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Health Policy 70 (2004) 67–83
HEALTH policy
www.elsevier.com/locate/healthpol

Household tobacco and alcohol use, and child health: an exploratory study from India

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Received 16 July 2003; accepted 4 February 2004

Abstract

The study uses data from the National Family Health Survey-II, a nationally representative survey from India of 92,486 households, to investigate the association between household tobacco and alcohol use, and child health. The study findings show that children from households that use tobacco or alcohol were less likely to be immunized, more likely to have acute respiratory tract infection, more likely to be malnourished, and more likely to die before first birthday, even after controlling for other socio-economic and demographic characteristics. Policies and programs for child survival may also need to incorporate strategies to control household tobacco and alcohol use in addition to other ongoing interventions.

Keywords: Alcohol; Child survival; Household; India; Tobacco

1. Introduction

More than two million children die before their fifth birthday in India, a tragedy of heightened urgency as child health improvements appear to be stalling [1]—the infant mortality rate in India has reduced from 79 in 1992–1993 to 68 in 1998–1999 [2]. Since households are the primary producers of health of a child [3], alcohol and tobacco consumption by the adult household members may affect the household's ability to provide childcare as well as increase environmental exposure to children, resulting in adverse child health outcomes. Though some studies in developing countries have suggested potential links between adverse child health outcomes and tobacco [4] and alcohol use [5] by household members, only a few studies have empirically tested the association [6,7]. Using data from a population-based, nationally

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doi:10.1016/j.healthpol.2004.02.003

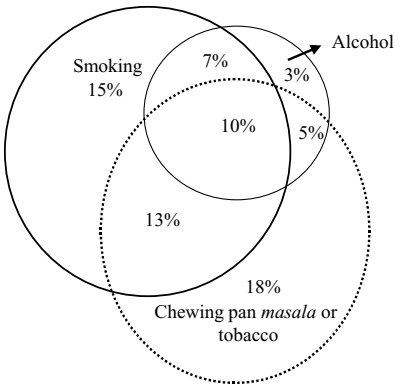

Fig. 1. Distribution of households who had at least one member 15 years or older who either smoked or chewed tobacco or drank alcohol (as a percent of all households in India). *Source*: NFHS-II [2] and authors' calculations.

representative survey, this study aims to delineate the association between household tobacco and alcohol use and child health in India.

Almost three-fourths of the households in India have at least one member 15 years and older who consumes either tobacco or alcohol (see Fig. 1). Past research on health effects of tobacco and alcohol consumption, in India and other developing countries, have largely focused on establishing the association between different chronic illnesses—lung cancer, liver cirrhosis, oral cancer—and tobacco and alcohol use among the consuming individuals only [8–14].

The World Health Report 2002, ranked underweight among children, tobacco use, and alcohol use as the first, fourth and fifth most important contributors, respectively, to the global burden of disease [15]. However, this quantification of the disability adjusted life years (DALYs) lost due to tobacco and alcohol consumption was primarily based on DALYs lost among the consuming individuals [16,17], not accounting for the potential adverse health effects on other household members, including children, leading to potential underestimation of DALYs lost due to tobacco and alcohol use.

Nichter and Cartwright [4] argue that the "effects of tobacco use need to be viewed not just in relation to the health of smokers but also to the health and welfare of all household members." The millennium development goals (MDGs) set by all the member countries of United Nations in 2000, including India, sought to reduce child mortality by two-thirds between 1990 and 2015 [18]. Due to scant evidence on detrimental effects of tobacco and alcohol consumption by household members on child survival, control of tobacco and alcohol use has not been integral to the child survival strategies for achieving child health related MDGs. Our study aims to contribute to the limited literature on tobacco and alcohol use, and child health by exploring the association between child health and tobacco and alcohol consumption at the household level in India. The findings of the study will have important implications for future research agenda, child survival policies and programs in India and elsewhere.

1.1. Conceptual framework and study hypotheses

The conceptual framework used to specify study hypotheses draws upon the child survival framework proposed by Mosley and Chen [19] and partly from works of Hu [20] and Nichter and Cartwright [4]. Fig. 2 presents the conceptual framework outlining the potential pathways between household tobacco and alcohol use, and distal as well as proximate determinants of child survival.

We suggest that adverse child health effects of tobacco and alcohol use are mainly through two distal determinants (indirect effects)—forgone household disposable income and caretakers' time for childcare—and one proximate determinant (direct effect) through environmental exposure to passive smoking in childhood and adverse effect of tobacco and alcohol in the intrauterine period [21]. In many developing countries, including India, out-of-pocket expenditures are the main source of financing of health care [22]. Diversion of scant economic resources for tobacco and alcohol use that could have otherwise used for seeking health care, may lead to self-care or delay in seeking health care. Efroymson et al. [6] found that the poorest household in Bangladesh were twice more likely to smoke than the wealthiest, and the poorest households could have easily added over 500 calories to the diet of one or two children with his or her daily tobacco expenditure that could have saved 350 children's lives each day in Bangladesh. Cohen [7] also suggested similar implications of tobacco use on child malnutrition in Bangladesh.

The other potential ways by which tobacco and alcohol use can reduce the household income are through

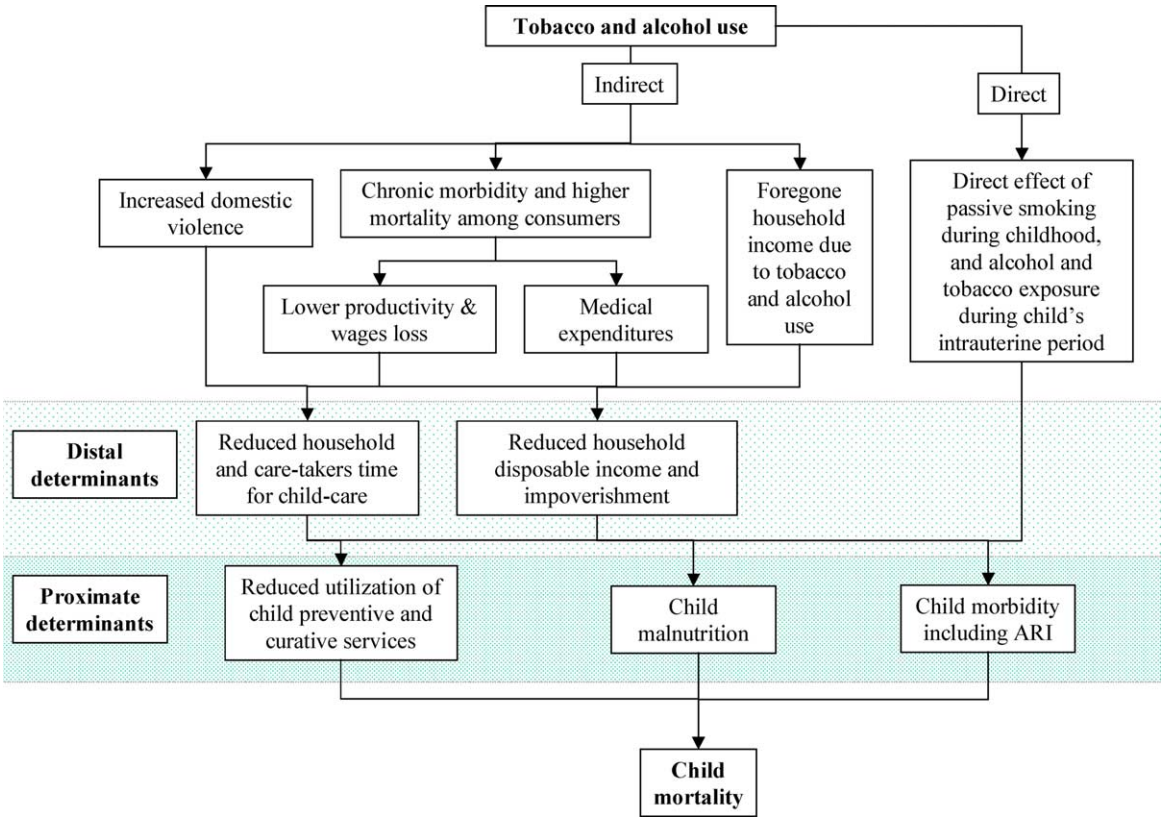

Fig. 2. Conceptual framework defining relationship between household tobacco and alcohol use and child health. Adapted from [19].

morbidity associated with these lifestyle habits among the consuming individuals, resulting in increase in medical expenditures and loss of income due to lost wages, and, sometimes, resulting in the premature death of sole wage earner in the household. Women are generally the primary caretakers of children in India, who are also primarily responsible for taking care of other sick members of the household. Chronic morbidity among other adult household members associated with tobacco and alcohol use may divert the time of the primary caretaker of the child from childcare. Higher levels of wife-beating associated with alcohol use, documented in India and elsewhere [23], may also affect the woman's ability to provide childcare, resulting in adverse child health outcomes [5].

Both the reduced income and reduced time to provide childcare may adversely affect the proximate determinants of child health, namely utilization of preventive and curative childcare and child nutrition, resulting in higher child morbidity and higher child mortality. In addition to its effect on distal determinants of child health, children living with tobacco smokers are more likely to be exposed to smoke inhalation, which might result in higher incidence of respiratory diseases [24,25].

Based on the above conceptual framework, the study explores the following hypotheses. Children from households with at least one adult member who consumes tobacco and/or alcohol: (a) are less likely to receive preventive child health services such as immunization; (b) are more likely to have tobacco smoke related morbidity such as acute respiratory tract infections; (c) are less likely to receive curative health services when sick; (d) are more likely to be severely underweight and stunted; and (e) are more likely to die before reaching first birthday. In addition, the study also investigates the hypothesis that: (f) the children from households with simultaneous use

of tobacco and alcohol are at greater risk of adverse health outcomes compared to households with single use of either tobacco or alcohol or none.

2. Materials and methods

2.1. Data

The data came from National Family Health Survey-II (NFHS-II) conducted between November 1998 and December 1999 in all the 25 states in India by International Institute of Population Studies (IIPS) and Macro International Incorporated with financial support from United States Agency for International Development [2]. NFHS-II is a nationally representative, cross-sectional, household sample survey based on two-stage stratified sampling design with selection of urban and rural primary sampling units in the first stage, followed by sampling of households in the second stage [2,26]. The study draws upon the household and the women questionnaire. The response rate for the household questionnaire and for the individual woman questionnaire was 98 and 96%, respectively. The data on "regular use" of tobacco and alcohol were elicited through the household questionnaire administered face-to-face to the head of the household (27% of the households) or other competent adult member (73%) of the household for all the household members 15 years or older. Majority of the respondents were in age group 25–39 years (42.6%) and 40–59 years (30.9%). Data for current tobacco and alcohol consumption for each household member 15 years and older including for the household respondent were elicited with the help of three questions: does he or she "chews *pan masala* or tobacco?", "smokes tobacco?", "drink alcohol?" (*pan masala* is a chewable tobacco containing areca nut). The individuals were classified as "chewing tobacco" if the household respondent answered "yes" to the question on chewing tobacco. Similarly, individuals were categorized as "smokers" and "alcohol drinkers" if household respondent answered "yes" to the question on "smoking tobacco" and to "drinks alcohol", respectively. Separate questions were asked for "ever use" (or life-time use) of tobacco and alcohol use, but this study uses data only on the current "regular" use of tobacco and alcohol. No data are available on the duration of use, which remains one of the limitations of the study. However, the effect of this limitation is potential dilution of the exposure and hence dilution of the possible association between exposure and child health outcomes, as discussed later.

The women's questionnaire was administered to all the ever-married women aged 15–49 years within the sampled households and detailed data on utilization of preventive and curative health care, anthropometrics, and child morbidity for the youngest two children born in the last 3 years preceding the survey was obtained. A sample of 92,486 households yielded a sample of 33,008 children aged 0–35 months at the time of survey [2]. This sample was used to investigate association between household tobacco and alcohol use and child immunization, prevalence of acute respiratory infection (ARI), severe underweight and stunting, seeking care for ARI, and infant mortality.

2.2. Outcome variables

The association of the household tobacco and alcohol consumption was explored with the following outcome variables, as described in Table 1: (a) complete immunization with six doses of vaccines recommended under Expanded Program on Immunization (EPI) in children 12–23 months old (yes = 1; no = 0); (b) had an episode of ARI in the last 15 days in children aged 0–35 months (yes = 1; no = 0); (c) sought medical care for ARI episode among children aged 0–35 months from a trained provider (yes = 1; no = 0); (d and e) prevalence of severe stunting and severe underweight among children aged 0–35 months (yes = 1; no = 0); and (f) infant mortality among children born during 3 years period prior to survey.

2.3. Explanatory characteristics

The definition and specification of explanatory variables for predicting child health outcomes are summarized in Table 1. The use of tobacco and alcohol was measured at the household level defined as use by at least one of the adult member of the household. To investigate the association of different combinations of household tobacco and alcohol use on child health, a categorical variable with eight different possible combinations of tobacco smoking, tobacco chewing and alcohol was used. Other explanatory variables

Table 1
Description of the variables and sample characteristics of children from NFHS-II survey used in the study

Variable	Definition	Mean of births in the last 3 years
Outcome variables		
Complete immunization	Children 12–23 months who had all the six EPI vaccines (yes = 1; no = 0)	0.40
Episode of ARI	Prevalence of acute respiratory illness within last 15 days before survey in children less than 3 years old (yes = 1; no = 0)	0.19
Seeking care for ARI	Seeking medical care for acute respiratory illness within last 15 days before survey in children less than 3 years old (yes = 1; no = 0)	0.62
Stunted severe	Height-for-age less than −3S.D. from the median of the international reference (yes = 1; no = 0)	0.23
Underweight severe	Weight-for-age less than −3S.D. from the median of the international reference (yes = 1; no = 0)	0.18
Infant mortality rate	Infant deaths before reaching 1 year of age for 1000 live births in children born in the last 3 years of survey	59
Independent variables		
Urban	Urban = 1; rural = 0	0.22
Wealth quintile	Belonging to which wealth quintile	
Poorest	Poorest quintile = 1; others = 0	0.23
Second poorest	Second poorest quintile = 1; others = 0	0.23
Middle	Middle quintile = 1; others = 0	0.21
Second richest	Second richest quintile = 1; others = 0	0.18
Richest	Richest quintile = 1; others = 0	0.15
Religion	Belongs to which religion	
Hindu	Hindu = 1; non-Hindus = 0	0.79
Muslims	Muslims = 1; non-Muslims = 0	0.16
Christians	Christians = 1; non-Christians = 0	0.02
Others	Other = 1; Hindus or Muslims = 0	0.03
Caste	Belongs to which caste	
FC	Forward castes = 1; others = 0	0.38
SC	Scheduled caste = 1; others = 0	0.20
ST	Scheduled tribe = 1; others = 0	0.10
OBC	Other backward castes = 1; others = 0	0.32
Mother's age category	Mother's age category	
15–19 years	15–19 years = 1; others = 0	0.24
20–29 years	20–29 years = 1; others = 0	0.63
30–39 years	30–39 years = 1; others = 0	0.12
40–49 years	40–49 years = 1; others = 0	0.01
Mother's education	Mother's education category	
None	None = 1; others = 0	0.55
Primary	Primary = 1; others = 0	0.15
Secondary	Secondary = 1; others = 0	0.30
Sex of the child	Male child = 1; female child = 0	0.51
Lifestyle (none)	No lifestyle habits at household = 1; at least one = 0	0.22
All three	All three lifestyle habits (smoking, chewing and alcohol) = 1; others = 0	0.12
Alcohol and smoking	Only alcohol and smoking = 1; others = 0	0.07
Smoking and chewing	Only smoking and chewing = 1; others = 0	0.16
Chewing and alcohol	Only chewing and alcohol = 1; others = 0	0.06
Alcohol only	Only alcohol = 1; others = 0	0.03
Smoking only	Only smoking = 1; others = 0	0.16
Chewing only	Only chewing = 1; others = 0	0.19

Table 1 (*Continued*)

Variable	Definition	Mean of births in the last 3 years
Birth order (first)	First birth = 1; others = 0	0.29
2–3	2–3 births = 1; others = 0	0.44
4–6	4–6 births = 1; others = 0	0.22
7+	7+ births = 1; others = 0	0.06
Preceding birth interval (<2 years)	Preceding birth interval <2 years = 1; others = 0	0.16
2–3 years	Birth interval 2–3 years = 1; others = 0	0.39
4+ years	Birth interval 4+ years = 1; others = 0	0.14
First birth	First birth = 1; others = 0	0.30
State	Provinces of India; reference being Uttar Pradesh and remaining 25 dummy state variables	

included residence (urban/rural), caste, household wealth, and religion at the household level; and age and education of mother, and sex of the child at the individual level. Due to lack of data on income or expenditure in NFHS-II, a household wealth index was created, based on ownership of different durable assets using principal component analysis following the approached used by [27].

The state governments in India have primary responsibility to provide public health services in India [22]. In addition, wide inter-state variations exist in socio-cultural, economic, policy and program aspects of tobacco and alcohol use, child health, and poverty. Hence, it was important to control for state-level variation by including state as an independent variable.

2.4. Statistical methods

Univariate analysis was used to assess the distribution of the sample. The bivariate analyses involved comparing various child health indicators with the household-level smoking, chewing tobacco and alcohol drinking. Wilcoxon signed-rank test was used to test the differences in rank distribution of child health outcomes in different combination of household tobacco and alcohol use. Life tables were generated to obtain estimates of child mortality with confidence intervals. STATA version 8 was used for statistical analysis [28].

Multivariate logistic regression was used to determine the independent association of tobacco and alcohol use at the household level with dichotomous outcome variables—immunization, prevalence of ARI, seeking care for ARI, severe stunting and underweight. The multivariate logistic model is shown as follows:

$$\text{logit}(p_{ij}) = \alpha + I_{ij}\beta_i + H_{ij}\beta_h + Z_j \quad (1)$$

where p_{ij} is the probability of observing the positive outcome for ith child in the jth state, I_{ij} a vector of individual level characteristics for the ith child in the jth state, H_{ij} a vector of household characteristics of the ith child in the jth state, and Z_j the vector of 24 dummy variables indicating the state of residence. All the estimates and the standard errors were adjusted for the multistage sampling design and clustering at the village level and were weighted at national level to give population-based representative and unbiased results. The association between childhood mortality and household consumption of alcohol and tobacco was modeled using Weibull proportional hazard survival models with covariates [28]. The Weibull hazard distribution is suitable for modeling data with monotone hazard rates that either increase or decrease exponentially with time and can be explained as follows.

Let $S(t)$ be the survival function at time t and $\lambda(t)$ be the hazard rate at time t. The basic Weibull model assumes the existence of a basic time invariant hazard time, λ, to which the hazard rate at time t is linked by the equation:

$$\lambda(t) = \lambda p(\lambda t)^{p-1} \quad (2)$$

where p is a parameter, with $p < 1$ indicating that $\lambda(t)$ falls continuously over time, while $p > 1$ indicating opposite. In the case of child survival, it is likely that p will be less than one, since $S(t)$ drops sharply in the

first year and then starts to level out. It is linked to basic hazard, λ and the parameter p by the function:

$$S(t) = e^{-(\lambda t)p}, \quad \text{where } \lambda_i = e^{x_i\beta} \tag{3}$$

We used a logistic regression of the final child survival model to obtain estimates of adjusted population attributable fraction and 95% confidence intervals by using an approach based on unconditional logistic regression using "aflogit procedures" in STATA version 8 [29–32].

3. Results

3.1. Bivariate analysis

Table 2 summarizes estimates of various child health outcomes other than child mortality by household tobacco and alcohol use. Children from households where no adult member consumed either tobacco or alcohol, by and large, had the best child health outcomes followed by households that consumed only alcohol. Generally, the child health outcomes were worse in households that consumed both tobacco and alcohol than the households that consumed only one of either of them. The worst child health outcomes were seen, by and large, in the households with members that smoked and chewed tobacco, and also drank alcohol.

Compared to children from households that do not consume either tobacco or alcohol, children who come from households that smoke and chew tobacco as well as drink alcohol were less likely to be completely immunized (52% versus 30%); more likely to have an episode of ARI (16% versus 21%); less likely to seek care if sick with ARI (68% versus 57%); and more likely to be severely stunted (17% versus 27%) and severely underweight (13% versus 22%).

Fig. 3 shows relative ranking of the child health outcomes discussed above by different combinations of household tobacco and alcohol use. The overall score was obtained by summing the individual ranks for different child health outcomes. Lower rank and lower overall score indicates more negative child health outcomes. Households that had all the three habits (smoking, chewing and alcohol) had the lowest overall score

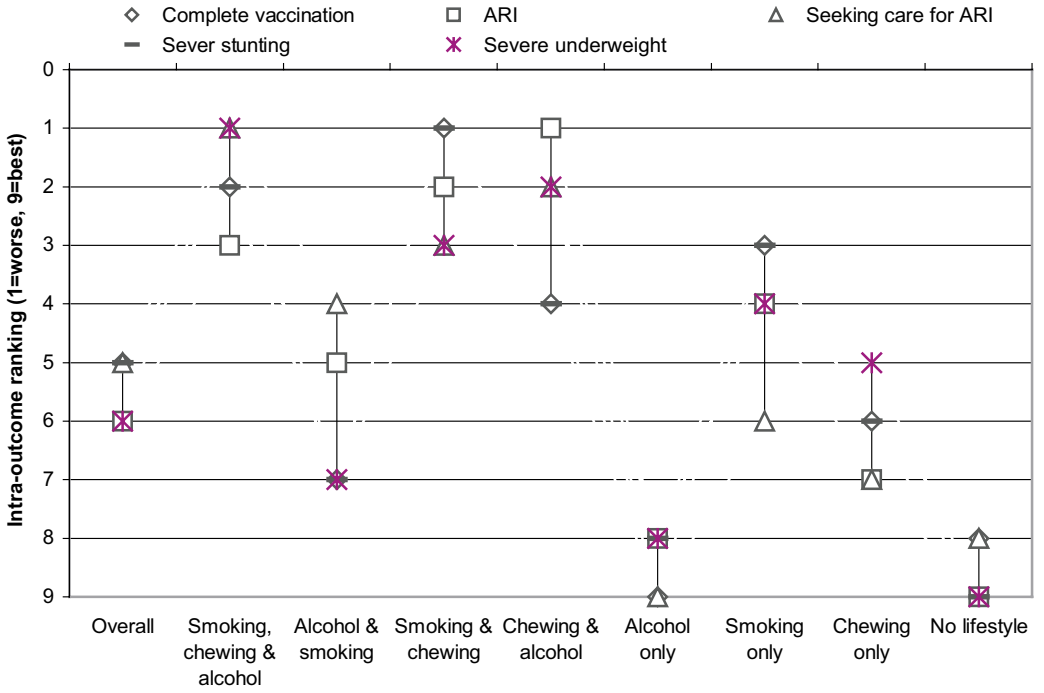

Fig. 3. Child health intra-outcome ranking by combination of household lifestyle use.

Table 2
Child health outputs and outcomes by various categories of household lifestyle habits

Variable		No lifestyle habits	Smoking, chewing and alcohol	Alcohol and smoking	Smoking and chewing	Chewing and alcohol	Alcohol only	Smoking only	Chewing only	*P*-value	Overall
All Vaccines	Percentage	52.15	30.04	48.15	26.8	38.17	58.76	35.2	40.57	**	39.9
	95% CI	[49.23–55.05]	[26.79–33.51]	[43.76–52.58]	[23.99–29.81]	[33.44–43.13]	[51.64–65.54]	[32.54–37.95]	[37.41–43.81]		[38.4–41.4]
	Number	2347	1188	700	1612	617	269	1539	1929		10205
Episode of ARI	Percentage	15.51	21.35	19.34	22.08	22.7	15.75	19.38	18.55	**	19.1
	95% CI	[14.37–16.73]	[19.77–23.01]	[17.06–21.86]	[20.39–23.86]	[20.13–25.5]	[12.89–19.11]	[17.97–20.87]	[17.17–20.02]		[18.4–19.8]
	Number	7046	3736	2058	4971	1770	776	4849	5765		30970
Seeking care for ARI	Percentage	68.35	56.81	60.74	58.62	58.32	71.69	63.76	64.64	**	62.5
	95% CI	[64.88–71.64]	[52.7–60.82]	[54.85–66.34]	[55.19–61.97]	[51.45–64.88]	[61.54–80.02]	[60.12–67.25]	[60.87–68.24]		[60.8–64.1]
	Number	1098	801	400	1102	403	123	943	1074		5944
Stunted severe	Percentage	17.04	27.32	19.56	27.71	23.86	18.85	24.19	21.68	**	22.5
	95% CI	[15.8–18.36]	[25.28–29.46]	[17.38–21.95]	[25.84–29.66]	[21.23–26.7]	[15.5–22.74]	[22.68–25.77]	[20.08–23.36]		[21.7–23.3]
	Number	5806	2939	1725	3857	1466	677	3787	4730		24989
Underweight severe	Percentage	12.92	22.28	15.28	20.45	20.78	14.29	18.45	18.04	**	17.7
	95% CI	[11.75–14.17]	[20.49–24.19]	[13.25–17.56]	[18.84–22.16]	[18.18–23.64]	[11.53–17.58]	[17.03–19.95]	[16.67–19.5]		[17.0–18.4]
	Number	5806	2939	1725	3857	1466	677	3787	4730		24989

** $P < 0.01$ for Pearson χ^2 showing that the estimates of at least one of the categories is statistically different from the rest.

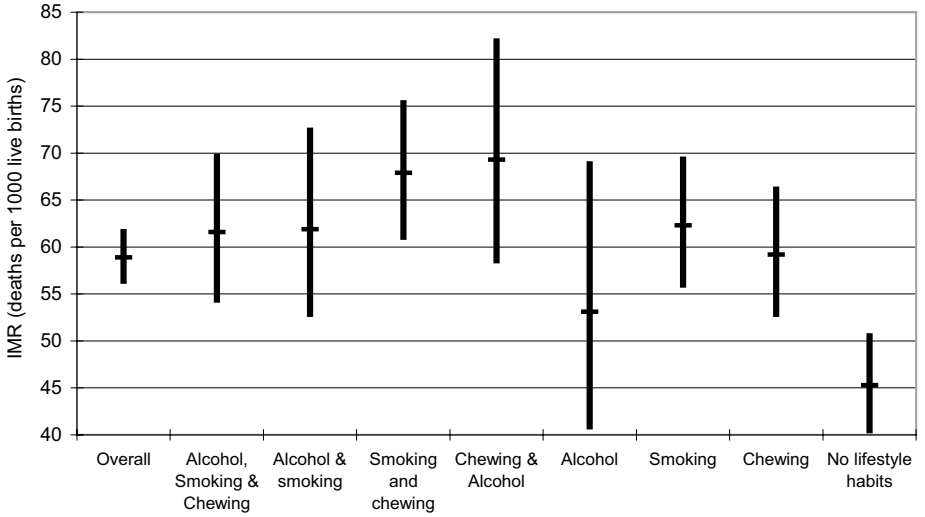

Fig. 4. Infant mortality rates with 95% confidence intervals by household lifestyle habits in children born within the last 3 years of survey.

and households with no lifestyle habit had the highest score. This is in line with our conceptual framework, with multiple consumption serving as a proxy for higher overall consumption and more diversion of economic resources.

Fig. 4 shows the aggregate infant mortality rates with 95% confidence interval among children born in the last 3 years before survey and household tobacco and alcohol use. Patterns, similar to that observed for immunization, ARI, malnutrition (Fig. 3), were also observed for infant mortality. Households with all the three lifestyle habits had the highest risk of child mortality compared to households with no lifestyle habits. Within households that had only one habit, the mortality rates were the highest in households that smoked, followed by households that chewed, followed by households that consumed alcohol. Among households with two habits, chewing of tobacco along with smoking or alcohol had higher infant mortality rates compared to smoking and alcohol use.

3.2. Multivariate analysis

Table 3 shows the results of multivariate logistic regression for immunization and ARI. After controlling for the state of residence, household characteristics and child and mother's characteristics that may affect the likelihood of the child being immunized, the children from households with all the three lifestyle habits were moderately less likely to be completely immunized (odds ratio (OR) = 0.82, $P < 0.05$). Similarly, children from households with both smoking and chewing (OR = 0.75, $P < 0.05$) and smoking only (OR = 0.79, $P < 0.05$) were also significantly less likely to be immunized than children from households with no such lifestyle habits. Children from households with all the three (OR = 1.29, $P < 0.05$) or at least two of the lifestyles had significantly higher odds of having ARI than children from households with no lifestyle habits. However, no significant association was observed between prevalence of lifestyle habits and seeking care for ARI.

Table 4 shows the results of multivariate logistic regression for severe underweight and severe stunting. After controlling for other household and individual level characteristics that may affect the likelihood of being severely stunted and underweight, children from households with all the three habits had significantly higher odds of being severely stunted (OR = 1.18, $P < 0.05$) or severely underweight (OR = 1.23, $P < 0.05$). Children from households that smoked and chewed tobacco also had a greater likelihood of severe stunting (OR = 1.18, $P < 0.05$) compared to children from households with no lifestyle habits. Also, children from households with smoking only had significant higher odds of being severely underweight (OR = 1.21, $P < 0.05$).

Table 3
Results of logistic regression for childhood vaccination and acute respiratory illness

Variable	Complete immunization		Had an episode of ARI		Sought medical care for ARI	
	OR	95% CI	OR	95% CI	OR	95% CI
Lifestyle (none)						
All three	0.82*	[0.66–1.03]	1.29**	[1.13–1.47]	0.89	[0.69–1.14]
Alcohol and smoking	1.12	[0.86–1.47]	1.28*	[1.07–1.53]	0.79	[0.57–1.10]
Smoking and chewing	0.75*	[0.61–0.93]	1.26**	[1.11–1.45]	0.95	[0.77–1.17]
Chewing and alcohol	0.97	[0.73–1.28]	1.46**	[1.23–1.73]	0.90	[0.65–1.24]
Alcohol only	1.24	[0.84–1.82]	1.05	[0.81–1.37]	1.10	[0.63–1.94]
Smoking only	0.79*	[0.65–0.96]	1.15	[1.00–1.33]	1.08	[0.84–1.38]
Chewing only	0.95	[0.77–1.16]	1.13	[0.99–1.28]	1.01	[0.80–1.27]
Urban (rural)	1.00	[0.85–1.19]	0.95	[0.83–1.07]	1.22	[0.97–1.53]
Wealth quintile (richest)						
Poorest	0.42**	[0.33–0.54]	1.08	[0.92–1.28]	0.37**	[0.26–0.52]
Second poorest	0.51**	[0.40–0.64]	1.28**	[1.09–1.51]	0.48**	[0.34–0.66]
Middle	0.65**	[0.52–0.81]	1.27**	[1.10–1.47]	0.56**	[0.41–0.77]
Second richest	0.81	[0.66–1.00]	1.16*	[1.01–1.33]	0.66*	[0.49–0.90]
Religion (Hindus)						
Muslims	0.60**	[0.47–0.76]	1.14*	[1.01–1.29]	1.16	[0.92–1.46]
Christians	1.11	[0.41–3.02]	1.17	[0.93–1.42]	0.73	[0.46–1.45]
Others	1.08	[0.62–1.90]	1.11	[0.86–1.45]	1.56	[0.85–1.23]
Caste (others)						
SC	0.99	[0.82–1.19]	1.03	[0.91–1.16]	1.00	[0.80–1.24]
ST	0.67**	[0.50–0.88]	1.08	[0.94–1.25]	0.70*	[0.53–0.91]
OBC	0.98	[0.84–1.13]	1.04	[0.94–1.15]	1.02	[0.85–1.23]
Mother's education (none)						
Primary	1.49**	[1.26–1.77]	0.98	[0.88–1.10]	1.28*	[1.05–1.54]
Secondary+	1.78**	[1.52–2.09]	0.98	[0.87–1.10]	1.31*	[1.08–1.59]
Mother's age category (<20 years)						
20–29 years	1.32**	[1.14–1.54]	0.90*	[0.82–0.99]	0.90	[0.75–1.09]
30–39 years	1.52**	[1.18–1.97]	0.78**	[0.67–0.92]	1.06	[0.79–1.43]
40–49 years	1.74	[0.89–3.40]	0.78	[0.50–1.21]	0.93	[0.43–1.99]
Birth order (first)						
2–3	1.03	[0.64–1.66]	1.06	[0.76–1.48]	0.80	[0.40–1.59]
4–6	0.72	[0.42–1.22]	1.07	[0.75–1.53]	0.74	[0.38–1.45]
7+	0.55	[0.30–1.00]	1.09	[0.74–1.62]	0.74	[0.35–1.56]
Preceding birth interval (<2 years)						
2–3 years	1.09	[0.94–1.27]	1.08	[0.98–1.19]	1.12	[0.93–1.36]
4+ years	1.05	[0.84–1.31]	1.07	[0.94–1.23]	1.22	[0.93–1.59]
First birth	1.57	[0.96–2.56]	1.21	[0.86–1.70]	1.04	[0.52–2.08]
Male child (female)	1.15*	[1.02–1.30]	1.22**	[1.14–1.30]	1.31**	[1.16–1.49]
State (Uttar Pradesh)						
Andhra Pradesh	3.18**	[2.34–4.32]	0.89	[0.71–1.12]	1.38	[0.96–1.97]
Assam	0.72	[0.46–1.12]	0.74*	[0.56–0.98]	0.45**	[0.31–0.65]
Bihar	0.48**	[0.36–0.64]	1.01	[0.85–1.20]	1.09	[0.85–1.39]
Goa	5.91**	[3.55–9.82]	0.89	[0.63–1.26]	11.26**	[2.79–45.52]
Gujarat	2.79**	[2.09–3.73]	0.50**	[0.39–0.63]	1.41	[0.89–2.21]
Haryana	3.95**	[2.91–5.35]	0.52**	[0.40–0.67]	3.90**	[2.14–7.14]
Himachal Pradesh	8.38**	[5.76–12.18]	0.47**	[0.34–0.65]	8.09**	[3.10–21.15]

Table 3 (*Continued*)

Variable	Complete immunization		Had an episode of ARI		Sought medical care for ARI	
	OR	95% CI	OR	95% CI	OR	95% CI
Jammu	4.51**	[3.22–6.30]	1.08	[0.85–1.39]	1.20	[0.81–1.77]
Karnataka	3.89**	[2.82–5.35]	0.32**	[0.25–0.42]	2.10*	[1.18–3.75]
Kerala	5.47**	[3.61–8.28]	1.15	[0.90–1.46]	1.79*	[1.13–2.82]
Madhya Pradesh	0.96	[0.74–1.24]	1.52**	[1.29–1.80]	0.91	[0.70–1.18]
Maharashtra	7.63**	[5.54–10.51]	0.61**	[0.47–0.79]	2.94**	[1.81–4.78]
Manipur	1.92*	[1.13–3.28]	1.27	[0.95–1.69]	0.78	[0.48–1.24]
Meghalaya	0.58	[0.28–1.19]	1.31	[0.96–1.77]	1.29	[0.66–2.50]
Mizoram	4.39**	[2.42–7.95]	0.40**	[0.27–0.59]	0.71	[0.31–1.65]
Nagaland	0.45*	[0.23–0.86]	0.75	[0.53–1.06]	0.38**	[0.20–0.72]
Orissa	2.55**	[1.86–3.49]	1.10	[0.90–1.35]	0.94	[0.69–1.28]
Punjab	4.39**	[2.82–6.84]	0.68*	[0.51–0.90]	6.36**	[2.71–14.91]
Rajasthan	0.70*	[0.54–0.91]	1.08	[0.91–1.29]	0.86	[0.66–1.14]
Sikkim	2.01**	[1.26–3.21]	1.54**	[1.15–2.07]	0.37**	[0.23–0.61]
Tamil Nadu	18.08**	[12.33–26.50]	0.44**	[0.34–0.57]	3.14**	[1.84–5.35]
West Bengal	3.09**	[2.15–4.43]	1.23	[0.99–1.53]	0.62**	[0.45–0.85]
New Delhi	1.52*	[1.06–2.18]	0.94	[0.70–1.27]	1.72	[0.89–3.32]
Arunachal Pradesh	0.65	[0.34–1.26]	1.03	[0.75–1.43]	0.80	[0.49–1.31]
Tripura	1.64	[0.95–2.85]	1.45**	[1.14–1.86]	1.42	[0.85–2.38]
Number of observations	10188		30914		5931	
F-statistic	35.06		11.48		10.76	
Prob. > *F*	0.00		0.00		0.00	

OR: odds ratio; CI: confidence interval; variables in parentheses are reference group.

* $P < 0.05$.

** $P < 0.01$.

Table 4
Results of logistic regression for childhood malnutrition

Variables	Stunted severe		Underweight severe	
	OR	95% CI	OR	95% CI
Lifestyle (none)				
All three habits	1.18*	[1.02–1.36]	1.23*	[1.06–1.44]
Alcohol and smoking	0.94	[0.79–1.12]	1.01	[0.84–1.23]
Smoking and chewing	1.18*	[1.03–1.36]	1.15	[1.00–1.33]
Chewing and alcohol	1.01	[0.86–1.19]	1.10	[0.90–1.34]
Alcohol only	1.16	[0.89–1.50]	1.20	[0.91–1.58]
Smoking only	1.12	[0.98–1.27]	1.21*	[1.05–1.40]
Chewing only	1.05	[0.91–1.20]	1.10	[0.96–1.25]
Urban (rural)	1.07	[0.95–1.21]	1.02	[0.89–1.17]
Wealth quintile (richest)				
Poorest	2.78**	[2.32–3.32]	3.17**	[2.54–3.96]
Second poorest	2.44**	[2.04–2.92]	2.84**	[2.29–3.53]
Middle	2.23**	[1.91–2.61]	2.36**	[1.91–2.92]
Second richest	1.60**	[1.37–1.86]	1.73**	[1.41–2.13]
Religion (Hindus)				
Muslims	1.17*	[1.03–1.33]	1.24**	[1.08–1.43]
Christians	1.03	[0.75–1.36]	0.96	[0.66–1.40]
Others	0.75*	[0.59–0.96]	0.73	[0.53–1.00]

Table 4 (*Continued*)

Variables	Stunted severe		Underweight severe	
	OR	95% CI	OR	95% CI
Caste (others)				
SC	1.24**	[1.10–1.39]	1.32**	[1.16–1.50]
ST	1.18*	[1.01–1.37]	1.52**	[1.29–1.79]
OBC	1.11*	[1.01–1.23]	1.23**	[1.09–1.38]
Mother's education (none)				
Primary	0.75**	[0.66–0.84]	0.76**	[0.67–0.86]
Secondary+	0.58**	[0.51–0.66]	0.58**	[0.50–0.67]
Mother's age category (<20 years)				
20–29 years	0.83**	[0.74–0.93]	0.86*	[0.76–0.96]
30–39 years	0.77*	[0.65–0.93]	0.76**	[0.63–0.91]
40–49 years	0.64*	[0.44–0.94]	0.63	[0.40–1.00]
Birth order (first)				
2–3	0.97	[0.70–1.35]	0.95	[0.63–1.41]
4–6	1.12	[0.80–1.56]	1.23	[0.82–1.87]
7+	1.34	[0.91–1.98]	1.49	[0.94–2.37]
Preceding birth interval (<2 years)				
2–3 years	0.79**	[0.71–0.87]	0.81**	[0.72–0.92]
4+ years	0.63**	[0.55–0.72]	0.78**	[0.68–0.90]
First birth	0.66*	[0.48–0.90]	0.70	[0.47–1.04]
Male child (female)	0.88**	[0.82–0.95]	0.87**	[0.80–0.95]
State (Uttar Pradesh)				
Andhra Pradesh	0.45**	[0.36–0.56]	0.50**	[0.39–0.66]
Assam	1.20	[0.88–1.65]	0.56*	[0.36–0.86]
Bihar	1.02	[0.88–1.18]	1.06	[0.90–1.25]
Goa	0.25**	[0.13–0.47]	0.46**	[0.28–0.76]
Gujarat	0.93	[0.78–1.11]	0.95	[0.78–1.16]
Haryana	1.01	[0.80–1.28]	0.57**	[0.43–0.76]
Himachal Pradesh	0.86	[0.67–1.10]	0.90	[0.68–1.19]
Jammu	0.63**	[0.47–0.83]	0.43**	[0.30–0.61]
Karnataka	0.52**	[0.41–0.66]	0.93	[0.74–1.17]
Kerala	0.37**	[0.25–0.55]	0.39**	[0.26–0.60]
Madhya Pradesh	0.90	[0.77–1.05]	1.11	[0.94–1.32]
Maharashtra	0.52**	[0.42–0.64]	1.19	[0.96–1.47]
Manipur	0.43**	[0.30–0.60]	0.29**	[0.19–0.44]
Meghalaya	0.84	[0.57–1.24]	0.45**	[0.30–0.69]
Mizoram	0.61*	[0.41–0.90]	0.31**	[0.18–0.53]
Nagaland	0.36**	[0.26–0.51]	0.32**	[0.21–0.49]
Orissa	0.48**	[0.40–0.58]	0.91	[0.75–1.11]
Punjab	0.85	[0.65–1.13]	0.68*	[0.49–0.96]
Rajasthan	0.94	[0.81–1.08]	0.94	[0.80–1.11]
Sikkim	0.37**	[0.25–0.57]	0.23**	[0.13–0.43]
Tamil Nadu	0.44**	[0.35–0.56]	0.63**	[0.49–0.79]
West Bengal	0.57**	[0.45–0.72]	0.78*	[0.62–0.99]
New Delhi	1.20	[0.86–1.66]	1.13	[0.76–1.67]
Arunachal Pradesh	0.38**	[0.26–0.54]	0.36**	[0.23–0.56]
Tripura	0.87	[0.53–1.44]	0.81	[0.56–1.17]
Number of observations	24949		24949	
F-statistic	38.90		25.40	
Prob. > *F*	0.00		0.00	

OR: odds ratio; CI: confidence interval; variables in parentheses are reference group.

* $P < 0.05$.

** $P < 0.01$.

Table 5
Results of Weibull proportional hazard model for infant mortality among children born during 3-year period before survey

	Infant mortality (births during last 3 years of survey)	
	HR	95% CI
Lifestyle (none)		
All the three habits	1.02	[0.83–1.25]
Alcohol and smoking	1.38*	[1.07–1.79]
Smoking and chewing	1.21	[0.99–1.47]
Chewing and alcohol	1.24	[0.95–1.61]
Alcohol only	1.30	[0.88–1.91]
Smoking only	1.11	[0.92–1.34]
Chewing only	1.11	[0.91–1.35]
Urban (rural)	1.01	[0.86–1.20]
Wealth quintile (richest)		
Poorest	1.46**	[1.11–1.93]
Second poorest	1.23	[0.93–1.65]
Middle	1.30	[0.98–1.72]
Second richest	1.06	[0.82–1.36]
Religion (Hindus)		
Muslims	0.83	[0.69–1.00]
Christians	0.96	[0.60–1.52]
Others	0.99	[0.62–1.59]
Caste (others)		
SC	1.12	[0.94–1.33]
ST	0.93	[0.73–1.19]
OBC	1.06	[0.91–1.24]
Mother's education (none)		
Primary	0.92	[0.77–1.10]
Secondary+	0.70**	[0.58–0.85]
Mother's age category (<20 years)		
20–29 years	0.77**	[0.67–0.89]
30–39 years	0.77*	[0.60–0.98]
40–49 years	1.03	[0.61–1.73]
Birth order (first)		
2–3	0.25**	[0.11–0.61]
4–6	0.28**	[0.11–0.69]
7+	0.32*	[0.13–0.82]
Preceding birth interval (<2 years)		
2–3 years	0.63**	[0.55–0.72]
4+ years	0.64**	[0.52–0.78]
First birth	0.23**	[0.10–0.56]
Male child (female)	1.05	[0.95–1.17]
State (Uttar Pradesh)		
Andhra Pradesh	0.76	[0.57–1.02]
Assam	0.92	[0.66–1.28]
Bihar	0.86	[0.70–1.05]
Goa	0.55	[0.28–1.09]
Gujarat	0.80	[0.61–1.04]
Haryana	0.84	[0.63–1.13]
Himachal Pradesh	0.47**	[0.30–0.73]
Jammu	0.94	[0.70–1.27]
Karnataka	0.62**	[0.47–0.82]
Kerala	0.27**	[0.11–0.63]
Madhya Pradesh	1.02	[0.85–1.23]
Maharashtra	0.60**	[0.44–0.84]
Manipur	0.57*	[0.35–0.93]
Meghalaya	1.32	[0.83–2.11]
Mizoram	0.58	[0.32–1.08]
Nagaland	0.62	[0.30–1.26]
Orissa	0.94	[0.73–1.20]
Punjab	0.78	[0.51–1.20]
Rajasthan	0.92	[0.76–1.12]
Sikkim	0.45*	[0.23–0.88]
Tamil Nadu	0.54**	[0.38–0.78]
West Bengal	0.50**	[0.36–0.70]
New Delhi	0.70	[0.48–1.03]
Arunachal Pradesh	0.59*	[0.35–0.98]
Tripura	0.49*	[0.26–0.92]
$\ln p$	−0.57**	[−0.60 to 0.55]
p	0.56	[0.55–0.58]
$1/p$	1.78	[1.74–1.82]
No. of subjects	32689	
No. of failures	1872	
Time at risk	315077	
Log pseudo-likelihood ratio	−9876	
Wald $\chi^2(55)$	538	
Prob. > χ^2	0.00	

HR: hazard ratio; CI: confidence interval; variables in parentheses are reference group.
* $P < 0.05$.
** $P < 0.01$.

Table 5 shows the results of Weibull proportion hazard model for infant mortality for children born within 3 years of the survey. After controlling for other potential confounding characteristics, children from households that smoke and drank alcohol had 1.38 times higher risk of dying before reaching first birthday.

We tested interaction between lifestyle habits and wealth as well as mother's education on child health outcomes, and found none of the interaction terms to be significant. Hence, the interaction terms were excluded in the final model. The adjusted population attributable fraction of risk of child mortality among children born during last 3 years before survey from

households that either smoked or chewed tobacco or used alcohol was approximately 12% (95% CI: 2–20%).

4. Discussion

The study provides preliminary empirical evidence demonstrating an association between household tobacco and alcohol use and adverse child health outcomes. However, the study findings should be interpreted taking into the account the limitations of data and study design. The cross-sectional nature of the study and lack of data on duration of tobacco or alcohol use makes it difficult to establish the temporal sequence of events. However, notwithstanding the limitation of lack of temporality, the findings are still valid and suggestive of an association between household tobacco and alcohol use and poor child health outcomes for three main reasons. First, not taking into account the intensity and duration of household consumption of tobacco and alcohol, and relationship of the consuming individual—whether it is parents or other relatives—with the child would result in misclassification of individual with shorter duration of consumption with individuals who might be consuming for longer duration. The net potential effect of this type of misclassification would be dilution of the association observed. The result of potential misspecification of the exposure variable due to underreporting by the respondent of the household questionnaire (which may be due to lack of awareness of consumption by other household members or due to social stigma attached with the consumption [2,26]) of consumption by other household members will also be further under estimation of the relationship [26]. Hence the effect of the biases present in the study is in underestimating the association between tobacco and alcohol use and child health outcomes and not in creating false associations when none existed: the magnitude of the true association may in fact be larger. Second, the consistency of findings across different outcome indicators and a dose–response relationship with multiple substance abuse (tobacco alone or tobacco plus alcohol, etc.) supports the conclusions. Third, there is little likelihood of 'reverse causation'—a major criticism of the cross-sectional studies—in this study. As it is highly unlikely that higher childhood malnutrition rates or higher childhood mortality will lead to higher consumption of tobacco or alcohol among adult household members. In addition, the findings of the study can be supported by the theoretical framework laid out in the study. It is possible that households that use tobacco and alcohol may share values and attitudes that may also be responsible for adverse child health outcomes. However, these effects may be minimal given that the study controlled for different socio-economic and cultural variables in the multivariate analysis that also confound attitudes and values mentioned above.

The study findings reveal that household tobacco and alcohol use is significantly associated with lower utilization of childhood immunization, higher prevalence of ARI, severe stunting, severe underweight, and higher child mortality. These associations persisted even after controlling for poverty and other socio-demographic characteristics that might confound the association. The results of the study are also in line with other studies that explored the relationship between household tobacco and alcohol consumption, and child health [4,6,7,24,25]. While most of the previous studies were based on small samples and investigated some aspects of child health, our study, based on nationally representative sample, investigated both child health outputs (immunization and seeking care for ARI) and health outcomes (morbidity, malnutrition and mortality).

The study findings shows that single use of tobacco smoking or tobacco chewing or alcohol use have weaker association with child health than combined use. This leads us to believe that the association between tobacco and alcohol use, and child health may be more due to "indirect" effects from foregone expenditures (Fig. 2). However, the strength of the association between different categories of alcohol and tobacco consumption and child health outcomes reveal stronger association of adverse child health outcomes with household smoking. The explanation for this relationship may be environmental conditions and more generally the proximal determinants of child health might be more detrimental than the hypothesized causal pathways for alcohol consumption. The findings are important for program and policy purposes: by targeting households with higher risk combination of tobacco and alcohol use—multiple use with smoking tobacco—it may be possible to achieve greater reduction in adverse child health outcomes.

Only alcohol use did not have measurable impact on child health and was closer to reference group—"no use". Further analysis of data shows that "alcohol only" users were better educated and wealthier than "smoking only" or "chewing only" adults. Perhaps "alcohol only" users are more health conscious adults who drink and avoid smoking/chewing. There was no association between household tobacco or alcohol use and seeking care for ARI, and the association of tobacco and alcohol use with complete immunization was also relatively weak; child health outputs—immunization, seeking care—are determined both by supply-side (not controlled by households) and demand-side factors, which might have weakened the association.

Clustering of child health outcomes at family or household level has been identified in previous studies on child health outcomes [33]. This is likely to be particularly relevant when considering associations of child health outcomes with lifestyle habits at the household level as all children in that household would be exposed to this factor. Further studies need to be conducted to determine the contribution of household tobacco and alcohol use on clustering of child mortality.

4.1. Policy implications

The MDGs set concrete child and maternal health targets to be achieved by 2015 [18], helping to rejuvenate international efforts to expedite human development in developing countries. Diagnostic analysis of health situation in various developing countries by the World Bank has focused on health policy, health systems, health care financing and household factors; which only briefly mentions lifestyle habits [34]. Most of the efforts to mitigate child mortality have been on the supply side. These include strengthening primary health care, provision of basic package of essential services to address most common communicable diseases of children, etc. So far, control of tobacco and alcohol use have not figured prominently in any of the strategies to address child and maternal health issues especially among the poor, mainly due to lack of evidence.

The attributable risk fraction of household tobacco or alcohol use on infant mortality arrived by our study was almost 7% (i.e., household tobacco or alcohol use explains 7% of the infant mortality at the population level), which is of policy as well as program significance for child survival. However, as mentioned earlier, the biases of the data may dilute the observed relationship and the actual attributable risk may even be higher. Since attributable risk depends on both the strength of association with the outcome and prevalence of consumption, the proportion of poor child health outcomes (such as malnutrition, infant mortality, etc.) explained by alcohol and tobacco consumption may even be higher in countries with higher prevalence of consumption. Hence, the strategies to control tobacco and alcohol use should become an integral part of any child survival packages in sub-Saharan African and South Asian countries—including India—with high prevalence of tobacco and alcohol consumption as well as poor child survival outcomes. Effective actions for tobacco control are well known and proven [35,36]. Comprehensive and collective action for tobacco control is underway through WHO's framework for tobacco control [37,38]. Though there is already a sense of urgency to control tobacco, our study adds a new dimension—child health—for tobacco and alcohol control. The study findings may bring new allies for tobacco and alcohol control from among child survival advocates, which should give greater impetus to tobacco and alcohol control.

The results of the study also justify more research with better study designs, such as longitudinal cohort studies or intervention trials to provide more conclusive empirical evidence on the potential causal relationship between household tobacco and alcohol use and adverse child health outcomes. With better empirical evidence, based on actual understanding of population attributable risk of household tobacco and alcohol consumption on child mortality, appropriate policy and program responses may need to be redesigned.

It may be appropriate to conclude the paper by reminding what Nichter and Cartwright [4] said "the success in child survival that may be realized by immunizing children and keeping them rehydrated will be vitiated by a second child survival crisis arising from the chronic ill health or the death of their parents [as a result of tobacco use]." World Health Report, 2002 [15] confirms this by highlighting the threats of "risk transition" and "double burden" of

disease in the developing countries—unconquered infectious diseases on one hand, and chronic diseases burden due to increasing prevalence of tobacco and alcohol consumption on the other hand. Our study suggests that household tobacco and alcohol use may interact with communicable diseases to worsen the child health outcomes, and hence strategies to address both—lifestyle habits and communicable diseases—simultaneously may increase the likelihood of reaching the child survival related MDGs sooner.

Acknowledgements

The authors would like to thank Dr. W.H. Mosley for providing valuable feedback on earlier drafts of the paper, and also thank the two anonymous referees for suggesting important changes.

References

[1] Claeson M, Bos ER, Mawji T, Pathmanathan I. Reducing child mortality in India in the new millennium. Bulletin of World Health Organization 2000;78:1192–9.
[2] IIPS. National Family Health Survey-II (1998–1999). Bombay: International Institute of Population Studies; 2000. Available at URL: http://www.nfhsindia.org/india2.html [Internet communication, 5 January 2004].
[3] Berman P, Kendall C, Bhattacharyya K. The household production of health: integrating social science perspectives on micro-level health determinants. Social Sciences and Medicine 1994;38:205–15.
[4] Nichter M, Cartwright E. Saving the children for the tobacco industry. Medical Anthropology Quarterly 1991;5:236–56.
[5] Jejeebhoy S. Associations between wife beating and fetal and infant death: impressions from a survey in rural India. Studies in Family Planning 1998;29:300–8.
[6] Efroymson D, Ahmed S, Townsend J, Alam SM, Dey AR, Saha R, et al. Hungry for tobacco: an analysis of the economic impact of tobacco consumption on the poor in Bangladesh. Tobacco Control 2001;10:210–1.
[7] Cohen N. Smoking, health, and survival: prospects in Bangladesh. Lancet 1981;16(8229):1090–3.
[8] Gupta PC, Nandakumar A. Oral cancer scene in India. Oral Diseases 1999;5:1–2.
[9] Gupta PC, Mehta H. Cohort study of all-cause mortality among tobacco users in Mumbai, India. Bulletin of the World Health Organization 2000;78:877–83.
[10] Moore SR, Johnson NW, Pierce AM, Wilson DF. The epidemiology of tongue cancer: a review of global incidence. Oral Diseases 2000;6:75–84.
[11] Gupta R, Prakash H, Gupta VP, Gupta KD. Prevalence and determinants of coronary heart disease in a rural population in India. Journal of Clinical Epidemiology 1997;50:203–9.
[12] Gupta R, Gupta VP, Ahluwalia NS. Educational status, coronary heart diseases, and coronary risk factors prevalence in rural population in India. British Medical Journal 1994; 309:1332–6.
[13] Hashibe M, Sankarnarayanan R, Thomas G, Kuruvilla B, Mathew B, Somanathan T, et al. Alcohol drinking, body mass index and the risk of oral leukoplakia in an Indian population. International Journal of Cancer 2000;88:129–34.
[14] Dikshit R, Kanhere S. Tobacco habits and risk of lung, oropharyngeal and oral cavity cancer: a population-based case-control study in Bhopal, India. International Journal of Epidemiology 2000;29:609–14.
[15] WHO. World Health Report, 2002. Geneva: World Health Organization; 2000.
[16] Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause, 1990–2020: global burden of disease study. Lancet 1997;349:1498–504.
[17] Ezzati M, Lopez AD, Rodgers A, Vander Hoom S, Murray CJ. Selected major risk factors and global and regional burden of disease. Lancet 2002;360:1347–60.
[18] UN. United Nations Millennium Declaration. United Nations General Assembly, 18 September 2000. Available at URL: http://www.un.org/millennium/declaration/ares552e.pdf [Internet communication, 6 January 2004].
[19] Mosley WH, Chen LC. An analytical framework for the study of child survival in developing countries. Population and Development Review 1984:25–45 [Supplement to vol. 10. Child survival: strategies for research].
[20] Hu T. Trading tobacco for health initiative: smoking and poverty. Powerpoint presentation, 2002. Available at URL: http://www.tobaccoevidence.net/pdf/smoking%20and%20poverty.pdf [Internet communication, 5 February 2003].
[21] Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. Bulletin of World Health Organization 1987;65:663–737.
[22] Peters DH, Yazbeck AS, Sharma RR, Ramana GNV, Pritchett LH, Wagstaff A. Better health systems for India's poor: findings, analysis, and options. Washington, DC: World Bank; 2002.
[23] Rao V. Wife-beating in rural South India: a qualitative and econometric analysis. Social Science and Medicine 1997;44:1169–80.
[24] Ernster V, Kaufman N, Nichter M, Samet J, Yoon S. Women and tobacco: moving from policy to action. Bulletin of the World Health Organization 2000;78:891–901.
[25] Chen Y, Li W, Yu S, Qian W. Epidemiological study of children's health: passive smoking and children's respiratory diseases. International Journal of Epidemiology 1988;17:348–55.
[26] Rani M, Bonu S, Jha P, Nguyen SN, Jamjoum L. Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey Tobacco Control 2003;12:e4 [http://www.tobaccocontrol.com/cgi/content/full/12/4/e4].

[27] Filmer D, Pritchett L. Estimating wealth effects without wealth or expenditure data: educational enrollment in India. Memo, DECRG. Washington, DC: The World Bank; 1998. Available at URL: http://www.worldbank.org/html/dec/Publications/Workpapers/WPS1900series/wps1994/wps1994.pdf [Internet communication, 30 January 2003].
[28] StataCorp. Stata statistical software: release 8.0. College Station, TX: Stata Corporation; 2001.
[29] Greene W. Econometric analysis. Upper Saddle River, NJ: Prentice-Hall; 1997.
[30] Bruzzi P, Green SB, Byar DP, Brinton LA, Schairer C. Estimating the population attributable risk for multiple risk factors using case-control data. American Journal of Epidemiology 1985;122:904–14.
[31] Benichou J, Gail MH. Variance calculations and confidence intervals for estimates of the attributable risk based on logistic models. Biometrics 1990;46:991–1003.
[32] Greenland S, Drescher K. Maximum likelihood estimation of the attributable fraction from logistic models. Biometrics 1993;49:865–72.
[33] Das Gupta M. Death clustering, mother's education and the determinants of child mortality in rural Punjab, India. Population Studies 1990;44:489–505.
[34] Claeson M, Griffin CC, Johnston TA, McLachalan M, Soucat ALB, Wagstaff A. Poverty reduction and the health sector: the health, nutrition and population network's chapter in the World Bank's poverty reduction strategy sourcebook. Washington, DC: World Bank; 2001.
[35] Jha P, Chaloupka FJ. Curbing the epidemic: governments and the economics of tobacco control. Washington, DC: World Bank; 1999.
[36] Jha P, Chaloupka FJ. Tobacco control in developing countries. New York: Oxford University Press, 2000.
[37] Taylor AL, Bettcher DW. WHO Framework Convention on Tobacco Control: a global "good" for public health. Bulletin of World Health Organization 2000;78:920–9.
[38] Joossens L. From public health to international law: possible protocols for inclusion in the Framework Convention on Tobacco Control. Bulletin of World Health Organization 2000;78:930–7.