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Parental tobacco use and child death: analysis of data from demographic and health surveys from South and South East Asian countries

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Abstract

Background: Child mortality is a public health challenge in developing countries, and exposure to second-hand smoke and prenatal exposure to smokeless tobacco are risk factors for child death. We determined the associations between parental tobacco use and child death under the age of five in eight South and South East Asian countries.

Methods: We analysed cross-sectional demographic and health survey data collected between 2005 and 2016, using multiple logistic regressions to estimate the unadjusted and adjusted associations between parental tobacco use and child death, accounting for demographic and economic covariates.

Results: Overall prevalence of tobacco smoking was 46.8% for fathers and 2.7% for mothers, smokeless tobacco use was 32.6% for fathers and 7.8% for mothers and any tobacco use was 67.1% for fathers and 10.1% for mothers. Adjusted for demographic and economic covariates, child death was significantly associated with fathers' [odds ratio: 1.10; 95% confidence interval (CI): 1.03, 1.17] and mothers' (1.44; 1.23, 1.70) smoking tobacco, fathers' (1.25; 1.17, 1.34) and mothers' (1.11; 1.00, 1.23) use of smokeless tobacco and fathers' (1.21; 1.13, 1.29) and mothers' (1.24; 1.12, 1.36) use of any tobacco.

Conclusions: Both smoked tobacco and smokeless tobacco policies should be aggressively implemented in public places and workplaces in developing countries, because they stimulate voluntary smoke and smokeless tobacco-free policies in homes.

Key words: Tobacco, low- and middle-income countries, chid mortality, smokeless tobacco, second-hand smoke

Introduction

Tobacco use remains the leading preventable cause of early death globally,[1] including six million annual deaths from smoking, 890 000 from second-hand smoke (including 150 000 children[2]) and 270 000 deaths due to smokeless tobacco, with 80% of the smokeless burden in South Asia.[3] Perinatal, neonatal and infant mortality, stillbirth, low birthweight, preterm birth, congenital anomalies and slow fetal

Key Messages

- Child mortality is a public health challenge in developing countries, and exposure to second-hand smoke and parental exposure to smokeless tobacco are risk factors for child death, but there has been no large-scale quantitative analysis of these association in South or South East Asian countries.
- Adjusted for demographic and economic covariates, child death under the age of five was significantly associated with fathers' and mothers' use of smoked and smokeless tobacco.
- Our findings suggest that both smoke and smokeless tobacco policies should be aggressively implemented in public places and workplaces in developing countries, because they stimulate voluntary smoke and smokeless tobacco-free policies in homes.

development and growth are common consequences of exposure to maternal smoking and use of smokeless tobacco during pregnancy and of second-hand smoke exposure.[4–11]

Child mortality rates are higher in South and South East Asia (22.3 and 40.6 deaths under age five per 1000 live births, respectively) than in Western Europe (3.7/1000) and the USAa (6.8/1000),[12] where aggressive tobacco control policies, including policies to reduce second-hand smoke exposure,[2,13] are more common and smokeless tobacco use is lower, particularly among women.[14] Comprehensive and effectively implemented and enforced tobacco control policies are associated with significant benefits to child health,[15,16] including reduced exposure to second-hand smoke exposure,[17,18] preterm birth and cardiovascular and respiratory diseases.[19–24] We assess the relationship between parental tobacco use (both smoked and smokeless) and child mortality under the age of five in eight South and South East Asian countries (Afghanistan, Cambodia, India, Indonesia, Maldives, Myanmar, Nepal and Timor Leste).

Methods

Data

Findings were based on the public Demographic and Health Survey[25] (DHS) dataset from the eight South and South East Asian countries where couple (fathers and mothers in the same household) data were available (69 142 couples from 234 345 sampled households in the eight countries). DHS, which is funded by the United States Agency for International Development and supported by several United Nations agencies in collaboration with participating countries, collects nationally representative cross-sectional data related to the health and well-being of women of reproductive age between 15 and 49 years, their households and their children, 5-year intervals in low- and middle-income countries (LMICs). The DHS uses two-stage sampling to select enumeration areas and households, using similar questionnaires and sampling methods in all countries.[26] We used the most recent dataset from each country for analysis, collected between 2005 and 2016. Sample sizes and numbers of events appear in Supplementary Table S1, available as Supplementary data at *IJE* online.

Variables

Child death

Child death was ascertained from fathers who answered 'Yes/death' or 'No/no death' to the question, 'Have you ever fathered a son or a daughter who was born alive but later died?' and for mothers, 'Have you ever given birth to a boy or girl who was born alive but later died?'[25] If any child's age at death was reported as under the age of 5 (from birth to 59 months) by either parent, we considered the response death, otherwise no death. Under-five mortality is a leading indicator of the level of child health and overall development in developing countries.

Tobacco use

Respondents were classified as 'tobacco smoker' if they reported currently smoking cigarettes, pipes or any other country-specific combusted tobacco products such as bidi, hookah or water pipe. Respondents were classified as 'smokeless tobacco user' if they reported currently using snuff, chew or any other country-specific smokeless tobacco product. Respondents who were classified as tobacco smoker or smokeless tobacco user were also classified as 'any tobacco user'.

Covariates

Residence (urban or rural), age (<25 years, 25–39 years, >39 years) for mother and father separately, education (no education; primary: received education for up to 5 years; secondary: received education for 6-12 years; higher: received education for more than 12 years) for mothers and fathers separately, wealth index (1st quintile: poorest to

5th quintile: richest, within each country), occupation (did not work; professional: technical, managerial, clerical, service, sales; agriculture: agriculture, household/domestic, unskilled manual) for mothers and fathers separately, and year of survey (centred on 2010) were included as covariates.

Statistical analysis

We used country-level data to estimate crude prevalence for parental tobacco use and child death and the proportion of child deaths as a function of the different tobacco use variables. We used multiple logistic regressions to estimate the unadjusted associations between tobacco smoking, use of smokeless tobacco and use of any tobacco with child death and adjusting for residence, mother's age, father's age, mother's education, father's education, wealth index, mother's occupation, father's occupation and year of the survey. We used standard weights that provided by DHS.

To pool the data across all eight countries, we created unique identifiers for primary sampling units (PSUs) and strata across the eight countries and re-normalized the weights for each survey before pooling the individual country datasets. Specifically, we generated new variables including country (values from 1 to 8 for the eight countries), PSU (renumbered the existing PSU values combined with country value to make all the PSUs unique in the pooled dataset) and strata (renumbered the existing strata values combined with country value to make them unique). Weights were adjusted by calculating the total sum of weights, and individual weight divided by the total weights, and then multiplied those weights by the country's sub-population.

Analysis was done in R software using the complex survey analysis function svyglm to account for the two-stage cluster sampling using sampling weights provided by DHS, which account for clustering and stratification in the sampling design and dissimilar probabilities of participation and selection.

Results

Table 1 shows the country-level demographic characteristics of both father and mother. The proportion of urban residents ranged from 13.6% (Cambodia) to 50.7% (Indonesia), and lowest household wealth index ranged from 15.2% (Maldives) to 21.9% (Myanmar). The mean age ranged from 33.8 (Afghanistan) to 37.9 (Indonesia) years for fathers and from 29.6 (Afghanistan) to 33.8 (Indonesia) years for mothers. The proportion with no formal education ranged from 2.7% (Indonesia) to 51.5% (Afghanistan) for fathers and from 3.3% (Indonesia) to 83.3% (Afghanistan) for mothers. The proportion not working ranged from 0.3% (Cambodia) to 3.2% (Afghanistan) for fathers and from 15.7% (Cambodia) to 87.8% (Afghanistan) for mothers.

There was wide variation in the prevalence of tobacco use. Overall, 46.8% of fathers and 2.7% of mothers reported smoking tobacco (Table 2). Among fathers, smoking was highest in Timor Leste (81.0%) and lowest in Afghanistan (23.1%). Among mothers, it was highest in Nepal (12.1%) and lowest in Indonesia (2.6%). Overall, 32.6% of fathers used smokeless tobacco, varying from a high of 47.8% in Nepal to a low of 0.5% in Indonesia. Overall, 7.8% of mothers used smokeless tobacco, varying from a high of 10.8% in India to a low of 0.2% in Myanmar. Overall, 67.1% of fathers used any tobacco product, from a high of 81.8% in Timor Leste to a low of 42.3% in Cambodia. Overall, 10.1% of mothers used any tobacco product, ranging from 16.5% in Nepal to 2.9% in Indonesia.

Table 3 shows the associations between parental tobacco use (smoked tobacco, smokeless tobacco, any tobacco) and child death in the unadjusted and adjusted

Table 1. Demographic characteristics of the couples

Country, year	Total couples	Urban residents	Lowest wealth quintile	Mean age in years (father)	No education (father)	Not working (father)	Mean age in years (mother)	No education (mother)	Not working (mother)
Afghanistan, 2015	10 414	22.1%	19.4%	33.8	51.5%	3.2%	29.6	83.3%	87.8%
Cambodia, 2014	3060	13.6%	18.3%	35.0	7.7%	0.3%	32.3	14.7%	15.7%
India, 2005–06	39 257	32.5%	18.4%	37.1	19.3%	1.4%	31.6	37.9%	57.9%
Indonesia, 2012	8225	50.7%	17.5%	37.9	2.7%	0.6%	33.8	3.3%	35.1%
Maldives, 2009	1233	35.0%	15.2%	37.3	27.7%	1.5%	32.6	23.6%	50.5%
Myanmar, 2015–16	2623	25.5%	21.9%	35.8	14.1%	0.6%	33.7	14.4%	30.1%
Nepal, 2011	2322	14.6%	17.6%	34.4	19.7%	1.7%	30.7	47.3%	22.4%
Timor Leste 2009–10	2008	24.4%	19.2%	36.2	23.9%	1.5%	32.0	33.1%	58.7%
Overall	69 142	34.7%	18.4%	35.9	20.6%	1.2%	32.1	38.7%	51.0%

Table 2. Prevalence of parental tobacco use and child death, percent (95% CI)

Country, year	Father			Mother			Child death
	Smoked tobacco	Smokeless tobacco	Any tobacco	Smoked tobacco	Smokeless tobacco	Any tobacco	
Afghanistan, 2015	23.1 (22.3, 23.9)	32.1 (31.2, 33.0)	48.5 (47.5, 49.5)	3.3 (3.0, 3.7)	2.3 (2.0, 2.6)	5.4 (5.0, 5.9)	23.2 (22.4, 24.0)
Cambodia, 2014	41.2 (39.4, 42.9)	6.6 (5.7, 7.5)	42.3 (40.5, 44.0)	3.4 (2.8, 4.1)	4.4 (3.7, 5.2)	7.3 (6.4, 8.2)	16.5 (15.2, 17.9)
India, 2005–06	45.1 (44.7, 45.6)	44.4 (43.9, 44.9)	72.9 (72.5, 73.4)	2.7 (2.5, 2.8)	10.8 (10.5, 11.1)	13.0 (12.6, 13.3)	27.5 (27.0, 27.9)
Indonesia, 2012	71.9 (70.9, 72.9)	0.5 (0.3, 0.6)	72.1 (71.1, 73.1)	2.6 (2.2, 2.9)	0.4 (0.3, 0.6)	2.9 (2.5, 3.3)	13.5 (12.8, 14.3)
Maldives, 2009	45.5 (42.7, 48.3)	7.5 (6.1, 9.1)	50.8 (47.9, 53.6)	4.5 (3.4, 5.8)	4.1 (3.1, 5.4)	8.6 (7.1, 10.3)	17.8 (15.7, 20.1)
Myanmar, 2015–16	44.7 (42.8, 46.6)	2.6 (2.0, 3.3)	45.8 (43.9, 47.7)	3.7 (3.0, 4.5)	0.2 (0.1, 0.5)	3.9 (3.2, 4.7)	19.5 (18.0, 21.1)
Nepal, 2011	40.9 (38.9, 42.9)	47.8 (45.8, 49.9)	66.3 (64.4, 68.2)	12.1 (10.8, 13.5)	5.6 (4.7, 6.6)	16.5 (15.0, 18.1)	20.3 (18.7, 22.0)
Timor Leste, 2009–10	81.0 (79.2, 82.7)	2.9 (2.2, 3.8)	81.1 (79.3, 82.8)	4.1 (3.3, 5.1)	1.9 (1.4, 2.6)	5.4 (4.4, 6.5)	30.2 (28.2, 32.2)
Overall	46.8 (45.9, 48.0)	32.6 (31.5, 34.0)	67.1 (66.4, 68.0)	2.7 (2.5, 3.0)	7.8 (7.3, 8.0)	10.1 (9.6, 11.0)	23.1 (22.4, 24.0)

models for the entire sample. (Supplementary Tables S2, S3 and S4, available as Supplementary data at *IJE* online, show the results for the individual countries.) For all countries pooled in the unadjusted model, child death under the age of five was significantly associated with fathers' (odds ratio: 1.34; 95% confidence interval: 1.26, 1.43) and mothers' (2.49; 2.12, 2.93) tobacco smoking, fathers' (1.49; 1.40, 1.60) and mothers' (2.01; 1.82, 2.22) use of smokeless tobacco and with fathers' (1.62; 1.52, 1.73) and mothers' (2.26; 2.07, 2.46) use of any tobacco. (The magnitudes of these relationships varied from country to country; see Supplementary Tables S3–S5, available as Supplementary data at *IJE* online.) The estimated effect of tobacco use decreased after adjusting for demographic and economic variables and survey year, but remained significant for all smoking variables for both fathers and mothers. Child death was significantly associated with fathers' (odds ratio: 1.10; 95% CI: 1.03, 1.17) and mothers' (1.44; 1.23, 1.70) smoking tobacco, fathers' (1.25; 1.17, 1.34) and mothers' (1.11; 1.00, 1.23) use of smokeless tobacco and fathers' (1.21; 1.13, 1.29) and mothers' (1.24; 1.12, 1.36) use of any tobacco.

Discussion

Though there was variation among countries, there was an overall high prevalence of parental tobacco use (smoked tobacco, smokeless tobacco and any tobacco) among parents in South and South East Asian countries, with higher prevalence among fathers than mothers. Smokeless tobacco use among mothers was twice that of tobacco smoking. This study presents strong evidence that child death under the age of five was significantly associated with all forms of parental tobacco use.

Our findings highlight the harmful impact that exposure to smokeless tobacco and second-hand smoke inflicts on child death in South and South East Asian countries. These findings are particularly important for developing countries, where rates of child death remain high[12] and tobacco use is more prevalent than in developed countries. Smoked tobacco use among mothers is low, but this situation and the harm to children resulting from exposure to smokeless tobacco and second-hand smoke will likely worsen as the tobacco industry increases targeting of women in developing countries.[27,28]

Because child health outcomes are constantly poor in developing countries, increasing tobacco use by parents in developing countries could significantly worsen outcomes and therefore slow progress in achieving the United Nations Sustainable Development Goal (SDG3). Children are at the heart of SDGs, and reducing tobacco use plays a key role in global efforts to achieve the SDG3 target to

Table 3. Association of parents' tobacco use with child death in eight South and South East Asiam countries

	Smoked tobacco and child death		Smokeless tobacco and child death		Any tobacco and child death	
	OR	*P*-value	OR	*P*-value	OR	*P*-value
Unadjusted						
Father						
No	1		1		1	
Yes	1.34 (1.26, 1.43)	0.000	1.49 (1.40, 1.60)	0.000	1.62 (1.52, 1.73)	0.000
Mother						
No	1		1		1	
Yes	2.49 (2.12, 2.93)	0.000	2.01 (1.82, 2.22)	0.000	2.26 (2.07, 2.46)	0.000
Adjusted[a]						
Father						
No	1		1		1	
Yes	1.10 (1.03, 1.17)	0.004	1.25 (1.17, 1.34)	0.000	1.21 (1.13, 1.29)	0.000
Mother						
No	1		1		1	
Yes	1.44 (1.23, 1.70)	0.000	1.11 (1.00, 1.23)	0.047	1.24 (1.13, 1.36)	0.000
Residence						
Rural	1		1		1	
Urban	0.86 (0.79, 0.93)	0.000	0.86 (0.79, 0.93)	0.000	0.85 (0.78, 0.93)	0.000
Father age						
<25	1		1		1	
25–39	1.91 (1.58, 2.31)	0.000	1.94 (1.61, 2.34)	0.000	1.91 (1.58, 2.31)	0.000
>39	2.78 (2.27, 3.41)	0.000	2.86 (2.33, 3.51)	0.000	2.78 (2.27, 3.40)	0.000
Mother age						
<25	1		1		1	
25–39	1.99 (1.79, 2.22)	0.000	2.02 (1.82, 2.25)	0.000	1.98 (1.78, 2.21)	0.000
>39	3.12 (2.72, 3.58)	0.000	3.18 (2.77, 3.65)	0.000	3.10 (2.70, 3.56)	0.000
Father education						
No education	1		1		1	
Primary	0.95 (0.87, 1.03)	0.239	0.94 (0.87, 1.03)	0.182	0.94 (0.87, 1.03)	0.225
Secondary	0.87 (0.80, 0.94)	0.001	0.85 (0.78, 0.93)	0.000	0.87 (0.80, 0.95)	0.001
Higher	0.73 (0.62, 0.86)	0.000	0.71 (0.60, 0.83)	0.000	0.74 (0.62, 0.87)	0.001
Mother education						
No education	1		1		1	
Primary	0.63 (0.57, 0.68)	0.000	0.63 (0.58, 0.69)	0.000	0.63 (0.58, 0.68)	0.000
Secondary	0.38 (0.35, 0.42)	0.000	0.38 (0.35, 0.42)	0.000	0.38 (0.35, 0.42)	0.000
Higher	0.19 (0.16, 0.24)	0.000	0.20 (0.16, 0.25)	0.000	0.20 (0.16, 0.25)	0.000
Father occupation						
Did not work	1		1		1	
Agriculture	1.26 (0.95, 1.67)	0.113	1.28 (0.96, 1.70)	0.091	1.27 (0.96, 1.70)	0.099
Professional	1.28 (0.96, 1.70)	0.093	1.29 (0.97, 1.71)	0.082	1.28 (0.96, 1.71)	0.089
Mother occupation						
Did not work	1		1		1	
Agriculture	1.06 (0.98, 1.14)	0.138	1.06 (0.99, 1.14)	0.109	1.05 (0.98, 1.13)	0.154
Professional	1.07 (0.95, 1.20)	0.260	1.08 (0.96, 1.22)	0.181	1.07 (0.95, 1.20)	0.285
Wealth index						
I quintile	1		1		1	
II quintile	0.84 (0.77, 0.92)	0.001	0.85 (0.78, 0.93)	0.000	0.85 (0.78, 0.94)	0.000
III quintile	0.67 (0.60, 0.73)	0.000	0.68 (0.62, 0.75)	0.000	0.68 (0.62, 0.75)	0.000
IV quintile	0.59 (0.53, 0.66)	0.000	0.60 (0.54, 0.67)	0.000	0.61 (0.55, 0.68)	0.000
V quintile	0.46 (0.40, 0.53)	0.000	0.47 (0.41, 0.54)	0.000	0.48 (0.42, 0.56)	0.000
Year of survey						
Year 2010	1		1		1	
Before or after 2010	0.59 (0.54, 0.64)	0.000	0.65 (0.60, 0.71)	0.000	0.62 (0.57, 0.67)	0.000

[a]Adjusting for residence, mother's age, father's age, mother's education, father's education, wealth index, mother's occupation, father's occupation and year of the survey.

reduce premature deaths from non-communicable diseases by one-third by 2030. Conversely, reducing tobacco exposure will contribute to meeting the SDG3 to reduce child death.[29] In addition to Goal 3, Goals 1, 5, 10, 12 and 17 have direct or indirect relationships with tobacco control and child health. Smoking is a main factor in increasing and impairing inequalities in health and other related areas.[30] Vulnerable groups, women and poor countries are increasingly targeted by tobacco companies. In addition, the tobacco industry is increasing its marketing and tobacco farming with child labour in poor countries, which remains a problem.[31,32]

A main target for Goal 3 is to reinforce the implementation of the WHO Framework Convention on Tobacco Control (FCTC) in all countries through national tobacco control policies.[30] Key FCTC provisions include reducing exposure to second-hand smoke and smokeless tobacco. However, whereas all the countries in this study except Indonesia have ratified the FCTC, only Nepal, Afghanistan and Cambodia report having implemented comprehensive smoke-free policies.[2,13] In addition, smoking cessation interventions are not widely available in most of the countries.[33] India reports having a national quit line with nicotine replacement therapy (NRT) and some cessation services costs covered; Nepal, the Maldives and Myanmar report moderate NRT and/or some cessation services, at least one is cost-covered; Afghanistan, Cambodia and Indonesia report minimal NRT and/or some cessation services, no costs covered; and Timor Leste has no cessation policies or programmes for treatment of tobacco dependence.[2] Our results support the importance of integrating tobacco cessation interventions into existing maternal health care delivery systems in developing countries.

Smokeless tobacco control also needs attention in the countries we studied, because smokeless tobacco contributes similar risks for child health as tobacco smoke. Unhygienic child care practices are common in developing countries among poor and rural families, which could increase the risk of exposure to smoke and smokeless tobacco early in life. Unintentional and accidental ingestion of smokeless tobacco products is a main reason for child toxic exposures.[34,35] Ingestion of as little as 1 mg of nicotine by a child can develop weakness, convulsions, unresponsiveness and impaired respiration and may lead to respiratory arrest and death.[36] *In utero* exposure to smoked and smokeless tobacco could be the direct and indirect cause of child death.[37] The pathophysiological link between smokeless tobacco exposure and reproductive health is not well understood, and warrants future research to identify the biological effects of smokeless tobacco used by father or mother. It is biologically plausible that the use of smokeless tobacco could increse the risk of death through cardiovascular disease-associated mechanisms.[38]

The magnitude of the associations between maternal tobacco use and child death is higher than that with paternal tobacco use. It is possible that the children are more exposed to their mothers' tobacco use than to their fathers'. Mothers are the primary source for child care and household work in most of the Asian countries. Variations in child mortality rate across the countries might be due to the use and quality of reproductive health services, and socioeconomic and environmental risk factors.

Strengths and limitations

The DHS has a substantial sample size and applies standard procedures for the selection of primary sampling units, strata, households and respondents, and the same tools were used for data collection in all the countries, which makes results between countries comparable.

Our study also has limitations. In DHS data, the use of tobacco products (smoked tobacco, smokeless tobacco and any tobacco) was self-reported, which might not reflect the true prevalence.[39] Although the magnitude of under-reporting of smoking status by women is unknown in developing countries, tobacco smoking might in fact be common in developing countries with strong social and cultural anxieties against tobacco smoking in women. DHS did not collect data on ever, every day and some days tobacco use, which could lead us to underestimate the effect of parental tobacco use on child mortality. Future research using biomarkers of tobacco exposure, such as cotinine levels in urine or hair, at least in a subsample of the population, could quantify the accuracy of self-reports. Similarly, child death-related information was self-reported, which raises the possibility of under-reporting. Misclassification of child death as non-death could influence our estimates if it happens at different rates among tobacco users and non-users. DHS data were collected in different years (2005 to 2016), which makes comparison of prevalences between countries difficult, especially since there is evidence that the prevalence of tobacco use could be growing for females in some low-income countries.[28,40] Our study is limited in its ability to control for other variables that might harm children, such as indoor or outdoor non-tobacco smoke exposure, which is highly prevalent in developing countries.[41,42] Our study was cross-sectional and temporal relationships cannot be established, although inverse causation is unlikely to be plausible. We could not control the morbidity-related variables and cause of death of a child, which may affect the result. Lack of availability and accessibility of quality maternal and child health services might be associated with child death in developing countries. Tobacco use by family members could divert household income from food to tobacco, putting infants at added risk of mortality.[33]

Conclusions

Parental tobacco use (smoked tobacco, smokeless tobacco, any tobacco) is associated with child death in the countries that we studied. Our study suggests that policies to reduce smoked and smokeless tobacco should be aggressively implemented in public places and workplaces in developing countries, particularly because these policies stimulate families to adopt voluntary smoke and smokeless tobacco-free policies in homes.[43]

Supplementary data

Supplementary data are available at *IJE* online.

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Author Contributions

S.G. secured funding for this work. D.N.B. had the idea for the study. Both authors designed the study, performed the analysis and wrote the paper.

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