


Trends in the prevalence and factors associated with indoor smoking in 24 countries Party to the WHO FCTC: implications for equitable policy implementation

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ABSTRACT

Introduction The health consequences of secondhand smoke (SHS) are a long-standing concern. The WHO Framework Convention on Tobacco Control (FCTC) is an evidence-based treaty that aims to protect people from health and environmental harms of commercial tobacco use and exposure to SHS. This study quantified the prevalence of daily smoking inside the house (indoor smoking) and change over time and examined the determinants of indoor smoking in 24 WHO FCTC Parties. **Methods** We used data from the 2 most recent Demographic and Health Surveys (DHS) from 24 countries. Countries were selected if they submitted at least one FCTC implementation report and had two DHS surveys conducted after 2010. The weighted prevalence and percentage changes in daily indoor smoking in the two consecutive surveys were calculated, including rate of change, and a two-sample test of proportions was used to assess changes. Multinomial logistic regression model was employed to examine the association between socioeconomic characteristics and indoor smoking. All results were presented by country. **Results** A significant decline in the prevalence of daily indoor smoking was detected in 16/24 countries, with the rate of decline ranging from -45.8% in Liberia to -15.2% in India. Jordan reported a significant increase in daily indoor smoking from 57% to 60%; $p=0.002$. The meta-analytical estimate showed that overall, the relative risk ratio (RRR) of daily indoor smoking was significantly lower for households in the 5th wealth quintile compared with counterparts in the 1st quintile (RRR=0.40; 95% CI: 0.30 to 0.52), and in households where head of the household attended higher education compared with no formal education (RRR=0.60; 95% CI: 0.53 to 0.69). **Conclusions** This study demonstrated that prevalence of daily indoor smoking was associated with low socioeconomic status. Reducing SHS exposure is critical, including addressing inequities to help improve health outcomes. Currently, over 2.8 billion people in low-income countries are not protected by smoke-free environment laws, and only 18% of the world's population is covered by strong restrictions on tobacco marketing.

Results A significant decline in the prevalence of daily indoor smoking was detected in 16/24 countries, with the rate of decline ranging from -45.8% in Liberia to -15.2% in India. Jordan reported a significant increase in daily indoor smoking from 57% to 60%; $p=0.002$. The meta-analytical estimate showed that overall, the relative risk ratio (RRR) of daily indoor smoking was significantly lower for households in the 5th wealth quintile compared with counterparts in the 1st quintile (RRR=0.40; 95% CI: 0.30 to 0.52), and in households where head of the household attended higher education compared with no formal education (RRR=0.60; 95% CI: 0.53 to 0.69).

Conclusions This study demonstrated that prevalence of daily indoor smoking was associated with low socioeconomic status. Reducing SHS exposure is critical, including addressing inequities to help improve health outcomes. Currently, over 2.8 billion people in low-income countries are not protected by smoke-free environment laws, and only 18% of the world's population is covered by strong restrictions on tobacco marketing.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The Framework Convention on Tobacco Control (FCTC) is a convention that reaffirms all people's right to the highest standard of health, currently ratified by 181 countries. Article 8 of the FCTC, which mandates protection from exposure to tobacco smoke, has seen widespread global adoption, however, there is no comprehensive evidence of the progress made by the low-income and middle-income countries.

WHAT THIS STUDY ADDS

⇒ This study is among the first to investigate the trends in the prevalence and determinants of indoor smoking in multiple countries Party to the FCTC. Using nationally representative data, we demonstrated that the prevalence of indoor smoking significantly declined in two-thirds of the countries included. We also found that there existed socioeconomic disparities in exposure to secondhand smoke, with the highest exposure in households in the lowest wealth quintile and those headed by individuals with no formal education.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ While these findings are encouraging, there is a pressing need to develop, implement and evaluate effective tobacco control strategies locally, nationally and internationally to accelerate reductions in tobacco use, increase smoke-free homes and eliminate commercial tobacco-related disease and death.

INTRODUCTION

The health consequences of secondhand smoke (SHS) or involuntary tobacco smoke exposure are a long-standing concern worldwide.¹ The number of individuals who died as a result of SHS exposure increased globally between 2006 and 2016. This was primarily driven by increases in SHS-related deaths in

low-income and middle-income countries (LMICs).² SHS exposure increases the risk of developing lung cancer, coronary heart disease and stroke by 20%–30%.^{3,4} SHS inside the house impacts people who do not smoke and increases the amount of harmful chemicals received by people who smoke when compared with those not exposed to SHS at home.⁵ The impact of smoking inside the house, particularly among priority groups including infants and children, must be addressed.^{4,6} Emerging evidence showed that exposure to indoor smoking is associated with a wide range of child health outcomes, such as low birth weight,⁷ growth failure^{8,9} and myopia.^{10,11}

The health expenditures and productivity losses due to exposure to SHS are substantial.^{12,13} This includes considerable costs that occurred in LMICs, highlighting the Tobacco Industry-generated burden placed on people, communities and countries and bearing many health, social and economic inequities.^{14,15} While this is completely preventable, robust evidence on the magnitude of costs associated with SHS exposure is lacking, mainly due to paucity of data on SHS exposure-related health expenditure.

The current prevalence of tobacco use is a public health concern. The number of people who smoke aged 15 years and over is continuing to grow. For example, in the African region, the number of people who smoke has increased from 59 million in 2000 to 61 million in 2020 and is projected to increase to 62 million in 2025.¹⁶ This is because the Tobacco Industry increasingly targets LMICs with a wide range of tactics and aggressive marketing strategies.^{17–19} Between 1995 and 2012, the land used for tobacco cultivation was increased by 65.3% in LMICs,²⁰ predominantly drawing farmers away from harvesting food security-enhancing crops,²¹ with approximately 90% of tobacco farming taking place in LMICs.²² There has been a dramatic increase in Tobacco Industry interference in LMICs over time, such as weakening existing protective measures and preventing tobacco control efforts from being adopted, including public smoke-free areas and attempts to circumvent smoke and nicotine-free areas.²³

People can be exposed to SHS in homes, cars, workplace and public places.^{24,25} However, smoking inside the house exposes everyone in the house or neighbours in a multiunit setting to SHS, especially increasing health risks for priority groups such as children, pregnant women, aged and sick people as they spend most of their time inside home. Additionally, enclosed homes can concentrate tobacco smoke, leading to greater and prolonged exposure, making it ultimately more dangerous than smoking outside home. There are many factors that are associated with smoking inside the house or exposure to other's smoking inside the house. These include household's wealth status, educational status and number of cigarettes smoked per day.²⁶ Consistent with the WHO Framework Convention on Tobacco Control (FCTC), smoke-free household impacts smoking behaviours. Literature indicates that fewer young people who live

in smoke-free homes initiate smoking compared with their counterparts from home that are not smoke-free.²⁷ Encouragingly, a number of countries plan to monitor smoking and smoke drift at residential premises such as multiunit housing and public housings,^{28,29} and others have actively reduced exposure to SHS from smoking inside the house. For example, Australia's rate decreased from 31.3% in 1995 to 2.8% in 2016.³⁰ However, the Tobacco and Nicotine Industry continues to evolve with attempts to undermine smoke-free and nicotine-free policies.²³ As a result, there is a need for comprehensive empirical investigations into the prevalence of daily indoor smoking and its changes over time in LMICs. This would imply developing policies banning home or household indoor smoking at least in multiunit housing in LMICs, which is currently missing.

Article 8 of the FCTC addresses the adoption and implementation of measures against exposure to tobacco smoke in indoors, public transport and other public places, despite unequal implementation of the FCTC measures.³¹ A growing body of literature has been reporting the declining trend in the prevalence of smoking.^{16,32} However, the observed rate of decline is not equitable and LMICs bear a disproportionately greater tobacco-related burden.^{15,32} Further, 2.8 billion people in LMICs are not protected by smoke-free environment laws.³³

The objectives of this study are to quantify the prevalence of daily indoor smoking, its changes over time and to examine the determinants of smoking indoor in the WHO FCTC countries by using Demographic and Health Survey (DHS) data. This analysis offers important insights into the indoor smoking prevalence, changes over time and determinants of smoking indoors.

METHODS

Data source and sampling procedure

This study used DHS data which are typically conducted about every 5 years from 24 countries. Two most recent (consecutive) surveys conducted after 2010 were selected for analysis over time. The countries and survey years included are presented in online supplemental table S1. The DHS samples are designed to give representative estimates on a range of topics at national and subnational levels, and it is also comparable globally. The programme collects data on a range of indicators supporting the Sustainable Development Goals. The survey design is based on a stratified two-stage cluster sampling procedure with the first-stage sampling frame consisting of a list of primary sampling units (clusters) that covered the entire country. From this stage, a sample of predetermined segments is selected randomly with probability proportional to the number of clusters within each stratum. In the second stage, a complete household listing is conducted in each of the selected cluster, and then households are systematically selected from a list of enumerated households in each selected cluster

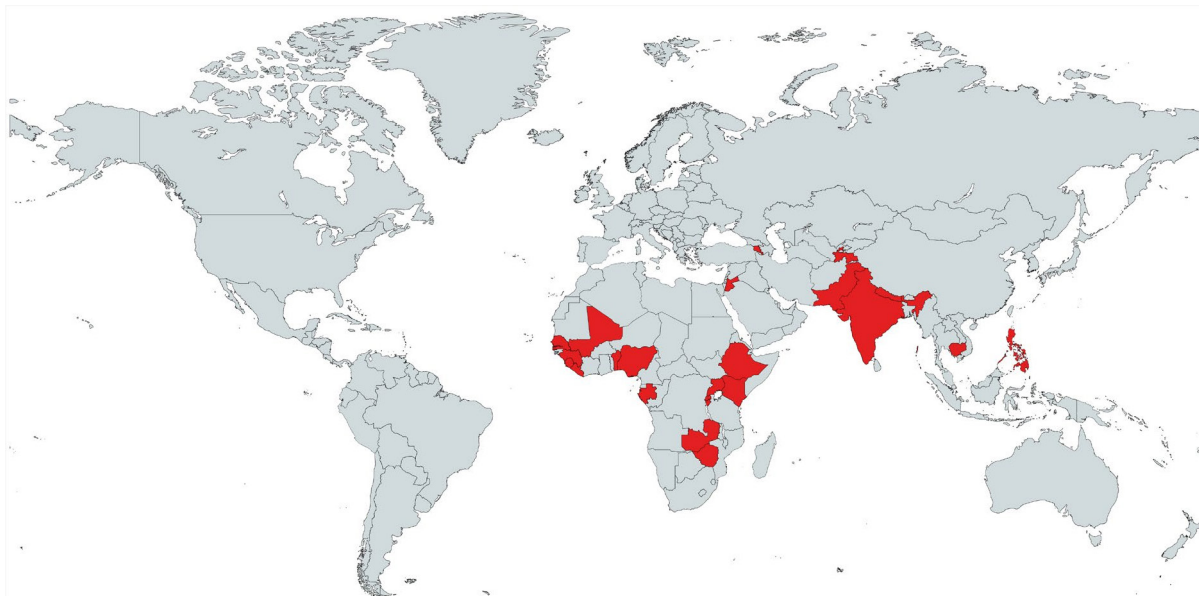


Figure 1 Map displays in red the countries included in the study. Map created at www.mapchart.net, extent trimmed for visualisation.

for face-to-face interviews. Mostly, the DHS surveys take 20–25 households in urban clusters and between 25 and 30 households in rural clusters. DHS uses a standard questionnaire and follows uniform data collection procedure including for tobacco use.

Selection criteria

Over 80 DHS surveys (countries) collected data on tobacco use. This study included countries that collected information on household members smoking inside the house (indoor smoking), ratified the WHO FCTC and submitted at least one progress report (online supplemental figure S1), two of their surveys conducted after 2010 (online supplemental table S1) and contained variables of interest (online supplemental table S2). The included surveys for trend analysis were conducted after countries had ratified the WHO FCTC, except for three countries (Ethiopia, Tajikistan and Zimbabwe) for which the included older surveys were conducted 3 years or less before they ratified the WHO FCTC. The inclusion of surveys only after countries had ratified the treaty was to ensure countries had certain degree of motivation and obligation to implement and monitor any tobacco control measures. The map in [figure 1](#) shows the 24 countries eligible for inclusion.

Outcome variable

The outcome of interest in this analysis is the frequency of household members smoke inside the house or indoor smoking, usually used to measure exposure to SHS at home. This is collected in the DHS as ‘any household member smokes inside the house’ and has five options: daily, weekly, monthly, less often than once a month or never. In this study, we examined the prevalence of daily indoor smoking over time. However, because there is no safe level of exposure to SHS, we describe the proportion

in each category and we formed three categories: (1) never, (2) daily and (3) occasionally by merging the ‘weekly, monthly and less often than once a month’ categories together to examine the determinants of indoor smoking.

Independent variables

We examined the associations between indoor smoking prevalence and socioeconomic factors, including household wealth index in quintiles (1st quintile: the lowest to the 5th quintile: highest wealth), place of residence (urban/rural), family size and sex (male/female), age (in complete year) and educational level (no formal education, primary, secondary and higher) of household head based on one recent round survey for each country. Further information on these variables is in online supplemental table S2.

Statistical analysis

Data management and analysis were performed by using Stata/MP V.18.0 and Microsoft Excel. Descriptive statistics were conducted for all variables and the trend in the proportion of daily indoor smoking was conducted based on the findings from the two consecutive surveys. The weighted prevalence of daily indoor smoking in the two consecutive surveys was calculated overall and by place of residence for each country. Percentage changes (decrease/increase) in daily indoor smoking prevalence were calculated based on the prevalence in the two consecutive surveys, and a two-sample test of proportions was used to evaluate whether those changes were statistically significant. Of the two wave surveys included in this study, the recent wave was used to examine the associations between selected socioeconomic variables and smoking inside the house. Unconstrained multinomial logistic regression model was fitted for each country

and estimates for daily and occasional indoor smoking were presented as adjusted relative risk ratio (RRR) with 95% CI. The included sociodemographic and economic factors could vary by countries, and the sample sizes in the included surveys had a wide gap (ranged from 47919 in India to 4416 in Senegal). Due to this, we fit the model for each country rather than pooling these surveys together. Never smoking inside the house provides the baseline category for comparison.

Then we conducted a separate meta-analysis for each determinant based on the RRR of daily indoor smoking obtained for each country using ‘metan’ command in STATA in accordance with Der Simonian and Laird method. The meta-analytical RRR and 95% CIs were visualised with forest plots.

Patient and public involvement

Patients and/or the public were not involved in the design or conduct or reporting of this study.

RESULTS

Most countries in this study ratified the WHO FCTC between 2005 and 2009, with two countries also ratifying in 2014. Overall, there were nine FCTC submissions by the time this study was conducted, with the latest in 2020, while the maximum report submitted by the countries in this study was seven (just one country) (online supplemental figure S1). In almost all countries, the two

selected surveys were conducted at least 5 years apart (online supplemental table S1).

Compared with the prevalence in the previous survey, the prevalence of daily indoor smoking in the recent survey decreased in 16/24 countries. The prevalence in the recent survey increased in Jordan (from 57% to 60%; $p=0.001$), and change was not detected in the remaining countries. Prevalence of daily indoor smoking was >20.0% in 12 countries in their old survey and this was reduced to 8 countries in the recent survey (figures 2 and 3 and online supplemental table S3). The rate of significant decline in daily indoor smoking prevalence ranged from 45.8% in Liberia to 15.2 in India, while the rate of increase was between 18.7% in Nigeria and 3.8% in Jordan (online supplemental figure S2).

The daily indoor smoking prevalence was generally lower in urban areas compared with rural. However, exceptions included Mali (recent survey: 24% in urban vs 14% in rural; previous survey: 23% in urban vs 16% in rural) and Senegal (recent survey: 18% in urban vs 13% in rural; previous survey: 22% in urban vs 16% in rural). The prevalence of daily indoor smoking in Jordan was 60% in urban and 57% in rural from its recent survey, whereas, in Tajikistan, it was 10% in urban and 5% in rural in its older survey. The remaining countries had greater daily indoor smoking prevalence in rural households than in urban in both of their surveys (figure 2 and online supplemental table S3).

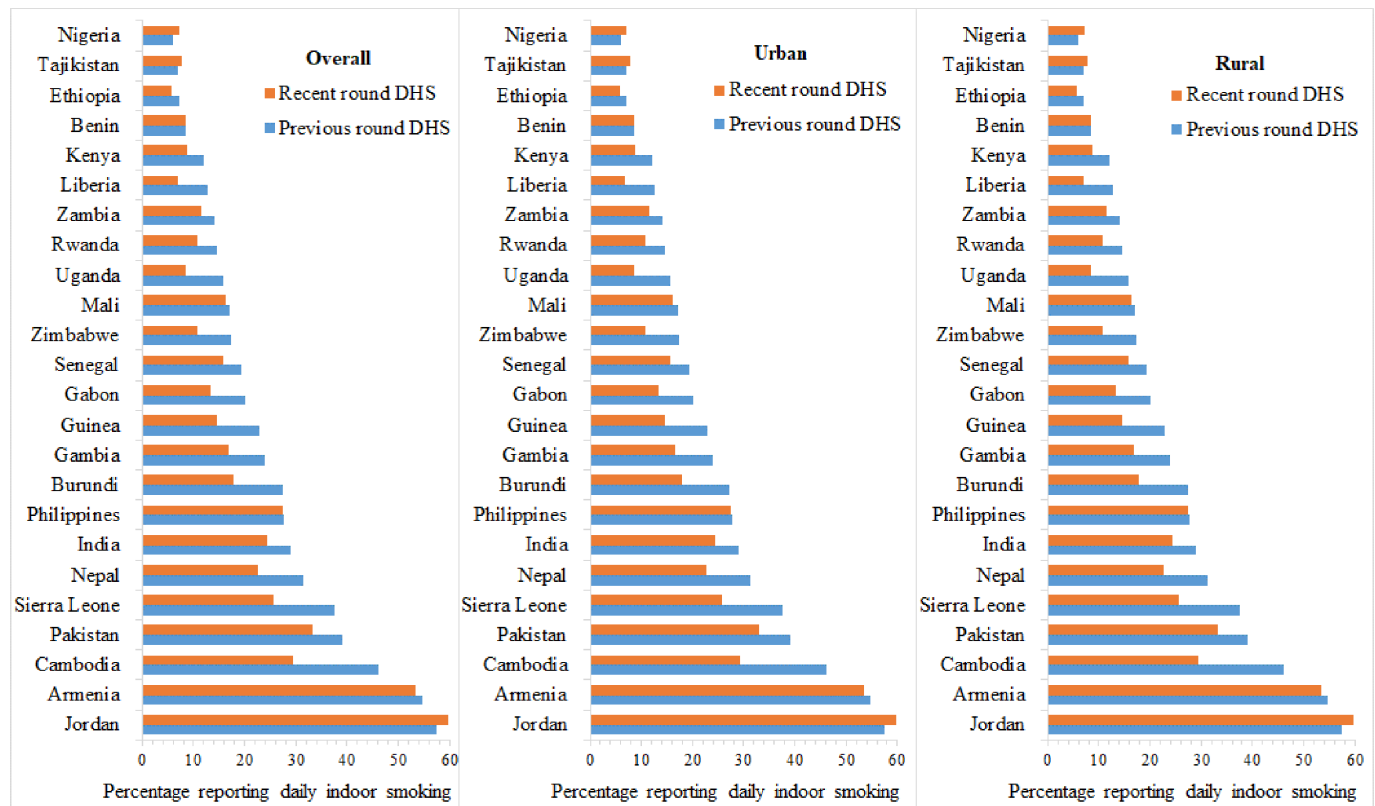


Figure 2 Percentage of daily indoor smoking in 24 countries party to the WHO FCTC, overall and by urban and rural. Data sorted based on previous survey. DHS, Demographic and Health Survey; FCTC, Framework Convention on Tobacco Control.

Country	Overall: trends in daily indoor smoking	Overall P-value	Urban: trends in daily indoor smoking	urban P-value	Rural: trends in daily indoor smoking	rural P-value
Armenia		0.214		0.033		0.551
Benin		0.985		0.995		0.922
Burundi		0.001		0.116		< 0.001
Cambodia		0.001		< 0.001		< 0.001
Ethiopia		0.225		0.354		0.368
Gabon		< 0.001		< 0.001		< 0.001
Gambia		< 0.001		0.004		0.004
Guinea		< 0.001		0.001		< 0.001
India		< 0.001		< 0.001		< 0.001
Jordan		0.002		< 0.001		0.468
Kenya		< 0.001		< 0.001		0.136
Liberia		< 0.001		0.029		0.001
Mali		0.492		0.635		0.286
Nepal		< 0.001		< 0.001		< 0.001
Nigeria		0.104		0.735		0.054
Pakistan		< 0.001		0.001		< 0.001
Philippines		0.724		0.209		0.291
Rwanda		0.001		0.437		0.002
Senegal		0.041		0.094		0.240
Sierra Leone		< 0.001		< 0.001		< 0.001
Tajikistan		0.654		0.446		0.318
Uganda		< 0.001		0.055		< 0.001
Zambia		0.031		0.346		0.045
Zimbabwe		< 0.001		0.025		< 0.001

Figure 3 Changes in the prevalence of daily indoor smoking in 24 countries party to the WHO FCTC, overall and by urban and rural households. Indicated p values are from two-sample test of proportions on the overall figure. FCTC, Framework Convention on Tobacco Control.

Figure 3 and online supplemental table S2 outline a statistically significant decrease in daily indoor smoking prevalence in 16/21 countries where the decline was observed, based on the findings from two consecutive surveys. There was a significant increase in the daily indoor smoking prevalence in one of the three countries where the daily indoor smoking prevalence increased. There was no significant change in the prevalence of daily indoor smoking by place of residence, except in Jordan where the prevalence in urban households was significantly increased (60.01% vs 57.32%; $p < 0.001$) (figure 3).

Determinants of daily and occasionally indoor smoking

The results found from analysis of the associations of daily and occasionally indoor smoking with selected socioeconomic characteristics in each country are presented in online supplemental tables S4 and S5. For example, households in the 3rd, 4th or 5th household wealth index categories had significantly lower RRR of daily indoor smoking in 19 countries and those in the 2nd wealth index categories had significantly lower RRR of daily indoor smoking in 15 countries, compared with household in the poorest wealth index category. Compared with household head who had

no formal education, significantly lower RRR of daily indoor smoking was observed in 11 and 16 countries where head of the household attended secondary and higher level education, respectively, whereas no significant association was observed in 12 countries where head of the household attended basic education level. Significantly lower RRR of daily indoor smoking was observed in all countries ($n=24$) where head of the household was female. Significantly higher RRR of daily indoor smoking was found in 15 countries as household members increased by one person. Having radio or television in the house had no statistical association with daily smoking inside the house in the majority of the countries (radio/television: 16/18 countries), while it showed inverse or positive association in the remaining countries. Compared with urban households, significantly lower and higher RRR of daily smoking inside the house was found in nine and seven countries, respectively. Occasionally indoor smoking was also associated with some of the selected socioeconomic characteristics in a few countries. All the results from fully adjusted multinomial regression models are presented as online supplemental tables S4 and S5.

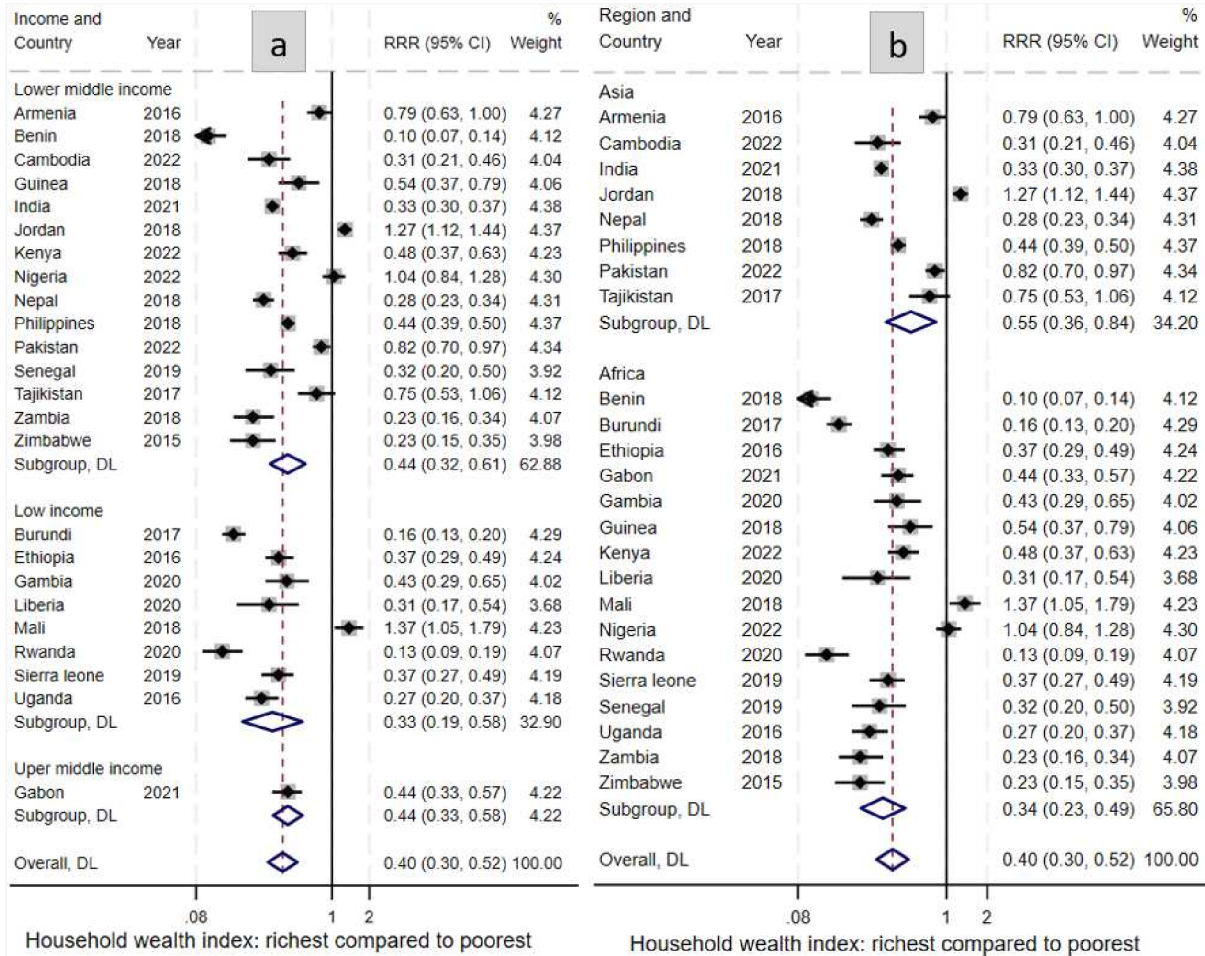


Figure 4 A meta-analysis of the RRR of daily smoking inside the house for household wealth index as a determinant: richest compared with poorest, stratified by income level (a) and by continent (b). RRR, relative risk ratio.

Meta-analysis of determinants of daily indoor smoking

The meta-analytical estimates showed that the RRR of daily indoor smoking was significantly lower for households in the 2nd (RRR=0.83; 95% CI: 0.76 to 0.92), 3rd (RRR=0.67; 95% CI: 0.58 to 0.78), 4th (RRR=0.54; 95% CI: 0.44 to 0.66) (online supplemental figures S3–S5) and 5th (RRR=0.40; 95% CI: 0.30 to 0.52) (figure 4) wealth quintile compared with counterparts in the first quintile. The pooled result showed that the RRR of daily indoor smoking was significantly lower in households where head of the household attended higher education (RRR=0.60; 95% CI: 0.53 to 0.69) compared with counterparts with no formal education (online supplemental figure S6).

DISCUSSION

In this study, we quantified the prevalence and trends of daily indoor smoking and examined its determinants in 24 WHO FCTC Parties based on DHS data. The study findings indicated a significant decline in daily indoor smoking prevalence in 16 of the 24 countries despite ongoing Tobacco and Nicotine Industry interference in public health programmes and policy. The results of this study also indicated that there were substantial variations

in the prevalence of indoor smoking at home by place of residence and socioeconomic status within countries and between countries.

This impact of FCTC could be a substantial factor in supporting the reduction in indoor smoking prevalence. Article 8 of the FCTC, which mandates protection from exposure to tobacco smoke, has seen widespread global adoption, further supporting this trend.³⁴ Moreover, robust measures to control SHS exposure in one country can potentially influence neighbouring countries to adopt similar regulations,^{35 36} contributing to the decline in indoor smoking at home and smoke prevalence more broadly. This is consistent with earlier studies reporting reductions in smoking prevalence and SHS exposure in countries that have ratified the FCTC.^{37 38} While these findings are encouraging, there is a pressing need to fully implement the WHO’s MPOWER measure, a technical package designed to guide countries on tobacco control,³³ including measures related to smoke-free environments, cessation support, advertising bans, raising tobacco taxes and health warnings on packs. As it is explicitly stated under Article 2 of the FCTC, these countries could go beyond the FCTC’s provisions and involve local communities in the design and implementation of

smoke-free home strategies to ensure cultural relevance and community buy-in.

In spite of such promising reductions in indoor smoking prevalence and SHS exposure, there is room for improvement to reduce and eliminate Tobacco and Nicotine Industry-generated harms, including harms from SHS.³⁹ It is also important to note that the countries included in this study are all LMICs where the number of people who smoke,¹⁶ cigarette consumed and individuals who died of SHS exposure is increasing.² This requires rapid structural changes and continuous action to combat the Tobacco Industry and to protect the human right to health, including protection from SHS exposure.

This study indicated that the prevalence of indoor smoking is lower in urban areas compared to rural areas. This variation may be attributable to differences in infrastructure, including health infrastructure, as well as lower awareness of the negative health effects associated with SHS exposure. Additionally, existing tobacco control measures may be less effectively enforced in rural areas compared with urban areas, which may help explain the observed differences between urban and rural settings.

Further, the Tobacco Industry establishes extensive distribution networks that ensure products are readily available often by offering lower prices or discounts in convenience stores and local shops, making it easy for rural consumers to access these products.⁴⁰ For example, a study showed that stores located in rural places were more likely to have/sell different tobacco brands and advertised discounts for tobacco than non-rural stores.⁴¹ Such factors help to actively normalise tobacco use and can directly and indirectly foster an environment for indoor smoking, including in rural places. Moreover, tobacco smoking is often connected with low socioeconomic status,^{42 43} which may explain the current finding due to social and economic disparities between urban and rural areas.

Determinants of daily smoking inside the house

Smoking behaviours are influenced by many factors including the Tobacco Industry's targeted marketing and misleading information, effectiveness of tobacco control measures and socioeconomic factors.^{44–48} This study indicated that smoking inside the house was followed a household wealth index gradient, and it is characterised by a gradual decrease in the RRR of smoking inside the house as households move from the first to the fifth wealth quintile. This gradient is observed in both the country-specific results and pooled estimates from meta-analysis. In accordance with these findings, evidence indicates that lower socioeconomic status was linked with increased SHS exposure^{49 50} and decreased SHS exposure from home with an increase in household wealth.⁵¹ This may reaffirm the perpetuation of disparities in SHS exposure and the associated negative health consequences across people of different socioeconomic background.⁵² This highlights the urgent need for a comprehensive approach to tobacco control, including ensuring an

equitable implementation of the FCTC across different socioeconomic backgrounds.⁵³ Consistent with the literature,⁵⁴ the current study also found that the probability of daily indoor smoking also increases with an increase in the number of family members. This may be explained in such a way that having large family size could be associated with low socioeconomic status,⁵⁵ which can facilitate easier access to commercial tobacco and potentially lead to increased tobacco use.

Limited understanding of the negative effects of SHS exposure could influence indoor smoking behaviours.⁵⁶ This study found that in two-thirds of the included countries, the risk of daily indoor smoking was lower in the house where head of the household attended higher education level compared with a counterpart with no formal education. These country-specific results of household head's educational status as a determinant for indoor smoking were also supported by the pooled estimate obtained from meta-analysis. Consistent with our findings, literature also reported the decreased likelihood of SHS exposure with higher education,⁵⁷ and conversely, lower educational status of household head was increased the odds of smoking inside the house.^{10 49 50 58} This specific finding highlights the need for addressing both supply and demand aspects to reduce tobacco prevalence and providing effective quit services, including cessation supports, quitlines and medications, which are often lacking in LMICs. Comprehensive supports for nicotine-free lives, in addition to educational initiatives, and implementation of FCTC Articles encourages people to remain nicotine free and/or to quit smoking.

Female leaders often emphasise public health initiatives and policies that prioritise the well-being of communities, families and children.⁵⁹ In this study, we found that households with a female head had lower probability of daily indoor smoking in all countries included. This phenomenon can be partly attributed to the fact that smoking is generally more prevalent among males than females in most of the countries included in this study.⁶⁰ Further, while there is great diversity in sex and gendered roles and responsibilities across region and the world, females are commonly involved in household caregiving responsibilities, demonstrating strong leadership in effectively influencing and enforcing smoke-free environments.⁶¹ Female leadership is expected to continue playing a crucial role in shaping public health outcomes, fostering healthier and nicotine-free homes and communities. We also observed that the chance of daily indoor smoking was increased with an increase in the age of head of the household in 11 out of the 24 countries, while it showed decreased probability in 5 out of the 24 countries. We could not find evidence to compare with this specific finding.

Household media presence—specifically radios and televisions—can play a role in shaping smoking behaviours and perceptions.⁶² However, this study found that having radio or television in the house had no statistical association with smoking inside the house in the

majority of countries included in the study. This absence of statistical association could have several interpretations, such as the content consumed might not directly correlate with smoking habits, outcome and exposure measurement challenges (being self-reported). Moreover, indoor smoking behaviour can be influenced by a complex interplay of socioeconomic and behavioural factors,²⁶ rather than simply the presence of radio or television.

In this study, the association between where households were located and daily smoking inside the house revealed mixed patterns. The finding indicated that households located in rural places are associated with lower chance of daily indoor smoking in about half of the countries, compared with counterparts in urban place. Contrarily, households located in rural places are associated with higher chance of daily indoor smoking in about one-third of the countries. Studies have also shown mixed results where there is both less frequent and a higher chance of indoor smoking in rural places.^{54 63} Factors such as cultural, social and regulatory contexts that shape smoking practice in different environments should require closer examination.

Overall, these findings have significant implications for further support for the implementation of tobacco control policies, particularly in LMICs. This is critically important as less than 30% of the world's population have access to appropriate tobacco control, including cessation services and only 18% of the world's population is covered by comprehensive restrictions on tobacco marketing.⁶⁴ It is essential to protect and uphold the human right to health, ensuring that all individuals have access to effective tobacco control measures and the resources needed to lead healthier lives.

Moreover, existing laws often restricted to controlling smoking in public places, might not reduce home or household indoor smoking as that is a private space. This would need to be emphasised as one policy implication of our findings that indoor smoking was more common among poorer households and by implication, these are people likely to be living in multiunit buildings. Hence our study supports banning smoking indoors in multiunit housing, especially laws restricting smoking indoors in public housing should be prioritised in LMICs. It is essential to continuously monitor the study findings in the face of the current and future tobacco control challenges, such as Tobacco Industry's interference and targeting of youth, promotion of emerging or new products, the rise in online tobacco sales, insufficient data on tobacco use and its health consequences and weak regulatory frameworks.^{17 65 66} In order to address these challenges, these countries will need to strengthen their regulatory capacity and mobilise resources for tobacco control through partnerships with national and international organisations and implement social mobilisation strategies, including actively engaging local communities in the design and implementation of tobacco control strategies and in countering and eliminating industry interference.

Strengths and limitations

To the best of our knowledge, this is one of the first analyses that comprehensively quantified the prevalence, trend and determinants of daily indoor smoking in multiple member states of the WHO FCTC after countries signed the convention. Our separate analysis by country would assist the included countries to evaluate their progress and inform where to focus in the future to ensure continuous reduction in the prevalence of indoor smoking, especially in reducing observed socioeconomic inequality. These findings are representative and comparable due to the use of DHS data, and this may make our findings likely to be generalisable to other LMIC members of the WHO FCTC and not included in this study. Additionally, our meta-analytical results on the determinants of indoor smoking would assist targeted tobacco control policies and actions. This study, however, is subject to some limitations. One of those limitations of this study is that we only included 24 countries Party to the WHO FCTC, which is due to the lack of data on indoor smoking from the two DHS surveys of the remaining member states. Additionally, the variables included in this study were collected by a self-report so they may be susceptible to various forms of reporting bias.

CONCLUSIONS

This study compared changes in the prevalence of daily indoor smoking over time in 24 countries Party to the FCTC based on DHS data and found that the prevalence of daily indoor smoking declined in 16 countries. The study also identified lower chance of daily indoor smoking in households with better wealth index position and in households where head of the household attained better education level. These findings underscore urgent need for comprehensive tobacco control measures to uphold the human right to health, including approaches that include both supply and demand reduction. The demand-side measures may include increasing taxes on tobacco products, implementing strict advertising bans and conducting public education campaigns, while supply-side measures may include regulating the production and distribution of tobacco products and enforcing laws against illicit trade. Despite advancements in tobacco control, many LMICs countries are exploited by the Tobacco and Nicotine Industry, necessitating stronger regulation, monitoring and evaluation to eliminate Tobacco and Nicotine Industry-generated harms. Implementing the FCTC recommendations is crucial to realising a nicotine-free future for upholding the right to health.

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