Research

Corresponding author
Mangesh S Pednekar, PhD
Director
Healis-Sekhsaria Institute for
Public Health
501 Technocity Plot X-4/5 TTC
Industrial Area
Mahape, Navi Mumbai
Maharashtra 400 701, India
Tel. 91 22 2778 0924/82/4002 5146
Fax: 91 22 2778 0923
E-mail: pednekarm@healis.org

Tobacco and Alcohol Associated Mortality among Men by Socio-Economic Status in India

Mangesh S. Pednekar, PhD[1*]; Jooi Vasa, MS[1]; Sameer S. Narake, MS[1]; Dhirendra N. Sinha, MD, PhD[2]; Prakash C. Gupta, DSc[1]

[1]*Healis Sekhsaria Institute for Public Health, Mahape, Navi Mumbai, India*
[2]*School of Preventive Oncology, Patna, India*

ABSTRACT

Background: Tobacco use, alcohol use and Socioeconomic status (SES) are all strongly associated with mortality. These risk factors however, are also strongly associated with each other. The effect of the interrelationship between these risk factors on mortality has not been examined in India.
Objectives: To study tobacco and alcohol associated Hazard Ratios (HRs) stratified by SES.
Methods: A cohort of 34,055 men (age>=45 years) was recruited through house visits and information collected through face-to-face interviews during 1994 to 1997. During 1999 to 2003, follow-up through repeat house visits was conducted and deaths were recorded. Education level was used as proxy for SES. Cox proportional hazards model provided HRs and 95% Confidence Intervals (CIs) for tobacco/alcohol associated mortality adjusted for alcohol/tobacco and other confounders. Additionally, HRs was stratified by SES for their individual (tobacco, alcohol use) and their joint effect on mortality.
Results: For tobacco associated mortality, stratification by SES showed higher HRs for high SES bidi smokers (HR=2.01) compared to corresponding low SES bidi smokers (HR=1.41). For alcohol associated mortality, HRs were higher among high SES 'country/desi' drinkers (HR=1.56) compared to corresponding low SES counterpart (HR=1.31). After adjusting for alcohol exposure, the highest attenuation of HRs (>20%) for tobacco associated mortality was observed for deaths from tuberculosis and digestive system diseases (mainly liver diseases) among various forms of tobacco users.
Conclusions: The examination of differences in mortality risks by SES, showing higher HRs among high SES bidi smokers and high SES 'country/desi' drinkers, have implications for public health policies.

KEYWORDS: Alcohol; India; Mortality; Risk ratios; Smokeless tobacco; Smoking; Socioeconomic status.

INTRODUCTION

Globally, tobacco kills approximately 6 million people and causes more than a trillion dollars of economic damage each year.[1] Similarly, the use of alcohol kills approximately 2.3 million people each year. More than half of these deaths occur from NCDs (Non-communicable disease) including cancer, cardiovascular disease, and liver cirrhosis.[2] Nearly, 80% of NCD deaths occur in low-and-middle-income countries (such as India). Tobacco consumption and alcohol use together accounts for about 18% of global deaths.[3] In addition to communicable diseases, NCDs are becoming major threat in India for increasing the burden of diseases. Age standardized NCD death rates (per 100,000 populations) ranges from 571 among women to 782 among men.[2] In addition to cigarette smoking the varying forms of tobacco and alcohol practices prevalent in India contribute to increasing the disease burden.[4-11] The mortality patterns may also vary by Socioeconomic status (SES). The common observed association between SES and health outcomes has been of a strong inverse relationship with those in lower SES

groups having higher mortality.[5-9] Thus, examining tobacco and/or alcohol associated mortality by SES may delineate the health disparities that may further help to address the disparities

Using the Mumbai cohort study,[8] we had previously reported tobacco as an independent risk factor for deaths from NCDs and communicable diseases. These earlier results on tobacco associated mortality, based on follow-up of 99,570 men and women (age=>35 year), showed higher Hazard Ratios (HRs) for bidi, cigarette smokers, and smokeless tobacco (SLT) users compared to never-users.[8] These HRs were adjusted for age and education (surrogate for socioeconomic status: referred here after as SES) but not for alcohol use (alcohol consumption information was not available for these 99570 individuals). Alcohol use information however, was available for a subsequent cohort[9-12] of 34,055 men (age=>45 year) and the follow-up results from this cohort[9] showed that alcohol use was associated with excess risk for all-causes mortality [Hazard Ratio (HR) 1.22, 95% Confidence Intervals (CIs) 1.13-1.31, adjusted for age, education, and tobacco use]. Since tobacco use and alcohol consumption were closely associated,[9-10] we now report results on the effect of adjustment of alcohol use on HRs associated with tobacco use. Furthermore, we are extending our findings to examine these associations by socioeconomic differences. Earlier, we had demonstrated the joint effect of tobacco and alcohol use on all-causes mortality.[9] In this paper, we present the joint effect of tobacco (SLT use, bidi, cigarette smoking) and alcohol use on all-causes mortality stratified by SES.

METHODS

This cohort[9-11] of 34,055 men (age=>45 year) was recruited through house-to-house visits and face-to-face interviews in the city of Mumbai during 1994 to 1997. The survey area was restricted to the main city, covering an area of around 70 sq. km. The persons were recruited from voter's list which provided name, age, sex, and address of all individuals 18 years and older. Some individuals not listed on the voters' list were included when they insisted that they were permanent residents (having ration card issued by the government considered as residence proof) of the place. This only formed ~5% of the sample. Additional recruitment detail is published elsewhere.[7] Verbal informed consent was taken from each participant. Data analyses plan was approved from Healis-Sekhsaria Institute for Public Health Institutional Review Board (IRB).

FOLLOW-UP

An active house-to house follow-up was conducted during 1999 to 2003 for recording the participant's vital status. Field investigators were provided with names and addresses of the cohort individuals and were ask to revisit each person. Deaths recorded were then linked with the information obtained from Mumbai (Bombay) Municipal Corporation death registers. The causes of death information were abstracted from the Municipal Corporation death records and an underlying cause of death was assigned and coded as per International Classification of Diseas-

es (ICD Version 10) guidelines. Less than 5% participants were lost-to-follow-up, the most common reason being demolition of their residence for re-development. Additional details regarding the follow-up methodology and estimation of person-years of follow-up have been published previously.[7-16]

MEASURES

Tobacco use was categorized into three categories: (1) never tobacco users (2) ever used SLT and (3) ever smoked tobacco (may include smokers who use smokeless tobacco as well). Smokers were further categorized as cigarette smokers and bidi smokers (may include bidi smokers who also use cigarette or other smoking forms). Information regarding the frequency per day of tobacco use was sub-divided into three groups: 1-5 times, 6-10 times and >10 times per day. Alcohol usage was categorized as never drinkers and ever drinkers. Alcohol ever drinkers were further categorized as country/desi drinker (brewed and distilled locally made using fruits or grains)[9] and any other type drinkers (such as Indian Made Foreign Liquor (IMFL), beer, toddy and spirits not presented due to smaller number in each form). IMFL are distilled and marketed in India, which include whisky, rum, brandy and gin. Frequency of drinking was categorized as those who drank once a month, five or less times a month, three or less times a week (recoded by clubbing these three categories into one referred as less than four times a week), four to five times a week and more than five times a week (recoded by clubbing these two categories into one and referred as four or more times a week).[9]

Socioeconomic status (SES) was defined using education as proxy. It was broadly categorised into two groups: low SES (included education level of illiterate, primary school-up to 5 yrs of education, and middle school-6 to 8 yrs of education) and high SES (included education level of secondary school-9 to 12 yrs of education, and college-above 12 yrs of education).

STATISTICAL ANALYSIS

SPSS Version 13 (IBM, USA) was used for all analysis. The analysis for this study was conducted in 2014. Cox proportional hazards model was used to estimate tobacco associated HRs adjusted for age, education and alcohol consumption, and alcohol associated HRs adjusted for age, education, and tobacco usage status. HRs for tobacco and alcohol associated all-cause and cause-specific mortality were further stratified by SES. HRs for joint effect of tobacco and alcohol consumption stratified by SES were also presented. HRs for joint effect of frequency of tobacco use and frequency of alcohol use by SES were also presented.

RESULTS

Demographics

Table 1 presents demographics of the 34,055 men according to tobacco habit. Around 90% of alcohol users were to-

bacco users while around 30% of tobacco users were alcohol users. Cigarette smoking was more common among high SES (2789/4631=64%), while in contrast, SLT use (6473/10169=60%) and bidi smoking (5479/7111=77%) was common among low SES.

SES Differences in Mortality from Use of Tobacco

Referring to Table 2, stratification of HRs by SES for all-cause mortality shows higher HR for high SES bidi smoker (HR=2.01) than low SES bidi smoker (HR=1.41). Additionally, within high SES smokers, HR for bidi smokers (2.01) was higher than cigarette smokers (1.28), while within low SES smoker the HRs were similar (1.40) for bidi and cigarette smokers. Bidi smoking increased the risk of mortality from respiratory diseases, TB, and neoplasm among smokers from both high as well as low SES, while cigarette smoking increased risk of mortality from neoplasms. SLT use increased the risk of mortality from respiratory diseases and neoplasms (only high SES), and TB (only low SES).

		Non user	Smokeless	Only Cigarette	Bidi[+]
		N=12144	N=10169	N=4631	N=7111
Age group	45-49	5111	3912	1721	2615
	50-54	1980	2047	863	1451
	55-59	1435	1399	633	860
	60-64	1325	1119	578	949
	65-69	929	786	393	578
	70-74	720	475	257	378
	75-79	333	244	118	153
	80-84	182	117	48	90
	85+	129	70	20	37
Alcohol	Never	11013	7179	2924	4516
	Ever	1131	2990	1707	2595
Education level	Higher	6377	3696	2789	1632
	Lower	5767	6473	1842	5479

[+]=may include bidi plus mixed (bidi and cigarette) smokers
Table 1: Sample characteristics of 34,055 men.

	Never Tobacco User	Smokeless Tobacco User[b]	Smoker[c]	
Cause of Death[a]			**Only Cigarette**	**Bidi[d]**
All-causes				
Person year	55648	45608	21126	30449
Deaths(n=)	1074	1046	550	915
HR[e](95% CI)	1	1.22(1.12, 1.33)	1.41(1.27, 1.57)	1.61(1.47, 1.76)
HR[f](95% CI)	1	1.18(1.08, 1.28)	1.33(1.20, 1.48)	1.52(1.38, 1.67)
Percent change in HR		3.28	5.67	5.29
High SES[g]				
Person year	31040	17922	12923	7388
Deaths(n=)	541	325	268	208
HR[h](95% CI)	1	1.20(1.05, 1.38)	1.32(1.14, 1.53)	2.08(1.77, 2.44)
HR[i](95% CI)	1	1.18(1.03, 1.36)	1.28(1.10, 1.48)	2.01(1.71, 2.37)
Percent change in HR		1.67	3.03	3.37
Low SES[g]				
Person year	24607	27686	8203	23060
Deaths(n=)	533	721	282	707

EPIDEMIOLOGY

Openventio
PUBLISHERS

ISSN 2473-4780

Open Journal

http://dx.doi.org/10.17140/EPOJ-1-102

HR[h](95% CI)	1	1.27(1.13, 1.42)	1.49(1.29, 1.73)	1.51(1.35, 1.69)
HR[i](95% CI)	1	1.21(1.08, 1.35)	1.40(1.21, 1.62)	1.41(1.26, 1.59)
Percent change in HR		4.72	6.04	6.62
Respiratory system diseases [J00-J99]				
Deaths(n=)	70	76	38	103
HR[e](95% CI)	1	1.40(1.01,1.95)	1.63(1.10, 2.43)	2.86(2.09, 3.93)
HR[f](95% CI)	1	1.32(0.95,1.84)	1.49(1.00, 2.23)	2.62(1.89, 3.64)
Percent change in HR		5.71	8.59	8.39
Pneumonia [J18]				
Deaths(n=)	12	20	4	21
HR[e](95% CI)	1	2.44(1.18, 5.04)	1.08(0.35, 3.35)	4.51(2.14, 9.53)
HR[f](95% CI)	1	2.33(1.12, 4.86)	1.00(0.32, 3.15)	4.19(1.95, 9.01)
Percent change in HR		4.51	7.41	7.10
COPD [J42-J46]				
Deaths(n=)	48	51	30	74
HR[e](95% CI)	1	1.31(0.88, 1.95)	1.84(1.16, 2.91)	2.73(1.87, 3.98)
HR[f](95% CI)	1	1.24(0.83, 1.85)	1.71(1.07, 2.72)	2.53(1.72, 3.73)
Percent change in HR		5.34	7.07	7.33
Respiratory system diseases [J00-J99]				
High SES[g]				
Deaths(n=)	33	27	17	17
HR[h](95% CI)	1	1.78(1.07, 2.97)	1.47(0.82, 2.64)	3.20(1.77, 5.78)
HR[i](95% CI)	1	1.76(1.05, 2.94)	1.41(0.77, 2.58)	3.10(1.70, 5.66)
Percent change in HR		1.12	4.08	3.13
Low SES[g]				
Deaths(n=)	37	49	21	86
HR[h](95% CI)	1	1.36(0.89, 2.09)	1.68(0.98, 2.88)	2.83(1.92, 4.18)
HR[i](95% CI)	1	1.24(0.80, 1.92)	1.51(0.87, 2.61)	2.53(1.70, 3.78)
Percent change in HR		8.82	10.12	10.60
TB [A15-A19]				
Deaths(n=)	40	64	25	63
HR[e](95% CI)	1	1.94(1.30, 2.90)	1.74(1.05, 2.87)	2.95(1.96, 4.45)
HR[f](95% CI)	1	1.54(1.03, 2.33)	1.27(0.76, 2.13)	2.19(1.43, 3.35)
Percent change in HR		20.62	27.01	25.76
High SES[g]				
Deaths(n=)	22	18	13	23
HR[h](95% CI)	1	1.42(0.76, 2.65)	1.43(0.72, 2.84)	4.49(2.49, 8.10)
HR[i](95% CI)	1	1.16(0.61, 2.19)	1.02(0.50, 2.06)	3.31(1.79, 6.09)
Percent change in HR		18.31	28.67	26.28
Low SES[g]				
Deaths(n=)	18	46	12	40
HR[h](95% CI)	1	2.37(1.37, 4.10)	1.95(0.94, 4.07)	2.46(1.41, 4.31)

Open Journal

HR^i(95% CI)	1	1.89(1.08, 3.31)	1.50(0.71, 3.17)	1.88(1.06, 3.36)
Percent change in HR		20.25	23.08	23.58

Neoplasms [C00-C97]

Deaths(n=)	39	53	45	66
HR^e(95% CI)	1	1.88(1.24, 2.86)	3.03(1.97, 4.66)	3.66(2.42, 5.54)
HR^f(95% CI)	1	1.83(1.20, 2.79)	2.90(1.87, 4.50)	3.51(2.30, 5.36)
Percent change in HR		2.66	4.29	4.10

Oral and pharynx neoplasms [C00-C14]

Deaths(n=)	1	3	3	11
HR^e(95% CI)	1	3.63(0.37, 35.50)	7.89(0.82, 76.07)	22.42(2.71, 185.29)
HR^f(95% CI)	1	3.23(0.33, 31.98)	6.62(0.67, 65.20)	19.46(2.31, 163.95)
Percent change in HR		11.02	16.10	13.20

Respiratory neoplasms [C30-C39]

Deaths(n=)	3	8	8	16
HR^e(95% CI)	1	3.26(0.86, 12.41)	6.84(1.81, 25.90)	10.35(2.93, 36.56)
HR^f(95% CI)	1	2.99(0.78, 11.49)	6.06(1.57, 23.37)	9.23(2.57, 33.14)
Percent change in HR		8.28	11.40	10.82

Neoplasms [C00-C97]

High SES^g

Deaths(n=)	18	19	23	19
HR^h(95% CI)	1	2.25(1.18, 4.30)	3.50(1.88, 6.49)	6.37(3.33, 12.21)
HR^i(95% CI)	1	2.26(1.18, 4.33)	3.53(1.88, 6.65)	6.43(3.32, 12.45)
Percent change in HR		-0.44	-0.86	-0.94

Low SES^g

Deaths(n=)	21	34	22	47
HR^h(95% CI)	1	1.55(0.90, 2.68)	2.79(1.53, 5.08)	2.50(1.49, 4.19)
HR^i(95% CI)	1	1.45(0.83, 2.53)	2.57(1.40, 4.74)	2.31(1.36, 3.92)
Percent change in HR		6.45	7.89	7.60

Circulatory system diseases [I00-I99]

Deaths(n=)	367	291	164	205
HR^e(95% CI)	1	1.09(0.94, 1.28)	1.26(1.05, 1.52)	1.24(1.04, 1.49)
HR^f(95% CI)	1	1.07(0.91, 1.25)	1.22(1.01, 1.48)	1.20(1.00, 1.44)
Percent change in HR		1.83	3.17	3.23

High SES^g

Deaths(n=)	199	114	83	53
HR^h(95% CI)	1	1.18(0.94, 1.49)	1.17(0.90, 1.51)	1.59(1.17, 2.16)
HR^i(95% CI)	1	1.19(0.94, 1.50)	1.19(0.91, 1.55)	1.61(1.18, 2.19)
Percent change in HR		-0.85	-1.71	-1.26

Low SES^g

Deaths(n=)	168	177	81	152
HR^h(95% CI)	1	1.06(0.85, 1.31)	1.38(1.06, 1.81)	1.10(0.88, 1.38)
HR^i(95% CI)	1	1.00(0.80, 1.24)	1.30(0.99, 1.70)	1.03(0.82, 1.30)

EPIDEMIOLOGY

Openventio
PUBLISHERS

ISSN 2473-4780

Open Journal

http://dx.doi.org/10.17140/EPOJ-1-102

Percent change in HR		5.66	5.80	6.36
Digestive system diseases [K00-93]				
Deaths(n=)	28	30	15	25
HR[e](95% CI)	1	1.41(0.84, 2.38)	1.41(0.75, 2.65)	2.04(1.16, 3.59)
HR[f](95% CI)	1	1.07(0.63, 1.84)	0.96(0.50, 1.84)	1.43(0.80, 2.57)
Percent change in HR		24.11	31.91	29.90
Liver [K70-77]				
Deaths(n=)	21	22	14	23
HR[e](95% CI)	1	1.34(0.73, 2.46)	1.75(0.89, 3.45)	2.43(1.31, 4.50)
HR[f](95% CI)	1	0.99(0.53, 1.84)	1.14(0.56, 2.30)	1.64(0.86, 3.11)
Percent change in HR		26.12	34.86	32.51
Digestive system diseases [K00-93]				
High SES[g]				
Deaths(n=)	21	15	7	6
HR[h](95% CI)	1	1.27(0.65, 2.47)	0.81(0.35, 1.92)	1.33(0.54, 3.32)
HR[i](95% CI)	1	1.00(0.51, 1.99)	0.55(0.23, 1.33)	0.95(0.37, 2.41)
Percent change in HR		21.26	32.10	28.57
Low SES[g]				
Deaths(n=)	7	15	8	19
HR[h](95% CI)	1	2.00(0.81, 4.92)	3.49(1.26, 9.68)	3.18(1.33, 7.60)
HR[i](95% CI)	1	1.47(0.58, 3.69)	2.41(0.84, 6.87)	2.19(0.89, 5.41)
Percent change in HR		26.50	30.95	31.13
Others				
Deaths(n=)	530	532	263	453
HR[e](95% CI)	1	1.22(1.08, 1.38)	1.40(1.20, 1.62)	1.51(1.33, 1.72)
HR[f](95% CI)	1	1.20(1.06, 1.35)	1.36(1.16, 1.58)	1.47(1.28, 1.68)
Percent change in HR		1.64	2.86	2.65
High SES[g]				
Deaths(n=)	248	132	125	90
HR[h](95% CI)	1	1.08(0.87, 1.33)	1.35(1.09, 1.67)	1.99(1.56, 2.54)
HR[i](95% CI)	1	1.07(0.87, 1.33)	1.34(1.07, 1.67)	1.97(1.54, 2.53)
Percent change in HR		0.93	0.74	1.01
Low SES[g]				
Deaths(n=)	282	400	138	363
HR[h](95% CI)	1	1.32(1.13, 1.54)	1.41(1.15, 1.73)	1.46(1.25, 1.71)
HR[i](95% CI)	1	1.29(1.10, 1.50)	1.36(1.11, 1.68)	1.42(1.21, 1.66)
Percent change in HR		2.27	3.55	2.74

[a]=Coded as per ICD 10
[b]=only non-smoker
[c]=may include smokers plus mixed (smoking and smokeless tobacco) users
[d]=may include bidi plus mixed (bidi and cigarette) smokers
[e]=age and education adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model
[f]=age, education and alcohol adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model
[g]=low SES (those reporting education below high school) and high SES (those reporting education high school or above)
[h]=age adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model
[i]=age and alcohol adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model

Table 2: Hazard Ratios in tobacco users for deaths reported among 34,055 men.

EPIDEMIOLOGY

Openventio
PUBLISHERS

ISSN 2473-4780

Open Journal

http://dx.doi.org/10.17140/EPOJ-1-102

SES Differences in Mortality from Use of Alcohol

Referring to Table 3, stratification of HRs by SES for all-cause mortality shows higher HRs for both high (1.56) and low (1.31) SES country/desi drinkers compared to any other type drinkers. Country/desi drinking increased the risk of mortality from respiratory diseases, TB, and digestive diseases for both high as well as low SES drinkers.

Table 4 shows joint effect of tobacco and alcohol use stratified by SES. Exclusive drinking was associated with excess mortality among low SES drinkers. Similarly, exclusive SLT use was associated with excess mortality among low SES users. While, exclusive cigarette and exclusive bidi smoking were associated with excess mortality among both low as well as high

SES smokers. The HRs were higher among those who drank and used tobacco compared to those who only drank or only used tobacco.

Table 5 shows the joint effect of frequency of tobacco and frequency of alcohol use stratified by SES.

Attenuation of Tobacco Hazard Ratios

Table 2 also shows the attenuation of tobacco associated HRs after adjusting for alcohol use. Among smokers and SLT users, the attenuation in HRs was highest (>20%) for deaths from digestive system diseases; mainly driven by deaths from liver diseases and for deaths from tuberculosis (TB). The next highest attenuation in HRs ranged between 10% to 20% for

		Ever Alcohol user	
Cause of Death[a]	Never Alcohol User	Any type	Country/desi liquor
All			
Person year	114459	38372	25819
Deaths	2556	1029	746
HR[b](95% CI)	1	1.34(1.25, 1.44)	1.50(1.38, 1.63)
HR[c](95% CI)	1	1.23(1.14, 1.33)	1.37(1.26, 1.49)
Percent change in HR		8.21	8.67
High SES			
Person year	52933	16341	7731
Deaths	999	343	193
HR[d](95% CI)	1	1.26(1.11, 1.43)	1.77(1.51, 2.06)
HR[e](95% CI)	1	1.12(0.99, 1.28)	1.56(1.33, 1.84)
Percent change in HR		11.11	11.86
Low SES			
Person year	61526	22031	18087
Deaths	1557	686	553
HR[d](95% CI)	1	1.36(1.24, 1.49)	1.42(1.29, 1.56)
HR[e](95% CI)	1	1.26(1.15, 1.38)	1.31(1.19, 1.45)
Percent change in HR		7.35	7.15
Disease of respiratory [J00-J99]			
Deaths	198	89	69
HR[b](95% CI)	1	1.66(1.29, 2.14)	2.00(1.51, 2.65)
HR[c](95% CI)	1	1.39(1.07, 1.81)	1.68(1.26, 2.24)
Percent change in HR		16.27	16.00
High SES			
Deaths	70	24	15
HR[d](95% CI)	1	1.35(0.85, 2.15)	2.38(1.35, 4.21)
HR[e](95% CI)	1	1.13(0.70, 1.84)	1.91(1.06, 3.45)
Percent change in HR		16.3	19.75

Low SES			
Deaths	128	65	54
HR[d](95% CI)	1	1.75(1.30, 2.37)	1.96(1.42, 2.70)
HR[e](95% CI)	1	1.48(1.08, 2.02)	1.66(1.19, 2.31)
Percent change in HR		15.43	15.31
TB [A15-A19]			
Deaths	100	92	81
HR[b](95% CI)	1	2.95(2.21, 3.92)	3.91(2.89, 5.28)
HR[c](95% CI)	1	2.56(1.90, 3.45)	3.38(2.47, 4.63)
Percent change in HR		13.22	13.55
High SES			
Deaths	38	38	32
HR[d](95% CI)	1	3.16(2.01, 4.96)	5.78(3.59, 9.30)
HR[e](95% CI)	1	2.71(1.69, 4.35)	5.03(3.02, 8.38)
Percent change in HR		14.24	12.98
Low SES			
Deaths	62	54	49
HR[d](95% CI)	1	2.62(1.82, 3.79)	3.04(2.08, 4.45)
HR[e](95% CI)	1	2.29(1.56, 3.35)	2.64(1.78, 3.91)
Percent change in HR		12.6	13.16
Neoplasms [C00-C97]			
Deaths	141	62	41
HR[b](95% CI)	1	1.51(1.12, 2.05)	1.65(1.15, 2.36)
HR[c](95% CI)	1	1.18(0.86, 1.60)	1.28(0.89, 1.84)
Percent change in HR		21.85	22.42
High SES			
Deaths	58	21	11
HR[d](95% CI)	1	1.39(0.84, 2.30)	1.90(0.99, 3.66)
HR[e](95% CI)	1	0.95(0.57, 1.59)	1.24(0.64, 2.42)
Percent change in HR		31.65	34.74
Low SES			
Deaths	83	41	30
HR[d](95% CI)	1	1.58(1.08, 2.30)	1.53(1.01, 2.34)
HR[e](95% CI)	1	1.33(0.91, 1.96)	1.30(0.84, 2.00)
Percent change in HR		15.82	15.03
Disease of circulatory [I00-I99]			
Deaths	772	255	156
HR[b](95% CI)	1	1.19(1.03, 1.38)	1.22(1.02, 1.45)
HR[c](95% CI)	1	1.14(0.98, 1.32)	1.16(0.97, 1.40)
Percent change in HR		4.20	4.92
High SES			
Deaths	356	93	39

HR[d](95% CI)	1	1.01(0.80, 1.27)	1.13(0.81, 1.58)
HR[e](95% CI)	1	0.94(0.74, 1.19)	1.03(0.73, 1.45)
Percent change in HR		6.93	8.85
Low SES			
Deaths	416	162	117
HR[d](95% CI)	1	1.30(1.08, 1.56)	1.26(1.02, 1.55)
HR[e](95% CI)	1	1.27(1.05, 1.54)	1.23(0.99, 1.53)
Percent change in HR		2.31	2.38
Digestive [K00-93]			
Deaths	49	49	37
HR[b](95% CI)	1	3.21(2.15, 4.78)	4.01(2.58, 6.23)
HR[c](95% CI)	1	3.07(2.02, 4.68)	3.86(2.42, 6.15)
Percent change in HR		4.36	3.74
High SES			
Deaths	26	23	15
HR[d](95% CI)	1	2.90(1.65, 5.09)	4.31(2.26, 8.21)
HR[e](95% CI)	1	3.16(1.74, 5.71)	4.85(2.43, 9.68)
Percent change in HR		-8.97	-12.53
Low SES			
Deaths	23	26	22
HR[d](95% CI)	1	3.48(1.97, 6.13)	3.73(2.06, 6.76)
HR[e](95% CI)	1	2.94(1.63, 5.30)	3.16(1.70, 5.84)
Percent change in HR		15.52	15.28
Others			
Deaths	1296	482	362
HR[b](95% CI)	1	1.21(1.09, 1.35)	1.35(1.20, 1.52)
HR[c](95% CI)	1	1.11(1.00, 1.24)	1.24(1.10, 1.40)
Percent change in HR		8.26	8.15
High SES			
Deaths	451	144	81
HR[d](95% CI)	1	1.16(0.96, 1.40)	1.61(1.26, 2.04)
HR[e](95% CI)	1	1.03(0.85, 1.25)	1.43(1.12, 1.84)
Percent change in HR		11.21	11.18
Low SES			
Deaths	845	338	281
HR[d](95% CI)	1	1.22(1.07, 1.38)	1.29(1.13, 1.48)
HR[e](95% CI)	1	1.13(0.99, 1.28)	1.19(1.03, 1.37)
Percent change in HR		7.38	7.75

[a]=Coded as per ICD 10
[b]=age and education adjusted hazard ratios (HRs) and confidence intervals (CIs) by using Cox model.
[c]=age, education and tobacco adjusted hazard ratios (HRs) and confidence intervals (CIs) by using Cox model
[d]= age adjusted hazard ratios (HRs) and confidence intervals (CIs) by using Cox model.
[e]=age and tobacco adjusted hazard ratios (HRs) and confidence intervals (CIs) by using Cox model

Table 3: Number of deaths and hazard ratios by cause of death and alcohol use among 34,055 men.

EPIDEMIOLOGY

Openventio
PUBLISHERS

ISSN 2473-4780

Open Journal

http://dx.doi.org/10.17140/EPOJ-1-102

HRs (95% CIs)[e]			
Tobacco use			
			Smoker[c]
Alcohol use	Never	Smokeless[b]	Only cigarette	Bidi[d]
Never	1	1.15(1.04, 1.26)	1.36(1.20, 1.54)	1.43(1.29, 1.60)
Person year	50081	32111	13061	19206
Deaths(n=)	975	714	338	529
Ever	1.03(0.84, 1.27)	1.46(1.28, 1.65)	1.52(1.31, 1.77)	1.96(1.74, 2.21)
Person year	5567	13497	8066	11242
Deaths(n=)	99	332	212	386
HRs(95% CIs)[h]				
High SES[g]				
Never	1	0.98(0.83, 1.15)	1.31(1.10, 1.57)	1.63(1.33, 1.99)
Person year	27491	12937	7845	4659
Deaths(n=)	494	220	166	119
Ever	0.81(0.60, 1.10)	1.51(1.22, 1.87)	1.34(1.08, 1.66)	2.25(1.79, 2.83)
Person year	3549	4985	5078	2729
Deaths(n=)	47	105	102	89
Low SES[g]				
Never	1	1.26(1.11, 1.43)	1.39(1.16, 1.65)	1.41(1.23, 1.61)
Person year	22590	19174	5215	14547
Deaths(n=)	481	494	172	410
Ever	1.35(1.01, 1.80)	1.44(1.23, 1.69)	1.72(1.39, 2.11)	1.91(1.65, 2.21)
Person year	2018	8512	2988	8513
Deaths(n=)	52	227	110	297

b=only non-smoker
c=may include smokers plus mixed (smoking and smokeless tobacco) users
d=may include bidi plus mixed (bidi and cigarette) smokers
e=age and education adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model
g=low SES (those reporting education below high school) and high SES (those reporting education high school or above)
h=age adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model

Table 4: Hazard Ratios in tobacco and alcohol users for deaths among 34,055 men.

deaths from oral pharynx and respiratory neoplasm.

DISCUSSION

It is well known in India (and in Mumbai) that bidi smoking is more prevalent among individuals in low SES and cigarette smoking among high SES.[4-7] The HRs in this study however, were higher among high SES bidi smokers and low SES cigarette smokers than their corresponding SES counterpart. Similarly, country/desi drinking was more prevalent in this study among individuals in low SES but higher HRs were observed among high SES country/desi drinkers. This contrasting

association of SES with risk factors (tobacco and alcohol use) in terms of prevalence and in terms of mortality risk needs additional cohort studies from other locations.

A general perspective is that risky behaviors such as smoking and alcohol consumption are more prevalent in lower SES groups, therefore population attributable risks are expected to be higher in low SES groups.[17] At present, a lot of research exists for explaining socioeconomic differences for tobacco use within India[4-5,18-19] including Mumbai[6-7] with higher prevalence of smoking and smokeless forms among lower SES groups. However, SES differences for mortality is minimally explored

	Alcohol use frequency		
	Never user	<4 times a week	>=4 times a week
Never user	1	0.94(0.70, 1.25)	1.16(0.87, 1.54)
Smokeless[b] Frequency per day 1 to 5	1.16(1.03, 1.30)	1.12(0.85, 1.47)	1.84(1.55, 2.19)
6 to 10	1.08(0.91, 1.29)	1.18(0.80, 1.75)	1.31(0.96, 1.81)
>10	1.18(0.91, 1.54)	0.99(0.49, 1.99)	1.92(1.35, 2.72)
Smoker[c] Only cigarette			
Frequency per day 1 to 5	1.28(1.04, 1.56)	0.75(0.45, 1.26)	1.52(1.11, 2.07)
6 to 10	1.39(1.14, 1.69)	1.30(0.85, 1.98)	1.55(1.12, 2.13)
>10	1.41(1.17, 1.70)	1.63(1.15, 2.33)	2.04(1.58, 2.63)
Bidi[d] Frequency per day 1 to 5	1.25(0.99, 1.58)	1.03(0.57, 1.88)	1.94(1.37, 2.73)
6 to 10	1.46(1.19, 1.79)	1.67(1.17, 2.40)	2.16(1.61, 2.90)
>10	1.55(1.36, 1.76)	1.54(1.17, 2.02)	2.40(2.06, 2.80)
High SES[g]			
Never user	1	0.75(0.51, 1.09)	0.80(0.50, 1.28)
Smokeless[b] Frequency per day 1 to 5	1.04(0.85, 1.27)	1.48(0.99, 2.20)	2.04(1.48, 2.82)
6 to 10	1.07(0.79, 1.46)	1.41(0.73, 2.72)	1.26(0.63, 2.54)
>10	1.12(0.69, 1.82)	0.55(0.14, 2.20)	3.81(2.03, 7.16)
Smoker[c] Only cigarette			
Frequency per day 1 to 5	1.24(0.93, 1.64)	0.37(0.15, 0.90)	1.36(0.84, 2.22)
6 to 10	1.06(0.78, 1.44)	0.99(0.54, 1.80)	1.21(0.73, 2.03)
>10	1.58(1.22, 2.03)	1.42(0.91, 2.22)	2.00(1.41, 2.84)
Bidi[d] Frequency per day 1 to 5	1.60(1.02, 2.51)	1.47(0.55, 3.94)	2.58(1.33, 5.00)
6 to 10	1.04(0.62, 1.73)	2.29(1.08, 4.83)	1.98(1.02, 3.83)
>10	2.13(1.69, 2.69)	2.18(1.32, 3.59)	2.71(1.99, 3.70)
Low SES[g]			
Never user	1	1.23(0.78, 1.95)	1.52(1.07, 2.17)
Smokeless[b] Frequency per day 1 to 5	1.28(1.11, 1.48)	0.95(0.65, 1.38)	1.84(1.49, 2.27)
6 to 10	1.13(0.91, 1.40)	1.09(0.67, 1.77)	1.36(0.95, 1.95)
>10	1.20(0.88, 1.65)	1.30(0.58, 2.91)	1.61(1.06, 2.45)
Smoker[c] Only cigarette			

EPIDEMIOLOGY

Openventio
PUBLISHERS

ISSN 2473-4780

Open Journal

http://dx.doi.org/10.17140/EPOJ-1-102

Frequency per day 1 to 5	1.28(0.96, 1.70)	1.46(0.78, 2.73)	1.65(1.09, 2.49)
6 to 10	1.75(1.34, 2.28)	1.65(0.91, 3.01)	1.88(1.24, 2.84)
>10	1.24(0.94, 1.64)	1.83(1.03, 3.25)	1.98(1.36, 2.89)
Bidi[d]			
Frequency per day 1 to 5	1.13(0.85, 1.49)	0.87(0.41, 1.84)	1.73(1.16, 2.59)
6 to 10	1.57(1.25, 1.98)	1.47(0.97, 2.22)	2.22(1.59, 3.09)
>10	1.40(1.21, 1.63)	1.32(0.96, 1.83)	2.27(1.90, 2.72)

b=only non-smoker
c=may include smokers plus mixed (smoking and smokeless tobacco) users
d=may include bidi plus mixed (bidi and cigarette) smokers
e=age and education adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model
g=low SES (those reporting education below high school) and high SES (those reporting education high school or above)
h=age adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) by using Cox regression model

Table 5: Hazard Ratios and 95% confidence intervals for frequency of tobacco and frequency of alcohol use for deaths among 34,055 men.

with only one study showing cancer mortality being higher among men with no formal education adjusting for ever-chewing of tobacco.[20] The higher HRs observed in this study for high SES 'country/desi' drinkers counters study findings from other countries showing individuals of lower educational status having higher alcohol-attributable mortality compared to those with higher education.[21-23] Thus the higher HRs among high SES bidi smokers and high SES 'country/desi' drinkers, deviates from widespread notion that higher risks or mortality are seen among lower SES groups,[12-13,15-17] requires further examination. Given these examples, though this data is limited to one study area and does not provide a complete socioeconomic picture of India, the results pose importance of examining for socioeconomic differences. Additionally, findings from this study reiterate the need for further research into risks and mortality outcomes for bidi smokers.

Although, this study shows the increase in the risk of all-cause mortality due to tobacco use (in smoking or SLT form) was attenuated minimally after adjusting for alcohol use. For alcohol associated diseases, such as TB and digestive system diseases (mainly liver diseases) the attenuation was over 20% among SLT users, cigarette and bidi smokers.

The attenuation in the excess risk of mortality for liver diseases among smokers (mainly bidi smokers) and SLT users is consistent with the well-established finding of alcohol intake affecting the liver. However, it may be pointed out that the smoking association with liver diseases [OR=1.6, 95% CI (1.4–1.9)] remained unchanged even after adjusting for alcohol use in a nationally representative case-control study from India.[24] However, these results were neither stratified nor adjusted for SLT use and the liver disease category included causes such as cirrhosis, hepatitis, jaundice, ascites, alcoholism, and alcohol poisoning. So there are few inconsistencies within and between countries but the IARC evaluated the evidence for relationship between smoking and liver cancer and found to be sufficient after adjusting for potential confounders.[25]

The high risk of all-cause and various specific causes

of mortality after adjustment for alcohol consumption among smokers observed in this study is consistent with findings from other studies within India[24,26] and a study from China.[27] Higher HRs among bidi smokers than cigarette smokers for all-cause and for specific causes of death reconfirm bidi smoking being as harmful as cigarette smoking.[8,28] This finding has important public health implication in India because about 90% of alcohol drinkers are tobacco users (Table 1) and 66% of smokers are bidi smokers.[4] These results suggest for giving similar priority to bidi smoking and its health effects in addition to cigarette smoking. This current study also supports the conclusion made by Thun et al[29] that after adjusting for age, further adjustment for behavioral and socioeconomic differences between smokers and non-smokers minimally affects the risk estimates associated with smoking.

For SLT users, the high risk of all-cause mortality after adjusting for alcohol use observed in this study is consistent with findings reported from two cohorts from USA[30] but is little different from Trivandrum (India) cohort fndings.[26] For specific causes, such as cancer, the increase in risk observed in our study was similar to other studies within India[26] and outside India.[30] While, for most other causes (such as respiratory, circulatory and digestive system diseases) our findings were little different.[30] Additionally, inconsistencies were also reported for SLT use between cohorts within country. These inconsistent associations of SLT use with all-causes and various specific causes within and between countries probably point out towards more complex nature of SLT products used in different countries and their systemic effect. To further delineate alcohol adjusted SLT and mortality association, there is a need for undertaking multicentre prospective studies in countries where SLT and alcohol use are prevalent.

There are a few limitations with this study. The sample is not representative of the population as individuals residing in upper-middle-class and upper-class housing were excluded. This exclusion was purposive due to reasons of it being difficult to approach because of security constraints and lack of cooperation from the individuals. Hence, these results may not apply to this division of society. This may partially explain the results that we

are seeing with this study. Stratifying the analysis by socioeconomic status, namely education, as high education and low education, the high SES individuals in this sample are different from the affluent group (upper-middle-class and upper-class). These high SES individuals may still have lower education and lower income compared to those affluent individuals and therefore we observe such findings from this study of higher HRs among high SES bidi smokers and high SES country/desi drinkers. Additionally, these high SES individuals might have some competing risk factors which is not known and not measured which possibly needs to be further explored. In relation to this, this study is limited to city of Mumbai, thus the results may be varied in other cities or areas within India, for which further research is necessary. Finally, this study reports results only for men. Although women in India do not smoke very much (~3%) but they do report the use of SLT (~18%). However, alcohol drinking among women is not expected to be major confounder for tobacco associated mortality because the prevalence of alcohol use among women in India is rather low (~2%).[31]

CONCLUSION

This study demonstrates the prominent role of SES in explaining mortality differences for risks from bidi smoking and 'country/desi' drinking for which multicentre additional studies are required. In addition to focusing on smoking forms of tobacco use, our study findings highlight the importance of estimating alcohol adjusted risk estimates for SLT users. Furthermore, the findings underscore the important role of alcohol use in tobacco associated mortality for causes such as TB and digestive diseases (mainly liver diseases).

ACKNOWLEDGEMENTS

AUTHOR'S CONTRIBUTION

Conceived and designed experiment: MSP. Analysed the data: MSP, PCG, SSN. Wrote the paper: MSP, PCG, DNS, JV. Supervised the field work: MSP. Oversaw the data management, the statistical procedures and tests: MSP. Interpreted the results: MSP, PCG, DNS, SSN. Conducted the literature search and interacted with co-authors in subsequent drafts of the paper: MSP, JV.

CONFLICTS OF INTEREST

We do not have any conflict of interest.

REFERENCES

1. World Health Organization. WHO report on the global tobacco epidemic 2013: enforcing bans on tobacco advertising, promotion, and sponsorship. http://apps.who.int/iris/bitstream/10665/85380/1/9789241505871_eng.pdf. Published 2013. Accessed February 10, 2016.

2. World Health Organization. Global status report on noncommunicable diseases 2010. http://www.who.int/nmh/publications/ncd_report_full_en.pdf. Published 2010. Accessed February 10, 2016.

3. Institute for Health Metrics and Evaluation. The Global Burden of Disease: Generating Evidence, Guiding Policy. Seattle, WA, USA. http://www.healthdata.org/sites/default/files/files/data_for_download/2013/WorldBank_SubSaharanAfrica/IHME_GBD_WorldBank_SubSaharanAfrica_FullReport.pdf. Published 2010. Accessed February 10, 2016.

4. Ministry of Health and Family Welfare, Government of India. Global Adult Tobacco Survey - India, 2009-2010. India: MOHFW, Mumbai. Web site. http://mohfw.nic.in/WriteReadData/l892s/1455618937GATS%20India.pdf. Published 2010. Accessed February 10, 2016.

5. Prabhakar B, Narake SS, Pednekar MS. Social disparities in tobacco use in India: the roles of occupation, education and gender. *Indian J Cancer.* 2012; 49(4): 401-409. doi: 10.4103/0019-509X.107747

6. Sorensen G, Gupta PC, Pednekar MS. Social disparities in tobacco use in Mumbai, India: the roles of occupation, education and gender. *Am J Public Health.* 2005; 95(6): 1003-1008. doi: 10.2105/AJPH.2004.045039

7. Gupta PC. Survey of sociodemographic characteristics of tobacco use among 99 598 individuals in Bombay, India using handheld computers. *Tob Control.* 1996; 5(2): 114-120.

8. Gupta PC, Pednekar MS, Parkin DM, Sankaranarayanan R. Tobacco associated mortality in Mumbai (Bombay) India. Results of the Bombay Cohort Study. *Int J Epidemiol.* 2005; 34(6): 1395-1402. doi: 10.1093/ije/dyi196

9. Pednekar MS, Sansone G, Gupta PC. Association of alcohol, alcohol and tobacco with mortality: findings from a prospective cohort study in Mumbai (Bombay), India. *Alcohol.* 2012; 46(2): 139-146. doi: 10.1016/j.alcohol.2011.08.006

10. Gupta PC, Maulik PK, Pednekar MS, Saxena S. Concurrent alcohol and tobacco use among a middle-aged and elderly population in Mumbai. *Natl Med J India.* 2005; 18(2): 88-91.

11. Gupta PC, Saxena S, Pednekar MS, Maulik PB. Alcohol consumption among middle aged and elderly men: A community

study from Western India. *Alcohol Alcohol.* 2003; 38(4): 327-331. doi: 10.1093/alcalc/agg077

12. Adler NE, Boyce T, Chesney MA, et al. Socioeconomic status and health, the challenge of the gradient. *Am Psychol.* 1994; 49(1): 15-24. doi: 10.1037/0003-066X.49.1.15

13. Adler NE, Newman K. Socioeconomic disparities in health: pathways and policies. *Health Aff (Millwood).* 2002; 21(2): 60-76. doi: 10.1377/hlthaff.21.2.60

14. Cutler DM, Lleras-Muney A, Vogl T. Socioeconomic status and health: dimensions and mechanisms. http://www.nber.org/papers/w14333. National Bureau of Economic Research working paper 14333. Published September 2008. Accessed February 10, 2016.

15. Williams DR, Collings C. US socioeconomic and racial differences in health: patterns and explanations. *Annu Rev Sociol.* 1995; 21: 349-386. https://sph.umich.edu/sep/downloads/Williams_and_Collins.pdf. Accessed February 10, 2016.

16. Galobardes B, Lynch J, Smith GD. Measuring socioeconomic position in health research. *Br Med Bull.* 2007; 81-82: 21-37. doi: 10.1093/bmb/ldm001

17. Lantz PM, Lynch JW, House JS, et al. Socioeconomic disparities in health change in longitudinal study of US adults: the role of health-risk behaviours. *Soc Sci Med.* 2001; 29-40. doi: 10.1016/S0277-9536(00)00319-1

18. 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. *Tob Control.* 2003; 12:e4. doi: 10.1136/tc.12.4.e4

19. Subramanian SV, Smith GD, Subramanyam M. Indigenous health and socioeconomic status in India. *PLoS Med.* 2006; 3(10): 1794-1804. doi: 10.1371/journal.pmed.0030421

20. Gajalaksmi V, Whitlock G, Peto R. Social inequalities, tobacco chewing, and cancer mortality in south India: a case-control analysis of 2,580 cancer deaths among non-smoking non-drinkers. *Cancer Causes Control.* 2012; 23 Suppl 1: 91-98. doi: 10.1007/s10552-012-9905-1

21. Rahu K, Parna K, Palo E, Rahu M. Contrasts in alcohol-related mortality in Estonia: education and ethnicity. *Alcohol Alcohol.* 2009; 44(5): 517-522. doi: 10.1093/alcalc/agp035

22. Pridemore WA, Tomkins S, Eckhardt K, Kiryanov N, Saburova L. A case-control analysis of socio-economic and marital status differentials in alcohol and non-alcohol related mortality among working-age Russian males. *Eur J Public Health.* 2010; 20(5): 569-575. doi: 10.1093/eurpub/ckq019

23. Tjepkema M, Wilkins R, Long A. Cause-specific mortality by education in Canada: a 16-year follow-up study. *Health Rep.* 2012; 23(3): 23-31.

24. Jha P, Jacob B, Gajalakshmi V, et al. A Nationally Representative Case–Control Study of Smoking and Death in India. *N Engl J Med.* 2008; 358: 1137-1147. doi: 10.1056/NEJMsa0707719

25. Vineis P, Alavanja M, Buffler P, et al. Tobacco and cancer: recent epidemiological evidence. *J Natl Cancer Inst.* 2004; 96(2): 99-106. doi: 10.1093/jnci/djh014

26. Ramadas K, Sauvaget C, Thomas G, Fayette JM, Thara S, Sankaranarayanan R. Effect of tobacco chewing, tobacco smoking and alcohol on all-cause and cancer mortality: A cohort study from Trivandrum, India. *Cancer Epidemiol.* 2010; 34(4): 405-426. doi: 10.1016/j.canep.2010.04.006

27. Gu D, Kelly TN, Wu X, et al. Mortality Attributable to Smoking in China. *N Engl J Med.* 2009; 360: 150-159. doi: 10.1056/NEJMsa0802902

28. Gajalakshmi V, Peto R, KanakaTS, Jha P. Smoking and mortality from tuberculosis and other diseases in India: retrospective study of 43 000 adult male deaths and 35000 controls. *Lancet.* 2003;362(9383):507-515.doi:10.1016/S0140-6736(03)14109-8

29. Thun MJ, Apicella LF, Henley SJ. Smoking vs other risk factors as the cause of smoking-attributable deaths: confounding in the courtroom. *JAMA*. 2000; 284(6): 706-712. doi: 10.1001/jama.284.6.706

30. Henley SJ, Thun MJ, Connell C, Calle EE. Two large prospective studies of mortality among men who use snuff or chewing tobacco (United States). *Cancer Causes Control.* 2005; 16: 347-358. doi: 10.1007/s10552-004-5519-6

31. Ministry of Health and Family Welfare Government of India. International Institute for Population Sciences, Deonar, Mumbai. National Family Health Survey (NFHS-3), 2005–06: Volume 1. https://dhsprogram.com/pubs/pdf/FRIND3/FRIND3-Vol1AndVol2.pdf. Published September 2007. Accessed February 10, 2016.