applying sample weights. GATS= Global Adult Tobacco Survey; HCS= Hardcore smoking; J&K= Jammu and Kashmir; HP= Himachal Pradesh; UP= Uttar Pradesh; MP= Madhya Pradesh; WB= West Bengal; AP= Andhra Pradesh

also reported an increase in hardcore smoking among males, although the increase was small. In Puducherry there was no change in hardcore smoking among males during this period.

Hardcore smoking was not reported by females in several states in GATS 2. However, a few states namely Jammu and Kashmir, Punjab, Uttarakhand, Haryana, Delhi, UP, Assam, and Gujarat reported an increase in hardcore smoking indicating an unhealthy hardcore smoking trend in women. The increasing trend in smoking among women in India was reported earlier also¹⁷. This could be due to the targeting of women and people belonging to low socioeconomic group by the tobacco companies circumventing the tobacco control laws in India as reported earlier¹⁸.

In GATS 1 the major factors associated with hardcore smoking were male gender, rural residents, working adults, older adults, those who initiated smoking before 20 years and those with no schooling or low education. Significance of urban rural difference of hardcore smoking disappeared in GATS 2. This was because of the reduced prevalence of hardcore smoking in both rural and urban areas in GATS 2 compared to the GATS 1. Those who initiated smoking before 20 years were more likely to report hardcore smoking in both GATS 1 and GATS 2 which was in the expected lines since early initiation has been reported to result in tobacco addiction more often than later initiation of smoking¹⁹.

Regarding smoking practices inside home, in both GATS 1 and GATS 2 hardcore smoking was more likely to be reported where smoking was allowed inside home, where there were no rules for smoking inside home or there were exemptions for the rule compared to those households where smoking was not allowed inside the home. This is a very positive finding that can be replicated in several Indian and other similar settings. It was already reported that such smoke free home initiatives of not allowing smoking inside home in Kerala State of India²⁰ and Indonesia²¹ were successfully implemented.

Although the use of the term hardcore smoking and hardening has been challenged recently²² researchers continue to report hardcore smoking and the groups in which this continues to be a problem. The strength of this study was the large representative data of the entire country. A limitation was that tobacco use was self-reported and there was no validation by bio-chemical measures such as cotinine estimation.

Conclusions

This study based on GATS 1 and GATS 2 data found that there was reduction in current daily smoking and hardcore smoking in India during the period between the two surveys. Although there was reduction in current daily smoking and hardcore smoking in the country as a whole a few states namely Punjab, Jharkhand and Tamil Nadu reported an increase in current daily smoking and six states namely Jammu and Kashmir, UP, MP, Uttarakhand, Assam and Gujarat reported an increase

in hardcore smoking. In all these six states where there was increase in hardcore smoking, current daily smoking prevalence decreased probably due to the accumulation of hardcore smokers as a result of reduced prevalence of current daily smokers. It was also seen that only in the poorest wealth group there was an increase in the hardcore smoking during the period between GATS 1 and GATS 2. In all other wealth groups, there was reduction in hardcore smoking. This is similar to the finding of the study from Australia that when current smoking prevalence decreases there is likely to be an accumulation of hardcore smokers particularly in the poorest socioeconomic groups. Tobacco control and cessation measures need to be implemented focusing on people belonging to the poorest socioeconomic groups in India.

Data availability

Underlying data

Open Science Framework: Trends and Correlates of Hardcore Smoking in India- Findings from Global Adult Tobacco Survey 1 & 2. <https://doi.org/10.17605/OSF.IO/FRBQ5>¹⁰.

This project contains the following underlying data:

- Global Adult Tobacco Survey 1 data (extracted and cleaned as per study objective)
- Global Adult Tobacco Survey 1 code book
- Global Adult Tobacco Survey 2 data (extracted and cleaned as per study objective)
- Global Adult Tobacco Survey 2 code book

Data description: The dataset comprises the data from Round 1 and Round 2 of Global Adult Tobacco Survey (GATS) conducted in India. The data sets comprise the variables which were extracted and cleaned as per the objective of the study. The original data sets of GATS surveys are available in the public domain and are accessible at <https://nced.cdc.gov/GTSSDataSurveyResources/Ancillary/DataReports.aspx?CAID=2>.

The data set includes the following variables:

1. Sample weights of the data
2. Variables on socio-demographic characteristics of the participants (gender, age, residence, educational status, state, occupational status etc.)
3. Variables Concerning smoking status of the participants (current smoking status, age of initiating smoking)
4. Variables concerning hardcore smoking status of the participants
5. Variables concerning wealth index of the participants.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

References

1. GBD 2019 Tobacco Collaborators: **Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990-2019: a systematic analysis from the Global Burden of Disease Study 2019.** *Lancet.* 2021; **397**(10292): 2337–2360.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
2. Sreeramareddy CT, Aye SN: **Changes in adult smoking behaviours in ten global adult tobacco survey (GATS) countries during 2008-2018 - a test of 'hardening' hypothesis.** *BMC Public Health.* 2021; **21**(1): 1209.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
3. Edwards R: **Hardening is dead, long live softening; time to focus on reducing disparities in smoking.** *Tob Control.* 2019; tobaccocontrol-2019-054937.
[PubMed Abstract](#) | [Publisher Full Text](#)
4. Brennan E, Greenhalgh EM, Durkin SJ, *et al.*: **Hardening or softening? An observational study of changes to the prevalence of hardening indicators in Victoria, Australia, 2001-2016.** *Tob Control.* 2019; tobaccocontrol-2019-054937.
[PubMed Abstract](#) | [Publisher Full Text](#)
5. Lund M, Lund KE, Kvaavik E: **Hardcore smokers in Norway 1996-2009.** *Nicotine Tob Res.* 2011; **13**(11): 1132–9.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
6. Yin S, Ahluwalia IB, Palipudi K, *et al.*: **Are there hardened smokers in low- and middle-income countries? Findings from the Global Adult Tobacco Survey.** *Tob Induc Dis.* 2019; **17**: 11.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
7. Buchanan T, Magee CA, V See H, *et al.*: **Tobacco harm reduction: are smokers becoming more hardcore?** *J Public Health Policy.* 2020; **41**(3): 286–302.
[PubMed Abstract](#) | [Publisher Full Text](#)
8. Clare P, Bradford D, Courtney RJ, *et al.*: **The relationship between socioeconomic status and 'hardcore' smoking over time--greater accumulation of hardened smokers in low-SES than high-SES smokers.** *Tob Control.* 2014; **23**(e2): e133–8.
[PubMed Abstract](#) | [Publisher Full Text](#)
9. **Tata Institute of Social Sciences (TISS), Mumbai and Ministry of Health and Family Welfare, Government of India. Global Adult Tobacco Survey GATS 2 India 2016-17.**
[Reference Source](#)
10. Mathews E: **Trends and Correlates of Hardcore Smoking in India-Findings from Global Adult Tobacco Survey 1 & 2.** 2021.
<http://www.doi.org/10.17605/OSF.IO/FRBQ5>
11. Kishore J, Jena PK, Bandyopadhyay C, *et al.*: **Hardcore smoking in three South-East Asian countries: results from the global adult tobacco survey.** *Asian Pac J Cancer Prev.* 2013; **14**(2): 625–30.
[PubMed Abstract](#) | [Publisher Full Text](#)
12. Sreeramareddy CT, Hon J, Abdulla AM, *et al.*: **Hardcore smoking among daily smokers in male and female adults in 27 countries: A secondary data analysis of global adult tobacco surveys (2008-2014).** *J Glob Health Rep.* 2018; **2**: e2018019
[Publisher Full Text](#)
13. Palipudi KM, Sinha DN, Choudhury S, *et al.*: **Predictors of tobacco smoking and smokeless tobacco use among adults in Bangladesh.** *Indian J Cancer.* 2012; **49**(4): 387.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
14. Thakur JS, Prinja S, Bhatnagar N, *et al.*: **Widespread inequalities in smoking & smokeless tobacco consumption across wealth quintiles in States of India: Need for targeted interventions.** *Indian J Med Res.* 2015; **141**(6): 789–98.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
15. Palipudi KM, Gupta PC, Sinha DN, *et al.*: **Social determinants of health and tobacco use in thirteen low and middle income countries: evidence from Global Adult Tobacco Survey.** *PLoS One.* 2012; **7**(3): e33466.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
16. Brett EI, Chavarria J, Liu M, *et al.*: **Effects of a brief motivational smoking intervention in non-treatment seeking disadvantaged Black smokers.** *J Consult Clin Psychol.* 2021; **89**(4): 241–250.
[PubMed Abstract](#) | [Publisher Full Text](#)
17. Goel S, Tripathy JP, Singh RJ, *et al.*: **Smoking trends among women in India: Analysis of nationally representative surveys (1993-2009).** *South Asian J Cancer.* 2014; **3**(4): 200–2.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
18. Bansal R, John S, Ling PM: **Cigarette advertising in Mumbai, India: targeting different socioeconomic groups, women, and youth.** *Tob Control.* 2005; **14**(3): 201–6.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
19. Darville A, Hahn EJ: **Hardcore smokers: what do we know?** *Addict Behav.* 2014; **39**(12): 1706–12.
[PubMed Abstract](#) | [Publisher Full Text](#)
20. Nichter M, Padmajam S, Nichter M, *et al.*: **Developing a smoke free homes initiative in Kerala, India.** *BMC Public Health.* 2015; **15**: 480.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
21. Padmawati RS, Prabandari YS, Istiyani T, *et al.*: **Establishing a community-based smoke-free homes movement in Indonesia.** *Tob Prev Cessat.* 2018; **4**: 36.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
22. West R, Jarvis MJ: **Is 'hardcore smoker' a useful term in tobacco control?** *Addiction.* 2018; **113**(1): 3–4.
[PubMed Abstract](#) | [Publisher Full Text](#)

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Coral Gartner

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This study analyses two waves of the GATS to examine changes in the prevalence of Hardcore smoking over time in India.

My main comment is related to the definition of 'Hardcore Smoking' employed in the manuscript. I don't understand why lack of knowledge of harmful effects of smoking is considered an attribute of HCS. It could be considered more 'hardcore' to know that smoking is harmful but to continue regardless than through lack of awareness. I don't think that including lack of awareness of health impacts of smoking is a useful measure of HCS. It would be good to demonstrate what the results would be if this part of the definition were omitted.

Minor issues:

- "Smoking was attributed to..." - I believe this should be phrased the other way around, i.e., the deaths were attributed to smoking not smoking attributed to the deaths.
- I was surprised to see no mention of smokeless tobacco in the discussion, given high rates of smokeless tobacco use in India compared to other countries mentioned in the manuscript (e.g. Australia).

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology, tobacco control policy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 25 February 2022

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Anish Thekkumkara Surendran Nair 

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Approved.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.**Reviewer Expertise:** Epidemiology, public health and infectious disease epidemiology**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.****Version 1**

Reviewer Report 21 January 2022

<https://doi.org/10.21956/wellcomeopenres.19313.r47827>

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**Anish Thekkumkara Surendran Nair** 

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It is a nice analysis of GATS data to check the relationship between Socio-economic status and prevalence of hard core smoking. The quality of the paper may get better if the authors are able to address the following issues:

1. It is not clear that why the authors took 25 years as a cut-off. "Age plays a role in hardening of smoking" is given as the reason to avoid younger age group, but it appears to be a reason for the importance of including people less than 25 also in the study. Reference number 10 given by the authors also argues the importance of young smokers in India. It is indicated in the first table of the current article that more than one-third of habitual smokers in India acquire that habit in an early age even less than 20 years. The prevalence estimations of the authors could also be incomparable to other studies because of a different age cut-off used other than that of GATS. So a stratified analysis of people less than 25 could also be added. Or it may be mentioned even in the title that the data is applicable to above 25 year old only.
2. Trend in HCC across socio-economic groups may be statistically tested as it is one of the objectives of the study.
3. Figure 3 appears to be confusing. A table may be more helpful for the readers.
4. Unadjusted risk ratios/OR could also be given in tables 5 and 6. It will help the readers to measure the confounding by external factors.

5. One of the major findings, compared to GATS 1 a socio-economic grading is noticed in prevalence of HCS (as moving from richest quintile the risk ratio increases) may be discussed. Now it may be more important to target the low SES group and targeted approaches may be initiated for people in low SES.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: Dr. K. R. Thankappan is known to me. They happened to be the editor of an article to which I am one of the authors:

<https://www.frontiersin.org/articles/10.3389/fpubh.2021.747065/full>.

Reviewer Expertise: Epidemiology, public health and infectious disease epidemiology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Comments on this article

Version 1

Author Response 13 Feb 2022

Elezebeth Mathews, Central University of Kerala, Kasaragod, India

We have addressed the reviewer comments and revised the earlier version of the published manuscript. The following changes are made:

1. The following sentence is added in the revised manuscript, "We included smokers aged 25 years

and above because the majority of the studies on hardcore smoking included smokers aged 25 years and above and, in many studies, the hardcore smoking definition included at least 5-6 years of smoking history⁷."

2. We have included the trend in hardcore smoking across socio-economic groups and the unadjusted odds ratio is reported (Table 5 and 6).

3. We have also added a new table (table 7) replacing Figure 2 on the change in the proportion of hardcore smokers among current daily smokers aged ≥ 25 years between GATS-1 and GATS-2.

4. We have added a new sentence as the last sentence in the second para of the discussion section. "It may be important to initiate tailor-made tobacco cessation efforts for smokers in the low SES groups."

Competing Interests: None
