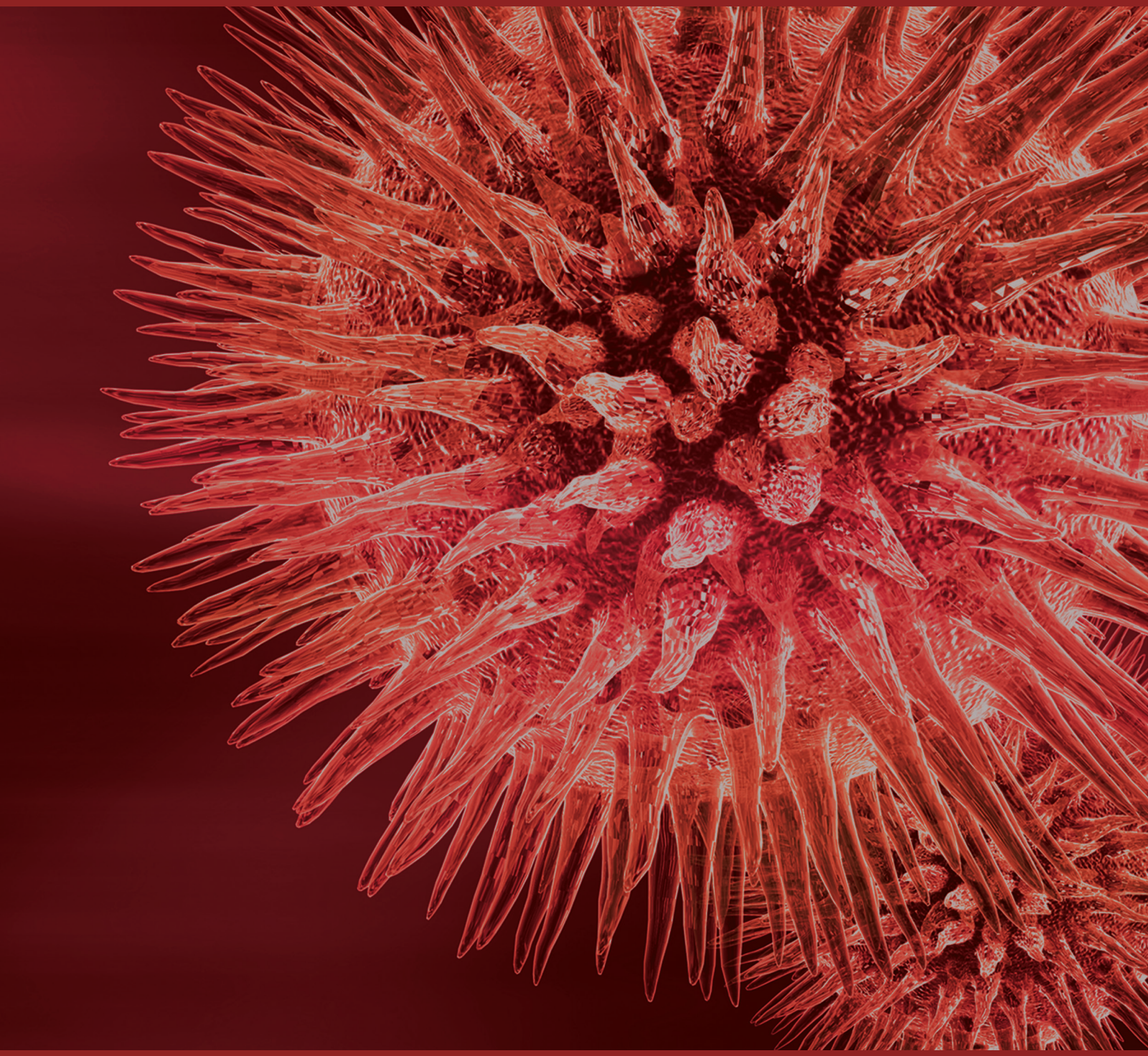
BioMed Research International

Tobacco and Health Disparities

Guest Editors: Kamran Siddiqi, Mohammed Jawad, Nasir Mushtaq, Shehzad Ali, and Javaid Ahmed Khan



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Contents

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Editorial

Tobacco and Health Disparities

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Tobacco use is a major threat to public health and if current consumption patterns remain unchanged, it will result in one billion deaths in 21st century [1]. A combination of public health efforts in recent years has resulted in a general decline in the prevalence of tobacco use worldwide; however, the total number of smokers has increased due to population growth [2]. Furthermore, the most poor, marginal, and vulnerable sections of the society have not benefitted from such efforts and hence tobacco consumption remains high in these groups leading to devastating consequences and rising health inequalities [3, 4]. These include those with low socioeconomic status, homeless people, indigenous and minority ethnic groups, and patients with debilitating conditions such as tuberculosis, HIV, and mental disorders. This is particularly devastating as their disadvantage increases their likelihood of consuming tobacco as a "coping strategy" and, subsequently, their tobacco use increases their disadvantage through poor health, less money for essentials, and economic burden [1]. In order to achieve further decline in global tobacco consumption, tobacco control communities need to focus their efforts on reducing tobacco-related health disparities. There are a number of potential barriers to such efforts. Firstly, we understand very little about how exposure to disadvantaged circumstances shapes smoking careers throughout the life course [5]. Secondly, measures such as socioeconomic status are often not included in the evaluation of tobacco control interventions. Thirdly, tobacco control interventions are often not tailored to the particular needs of disadvantaged populations. Finally, tobacco control policy is generally not linked to policies to tackle social determinants of health [6]. It is, therefore, not a surprise that, apart from taxation measures, tobacco control interventions appear to have very little effect on reducing health inequalities [7]. In this special issue, we have included eleven research articles that help to expand our understanding of social disparities in tobacco use and highlight the need for progressive approaches to tackle these.

Three studies by M. Lund, N. J. Grills et al., and F. Janssen and F. van Poppel remind us of the role of education, occupation, and gender in determining the course of tobacco epidemic. In a study of 1,200 Norwegian smokers that used successive cross-sectional data, M. Lund demonstrated a strong association between low levels of education and high levels of cigarette consumption, dependence, and lack of intention to quit. In another large study of tobacco prevalence and attitudes from North India, where nearly 70% of men are tobacco users, N. J. Grills et al. identified a range of educational and occupational disparities in tobacco use. Applying a historical perspective, F. Janssen and F. van Poppel examined gender differences in smoking adoption patterns in Netherlands and found that these differences played a major role in differences in life expectancy and smoking related cancer mortality between men and women.

Two other studies by K. A. Vickerman et al. and R. Hiscock et al. examined the distribution and determinants of low cessation rates in tobacco quitline programme in three USA states and in English Stop Smoking Services, respectively. In the USA-based study, K. A. Vickerman et al. followed up 3,262 clients for a period of seven months and found that the self-reported quit rates among those with one or more than one mental health condition were lower than those without. Authors concluded that, for those with mental health conditions, cessation programmes such as quitline need to be tailored accordingly. In the UK-based study, R. Hiscock et al. identified some important factors, which contribute to lower cessation rates among smokers who belong to lower socioeconomic status. Material factors, such as housing tenure, along with social factors and use of cessation medication were identified as significantly associated with smoking abstinence among this group.

In a series of three studies, A. Singh et al., M. Jawad et al., and M. Jawad et al. examined noncigarette forms of tobacco, a neglected but important topic from the perspective of vulnerable populations. In a secondary analysis of Global Adult Tobacco Survey (GATS) 2009-10 data, A. Singh et al. demonstrated that in India social gradient for tobacco use changes with the type of tobacco products where cigarette smoking is common among wealthier individuals while bidi smoking and smokeless tobacco are common among impoverished and less educated. The other two studies focused on waterpipe smoking, a traditional form of tobacco smoking in Middle East and South Asia but a relatively modern trend among young people in Europe and USA. In a qualitative study, M. Jawad et al. assessed the impact of health warning labels on waterpipe. The findings highlights that noncigarette forms of tobacco may not be as sensitive to existing tobacco control legislation as cigarettes, and in attempt to address disparities we may need to adapt our interventions accordingly. In the other paper by M. Jawad et al., the longitudinal analysis of a simple social media campaign gives us insight into how disparities in intervention effects can be unique to different social media platforms. The description of a low-resource social media campaign may be a valuable tool for those wishing to embark on mass media campaigns for further tobacco control interventions.

Two of the studies included here by A. J. Saari et al. and A. H. Al-Zalabani et al. remind us of the importance of adolescence in establishing tobacco-related norms. In a longitudinal study in Finland, A. J. Saari et al. showed the predictive effect of low self-esteem during adolescence on subsequent smoking behaviours during adulthood. In another school-based survey in Saudi Arabia, A. H. Al-Zalabani et al. demonstrated a considerable high prevalence of second-hand smoke exposure among adolescents, which was strongly associated with the smoking behaviours of their parents, peers, and other family members.

Finally, in a systematic review examining the epidemiology of tobacco use among khat users, S. Kassim et al. emphasize the high prevalence of tobacco use among people who chew khat, a socially acceptable mild amphetamine popular in parts of the Middle East and East Africa. Not only does this remind us that risk behaviours come in tandem, but also the review provides interesting hypotheses about the synergism that khat plays in the dependence profile of tobacco users.

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Research Article

Tobacco Usage in Uttarakhand: A Dangerous Combination of High Prevalence, Widespread Ignorance, and Resistance to Quitting

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Background. Nearly one-third of adults in India use tobacco, resulting in 1.2 million deaths. However, little is known about knowledge, attitudes, and practices (KAP) related to smoking in the impoverished state of Uttarakhand. *Methods*. A cross-sectional epidemiological prevalence survey was undertaken. Multistage cluster sampling selected 20 villages and 50 households to survey from which 1853 people were interviewed. Tobacco prevalence and KAP were analyzed by income level, occupation, age, and sex. 95% confidence intervals were calculated using standard formulas and incorporating assumptions in relation to the clustering effect. *Results*. The overall prevalence of tobacco usage, defined using WHO criteria, was 38.9%. 93% of smokers and 86% of tobacco chewers were male. Prevalence of tobacco use, controlling for other factors, was associated with lower education, older age, and male sex. 97.6% of users and 98.1% of nonusers wanted less tobacco. Except for lung cancer (89% awareness), awareness of diseases caused by tobacco usage was low (cardiac: 67%; infertility: 32.5%; stroke: 40.5%). *Conclusion*. A dangerous combination of high tobacco usage prevalence, ignorance about its dangers, and few quit attempts being made suggests the need to develop effective and evidence based interventions to prevent a health and development disaster in Uttarakhand.

1. Introduction

Globally, tobacco use is the second-leading cause of preventable death [1], being responsible for more than 5 million deaths annually [2]. The present burden of tobacco deaths is equally shared between developed and developing countries [1]. However, whilst tobacco consumption is declining in high-income countries, consumption is increasing in low and middle income countries (LMIC). 84% of the world's smokers now reside in LMIC countries [3] and, by 2030, 70% of tobacco-related deaths are predicted to occur in LMIC [4, 5].

In India, The World Health Organization predicts that by 2020 tobacco deaths in India may exceed 1.5 million annually [6]. More than one-third (35%) of Indian adults use tobacco [7]; however there are great variations in prevalence between the sexes, between urban and rural communities, and between different states and among different socioeconomic and cultural groups [8]. Smokeless tobacco products are the most commonly used form (21%); however over one-quarter of tobacco consumers only use smoked forms (9%), whilst one-seventh (5%) use both [7]. Smoking prevalence is much higher in men (23%) with only 3% of women smoking tobacco. Additionally, the diversity of forms of tobacco usage in India creates additional complexity for tobacco control initiatives.

The health burden of tobacco is particularly relevant for a country which is the second largest consumer of tobacco products in the world [5, 9]. The negative impacts of tobacco on health have been known by the research community for decades [10]. All forms of tobacco cause fatal and disabling health problems throughout life. However, whilst community awareness around the major tobacco related diseases has generally improved, awareness about the litany of other diseases caused by tobacco tends to be low.

Evidence shows that Tobacco use is influenced by a variety of factors, including individual attitudes and beliefs, social norms and acceptability, availability, and advertising campaigns [11]. There are also many misperceptions with regard to tobacco use, for example, that it aids concentration, suppresses appetite, reduces anxiety and tension, causes skeletal muscle relaxation, and induces feelings of pleasure [11, 12].

In Uttarakhand the Global Adult Tobacco Survey study indicates that the prevalence of tobacco use in Uttarakhand state is approximately 31%, which is the highest of all the Northern states. 44% of males use tobacco, while only 6% of females do, replicating the pattern of male-dominated tobacco use across India [7]. Another prevalence study done by Grills et al. in Tehri Garhwal District of Uttarakhand revealed that the prevalence of adult tobacco usage was similar to the national data [13]. Not only were high rates of tobacco consumption observed in Tehri Garhwal and Dehradun but also myths and misconceptions surrounding the use of tobacco were observed which reinforce consumption behaviour in communities of these two districts. Grills et al., who work in hospitals in Uttarakhand, see high numbers of tobacco related illnesses including respiratory diseases, otitis media in children, strokes, and cardiac disease.

Although preliminary surveys [13] and the GATS indicate high prevalence of tobacco usage in Uttarakhand there is limited sub-group analysis or data on the various factors influencing usage (individual attitudes and beliefs, social norms and acceptability, availability, and advertising campaigns). Given indications that Uttarakhand has a high prevalence of tobacco use, it is important to develop a more detailed understanding of tobacco usage in this rural and mountainous area of North India. This will inform the development of high quality, integrated, and cost effective tobacco control programs to decrease harm from tobacco usage in India. In particular we will undertake a detailed analysis amongst different subgroups of prevalence, knowledge of the dangers, and the importance of different factors affecting initiation and quitting behaviour.

2. Subjects and Methods

2.1. Study Design. A cross-sectional cluster randomized epidemiological mapping survey was done in two rural and mountainous districts of Uttarakhand state over a four-week period.

A power calculation suggested that a sample size of >1800 people would be adequate to estimate the outcomes in Uttarakhand (based on an ICC of 0.01). This was derived using "sampsi" and "samclus" in STATA.

From thirteen districts in Uttarakhand two were selected nonrandomly in that they represented a one-quarter of the population of Uttarakhand and also where the intervention will be taking place. In the first stage, cluster randomisation resulted in the selection of twelve out of 764 clusters (villages) from Tehri District and eighteen clusters (villages) from 1901 clusters in Dehradun district (the second district had roughly twice the population). These clusters were chosen randomly using a standard formula for probability proportionate to the size (PPS). In the second stage of the sampling, fifty households in each village were selected using standard sampling methods. Where the entire village was between 45–55 households, the entire village was interviewed. Where the cluster did not have enough households, the nearest villages were also incorporated into the cluster. Where villages had more than 55 households, we selected households by walking in a randomly determined direction and seeking to interview every second household. If households were unoccupied, and where enquiries could not determine their whereabouts, then the next household was surveyed. The response rate was extremely high with less than 15 people refusing to be interviewed, giving a response rate >99%.

2.2. Assessment and Outcomes. The survey tool was developed utilizing validated questions drawn from various other surveys that assessed KAP [7, 11, 14]. The two-page survey tool can be found in the Appendix. The tool was intended to measure the prevalence of tobacco usage (smoked and smokeless), media and advertising exposure, and KAP.

The survey was developed in English, translated into Hindi, and tested for readability and accuracy by both a local clinician and layperson. The survey was then piloted over a two-day period and adapted accordingly. To maximize the consistency between researchers a one-day orientation was given to them.

The primary outcomes of interest of this study were as follows:

(i) prevalence of tobacco consumption: current use of tobacco was defined as any use in the last month, an ex-user as having used tobacco in the past, but not in the last month, and never smoker as having never used tobacco in any form;

(ii) awareness levels of the dangers of tobacco;

(iii) attitudes towards tobacco usage and quitting;

(iv) practices around tobacco use and quitting.

The research team collected the data on paper forms (questionnaire) and then entered deidentified data into STATA. Only one out of 1854 forms was inadequately completed and this was removed from the sample. The data was then cleaned and inconsistencies checked against the original forms. Various subanalyses on tobacco usage were tabulated and prevalence was analyzed by *income level, occupation, age, and sex and numbers cohabitating*. Estimates were accompanied by 95% confidence intervals calculated using standard formulas and incorporating assumptions in relation to the clustering effect by village and residence unit. These *clustering effects* were taken into account in all the appropriate analyses.

2.3. Ethical Issues. Ethics approval was also obtained from the Alfred Health Human Ethics Committee, Alfred Health, Australia, and the Chamba Hospital Ethics Committee (India). An Information and Consent Form was developed, translated into Hindi, and approved by both ethics committees. Additionally, upon entering a village, the team would sit with the village head (Pradhan), other village members, and the community health workers in order to answer any questions.

Table 1: Prevalence of tobacco usage in Uttarakhand.

	Female (%)	95% CI	Male (%)	95% CI	Overall (%)	95% CI
Current tobacco users (both smokers and chewers)	**9.4**	(6.4, 12.4)	**69.5**	(63.2, 75.8)	**38.9**	(35.3, 42.7)
Current tobacco smokers	**3.7**	(1.2, 6.1)	**54.0**	(42.1, 66.0)	**28.5**	(23.6, 33.4)
Current tobacco chewers	**5.9**	(2.0, 9.7)	**36.7**	(29.9, 43.6)	**21.0**	(16.3, 25.8)
Ex-smokers	**0.5**	(0, 1.09)	**3.2**	(0.0, 6.7)	**1.8**	(0.0, 3.8)
Ex-tobacco chewers	**0.1**	(0, 0.29)	**1.1**	(0.0, 2.5)	**0.6**	(0.0, 1.3)

Table 2: (a) Prevalence of tobacco usage in Uttarakhand by occupation, education status, and household income. (b) Prevalence of tobacco usage in Uttarakhand by age.

(a)

Occupation	(%)	95% CI	Education level/students	(%)	95% CI	Income level* (Rs.)	(%)	95% CI
Agriculture	26.2%	21.3–31.1	Higher studies	30.0%	22.3–37.4	**0–2000**	32.7%	27.7–37.6
Driver	62.2%	42.4–81.9	Higher Secondary	40.6%	31.7–49.5	**2001–4000**	39.2%	36.1–42.3
Government	76.6%	54.0–99.2	Upper primary	40.2%	35.1–45.2	**4001–6000**	39.9%	34.9–44.9
Labourer	75.1%	69.0–81.2	Primary	40.0%	33.3–46.7	**6001–8000**	44.3%	33.7–54.9
Housework	8.96%	5.2–12.8	None	42.2%	35.5–48.8	**8000+**	39.3%	28.6–49.9
Shopkeeper	57.2%	46.2–68.1						
Student	22.6%	11.2–34.1						

*Household income is commonly estimated by food expenditure in Rupees/month.

(b)

Age	Prevalence of tobacco usage (smoking or chewing)	95% CI	Prevalence of smoking	95% CI	Prevalence of chewing	95% CI	Prevalence of both chewing and smoking	95% CI
18–34	25.7%	22.6–28.8	16.5%	13.9–19.16	16.9%	14.3–19.6	7.7%	5.9–9.6
35–51	41.0%	37.8–45.7	31.6%	28.0–35.4	17.2%	14.2–20.3	7.1%	5.1–9.2
52–67	54.2%	49.0–59.4	47.4%	42.2–52.2	10.7%	7.5–13.9	3.8%	1.9–5.8
>68	55.9%	46.5–65.2	45.9%	35.5–55.3	14.4%	7.8–21.0	4.5%	0.6–8.4

There is little, or no, perceived risk to the participants. Data did not contain identifiable information.

3. Results

(*More detailed data is available on request but there was inadequate space to present it all here.*)

3.1. Subjects/Participants. The study sample size was 1853 people, including 927 men and 926 women. These participants were spread amongst 15 clusters and selected from a total sampling frame of 195354 people.

The villagers were similar in many respects with high illiteracy, poor quality housing, and widespread poverty. The demographic data demonstrated a similarity between the clusters in terms of sex ratio, age profile, education status, and occupational profile. This suggests a low intercluster variance.

Among all current tobacco users the overall prevalence was 38.9%. However, 69.5% of males used tobacco and 54.0% smoked tobacco. 96.3% of women were not tobacco users compared with only 46% of males (see Table 1). A current user (for both smoked and nonsmoked forms) was considered to be a user if they had used any at all in the last month. An ex-smoker or ex-user of chewed forms was a person who had smoked/or chewed tobacco in the past, but not in the last month.

3.1.1. Tobacco Usage Prevalence across Different Demographics. The prevalence of people smoking increases as age increases, with rates in the oldest age category (>68 years old) being around double that in the youngest category (18–34 years old). However, the majority of the burden of tobacco usage (64% of users) existed in the younger age categories (<52 years old). That is, although the rates were higher in the older ages there were less people alive in these age groups. Interestingly prevalence of chewing actually decreased with age perhaps suggesting substitution with smoked forms of tobacco (Table 2(b)).

Lower education status was also associated with an increased prevalence of tobacco usage, with 42.1% of those with no education using tobacco, 40% of those who reached upper primary, and only 29.9% of those who had completed higher studies. The association between smoking and prevalence was strengthened when controlling for other factors through the regression analysis.

As shown in Table 2(a), in relation to occupation, the mean prevalence of current tobacco users was among drivers (76.6%), labourers (75.1%), and government workers (62%). Students used tobacco at lower rates (22%) whilst occupations undertaken mainly by women had low prevalence (houseworkers (8.9%), agricultural labourers (26.2%)). Surprisingly there is no clear relationship between household income and tobacco usage.

Table 3: Awareness about risks/harms of tobacco usage in subgroups (percentage of those who were aware of the risks).

	Passive smoking (%)	Stroke association (%)	Infertility (%)	Heart disease (%)	Lung cancer (%)
Overall % who were aware of harms	73.5	40.5	32.5	67	89.3
Age group					
18–34	75.9	44.6	42.5	74.1	97.5
35–51	78.5	36.7	28.5	63.7	92.1
52–67	65.0	26.2	17.4	62.9	91.1
68>	46.3	15.5	13.4	29.5	88.8
Gender					
Male	80.0	41.7	33.4	72.1	93.0
Female	67.0	33.7	33.7	62.0	85.5
Education status					
Higher studies	85.1	58.8	46.1	90.2	98.0
Higher secondary	87.2	49.9	41.7	83.0	97.3
Upper primary	75.8	43.7	40.2	76.2	97.2
Primary	68.2	41.7	29.7	56.6	92.2
No formal education	63.1	18.6	20.1	49.0	77.4

A logistic regression analysis which incorporated sex, age group, occupation type, education level, and income group was conducted to predict tobacco use and was found statistically to be significant against a constant only model (chi square 947.2, $P < .001$ with df 20). The Wald criteria demonstrate that sex, age group, and education made a significant contribution in prediction of tobacco usage ($P < 0.05$). The odds ratio indicates that females are less likely to smoke or chew tobacco compared to males (OR 0.04, 95% CI 0.02–0.05); similarly a younger age group (i.e., 18–34 years) is less likely to use tobacco compared to the oldest age group of >68 years (OR 0.43, 95% CI 0.23–0.80) and people who have completed higher studies tend to use tobacco less compared to people with no education (OR 0.36, 95% CI 0.23–0.58).

Attitudes and Practices towards Tobacco Use. 97.9% of those surveyed wanted less tobacco usage in their villages, including 97.6% of users and 98.1% of nonusers. 70% of current users wished to quit and of those who did not want to quit 58% wanted to cut back. 82.4% of those surveyed, including 83.5% of users and 81.7% of nonusers, supported clear and prominent health messages on tobacco products.

87% of tobacco users were aware that tobacco was harmful to health and awareness was higher amongst males (89.7% versus 77% in females), the young (85% in those 18–34 year olds versus 51% in >68 year olds), and educated (93.9% if higher education versus 75.4% if primary educated only). See Table 3.

Awareness That Smoking Causes Serious Harm across Different Education/Sex/Age. Interestingly males, despite using tobacco at much higher rates, also tended to have more awareness about the dangers of tobacco (Table 3). As expected those with lower formal education levels tended to have lower awareness of all dangers. Those who were older (especially over 68) had much lower levels of awareness than younger groups.

Reasons for not stopping were that they use tobacco to relieve stress (64%), they simply like using (43.5%), cravings make it difficult to stop (43.5%), and they spend time with tobacco users (37.8%). 14% stated that peer pressure was a barrier to quitting.

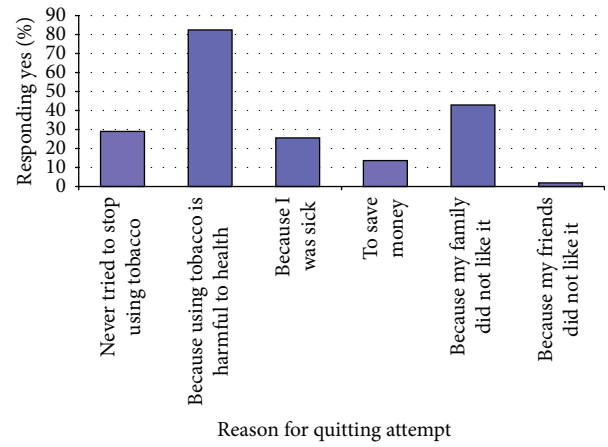

Figure 1: Factors that promoted attempts to stop using tobacco.

Assistance Given for Cessation. *27.4% of all tobacco users had attempted to stop using tobacco* and the stand-out reasons for the attempt were health reasons. 84% stated this as a main reason (see Figure 1). Of those who tried to stop using tobacco 35% received no assistance at all, 54% received advice, support, or encouragement from family and friends, and 11% advice/support/encouragement from a health practitioner or chemist. Only 1% received medicines from a medical doctor and a further 1% from traditional doctors. None of the smokers had been given assistance in the form of nicotine replacement therapy.

Advertising and Marketing Messages. Survey participants were obtaining information about the dangers of tobacco through a variety of media especially from television (85%). In contrast, as shown in Table 4, very few people noticed tobacco

Table 4: Source of advertising of tobacco products and information about the dangers.

Medium	Warnings/demotions			Tobacco promotions		
	Yes (%)	No (%)	Unsure	Yes (%)	No (%)	Unsure
Newspaper/magazines	46.5	37.5	16	4.3	74.8	12.9
Television/films	**85.9**	5	9.1	25.7	52.9	21.5
Radio	22.2	57.5	12.3	0.6	74.2	25.2
Billboards/posters/signage	33.8	44.6	21.6	0.3	75.2	24.5
Public transport vehicles	41.7	36.6	21.7	0.2	75.6	24.2
On tobacco packaging	18	33.8	48.2	12.9	68.4	18.7
Talking to family	41.7	40.5	17.8	N/A	N/A	N/A
Talking to friends	15.5	45.8	38.7	N/A	N/A	N/A
Stores where products are sold	N/A	N/A	N/A	16.2	65	18.8

promotions, with the exception of in TV/films (25.7%), on packaging (17%), and at stores (16%).

There were no significant differences between the males and females in regard to where they obtained information on the danger of tobacco and where they saw tobacco advertisements.

4. Discussion

The analysis of this survey indicates a large burden of tobacco usage in the state of Uttarakhand with 38.9% being current users of tobacco: 28% smoked and 21% using nonsmoked forms. We know that tobacco smoking kills one in three of long term users [15, 16]. Therefore, these very high tobacco usage rates represent a time bomb in Uttarakhand as tobacco associated morbidity and mortality is increasingly experienced over the coming decades. The rate in this study is higher than the national average (35%) and higher than that previously estimated in Uttarakhand (31%) [7]. However, this is consistent with other studies which consistently demonstrate higher rates of overall tobacco use in rural areas compared to urban areas [7, 14, 17].

In the general population smokeless tobacco products are the most commonly used (21% of the population) compared with smoked forms (9% of the population), whilst one-seventh (5% of the population) use both [7]. Our figures display a much more harmful pattern in Uttarakhand where more people use smoked forms than nonsmoked forms. Whilst chewing and smoking both have harmful effects, tobacco smoking has a far greater impact on mortality than do nonsmoked forms. Tobacco related cancers, heart disease, stroke, and other ill effects are far greater with smoked forms of tobacco than nonsmoked forms.

This combined prevalence figure masks an astounding prevalence amongst males whereby 69.5% of males use tobacco, 54.0% smoke, and 36.7% use nonsmoked forms. This survey shows that 93% of all smokers in Uttarakhand are male indicating that this is a male epidemic. These findings support an approach to tobacco control in Uttarakhand that predominantly targets young males. This discrepancy is consistent with GATS; however the gross prevalence amongst males in Uttarakhand (69%) is far higher than the national average for males (48–57%) [7]. Prevalence of tobacco smoking amongst men in Uttarakhand (54.0%) is more than double the national average of 23%, as recently estimated in a national survey undertaken in the same year [8]. The gender difference is particularly pronounced amongst tobacco smokers (54% in men versus 3.7% in women) due to cultural norms in India which discourage women from smoking [18]. In countries of South Asia, particularly India, traditional values tend to discourage smoking by the young or by women, but there is no such taboo against using smokeless tobacco. Thus, most women who use tobacco use it in smokeless forms. Tobacco use, in whatever form, generally begins during adolescence.

Consistent with other surveys such as the GATS, the analysis describes higher tobacco usage rates in older cohorts [7, 19]. This could reflect that younger people are now using less tobacco; however given the extremely low rates of ex-users it more likely reflects accumulation of users over time. Additionally, we found higher rates amongst the labourers and the least educated in the population, a finding that is consistent with most countries [7, 14, 20–23]. In Uttarakhand, after controlling for age/sex/income/education level there was a three times higher rate of tobacco usage amongst the least educated when compared with the most educated. This is consistent with India-wide studies that show those with no education are three times more likely to smoke, and almost twice as likely to use smokeless tobacco, compared to those with a postgraduate education [14, 20, 23]. This reinforces the need to focus tobacco control messages at lower education levels in Uttarakhand.

4.1. Knowledge of Harms. Despite the high levels of illiteracy, rurality, and poverty in Uttarakhand, nearly all respondents were aware that smoking was injurious to health (89.3%) and harmed others (73.5%). In contrast, few were aware that smoking causes infertility (32% awareness) and strokes (12% awareness). This lack of awareness is important because awareness of infertility and birth defects might be more impactful for younger people than ill-health in the distant future would. The mediums for most tobacco control campaigns have poor penetration into poor and uneducated demographics [7]. In this study those who were female, uneducated, and older had lower awareness that tobacco was harmful (see Table 3). There is solid evidence in that graphic rotating warnings on packages would be an effective

intervention to raise awareness about the myriad of diseases caused by tobacco [24, 25]. Interestingly, 85% of our study group, and more than 83.5% of tobacco users, wanted better health warnings on tobacco packages. This positive attitude towards better health warnings is consistent with other national studies such as Arora et al., 2013 [24].

4.2. Advertising and Marketing. Tobacco promotion and advertising increase tobacco usage as indicated by Global Youth Tobacco Survey data demonstrating that youth exposed to cigarette advertising through sports events, televised events, newspapers/magazines, and free cigarettes promotions were significantly more likely to be smokers [26]. Conversely, youth exposed to antismoking media messages were less likely to be current smokers [26]. The same media forms are used to both promote tobacco and protect people from it.

This study indicates that in Uttarakhand we may be winning the advertising and marketing war as few noticed tobacco advertising information whereas most noticed warnings in the media. In Uttarakhand, advertising is banned except at point of sale and packaging. With the exception of shops where tobacco is sold there is little exposure to adverts which partly explains why advertising was often unnoticed. In regard to television and film, which are particularly effective at promoting behaviours, only 25.7% noticed advertising of tobacco products (presumably they are referring to their stars smoking in films) whereas nearly everyone noticed warnings about tobacco. Tobacco advertising bans and limits on showing tobacco usage in Bollywood movies are having an impact (COTPA, 2003). Decreasing exposure to advertising is very important to limit recruitment of young tobacco users. A recent study of 4,000 adolescents in New Delhi showed a significant association between exposure to tobacco in Bollywood movies and students' own tobacco use [27]. Further, analysis of the third National Family Health Survey indicates attending the cinema once a month or more increases the likelihood of an individual either smoking (both males and females) or chewing (males only) tobacco [28].

4.3. Recommendations for Tobacco Control Interventions. What is clear from this study is that additional tobacco control interventions are necessary and desired by the community with both users and nonusers wanting less tobacco use (97.8%) and 82.4% favouring more graphic health warnings. At an individual level the majority of users (70%) wanted to stop and 58% of those who did not want to stop at least wanted to cut back. This appetite for controlling tobacco in Uttarakhand potentially provides an enabling sociopolitical environment and should support the implementation of government tobacco control initiatives currently being considered. However, currently little help is available to aid quitting with only 1 in 10 obtaining professional input and 1 in 100 receiving medications to help them quit. Such help has been shown to increase quitting successes. Cessation programs and interventions that provide assistance are urgently required if we are to mitigate the Uttarakhand tobacco usage epidemic.

Doctors need to be trained in providing cessation advice and increasing awareness as in this study only 1% of those trying to quit received any assistance from a doctor. Where doctors are difficult to access, as is the case in these mountain areas, health workers such as accredited social health activist (ASHA) workers need to be similarly trained. Community health workers, from both government and NGOs, are well placed to be tobacco control advocates in their local community.

Various results suggest that a community based information and awareness campaign might be a timely intervention in Uttarakhand. Interestingly, ex-smokers (2%) and ex-tobacco chewers (0.5%) are few which indicates that having initiated, very few stop using tobacco. When considered alongside the finding that only a quarter have ever attempted to quit this may represent *low hanging fruit* in Uttarakhand. That is, it is reasonable to expect a good number to quit when simply informed fully of the tobacco impact. Studies have shown that where prevalence is high and number of ex-smokers is low, then with simple awareness campaigns a large number of smokers will simply choose to quit. Any awareness campaigns should focus on the health impacts on users, their children, and their community because for those who had attempted to quit their health problems were the most important motivating factor.

Tobacco control efforts should target youth, given that peer pressure was important in promoting initiation of tobacco (this study) and 40% of all tobacco users in India initiate before 18 years of age (GATS) [7] and the mean age of initiation of tobacco use amongst users aged 20–34 years was 17.9 years old. Therefore, behaviour change counselling activities, counselling, and quit-line programmes need to be started at schools and colleges and at community level for drop outs and illiterates. After initiation of tobacco use, overcoming addictive behaviours is more difficult (43.5% named cravings as a barrier to quitting).

4.4. Limitations. Smoking and chewing status was by self-report, and taboo about tobacco use, particularly in females, might have resulted in underreporting. Additionally, smoking rates were highest amongst drivers, labourers, and government workers and as these professions are based away from the home they may have been underrepresented due to the methodology of selecting from those present at home. However, this bias would lead to an underestimating the size of the problem. Generalisability beyond Uttarakhand is difficult given that the sampling frame was limited to India. Only two districts were included due to time and financial constraints, but these were felt to reflect the demographics of other districts in Uttarakhand.

5. Conclusions

This study demonstrates high prevalence of tobacco usage, particularly smoked forms, amongst men in the mountains of North India. Very few users have successfully quit and yet both tobacco users and nonusers supported tobacco control in their community. These findings substantiate the need for development and implementation of a tobacco control program in the area. A proposal to initiate such a community based program is being discussed with the Uttarakhand

government and other partners. These study results will permit high quality, integrated, and cost effective tobacco control programs in North India.

Appendix

Code Number

—/—/— (Village (00-30)/Family (00-99)/Participant (00-99))

Age

— (Estimated Years)

Date

—/— (Day/Month)

Occupation

—

Caste (or Religion)

—

Sex: Female/Male

Highest Educational Attainment:

None/Primary/Junior High/High school/Intermediate/College (Up to 5th/8th/10th/12th)

How many people live in your house? (currently)

—

All Participants

(1a) Based on what you know or believe, does smoking tobacco (such as cigarettes, bidis, hukkah, cigars or pipes) cause serious illness?

(Yes/No/Don't Know/Refused)

(1b) (If yes) Which of the following illnesses?

(a) Lung and throat cancer
(Y/N/DK/R)

(b) Heart disease
(Y/N/DK/R)

(c) Infertility
(Y/N/DK/R)

(d) Stroke
(Y/N/DK/R)

(e) Harm to non-smokers who are in the same room and breathe in the smoke
(Y/N/DK/R)

(f) Other. . .please specify
—

(1c) Based on what you know or believe, does using smokeless tobacco (such as paan, khaini or gutkha) cause serious illness?

(Y/N/DK/R)

(2) How many rupees does your household spend on food each month? (circle)

0–1000
1001–2000
2001–3000
3001–4000
4001–5000
5001–6000
6001–7000
7001–8000
8001–9000
>9001

(3) Have you ever smoked tobacco? (circle)

Current/ex-smoker/never
(*current— smoked any amount in the last month, ex-smoker—If the patient smoked any in the past, but not in the last month*)

If yes then

— (Per day/week/occasional)

(4) Have you ever used smokeless tobacco? (circle)

Current/ex-user/never
(*current—used tobacco (non smoked forms) in last month, ex-user—used tobacco (non-smoked) in past, but not in last month*)

If yes then

— (Per day/week/occasional)

If the Participant Currently Uses Tobacco of Any Form. . .

(5) How many rupees have you spent on tobacco for yourself in the past month? (circle)

0
1–150
151–300
301–450
451–600
601–750
751–900
901–1050
>1051

(6) Would you like to give up using tobacco?

(Y/N/R)

(If yes) How soon? In the next

month/year/not sure

(If no) Would you like to reduce how much tobacco you use?

(Y/N/R)

If the Participant Has Ever Used Tobacco…

(7) How many years ago did you start using tobacco? (*Number of years ago*)

—

(8)

(a) Have you ever tried to stop using tobacco?

(Y/N/R)

(If yes) When you attempted to stop, did you try any of the following to help you?

(b) Receiving advice, support or encouragement from family and friends

(Y/N/DK/R)

(c) Receiving advice, support, encouragement from a health practitioner or chemist

(Y/N/DK/R)

(d) Nicotine replacement therapy, for example, patches, gum or lozenges

(Y/N/DK/R)

(e) Medicines from a medical doctor

(Y/N/DK/R)

(f) Traditional medicines to help stop using tobacco

(Y/N/DK/R)

(g) Other…please specify

—

(9) I will now give you a list of common reasons why people find it difficult to stop using tobacco. Do/did any of these apply to you?

(a) Because most of the people I spend time with also use tobacco

(Y/N/DK/R)

(b) Because of pressure from friends, or wanting to fit in with friends

(Y/N/DK/R)

(c) Because I like using tobacco too much

(Y/N/DK/R)

(d) Because using tobacco helped me to relieve stress or negative moods

(Y/N/DK/R)

(e) Because of cravings or physical urges to use tobacco

(Y/N/DK/R)

(f) Because I do not believe that using tobacco is bad for health

(Y/N/DK/R)

(g) Other…please specify

—

(10)

(a) Have you ever attempted to stop using tobacco?

(Y/N/R)

(If yes) What were the main reasons you decided to stop?

(b) Because using tobacco is harmful to health

(Y/N/DK/R)

(c) Because I was sick

(Y/N/DK/R)

(d) To save money

(Y/N/DK/R)

(e) Because my family did not like it

(Y/N/DK/R)

(f) Because my friends did not like it

(Y/N/DK/R)

(g) Other…please specify

—

All Participants

(11) I will now give you a list of options. Please tell me if any of these are places you have noticed information about the dangers of tobacco in the past 30 days?

(a) Newspapers/magazines?

(Y/N/DK/R)

(b) Television?

(Y/N/DK/R)

(c) Radio?

(Y/N/DK/R)

(d) Billboards/Posters/Signage?

(Y/N/DK/R)

(e) Cinemas?

(Y/N/DK/R)

(f) Public transport vehicles?

(Y/N/DK/R)

(g) When talking to your family?

(Y/N/DK/R)

(h) When talking to your friends?

(Y/N/DK/R)

(i) On the packaging of tobacco products?

(Y/N/DK/R)

(j) Somewhere else? (specify)

—

(12) Are any of the following options places where you have noticed advertising of tobacco products in the past 30 days?

(a) Stores where products are sold?

(Y/N/DK/R)

(b) On the packaging of tobacco products?

(Y/N/DK/R)

(c) Newspapers/magazines?

(Y/N/DK/R)

(d) Television?

(Y/N/DK/R)

(e) Radio?

(Y/N/DK/R)

(f) Billboards/Posters/Signage?

(Y/N/DK/R)

(g) Cinemas?

(Y/N/DK/R)

(h) Public transport vehicles?

(Y/N/DK/R)

(i) Somewhere else? (specify)

—

(13) Would you like to see less tobacco use in your village or community?

(Y/N/DK/R)

(14) Are you in favour of having clear and prominent messages on all tobacco products that warn users about the dangers of tobacco?

(Y/N/DK/R)

(15) Field Notes (e.g., please comment on overcrowding, types of animals/pets, supply of tobacco).

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contribution

Nathan John Grills conceived the study, carried out the planning, background work, and methodology development and drafted the paper. Rajesh Singh and Rajkumari Singh initiated the research, developed the methods, undertook sample selection, helped deliver the research, and undertook the initial write-up. Bradley C. Martin participated in project development and led the fieldwork. All authors read and approved the final paper.

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Research Article

Quitline Use and Outcomes among Callers with and without Mental Health Conditions: A 7-Month Follow-Up Evaluation in Three States

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Objectives. To examine abstinence outcomes among tobacco users with and without a reported mental health condition (MHC) who enrolled in state tobacco quitline programs. *Methods*. Data were analyzed from a 7-month follow-up survey (response rate: 41% [3,132/7,459]) of three state-funded telephone quitline programs in the United States that assessed seven self-reported MHCs at quitline registration. We examined 30-day point prevalence tobacco quit rates for callers with any MHC versus none. Data were weighted to adjust for response bias and oversampling. Multivariable logistic regression was used to examine cessation outcomes. *Results*. Overall, 45.8% of respondents reported ≥1 MHC; 57.4% of those reporting a MHC reported ≥2 MHCs. The unadjusted quit rate for callers with any MHC was lower than for callers with no MHC (22.0% versus 31.0%, $P < 0.001$). After adjusting for demographics, nicotine dependence, and program engagement, callers reporting ≥1 MHC were less likely to be abstinent at follow-up (adjusted OR = 0.63, 95% CI = 0.51–0.78, $P < 0.001$). *Conclusions*. More intensive or tailored quitline programs may need to be developed among callers with MHCs as their quit rates appear to be lower than callers without MHCs.

1. Introduction

Individuals with mental health conditions (MHCs) are twice as likely to smoke compared to the general population [1] with smoking prevalence varying from 34% to over 60% depending on specific diagnosis [2, 3]. Individuals with MHCs are also more likely to die prematurely—up to 25 years earlier on average in some populations [4]—and, similar to the general population, tobacco-related conditions such as heart disease and cancer are the leading causes of death among individuals with MHCs [4].

Smoking rates have significantly declined over the past decade among the general population [5], but rates have not declined among individuals with MHCs [6]. Although studies have shown that evidence-based treatment increases cessation among persons with MHCs [7–10], individuals with MHCs may have unique treatment needs [2, 11] and, based on epidemiological evidence, have a lower rate of successful cessation than those without MHCs [1, 12]. There is growing evidence that, on average, quitting tobacco does not negatively impact long-term psychological functioning for persons with MHCs—a concern often raised by providers [13]. In fact, treatment may reduce MHC symptoms and improve functioning [14–17].

State tobacco quitlines in the United States provide evidence-based tobacco cessation treatment to more than

400,000 smokers annually, including free phone-based cessation counseling and often access to nicotine replacement therapy (NRT) [18, 19]. Approximately one-fourth of quitline callers meet criteria for major Depression [20] and approximately half or greater may have a MHC [21, 22]. Compared to those who try to quit with no support, quitline counseling increases the odds of quitting by 60% in the general population [11] and is a cost-effective public health intervention [23–27]. Quitlines may be a particularly valuable resource for individuals with MHCs because they reduce barriers to care (i.e., cost and transportation) [28]. Little is known about the effectiveness of quitline counseling for individuals with MHCs. Lower quit rates for callers with a MHC have been reported in several conference presentations [21, 22, 29], whereas other researchers found no differences in quit rates for MHC and non-MHC populations [30] or for callers with and without a positive Depression screen [27]. In the two published studies examining MHCs among quitline callers, callers to the California Smokers' Helpline with major Depression were less likely to quit at two-month follow-up (19% versus 28%) [20], and callers to the New York State Smokers' Quitline who were heavy drinkers had lower abstinence rates at two-week follow-up compared to moderate drinkers [31]. Quit rates among quitline callers with other MHCs, such as Attention Deficit Hyperactivity Disorder, Bipolar Disorder, Generalized Anxiety Disorder, Posttraumatic Stress Disorder, and Schizophrenia, have not been published.

Accordingly, the current study examines characteristics and quit outcomes for callers to three state quitlines who reported on seven MHCs at program registration. We hypothesized that callers with MHCs would also have other characteristics that may make it more challenging for them to quit, such as higher tobacco dependence and lower socioeconomic status [1, 11, 32] and that callers with MHCs would have lower 30-day point prevalence quit rates at 7-month follow-up after adjusting for these factors.

2. Methods

2.1. Sample Selection. This observational study includes data from four evaluation samples of quitline registrants from January 2012 through May 2013: one in Maryland, one in Nebraska, and two in North Carolina (one with January–June 2012 registrants and the other with August 2012–May 2013 registrants). These evaluations were conducted as part of each state's ongoing program outcome evaluation procedures. The states agreed to contribute their evaluation data and participate in this secondary data analysis. These state quitlines were selected because they asked a custom registration question to assess self-reported MHC status, offered a multiple-call phone-based cessation program, and had quitline services delivered and evaluations conducted by the same quitline vendor (Alere Wellbeing). After enrolling in the quitline program and completing their first coaching call, callers were selected for evaluation follow-up based on the following criteria. All tobacco users who had enrolled in the phone-based state quitline program in Maryland and Nebraska were selected for evaluation (census sample), until the final three months of the Maryland evaluation, when random sampling was used due to increased quitline call volumes, and thus an influx of individuals eligible for the evaluation. Callers who were pregnant, Medicaid-insured, or reported having a MHC were oversampled using a probability sampling scheme in the North Carolina evaluations. Additional details regarding sampling methods are presented in Table 1. For all evaluations, quitline participants were eligible for inclusion if they were English or Spanish speaking, 18 years or older, and a tobacco user at enrollment, provided a valid phone number, consented to evaluation follow-up during registration, and had completed at least one coaching call. Data weighting procedures were used to accommodate population oversampling during analysis.

2.2. The Quitline Program. All three states offered a multiple-call phone-based cessation program for the duration of the study time frame, which included an initial assessment and planning call plus three to four additional coaching calls, a printed quit guide, and access to the Web Coach website, an interactive web-based cessation resource designed to complement the phone program. The quitline program is based on social cognitive theory and the United States Public Health Service Clinical Practice Guidelines [11, 33]. Calls focus on creating a quit plan, using problem solving and skills development to address cravings and triggers, leveraging social support, and using cessation medications to achieve abstinence and avoid relapse. All tobacco users who were ready to quit in the next 30 days at the time of registration were eligible for the multiple-call program. A one-call program was available for callers not ready to quit or not interested in the multiple-call program. Only a small number of callers selected the one-call program, and only 98 completed a follow-up survey (2.9% of all completed surveys) during the study time frame. Accordingly, we have excluded those opting for the one-call program from these analyses. Free NRT was provided through the quitline to eligible callers in Maryland and North Carolina. Table 1 presents additional details regarding quitline services and NRT offerings during the study time frame.

2.3. Follow-Up Survey Administration. Evaluations were conducted in accordance with recommendations from the North American Quitline Consortium for assessing quit outcomes for state quitlines in North America [34]. Sampled participants were contacted approximately 7 months after completing their first coaching call. Participants with a valid email address who consented to being contacted via email were emailed an invitation to complete the follow-up survey online. Those who did not complete the survey after three reminder emails were then contacted by trained interviewers to complete a phone-based survey. Interviewers made at least one attempt per day to reach each participant by phone; attempts were made on up to 11 different days over approximately a 4-week period.

Across the three states, 7,646 tobacco users who enrolled in the multiple-call programs within January 2012–May 2013

Table 1: Quitline services for tobacco users enrolled in the Nebraska, North Carolina, or Maryland state tobacco quitlines.

Services	State quitline		
	Nebraska	North Carolina	Maryland
Registration dates included	1 August 2012–31 October 2012	Evaluation 1: 1 January 2012–30 June 2012 Evaluation 2: 8 August 2012–31 May 2013	1 December 2012–31 May 2013
7 M responders/number in sample	136/342	Evaluation 1: 827/1,966 Evaluation 2: 753/1,875	1,546/3,463
Evaluation sample selection	Census	Evaluation 1: oversampled Medicaid Evaluation 2: oversampled Medicaid, pregnant, MHCs	Census; random sampling (March–May 2013)
One-call program[a]	All tobacco users	All tobacco users	All tobacco users
Multiple-call program (Assessment and planning call plus 3-4 outbound calls)	Five-call program for tobacco users ready to quit in the next 30 days	Four-call program for tobacco users ready to quit in the next 30 days	Four-call program for tobacco users ready to quit in the next 30 days
Ten-call program	Pregnant tobacco users	Pregnant tobacco users	Pregnant tobacco users
Web Coach (Interactive online complement to phone coaching)	All phone program participants	All phone program participants	All phone program participants
Stand-alone web-based tobacco cessation Program[a]	Not offered	For tobacco users who preferred to receive only online support (starting 1 January 2012)	For tobacco users who preferred to receive only online support (starting 12 January 2012)
Direct Mail Order (DMO) nicotine replacement therapy (NRT)	(i) Not offered (ii) Proof of quitline enrollment and completion of a program call was a component for some Medicaid participants to receive NRT or medications through their pharmacy benefits manager	(i) Eight-week supply of patch, lozenge, or gum to multiple-call enrollees in the following groups: (a) all (1 January 2012–20 May 2012) (b) uninsured (starting 19 December 2012) (c) Orange County residents (starting 13 February 2013) (ii) Two-week (starting 13 February 2013) supply of patch, lozenge, or gum for multiple-call enrollees who were insured (expanded to 8-week supply on 22 May 2013) (iii) Eight-week supply of patches for multiple-call enrollees with state employees' health insurance (duration of study timeframe)	Four-week supply of patch, lozenge, or gum to all multiple-call (once every 12 months)

Note: 7 M = 7-month survey; MHCs = mental health conditions (conditions assessed: Attention Deficit Hyperactivity Disorder, Bipolar Disorder, Depression, Drug or Alcohol Use Disorder (or Substance Use Disorder), Generalized Anxiety Disorder, Posttraumatic Stress Disorder, and Schizophrenia).
[a]This study focused on callers who enrolled in a multiple-call telephone program. Individuals who selected the one-call program or the stand-alone web-based tobacco cessation program were not included. Limited 7-month evaluation data was available for these groups because a small minority selected these services and only Maryland collected follow-up data for the stand-alone web-based program during this timeframe.

were selected for evaluation; 3,262 completed the 7-month survey (response rate: 42.7%). The final sample includes 3,132 participants (40.9%) who responded to the question assessing MHC status during quitline registration and also provided their quit status at 7-month follow-up.

2.4. Measures

2.4.1. Baseline Program Registration Data. To assess MHC status at program registration, callers were asked a behavioral health question similar to one developed by a NAQC advisory forum [35]: "Do you currently have any mental health conditions, such as Attention Deficit Hyperactivity Disorder (ADHD), Bipolar Disorder, Depression, Drug or Alcohol Use Disorder (or Substance Use Disorder; SUD), Generalized Anxiety Disorder (GAD), Posttraumatic Stress Disorder (PTSD), and Schizophrenia?" Registration agents paused briefly after each condition to allow participants to respond. We examined outcomes for callers who reported any MHC versus no MHCs. In addition, because the majority of callers with a MHC reported comorbid MHCs, we also established four mutually exclusive diagnostic groups. The groups were based on conditions that typically have the greatest impact on daily functioning and conditions that were highly comorbid in our sample, such as Depression and anxiety disorders: (Group 1) Schizophrenia or Bipolar

Disorder; (Group 2) Depression, GAD, or PTSD but no report of Schizophrenia or Bipolar Disorder; (Group 3) SUD or ADHD but no report of the other conditions; and (Group 4) no MHC. Demographics (age, gender, education, race/ethnicity, and chronic health condition status [presence of asthma, diabetes, chronic obstructive pulmonary disease, and/or coronary artery disease]), baseline tobacco use data (type [cigarette, cigar, pipe, smokeless, and other], amount [cigarettes per day or CPD], time to first use after waking [TTFU]), and health insurance status (private, Medicare, Medicaid, and uninsured) were collected during quitline registration, per NAQC guidelines [36]. CPD and TTFU were used to create a nicotine dependence index. CPD was recorded on a continuous scale and categorized into four groups: (1) 0–10, (2) 11–20, (3) 21–30, and (4) 31 or more. TTFU was recorded on a 4-point scale: (1) 61 or more minutes, (2) 31–60 minutes, (3) 6–30 minutes, and (4) within 5 minutes. The index is the mean of these two 4-point scales.

2.4.2. Program Engagement. The number of coaching calls completed in the program and whether NRT was sent from the quitline were recorded and examined as indicators of program engagement.

2.4.3. 7-Month Follow-Up Survey. Tobacco cessation outcomes were assessed during the 7-month follow-up survey by asking respondents, "When did you last use tobacco, even a puff or a pinch? (Please do not include electronic cigarettes)". Respondents' self-reported last tobacco use data were used to calculate 7- and 30-day point prevalence tobacco quit rates. Participants were also asked whether they had used any cessation medications to help them quit since enrolling in the quitline (NRT patch, gum, lozenge, inhaler, nasal spray, Chantix/varenicline, Zyban/bupropion/Wellbutrin, and "other" medication).

2.5. Analyses. Data were weighted separately to the populations eligible for the evaluation for each state for nonresponse to the 7-month survey based on age, gender, race/ethnicity, insurance status, call completion, and dependence level. Data from the three states were then combined and poststratification weights were computed to adjust for oversampling in North Carolina evaluations (by pregnancy status, presence of a MHC, and Medicaid status); all variables used during response bias weighting were also included in this step. Weights were computed using a raking macro [37]. Weighted analyses were conducted in SAS 9.3 (SAS Institute Inc., Cary, NC). The purpose of these weighting procedures was to increase the generalizability of the 7-month survey results to the entire population eligible for evaluation in these states (N = 28,391) by adjusting the weights of individuals' 7-month survey data to ensure that respondent characteristics were similar to population characteristics on the weighting variables listed above.

Demographics, tobacco use characteristics, program engagement, and 7-month survey outcomes were examined for callers with and without reported MHCs. Multivariable logistic regression was used to assess whether callers with any MHCs were less likely to quit for 30 days or more at follow-up compared to those without MHCs, controlling for age, gender, race/ethnicity, education, insurance status, number of calls completed, use of cessation medications reported at follow-up, and state (to account for state-level differences in tobacco control environment and quitline services). Two models were estimated; the first examined any versus no MHCs, and the second examined MHC status divided into the four mutually exclusive condition groups described above (Group 1: Schizophrenia/Bipolar Disorder; Group 2: Depression/GAD/PTSD; Group 3: SUD/ADHD; Group 4: no MHC). In the second model, each condition group was compared to no MHC and to each other.

3. Results

Nearly half (45.8%) of survey respondents reported one or more MHCs at baseline including: 31.9% Depression, 21.2% GAD, 13.6% Bipolar Disorder, 8.4% PTSD, 7.4% ADHD, 6.7% SUD, and 3.6% Schizophrenia. The majority (57.4%) of those reporting a MHC reported two or more comorbid MHCs (26.3% of the total sample).

Compared to those without MHCs, a higher percentage of respondents with a MHC were younger, female, White non-Hispanic, and Medicaid-insured, had less than a high school degree, had higher tobacco dependence (based on CPD and TTFU), had a chronic health condition, and completed three or more program calls (Tables 2 and 3). A lower percentage of callers with a MHC had been mailed NRT through the quitline; however, there were no differences in self-reported use of NRT since program registration (Table 3). There were no differences in type of tobacco used (Table 2) or satisfaction with the quitline (Table 3).

3.1. Quit Rates for Callers with and without MHCs. At the time of the 7-month survey, the unadjusted quit rate for callers with a MHC was significantly lower than for callers without a MHC (30-day point prevalence quit rates: 22.0% (95% CI = 19.5%–24.5%) versus 31.0% (95% CI = 28.4%–33.6%), $P < 0.001$) (Table 3). Multivariable logistic regression analyses confirmed that callers who reported one or more MHCs were significantly less likely to quit at follow-up (adjusted OR = 0.63, 95% CI = 0.51–0.77, $P < 0.001$) (Table 4). Callers with higher baseline tobacco dependence and Medicaid insurance (compared to private) were also less likely to quit at follow-up, and callers who completed more program calls were more likely to quit.

3.2. Quit Rates by MHC Group. Unadjusted 30-day point prevalence quit rates for the mutually exclusive MHC groups were as follows: Schizophrenia or Bipolar Disorder (Group 1) [19.4% (95% CI = 15.4%–23.3%)]; Depression, GAD, or PTSD without Schizophrenia or Bipolar Disorder (Group 2) [24.0% (95% CI = 20.6%–27.5%)]; SUD or ADHD without the other five conditions (Group 3) [18.3% (95% CI = 9.5%–27.1%)] (data not shown in tables). In multivariable logistic regression analyses, all three condition groups were significantly less likely to quit compared to callers with no MHC (Table 4);

Table 2: Baseline characteristics among multiple-call program callers with and without self-reported MHCs in three states.

Baseline data	Total (N = 3,132) Weighted %	No MHCs (N = 1,697, 54.2%) Weighted %	One or more MHCs (N = 1435, 45.8%) Weighted %	P value[a]
Age – mean (SD)	46.3 (13.2)	47.0 (13.8)	45.5 (12.4)	0.0134
Gender				
Male	36.6	39.8	32.7	0.0005
Female	63.4	60.2	67.3	
Education				
Less than high school	21.0	18.4	24.1	
GED	6.4	5.7	7.1	
High school degree	28.7	31.4	25.6	0.0007
Some college/trade school	27.5	27.2	27.9	
College/trade school degree	16.4	17.4	15.2	
Race/ethnicity				
White, non-Hispanic	59.7	52.0	68.9	
Black, non-Hispanic	33.2	39.9	25.1	<0.0001
Hispanic	2.4	2.9	1.9	
Other, non-Hispanic	4.7	5.2	4.1	
Insurance status				
Medicaid	22.1	16.5	28.8	
Uninsured	39.7	42.2	36.7	<0.0001
Private	23.9	29.0	17.8	
Medicare	14.3	12.2	16.7	
Tobacco type[b]				
Cigarette	97.6	97.0	98.1	0.0978
Cigar	2.7	2.6	2.9	0.7038
Pipe	0.3	0.4	0.3	0.7091
Smokeless	2.0	2.2	1.7	0.4111
Other	0.8	0.5	1.2	0.1066
CPD – mean (SD)	18.6 (11.3)	17.7 (10.5)	19.8 (12.0)	<0.0001
0–10	30.5	32.8	27.9	
11–20	46.7	47.6	45.6	0.0003
21–30	12.7	11.9	13.6	
31+	10.1	7.8	12.9	
Time to first use				
<5 min	52.9	49.0	57.6	
6–30 min	28.7	30.3	26.9	0.0003
31–60 min	9.0	9.8	8.1	
60 min+	9.3	10.9	7.4	
Dependence index[c]	2.6 (0.8)	2.6 (0.8)	2.7 (0.8)	<0.0001
Below median (1–2.5)	52.3	55.9	47.9	0.0001
Above median (3-4)	47.7	44.1	52.1	
Chronic health conditions				
Any of 4 conditions	45.9	38.3	54.9	<0.0001
Asthma	18.4	11.4	26.5	<0.0001
Diabetes	14.9	12.6	17.5	0.0004
COPD	19.2	14.5	24.7	<0.0001
CAD	9.2	8.2	10.4	0.0481

Note: MHCs = mental health conditions (conditions assessed: Attention Deficit Hyperactivity Disorder, Bipolar Disorder, Depression, Drug or Alcohol Use Disorder (or Substance Use Disorder), Generalized Anxiety Disorder, Posttraumatic Stress Disorder, and Schizophrenia); GED = General Education Development; CPD = cigarettes per day; time to first use = time to first tobacco use after waking; COPD = chronic obstructive pulmonary disease; CAD = coronary artery disease.

[a]P values computed using proc surveylogistic for categorical variables and proc surveyreg for continuous variables. P values tested for significant differences in baseline variable proportions or mean values for callers who reported no MHCs versus 1 or more MHCs; a cutoff of $P < 0.05$ was used for statistical significance. Missing data are excluded for each variable.

[b]These are not mutually exclusive categories. Participants could choose multiple tobacco products, if appropriate.

[c]Four-point scale index to represent tobacco dependence level based on cigarettes per day and time to first tobacco use after waking. Higher scores on the index represent a higher level of tobacco dependence.

Table 3: Program engagement and 7-month survey outcomes among multiple-call program callers with and without self-reported MHCs in three states.

Program engagement and 7-month survey responses	Total (N = 3,132)	No MHCs (N = 1,697, 54.2%)	One or more MHCs (N = 1435, 45.8%)	P value[a]
	Weighted %	Weighted %	Weighted %	
Program engagement				
Calls completed - mean (SD)	1.8 (1.0)	1.8 (1.0)	1.9 (1.1)	0.0020
1-2	80.1	82.3	77.5	0.0008
3+	19.9	17.7	22.5	
Received NRT from quitline	74.6	79.2	69.1	<0.0001
Seven-month survey responses				
Used cessation medication to help quit since enrollment	74.0	73.7	74.4	0.7196
Satisfied with quitline program	92.9	93.1	92.6	0.6376
Quit 7 days	31.9	35.5	27.6	<0.0001
Quit 30 days	26.9	31.0	22.0	<0.0001

Note: MHCs = mental health conditions (conditions assessed: Attention Deficit Hyperactivity Disorder, Bipolar Disorder, Depression, Drug or Alcohol Use Disorder (or Substance Use Disorder), Generalized Anxiety Disorder, Posttraumatic Stress Disorder, and Schizophrenia).
[a]P values computed using proc surveylogistic for categorical variables and proc surveyreg for continuous variables. P values tested for significant differences in program engagement and 7-month survey variable proportions or mean values for callers who reported no MHCs versus 1 or more MHCs; a cutoff of $P < 0.05$ was used for statistical significance. Missing data are excluded for each variable.

the three MHC groups did not significantly differ in likelihood of being quit [Group 1 versus 2: adjusted OR = 0.76 (95% CI = 0.54–1.06), $P = 0.11$; Group 1 versus 3: adjusted OR = 1.21 (95% CI = 0.58–2.51), $P = 0.61$; Group 2 versus 3: adjusted OR = 1.60 (95% CI = 0.79–3.22), $P = 0.19$].

4. Discussion

Among callers to three state quitline multiple-call programs, nearly half (46%) reported one of seven current MHCs, and callers reporting a MHC were significantly less likely to quit at 7-month follow-up compared to callers without a MHC. After controlling for demographics, baseline tobacco dependence, program utilization characteristics, and state, callers with a MHC had 0.6 times lower adjusted odds of being quit compared to callers without a MHC. These findings may seem to suggest that callers with MHCs are not benefiting from quitline services; however, less than 10% of people in the general population who use no support or minimal self-help successfully quit smoking [11]. Epidemiological research indicates that odds of successfully quitting may be even lower for individuals with MHCs [1, 12]. Because this was an observational study, we could not determine what the relative likelihood of quitting without assistance would have been for those with and without a MHC, so we could not determine how much the quitline intervention increased the odds of success, and whether this differed for callers with and without a MHC.

Quitline callers with MHCs also have other characteristics that have been shown in previous research to make quitting harder, including higher tobacco dependence, lower education and socioeconomic status, and having other chronic health conditions [1, 11, 32]. Given that callers with MHCs are more likely to have sociodemographic characteristics associated with higher tobacco use and greater difficulty quitting, improving treatment for callers with MHCs may also help other priority populations disproportionately impacted by tobacco use. Assessing mutually exclusive MHC groups, we found that all three condition groups differed from callers with no MHCs in multivariable models but did not differ from one another. Together with the finding that callers with any MHCs were less likely to quit than those with none, this suggests that any report of a MHC may predict increased difficulty in quitting, even though the population of individuals with any MHC is likely a heterogeneous group in terms of symptoms, stressors, and daily functioning.

Despite having characteristics that can hinder quitting, our data suggest that callers with MHCs are engaged in the quitting process. For example, callers with MHCs were more likely than those without MHCs to complete three or more program calls, which has been associated with greater quit success [24, 32, 38]. Findings indicating greater treatment engagement among those with MHCs could be due to an increased need for support and/or high motivation to change. More research is needed to assess why quitline program engagement is higher in this population.

Callers with and without MHCs were equally likely to report having used cessation medications during their quit attempt; however, fewer callers with MHCs were sent medications through the quitlines, which may have been due to NRT contraindication guidelines, eligibility criteria for the specific states, or interest in using medications not covered by the quitlines (e.g., varenicline and bupropion). It is encouraging that callers with MHCs obtained cessation medications from other sources, particularly given that callers with MHCs are more likely to have higher tobacco dependence [1, 20]

Table 4: Multivariable models of the relationship of 30-Day tobacco abstinence and MHC status, by any conditions versus none (Model 1) and by condition group versus none (Model 2) in three states.

	Model 1		Model 2	
	Quit 30+ days[a] (N = 2,870)		Quit 30+ days[a] (N = 2,870)	
	AOR (95% CI)	P value	AOR (95% CI)	P value
Age	0.99 (0.99–1.00)	0.17	0.99 (0.98–1.00)	0.11
Gender				
Male	ref	0.12	ref	0.08
Female	0.85 (0.69–1.04)		0.83 (0.67–1.02)	
Education				
Less than high school	ref		ref	
GED	0.79 (0.48–1.29)		0.78 (0.48–1.27)	
High school degree	1.08 (0.81–1.42)	0.15	1.08 (0.81–1.43)	0.14
Some college/trade school	0.78 (0.58–1.04)		0.78 (0.58–1.04)	
College/trade school degree	0.91 (0.66–1.26)		0.91 (0.65–1.26)	
Race/ethnicity				
White, non-Hispanic	ref		ref	
Black, non-Hispanic	0.88 (0.70–1.09)	0.69	0.88 (0.70–1.09)	0.69
Hispanic	0.93 (0.45–1.95)		0.91 (0.44–1.91)	
All other races, non-Hispanic	0.90 (0.55–1.48)		0.91 (0.55–1.49)	
Insurance status				
Private insurance	ref		ref	
Medicare-insured	0.74 (0.54–1.00)	0.03	0.75 (0.55–1.02)	0.048
Medicaid-insured	0.68 (0.52–0.89)		0.69 (0.53–0.90)	
Uninsured	0.83 (0.64–1.08)		0.84 (0.64–1.09)	
Dependence index[b]	0.78 (0.69–0.89)	<0.001	0.78 (0.69–0.89)	<0.001
Chronic health condition				
None	ref	0.14	ref	0.12
Any of 4	1.18 (0.95–1.46)		1.19 (0.96–1.48)	
Calls completed	1.31 (1.20–1.42)	<0.001	1.31 (1.21–1.43)	<0.001
Use of cessation medications				
Reported no use	ref	0.53	ref	0.54
Used medications	0.93 (0.73–1.17)		0.93 (0.73–1.18)	
Mental health condition status (0 versus 1+)				
None reported	ref	<0.001	n/a	
One or more	0.63 (0.51–0.77)			
Mental health condition group				
None reported			ref	
Group 1: Schizophrenia/Bipolar Disorder			0.53 (0.39–0.73)	
Group 2: Depression/Anxiety/PTSD (no Group 1)	n/a		0.70 (0.55–0.90)	<0.001[c]
Group 3: ADHD or SUD (no Group 1 or 2)			0.44 (0.22–0.87)	

Note: N = total sample size; AOR = Adjusted Odds Ratio; CI = Confidence Interval; ref = reference group.
[a]30-day point prevalence abstinence at 7-month survey.
[b]Four-point scale index to represent tobacco dependence level based on cigarettes per day and time to first tobacco use after waking. Higher scores on the index represent a higher level of tobacco dependence.
[c]The three MHC groups did not significantly differ in likelihood of being quit (Group 1 versus 2: adjusted OR = 0.76 (95% CI = 0.54–1.06), P = 0.11; Group 1 versus 3: adjusted OR = 1.21 (95% CI = 0.58–2.51), P = 0.61; Group 2 versus 3: adjusted OR = 1.60 (95% CI = 0.79–3.22), P = 0.19).
Notes: models also included state as a fixed effect. Callers with missing data on one or more model variables were excluded from the model. P values indicate whether variables were a significant predictor of quit status in the multivariable models; a cutoff of $P < 0.05$ was used for statistical significance.

and may need more intensive medication support than the general population [11, 28, 39]. Since barriers such as copays and prior authorizations can negatively impact access to cessation medication and quitting success [40–42], provision of free NRT directly through quitlines could further improve medication use for all callers. Reported medication use was not a significant predictor of quit status at 7 months in the multivariable model, which is not an unusual finding in quitline observational studies where participants self-select whether to use cessation medications [32]; this should not be interpreted as medications being unimportant in callers' quitting process.

More knowledge is needed about mechanisms of connection between smoking addiction and MHCs, which may be environmental or social (e.g., tobacco norms and smoking exposure among peers and in treatment facilities), result from common genetic predispositions, brain functioning or other risk factors, or stem from behavior associations or symptom management habits (e.g., alcohol use as a trigger for smoking and vice versa and symptom self-medication) [5, 43, 44]. Reasons for comorbidity between tobacco addiction and MHCs also may differ for specific disorders. Determining the best method of assessing and identifying callers with MHCs will aid in and inform research on whether tailored treatments improve outcomes for callers with MHCs and how best to tailor treatment.

Experts have put forth recommendations for tailoring treatment for people with MHCs. These include provision of more intensive counseling, higher doses of NRT or combination therapy, and cessation medications that also target mood (i.e., varenicline and bupropion) [2, 11, 15, 28, 39]. Care comanagement with mental health providers has been suggested, particularly with psychiatric medication prescribers. Since nicotine impacts how some common psychiatric medications are metabolized, medications may need adjustment during and after quitting [11, 28, 45, 46]. Treatment providers may also need to address tobacco users' concerns about weight gain, which could be complicated by medication side effects and higher rates of inactivity, focus on beliefs about self-medication with tobacco and alternative coping strategies, and use concrete smaller goals for individuals with lower cognitive functioning [2, 15, 28, 39]. Finally, changes in psychiatric symptoms should be monitored during quitting [2, 17, 28]. Strategies such as reducing to quit, pairing tobacco quitline treatment with a brief alcohol intervention, or combining quitline and community treatment may also warrant additional research [2, 31].

More research is needed to test which recommendations yield improvements in quit outcomes, particularly in quitline settings. Several quitline studies provide relevant findings to inform future research. Outcomes were similar for tobacco users with and without a psychiatric history (identified via chart review) who received 12 weeks of varenicline and phone and/or web-based behavioral treatment [8]. Given these findings, future research should examine whether varenicline is particularly effective for callers with MHCs. Second, a prospective study of callers to the Victorian Quitline in Australia provides some support for a quitline-doctor comanagement model; 83% of callers who self-disclosed doctor-diagnosed Depression believed it would be beneficial to involve their doctor in their quit attempt, and those receiving comanagement were more likely to make a quit attempt [46]. Finally, a promising randomized controlled trial in the Dutch National Quitline examined whether a mood management component integrated into standard quitline treatment improved outcomes over the standard program for callers with past major Depression; they found the additional sessions and content increased prolonged abstinence rates at 6 and 12 months but did not impact a recurrence of depressive symptoms, and differences in 7-day point prevalence abstinence rates were not significant [47].

4.1. Limitations. A number of limitations should be considered when interpreting these findings. First, MHCs in this study were assessed by asking callers whether they currently had one of seven MHCs. This assessment method may not have captured individuals with undiagnosed MHCs, disorders not assessed (e.g., anxiety disorders other than GAD or PTSD), subclinical symptoms, or a diagnosis they preferred not to report. Failure to capture all individuals with clinical or subclinical MHCs, or the potential for false positives from people who self-reported "yes" to an MHC but may not have been screened positive for symptoms, may have impacted results. For example, previous research suggests that individuals with subclinical levels of MHCs are more likely to smoke [48], and subclinical levels may reduce the likelihood of quit success [49]. While rates of any reported MHCs were higher in this sample (46%) compared to those estimated in the general population of smokers in the United States (30%, excluding SUD [1]), the high rate of MHCs is not surprising since many state quitlines target underserved populations, and rates of MHCs are higher in smokers [1, 6]. The assessment method used may still underidentify MHCs in our sample. For example, SUD appears likely to be underreported by participants (6.7% in this study versus 23% of callers when amount of drinking was assessed in a New York State Smokers' Quitline study [31]). When developing the questions used in this study, an expert quitline workgroup convened by NAQC considered assessment options while weighing time and other treatment considerations [2]. However, as the workgroup noted, more research is needed to identify the most effective and efficient assessment approach for the more than 400,000 annual tobacco quitline callers.

Second, many states offer a one-call program instead of or in addition to a multiple-call program. We did not have sufficient samples to examine outcomes for one-call program enrollees with and without a MHC. Based on recommendations for more intensive treatment [2, 28], we expect one-call programs may be less effective for callers with MHCs. Third, our study focused on only three states, which may limit the generalizability of findings. However, our findings concur with unpublished data presented at conferences for more than seven other states [21, 22, 29]. Fourth, the 7-month survey response rate was 41%. This is in line with state

quitline evaluation survey response rates reported elsewhere [18, 32] but again may impact the generalizability of findings. All analyses included weights to adjust for survey response bias to improve the representativeness of results. Finally, our outcome measure was self-reported abstinence from tobacco for 30 or more days at the time of the 7-month survey; we did not examine prolonged abstinence and did not have access to biochemically verified quit status (i.e., cotinine or carbon monoxide data). We used this outcome metric because it is the standard for evaluating quitline outcomes in North America [34]. Furthermore, the Society for Research on Nicotine and Tobacco Subcommittee on Biochemical Verification has recommended that biochemical verification of abstinence is not necessary in large-scale studies with no face-to-face contact where data collection is done by mail, telephone, or internet [50].

5. Conclusion

More research is needed to address the best approach to treatment for quitline callers with MHCs, to determine what information should be assessed to provide the best care to quitline callers with MHCs (e.g., diagnoses, symptoms, and current medications), and to understand relapse profiles, reasons, and timing for this population. Given that half of quitline callers report a MHC and these callers had significantly lower quit rates, development and testing of more intensive or tailored programs to improve outcomes are warranted. Mental health and tobacco control communities should continue to develop partnerships to address this health disparity.

Disclosure

Katrina A. Vickerman and Chelsea M. Nash declare employment at Alere Wellbeing, the provider of quitline services in this study.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conflict of Interests

The authors declare no other conflict of interests regarding the publication of this paper.

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Review Article

The Epidemiology of Tobacco Use among Khat Users: A Systematic Review

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Khat, an "amphetamine-like green leaf," may influence the consumption of tobacco. This study reviews the epidemiology of tobacco use among khat users. Electronic database searches using appropriate keywords/terms were conducted to identify observational studies of khat use. Assessment of quality and risk of bias of all included studies was conducted, and the results were synthesised descriptively. Nine eligible cross-sectional studies were identified. All assessed self-reported tobacco among khat users and were carried out in Africa and the Middle East. Eight reported cigarettes and one reported waterpipes as the mode of use. Methods of tobacco use prevalence assessment varied. Prevalence of "current" tobacco use among students and university teachers ranged from 29 to 37%; "lifetime" tobacco use in university teachers was 58% and "undefined" tobacco use in nonspecific adults and students ranged from 17 to 78%. Daily tobacco use among adults was reported as 17% whilst simultaneous tobacco and khat use was reported as between 14 and 30% in students. In conclusion, tobacco prevalence among khat users appears significant. Findings should be interpreted cautiously due to self-reported tobacco use, diversity in questions assessing tobacco use, and type of tobacco consumption. Future research should address the methodological shortcomings identified in this review before appropriate policy interventions can be developed.

1. Introduction

Tobacco smoking is a significant cause of preventable death and ill health worldwide [1]. Based on current trends, 80% of tobacco-related mortality is predicted to occur in low and middle income countries [2]. Reduction/control of tobacco use in these countries is one of the Millennium Development Goals [3]. Ethnicity/culture alongside other factors (e.g., socioeconomic status) contributes to the uptake of tobacco [4–6], although determinants of tobacco use are complex [7].

The khat leaf is an "amphetamine-like" stimulant [8] that is socioculturally embedded and widely practiced in certain areas of Africa and the Arabian Peninsula [9] and in the diaspora communities from these regions [10, 11]. Khat is an acceptable and habitual practice for these populations, specifically among Muslims [12, 13]. Khat may also be used by students to prevent fatigue when studying [14, 15]. Importantly, in countries where khat is endemic (e.g., Yemen) or among their diaspora, khat is often used within the family [12, 16, 17]. For males, khat is often initiated during early adolescence or even before [15, 18], and for females it may be initiated in late adolescence [15] or after marriage [11, 17].

Khat is often chewed; users may place tender khat leaves in the buccal sulcus and chew for a while and then store the bolus in the pouch of the cheek, often in the left side of the mouth [19] to allow the juice to be systemically absorbed through the oral mucosa [20]. Factors that contribute to the spread of khat use in homeland and diasporas include the deviation from cultural norms of use (e.g., using khat at night) [9, 21]. In addition to this, khat is affordable, accessible,

and available throughout the year and in multiple settings [22, 23]. Policies to curb widespread khat agriculture [22, 24] and reduce the importance of khat as a cash crop, as it is in Kenya, are absent [25]. Frequent khat use is associated with negative general, oral, and mental health outcomes [26]. Khat use has become a national and international public health concern, with many countries such as the United Kingdom banning its use [27, 28]. Such an intervention awaits evaluation. Anecdotal evidence suggests powdered and dried leaves have emerged as a replacement to the khat leaf in the UK [29].

Khat is often used in groups and is associated with using other substances such as alcohol [30, 31] and commonly tobacco [32, 33]. Information about the role tobacco and khat play in each other's initiation is scarce [34], and evidence suggests some khat users may only use tobacco during sessions of khat [10, 32, 33, 35, 36]. Dual khat and tobacco users may increase their tobacco consumption during khat sessions [10, 11, 32] and one study showed that regular tobacco smokers were ex-khat users [37]. Khat use may serve as a "gateway" to tobacco use: 12–30% of khat users in the diaspora and homeland report initiation or use of tobacco only when using khat (simultaneous tobacco and khat users (STKU)) [10, 36]. Daily cigarette smokers and STKU report that smoking tobacco enhances the impacts of khat [32]. Also, those who are both regular (daily) tobacco user khat users and STKU reported smoking tobacco more during the first hours of khat use [32] and daily cigarette smoker khat users continued smoking after finishing khat use [32]. Finally, the cooccurring of khat and tobacco smoking dependence is growing [10, 32]. Therefore, there is a possibility that khat use interacts with tobacco use, which may undermine tobacco cessation programs.

The influence of khat use on aspects of tobacco use has not been assessed systematically. We seek in this review to inform the scientific debate about the neglected public health issue that khat use is often associated with tobacco. Our primary aim is to systematically identify, appraise, synthesise, and summarise the best available evidence on the epidemiological association between khat use as the exposure and tobacco use (prevalence, pattern, and mode of tobacco) as the outcome. The secondary aim is to explore factors associated with concurrent tobacco and khat use and the level and methods used for measuring tobacco dependence amongst khat users. The review question is as follows: What is the best available evidence on the epidemiology of tobacco among khat users?

2. Materials and Methods

A protocol for this review has been published in Prospero [38].

2.1. Eligibility Criteria. We used the following inclusion criteria for our systematic review:

(i) Original quantitative (cross-sectional and cohort) studies.

(ii) Studies detailing tobacco epidemiology among khat users.

(iii) Any time frame or population group.

We used the following exclusion criteria:

(i) Case-control studies, case reports, case series, clinical trials, reviews, and experimental laboratory studies (prevalence cannot be estimated).

(ii) Studies using convenience and purposive sampling (prone to selection bias).

(iii) Studies including tobacco user khat users for specific population, for example, with mental health conditions (prone to confounding).

(iv) Duplicate studies.

2.2. Search Strategy. In November 2014 we searched the following electronic databases: MEDLINE (1950–present), Embase (1980–present), PsycINFO (1806–present), and ISI Web of Science. Search terms were "catha," "miraa," "qat," "khat," and "kath." These were based on the peer-reviewed literature and the expertise of the research team in the field. We did not combine khat keywords/terms with tobacco keywords/terms to allow pooling all of the available literature of khat. Only full texts written in English or Arabic were considered. We screened the bibliography of review articles for relevant citations. Finally, we created EndNote libraries (software package Endnote XIII) for each database search, merged them, and removed duplicates.

2.3. Selection Process. Based on the eligibility criteria, two reviewers (S. Kassim and M. Jawad) independently screened the title and abstract of available citations to identify potentially eligible studies. We retrieved full texts of studies considered potentially eligible by at least one reviewer. The same two reviewers then independently screened full texts using a standardised and pilot-tested screening form, resolving disagreements with the help of a third reviewer (E. A. Akl).

2.4. Data Abstraction and Analysis. Two reviewers (S. Kassim and M. Jawad) independently abstracted data from each eligible study using a standardised and pilot-tested data abstraction form, again resolving disagreements with the help of a third reviewer (E. A. Akl). Quality assessment was based on a previous systematic review for observational studies [39]. For all included studies we abstracted data on the methodology (sampling frame, sampling method, recruitment method, and administration method), methodological quality (presence of a sample size calculation, sampling type, validity of tool, presence of pilot testing, and response rate), population and setting (population, country, setting, number of subjects sampled, number of subjects participated, and number of subjects' data items analysed), and prevalence data (prevalence and pattern of khat use and prevalence, pattern, and mode of tobacco use among people who use khat, including biochemical verification). We contacted authors for additional information if not available in the published paper. Other information abstracted included associated factors with dual khat and tobacco use and the levels and methods used for measuring tobacco dependence amongst

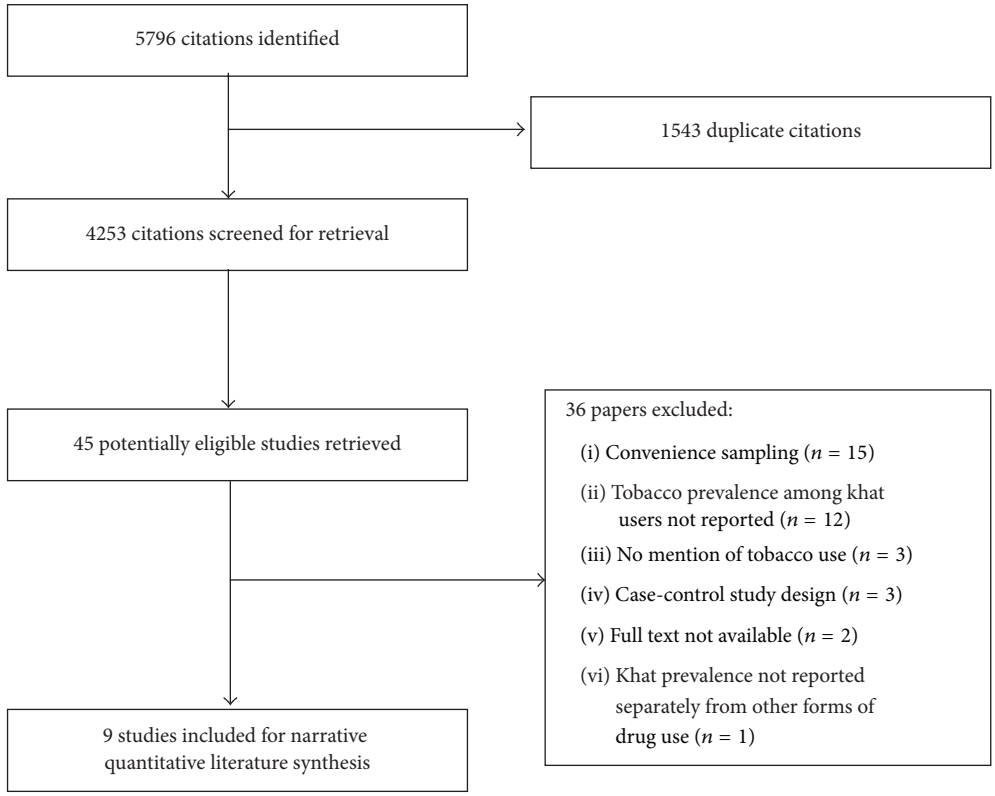

Figure 1: Study flow diagram.

khat users. Data were analysed descriptively and formulated into a quantitative narrative synthesis. Results were expressed as percentages for the prevalence and frequency with percentages for mode of tobacco delivery and pattern of use.

3. Results

3.1. Description of Included Studies. Figure 1 presents the study flow. All studies were identified through electronic searches only. Of 45 considered studies, we excluded 36 studies.

Table 1 provides the full details of the nine included studies, all of which were cross-sectional. The target populations in the nine identified studies were adults ($n = 4$), university students ($n = 2$), and high school and/or college students ($n = 3$).

Studies varied in the way they measured khat prevalence. Some studies opted for measures of regularity, such as daily or weekly use ($n = 5$) [14, 21, 40–42], while others opted for current ($n = 4$) [15, 41, 42, 44] or ever occurring use ($n = 3$) [15, 36, 44]. One study measured khat prevalence as those who used khat for greater than three years [43].

Studies also varied in the way they measured tobacco prevalence among khat users. Most studies opted for current ($n = 2$) [36, 44] or ever occurring use ($n = 3$) [14, 36, 44] whereas others opted for measures of intensity, such as mild or heavy ($n = 1$) [41], or simply the number of cigarette smoked as a measure of prevalence [43]. Over half of studies did not specify the measure of tobacco use ($n = 5$). Eight studies reported cigarettes and one study reported waterpipe [36] as mode of tobacco use. Finally, none of these studies measured level of tobacco dependence among khat users.

3.2. Methodological Quality of Included Studies. Three studies included sample size calculations [15, 21, 42]. The instruments used to measure khat prevalence were as follows: previously reported validated tools ($n = 3$) [15, 21, 42], a validated self-developed tool ($n = 1$) [41], and an unvalidated self-developed tool ($n = 1$) [40] and four studies did not report the instrument used ($n = 4$) [14, 36, 43, 44]. Six studies reported pilot testing of the measurement instrument [15, 21, 36, 41, 42, 44]. Seven studies reported a response rate which varied from 70.4% to 96% [15, 21, 36, 40–42, 44] whilst in two studies this was not reported [14, 43].

We used the tool proposed by Siegfried et al. [39] to assess methodological quality. For external validity (representativeness of the sample), seven studies reported representative sample (probability sampling) of the targeted population and two studies reported a broad sample (the whole population was included in the study) [40, 44]. With respect to internal validity, tobacco and khat use was self-reported and any performance bias such as the blindness of the assessor to tobacco and khat use status was not reported. Prevalence estimates were not provided with confidence intervals and there were wide variations in the time frames used for the estimate of prevalence. Adjustments for confounding factors for tobacco and khat use were only reported by one study conducted among doctors in Yemen, which explored the

Table 1: Details of included studies.

Study ID	Methodology	Methodological quality	Population/setting	Prevalence results	Additional results
Al-Dubai and Rampal, 2012 [40]	(i) Sampling frame: four main government hospitals (N = not reported) (ii) Sampling method: universal sampling (all doctors) (iii) Recruitment method: in person (iv) Administration method: in person, self-administered	(i) Sample size calculation: no (ii) Sampling type: nonprobability sampling (broad sampling, covered all doctors) (iii) Validity of tool: for khat/tobacco: self-developed tool, no validation reported (iv) Pilot testing done: no (v) Response rate: 70.4%	(i) Population: Yemeni doctors (ii) Country: Yemen (iii) Setting: hospitals (iv) n (sampled) = 800 (v) n (participated) = 563 (vi) n (included in analysis) = 563	(i) Prevalence of khat, n (%): 248 (44.0%) (sometimes 21.7%, frequently 9.95%, and daily 12%) (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): 99 (17.6%) (cigarettes, pattern not specified) (iii) Prevalence of tobacco among khat chewers (specify tobacco type and pattern of use), cigarette, n (%): 84/248 (33.9%)	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: cigarette smoking among khat chewers is significantly associated with male gender (AOR 3.77 (1.10–12.92)), working in government and private compared to government only (0.40 (0.21–0.75)), and for working > 10 years compared to less than 10 years (AOR 3.54 (1.44–8.67)). Model also adjusted for age, marital status, residence, and income
Alem et al., 1999 [41]	(i) Sampling frame: nine peasant associations and one urban dwellers association (N = 15,000) (ii) Sampling method: cluster random sampling (iii) Recruitment method: in person (iv) Administration method: in person, self-administered (with assistance)	(i) Sample size calculation: no (ii) Sampling type: probability (iii) Validity of tool: self-developed tool, validation reported (questions rephrased after showing them to pilot group of forty adults) (iv) Pilot testing done: yes (v) Response rate: 85.1%	(i) Population: persons aged over 15 years resident in Butaijra town (ii) Country: Ethiopia (iii) Setting: house-house (community-based) (iv) n (sampled) = 12,531 (v) n (participated) = 10,658 (vi) n (included in analysis) = 10,468	(i) Prevalence of khat, n (%): 911 (8.7%) daily, 5234 (50%) current (pattern not specified) (ii) Prevalence of tobacco use (specify tobacco type), n (%): 186 (1.8%) were mild cigarette smokers, 132 (1.3%) were moderate cigarette smokers, and 141 (1.3%) were heavy cigarette smokers (iii) Prevalence of tobacco among khat chewers (specific tobacco type), n (%): among daily khat chewers, 46 (5.0%) were mild (1–3 daily) cigarette smokers, 47 (5.2%) were moderate (4–9 daily) cigarette smokers, and 59 (6.5%) were heavy (>9 daily) cigarette smokers (iv) Pattern of tobacco use among khat chewers: we only have data for daily cigarette smokers (v) Daily khat and tobacco (cigarette): 46 + 47 + 59 = 152 ∗ 100/911 = 17%	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported
Al-Sanosy, 2009 [21]	(i) Sampling frame: total number of students enrolled in 11 colleges in the region (N = 18243) and secondary schools (N = 46760), total 102 schools (ii) Sampling method: systematic random sampling (iii) Recruitment method: in person (iv) Administration method: in person, self-administered	(i) Sample size calculation: yes (ii) Sampling type: probability sampling (iii) Validity of tool: previously reported validated tool (iv) Pilot testing done: yes (v) Response rate: 89.7%	(i) Population: secondary school and college students, 51.7% male, mean age 18.9 (2.58) years (ii) Country: Saudi Arabia (iii) Setting: secondary schools and colleges, May 2006 (iv) n (sampled) = 10,000 (v) n (participated) = 8965 (vi) n (included in analysis) = 8965	(i) Prevalence of khat, n (%) (specify pattern of use): past 30-day use: 1795/8965 (20.0%), daily khat chewers: 250/8965 (2.8%), most of week days: 322/8965 (3.6%), weekends: 765/8965 (8.5%), and occasionally: 468/8965 (5.2%) (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): smoking (not defined) 863/8965 (9.6%) (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): 863/1101 (78.4%) of khat chewers were also cigarette smokers (iv) Mentioned only cigarettes	(i) Level of dependence among khat chewers who use tobacco: Not reported (ii) Associated factors: not reported
Alsanosy et al., 2013 [15]	(i) Sampling frame: intermediate educational level and high school students in the Jazan region (ii) Sampling method: cluster multistage sampling (iii) Recruitment method: in person (iv) Administration method: in person, self-administered	(i) Sample size calculation: yes (ii) Sampling type: probability sampling (iii) Validity of tool: previously reported validated tool (iv) Pilot testing done: yes (v) Response rate: 95.68%	(i) Population: full-time intermediate and high school students aged 13–21 years (75.1% aged 15–19 years, 56.3% male, and 61.3% urban residence) (ii) Country: Saudi Arabia (iii) Setting: schools in academic year 2011/2012 (iv) n (sampled) = 4100 (v) n (participated) = 3923 (vi) n (included in analysis) = 3923	(i) Prevalence of khat, n (%): current (past 30 days): 806/3923 (20.5%, 95% CI 19.27–21.79); ever: 952/3923 (24.2%, 95% CI 22.9–25.57) (ii) Prevalence of tobacco use (specify tobacco type), n (%): smoking status yes/no: 627 (17.3%) (iii) Prevalence of tobacco among khat chewers (specific tobacco type), n (%): cigarettes 489 (54.3%).	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported

Table 1: Continued.

Study ID	Methodology	Methodological quality	Population/setting	Prevalence results	Additional results
Ayana and Mekonen, 2004 [42]	(i) Sampling frame: all registered university students in 2001/2002 (N = 2073) (ii) Sampling method: systematic random sampling (iii) Recruitment method: not reported (iv) Administration method: in person self-administered	(i) Sample size calculation: yes (ii) Sampling type: probability sampling (iii) Validity of tool: previously reported validated tool (iv) Pilot testing done: yes (v) Response rate: 94.4%	(i) Population: university students, mean age 24 (range 16–46), 76.91% male, 59.5% orthodox, and 49.2% Amhara ethnicity (ii) Country: Ethiopia (iii) Setting: university, January 2002 (iv) n (sampled) = 500 (v) n (participated) = 472 (vi) n (included in analysis) = 472	(i) Prevalence of khat, n (%) (specify pattern of use): current (daily, weekly, or occasionally) prevalence 117/472 (24.79%), divided into 52/472 (11.0%) every day, 35/472 (7.4%) once a week, and 30/472 (6.4%) occasionally (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): 64/472 (13.56%) were cigarette smokers (pattern not defined) (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): among khat chewers, 53/117 (45.3%) were cigarette smokers. 16/117 (13.7%) of students smoke cigarettes while chewing khat; 8/117 (6.8%) of students smoke cigarettes after chewing khat	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported
Gorsky et al., 2004 [43]	(i) Sampling frame: one city in Israel (not mentioned) (ii) Sampling method: not reported (iii) Recruitment method: not reported (iv) Administration method: not reported	(i) Sample size calculation: no (ii) Sampling type: not reported (iii) Validity of tool: not reported (iv) Pilot testing done: no (v) Response rate: not reported	(i) Population: Yemenite Jews (all > 30 years old, male, and parents born in Yemen) (ii) Country: Israel (iii) Setting: unnamed city (iv) n (sampled) = 1500 (v) n (participated) = 1500 (vi) n (included in analysis) = 47	(i) Prevalence of khat, n (%) (specify pattern of use): 102/1500 (6.8%) (all used khat > 3 years) (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): N/A (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): 32/47 (68%) were cigarette smokers and smoked more (29.5/day) than nonchewers (22.3/day) $p = 0.03$	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported
Kebede, 2002 [44]	(i) Sampling frame: all university instructors in four northwestern colleges (N = 321) (ii) Sampling method: universal sampling (iii) Recruitment method: not reported (iv) Administration method: self-administered	(i) Sample size calculation: no (ii) Sampling type: nonprobability (broad sampling, covered all instructors in four colleges) (iii) Validity of tool: not reported (iv) Pilot testing done: yes (v) Response rate: 75.1%	(i) Population: university instructors, 93.9% male, mean age 35.2 (8.36) years, 73.5% Christian, 12.7% Protestant, and 91.7% Ethiopians (ii) Country: Ethiopia (iii) Setting: colleges, January 2001 (iv) n (sampled) = 241 (v) n (participated) = 181 (vi) n (included in analysis) = 181	(i) Prevalence of khat, n (%) (specify pattern of use): lifetime khat use 59/181 (32.6%), current (past 30 days) use 38/181 (21.0%) (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): lifetime cigarette use 51/181 (28.2%), current (past 30 days) use 24/181 (13.3%) (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): 34/59 (57.6%) of lifetime khat chewers were lifetime cigarette smokers, and 14/38 (36.8%) of current khat chewers were current cigarette smokers	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported
Lemma et al., 2012 [14]	(i) Sampling frame: all students enrolled at two universities (N = 29823) (ii) Sampling method: multistage sampling (iii) Recruitment method: not reported (iv) Administration method: self-administered	(i) Sample size calculation: no (ii) Sampling type: probability sampling (iii) Validity of tool: not reported (iv) Pilot testing done: no (v) Response rate: not reported	(i) Population: students, mean age 21.6 (1.7) years, and 77.3% male (ii) Country: Ethiopia (iii) Setting: universities (iv) n (sampled) = not reported (v) n (participated) = 2817 (vi) n (included in analysis) = 2230	(i) Prevalence of khat, n (%) (specify pattern of use): 209/1960 (10.7%) (1-2 and ≥ 3 times per week) (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): 84/2230 (3.8%) ever cigarette smokers (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): 28.7% of khat chewers were current cigarette smokers, 2.4% of khat chewers were former cigarette smokers	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported
Reda et al., 2012 [36]	(i) Sampling frame: all students enrolled in high schools in Harar town (capital city of one of the nine regions of Ethiopia) (N = 6523) (ii) Sampling method: stratified random sampling (iii) Recruitment method: not reported (iv) Administration method: Self-administered	(i) Sample size calculation: no (ii) Sampling type: probability sampling (iii) Validity of tool: not reported (iv) Pilot testing done: yes (v) Response rate: 91.1%	(i) Population: high school students, 50.1% male, mean age 16.4 (1.6) years, 48.9% 9th grade, 52.8% Orthodox, 32.2% Catholic, and 11.2% Muslim (ii) Country: Ethiopia (iii) Setting: high schools, April 2010 (iv) n (sampled) = 1890 (v) n (participated) = 1721 (vi) n (included in analysis) = 1721	(i) Prevalence of khat, n (%) (specify pattern of use): 427 (24.2% 95% CI 22.2–26.2) had ever chewed khat, 89/1721 (5.2%) chewed khat daily (ii) Prevalence of tobacco use (specify tobacco type and pattern of use), n (%): 4.2% were current (past 30 days) smokers, and 12.4% were ever smokers (iii) Prevalence of tobacco among khat chewers (specific tobacco type and pattern of use), n (%): among ever chewers, 128/427 (29.9%) used waterpipe when they chewed khat	(i) Level of dependence among khat chewers who use tobacco: not reported (ii) Associated factors: not reported

association between cigarette smoking among khat users and sociodemographic factors [40]. Table 1 provides detailed description of the characteristics of included studies.

3.3. Epidemiology of Tobacco Use among Khat Users

3.3.1. Prevalence of Tobacco among Khat Users

Adults. Three studies measured tobacco prevalence among khat users in Ethiopia. In one study of 10,468 respondents, 8.7% were daily khat users, 1.8% were mild (smoked 1–3 daily) cigarette smokers, 1.3% were moderate (smoked 4–9 daily) cigarette smokers, and 1.3% were heavy (smoked > 9 daily) cigarette smokers. Among the 8.7% daily khat users, 5.0% were mild cigarette smokers, 5.2% were moderate cigarette smokers, and 6.5% were heavy cigarette smokers [41]. In a second study [44] among mainly male university instructors, 32.6% were ever khat users, 21.0% were current (past 30 days) khat users, 28.2% were ever cigarette smokers, and 13.3% were current (past 30 days) cigarette smokers. Among users who ever used khat, 57.6% were ever cigarette smokers, and, among current khat users, 36.8% were current cigarette smokers.

In one study of 568 doctors in Yemen, 44.0% were khat users (defined as sometimes, frequently, or daily) and 17.6% were cigarette smokers. Among khat users, the prevalence of cigarettes use was 33.9% [40]. Finally, in a study of 1500 Yemenite Jews, 6.8% used khat for greater than three years. Among khat users 68.0% were cigarette smokers and khat users smoked more than nonkhat users (29.5 versus 22.3 cigarettes/day, $p = 0.03$) [43].

Students. Two studies measured tobacco prevalence amongst khat using university students in Ethiopia. In one study among 2,230 respondents, 10.7% used khat at least 1-2 times per week and 3.8% were ever cigarette smokers. Of the khat users, 28.7% were current cigarette smokers and 2.4% were former cigarette smokers [14]. In another study of 472 respondents 24.8% were current (daily, weekly, or occasionally) khat users and 13.6% were cigarette smokers. Among current khat users 45.3% were cigarette smokers, 13.7% smoked cigarettes while using khat, and 6.8% continued to smoke cigarettes after completing a session of khat chewing [42].

Among high school students, three studies measured tobacco prevalence among khat users. In a study of 8,965 students in Saudi Arabia, 20.0% were current (past 30 days) khat users and 9.6% were cigarette smokers. 78.4% of current khat users were also cigarette smokers [21]. In a second Saudi Arabian study of 3,923 students, 20.5% were current (past 30 days) khat users and 17.3% were cigarette smokers. Amongst current khat users, 54.3% were cigarette smokers [15]. In the third study of 1,721 students in Ethiopia, 24.2% had ever used khat and 4.2% were current (past 30 days) smokers. Among users who ever used khat, 128/427 (29.9%) used waterpipe when using khat [36].

3.3.2. Factors Associated with Tobacco and Khat Use. A logistic regression model adjusted for age, marital status, residence, and income found that cigarette smoking among khat users was significantly associated with male gender (AOR 3.77, 95% CI 1.10, 12.92) working in governmental and private sectors compared to working in government only (AOR 0.40, 95% CI 0.21, 0.75) and with working greater than 10 years compared to less than 10 years [40].

4. Discussion

4.1. Key Findings. This review evaluated the epidemiology of tobacco use among khat users. We demonstrated that tobacco prevalence among khat users appears significant. Particularly worrying are high levels of use among high school, college, and university students. The main pattern of tobacco use was daily cigarette smoking, although two studies identified instances of simultaneous tobacco and khat users (STKU). The main mode of tobacco use was cigarettes, which was reported in eight out of nine studies.

4.2. What This Study Adds and Confirms. This is the first review to report on tobacco epidemiology among khat users, and it benefits from its systematic methodology. The cooccurrence of tobacco use among khat users may be underpinned by many potential mechanisms which await further exploration in research of better quality. One should consider that khat use often occurs in group sessions in which tobacco use is prevalent [32, 45, 46]; the likelihood of conditioning (use of tobacco with khat) among naïve khat users should be considered as it has been reported elsewhere [47]. In addition to this, khat users reported that tobacco enhances khat effects [32]. Notably, the use of khat and hence associated tobacco among school children and colleagues and university students has been highlighted here in this study. Whilst students use khat to accommodate for their academic commitments and to keep them awake at nights to study [48], one should consider as well the use of khat and tobacco in school children to be multifactorial [21] though the likelihood of the family context in children use is plausible [17].

This review has lent further support to the current literature of social (particularly ethnocultural) determinants of tobacco use [4, 5, 49]. Tobacco use is embedded within the culture of khat and in certain geographic areas, namely, areas of Africa and the Middle East. Tobacco use among khat users also appears to be irrespective of religion, as our review identified both Muslim and Jewish population groups [15, 40, 43]. Furthermore, tobacco use among khat users may be irrespective of level of education or income. Not only was a significant level of tobacco use reported among university teachers [44] and health care providers who used khat [40], but also high income (measured by proxy of working in government and private sector) was associated with dual use [40]. These findings lend further support to the complexity of tobacco use and support the argument that tobacco use is context dependent and has its specific determinants [7]. A number of khat users were identified in this review to be former tobacco smokers and the likelihood of reinitiating tobacco use when using khat is plausible as reported elsewhere [34].

4.3. Limitations and Strengths. The limitations of our review include the exclusive inclusion of studies published in English and Arabic and not searching the grey literature. Remaining limitations relate to the shortcomings of included studies. Indeed, these studies assessed only self-reported tobacco use with no biochemical verification (e.g., carbon monoxide). Ascertaining tobacco use biochemically may eliminate the performance bias of the assessor, recall bias, and social desirability bias [39, 50], particularly among female khat users for whom cigarette use is stigmatised [33, 46]. No studies elicited tobacco use with standardised questionnaires (e.g., WHO Global Adult Tobacco Survey) so we could not compare tobacco use in different settings and populations of khat users. In addition, the diversity of the background of khat users and pattern of tobacco use (daily or STKU) should be considered when trying to infer the epidemiology of tobacco use among khat users. Nevertheless, all studies have shown the association between khat use and the epidemiology of tobacco consumption (prevalence, pattern, and mode of use) in different population and setting of khat users.

4.4. Future Research and Policy Implications. Researchers measuring the prevalence of tobacco among khat users should ensure the use of validated tobacco questionnaires and include items that identify those that are STKU. Future studies should estimate uses of tobacco among specific group khat users "at risk" (pregnant and diabetic patients) as well as patients with mental health disorders. Importantly, a high prevalence of tobacco use among female khat users has been reported elsewhere [33] and we have reported that tobacco uses among khat users are more likely to be by male [40]. Rigorous mixed methods approaches that address the relationship of khat and tobacco use should explore the determinants of dual use, the perception of tobacco status among those who smoke tobacco only during a khat session, and the levels of dependence among these users; all while appreciating other forms of khat (e.g., powdered and dried leaf versions) may be used.

Currently a lack of knowledge exists about aspects of STKU among certain groups who demonstrate khat use disorders (e.g., daily khat users). These groups are likely to reside in countries where khat is widespread and socioculturally embedded, such as East Africa and the Arabian Peninsula. Whilst the psychosocial and biobehavioural factors of khat use need to be developed and expanded to understand its influences, the concern is mainly related to the indirect impact of khat use on the uptake of tobacco. In all studies, we found that the prevalence of tobacco among khat users was higher than among tobacco users alone in all populations and in different settings. Importantly, the level of tobacco use among students in school or children is worrying; tobacco is addictive and the risk of tobacco dependence increases when smoking begins early [51]. Yet, for example, the khat-endemic Yemen has ratified the WHO FCTC [52] but we only identified one Yemeni study meeting the methodological rigour that addressed the prevalence of tobacco among khat users, and this was among healthcare providers [40]. Population-level behavioural surveillance data to explore tobacco use specifically embedded in khat should be undertaken. This surveillance may guide effective mechanism(s) that involve professional policy makers. As we have previously outlined achievement of the Millennium Development Goals is possible if a main focus becomes the reduction of tobacco use in poor countries [3].

5. Conclusions

The prevalence of tobacco use among khat users appears significant, specifically, among high school students, university students, and health care workers in certain African countries and the Middle East. Patterns of use were either daily tobacco use or only using tobacco during khat sessions. The study underscores many knowledge gaps and methodological shortcomings in studies that measure tobacco and khat prevalence. Policy should take into account the current changes in the khat market in the diasporas and the impacts that may contribute to tobacco use. Meanwhile future research should explore the level and nature of tobacco dependence among khat users who also use tobacco, and specific tobacco cessation interventions should be developed to target this population group.

Conflict of Interests

The authors have no conflict of interests to declare.

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Research Article

Weaker Self-Esteem in Adolescence Predicts Smoking

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Background. To study whether weaker self-esteem in adolescence is connected with smoking behavior in adulthood. *Methods*. An age cohort born in 1979 responded to the Lawrence Self-Esteem Questionnaire (LAWSEQ) at the age of 16 ($n = 1,072$). Respondents' smoking behavior was monitored annually during adolescence and 75.3% ($n = 813$) of them remained nonsmokers during adolescence. A follow-up questionnaire eliciting smoking behavior was sent to the adolescent nonsmokers at the age of 29 years. Response rate at follow-up was 46.2% ($n = 376$). *Results*. Weaker self-esteem (LAWSEQ score ≥ 3) during the adolescence was not significantly associated with smoking in adulthood. However, those respondents who had weaker self-esteem in adolescence had increased risk of having been smoking regularly (adjusted OR 1.8, 95% CI 1.1–3.0) although not all of them were smokers at the time of the follow-up. *Conclusions*. Those with weaker self-esteem in adolescence are more likely to smoke regularly in adulthood.

1. Background

Tobacco smoking is a significant cause of a variety of problems for communities and individuals [1, 2]. WHO defines adolescents as people between 10 and 19 years old [3]. According to WHO, many adolescents are prone to develop unhealthy lifestyle and engage in risk behavior. Habitual smokers usually start smoking during adolescence [4, 5]. If smoking becomes a persistent habit, it greatly increases the risk of premature death [1].

A variety of personality-related factors have been shown to be associated with smoking. Problems with concentration had an independent effect on the probability of becoming a current smoker according to a Finnish twin study [6]. Among adults, personality factors such as neuroticism, poor self-discipline, impulsiveness, and low deliberation [7] as well as depressiveness [8] have been associated with smoking initiation and continuation. Continuing smoking and smoking cessation increase the risk of depression [9] and history of depression or anhedonia predicts smoking [10]. The link between smoking and depressive emotions seems to be due to problems with negative affect regulation; smoking is assumed to alleviate negative emotions [11]. There is no previously published study evaluating a potential association between self-esteem in adolescence and smoking in adulthood.

Weak self-esteem is a sign of vulnerability when it comes to affective disorders. According to Blatt and Zuroff's [12] theory of personality predispositions to depression, individuals with high levels of self-criticality and/or dependency are prone to develop depression after negative life-events. In addition to depressive symptoms, weak self-esteem is linked to weight problems [13] and social phobia [14]. Mental illness in young people predicts greater likelihood of starting smoking [15]. Decrease in self-esteem is linked with the development of social phobia and depression among adolescents [16].

A variety of methods to measure self-esteem have been developed. A commonly used method of measuring self-esteem is Lawrence Self-Esteem Questionnaire (LAWSEQ) [17], which has been shown to be a valid measure of an individual's self-esteem [18, 19].

In summary, smokers often have weaker self-esteem and those with weaker self-esteem are likely to smoke. The aim of this study was to find out if weaker self-esteem in adolescence

is associated with smoking in adulthood. While the likelihood to start smoking cannot be measured, it is rational to try to find some measurable indicators that could be used to point out those individuals who are prone to start smoking.

2. Methods

The sample was picked from those age cohort subjects born in 1979 [20] who completed the Lawrence Self-Esteem Questionnaire (LAWSEQ) at the age of 16 while living in one of three Finnish towns and self-reported no smoking experimentations during ages of 12–16 ($n = 813$).

A back-translation (from Finnish into English) of our version of LAWSEQ is presented as an appendix. Two versions of LAWSEQ had been used in 1995, one in Finnish and one in Swedish. Those subjects whose mother tongue was Finnish had responded to the Finnish translation and vice versa. The responses to the LAWSEQ were used to assess respondents' self-esteem. We used a sum variable (later LAWSEQ score) that was the total number of points from the LAWSEQ questions. A "yes" answer to a question yielded 2 points, "cannot say" yielded 1 point, and "no" yielded 0 points except for the question "do you think that your parents usually like to hear about your own ideas?" where "yes" yielded 0 points, "cannot say" yielded 1 point, and "no" yielded 2 points. Consequently, LAWSEQ scores were between 0 (zero) and 20, where 0 represented the strongest and 20 the weakest self-esteem.

At the age of 16 the responses to LAWSEQ were received from 813 subjects. Of these subjects 51.7% ($n = 402$) got LAWSEQ score of 0, 1, or 2. Because of this we classified the respondents with LAWSEQ scores from 3 to 20 as having weaker self-esteem and those with LAWSEQ scores of 2 or less as having stronger self-esteem. Second, we classified the responses to separate self-esteem questions as weaker (1-2 points) and stronger (0 points). These responses were then used in binary logistic regression to see if individual responses representing weaker or stronger self-esteem had a connection with smoking behavior in adolescence or adulthood.

The subjects had also responded to a separate questionnaire about their smoking habits at the ages of 13, 14, 15, and 16. The question we used to classify respondents into adolescent nonsmokers (and study population) or adolescent smokers (and exclusion) was "do you smoke?" (no/yes). Their parents' smoking behavior was also elicited annually in the questionnaire. The respondent's gender and parents' smoking behavior were noted as potential confounding factors for smoking in adolescence.

In 2008 we mailed a follow-up questionnaire to assess the smoking of the cohort in adulthood. The addresses of the sample population were obtained from the Finnish Population Register Centre. We sent the follow-up questionnaires in 2008. The response rate was 46.2% ($n = 376$).

We used two methods for measuring smoking behavior from the responses to the follow-up questionnaire. Those respondents answering "yes" to the question "do you smoke?" were classified as being smokers in adulthood. Those respondents answering "yes" to both questions "during your life have you smoked more than 5 packs of cigarettes or cigars or smoked at least an estimated equivalent amount of loose or pipe tobacco?" (yes/no) and "do you smoke or have you smoked tobacco products regularly, in other words daily or nearly daily?" (yes/no) were classified as having been smoking regularly. The respondent's gender was noted as a potential confounding factor for being a smoker in adulthood or having been smoking regularly.

In the follow-up envelopes there was also a cover letter describing the purpose and methodology of the study and enclosing a consent form. Only questionnaires returned with a signed consent form were used as data. The Ethics Committee of the Pirkanmaa Hospital District, Finland, approved the study protocol (R08017).

We used IBM SPSS 20.0 for the statistical analyses. Nonrespondents were excluded from the analysis. The data was analyzed using frequencies, percentages, cross-tabulation, and Fisher's exact test. Independent samples t-test was used to analyze differences in LAWSEQ scores between smokers and nonsmokers. Logistic regression analysis was performed to obtain odds ratios (OR) and 95% confidence intervals (CI). The dependent variable was smoking in adulthood or having been smoking regularly. Multivariate analyses were also conducted to adjust for confounders.

3. Results

Of all the respondents, 8.8% ($n = 33$) were adulthood smokers. Among the respondents, 7.6% ($n = 18$) females and 11.0% ($n = 15$) males were smokers. There were no statistically significant gender differences in smoking.

Median LAWSEQ score in the study population was 3. Of all the respondents, 76.1% ($n = 286$) scored less than the median value 3 (three). This was considered to be close enough to the original distribution of LAWSEQ scores (see Section 2) and thus the cut-point of median was accepted for dichotomization of LAWSEQ scores to those representing stronger or weaker self-esteem. There were no statistically significant differences in LAWSEQ scores between the groups of adulthood smokers and adulthood nonsmokers (Figure 1). Weaker self-esteem during the adolescence was not significantly associated with smoking in adulthood (Table 1).

Among all respondents, 24.5% ($n = 58$) females and 36.7% ($n = 51$) males had been smoking regularly ($p = 0.014$). Those with weaker self-esteem during adolescence were more likely to have been smoking regularly (adjusted OR 1.8, 95% CI 1.1–3.0) (Table 1).

When looking at each LAWSEQ question separately, responses to the separate LAWSEQ questions were not associated with increased or decreased risk of being a smoker in adulthood.

4. Conclusions

Smoking behavior in adulthood seems to be connected with higher LAWSEQ score and thus lower self-esteem in adolescence. It seems that the effect of poor self-esteem does not affect adolescents' smoking during adolescence, but as time

Table 1: Odds for being smoker in adulthood or having been smoking regularly among the groups with weaker or stronger self-esteem.

	Smoking behavior			
	One variable		Adjusted*	
	OR (95% CI)	p value	OR (95% CI)	p value
	Smoker in adulthood			
Self-esteem		0.370		0.414
Stronger	1		1	
Weaker	1.43 (0.65–3.13)		1.39 (0.63–3.05)	
	Has been smoking regularly			
Self-esteem		**0.018**		**0.030**
Stronger	1		1	
Weaker	1.82 (1.11–3.01)		1.75 (1.05–2.91)	

OR = odds ratio, CI = confidence interval, stronger = LAWSEQ score <3, and weaker = LAWSEQ score 3 or more.
*The adjusted model includes gender and smoking of parents.

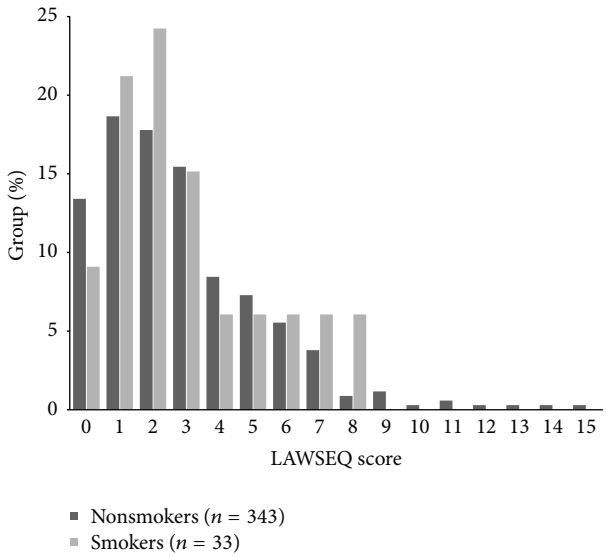

Figure 1: Distribution of LAWSEQ score measured at the age of 16 in the groups of adult smokers and adult nonsmokers. Higher scores indicate weaker self-esteem.

passes and they grow into adulthood, poor self-esteem has a predictive effect on their smoking behavior. The back-translation of LAWSEQ was partially noncomparable (see appendix) and this may have caused bias on the results. The reliability of LAWSEQ scores has been found satisfactory in recent analyses [21]. However, LAWSEQ has not been validated in Finnish populations and cultural differences may also have an effect on the adequacy of the translation used in this study. It should also be kept in mind that measuring self-esteem is controversial. It is not possible to determine one value where LAWSEQ score interpretation changes from strong self-esteem to weak self-esteem. In this study we used the LAWSEQ score cut-point where half of the originally tested subjects scored under and another half over the cut-point value. Our justification on this method is its simplicity; tests to define personality-related factors should be compared to the population to which the test has been conducted.

Our respondents mostly had high education, were living in a pair relationship, and perceived their health to be very good; thus according to existing knowledge they are unlikely to be smokers. If we had been able to analyze the adulthood smoking behavior of the nonrespondents, it is possible that there would have been more of those with problems with both self-esteem and smoking. This selection bias is likely to undermine our results. Half of the cohort received up to four brief tobacco interventions in school age. This is unlikely to cause any bias in our study since the intervention did not prove effective in long-term follow-up [22]. Recent evidence of the long-term ineffectiveness of cessation interventions concurs with the assumption that earlier interventions did not bias our results [23].

Since the findings reported here have not been observed before, we call for further studies to elucidate further the relationship between self-esteem and smoking behavior. Using a different method for grading self-esteem and/or collecting the responses at a different age or from a different population could have been useful. SES (Rosenberg Self-esteem Scale) [24] has been used as a golden standard to measure self-esteem. It has been validated in many different countries and translated into many languages [25, 26]. The Finnish translation of SES has been used in a study concluding that self-esteem is affected by environmental factors [27]. However, SES had not been translated to Finnish at 1996 when this study was put into practice.

In conclusion weaker self-esteem in adolescence is associated with smoking in adulthood. Problems with self-esteem may be a practical indicator of a specific need for antismoking interventions, and we call for further studies to see if adolescents with self-esteem issues benefit from antismoking interventions.

Appendix

(1) Are there many things you would like to change about yourself?

(2) Do you think your school friends often talk ill of you?

(3) Do others often think you are lying?

(4) Do your parents usually want to hear your thoughts?

(5) Do you usually feel yourself stupid when talking with your parents?

(6) Do you often find it difficult to address your teacher?

(7) If there is something that you need to tell your teacher, do you usually feel yourself stupid?

(8) Do other pupils often run into conflicts with you?

(9) Do you often feel yourself lonely at school?

(10) Do you often need to find new friends because your old friends are with someone else?

Ethical Approval

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Conflict of Interests

The authors declare that they have no conflict of interests.

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Research Article

Impact of Waterpipe Tobacco Pack Health Warnings on Waterpipe Smoking Attitudes: A Qualitative Analysis among Regular Users in London

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Background. Despite the rise in prevalence of waterpipe tobacco smoking, it has received little legislative enforcement from governing bodies, especially in the area of health warning labels. *Methods*. Twenty regular waterpipe tobacco smokers from London took part in five focus groups discussing the impact of waterpipe tobacco pack health warnings on their attitudes towards waterpipe smoking. We presented them with existing and mock waterpipe tobacco products, designed to be compliant with current and future UK/EU legislation. Data were analysed using thematic analysis. *Results*. Participants felt packs were less attractive and health warnings were more impactful as health warnings increased in size and packaging became less branded. However, participants highlighted their lack of exposure to waterpipe tobacco pack health warnings due to the inherent nature of waterpipe smoking, that is, smoking in a café with the apparatus already prepacked by staff. Health warnings at the point of consumption had more reported impact than health warnings at the point of sale. *Conclusions*. Waterpipe tobacco pack health warnings are likely to be effective if compliant with existing laws and exposed to end-users. Legislations should be reviewed to extend health warning labels to waterpipe accessories, particularly the apparatus, and to waterpipe-serving premises.

1. Introduction

Waterpipe tobacco smoking is a growing public health concern. It is the predominant tobacco product used by young people in Jordan [1] and Lebanon [2], and a noticeable prevalence is also noted in Western settings, especially among young adults [3]. For example, 1% of adults in Great Britain are regular waterpipe tobacco smokers, a figure which is 10-fold higher among young adults of South Asian origin [4]. In the US, reports from a national survey estimate that 6.1% of adults aged 18–24 years are current waterpipe tobacco smokers [5] and an analysis of the Global Adult Tobacco Survey suggests waterpipe tobacco smoking is increasing across continents with important country-level differences in patterns of use [6].

Among the main motives for initiation and maintenance of use is the notion that waterpipe tobacco smoking is a less harmful alternative to cigarette smoking [7]. Evidence continues to show the contrary; waterpipe tobacco smoke contains many of the chemicals found in cigarettes that are known to induce disease and dependence, such as tar, nicotine, carbon monoxide, and tobacco-specific nitrosamines [8, 9]. A recent systematic review and meta-analysis of the health effects of waterpipe tobacco smoking identified a host of conditions associated with its use, including lung cancer, respiratory disease, low birth weight, and periodontal disease [10, 11]. Despite research efforts to identify waterpipe tobacco smoking as a public health issue warranting attention, interventions promoting its cessation are few [12, 13].

Legislation has played an instrumental role in the decline of cigarette smoking, yet it seems almost absent with regard to waterpipe tobacco use. For example, some cities in the US have smoke-free laws for cigarettes, but waterpipe tobacco is often exempt [14]. Exemptions for waterpipe tobacco are also seen in upcoming European bans on flavoured tobacco which are exclusive to cigarettes and hand-rolled tobacco [15]. This lack of direct legislative attention may have resulted in the proliferation of a largely unregulated industry; London alone has approximately 400 known waterpipe-serving premises [16], the industry has been shown to market their products with misleading descriptors [17]. In the US, waterpipe-serving premises in Oregon exploited a loophole in the Indoor Clean Air Act which exempted retail stores that offered "sampling" to consumers onsite, allowing them to continue serving waterpipe indoors [18].

Placing health warning labels on cigarette packs is a well-established measure to raise awareness of the harms of smoking, promote cessation among continuing users, and prevent initiation among nonusers [19]. Evidence from Lebanon suggests widespread noncompliance of health warning labels on waterpipe tobacco products [20]. One qualitative study in the UK and Canada suggested that the lack of health warnings on waterpipe tobacco packs implied tacit approval of its safety, and where health warnings were salient they were frequently not understood as they were written in Arabic [21]. However, no studies to our knowledge have tested the effectiveness of health warnings on waterpipe tobacco packs; this study sought to address this deficit in the literature.

2. Materials and Methods

2.1. Design, Sample, and Setting. In order to generate insights from this hard to reach group, focus groups were utilised as a data collection tool over individual qualitative interviews [22]. Moreover, we restricted the size of the focus groups in order to enable a high level of researcher control [23]. Our sample frame consisted of London university students, a group known to have particularly high prevalence of waterpipe tobacco smoking [4]. In 2014, two researchers (Ali Bakir and Mohammed Ali) acted as gatekeepers to recruit their peers who were regular waterpipe tobacco smokers adopting snowball sampling to recruit additional participants [24], a technique used previously to target this group in London [25]. Participants were recruited in person (face-to-face) and by electronic media (emails, phone calls, and social media). They were invited to attend focus group discussions to discuss attitudes towards waterpipe tobacco pack health warnings. A topic guide was developed using a framework based on the theory of reasoned behavior [26].

2.2. Waterpipe Tobacco Pack Health Warnings. Existing waterpipe tobacco packs are known to be noncompliant with tobacco health warning requirements [20]. In the UK, one of the most known waterpipe tobacco brands is "Al-Fakher" and two different packs of these were purchased at a local retail store in London. One pack contained no visible health warning labels on its front or back surface (Figure 1, Pack 1) and one contained health warning labels that were

Figure 1: Health warning labels (top row = front of pack; bottom row = back of pack).

noncompliant with existing legislation as it contained bilingual (English/Arabic) health warnings (Figure 1, Pack 2). We purchased two more Al-Fakher waterpipe tobacco packs with no visible health warnings and used these to apply our own health warnings. For one pack we created health warnings to comply exactly with current English legislative requirements on tobacco health warnings [27, 28], which involved a text warning covering the front 30% of the pack, and a graphic plus text warning covering the back 40% of the pack (Figure 1, Pack 3). This is also compliant with requirements of the European Union Tobacco Products Directive [29]. For the other pack we created health warnings to comply with recommendations based on the Hammond review of health warnings labels worldwide [19] (which comply with potentially future EU legislation), which involved a text warning covering the front 75% of the pack, and a graphic plus text warning covering the back 75% of the pack (Figure 1, Pack 4). Finally, we created a waterpipe tobacco pack to mimic standardised packaging ("plain packs," Figure 1, Pack 5), based on the legislative guidelines outlined by Australia [30]. Packs 3–5 contained the same health warnings (front: "Shisha smoking kills"; back: "Shisha causes fatal lung cancer"), based on the best available evidence on waterpipe health outcomes [10], which we stuck underneath the cellophane of the tobacco pack to promote a sense of authenticity. In order to reduce response bias, we did not tell focus group participants that some waterpipe tobacco pack health warnings were created by us.

2.3. Pilot Focus Group. We conducted a pilot focus group among three participants (Group 1). This confirmed the authenticity of our health warnings and enabled the possibility of feedback to the facilitators (Ali Bakir and Mohammed Ali) from a more experienced qualitative researcher (Aimee Grant). We provided a range of health warning messages to this group ("Using coal to heat shisha tobacco causes carbon monoxide poisoning," "Shisha smoking causes fatal cancers," "Shisha can spread tuberculosis," "Shisha smoking can cause premature death," "Shisha smoking harms pregnancy," "Shisha smoking kills," and "The water in shisha does not filter harmful chemicals") and participants indicated that shorter adverse health outcomes were better received than longer ones. The two health warnings "Shisha smoking

kills" and "Shisha causes fatal lung cancer" were selected as examples of better received health warnings, which we incorporated across both packs we created. We also tested the appropriateness of our prompts and questions after reading the transcript and hearing its audio recording. Suggestions for improvement were fed back to the facilitators via a series of meetings with the research team.

2.4. Data Collection and Analysis. Twenty participants took part in five focus groups with a mean of four participants per group (range 3–6). Focus groups occurred in university campus meeting rooms (Groups 2 and 3) or at one of the participants' homes during a meeting of friends which invariably involved waterpipe tobacco smoking (Groups 1, 4, and 5). No discernable difference occured in participant engagement or focus group duration which could be attributed to the research venue. We provided all participants with written information about the study and informed consent was obtained prior to focus group discussions. All focus groups were conducted by Ali Bakir and Mohammed Ali, who alternated between roles as facilitator and note-taker in each focus group, providing feedback to one another in an iterative process. All focus groups were audio-recorded and transcribed verbatim. Mean focus group length was 39 minutes. Thematic analysis [31] was undertaken by one researcher (Aimee Grant), facilitated by the use of NVivo 10. 20% of the data was independently coded by a second researcher (Mohammed Ali), and a high proportion of interrater reliability was obtained, with minor inconsistencies discussed and resolved. This study was approved by the Imperial College Research Ethics Committee.

3. Results

3.1. Participant Characteristics. The mean age was 24.4 ± 3.2 years and 17 of the 20 participants were male. Half were Arab, nine were of South Asian ethnicity, and one participant was White British. Twelve were students, seven were employed, and one was self-employed. Twelve only smoked waterpipe, and eight smoked both waterpipe and cigarettes. Mean age of waterpipe initiation was 17.9 ± 2.8 years (range 13–25 years). Eight smoked waterpipe less than weekly, six smoked weekly, three smoked two to three times per week, and three smoked daily. Only two participants had made previous quit attempts.

3.2. Themes. Our findings are divided into the impact of health warnings on perceived attractiveness of waterpipe smoking, the clarity of health warnings on the five waterpipe tobacco packs, the perceived impact on compliant health warning labels, and participants' real world exposure to health warning labels. Throughout, the impact of standardised (plain) packaging and the impact on nonusers will be discussed.

3.2.1. Health Warnings and Attractiveness. Overall, participants found packages without health warnings (Pack 1) or with UK compliant health warnings (Pack 3) most attractive. Attractiveness decreased as the size of health warnings increased (Pack 4), or as the packaging lost its branding (Pack 5):

> [Pack 1] may taste nicer also because if it does not have a health warning on it, you would assume that it would taste nicer, coz something with a health warning on it you would assume it has chemicals in it so it wouldn't taste that nice.... (Group 5, Participant 1: male, aged 23, Indian ethnicity, weekly waterpipe-only user)

> I think they ruined the look of the mo'assal (tobacco) [on Pack 5]. There is no brand name, it covers the whole thing with the [health warning] picture. (Group 4, Participant 3: male, aged 29, Arab ethnicity, twice weekly waterpipe user, dual waterpipe/cigarette user)

In every focus group, the concept of the colourfulness of packaging was discussed, and references to the waterpipe tobacco packaging (Packs 1–4) looking like "candy" were frequent. Alongside this, many of the participants stated that the packaging would be attractive to children. The appeal of brightly coloured packaging for adults, however, was contested. Some participants thought that the colourful waterpipe tobacco packages (Packs 1–4) were generally unsophisticated and unattractive. One participant noted that it would be embarrassing to be seen with such a package:

> [Pack 1 is] too loud and they look a bit messy...like the other one [Pack 2] is like bright yellow thing, I don't really want to be carrying that around... [Pack 2] could be like candy or lollipops.... (Group 1, Participant 1: male, aged 22, White British ethnicity, weekly waterpipe-only user)

Other participants suggested that the colour was attractive and that by making the packaging "plain" or standardised (Pack 5) the product would be less attractive to them.

3.2.2. Clarity of Health Warnings. The existing, noncompliant warning "Shisha smoking is more dangerous than you think," accompanied by a picture of a snake wrapped around a waterpipe (Pack 2), was viewed as less clear than "Shisha smoking kills" alongside a UK compliant pictorial health warning (Packs 3–5). Speaking about Pack 2,

> It's not really a warning, you look at the picture more than the words really and the picture is of a shisha so it's not very intimidating. (Group 4, Participant 3: male, aged 29, Arab ethnicity, twice weekly waterpipe user, dual waterpipe/cigarette user)

In addition to this, bilingual (English/Arabic) health warnings found on Pack 2 were viewed as a distraction, particularly for users who did not understand Arabic. For some participants, making packaging looking more similar to cigarette packaging (Packs 3–5) reinforced that waterpipe smoking was dangerous for health: "I think that one (Pack 3) is more like

cigarette box and we associate cigarettes as being bad. . .." (Group 4, Participant 5: male, aged 26, Arab ethnicity, 3x week waterpipe user, dual waterpipe/cigarette user).

3.2.3. Perceived Impact of Health Warnings on Waterpipe Smoking. Participants varied in the extent to which they reported that warning labels would influence their waterpipe smoking behaviour. Some participants noted that even regular waterpipe users would not choose to buy waterpipe tobacco in plain packaging (pack 5), but throughout the focus groups, participants noted the importance of addiction on behaviour:

> Interviewer: Would you be deterred by messages, by packages like these [Packs 3 and 4]?
>
> Participant: Slightly yeah, it's hard, if you are in the habit of smoking it's hard for you to keep off easily, but it does have some sort of impact. (Group 4, Participant 5: male, aged 26, Arab ethnicity, 3x week waterpipe user, dual waterpipe/cigarette user)

For those who reported that their behaviour would not be affected, viewing health warnings was still perceived to be a negative experience:

> [if health warnings were on waterpipe tobacco packaging] it will be annoying and it won't have an effect on me, that's for sure. . . It'll be like I wasn't to see the packaging, I don't want to see that. . . It wouldn't make me any less of thinking about quitting. . . I will quit everything in my life before I quit shisha. . .shisha is like my blood. . .. (Group 2, Participant 2: male, aged 23, Indian ethnicity, daily waterpipe user, dual waterpipe/cigarette user)

Participants reported that they felt that making waterpipe tobacco less attractive, by introducing standardised packaging (Pack 5) or large health warnings (Pack 4), would reduce the appeal for young people. However, the lack of exposure to packaging was noted as a disadvantage for attempting to expose young people to health warnings.

3.2.4. Exposure to Waterpipe Tobacco Packaging. There was wide agreement from participants that they did not regularly come into contact with waterpipe tobacco packaging. Three reasons were provided for this. Firstly most participants used waterpipes in public venues, where the pipe was prepared by venue staff and presented prepacked with tobacco. Secondly, where participants shared waterpipes with friends another person would be involved in preparing the pipe. Thirdly, participants purchased waterpipe tobacco that was sold (illegally) in plastic bags or unbranded containers or from other countries:

> I don't think many people have shisha in their houses. They smoke shisha at the cafes, and at cafes we don't see the package at all. . . I never ever in my life. . .bought from a British [shop]. . .. (Group 2, Participant 6: male, aged 23, Arab ethnicity, weekly waterpipe user, dual waterpipe/cigarette user)

However, six participants noted that when they smoked waterpipe in public venues, a health warning was attached to the pipe. Participants stated that they found viewing these warnings uncomfortable ("annoying") whilst others actively attempted to avoid the warning:

> When I have a shisha, I turn it around; I don't like looking at it. . .it is putting me off. . . So I turn the pictures around. . .the text doesn't bother me. . .whereas the pictures it will automatically register regardless of whether I consciously look at it or not. (Group 1, Participant 2: male, aged 23, Pakistani ethnicity, weekly waterpipe-only user)

One participant reported that the presence of health warnings attached to the pipe deterred him from smoking waterpipe in that café.

4. Discussion

To our knowledge this study is the first to assess the impact of waterpipe tobacco pack health warning labels on waterpipe tobacco users. Using a legislative gradient of health warnings ranging from noncompliant (Pack 1) to standardised ("plain") packs (Pack 5), participants' reactions to them were "dose-responsive"; that is, the bigger the health warning/more plain the packaging, the greater the negative response. This was especially true regarding package attractiveness and the perceived impact of health warnings on waterpipe smoking.

Health warning labels on existing UK waterpipe tobacco packs appear ineffective and participants suggested their absence and subsequent colourful packaging may appeal to children. Indeed, young people and adolescents appear particularly vulnerable to waterpipe tobacco smoking in both Western and Middle Eastern settings [1, 2]. Irrespective of the health warning compliance level of waterpipe tobacco packs, the lack of exposure appeared to highlight a fundamental flaw in existing tobacco control legislation; namely, waterpipe tobacco smoking is not homogenous with cigarette smoking. While health warning labels are apparent to cigarette users at point of sale and the point of consumption, opportunities to present health warnings to waterpipe users appear concentrated at the point of consumption. Some local governments in the UK appear to be attaching health warnings to waterpipes in shisha cafes, and our findings show some evidence to suggest that this may be an effective way of communicating health risks to waterpipe users.

The literature is bereft of information on health warning labels. In a qualitative study among English and Canadian waterpipe smokers, some recalled seeing health warnings in foreign languages only, or none at all [21]. A study in Lebanon showed that the majority of the 74 purchased waterpipe tobacco products contained text-only warnings covering an average of 3.5% of their total surface area [20]. On waterpipe tobacco retail websites, only 4% contained a health

warning of any description on any page [32]. In a qualitative study of staff responsible for enforcing laws on waterpipe-serving premises, several provided health warning lanyards to premises for placement over the waterpipe apparatus; however most premises were noncompliant [16].

This study preliminarily demonstrates the benefits of increasing health warning label size and moving towards standardised ("plain") waterpipe tobacco packs. However due to lack of exposure, emphasis should be placed on communicating health risk on waterpipe apparatuses and other accessories, particularly at waterpipe-serving premises. Consideration should be given to displaying health warning posters on premises dedicated to the sale of waterpipe tobacco. Better control of waterpipe tobacco sales is needed in the context monitoring the illicit market, which appears to contribute a significant proportion of waterpipe tobacco sales in the UK [16]. Communicating health risks is somewhat fraught with inconsistent and potentially harmful messages from public health staff and organisations [33], and efforts should be made to communicate a unified and clear message of harm. To our knowledge only Lebanon has laws on specific messages for waterpipe tobacco pack health warning labels [34], which could be used as a basis for other countries looking to implement waterpipe-specific health messages.

This is the first published study to evaluate the impact of waterpipe tobacco pack health warnings on waterpipe smoking behaviour. Health warning labels were created in accordance with existing and (potential) future European legislation and were piloted for authenticity. However this sample relied on a small, convenience sample limited to one area of the UK. We also did not seek to select a representative sample of existing waterpipe tobacco products on the UK market and limited our study to one brand. Furthermore, we only tested one set of health warnings ("Shisha smoking kills" and "Shisha causes fatal lung cancers") and we anticipate a slightly different response to messages communicating the benefits of cessation or referral to a cessation service.

5. Conclusions

Waterpipe tobacco pack health warning labels are likely to be more effective if larger or if displayed as part of a standardised ("plain") pack. However, due to the inherent ways in which it is smoked, waterpipe tobacco pack health warning labels may have limited exposure to waterpipe users, especially in a café setting. Laws on waterpipe tobacco pack health warning labels should be revised to accommodate for this difference by extending health warnings to waterpipe accessories and parts of waterpipe-serving premises.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contribution

Mohammed Jawad and Aimee Grant conceptualised the project and developed the study protocol. Ali Bakir and Mohammed Ali commented on the study protocol. Aimee Grant trained Ali Bakir and Mohammed Ali in qualitative methods. Ali Bakir and Mohammed Ali conducted all focus group discussions and transcribed audio-recordings. Aimee Grant conducted the main analysis, with support from Ali Bakir. Mohammed Jawad wrote the first draft of the paper. All authors read and approved the final version of the paper.

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Research Article

Socioeconomic Gradients in Different Types of Tobacco Use in India: Evidence from Global Adult Tobacco Survey 2009-10

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Socioeconomic differences in tobacco use have been reported, but there is a lack of evidence on how they vary according to types of tobacco use. This study explored socioeconomic differences associated with cigarette, bidi, smokeless tobacco (SLT), and dual use (smoking and smokeless tobacco use) in India and tested whether these differences vary by gender and residential area. Secondary analysis of Global Adult Tobacco Survey (GATS) 2009-10 (n = 69,296) was conducted. The primary outcomes were self-reported cigarette, bidi smoking, SLT, and dual use. The main explanatory variables were wealth, education, and occupation. Associations were assessed using multinomial logistic regressions. 69,030 adults participated in the study. Positive association was observed between wealth and prevalence of cigarette smoking while inverse associations were observed for bidi smoking, SLT, and dual use after adjustment for potential confounders. Inverse associations with education were observed for all four types after adjusting for confounders. Significant interactions were observed for gender and area in the association between cigarette, bidi, and smokeless tobacco use with wealth and education. The probability of cigarette smoking was higher for wealthier individuals while the probability of bidi smoking, smokeless tobacco use, and dual use was higher for those with lesser wealth and education.

1. Introduction

Mortality and morbidity due to active smoking and the resulting involuntary exposure of nonsmokers to tobacco smoke are well substantiated globally [1–3] and in India [4–8]. While a recent multicountry study reported global reductions in cigarette smoking [9], the Indian Global Adult Tobacco Survey [10] reported high smokeless tobacco (SLT) use among both men and women. Considering the availability of tobacco in myriad varieties in India in addition to smoked forms of tobacco, cigarettes and bidis (tobacco rolled in a leaf), it is complicated to assess the overall tobacco burden in India [11]. The growing burden of noncommunicable diseases (NCDs) associated with tobacco use in India points towards the need to study its underlying determinants in order to design appropriate policy interventions to address this public health issue.

Previous studies have also assessed and reported socioeconomic differences in tobacco use both globally [12–17] and in India [18–21]. A study conducted by Thakur et al., 2013, revealed differences according to geographical regions in the association between socioeconomic attributes with smoking and smokeless tobacco use. The study further revealed consistent inverse gradients for both smoking and smokeless tobacco use in India [22]. On the contrary, a recent study conducted by Corsi and Subramanian (2014) assessed socioeconomic inequalities in smoking behavior amongst males in India and reported that while cigarette smoking was concentrated among people who were wealthier, more educated, and with higher occupational status, on the contrary bidi smoking was more concentrated among the disadvantaged [19]. Similar contrasting gradients have also been reported from a regional study in India [23]. This unusual variation in socioeconomic gradients in consumption of the two smoking products among Indian males raises both concerns and curiosity to assess how usage across the different types of tobacco products (SLT and cigarette, bidi) differs by socioeconomic profile. While this inconsistency in results highlights

the importance of treating each of these types of tobacco products differently, a greater concern which has been ignored in these studies is the growing prevalence of dual use (use of both smokeless and smoking forms of tobacco) in India [24]. Dual users are potentially at a greater risk for morbidity and mortality when compared with those who use one tobacco product only [25].

Most of the previous studies from India reported socioeconomic differences in tobacco use but to our knowledge none has studied the socioeconomic differences in tobacco use for all the different types of tobacco collectively or assessed the variations in these differences according to gender and area of residence. To address this gap in evidence, we therefore assessed the socioeconomic differences in different types of tobacco use (smoking (cigarette, bidi), SLT, and dual tobacco use) in India and further studied the variations in some of these differences according to gender and area of residence using a nationally representative survey of tobacco use in India.

2. Methodology

2.1. Study Population. The Global Adult Tobacco Survey (GATS 2009-2010) is a multicountry household survey launched in 2007 for formulation, tracking, and implementation of effective tobacco control interventions in the study countries. We analyzed data from 69,296 adults (ages 15 years and above) from the Indian GATS, which was conducted in 2009-10. The sample was drawn using multistage sampling. In urban areas, the primary sampling units (PSUs) were the city wards, the secondary sampling units (SSUs) were the census enumeration blocks, and the tertiary sampling units (TSUs) were households. In rural areas, villages comprised the PSUs [10].

2.2. Eligibility Criteria. Individuals aged over 15 years in the identified PSUs and living in the selected households were eligible to participate in the survey. All noninstitutionalized individuals who gave their agreement to voluntarily participate in the study were eligible. In the case of minor respondents (15–17 years), consent was sought from the participant as well as from their parent/guardian [10].

2.3. Variables. GATS data was collected using household and individual questionnaires that were developed in English and later translated into 19 regional languages [10]. The self-administered individual questionnaires covered information broadly on the following eight sections: demographic characteristics, tobacco smoking, SLT use, cessation, second hand smoke, economics, media and knowledge, and attitude and perceptions. Details of the sampling procedure and data collection have been published [10].

The primary outcomes for this analysis were self-reported current smoking and SLT use. Respondents were asked, "On average, how many of the following products do you currently smoke each day? Also, let me know if you smoke the product, but not every day." Those who responded smoking one or more than one for manufactured/rolled tobacco in paper and leaf daily were categorized as current cigarette smokers and those who responded smoking one or more than one bidi were categorized as current bidi smokers. For the outcome of current SLT use the respondents were asked, "Do you currently use smokeless tobacco on a daily basis, less than daily, or not at all?" All those who answered "daily" or "less than daily" were recategorized as "Yes" and those who responded "not at all" and "do not know" and "refused" were recategorized as "No" considering that there were no observations in these categories. Those respondents who answered yes to both current smoking (cigarette, bidi smoking) and current SLT use were categorized as dual users. In order to avoid duplication of these respondents in current smoking (cigarette, bidi smokers) and current SLT users, these respondents were excluded from only cigarette, bidi, and SLT users in previous categories. Hence, the four outcomes were exclusive cigarette smoking, bidi smoking, smokeless tobacco use, and dual users.

Socioeconomic status, the main explanatory variable, was assessed through "educational attainment," "wealth," and occupational groups. Educational attainment, measured through the "highest level of education completed," was categorized as "no education," "primary school or less," "less than secondary school," and "more than secondary school." Principal components analysis (PCA) of household assets was used to create a wealth index [15]. Assets included electricity, flush toilet, car/scooter, motorcycle, television, refrigerator, washing machine, telephone and mobile phone, and radio. The wealth index was divided into quintiles. The occupational groups were categorized as "government employee," "private employee," "housewives, students, and retirees," "unemployed but able," and "unemployed and unable." Respondents with missing information on education, wealth, and occupation were excluded from the analyses [10].

Other covariates included age, sex, area of residence (urban versus rural), and geographical region of India. Analysis adjusted for age (measured in years) was categorized using six groups: "15–17" (minors), "18–30," "31–45," "46–60," "61–75," and "76 and above".

2.4. Statistical Analysis. Multinomial logistic regression was used to estimate odds ratios and attendant 95% confidence intervals for the associations between tobacco use and socioeconomic variables (education, wealth, and occupation). Multinomial logit model (MNLM) simultaneously allows estimation of binary logits for all possible comparisons among different outcome categories and is well suited to examine multiple outcomes [26]. In order to conduct this regression, a composite nominal variable with nonusers as the reference and cigarette, bidi, SLT, and dual users as index categories was created and regression models were fitted with each of the SES variables.

In the first models, the outcomes were fitted with each SES variable alone (Model 1). Demographic variables of age, sex, area of residence, and geographical regions were included in the next set of models (Model 2). Finally, Model 3 included these demographic variables and all SES variables simultaneously. Model 3 was extended by fitting interactions (one at a time) between the socioeconomic variables (wealth and education) and gender and place of residence. Participants

Table 1: Sociodemographic characteristics of the sample according to current tobacco use (n = 69,030).

Characteristics	Categories	n (%)	Cigarette smoking (%)	Bidi smoking (%)	SLT use (%)	Dual use (%)
Total		69,030 (100)	2,999 (2.8)	4,192 (5.7)	12,668 (20.5)	4,058 (5.3)
Gender	Male	33,685 (51.7)	5.3	9.9	23.6	9.2
	Female	35,345 (48.3)	0.1	1.2	17.2	1.1
Age (years)	15–17	2,878 (7.6)	0.1	0.2	8.3	0.9
	18–30	23,092 (38.4)	1.4	2.2	17.4	4.4
	31–45	25,543 (29.8)	2.7	7.4	23.8	7.0
	46–60	11,758 (16.0)	2.7	11.5	25.3	6.2
	61–75	4,773 (6.7)	1.7	10.8	29.2	5.7
	76 and above	986 (1.5)	0.2	9.1	26.3	8.2
Area of residence	Urban	27,437 (29.3)	4.4	3.7	14.1	3.5
	Rural	41,593 (70.7)	2.2	6.5	23.2	6.0
Geographical regions	North	13,976 (5.2)	4.7	6.6	4.9	2.2
	Central	9,993 (32.5)	1.1	7.2	22.5	6.6
	East	9,686 (21.1)	3.1	5.5	29.8	7.9
	North-East	15,197 (3.6)	4.8	4.2	24.9	9.8
	West	9,091 (14.9)	1.6	3.6	22.4	2.9
	South	11,087 (22.7)	5.1	5.1	10.8	2.6
Educational attainment	No formal education	18,735 (31.0)	1.4	8.3	27.5	6.0
	Less than primary	7,983 (12.2)	2.9	9.4	24.9	8.2
	Primary but less than secondary	19,511 (28.9)	3.2	4.8	19.8	5.4
	Secondary and above	22,801 (28.0)	4.0	2.1	11.7	3.1
Wealth (asset quintiles)	Poorest	13,998 (27.9)	1.1	7.6	30.2	7.8
	Poor	16,033 (26.4)	2.1	6.5	23.0	5.3
	Middle	11,571 (16.5)	3.4	5.8	17.6	4.4
	Rich	13,830 (17.1)	4.4	4.1	13.0	4.0
	Richest	13,597 (12.1)	5.3	1.6	7.7	2.6
Occupation	Unemployed and unable	1,220 (1.9)	1.6	11.9	29.0	5.6
	Unemployed and able	1,500 (2.1)	2.8	5.0	26.8	10.1
	Housewife/retired/student	30,810 (43.2)	0.7	1.7	13.6	1.4
	Self-employed	19,575 (28.5)	4.0	9.9	26.9	8.3
	Nongovernment employee	11,923 (21.1)	4.7	8.0	25.4	8.7
	Government employee	4,002 (3.2)	8.9	4.2	16.4	4.9

who reported dual use (5.3%) were dropped from the interaction analyses. We further tested for differences in the wealth and educational gradients between the different tobacco products. We accounted for the sampling design and the sample weights [27] by using the "survey" command in Stata, version 11.1 (StataCorp, College Station: TX). All p-values reported are from Wald's tests.

3. Results

Overall 69,296 respondents participated in the GATS with a response fraction of 91.8% (GATS, 2010). We excluded 266 respondents (0.038%) who did not report socioeconomic status (SES) information, leaving 69,030 respondents for the analysis. The sociodemographic profile of the participants is described in Table 1. About half of the sample were male, almost half were 15–30 years of age, 70% were from rural areas, and 31% had no formal education.

The prevalence of current SLT use (20.5%) was much higher than the prevalence of cigarette smoking (2.8%), bidi smoking (5.7%), and dual use (5.3%) (Table 1). These differences were more pronounced for females than for males and in rural compared with urban areas. Compared with other tobacco products, use of smokeless tobacco was much more prevalent among 15–17 year olds. The prevalence of current SLT use varied significantly with educational attainment and wealth. While SLT use, bidi smoking, and dual use were inversely associated with wealth, cigarette smoking was positively associated with wealth. Similarly, the prevalence of current cigarette smoking was positively associated

with education while prevalence of SLT use was inversely associated with education. Compared with other occupational groups, homemakers, students, and retirees had much lower prevalence for any type of tobacco use (Table 1).

Table 2 shows results of the multinomial logistic regression analyses. Wealth was positively associated with cigarette smoking both crudely and after adjustment for demographic factors. The association became stronger after adjusting for educational attainment and occupation. The odds ratio for the richest category was 3.86 (95% CI: 2.54–5.86) relative to the poorest group. Bidi smoking, SLT use, and dual use were inversely associated with wealth after adjusting for demographic variables as well as education and occupation. For bidi smoking, after adjusting for education and occupation the odds ratio among poorer groups compared to the richer groups became closer to one while the association between SLT use and dual use with wealth changed a little after adjustment for educational attainment and occupation (Table 2).

Similar to the association between cigarette smoking and wealth, cigarette smoking was positively associated with educational attainment in the unadjusted analysis (Model 1). Without adjustment for wealth, educational attainment was not associated with cigarette smoking (Model 2), but after adjustment, it was inversely related (Model 3). Educational attainment was inversely related to bidi smoking, SLT use, and dual tobacco use. Of the four types of tobacco use, bidi smoking had the strongest association with education after adjustment for wealth and occupation (Table 2).

Government employees had the highest odds ratio for cigarette smoking 3.27 (1.34, 7.99), nongovernment employees had the highest odds ratio 2.00 (1.36, 2.96) for bidi smoking, and self-employed had the highest odds ratio for SLT use 1.60 (1.26, 2.03) compared with those who were unemployed and unable to work. The highest odds for dual use was observed for those unemployed and able to work 2.56 (1.44, 4.54) when compared with those who were unemployed and unable to work (Table 2). All p-values comparing the coefficients for wealth and educational attainment for the different types of tobacco were < 0.001.

The positive association between cigarette smoking and wealth did not vary by region (p interaction = 0.88, Figure 1), while for education there was no association in urban areas but an inverse association in rural areas ($p = 0.03$, Figure 1). For bidi smoking and SLT use, urban and rural regions had similar inverse associations with wealth (bidi, p interaction = 0.23; SLT, $p = 0.80$) and education (bidi, p interaction = 0.05; SLT, $p = 0.09$).

While a positive association was observed between cigarette smoking and wealth for males, an inverse association was observed for females (p interaction = 0.0017, Figure 2). For males, there was little association between cigarette smoking and education, but a strong inverse association for females (p interaction < 0.0001, Figure 2). For SLT, males and females had similar inverse associations with wealth (p interaction = 0.38, Figure 2), but the inverse association with education was stronger for females (p interaction $<$ 0.0001, Figure 2). Too few women smoked bidi smoking to test interactions between SES and gender for this outcome.

4. Discussion

The current study assessed associations of current tobacco use with socioeconomic positions and further studied gender and area wise differences using a nationally representative sample from India. Marked socioeconomic differences in the most prevalent forms of tobacco use (cigarettes, bidi, SLT, and dual use) were observed. While cigarette smoking had positive associations with wealth, inverse associations were observed for bidi smoking, SLT use, and dual use. Consistent positive associations were observed with educational attainment for all three forms of tobacco use and variations were observed in the probability of different types of tobacco use according to different occupational groups. With regard to wealth, bidi smoking showed larger variation according to area of residence when compared with cigarette smoking and SLT use regardless of the direction of the association. Considerable variations according to gender in the socioeconomic (both wealth and education) gradients were observed for cigarette smoking.

Several studies have previously assessed and identified the importance of social determinants of tobacco use both globally and in India [6, 9, 11, 13, 15, 17–19, 28–30]. Of the studies which assessed these inequalities in India, some assessed the socioeconomic differences at a multicountry level [13, 15] while others reported inequalities at national [2, 20, 21] and subnational level [30]. A previous study from India based on data from earlier surveys reported that India is currently between stages II and III of the cigarette epidemic model only for men, but it distinctly differs from the model on the patterns observed for women [18]. Based on the findings of the current study we also observe that it is difficult to classify tobacco use in India under the conventional cigarette epidemic model due to the considerable variations in the socioeconomic gradients by different types of tobacco use.

Consistent with findings of previous studies [19, 23], the current study also observed divergent gradients for cigarette and bidi smoking. The current study further substantiates these findings by showing that, apart from bidi smoking, the SLT and dual use also follow the same pattern. Hence, an obvious interpretation of these findings is that tobacco usage in the Indian subcontinent is very different from that in high income countries as there is ample evidence on social gradients in cigarette smoking from high income countries suggesting higher prevalence of smoking among lesser educated and income groups [31, 32] while these gradients differ according to tobacco products in India and surrounding countries. To some extent this shows that higher disposable income along with stable occupation (e.g., a government job) are predictors of cigarette smoking but not other types of tobacco use, which is comparatively more prevalent amongst the disadvantaged. The positive association of cigarette smoking and educational attainment was reversed after adjustments for demographic and other socioeconomic variables including wealth and occupation highlighting that educational attainment is a strong predictor for all types of tobacco use in India.

A study conducted by Gupta et al., 2012 [24], showed that while dual use is increasingly becoming a concern for tobacco

Table 2: Odds ratios (95% CI) for the association between current tobacco use (smoking, smokeless tobacco, and dual use) and wealth/education (n = 67,988).

	Smoking						Smokeless tobacco			Dual use		
		Cigarettes			Bidi							
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Wealth												
Poorest	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Poor	2.00 (1.35, 2.98)	1.66 (1.11, 2.48)	1.74 (1.16, 2.62)	0.72 (0.63, 0.83)	0.84 (0.72, 0.97)	1.12 (0.95, 1.31)	0.64 (0.58, 0.70)	0.70 (0.64, 0.77)	0.80 (0.73, 0.88)	0.57 (0.48, 0.67)	0.64 (0.54, 0.77)	0.82 (0.68, 0.98)
Middle	3.67 (2.52, 5.34)	2.50 (1.69, 3.68)	2.70 (1.81, 4.05)	0.58 (0.49, 0.70)	0.64 (0.52, 0.78)	1.02 (0.82, 1.26)	0.44 (0.39, 0.50)	0.48 (0.43, 0.55)	0.61 (0.53, 0.69)	0.42 (0.35, 0.51)	0.47 (0.39, 0.58)	0.68 (0.55, 0.84)
Rich	4.94 (3.46, 7.06)	3.14 (2.16, 4.56)	3.38 (2.27, 5.05)	0.38 (0.31, 0.47)	0.41 (0.33, 0.52)	0.81 (0.64, 1.03)	0.30 (0.27, 0.34)	0.32 (0.29, 0.37)	0.44 (0.39, 0.51)	0.35 (0.29, 0.44)	0.39 (0.31, 0.49)	0.65 (0.51, 0.82)
Richest	6.46 (4.52, 9.25)	3.63 (2.49, 5.30)	3.86 (2.54, 5.86)	0.14 (0.10, 0.19)	0.12 (0.08, 0.91)	0.30 (0.21, 0.43)	0.16 (0.14, 0.19)	0.16 (0.14, 0.19)	0.30 (0.21, 0.43)	0.21 (0.16, 0.26)	0.20 (0.16, 0.27)	0.40 (0.30, 0.52)
Education												
No formal education	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Less than primary	2.56 (1.82, 3.60)	1.14 (0.81, 1.61)	0.97 (0.68, 1.39)	1.15 (0.97, 1.36)	0.69 (0.57, 0.84)	0.75 (0.62, 0.92)	0.92 (0.82, 1.02)	0.79 (0.70, 0.89)	0.92 (0.81, 1.03)	1.39 (1.17, 1.65)	0.81 (0.67, 0.97)	0.89 (0.74, 1.07)
Primary but less than secondary	2.67 (1.99, 3.59)	1.14 (0.85, 1.52)	0.88 (0.64, 1.19)	0.48 (0.41, 0.56)	0.30 (0.25, 0.35)	0.35 (0.29, 0.41)	0.60 (0.54, 0.65)	0.51 (0.47, 0.57)	0.67 (0.61, 0.74)	0.75 (0.64, 0.88)	0.39 (0.33, 0.47)	0.47 (0.40, 0.56)
Secondary and above	4.02 (3.02, 5.34)	1.24 (0.93, 1.65)	0.73 (0.53, 1.02)	0.17 (0.14, 0.21)	0.09 (0.08, 0.11)	0.12 (0.09, 0.14)	0.30 (0.27, 0.33)	0.25 (0.22, 0.28)	0.39 (0.35, 0.44)	0.36 (0.30, 0.43)	0.17 (0.14, 0.20)	0.22 (0.18, 0.27)
Occupation												
Unemployed and unable to work	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Unemployed and able to work	2.13 (0.86, 5.25)	2.95 (1.15, 7.58)	2.76 (1.07, 7.10)	0.38 (0.24, 0.60)	1.04 (0.62, 1.75)	1.18 (0.69, 2.01)	0.82 (0.62, 1.10)	1.54 (1.13, 2.08)	1.60 (1.17, 2.18)	1.60 (0.95, 2.69)	2.32 (1.32, 4.06)	2.56 (1.44, 4.54)
Housewife, students, and retirees	0.29 (0.12, 0.68)	1.18 (0.49, 2.84)	0.91 (0.38, 2.22)	0.08 (0.06, 0.12)	0.50 (0.33, 0.74)	0.76 (0.51, 1.14)	0.28 (0.22, 0.34)	0.58 (0.46, 0.75)	0.76 (0.59, 0.96)	0.15 (0.10, 0.22)	0.52 (0.33, 0.84)	0.74 (0.46, 1.20)
Self-employed	2.67 (1.18, 6.06)	2.76 (1.17, 6.52)	2.33 (0.99, 5.50)	0.79 (0.59, 1.07)	1.74 (1.22, 2.48)	1.97 (1.37, 2.83)	0.88 (0.71, 1.10)	1.50 (1.18, 1.91)	1.60 (1.26, 2.03)	1.40 (0.94, 2.08)	1.82 (1.17, 2.82)	2.02 (1.30, 3.14)
Nongovernment employee	3.32 (1.48, 7.45)	3.72 (1.58, 8.76)	3.08 (1.31, 7.26)	0.62 (0.44, 0.86)	1.85 (1.26, 2.71)	2.00 (1.36, 2.96)	0.80 (0.64, 1.00)	1.57 (1.23, 2.01)	1.58 (1.24, 2.01)	1.42 (0.06, 2.10)	2.35 (1.51, 3.66)	2.50 (1.61, 3.89)
Government employee	6.04 (2.60, 14.01)	4.89 (2.03, 11.79)	3.27 (1.34, 7.99)	0.26 (0.17, 0.40)	0.54 (0.33, 0.87)	1.41 (0.85, 2.32)	0.42 (0.32, 0.54)	0.72 (0.54, 0.97)	1.36 (1.02, 1.82)	0.64 (0.39, 1.05)	0.82 (0.48, 1.39)	1.74 (1.02, 2.97)

Model 1: unadjusted estimates. Model 2: adjusted for age, gender, area of residence, and geographic region. Model 3: adjusted for age, gender, area of residence, geographic region, and other socioeconomic variables.

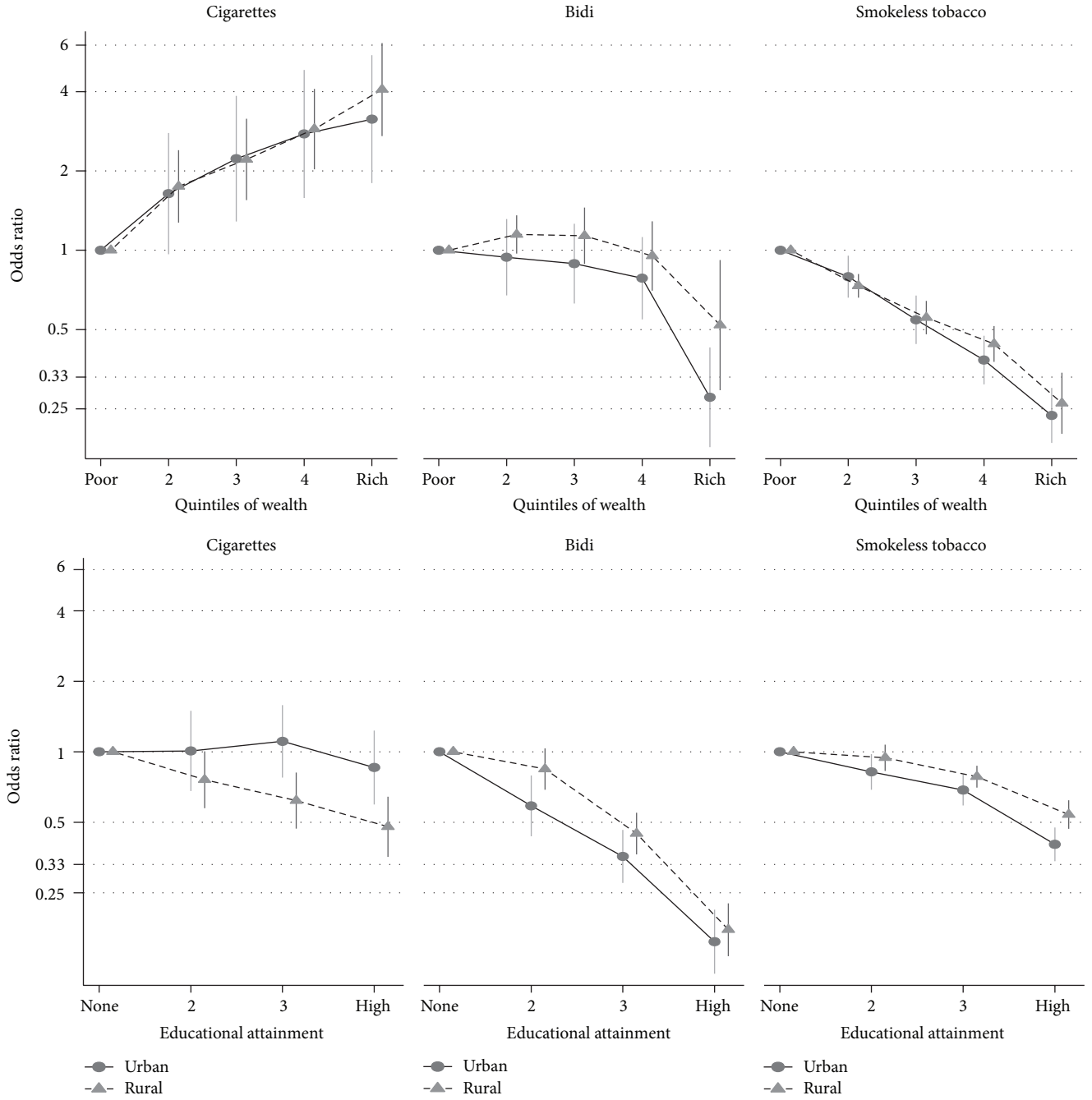

Figure 1: Urban-rural differences in educational and wealth gradients in the relationship between prevalence of cigarette smoking, bidi smoking, and smokeless tobacco use and socioeconomic status in India (odds ratios adjusted for age, gender, area of residence, and education and wealth).

control in India, few studies have attempted to study its determinants. While the current study reports a low prevalence of dual use in India, the consistent inverse wealth and educational gradients show greater vulnerability of the poorer and lesser educated in comparison with their richer and more educated counterparts. Similarly, considering the strong causal associations reported between SLT use and oral precancerous and cancerous lesions and the increasing evidence of its association with other systemic diseases, the current study also indicates that the inverse wealth and educational gradients may lead to health inequalities in the absence of effective tobacco control policies.

Apart from the evidence reported on geographical variations in the social gradients in smoking and SLT use [22], the current study also found variations according to area of residence and gender. The greater vulnerability of poorer and

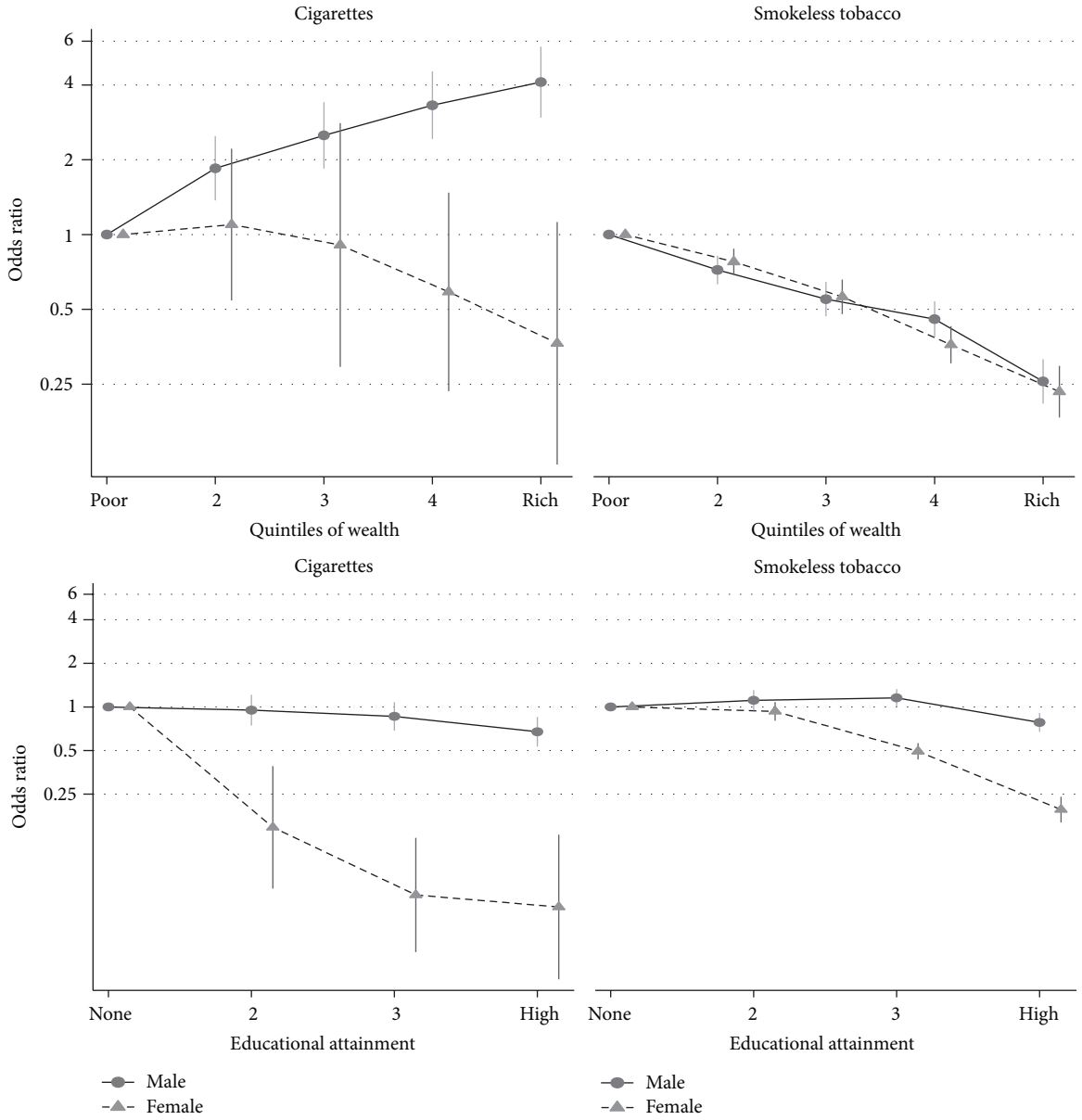

Figure 2: Gender differences in educational and wealth gradients in odds for association between cigarette and smokeless tobacco with socioeconomic status in India (odds ratios adjusted for age, gender, area of residence, and education and wealth).

lesser educated females towards cigarette smoking and SLT use raises important concerns as more health related complications are associated with tobacco use for females when compared with males [33]. Hence, the more disadvantaged females and their families may have to bear a considerable amount of economic burden due to the associated health costs due to tobacco use. These variations in the gradients further point towards the need for future research to study the sociocultural, psychosocial, and material pathways which lead to such health compromising behaviours irrespective of the relative position in the social structure and accordingly frame policies that will reduce demand for tobacco use.

The current study had several strengths and limitations. The study assessed the association of the most prevalent forms of tobacco use with three different measures (wealth, educational-attainment, and occupation). The literature suggests that these measures highlight different underlying socioeconomic processes [34] and the findings from the current study further highlight that different types of tobacco use are associated differently with these socioeconomic attributes. The study also assessed whether these socioeconomic inequalities differ for males and females and also for those living in urban versus rural areas. The current study used multinomial logistic regression, which allowed simultaneous comparisons of different outcome categories. Some limitations of our study could be that the information on tobacco may suffer from social desirability, especially for women as discussed in a previous study [18]. Finally, our

analysis of cross-sectional data does not imply causation of these social factors.

The current study has some interesting findings and important research as well as policy implications. The underlying answers to the social inequalities in different types of tobacco use in India cannot be sought without understanding the sociocultural milieu of tobacco use. Future research using more sophisticated measures of social class and social position [35, 36] may help in understanding the relationship between different types of tobacco use and complex socioeconomic processes. The differences in probabilities for types of tobacco use in different occupational groups underscore the need to understand how these employment relations are driving tobacco use in India. The steep socioeconomic gradients in the SLT use compared with cigarette and bidi smoking build evidence for the Ministry of Health and Family Welfare, Government of India's Gutkha (most prevalent form of smokeless tobacco) ban [37], as a whole population approach to reduce the associated public health burden. With the growing prevalence of dual use of tobacco (5.4%) reported by GATS [10] and the current policy scenario (Gutkha ban) future research studies should be designed to study its underlying determinants. Consistent educational gradients across the population further highlight the need to focus on wider determinants of health and point towards the amalgamation of tobacco control activities in school and college education for further reducing the public health burden of tobacco use. The current results in line with WHO's World No Tobacco Day's 2014 theme [38] support the evidence to increase tobacco taxation across all products as a whole population intervention in order to reduce the tobacco use across the social gradients.

5. Conclusion

In the light of the differences in social gradients according to types of tobacco use in India the findings from the current study point towards the need to combine tobacco control strategies for the whole population and for targeted or vulnerable subgroups while addressing the underlying determinants or "the causes of the causes" [39].

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Research Article

Social Media Use for Public Health Campaigning in a Low Resource Setting: The Case of Waterpipe Tobacco Smoking

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Introduction. Waterpipe tobacco smoking prevalence is increasing worldwide despite its documented health effects. A general belief that it is less harmful than cigarettes may be fuelled by the lack of media campaigns highlighting its health effects. We aimed to create and assess the impact of a social media campaign about dangers of waterpipe smoking. *Methods*. The "ShishAware" campaign included three social media (Facebook, Twitter, and YouTube) and a website. Nine months after launch we collected data to assess use of, and reaction to, our media accounts. *Results*. Requiring limited maintenance resources, Facebook attracted campaign supporters but YouTube attracted opposers. Twitter enabled the most organisation-based contact but Facebook was the most interactive medium. Facebook users were more likely to "like" weekday than weekend statuses and more likely to comment on "shisha fact" than "current affairs" statuses. Follower subscription increased as our posting rate increased. Our YouTube video gained 19,428 views (from all world continents) and 218 comments (86% from pro-waterpipe smokers). *Conclusions*. Social media campaigns can be created and maintained relatively easily. They are innovative and have the potential for wide and rapid diffusion, especially towards target audiences. There is a need for more rigorous evaluation of their effects, particularly among the youth.

1. Introduction

Tobacco smoking using waterpipe—also known as nargileh, hookah, and shisha—is traditional to the Middle Eastern and South Asian region although its prevalence is alarmingly high among school students and university students in the Middle East and among groups of Middle Eastern descent in Western countries [1]. Among high school students in London, the prevalence of waterpipe tobacco smoking was over double that of cigarette smoking (7.6% versus 3.4%) [2], whereas in the US national reports suggest 2.6% of adolescents are current waterpipe users [3].

Studies have found that waterpipe tobacco smoking is significantly associated with lung cancer, respiratory illness, low birth weight, and periodontal disease [4, 5]. There are also possible associations with bladder cancer, nasopharyngeal cancer, oesophageal cancer, oral dysplasia, and infertility [4], which are expected in lieu of the high level of toxicants found in waterpipe tobacco smoke aerosol [6]. In spite of both the proven and suspected deleterious health effects, waterpipe users widely believe it to be less harmful and a safer alternative to cigarette smoking [7, 8]. They believe it contains less nicotine, that the water has filtering properties, and that switching from cigarettes to waterpipe would reduce their health risks [9–11]. In one study, respondents considered that the lack of media campaigns implies that waterpipe smoking must be safer than cigarette smoking [10].

Social media is a popular method of communication and a regular source of information for internet users, including health information [12]. It has been shown to reach wide

audiences; however its position in public health campaigning is relatively new. Importantly, it can be used as a powerful tool for promotion of the tobacco industry [13] yet we remain unsure how best to use social media campaigns for the purposes of prevention [14].

In order to address this emergent public health problem, we have conducted a public health campaign, entitled "ShishAware," to raise awareness about the health risks of waterpipe tobacco smoking. The objective of this paper is to describe the use of social media in conducting this campaign, for tobacco control purposes.

2. Materials and Methods

2.1. Campaign Description. The ShishAware campaign was an unfunded, grassroots initiative which aimed to raise awareness about the health risks of waterpipe tobacco smoking. While the campaign included a number of field activities, it mainly relied on three social media (Facebook, Twitter, and YouTube) and a campaign website. The target audience of the campaign was the local government organisations (through the field activities) but also the wider global community (through the social media). The campaign had no formal funding.

2.2. Campaign Team. The campaign team consisted of two fifth year medical students (Mohammed Jawad and Ahmad Hariri) and a pharmacist (Jooman Abass). The team members initiated the campaign and worked on it on a volunteer basis. They did not have any formal training in using social media but were experienced through their personal use.

Accurate and relevant health information was sought by conducting a literature review on waterpipe tobacco smoking, prioritising systematic reviews and peer-reviewed papers. These were synthesised into "shisha facts"—short, snappy pieces of information, for example, "shisha is just as bad for your lung function as cigarettes (Raad et al., 2011)" [5]. We also posted current affairs information by using the online content retriever "Google Alerts," a service which automatically scans for new online news articles based on specific key words [15], and these were screened for newsworthiness.

2.3. Development of Social Media. Facebook and Twitter accounts were created in less than an hour, and ShishAware posted "shisha facts" and global news articles, as well as general communication posts with its audience. ShishAware was advertised by posting content on other, related social media accounts. It caught the attention of a local government in London, who collaborated on a waterpipe tobacco smoking awareness video for young people and invited ShishAware to speak at meetings, youth workshops and conduct lesson plans for fifteen local high schools. The video was designed by young people and its content included background information on waterpipe smoking, excerpts from interviews with (i) young people who had just attended a workshop on waterpipe smoking, (ii) an ex-waterpipe smoker, who detailed reasons for cessation, (iii) one of the ShishAware members, who explained the aims of this campaign, and (iv) general public. It ended with information on the health effects of waterpipe smoking and maintained an "It's your choice" message throughout. The video can be found at https://www.youtube.com/watch?v=sWTgzJGzGv4. No methods were used to promote the waterpipe tobacco smoking awareness video. The website was created using WordPress, a user-friendly, free website-building program with the help of other team members, and included evidence-based information.

2.4. Evaluation of the Campaign. ShishAware underwent a process evaluation by looking at longitudinal usage data at three, six, and nine months. This included page traffic, page views, unique trends, and views. We also performed descriptive analyses for our posts and used the number of "likes" and comments as proxies for popularity. Facebook provided a database of user interaction and hence allowed for more detailed analyses than Twitter or YouTube.

3. Results

On Facebook, ShishAware posted 130 status updates over nine months (14.4 posts per month), yielding 214 user "likes" and 70 comments. ShishAware had 520 users subscribed at month three, 672 at month six and 776 users at month nine. The majority of users were from the UK (63.9%), male (54.2%), and predominantly aged between 18 and 24 years (63.2%). Sixty-eight and a half percent of status updates had at least one "like"; 23.1% had at least one comment from users. After using an independent samples t-test, users were more likely to comment on "shisha facts" than current affairs items (M = 0.29 (SD = 0.70) versus M = 0.10 (SD = 0.31); $P < 0.05$). Longitudinally, there was a strong, positive correlation between the number of weekly active users (as calculated by Facebook) and our weekly posting rate ($r = 0.71$, $n = 273$, $P < 0.001$) and between our weekly posting rate and the page's weekly subscribing rate ($r = 0.54$, $n = 273$, $P < 0.001$).

On Twitter, ShishAware "tweeted" 373 times, averaging 1.4 "tweets"/day. Our longitudinal "tweeting rate" declined over time, from 2.2 "tweets"/day from months 0–3 to 1.1 "tweets"/day from months 3–6 and then to 0.8 "tweets"/day from months 6–9. ShishAware accumulated 563 followers and mainly "tweeted" about current affairs (73.2%). 8.0% of our "tweets" were "retweeted" and nearly two thirds of these (63.0%) were "tweets" mentioning waterpipe tobacco smoking health effects. Other users interacted with ShishAware 70 times (using the notation "@shishaware"), one of which was from a journalist that interviewed ShishAware in person and broadcast the interview on a Somali satellite channel.

On YouTube, ShishAware's video accumulated 7,041 views in six months, and by nine months it had gained 19,428 views. At nine months it gained 69 "likes," 67 "dislikes," and 218 comments (112.2 comments/10,000 views) (not including ShishAware's comments), 188 (86%) of which were from pro-waterpipe tobacco smoking individuals. It was also "favourited" by 28 users. YouTube statistics revealed that 76% of viewers were male, and 41% were aged 18 to 34 years, and viewers were from all world continents.

4. Discussion

ShishAware was successful in that it was able to reach its target audience, the young, global online community. Not only was ShishAware able to interact with these users on social media, but its campaign resulted in in-person collaboration with a local government organisation and a media interview. ShishAware was able to discern between the types of users for each medium: Facebook attracted supporters of the campaign, YouTube attracted those against the campaign, and Twitter attracted a more balanced mixture of both as well as larger organisations and waterpipe tobacco smoking businesses.

ShishAware also learnt about the suitability of interaction for each medium: Facebook was more suited to more intermittently posted, short health facts and had more interaction with users, whereas Twitter was more suited to daily, external links and current affairs news. The more users joined the Facebook campaign the more active ShishAware was. ShishAware's YouTube video reached the most users (about 20,000) in nine months with no promotional advertising and produced a rich array of user comments that give insight into future improvements of the campaign.

One of the strengths of this case is the use and linkage of multiple social media to reach a young population that may not be as easily reachable through other media. This serves to reduce inequalities in access to healthcare information. ShishAware was also the first public health initiative to produce a social media campaign focussed solely on waterpipe tobacco smoking. ShishAware showed that, with no funding and resources, it was able to engage with the online community and also with the local community in person. The major limitation of ShishAware is the lack of evidence beyond process data. For example, there are no data on the effects on awareness, knowledge, and attitude of media users, let alone data on starting or quitting waterpipe tobacco smoking. More evaluative methods are needed for social media, including the need to measure the quality of health campaigns.

Social media tools for health promotion and education can be broad and varied, ranging from the mainstream tools mentioned in this paper to others such as message boards, e-Games, widgets, and wikis [16]. Large organisations such as the Center for Disease Control (CDC) have a multitude of Facebook Pages and Twitter accounts, each with a substantial number of subscribers. For example, CDC eHealth is dedicated to the use of social media in health promotion that local public health professionals should be made aware of (http://www.cdc.gov/metrics/reports/).

The public campaign for the 2011 World Aids Day (http://www.worldaidsday.org/) is another example of the use of social media in public health campaigns. The public was encouraged to participate by posting pictures of themselves wearing the symbolic red ribbon onto the World Aids Day Facebook page [17]. This example shows how a sense of public attachment was created through user interaction.

We recommend the following: healthcare organisations aiming at raising awareness about waterpipe tobacco smoking should consider social media as an adjunct for healthcare communication. Social media account creation and maintenance should involve its target audience, to take advantage of interlinking social networks and thus attract its target audience, as in ShishAware's case. Responsibility of social media maintenance should rotate across individuals to avoid burnout and enhance interaction variety—something ShishAware probably suffered from. If funding is available, healthcare organisations should seek advertising their campaigns online and developing high-quality videos to expand their reach. A website should be created to allow posting of larger volumes of text, images, and files as a supportive tool to a campaign. Planning stages of social media development should consider setting up intervals of evaluation to monitor progress.

5. Conclusions

Social media campaigns are feasible, can be relatively resource nonintensive, and are likely to be effective in raising health awareness. Future studies should assess the effects of social media campaigns on awareness, knowledge, and attitude of media users and ideally the effects on starting or quitting waterpipe tobacco smoking. Researchers need to develop and explore the research methodology and outcome assessment tools for these new types of public health interventions. Further research is needed on validating health information on social media to ensure health messages are accurate and reliable.

Conflict of Interests

The authors declare no conflict of interests.

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Research Article

Social Inequality in Cigarette Consumption, Cigarette Dependence, and Intention to Quit among Norwegian Smokers

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Background. The study aim was to examine the influence of education and income on multiple measures of risk of smoking continuation. *Methods*. Three logistic regression models were run on cigarette consumption, dependence, and intention to quit based on nationally representative samples (2007–2012) of approximately 1 200 current smokers aged 30–66 years in Norway. *Results*. The relative risk ratio for current versus never smokers was RRR 5.37, 95% CI [4.26–6.77] among individuals with low educational level versus high and RRR 1.53, 95% CI [1.14–2.06] in the low-income group versus high (adjusted model). Low educational level was associated with high cigarette consumption, high cigarette dependence, and no intention to quit. The difference in predicted probability for having high cigarette consumption, high cigarette dependence, and no intention to quit were in the range of 10–20 percentage points between smokers with low versus those with high educational level. A significant difference between low- and high-income levels was observed for intention to quit. The effect of education on high consumption and dependence was mainly found in smokers with high income. *Conclusion*. Increased effort to combat social differences in smoking behaviour is needed. Implementation of smoking cessation programmes with high reach among low socioeconomic groups is recommended.

1. Introduction

While smoking rates among countries across the Western world are gradually decreasing, concerns over social inequality in smoking behaviour are increasing. Many studies have found an association between smoking behaviour and different measures of socioeconomic status (SES) such as education, income, and occupational class [1–3]. Smokers with low SES also have poorer cessation outcomes. This inequality pattern has been observed in studies of smoking cessation interventions and aggregated-level quit rates [4–6]. There is also some evidence of increasing social inequality in smoking behaviour and substantial health disparity consequences [7, 8].

In Norway, smoking rates are gradually declining, with a rate of 22% in 2014 in the adult population aged 16–74 years (13% are daily smokers). Norway has a strong welfare system and strives to be an egalitarian society that provides equal opportunities for all citizens. Despite reduced mortality in all educational groups, educational inequality in mortality increased in Norway in the period 1960–2000 [9]. Smoking is one mechanism behind this inequality [10]. Increased knowledge about social inequality in smoking behaviour can inform tobacco prevention efforts.

The pathways to successful quitting have been widely studied. Nicotine dependence is regarded as a primary barrier to giving up smoking and is predictive of smoking continuation [11]. Number of cigarettes per day (CPD) has often been used as a proxy for nicotine dependence, although some studies indicate that one should be cautious in interpreting high cigarette consumption as nicotine dependence. CPD is significantly associated with nicotine dependence, but differences in dependence are found to be independent of CPD level [12]. However, high cigarette consumption indicates a strong habit and illustrates aspects of dependence such as the time and effort the smoker dedicate to the behaviour [13].

Nicotine dependence has been widely measured in population-based surveys using different measurements like the Fagerström Test for Nicotine Dependence (FTND) and associated short versions such as the Heaviness of Smoking Index (HSI) and time to first cigarette in the morning (TTFC). The TTFC is likely the single item in the FTND

that most strongly predicts addiction to nicotine, probably because morning smoking reflects the smoker's overnight withdrawal symptoms [14]. TTFC also shows good correlation with biological measures of nicotine ingestion [15].

The FTND, TTFC, and number of CPD are all predictive of smoking continuation and significantly associated with relapse following a quit attempt [16, 17]. Having an intention to quit smoking is strongly associated with quit attempts but is less consistent with quitting success [18].

Measures of nicotine dependence such as the FTND, HSI, and TTFC are significantly related to SES and show increasing dependence with decreasing SES [17, 19, 20]. The association between nicotine dependence and SES is also found in studies using biochemical measures of dependence, such as levels of cotinine in plasma [21].

However, the association between intention to quit and SES is less clear. Some studies report a positive relationship between low-SES smokers and intention to quit or quit attempts but reduced smoking cessation success among low-SES smokers [6, 22]. Other studies investigating the transtheoretical model of change report a higher proportion of smokers with a low educational level in the precontemplation stage (i.e., a smoker who does not intend to quit) [23, 24].

Norway is in the final stage of the tobacco epidemic, experiencing both a gradual decline in smoking prevalence and persistent inequality in smoking habits. In this situation, it is of interest to investigate differences in smoking behaviour that indicate smoking continuation. Risk of continued smoking is defined in three ways: high cigarette consumption, high cigarette dependence, and having no intention to quit. The aim of this study was to investigate the associations between education and income and risk of high cigarette consumption, cigarette dependence, and intention to quit. Because education and income are related, it was of interest to explore the combined effect of social inequality measures on risk of smoking continuation.

2. Method

2.1. Study Sample. Data were pooled from six cross-sectional datasets representative of the Norwegian population during 2007–2012. Approximately 1 200 respondents aged 16 years or older were surveyed by telephone during the autumn of each year by Statistics Norway. The study sample was 4 591 respondents aged 30–66 years. The lower age cut-off for inclusion was 30 years because younger adults may not have completed their education. A study sample aged 30 years or older also represents a population of individuals with an established smoking history, since more than half of daily smokers start smoking before age 18. Individuals who received early retirement pensions ($n = 197$) were excluded from the study sample, along with 89 individuals with missing education information. Survey response rates were 67% (2007), 57% (2008), 61% (2009), 54% (2010), 58% (2011), and 61% (2012).

2.2. Dependent Variables: Cigarette Consumption, Cigarette Dependence, and Absence of Intention to Quit. Three measures were used to capture risk of smoking continuation: cigarette consumption, nicotine dependence, and intention to quit. High *cigarette consumption* was defined as consumption of 15 CPD or more. Occasional smokers with an average weekly consumption above 105 were coded in the +15 CPD group. *Cigarette dependence* was the time to first cigarette in the morning (TTFC); individuals smoking within the first 30 minutes after awakening were defined as having high cigarette dependence and individuals who smoked 31 minutes or more after wakening had low cigarette dependence [14]. Although TTFC is most often referred to as a measure of *nicotine dependence*, it also captures nonpharmacological aspects of cigarette dependence such as psychosocial functions [13]. The term *cigarette dependence* is therefore preferred in the present study. Having no *intention to quit* was a measure of smokers' short- or long-term intention to quit; smokers with no intention to quit within the next 6 months and who also believed they would still be smoking in 5 years were defined as having no intention to quit.

2.3. Socioeconomic Measures: Education and Income. Two measures of SES were included as independent variables: educational level and income level. Educational level was recoded from the original nine-level variable to three levels: completion of lower secondary, upper secondary, and university levels. For the interaction analysis, we used a dichotomous measure of education with *high educational level* including completion of upper secondary school or university and *low educational level* representing completion of lower secondary school. Income was defined by combining the gross household income and marital status. Those with an annual household income above the median (NOK 700 000, ≈USD 160 000 or more) were coded in the high-income group. Medium income was NOK 300 000–699 000 (≈USD 36 000–50 000) and low income was below NOK 300 000. Those with a household income of NOK 300 000–699 000 and living alone were coded as having high income. In the study sample, 12% were in the low-income group (7% of the population sample, see Table 1). This is comparable to the percentage defined as having low income in Norway using the EU definition of 60% of median income [25].

2.4. Analyses. Data analyses were conducted in two parts. First, the representative sample was used to confirm socioeconomic differences in smoking status. For the multinomial regression, the smoking outcome category was defined as current and former smokers, with nonsmokers as the reference category. Results from this analysis are presented as a relative risk ratio (RRR) in Table 2. The characteristics of the population sample and study sample of all current smokers (daily and occasional smokers) are presented in Table 1. The logistic regression analysis included three binary outcomes reflecting risk of smoking continuation (cigarette consumption, cigarette dependence, and intention to quit), with education and income as independent variables. The models were adjusted for survey year, age, sex, and numbers of household members. Three logistic models were used to compute adjusted prediction (predicted probabilities) of the

Table 1: Characteristics of the population and study samples (current smokers). Participants aged 30–66 years. Data were pooled from 2007 to 2012.

	Population sample ($N = 4\,600$)	n	Study sample (current smokers, $n = 1\,282$)	n
Age (mean, SD)	47.7 (10.2)	4 600	47.7 (9.7)	1 282
Male (%)	49.1	2 260	49.9	640
Educational level				
High	39.1	1 798	23.7	304
Medium	43.7	2 008	47.4	607
Low	17.3	794	28.9	371
Household income				
High	66.9	2 849	60.1	701
Medium	25.9	1 105	27.8	324
Low	7.2	308	12.2	142
Daily smokers (%)	20.4	937	73.1	937
Heavy smoking ≥15 CPD	7.9	365	28.5	365
TTFC ≤30 minutes	9.3	423	34.3	423
No intention to quit	7.1	327	25.7	237

Table 2: Adjusted multinomial regression for education and income according to smoking status with never smoker as reference group. Relative risk ratio (RRR) and 95% confidence interval. Bivariate and adjusted models.

	Model 1: bivariate relationship Never smoker = ref.		Model 2: adjusted for survey year, age, sex, and members of the household Never smoker = ref.	
	Current smoker	Former smoker	Current smoker	Former smoker
High education	Ref.	Ref.	Ref.	Ref.
Medium education	2.59 (2.21, 3.06)***	1.92 (1.63, 2.25)***	2.53 (2.12, 3.02)***	1.75 (1.47, 2.08)***
Low education	5.66 (4.61, 6.95)***	2.31 (1.84, 2.89)***	5.37 (4.26, 6.77)***	2.05 (1.59, 2.65)***
High income	Ref.	Ref.	Ref.	Ref.
Medium income	1.44 (1.22, 1.70)***	1.44 (1.22, 1.71)***	1.07 (0.89, 1.29)	1.16 (0.97, 1.40)
Low income	2.76 (2.12, 3.59)***	1.17 (0.84, 1.64)	1.53 (1.14, 2.06)**	0.84 (0.58, 1.21)

***$P < .001$, **$P < .01$, *$P < .05$.

outcomes across the SES measures and marginal effects (differences in predicted probabilities) between different levels of SES (Table 3). Marginal effects show how the outcome changed for each change in the categorical independent variable. Marginal effects are estimated as average marginal effects, which means that other variables in the model are used *as observed* for each case. Tables 4 show the predicted probability for each combined group of education and income using the margins command (education # income) and the delta method was used to examine the statistical significance of group comparisons [26]. Only dichotomous measures of education and income were used for the combined effect (high versus low). All analyses were conducted using Stata statistical software (v.13).

3. Results

The proportion of individuals with low educational level (28.9%) was higher in the study sample of current smokers than in the population sample (17.3%) (Table 1). The proportion with low income level was 12.2% in the study sample and 7.2% in the population sample. One out of four current smokers reported having high cigarette consumption and no intention to quit, while one out of three reported having high cigarette dependence. Social inequality in smoking behaviour was confirmed. Educational differences were present in both the bivariate and the adjusted models, with RRR of 5.37, 95% confidence interval [4.26–6.77] for current compared with never smokers in the low educational level (Table 2).

Table 3: Adjusted predicted probabilities and marginal effects (differences in predicted probabilities) of the outcomes high consumption, high cigarette dependence, and no intention to quit smoking by education and income. All variables included in each model, in addition to survey year, age, sex, and number of persons in household. Current smokers aged 30–66 years. Data were pooled from 2007 to 2012.

	High consumption $N = 1\,147$ Percent (95% CI)		High cigarette dependence $N = 1\,105$ Percent (95% CI)		No intention to quit $N = 1\,142$ Percent (95% CI)	
	Adjusted predicted probability	Marginal effects (difference in predicted probability)	Adjusted predicted probability	Marginal effects (difference in predicted probability)	Adjusted predicted probability	Marginal effects (difference in predicted probability)
Education						
High	17.9 (13.2, 22.6)	Reference	19.8 (14.7, 24.8)	Reference	19.1 (14.2, 24.1)	Reference
Medium	29.8 (26.1, 33.5)	11.9 (5.9, 18.0)***	36.3 (32.2, 40.3)	16.5 (10.0, 23.0)***	25.0 (21.4, 28.5)	5.9 (−0.2, 12.0)
Low	33.3 (28.1, 38.4)	15.4 (8.2, 22.5)***	39.0 (33.5, 44.4)	19.2 (11.6, 26.8)***	30.6 (25.6, 35.6)	11.5 (4.3, 18.7)**
Income						
High	25.1 (21.8, 28.4)	Reference	29.5 (25.9, 33.1)	Reference	20.8 (17.9, 24.3)	Reference
Medium	35.1 (29.8, 40.3)	10.1 (3.7, 16.3)**	39.3 (33.9, 44.7)	9.8 (3.2, 16.4)**	30.4 (24.8, 35.0)	9.6 (3.5, 15.7)**
Low	26.2 (19.0, 33.4)	1.1 (−7.0, 9.2)	36.6 (28.4, 44.8)	7.1 (−2.0, 16.2)	34.7 (25.1, 42.1)	13.9 (4.8, 23.1)**

***$P < .001$, **$P < .01$, *$P < .05$.

Table 4: Margins (adjusted predicted probability) for high consumption of cigarettes, high cigarette dependence, and no intention to quit by education and income (margins income # education).

Education	Income	High cigarette consumption			n	High cigarette dependence			n	No intention to quit			n
		Margins	Unadjusted groups			Margins	Unadjusted groups			Margins	Unadjusted groups		
High	High	25.7	A		758	30.3	A		725	21.4	A		755
High	Low	26.7	A	B	76	34.2	A	B	74	31.8	A	B	76
Low	High	35.9		B	252	39.7		B	247	30.6		B	252
Low	Low	26.2	A	B	61	40.9	A	B	59	40.3		B	59

Margins sharing a letter in the group label are not significantly different at the 5% level.

A significant association between income and current smoking was observed in the bivariate model. In the adjusted model, the RRR for current smoking was 1.53, 95% confidence interval [1.14–2.06] in the lowest compared with the highest income group.

Table 3 presents three separate logistic regression models for the outcome variables high cigarette consumption, high cigarette dependence, and having no intention to quit. Adjusted predicted probabilities for the outcomes of interest are presented for each SES group. Among current smokers, the probability of high cigarette consumption, high cigarette dependence, and having no intention to quit increased with reduced educational level (Table 3). The marginal effect shows a 15 percentage point increase between the highest and lowest educational groups in the predicted probability of having high cigarette consumption. The marginal effect of education on cigarette dependence showed a 19 percentage point increase.

Income produced somewhat different results than educational level, with the highest probability of the outcomes of high consumption and high cigarette dependence among those with medium income level. Low-income smokers had the same probability of being a high-consuming smoker as the high-income group, 26% and 25%, respectively (Table 3). The probability for cigarette dependence for high-, medium-, and low-income groups was 30%, 39%, and 37%, respectively.

Having no intention to quit was significantly associated with low educational level and low or medium income (Table 3). The adjusted predicted probability that a smoker with a low educational level would have no intention to quit was 31%, while the corresponding percentage for smokers with a high educational level was 19%.

Table 4 presents the adjusted predicted probabilities for the outcome variables for every combination of high and low educational levels and income. The education effect for the outcome cigarette consumption and cigarette dependence was only found among those with high income. There was a 10 percentage point difference in the probability of having a high cigarette consumption and being highly dependent on cigarettes between the highly educated with high income compared with those with a low educational level with high income (Table 4). A 10 percentage point difference was also found for cigarette dependence between those with high levels of both education and income compared with those with low levels of both education and income ("top-bottom" differences), but the difference did not reach statistical significance. An educational effect among the high-income smokers was

also found for no intention to quit smoking, with a 9 percentage point difference. A significant "top-bottom" difference for having no intention to quit smoking was also observed, with a 19 percentage point difference in predicted probabilities. For example, a smoker with high educational level and high income had a predicted 21% chance of having no intention to quit smoking, while the corresponding number for a smoker with low educational level and low income was 40%.

4. Discussion

This study revealed a strong association between education and the outcomes indicating risk of smoking continuation: high cigarette consumption, high cigarette dependence, and having no intention to quit. Low income had an independent effect on intention to quit. The effect of education was only valid for those defined as having a high-income level. There was a 10–20 percentage point difference between high and low education level in relation to probability of high consumption, dependence, and no intention to quit.

Several studies confirm the importance of education for lack of smoking cessation and risk of smoking continuation [5, 19, 21, 27]. Possible explanations for the strong influence of education on smoking have included knowledge and cognitive resources, social networks, number of smokers and social norms regarding smoking in the social environment, health literacy, psychosocial stress, and health risk perceptions [28–30]. It has been suggested that education creates a culture that discourages smoking [31]. Being in a culture where smokers are in the minority and where norms against smoking dominate may make it easier for someone who smokes to quit. Stronger no-smoking norms among those with greater education may explain some of their lower risk of smoking continuation.

The strong association between education and smoking continuation may be ascribed to the association between delay discounting/impulsivity and education; several studies show that less educated individuals choose smaller, immediate rewards over larger, delayed rewards [32, 33]. This means that smoking would be valued more highly than future health. Current smokers discount delayed rewards more than never and former smokers and are more nicotine dependent than less dependent smokers, even when controlling for education [34, 35]. However, the association between education/income and nicotine dependence is stronger than the association between delay discounting and nicotine dependence [35]. A Norwegian study of adolescents found that both education and impulsivity predicted smoking initiation, but only education (not impulsivity) predicted smoking cessation. No interaction between education and impulsivity on smoking cessation was found [36].

The somewhat stronger relationship between education and smoking behaviour compared with income and smoking behaviour may vary by country [37]. Income had a curvilinear impact on high consumption. The high price of cigarettes in Norway may explain the low probability of high cigarette consumption in the low-income group, a finding in line with studies showing that low-SES groups are sensitive to increasing cigarette taxes [38]. However, this does not explain the low consumption levels among the high-income group in this study. Having low income may reduce cigarette consumption, but being financially deprived does not necessary imply an increased motivation to quit smoking.

Increases in the price of or tax on cigarettes are seen as having the most consistent positive impact, for example, the greatest potential to reduce inequality in smoking behaviour [38]. Interventions such as compulsory and national smoke-free policies and control on advertising, promotion and marketing of tobacco are regarded as having a positive or neutral impact; here, a neutral impact means that the effect would be equal regarding SES [38]. Norway scores relatively high on the cigarettes price score (20 out of 30 points) in the tobacco control scale in Europe [39]. Further tax increases are seen as problematic due to fear of increased cross-border trade with subsequent lost tax revenue and smuggling. Smoke-free legislation was introduced in Norway in 2004, with positive health effects among employees in the hospitality industry [40]. The impact of national smoke-free policies on reducing inequalities is found mainly in reduced social inequalities in passive smoking (nine out of 19 studies) [38]. Smoke-free legislation is expected to reduce the social acceptability of smoking, thereby contributing to the ongoing process of smoking denormalization. Whether denormalization processes have the same impact regardless of social status is unclear and highly debated (cf. the smoker stigma debate [41]).

Tobacco control interventions such as price/taxation increases and sales restrictions are considered highly effective because they affect most people. The population-level cessation support in Norway, with the exception of individual media campaigns that have been launched earlier, comprises a national quit line and a web site for smoking cessation support hosted by health authorities. Call rates to the quit line are higher among high-SES groups than low-SES groups and these SES differences are stable over time [42]. A study evaluating the Norwegian quit line is currently in progress. More intensive smoking cessation services implemented through the health care service with special focus on deprived areas have shown positive effects in reducing social inequality in smoking in England [43]. Reaching proportionally more low-SES smokers than high-SES smokers may compensate for the lower quit rates usually found in socially disadvantaged groups of smokers.

The present study results are consistent with others and show the need to increase motivation to quit and assist nicotine-dependent low-SES smokers to quit smoking. In addition, the present study has disentangled the effect of two SES measures (education and income) on three separate indicators of prolonged smoking. The results show substantial differences in motivation to quit between those with both high educational level and high income, compared with those with both low educational level and low income.

Many Western countries including Norway have made substantial progress in reducing smoking prevalence over the last two decades but have been unable to decrease social inequality in smoking behaviour. New population-based interventions are currently being debated, including plain packaging and harm reduction strategies such as use of electronic cigarettes. Given the high mortality rate from cigarette

smoking and its contribution to health inequality, interventions that reduce smoking rates in low-SES populations are needed. However, few population-based interventions with an equity impact beyond those already identified, including price and tax increases, exist. A report from the Royal College of Physicians states that harm reduction strategies, such as electronic cigarettes, may have a potential role in preventing deaths from cigarette smoking and reducing social inequalities in smoking-related morbidity and mortality [44]. Further investigation on the potential role of electronic cigarettes to reduce social inequality in smoking is needed, both to assess their potential for helping nicotine-dependent smokers to quit as well as their potential to increase motivation to quit among smokers unwilling to quit smoking.

Limitations

The cross-sectional design of this study makes it impossible to deduce causation. The validity of the outcome variables requires attention. Having high cigarette consumption, high cigarette dependence, and no intention to quit were used as indices of risk for smoking continuation. This is consistent with several studies reporting these measures in relation to unsuccessful cessation among hardcore smokers. In a longitudinal study, the predictive ability of high consumption, high dependence, and intention to quit was investigated in relation to continued smoking after 1 year. All components predicted smoking continuation, but nicotine dependence was the best predictor of smoking continuation [16].

Conflict of Interests

No conflict of interests exists.

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Research Article

Smoking Cessation and Socioeconomic Status: An Update of Existing Evidence from a National Evaluation of English Stop Smoking Services

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Smokers from lower socioeconomic groups are less likely to be successful in stopping smoking than more affluent smokers, even after accessing cessation programmes. Data were analysed from 3057 clients of nine services. Routine monitoring data were expanded with CO validated smoking status at 52-week follow-up. Backwards logistic regression modelling was used to consider which factors were most important in explaining the relationship between SES and quitting. The odds ratio of stopping smoking among more affluent clients, compared with more disadvantaged clients, after taking into account design variables only, was 1.85 (95% CI 1.44 to 2.37) which declined to 1.44 (1.11 to 1.87) when all controls were included. The factors that explained more than 10% of the decline in the odds ratio were age, proportion of friends and family who smoked, nicotine dependence, and taking varenicline. A range of factors contribute to lower cessation rates for disadvantaged smokers. Some of these can be modified by improved smoking cessation service provision, but others require contributions from wider efforts to improve material, human, and social capital.

1. Introduction

In this paper, we explore why smoking cessation rates among lower socioeconomic status (SES) smokers are poorer than those of higher SES smokers. The study focuses on adults who accessed stop smoking services in England. To contextualise our work, we first introduce SES and the relationship between SES and health. Using data collected from services, we then explore the relationship between SES and smoking, smoking cessation, and behavioural support.

SES can be described as the position of a person in the structure of society due to social or economic factors [1]. There is no single measure of SES [1] but SES embodies an array of resources: material capital such as money and goods, human capital such as skills, knowledge, prestige or power, and social capital—beneficial social connections [2–4]. Building upon Coleman's Social Theory [4], Oakes and Rossi [3] suggest that SES should be assessed through measures of material capital including measures of income and housing status [3], measures of human capital including measures of education and occupation [3] and measures of beneficial social connections such as measures of marital status and two parents rather than a single parent [1].

These material, human and social resources can be deployed in order to promote health [2, 3]. The theory of fundamental causes [2] posits that SES can be a cause of poor health because it can be persistent over time and it influences multiple disease outcomes, through disease risk factors and mechanisms. These include demographic differences, psychological factors, access to medical care, social environment, exposure to carcinogens and pathogens, CNS and endocrine response, and health behaviours [5]. Health behaviours have been found to be an important mechanism: together, smoking, physical activity, and consuming alcohol

have been found to explain 68% [6] of the mortality difference between low SES groups. Tobacco use alone has been found to be responsible for 50 to 65% of the difference in mortality rates based on socioeconomic status [7, 8]. This is because smoking rates are higher among those with lower SES in the majority of developed countries [9] and also in many low and middle income countries [10]. Despite an overall decline in smoking rates in the developed world, declines have been slower or nonexistent amongst disadvantaged groups, thus increasing inequalities [11–18].

Smoking prevalence may decline through lower uptake of smoking and through smoking cessation. However, disadvantaged smokers have higher rates of uptake and lower rates of successfully stopping [19–25] and findings from studies examining SES and intention to quit are inconsistent [23, 26]. It appears that, in England at least, recent declines in prevalence may be more to do with reduced uptake rather than increased quitting with quit rates possibly even declining among more disadvantaged groups [17]. Therefore, in order to improve the chances of current smokers successfully stopping, we need to increase our understanding of why low SES smokers find stopping smoking more difficult and use this to inform policies and interventions. A recent review [10] concludes that some disadvantaged smokers have more stressful lives due to material hardship (or in other terms less material capital): psychological differences and greater dependence on tobacco coupled with less motivation to quit (even when they have embarked on a quit attempt) and a higher rate of smoking among family and friends (or less social capital related to smoking).

SES differences in quit rates have also been observed in studies of smoking cessation interventions [27–29]. Reviews of the evidence suggest that the most promising tobacco control interventions to reduce smoking rates among disadvantaged smokers are fiscal measures, in particular tobacco taxation. However, there is also evidence to suggest that individual level smoking cessation programmes providing a combination of both pharmacotherapy and structured behavioural support have some success among disadvantaged smokers [30–32]. Smoking cessation quit rates are poorer for disadvantaged smokers but this can be mitigated by focusing resources on these communities [30]. In countries where smoking cessation services are widely available and have successfully targeted disadvantaged groups (such as in the UK) [33], inequalities have not yet declined although they may have stabilised [34, 35]. Ideally, however, quit rates would be similar in all social groups so it would be helpful to find out why there are differences between socioeconomic groups taking part in such programmes.

In a previous paper [36] we used data from two longer term evaluations of Stop Smoking Services in the UK to examine the relationship between SES and quitting. The main factor associated with an unsuccessful quit attempt amongst disadvantaged clients, in addition to dependence and social networks, was not adhering to treatment (a stop smoking programme including access to medication and behavioural support). However, it is possible that inclusion of adherence in the model in our study was merely a reflection of quitting given that clients who relapse would tend to stop taking medication and attending sessions; this would imply that adherence differences may be masking underlying reasons for the difference in quit rates between disadvantaged and more affluent smokers. Thus, a new analysis is needed using more recent data.

The purpose of this paper is threefold. First, to explore whether material, human, and social capital-related indicators of SES are associated with smoking cessation amongst clients of smoking cessation services in England, second, to explore which material, human, and social capital related predictors of cessation are associated with SES, and third, to explore whether predictors of cessation explain why there is a relationship between SES and successfully stopping smoking.

2. Methods

2.1. Data. This paper reports results from a prospective cohort study involving longer term follow-up of smokers accessing Stop Smoking Services in England (ELONS) [37]. All clients were offered behavioural support delivered by trained advisors based on national guidelines and pharmacotherapy (NRT and varenicline) during their quit attempt. About 5% of clients who attended nine services (Bristol, County Durham and Darlington, Hull and East Riding, Leicestershire County and Rutland, North and North East Lincolnshire, Northamptonshire, Oldham, Rotherham and South East Essex) between March 2012 and March 2013 were enrolled. Data from the 3057 clients who were enrolled to the ELONS study were included in the analysis.

Stop smoking service practitioners were asked to recruit clients to the study. If clients consented to be part of the study, monitoring data collection was enhanced compared with normal practice. Clients were asked to set a quit date and if they reported to their practitioner that they were quit at four weeks, they were followed up at 52 weeks by a social research company (TNS-BMRB) through a telephone interview. If they reported they did not quit they were assumed to be relapsed at 52 weeks. Clients lost to follow-up were also coded as smoking in an intention to treat approach.

If clients indicated that they quit they were asked to complete a carbon monoxide (CO) breath test during a home visit and whether they had smoked since their quit date. The outcome variable was CO validated continuous abstinence but clients were allowed to have smoked up to five cigarettes. Data collection complied with the Russell standard commonly used in smoking cessation studies [38–41].

Weighting was undertaken to correct for nonresponse. In order to create the weights, the research team acquired anonymised routine monitoring data on all quit attempts (with quit dates) that took place at the nine study sites from March 2012 to March 2013 (the months where any ELONS client set a quit date). Applying weights enabled quit rates to be generalizable to all clients who were supported by the nine services that took part in ELONS. The weights were trimmed rim weights which were provided by TNS-BMRB and took into account behavioural support type, age, gender, and SES (measured by NS-SEC [42]). Note that the "other/unclear" group of behavioural support in ELONS was too small for

weighting so quit attempts in this group were redistributed to either the nearest group or the group of which they were most likely to be a member (three quit attempts to GP practice service and the remainder to one to one specialist). We intended to also weight for location (study site) but there were large differences in proportions recruited by location which led to instability in the weighting and so the decision was made to exclude this. As an alternative, quit rates were calculated taking into account clustering by location. The software used to create these weighted quit rates was Stata [43]. Note that wide confidence intervals resulted from the weighting procedure as found elsewhere when the variance between groups is large [44, 45].

2.2. Measures. Two measures of SES were already included in routine monitoring data collection: eligibility for free prescriptions (a measure of income) and economic status (through NS-SEC [42] which codes type of occupation for respondents with a job and reasons for not working for others). Through the enhanced monitoring data, three more SES indicators were collected: housing tenure, highest educational qualification, and household type. These were added because they are common measures of SES and they correspond to material capital, human capital, and social capital, respectively. To derive a composite measure of SES, the five indicators of SES were divided into two categories, one of which included clients who were disadvantaged according to that indicator. The disadvantaged categories were social or private renter, eligible for free prescriptions, routine or manual occupation or unemployed or permanently sick, basic (GCSE) or no educational qualifications, and single parent household. The number of these disadvantaged characteristics possessed by each client was counted. Clients possessed between zero and five of these characteristics. This count of indicators was dichotomised into more affluent (zero to one indicators) and more disadvantaged (two to five indicators). The low cut off point was chosen for two reasons. First, some population groups were only affected by some indicators; for example, all clients aged sixty or more were eligible for free prescriptions and men are less likely to be single parents. Second, this cut point provided adequate sample sizes for analysis.

Demographic variables included age, gender, and ethnicity. Age at first contact was included in the analysis. Ethnicity was categorised as white British, other white, Asian (including mixed white and Asian) and other. To assess wellbeing, following standard practice, the WHO-5 Wellbeing scale [46] items were converted to a percentage. Thus, a score of 0 indicates the lowest wellbeing and a score of 100 represents the highest wellbeing.

Stop Smoking Services' behavioural support provision can either be provided through "specialist" or "level 2" services by trained practitioners. Specialist practitioners are directly employed by the stop smoking services and only provide stop smoking support. Level 2 services involve staff employed by other organisations (chiefly GP practices and pharmacies) who provide stop smoking support alongside their other duties. The behavioural support types analysed were specialist groups, specialist drop ins, specialist one to one, level 2 GP practice/pharmacy service (note this is chiefly one to one), and other/unknown.

Seasonality effects were included because our previous work [47] suggested that the success of quit attempts varied throughout the year with quit attempts in the new year being particularly successful. Such effects were analysed in this analysis through the time of year that a quit attempt started. Quit attempts which started during the main summer holiday period, the postsummer holiday "back to school" period and the new year were differentiated from those starting at other times of year. Medication was operationalised by whether or not clients had taken varenicline at week one. NRT was not differentiated because of multicollinearity with behavioural support (due to site choices of types of medication and behavioural support provision provided). Varenicline at week one was measured because abstinence from smoking was strongly associated with higher numbers of records of smoking medication and clients who had more records had more opportunity to change medication.

Initial analysis of dependence showed that high daily consumption and smoking within five minutes of waking were associated with low quit rates. However, there was not a linear relationship between either of these variables and quitting. Thus, the Heaviness of Smoking Index (HSI) was only of borderline significance in preliminary analysis [37] and concerns arose that the true importance of being dependent might be missed if the HSI was used to represent dependence so instead a dichotomous variable was used: clients who smoked >30 cigarettes per day or who smoked within five minutes of waking were coded as dependent and contrasted with all other clients.

Clients who stated that their spouse or partner was supporting them during their quit attempt were also differentiated from other clients as were clients who indicated that half, a few, or none of their friends and family smoked.

2.3. Analysis

2.3.1. Which Markers of SES Predicted Smoking Cessation? To provide an understanding of the components of our composite measure of SES, weighted quit rates (and 95% confidence intervals) were calculated for each of the five markers of SES: eligibility for free prescriptions, NS-SEC, housing tenure, educational qualifications, and household type.

2.3.2. Which Predictors of Cessation Were Associated with SES? Elsewhere [37], we have used multivariate logistic regression to model significant predictors of CO validated quitting 52 weeks after clients set a quit date. Here, we have calculated weighted disadvantage rates (and 95% confidence intervals) for each categorical characteristic that predicted quitting and weighted means of more affluent and more disadvantaged clients (and 95% confidence intervals) for the characteristics operationalised through continuous variables. We also present weighted quit rates and weighted means of quitters and nonquitters (and 95% confidence intervals).

Table 1: Distribution and CO validated quit rates among SES indicators.

	N	%	% CO validated quit at 52 weeks (weighted)
NSSEC–economic status			
Routine and manual occupations*	939	30.7	6.5 (4.7 to 8.9)
Managerial/professional and intermediate occupations	716	23.4	9.3 (6.0 to 14.0)
Sick/disabled and never worked/long term unemployed*	660	21.6	6.8 (4.7 to 9.9)
Other (e.g., retired)/unknown	742	24.3	8.5 (6.6 to 10.8)
Highest educational qualification			
Basic (GCSE) or none*	1452	47.5	7.1 (5.5 to 9.3)
Other (e.g., vocational)/unknown	1000	32.7	8.2 (5.8 to 11.6)
A level or degree	605	19.8	8.6 (6.0 to 12.1)
Eligibility for free prescriptions			
Free*	1433	46.9	6.3 (5.1 to 7.9)
Pays	1080	35.3	8.4 (6.1 to 11.4)
Outside relevant age range (19–59) or unknown	544	17.8	9.7 (7.6 to 12.5)
Housing tenure			
Social/private renting*	1487	48.6	6.1 (4.9 to 7.4)
Other/unknown	316	10.3	4.1 (1.3 to 12.6)
Owner occupier	1254	41.0	10.8 (9.3 to 12.5)
Household type			
Single parent*	309	10.1	5.1 (2.3 to 10.9)
Married/cohabiting and children	664	21.7	9.4 (5.8 to 14.8)
No children in household	1832	59.9	7.9 (7.0 to 8.9)
Other/unknown	252	8.2	4.7 (1.6 to 13.3)
Total	3057	100.0	7.7 (6.6 to 9.0)

*These categories were included in the count of markers of disadvantage.

2.3.3. Did Any Predictors of Cessation Explain Any of the Relationships between SES and Abstinence from Smoking? SPSS version 22 was used for regression analysis. Confounders for the relationship between SES and cessation were identified by the following procedure. First, SES was entered alone into a logistic regression model predicting quitting and the odds ratio of more affluent clients (compared to more disadvantaged clients) was noted. Second, design variables (behavioural support type) were added to the model. These reflected differential recruitment and the model would not provide generalizable results without their inclusion. Again the odds ratio of more affluent clients was noted. Third, all other variables that had previously been identified as significant predictors of cessation [37] were entered and the odds ratio of more affluent clients was noted. Then, each significant predictor in the full model was removed in turn and the odds ratio of more affluent clients was noted.

The difference between the odds ratio of more affluent clients in the design variable model and the final model was calculated. The threshold for a variable being a confounder between SES and quitting was set as reducing the difference by more than 10%.

3. Results

3.1. Which Markers of SES Predict Smoking Cessation? Quit rates by each marker of SES are presented in Table 1 in order to explore the components of our composite measure of SES. Confidence intervals overlapped for all economic status groups, suggesting differences were not significant; we could not be sure the difference found would be similar in the population, although clients with managerial/professional and intermediate occupations did have higher quit rates. Clients with routine and manual occupations or who were unemployed or permanently sick had similar (lower) quit rates.

Confidence intervals overlapped for all education categories (again suggesting differences were not significant) but quit rates were in the expected direction: clients with basic or no qualifications had the lowest quit rates and clients with A levels or tertiary education had the highest. Clients eligible for free prescriptions had the lowest quit rates. The highest quit rates were for those outside the relevant age group, possibly because older clients, who may also have reached the age where they become eligible for free prescriptions in England, irrespective of income, are more likely to stop smoking. Confidence intervals did not overlap between clients living in rented accommodation and clients who lived in owner occupied housing suggesting that the latter clients were significantly more likely to quit. Confidence intervals overlapped between all household types suggesting no significant differences. Clients who did not answer this question or had a nonspecified household type were least likely to stop smoking followed by single parents. Note that only ten percent of the sample could be categorised as single parents.

Table 2: ELONS 52-week weighted CO validated quit rates (percents and weighted 95% CI), weighted means of age and wellbeing (and weighted 95% CI) by key variables*.

	N	%	% CO validated quit at 52 weeks (95% CI) (weighted)	% disadvantaged (95% CI) (weighted)
SES				
0-1 indicators of disadvantage	1123	36.7	10.3 (8.4 to 12.7)	0
2–5 indicators of disadvantage	1934	63.3	6.2 (5.0 to 7.7)	100
Behavioural support				
Group specialist	652	21.3	12.1 (10.5 to 13.8)	57.5 (46.8 to 67.6)
Drop in specialist	887	29.0	7.6 (5.1 to 11.0)	70.3 (63.7 to 76.2)
One to one specialist	1131	37.0	10.2 (7.6 to 13.7)	64.1 (55.0 to 72.2)
GP practice/pharmacy service	366	12.0	5.1 (2.8 to 9.3)	60.1 (53.7 to 66.2)
Other or unknown	21	.7	Not available	Not available
Time of year of quit attempt				
Other months	767	25.1	7.0 (5.2 to 9.4)	61.7 (55.3 to 67.6)
Summer: July, August	970	31.7	6.3 (4.4 to 8.9)	64.3 (56.4 to 71.5)
Back to school: September, October	1128	36.9	8.7 (6.4 to 11.7)	65.6 (61.1 to 69.8)
New Year: January, February	192	6.3	13.1 (5.1 to 29.6)	51.5 (29.5 to 73.0)
Age (in years)			*Not quit 43.3 (42.5 to 44.1)*	*2–5 disad.* 41.2 (39.7 to 42.7)
(weighted mean)			*Quit 46.8 (44.4 to 49.2)*	*0-1 disad.* 47.7 (45.5 to 49.9)
Gender				
Female	1710	55.9	7.2 (6.0 to 8.5)	64.0 (59.6 to 68.2)
Male	1347	44.1	8.4 (6.8 to 10.2)	62.4 (56.1 to 68.3)
WHO_5 Wellbeing			*Not quit 52.7 (51.4 to 53.9)*	*2–5 disad.* 51.3 (47.5 to 55.2)
(weighted mean)			*Quit 59.3 (56.5 to 62.1)*	*0-1 disad.* 56.4 (52.5 to 60.3)
Medication in week 1				
Varenicline not recorded	1661	54.3	6.2 (4.9 to 7.7)	66.3 (60.7 to 71.5)
Took varenicline	1396	45.7	10.0 (7.2 to 13.8)	58.8 (50.8 to 66.4)
Dependence				
Other	1681	55.0	9.8 (7.7 to 12.4)	57.9 (53.2 to 62.4)
Highly dependent	1376	45.0	4.9 (2.9 to 8.2)	70.5 (65.9 to 74.7)
Support from spouse partner				
Other	1507	49.3	6.2 (4.5 to 8.5)	67.1 (60.7 to 72.9)
Support from spouse/partner	1550	50.7	9.2 (7.4 to 11.3)	59.6 (54.3 to 64.6)
Friends and family				
Other	771	25.2	3.4 (2.6 to 4.4)	75.2 (66.5 to 82.3)
Half or fewer smoke	2286	74.8	9.1 (7.5 to 10.9)	59.5 (55.3 to 63.6)
Base	**3057**	**100**	**7.7 (6.6 to 9.0)**	**63.3 (58.7 to 67.6)**

*Significant differences in SES but not quitting by location (not shown).

Thus, the only marker of SES where confidence intervals between the highest SES group and the lowest SES group did not overlap was housing tenure. The disadvantaged category with the lowest cessation rate was single parents (weighted quit rate 5.1% (95% CI 2.3 to 10.9)) and the affluent category with the highest quit rate was owner occupiers (weighted quit rate 10.8% (95% CI 9.3 to 12.5)).

The cessation rates of the more affluent smokers and disadvantage smokers (from the derived variable where indicators of disadvantage were counted) are presented in Table 2. Confidence intervals of the cessation rates for affluent and disadvantaged smokers did not overlap (more affluent 10.3% (95% CI 8.4 to 12.7) and more disadvantaged 6.2% (95% CI 5.0 to 7.7)) suggesting a significant difference between SES groups.

3.2. Which Predictors of Cessation Are Associated with SES? Before analysis to find intermediate variables on the pathway between SES and smoking cessation, bivariate relationships between each candidate with firstly quitting and secondly SES should be considered. The quit rates and rates of disadvantage for each characteristic are presented in Table 2.

Confidence intervals overlapped, suggesting no significant difference, for the following variables: behavioural support type and location (there were more disadvantaged clients

Table 3: 52-week adjusted odds ratios (and 95% CI) by key variables and OR (95% CI) of disadvantaged SES is models varying the entry of other variables.

	Adjusted odds ratios in full model	Odds ratio (95% CI) of CO validated quitting for low SES clients (2 to 5 indicators of disadvantage) compared to more affluent clients (0 to 1 indicators of disadvantage)
SES only entered		1.93 (1.51 to 2.47)
Design variable* model		1.85 (1.44 to 2.38)
SES		
0-1 indicators of low SES	1.4 (1.1 to 1.9)	1.44 (1.11 to 1.87)
2–5 indicators of low SES	1	
Age (in years)*	1.011 (1.002 to 1.020)	**1.52 (1.18 to 1.97)**
Gender		1.43 (1.10 to 1.86)
Female	1	
Male	1.2 (0.9 to 1.5)	
Seasonality		1.43 (1.10 to 1.86)
Other months	1.2 (0.8 to 1.7)	
Summer: July, August	1	
Back to school: September, October	1.2 (0.9 to 1.6)	
New Year: January, February	1.7 (1.0 to 2.9)	
Wellbeing	1.007 (1.0003 to 1.013)	1.47 (1.13 to 1.91)
Dependence		**1.50 (1.15 to 1.94)**
Other	1.5 (1.1 to 1.9)	
Highly dependent	1	
Support from spouse partner		1.47 (1.14 to 1.91)
Other	1.0	
Support from spouse/partner	1.4 (1.0 to 1.8)	
Social network		**1.50 (1.15 to 1.95)**
Other	1.0	
Half or fewer smoke	2.0 (1.4 to 2.9)	
Medication		**1.49 (1.15 to 1.93)**
Varenicline not recorded	1	
Took varenicline	1.7 (1.3 to 2.3)	

*Design variable model includes behavioural support type and location due to differential recruitment.
Bold area indicates variable passed the threshold (calculated as 1.48) of being relevant in the relationship between SES and CO validated quitting.

who attended specialist drop-ins and fewer disadvantaged clients among those who attended groups), seasonality (there were fewer disadvantaged clients among those who started their quit attempt in the new year), gender, wellbeing (more affluent clients had higher levels of wellbeing than more disadvantaged clients), medication (fewer disadvantaged clients took varenicline at the start of their quit attempt), and a spouse or partner who supported the quit attempt (fewer disadvantaged clients had a supportive spouse or partner).

Confidence intervals did not overlap, implying significant differences, for the following variables: age (disadvantaged clients tended to be younger), tobacco dependence (disadvantaged clients were more likely to be dependent), and proportion of family and friends (social network) who smoked (disadvantaged clients were less likely to say that half or fewer of their family and friends smoked).

3.3. Did Any Predictors of Cessation Explain Any of the Relationships between SES and Abstinence from Smoking? The odds ratio of stopping smoking for more affluent clients with the design variables only entered besides SES was 1.85 (1.44 to 2.38) (Table 3). This attenuated to 1.44 (1.11 to 1.87) when all other significant predictors of quitting were added. Note that SES is still a significant predictor of cessation. The variables that crossed the threshold suggesting they were important in explaining the relationship between SES and quitting were age (OR of more affluent 1.52 (1.18 to 1.97)), dependence (OR of more affluent 1.50 (1.15 to 1.94)), social network smoking

(OR of more affluent 1.50 (1.15 to 1.95)), and varenicline use (OR of more affluent 1.49 (1.15 to 1.93)).

4. Discussion

Socioeconomic disadvantage has an important role to play in the differences in success rates in stopping smoking between more and less affluent smokers. This study illustrates that these differences remain even when smokers have access to effective treatment services that are free at the point of use. We discuss here the main findings of the study, as well as some of the limitations of the research.

4.1. Main Findings of the Study. In the introduction, we introduced three types of capital pertinent to SES: material capital, human capital, and social capital. We included measures of SES that reflect these. The first area of investigation was the association between these various indicators of SES and cessation. The difference between housing tenures was the most marked of the SES indicators because confidence intervals did not overlap suggesting a significant difference. The two main tenure categories (renting and owner occupation) both contained over 1000 clients and the other/unknown category was one of the smallest. This may have helped strengthen the association. In addition there was a larger gap between the two main tenure categories than the other SES indicators (over four percent gap for tenure compared with less than a two percent gap for education) suggesting the difference was not just due to methodological reasons. Particularly marked differences between housing tenures when compared to other SES indicators has been found elsewhere perhaps because it may reflect cumulative prosperity (wealth over a long time period) [48, 49].

Housing tenure differences appearing more marked than educational differences may suggest that it is material factors that are more important in hindering smoking cessation rather than human capital, cognitive or acquired skill differences between more affluent and more disadvantaged groups. We did not look at cognitive differences in the study but we did look at wellbeing differences. Although wellbeing differences were found in the expected direction they were not as marked as other factors. Our findings may also suggest that material differences were more marked than the social differences (between lone parent and other households, for example). However, the small number of single parents in the study may have reduced the valence of this measure.

In the second part of the study, we considered whether other measured factors might affect the relationship between SES and smoking cessation.

In terms of material capital, even though our method of deriving the composite SES variable was intended to reduce the age bias, age was still the strongest confounder of the relationship between SES and stopping smoking. Internationally, evidence suggests that older people are, in general, wealthier [50] and that younger people were disproportionally affected by the recent global recession [51]. As smokers age the health effects of smoking become more apparent [52] but it might also be the case that younger smokers fail to stop smoking due, at least in part, to the considerable stresses of material hardship.

Human capital includes motivation. In this dataset motivation did not predict cessation in the long term, possibly because more disadvantaged smokers in the study reported higher levels of determination to quit. We found that 64% (95% CI 60 to 68) of more disadvantaged smokers were very or extremely determined to quit compared with 57% (95% CI 51 to 62) of more affluent smokers.

Other human capital-related concepts were important for cessation such as lower dependence on tobacco and taking medication intended to help with stopping smoking. Our results also suggest that more disadvantaged smokers were less likely to quit because they were less likely to be offered or take varenicline (an effective pharmacotherapy) as part of their treatment programme. This may reflect that some of the measures of disadvantage (particularly an economic status of "permanently sick" and qualifying for free prescriptions) are indicators of health disadvantage as well as socioeconomic disadvantage. Smokers with some health conditions have contraindications for varenicline. Conversely, an Australian study using education, income and neighbourhood deprivation as SES indicators found that low socioeconomic status smokers were more likely to take prescription medicine [53]. Another explanation is that practitioners within some services in the study may have been less likely to recommend or offer varenicline to particular groups of clients, although this is not something we were able to explore within the data available to us.

In terms of social capital, the results of the study are similar to previous work that has suggested that having more smokers in social networks (family and friends) may serve as a barrier to smoking cessation [10].

Our analysis of measures of SES suggested factors that reflect material disadvantage may be most important. However, our analysis of factors that confound the association between SES and smoking suggested that human and social issues are also relevant. Although we have split our measures of SES and confounding variables into those that are material, human, and social capital-related, in reality these factors are interlinked. For example, tobacco dependence tends to be higher among smokers with more friends and family who also smoke, perhaps due to higher levels of consumption through time [54].

4.2. Limitations. This study faced a number of limitations. We were only able to recruit a small proportion of eligible service clients in each of the nine areas, primarily because of the consent process required for the study which was at odds with staff being able to introduce the research to all the smokers they saw. We therefore attempted to address this recruitment issue by applying weights to the data. Additionally, although the data came from nine contrasting areas of the England, these areas are not necessarily representative of cessation service clients although we deliberately recruited from areas with varying success rates [37].

Less than 10% of quit attempts in the UK involve the use of cessation services [55] and only 5% of clients attending

nine services were recruited to the study. Thus the evidence in this paper only applies to a small proportion of smokers. Nevertheless, these services are one of the most cost-effective of all healthcare interventions [56] and evidence of the kind outlined in this paper can contribute to expanding the reach and effectiveness of these programmes.

Asking stop smoking service practitioners rather than researchers to recruit may have resulted in a lower response rate due to competing priorities. However, employing the required number of researchers to cover nine areas would have been expensive and was beyond the scope of the study. In addition, we would ideally have used a more formal mediation analysis but given the need for weighting, a dichotomous outcome and multicategory design variables no such methodology was found to be suitable. Furthermore our comparisons of quit rates and rates of disadvantage are somewhat exploratory because we did not undertake formal tests of differences for similar reasons.

The factors included in the modelling were unable to fully explain the relationship between SES and smoking. In future, studies should compare and contrast material, cognitive, and psychological consequences of deprivation for smoking cessation in order to understand how lower SES smokers can be helped to maintain abstinence from smoking in the long term.

5. Conclusion

Findings from this evaluation of longer term outcomes for smokers enrolled in a national cessation service suggest that these types of services face a number of challenges in supporting more disadvantaged smokers to quit. Most of the barriers identified relate to the individual circumstances of these smokers. Services need to be able to identify these factors and, if appropriate, tailor behavioural support to help address them in some measure. In addition, higher levels of tobacco dependence amongst these smokers should be recognised and treated with appropriate provision of and advice around pharmacotherapy including, importantly, use of varenicline where available. There is also an ongoing need to link cessation programmes with wider tobacco control measures that support disadvantaged populations to change behaviour. Some of the more effective policies should focus on how material hardship can be alleviated alongside promoting smoking cessation. Our results also highlight the need for further research, in particular to explore why specific markers of socioeconomic status, such as housing tenure, serve as a predictor of abstinence from smoking after accessing a treatment programme.

Ethical Approval

Ethical approval for ELONS was obtained from NHS Lothian (South East Scotland Research Ethics Committee 2003) in June 2011. All work was conducted in accordance with the Declaration of Helsinki (1964).

Disclaimer

The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the HTA programme, NIHR, NHS, or the Department of Health.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Research Article

Second-Hand Smoking among Intermediate and Secondary School Students in Madinah, Saudi Arabia

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Background and objectives. Second-hand smoke (SHS) is an important public health problem worldwide. The study aimed to estimate the prevalence of SHS exposure and its associated risk factors among intermediate and secondary school students. *Methods*. A cross-sectional study was conducted in 2013 among 3400 students from 34 intermediate and secondary schools in Madinah City, Saudi Arabia. Data about sociodemographic and smoking-related factors and SHS exposure were collected using a self-administered questionnaire. *Results*. Of the 3210 students analyzed, the prevalence of SHS exposure was 32.7% 49.3%, and 25% inside, outside, and both inside and outside the home, respectively. The highest risk of SHS exposure was associated with the adolescent's smoking status, parental smoking, close friends smoking, and family structure. The risk was markedly increased in association with parental smoking for exposure inside the home (OR = 6.49; 95% CI = 5.44–7.73) and with close friends smoking for exposure outside the home (OR = 4.16; 95% CI = 3.54–4.77). The risk of SHS, however, was lower among adolescents having knowledge about smoking and highly educated parents. *Conclusion*. The study revealed a considerably high prevalence of SHS both inside and outside the home among adolescents. Knowledge and beliefs about SHS exposure are the main preventable approach.

1. Introduction

Second-hand smoke (SHS), which is also called environmental tobacco smoke (ETS), is the combination of side stream smoke given off by a burning tobacco product and mainstream smoke exhaled by a smoker [1, 2]. Exposure to SHS can cause heart disease and lung cancer in adults. In children, it is associated with increased risks for acute respiratory infections, middle ear disease, worsened asthma, respiratory symptoms, and slowed lung growth [2–4]. Research indicates there is no safe level of exposure to SHS [2]. Worldwide, 40% of children, 33% of male nonsmokers, and 35% of female nonsmokers were exposed to SHS, according to a 2004 WHO report [5]. In the Kingdom of Saudi Arabia (KSA), a national study conducted in 2008 reported a smoking prevalence of 36% and 3% among male and female adults, respectively [6].

Adolescence is a critical period characterized by psychological and behavioral changes that may affect adolescents' smoking behavior [7]. This makes intermediate and secondary school years a crucial period to study not only smoking prevalence and predictors but also the prevalence and risk factors of SHS during this period.

In developed countries, educating people about hazards of SHS was a focus area for health education efforts [8]. Article 8 of the WHO Framework Convention on Tobacco Control (FCTC) addresses the issue of protecting individuals from the dangers of SHS [9]. KSA is one of the countries that agreed with and became a part of the FCTC. It has implemented restrictions on tobacco use in enclosed places through ministerial decrees. The restrictions include 100% smoke-free hospitals and health care facilities, educational facilities, and governmental facilities [10].

Previous studies in the region showed low awareness about policies related to the framework convention [11], which highlight importance of raising awareness to enhance control efforts.

The Global Youth Tobacco Survey (GYTS) worldwide data indicated that approximately 47% of adolescents who never smoked were exposed to SHS at home, and approximately 48% were exposed to SHS outside households. Those who have been exposed to SHS at home were more likely to initiate smoking than those who were not exposed. Adolescents exposed to SHS in places other than home were more likely to start smoking than those not exposed [12]. In KSA, about 29.5% of adolescents were exposed to SHS at home, and approximately 37.5% were exposed to SHS outside households. Exposure to SHS significantly impacts the lives of people throughout the Eastern Mediterranean Region, as evidenced by a recent retrospective review of the burden of disease [5]. There is a scarcity of data about the prevalence and risk factors of SHS exposure among adolescents in Saudi Arabia. This study aimed to estimate the prevalence of SHS exposure at home and outside the households and to investigate the possible associated risk factors among intermediate and secondary school students in Almadinah Almunawwarah (Madinah) city, Saudi Arabia.

2. Methods

This school-based, cross-sectional study analyzed data collected from 3210 students from intermediate and secondary schools in Madinah City, Saudi Arabia, during the period from the first of January to the first of May of 2013. A multistage, stratified cluster sampling procedure was employed in which schools in Madinah city were divided into strata according to their levels (intermediate versus secondary) and students' sex (male versus female), with the final sample being proportional to the size of the stratum. Within each stratum, cluster sampling was implemented in which the primary sampling unit was the school. Finally, within each selected school, one class from each grade was randomly selected, where all students in the selected class were invited to participate.

The study data were collected through a structured, self-administered, anonymous questionnaire. The questionnaire was based on the Global Youth Tobacco Survey (GYTS) questionnaire [13]. The questionnaire was translated to Arabic and verified by back-translation performed by a different bilingual person. The face validity of the Arabic questionnaire was discussed with public health and tobacco control experts.

The primary calculated sample of this study was 780 students based on averages of the estimated smoking prevalence among school students in previous Saudi studies (20–30%), an assumed precision of 3% and a confidence interval of 95%. To obtain the same level of accuracy in both male and female students as well as in intermediate and secondary schools, the sample size was quadrupled to 3120 students. Accounting for nonresponse, the sample size increases to 3400 students.

Trained public health personnel briefed the students about the study and their participation and asked them to complete the study questionnaire anonymously after giving their consent. The school officials were clearly informed about the aim and scope of the study. Students were informed that participation was voluntary. The confidentiality and privacy of the collected data were ensured throughout the study. Finally, the study protocol was approved by the Ethics Committee at College of Medicine, Taibah University.

Second-hand smoke exposure (the dependent variable) was assessed in the study questionnaire by the following questions: "during the past 7 days, on how many days has anyone smoked inside your home, in your presence?" and "during the past 7 days, on how many days has anyone smoked in your presence, in a public place other than your home?" Exposure to SHS was defined as being exposed to SHS at least one day in the past 7 days, while nonexposure was having never been exposed to SHS in the past 7 days. Finally, the SHS exposure variable was categorized into three categories: at home exposure only, outside households exposure only, and overall exposure. Outside household exposure included SHS exposure in school, public places, social clubs, playgrounds, Internet cafes (Cybercafés), parks, and restaurants.

The independent variables included in this study were (i) sociodemographic characteristics, including age in years, sex (male versus female), school level (intermediate versus secondary), mother's and father's education (no formal education, less than university, university, and higher), and living status (lives with one or both parents versus lives with neither) and (ii) smoking-related factors, including smoking status (smoker versus nonsmoker), parental smoking (none versus one or both parents smoke), close friends smoking (none versus some or all friends smoke), knowledge about smoking from family or school (yes versus no), and belief in the negative effects of smoking (yes versus no).

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 16 [14]. Descriptive statistics were used to estimate the prevalence of SHS, and the chi-square test was used to compare exposed and nonexposed groups by socioeconomic variables. P values ≤ 0.05 were considered as evidence of statistical significance. Multivariate logistic regression analyses were used to investigate the association between SHS exposure and the possible risk factors.

3. Results

The overall response rate in this study was 97.7% (3322/3400), with no significant school-level difference. The response rate was 97.5% (1561/1600) in intermediate schools and 97.8% (1761/1800) in secondary schools. Because of missing data related to the studied variables, a total of 3210 students were included in the study analyses. The prevalence of SHS exposure among the studied adolescents was 32.7%, 49.3%, and 25% at home, outside households, and overall exposure, respectively.

Table 1 presented the characteristics of the studied adolescents by sociodemographic variables and SHS exposure. There were highly significant differences between exposed and nonexposed adolescents regarding nearly all sociodemographic variables. The highest percentage of exposure was among adolescents living with neither parent (71.4%), age >16

Table 1: Characteristics of the studied adolescents by sociodemographic variables and SHS exposure.

Variable	SHS exposure				P value
	Exposed		Not exposed		
	Number	%	Number	%	
Exposure					
Outside household	1049	32.7	2161	67.3	
At home	1584	49.3	1626	50.7	
Overall	801	25.0	2409	75.0	
Smoking status					
Nonsmoker	365	16.8	1811	83.2	0.00*
Smoker or former smoker	436	42.2	598	57.8	
Age (in years)					
<13	213	45.4	256	54.6	
13–16	919	55.5	738	44.5	0.00*
>16	700	64.6	384	35.4	
Sex					
Female	809	51.8	754	48.2	0.00*
Male	1023	62.1	624	37.9	
School grade					
Intermediate	912	52.3	831	47.7	0.00*
Secondary	920	62.7	547	37.3	
Father's education					
No formal education	96	61.1	61	38.9	
Less than university	833	59.6	564	40.4	0.01*
University or higher	903	54.5	753	45.5	
Mother's education					
No formal education	127	55.5	102	44.5	
Less than university	931	58.4	664	41.6	0.33
University or higher	774	55.8	612	44.2	
Family structure					
One or both parents	1767	56.7	1352	43.3	0.00*
Neither	65	71.4	26	28.6	

*Significant difference.

years (64.6%), male (62.1%), and secondary school students (62.7%). Also, the highest frequency of SHS exposure was among adolescents whose fathers have no formal education (61.1%).

Table 2 presents adjusted odds ratios and their 95% confidence intervals for the association between sociodemographic and smoking-related variables and overall SHS exposure (at home and outside household exposures). The highest odds of exposure were associated with parental smoking (OR = 4.95; 95% CI = 4.15–5.90), close friends smoking (OR = 3.71; 95% CI = 3.09–4.33), smoking status of the adolescent (OR = 3.66; 95% CI = 3.06–4.27), and living with neither parent (OR = 2.66; 95% CI = 1.75–4.05). Adolescents' age, sex, and school level were also associated with increased odds of exposure. On the other hand, however, the risk was reduced among adolescents with highly educated parents and those having knowledge about smoking and belief in the harmful effects of SHS.

Table 3 presents the risk of adolescents' exposure to SHS at home. Parental smoking was associated with the highest odds of SHS exposure, with an adjusted OR of 6.49 (95% CI = 5.44–7.73). The smoking status of the adolescent, close friends smoking, and living with neither parent were also associated with increased odds of exposure to SHS at home, with an adjusted OR of 3.11 (95% CI = 2.66–3.63), 2.75 (95% CI = 2.36–3.20), and 2.26 (95% CI = 1.48–3.42), respectively. Parents' education, particularly education of the father, was associated with significantly decreased odds of SHS exposure at home. The risk was reduced, however, among adolescents with a highly educated father and among adolescents with beliefs about the harm of SHS.

Table 4 presents the risk of adolescents' exposure to SHS outside household. The main factors were associated with increased odds of SHS exposure outside household. The odds were increased 4-fold among adolescents who were smokers (OR = 4.12; 95% CI = 3.34–4.60) and those having close friends smoking (OR = 4.16; 95% CI = 3.54–4.77). Other factors found to increase the odds of exposure were parental smoking, age >16 years, living with neither

Table 2: Adjusted odds ratios and their 95% confidence intervals (CIs) for the association between sociodemographic and smoking-related variables with overall SHS exposure.

Factor	Overall SHS exposure		OR*	95% CI
	Exposed $N = 801$	Not exposed $N = 2409$		
Age (in years)				
<13	91	378	**1.00**	**Reference**
13–16	415	1242	1.43	1.24–1.61
>16	295	789	1.61	1.14–2.25
Sex				
Female	377	1186	**1.00**	**Reference**
Male	424	1223	1.14	0.92–1.28
School grade				
Intermediate	398	1345	**1.00**	**Reference**
Secondary	403	1064	1.33	1.09–1.50
Father's education				
No formal education	49	108	**1.00**	**Reference**
Less than university	377	1020	0.76	0.67–0.98
University or higher	375	1281	0.65	0.50–0.87
Mother's education				
No formal education	67	162	**1.00**	**Reference**
Less than university	389	1206	0.82	0.66–1.17
University or higher	345	1041	0.85	0.71–1.20
Family structure				
One or both parents	759	2360	**1.00**	**Reference**
Neither	42	49	2.66	1.75–4.05
Smoking status				
Nonsmoker	365	1811	**1.00**	**Reference**
Smoker or former smoker	436	598	3.66	3.06–4.27
Parents smoking				
Nonsmokers	408	2017	**1.00**	**Reference**
One or both are smokers	393	392	4.95	4.15–5.90
Close friends smoking				
No	265	1552	**1.00**	**Reference**
Some of them smoke	536	857	3.71	3.09–4.33
Knowledge about harmful effects of smoking				
No	593	1731	**1.00**	**Reference**
Yes	208	678	0.89	0.75–1.07
Belief in harmful effects of SHS				
No	311	791	**1.00**	**Reference**
Yes	490	1618	0.71	0.65–0.90

*Each variable is adjusted by the other variables in the table.

parent, being secondary school students, and male sex. The risk of exposure, however, was significantly reduced among adolescents having knowledge about the harmful effects of smoking, with an adjusted risk of 0.68 (95% CI = 0.58–0.84).

4. Discussion

The prevalence of adolescents' exposure to SHS in Madinah, Saudi Arabia, was 32.7% at home and 49.3% outside households, with the overall SHS exposure being 25%. A similar high prevalence of adolescent SHS was also reported in a recent study conducted in Hong Kong [15], in which the prevalence of SHS exposure was 42% among the studied adolescents. The GYTS reported that more than half of the surveyed students worldwide have been exposed to SHS in public places. In the Eastern Mediterranean region, exposure to SHS was 38% inside homes and 46% in public places [16]. In a recent study conducted in Riyadh, Saudi

Table 3: Adjusted odds ratios and their 95% confidence intervals (CIs) for the association between sociodemographic and smoking-related variables and SHS exposure at home.

Factor	SHS exposure at home		OR*	95% CI
	Exposed $N = 1049$	Not exposed $N = 2161$		
Age (in years)				
<13	128	341	**1.00**	**Reference**
13–16	555	1102	1.33	0.96–1.49
>16	366	718	1.36	0.98–1.52
Sex				
Female	520	1043	**1.00**	**Reference**
Male	529	1118	0.95	0.82–1.10
School grade				
Intermediate	544	1199	**1.00**	**Reference**
Secondary	505	962	1.16	0.99–1.34
Father's education				
No formal education	64	93	**1.00**	**Reference**
Less than university	497	900	0.75	0.66–0.86
University or higher	488	1168	0.53	0.42–0.69
Mother's education				
No formal education	84	145	**1.00**	**Reference**
Less than university	527	1068	0.95	0.74–1.15
University or higher	438	948	0.84	0.62–1.11
Family structure				
One or both parents	1002	2117	**1.00**	**Reference**
Neither	47	44	2.26	1.48–3.42
Smoking status				
Nonsmoker	531	1645	**1.00**	**Reference**
Smoker or former smoker	518	516	3.11	2.66–3.63
Parents smoking				
Nonsmokers	539	1886	**1.00**	**Reference**
One or both are smokers	510	275	6.49	5.44– 7.73
Close friends smoking				
No	419	1398	**1.00**	**Reference**
Some of them smoke	630	763	2.75	2.36–3.20
Knowledge about harmful effects of smoking				
No	780	1544	**1.00**	**Reference**
Yes	269	617	0.87	0.73–1.02
Belief in harmful effects of SHS				
No	393	709	**1.00**	**Reference**
Yes	656	1452	0.75	0.69–0.95

*Each variable is adjusted by the other variables in the table.

Arabia, the prevalence recorded was 27.9% for exposure at home and 38.2% for exposure outside household [17]. The higher prevalence of exposure at home and outside household compared to that in the Riyadh study may be attributed to different locations or may be because the Riyadh study has included young adolescent intermediate school students.

In this study, the majority of those in the exposed group were males (55.8%), compared with 44.2% of females. The same result was found in the Riyadh study, where males were exposed to SHS (either inside or outside the home) more than females. Regarding education of the father, the highest frequency of exposure was among those adolescents whose fathers have no formal education (61.1%) and those with less than university educated mothers (58.4%). These findings coincided with the results of a survey study conducted on Malaysian children [18], which found that the highest

Table 4: Adjusted odds ratios and their 95% confidence intervals (CIs) for the association between sociodemographic and smoking-related variables and SHS exposure outside household.

Factor	SHS outside households		OR*	95% CI
	Exposed $N = 1584$	Not exposed $N = 1626$		
Age (in years)				
<13	176	293	**1.00**	**Reference**
13–16	779	878	1.55	1.12–1.74
>16	629	455	2.42	1.74–2.85
Sex				
Female	666	897	**1.00**	**Reference**
Male	918	729	1.70	1.40–2.07
School grade				
Intermediate	766	977	**1.00**	**Reference**
Secondary	818	649	1.74	1.39–1.85
Father's education				
No formal education	81	76	**1.00**	**Reference**
Less than university	713	684	0.92	0.74–1.26
University or higher	790	866	0.88	0.72–1.07
Mother's education				
No formal education	110	119	**1.00**	**Reference**
Less than university	793	802	1.01	0.66–1.79
University or higher	681	705	0.99	0.50–1.24
Family structure				
One or both parents	1524	1595	**1.00**	**Reference**
Neither	60	31	2.12	1.30–3.14
Smoking status				
Nonsmoker	846	1330	**1.00**	**Reference**
Smoker or former smoker	738	296	4.12	3.34–4.60
Parents smoking				
Nonsmokers	1076	1349	**1.00**	**Reference**
One or both are smokers	508	277	2.29	1.94–2.71
Close friends smoking				
No	629	1188	**1.00**	**Reference**
Some of them smoke	955	438	4.16	3.54–4.77
Knowledge about harmful effect of smoking				
No	1207	1117	**1.00**	**Reference**
Yes	377	509	0.68	0.58–0.80
Belief in harmful effects of SHS				
No	530	572	**1.00**	**Reference**
Yes	1054	1054	1.08	0.93–1.24

*Each variable is adjusted by the other variables in the table.

concentration of salivary cotinine (resulting from exposure to SHS) was among children with a middle-school-educated father, and the lowest percentage was for those with a university educated father.

The present study revealed that the highest risk of exposure at home and outside household was associated with parental smoking, close friends smoking, the smoking status of the adolescent, and living with neither parent. A marked risk was observed with parental smoking for SHS exposure at home and with close friends smoking for SHS exposure outside household. Nearly the same results were found in the Raute et al. study [19]. They ranked the risk factors associated with SHS exposure at home as follows: parental smoking (OR = 9.40; 95% CI = 5.32–16.41), followed by close friends

smoking (OR = 2.93; 95% CI = 2.20–3.89), and, finally, the smoking status of the studied adolescents (OR = 2.11; 95% CI = 1.33–3.34).

The odds of adolescent exposure to SHS and specifically outside household were significantly increased among late adolescents (>16 years). Nearly the same results were found by Raute et al. [19], who reported that the age range of 15 to 17 years poses a higher risk for SHS exposure both at home and outside household. Males were also found in our study to have a higher risk of exposure to SHS and specifically to SHS outside household.

Secondary school students were at a higher risk of exposure to SHS both at home and outside household. This finding may be attributed to the higher ages of the secondary school students and more freedom given to them compared with young intermediate school children. The adolescents living with neither parent were at increased odds for overall SHS exposure.

In the present study, the risk of SHS exposure outside household was decreased among adolescents having knowledge about the harmful effects of smoking compared with those having no knowledge. The association between knowledge about smoking health hazards and the risk of SHS exposure was not addressed properly in previous studies, but knowledge was measured among adolescents in some studies [13] and showed that the median percent of students who reported having been taught in school about the dangers of smoking was 50.8%, ranging from 83% in China to less than 30% in some states in India. In Saudi Arabia, a GYTS study conducted in 2007 [17] reported that 58.8% of surveyed students (66.1% among females and 52.9% among females) had been taught in their schools about the dangers of smoking.

The present study revealed a 25% reduction in the risk of exposure to SHS at home among adolescents believing that smoking is harmful. In a Mumbai study [19], there were increased odds of SHS exposure at home among adolescents who had no awareness about the harmful effects of SHS. The perception of harmfulness of exposure to SHS was addressed also in another study [20] as a protective factor for adolescents' initiation of smoking.

The present study has a number of strengths that include being school-based with a relatively large sample size and high response rate among the interviewed students, which supports the robustness of the study findings. Furthermore, the study addressed SHS exposure both at home and outside household. Finally, the results presented in this study were precisely estimated, as indicated by the observed narrow confidence intervals.

However, the limitations of this study should not be overlooked. The data collection in the study was based on self-completion of the GYTS questionnaires. The validation of self-report via biochemical tests was not feasible due to logistical and cultural constraints.

In summary, although Saudi Arabia is considered one of the pioneer tobacco control countries in the region, this study revealed a considerably high prevalence of adolescents being exposed to SHS in Madinah City. One of the main findings of this study was the decreasing risk effect of knowledge about the harmful effects of smoking and beliefs of adolescents that SHS is very harmful. This signifies the need for schools and families to increase awareness of their students towards the hazards of SHS exposure.

The risk of SHS exposure in this study was related to the adolescents' and parents' smoking status. This finding reflects the need to design an appropriate and effective antismoking education program addressing smoking predictors and targeting not only school students but also their friends, families, and school members. SHS exposure is a risk factor to start smoking especially in this critical period in adolescents' life.

Also, the study findings provide a significant alarm to the country authorities regarding the need to adopt more preventive strategies in addition to the present smoking legislation. Adolescents are exposed to SHS inside and outside home, so parental education is of paramount importance. Health advocacy toward adopting smoke-free policies for homes, restaurants, and coffee shops is highly needed. The existing activities conducted in schools in collaboration with tobacco control governmental agencies as well as nonprofit organizations need to be augmented by formal training programs for teachers with outcome monitoring. Finally, in such Moslem communities, mosques appeared to have a crucial role in raising the awareness of youth and their families not only on the harmful effect of smoking, but also on religion's stance on this habit.

Conflict of Interests

The authors declare that they have no competing interests regarding the publication of this paper.

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Research Article

The Adoption of Smoking and Its Effect on the Mortality Gender Gap in Netherlands: A Historical Perspective

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We examine in depth the effect of differences in the smoking adoption patterns of men and women on the mortality gender gap in Netherlands, employing a historical perspective. Using an indirect estimation technique based on observed lung cancer mortality from 1931 to 2012, we estimated lifetime smoking prevalence and smoking-attributable mortality. We decomposed the sex difference in life expectancy at birth into smoking-related and nonsmoking-related overall and cause-specific mortality. The smoking epidemic in Netherlands, which started among men born around 1850 and among women from birth cohort 1900 onwards, contributed substantially to the increasing sex difference in life expectancy at birth from 1931 (1.3 years) to 1982 (6.7 years), the subsequent decline to 3.7 years in 2012, and the high excess mortality among Dutch men born between 1895 and 1910. Smoking-related cancer mortality contributed most to the increase in the sex difference, whereas smoking-related cardiovascular disease mortality was mainly responsible for the decline from 1983 onwards. Examining nonsmoking-related (cause-specific) mortality shed new light on the mortality gender gap and revealed the important role of smoking-related cancers, the continuation of excess mortality among women aged 40–50, and a smaller role of biological factors in the sex difference than was previously estimated.

1. Introduction

It is well known that there are clear sex differences in mortality, with women generally having lower mortality and thus higher life expectancy than men [1]. In many western countries this female advantage in mortality started to increase in the early decades of the 20th century [2, 3] and rose rapidly during the 1950s and 1960s. In the final decades of the 20th century, however, the female advantage started to decline (e.g., [4]). In northwestern Europe, the female advantage in life expectancy at birth is currently about four to five years. In eastern Europe, however, the female advantage continues to be large, at around 10 years [5, 6].

Differences in health-related behaviour/lifestyle have been shown to play an important role in explaining sex differences in mortality. Although biological differences account for about 25% of the sex difference in life expectancy in western European countries [7], the remainder of the gap can in large part be explained by social and behavioural factors (e.g., [3]). Because the role of socioeconomic factors seems to have been limited in western Europe in the late 20th century [8], the majority of the gap appears to be attributable to the earlier adoption among men than women of risky health behaviour [9, 10], including smoking [11, 12], motor vehicle driving [13, 14], substance use, alcohol consumption, and extreme sports [15].

The fact that men are generally more prone to risk-taking than women [16] can be related to their sensation-seeking personality, to the "risk as value" hypothesis, and to the restrictions placed on risk-taking by the cultural context. The size of the gender gap in the adoption of risky behaviour varies as a function of a culture's restrictiveness, the norms for appropriate gender role behaviour [16], and time. Women, in general, however, tend to follow men some decades later in the adoption of risky behaviour. Waldron has offered several hypotheses regarding how the changed position of women in

society led to the adoption of risky health behaviour among women [17]. With the rise in women's labour force participation, women increasingly became exposed to occupational hazards and job stresses, and their levels of independence and personal income grew, which made women more prone and more able to adopt risky health behaviour. But also, the increase in women's labour force participation may have indirectly changed females roles and led to a general liberalisation of norms concerning women's behaviour. Moreover, the interaction of socioeconomic, cultural, and material conditions with fundamental aspects of traditional gender roles may have contributed to the delayed adoption of risky behaviour among women.

An important health-related behaviour with a clear impact on sex differences in mortality is smoking (e.g., [3, 5, 7, 18–21]). Although estimates of the contribution of smoking vary according to the time period and the country studied, McCartney et al. recently estimated that smoking-related causes of death explained 40%–60% of the gender gap in all-cause mortality in Europe in 2003–2005 [5]. Similarly, based on an analysis of 44 European countries over the period 1950/55 to 2005/2009, Luy and Wegner-Siegmundt showed that smoking explained on average more than 40% of the sex difference in life expectancy in 21 of these countries, most of them in western Europe [7].

However, previous studies on the contribution of smoking to the sex gap in mortality were not able to depict the full smoking epidemic because of their limited time range. In addition, most of these studies examined the contribution of smoking to sex differences in all-cause mortality, without exploring the underlying causes of death. Given that smoking is an important, but not the only contributing, factor in the gender gap, it would be helpful to look beyond the role of smoking, as Luy and Wegner-Siegmundt have also recently recommended [7]. Examining the remaining sex difference when the role of smoking is eliminated is one of the most obvious ways of doing this.

In this paper we will analyse in depth the effect of sex differences in the adoption of smoking on the gender gap in mortality in Netherlands. In conducting our analysis, we will (i) adopt a historical perspective, (ii) identify by which causes of death smoking mainly contributed to both the increase and the decrease in the sex difference, and (iii) evaluate the sex difference in nonsmoking-related mortality. Netherlands is particularly interesting given the enormous high smoking prevalence among Dutch men in the past and the relatively late onset of the smoking epidemic among Dutch women.

2. Materials and Methods

To assess the contribution of smoking- and nonsmoking-related mortality to the sex difference in life expectancy at birth for Netherlands, we first obtained life table data, all-cause mortality, and exposure data from the Human Mortality Database for 1900–2009 by year, sex, and single year of age and complemented these data based on death and population numbers from Statistics Netherlands for 2010–2012 [25].

We estimated, for each year, lifetime smoking prevalence and the share of all deaths that can be attributed to smoking (= smoking-attributable mortality fractions) by five-year age groups and sex using the indirect Peto et al., 1992, method [26]. This methodology uses observed lung cancer mortality rates as a proxy for lifetime smoking prevalence, using the fact that almost all lung cancer mortality is due to smoking and combines this prevalence with relative risks of dying from smoking to assess smoking-attributable mortality, thereby taking into account the fact that smoking affects not only lung cancer mortality but also other causes of death.

The necessary lung cancer mortality deaths (ICD3: 47ab; ICD4: 47abc; ICD5: 47abc; ICD6-7: 162-163; ICD8: 162; ICD-9: 162; ICD-10: C33-C34) by age (40–44,45–49, . . . , 80+) and sex were available from 1931 onwards and were obtained directly from publications by Statistics Netherlands for 1931–1949 [27], through WHOSIS (http://www.who.int/health-info/statistics/mortality_rawdata/en/) (update July 2012) for 1950–2009 and from Statistics Netherlands for 2010–2012 [25].

As a first step in the indirect estimation of smoking-attributable mortality, we obtained, for each year and sex, estimates of the proportion of the population exposed to smoking during their lifetime, which we label here as lifetime smoking prevalence by five-year age groups (p_i).

We used the lung cancer mortality data for this purpose but controlled for lung cancer mortality that is not due to smoking, by comparing, for each sex, the obtained age-specific lung cancer mortality rates (r_i^T) with the smoothed age-specific lung cancer rates of the smokers (r_i^{SM}) and the never-smokers (r_i^{NS}) in the American Cancer Study (ACS) CPS-II [26]. More specifically, lifetime smoking prevalence by age group (p_i) is calculated for each year and sex by

$$p_i = \frac{r_i^T - r_i^{\mathrm{NS}}}{r_i^{\mathrm{SM}} - r_i^{\mathrm{NS}}}. \quad (1)$$

Negative results were converted to zeros, while results larger than one were converted to one [28]. We graphed the lifetime smoking prevalence by birth cohort, age, and sex.

As a second step, we estimated for each sex and year the age-specific proportions of deaths attributable to smoking (SAF_i) using the formula of the population attributable fraction: $\mathrm{SAF}_i = p_i(\mathrm{RR}_i - 1)/(p_i(\mathrm{RR}_i - 1) + 1)$, where p_i reflects the obtained estimates of the lifetime smoking prevalence by age group and RR_i, the relative risks of dying from smoking by age group. The RR_i were calculated directly from the all-cause mortality rates for smokers and never-smokers in the ACS CPS-II study [26] and were subsequently smoothed by applying a second-degree polynomial. We reduced the excess risk by 30% to control for the exposure of smokers to other risk factors [28]; that is, we applied $1 + (\mathrm{RR}_i - 1) * 0.7$.

The Peto et al. methodology we used to indirectly estimate smoking-related mortality [26] assumes that the relative risk of dying from smoking—and the difference in the risk faced by males and females—stays the same over time. This assumption can certainly be debated. The methodology is, however, frequently used, and the estimates have been shown to be largely similar to recent regression-based methods [29,

30]. As these regression-based techniques can only be applied to all-cause mortality from 1950 onwards, they were not useful for our more historical perspective, in which we also examine cause-specific mortality, and, indirectly, estimated lifetime smoking exposure.

To assess the role of smoking in more detail, we compared, for each single age, the relative sex differences in mortality for all-cause mortality with the sex differences in nonsmoking-related mortality using the so-called two shaded contour maps [31]. To make the contour map of the ratio of male to female nonsmoking-related mortality, we obtained nonsmoking-related mortality rates for each sex and single year of age (x) by multiplying the all-cause mortality rates (M_x^T) by one minus the smoking-attributable mortality fractions by single year of age; that is, $M_x^{\mathrm{NS}} = M_x^T * (1 - \mathrm{SAF}_x)$. For this purpose, we turned the earlier obtained smoking-attributable mortality fractions by five-year age groups into single-year values using least squares linear regression, with the value for ages 80+ applied to all single ages 83 to 110+.

To examine by which causes of death smoking contributed the most to both the increase and the decrease in the sex difference, we obtained cause-of-death data and divided the cause-specific mortality into smoking-related and nonsmoking-related mortality.

The cause-of-death data for 65 cause-of-death groups were obtained from Wolleswinkel-van den Bosch for 1901–1992 [22] and from Statistics Netherlands for 1993–2012. Based on these 65 causes and their classifications [23], six main cause-of-death groups were constructed: infectious diseases, cancers, cardiovascular diseases, chronic respiratory diseases, external causes, and others. See (1) of the Appendix for the ICD-9 codes used. The cause-of-death data were available by age (age groups 0, 1–4, 5–14, 15–19, 20–49, 50–64, 65–79, and 80+) and sex.

To divide the cause-specific deaths into smoking-related and nonsmoking-related mortality, we used RRs of dying from smoking for the selected causes of death which were based on the unsmoothed cause-specific mortality rates for smokers and nonsmokers from the ACS-CPS II study [26] by sex and by ages 35–39, . . . , 75–79, 80+. We smoothed these values by age by means of a second polynomial. Note, however, that we had to use different starting ages for the regressions, and in some cases we had to set a RR smaller than one to one. See (2) of the Appendix. Again, we reduced the excess risk of the different causes of death by 30% to control for confounding, as suggested by Ezzati and Lopez [28].

To obtain the smoking-attributable mortality fractions (originally 35–39, . . . , 75–79, 80+) for the right age groups (20–49, 50–64, 65–79, 80+), they were regrouped using weights based on mortality for the different age groups for the specific cause of death in 2012 [25].

For infectious disease we did not distinguish between smoking- and nonsmoking-related mortality, because of a lack of information on the RR of dying from smoking for infectious disease. We calculated "other smoking-related mortalities" by subtracting cause-specific smoking-related mortality from total smoking-related mortality.

Using the Arriaga decomposition technique, we decomposed the sex difference in life expectancy at birth into the main contributing causes of death and age groups [32], thereby distinguishing for each cause of death the smoking-related mortality and the nonsmoking-related mortality.

Our approach heavily relies on the quality of the cause-of-death information. For lung cancer mortality, which is very important for the estimation of smoking-attributable mortality, the data quality is generally high because the disease has a straightforward diagnosis. Despite possible changes in diagnosing lung cancer over time, it should be noted that in Netherlands in the late 1920s the cancer statistics obtained already a lot of attention by many specialists [33]. To overcome quality issues for the remaining causes of death, we used large cause-of-death groups that were proven to be consistent over time, according to the meticulous reclassification approach by Wolleswinkel-van den Bosch [23].

3. Results and Discussion

3.1. The Smoking Epidemic in Netherlands. In Netherlands, in the absence of national smoking prevalence data before the 1950s, the start of the smoking epidemic can be estimated using information from the cigar and cigarette industry. The industrial production of cigars and the automation of the production process of cigarettes started around 1880–1885. Between 1914 and 1920 the cigarette industry expanded and cigarettes started to become consumer goods [34].

Data for 1907 in Amsterdam indicate that, among 25,000 schoolboys aged 6–12, more than half smoked, and 74% of the boys aged 11-12 smoked. In other large cities, but also in the countryside, comparable figures were observed [35]. Around this point in time, especially in countries not involved in WWI, the only concerns expressed about smokers in health textbooks were about young male smokers [36]. Also, cigarette marketing campaigns focused only on males [37]. Before WWII, smoking among ordinary women in Netherlands was stigmatised [38].

After 1950, more information on the sex differences in smoking became available. A study among schoolchildren in Amsterdam in 1957 showed that 47% of the boys and 11% of the girls had smoked more than once [35]. The first survey on smoking in 1958 indicated that smoking prevalence was 90% among adult men and 29% among adult women [24] (Figure 1). Whereas among adult men the smoking prevalence was around 90% in all age groups, among women smoking prevalence was highest in the age group 20–34, at 46% [24]. Gadourek observed that it were especially the better educated women who smoked and who consumed more cigarettes [39]. It was a combination of changes in the role and status of women and the promotion by the tobacco industry of smoking as a symbol of emancipation that made smoking by women socially acceptable [40].

Whereas the percentage of men who smoked dropped to 27% in 2012, the percentage among women increased rapidly, rising to 42% in 1967. After 1975 (still 42%), the share declined slowly, falling to around 25% in 2012 (Figure 1). Whereas almost all men started smoking in a period in which the health risks of smoking were not yet known, smoking did not start to become popular among Dutch women until

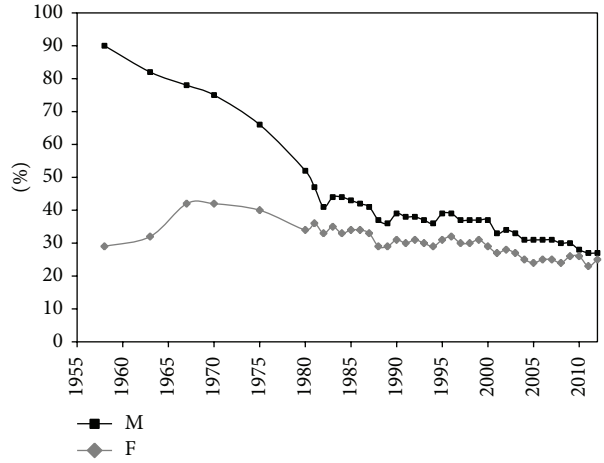

Figure 1: Smoking prevalence (15+) by sex, Netherlands, 1958–2012. Source data: Stivoro (2013) [24]; M = males; F = females.

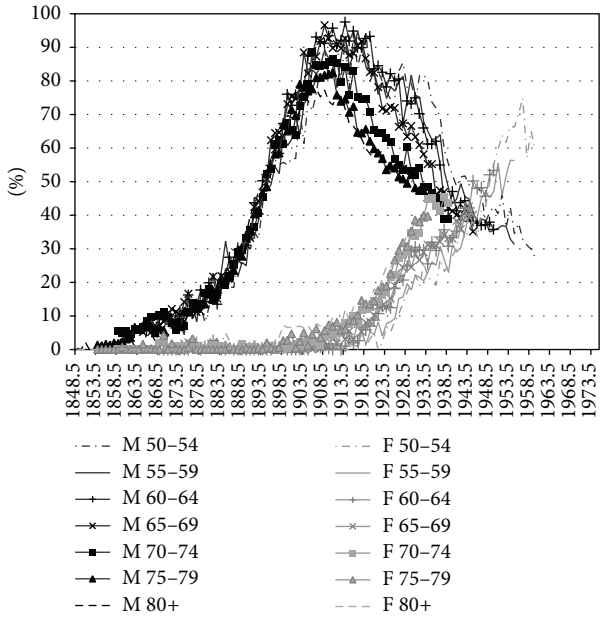

Figure 2: Estimated lifetime smoking exposure by age and sex, by birth cohort, Netherlands, 1931–2012. M = males; F = females.

the 1950s–1960s, when the dangers of smoking were already known [35]. As a result the smoking prevalence among women peaked at much lower levels (42%) as compared to men (90%).

The peak in smoking prevalence among women around 1965–1970 is reflected in a peak in estimated past smoking intensity about 35 years later ((3) of the Appendix), which seems to indicate that the peak in smoking prevalence among men occurred a few years before 1958.

Figure 2 shows the differences between men and women in terms of their estimated lifetime smoking exposure by birth cohort. Also here it can clearly be observed that the smoking epidemic started earlier among Dutch men than among Dutch women. A sharp rise in lifetime smoking exposure can be seen among men born as early as 1850. But among women, lifetime smoking exposure started to increase only from the birth cohort 1900 onwards. Men born between 1895 and 1910 clearly had the highest lifetime smoking exposure, which was demonstrated earlier as well [41]. Also, the increasing tobacco consumption among women born after 1930, who reached adulthood after 1950, was observed before [42].

Comparing the estimated lifetime smoking intensities by age and cohort with the observed smoking prevalence data by five-year age groups and birth cohort (based on data from calendar year 1988 onwards) in (4) of the Appendix, it can be observed that (i) a clear decline in smoking prevalence for men born between 1905 and 1935 occurred, although the observed smoking prevalence levels are much lower than those estimated by means of the past smoking intensities, which is likely because the smoking prevalence data only include current smokers and not previous smokers, (ii) the smoking prevalence for adult men born from 1935 onwards

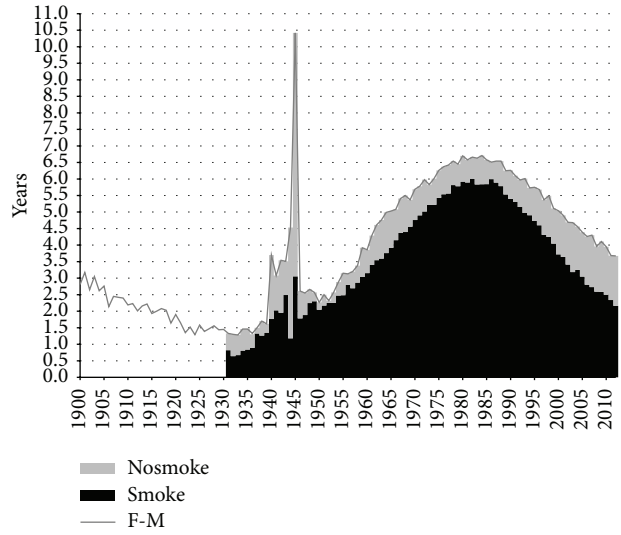

Figure 3: Contribution of smoking- and nonsmoking-related mortality to the difference in life expectancy at birth between men and women, in years, Netherlands, 1900–2012. Nosmoke = nonsmoking-related mortality; smoke = smoking-related mortality. M = males; F = females.

is quite stable at levels around 40%, and (iii) for women the increase for birth cohorts from 1905 up to 1955 and the decline thereafter are clearly in line with the estimated past smoking intensities, although the observed smoking prevalence levels are slightly lower than the estimated smoking intensities. Note, however, that the original sources behind the observed prevalence data differ for calendar years 1958, 1963–1975, and 1979–2012. Only from calendar year 1980 onwards the data are based on a sample size of 10,000 to 20,000 [24]. Also, the smoking prevalence data do not reflect the dosage of smoking, an important factor when estimating the effects of smoking on mortality and health, whereas our indirect estimation of lifetime smoking exposure does.

3.2. Effect of Smoking on the Mortality Gender Gap. Smoking contributed substantially to the sex difference in life expectancy (Figure 3). The female advantage in life expectancy at birth in Netherlands declined from around three years in 1900 to around 1.5 years in the 1920s. From 1931 onwards, when the difference in life expectancy was 1.3 years, the female advantage began to increase substantially. This trend, which lasted until around 1982, resulted in a maximum difference in life expectancy of 6.7 years. From 1982 onwards, the female advantage underwent a strong decline. By 2012, life expectancy was 3.7 years higher for Dutch women than for Dutch men. Whereas smoking contributed just 0.8 years in 1931, this number went as high as 6.0 years in 1982 and 1986, though it subsequently declined to 2.2 years in 2012. The relative contribution of smoking to the sex difference in life expectancy was the highest in 1952, when it reached 98%. The share declined thereafter, falling to 59% by 2012.

When we examined the underlying ratio of male-to-female all-cause mortality rates using a contour map, we found two distinct patterns of male excess mortality (Figure 4(a)). First, a strong increase in excess mortality among men aged 16–26 years occurred since the 1940s. Second, an increase in excess mortality among men occurred at ages above 55 after 1950, reflecting high mortality rates among male cohorts born between 1892 and 1905. In addition, we can see that women actually had slightly higher mortality than men, particularly in the age group 30–40, up to the 1930s. From 1980 onwards, girls had even higher death rates than boys for certain ages up to age of 17.

Whereas accidents and suicide are frequently mentioned as being the main source of excess mortality among men around age 20 [3] and maternal mortality is cited as being the primary cause of excess mortality among women in the age group 30–40 [43], smoking is clearly behind the excess mortality among older men after 1950 as it reflects the high lifetime smoking exposure among Dutch men born between 1895 and 1910. And indeed, when we examine the contour map for nonsmoking-related mortality, the cohort pattern is no longer visible (Figure 4(b)).

When we examine the causes of death and the age groups that are behind the trends in the sex difference in life expectancy, we find that the increase in life expectancy between 1931 and 1950 can already be attributed to smoking-related cancer and cardiovascular disease mortality, even though external mortality and infectious diseases are the most important causes of death in that period (Figure 5, Table 1). Note as well that, in this period, there was actually excess mortality among women for nonsmoking-related cancers—probably due to breast cancer and gynaecological cancers [44]—and nonsmoking-related cardiovascular disease, the latter being in line with observed slightly higher rates of overall cardiovascular disease mortality for Dutch women as compared to Dutch men in this period.

The rapid increase in the sex difference after 1950 is largely attributable to cardiovascular disease and cancer in the age group 65–79. Smoking-related cancer mortality was the main contributor, and the total contribution of cancer mortality was made up of a very strong effect of smoking-related cancer

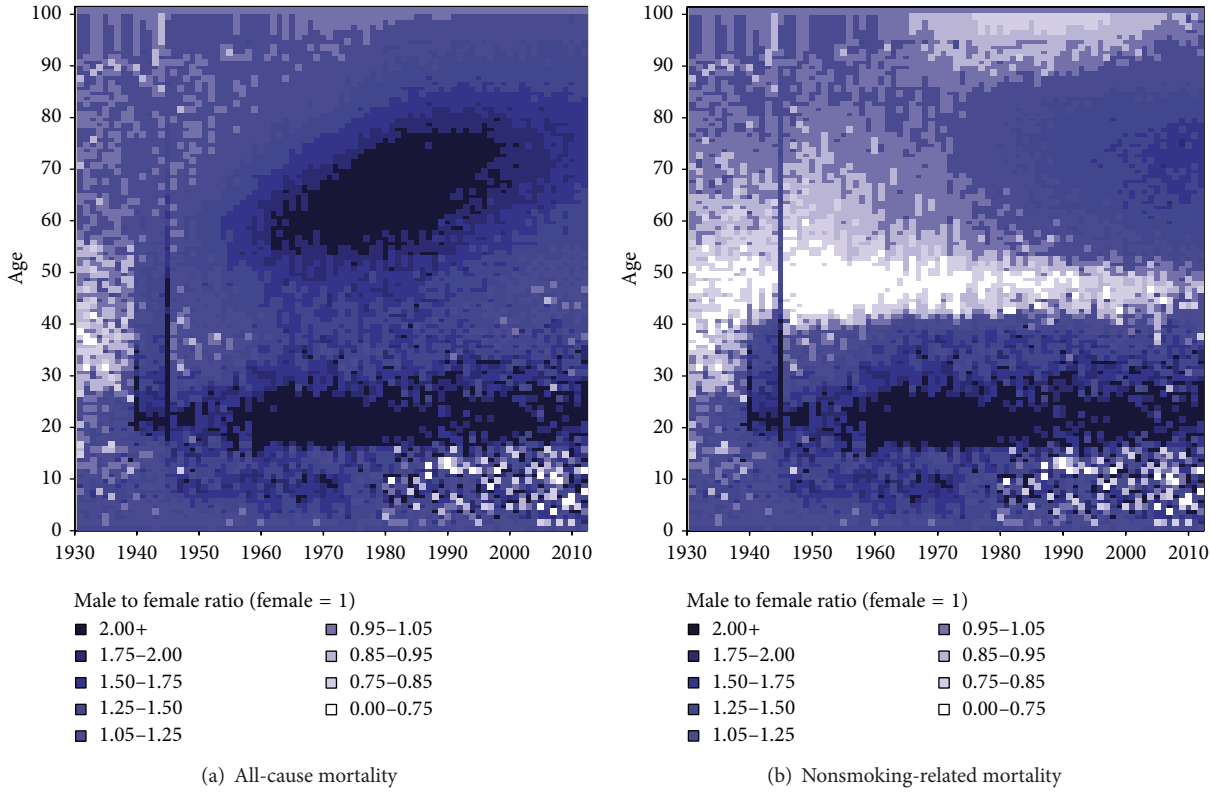

Figure 4: Comparison of the ratios of male-to-female mortality rates for all-cause mortality versus nonsmoking-related mortality, 1931–2012.

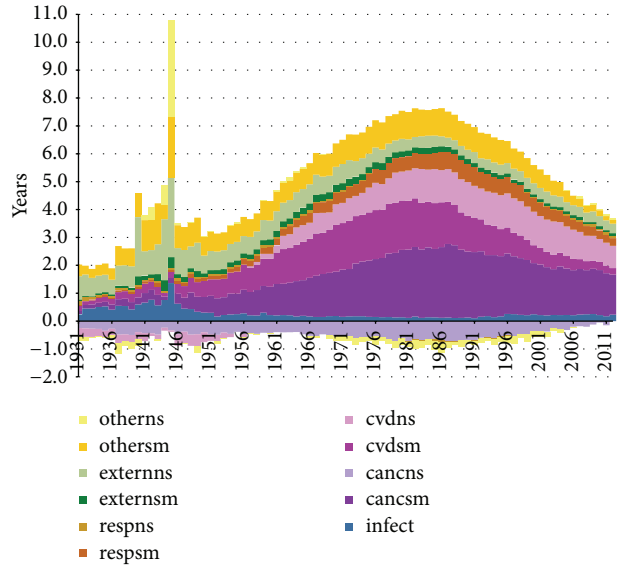

Figure 5: Contribution of smoking- and nonsmoking-related cause-specific mortality to the differences in life expectancy at birth between men and women, in years, Netherlands, 1931–2012. infect = infectious disease mortality; cancsm = smoking-related cancer mortality; cancns = nonsmoking-related cancer mortality; cvdsm = smoking-related cardiovascular disease mortality; cvdns = nonsmoking-related cardiovascular disease mortality; respsm = smoking-related respiratory disease mortality; respns = nonsmoking-related respiratory disease mortality; externsm = smoking-related external disease mortality; externns = nonsmoking-related external disease mortality; othersm = other smoking-related mortalities; otherns = other nonsmoking-related mortalities.

Table 1: The contribution of different age groups and different causes of death to the sex difference in life expectancy at birth (e0), separately for smoking-related and nonsmoking-related mortality, Netherlands, selected years.

	Absolute contribution (in years)				Relative contribution (in percentage)			
	1931	1950	1983	2012	1931	1950	1983	2012
Sex difference (e0) all-cause mortality	**1.33**	**2.27**	**6.63**	**3.67**	**1.33**	**2.27**	**6.63**	**3.67**
Contribution of smoking-related mortality	0.82	2.05	5.83	2.16	62%	90%	88%	59%
Contribution of nonsmoking-related mortality	0.51	0.22	0.80	1.51	38%	10%	12%	41%
Contribution causes of death								
Mortality from infectious diseases	**0.24**	**0.31**	**0.11**	**0.23**	**18%**	**13%**	**2%**	**6%**
Cancer mortality	**−0.11**	**0.16**	**1.77**	**1.43**	**−8%**	**7%**	**27%**	**39%**
Smoking-related cancer mortality	0.14	0.56	2.46	1.43	11%	25%	37%	39%
Nonsmoking-related cancer mortality	−0.25	−0.40	−0.69	0.00	−19%	−18%	−10%	0%
CVD mortality	**−0.15**	**0.22**	**2.88**	**1.03**	**−11%**	**10%**	**43%**	**28%**
Smoking-related CVD mortality	0.17	0.57	1.67	0.24	13%	25%	25%	6%
Nonsmoking-related CVD mortality	−0.32	−0.35	1.21	0.80	−24%	−16%	18%	22%
Respiratory disease mortality	**0.17**	**0.15**	**0.55**	**0.37**	**13%**	**7%**	**8%**	**10%**
Smoking-related respiratory disease mortality	0.04	0.12	0.57	0.28	3%	5%	9%	7%
Nonsmoking-related respiratory disease mortality	0.13	0.03	−0.02	0.09	9%	1%	0%	3%
External mortality	**0.89**	**0.76**	**0.61**	**0.42**	**67%**	**34%**	**9%**	**12%**
Smoking-related external mortality	0.05	0.12	0.18	0.08	3%	5%	3%	2%
Nonsmoking-related external mortality	0.85	0.65	0.42	0.34	64%	28%	6%	9%
Other	**0.29**	**0.68**	**0.71**	**0.18**	**22%**	**30%**	**11%**	**5%**
Other smoking-related mortality	0.42	0.68	0.95	0.13	31%	30%	14%	4%
Other nonsmoking-related mortality	−0.13	0.00	−0.25	0.05	−10%	0%	−4%	1%
Contribution of age groups								
0	0.90	0.48	0.14	0.05	68%	21%	2%	1%
1–4	0.17	0.09	0.03	0.02	13%	4%	0%	1%
5–19	0.11	0.26	0.15	0.06	9%	12%	2%	2%
20–49	−0.14	0.43	0.74	0.36	−10%	19%	11%	10%
50–64	0.06	0.62	1.89	0.58	4%	27%	28%	16%
65–79	0.19	0.31	3.07	1.63	14%	14%	46%	44%
80+	0.05	0.08	0.61	0.97	4%	3%	9%	27%

mortality offset by a negative contribution of higher mortality from nonsmoking-related cancers among women. Smoking-related cardiovascular disease mortality made the largest contribution to cardiovascular disease mortality, although the contribution of nonsmoking-related cardiovascular disease mortality also increased from 1955 onwards.

The decline in the sex difference in life expectancy from 1983 onwards seems to mainly be due to smoking-related cardiovascular disease mortality in the age group 50–64. The sex difference in smoking-related cardiovascular disease mortality greatly diminished from 1983 to 2012 and is currently only marginal. The contribution of nonsmoking-related cardiovascular disease mortality stayed around one year.

Additional analysis of the effect of smoking on the sex difference in remaining life expectancy at age 50 (see (5) of the Appendix) revealed that the trend in the sex difference in remaining life expectancy at age 50 is similar to the one observed for life expectancy at birth, although the sex difference is slightly smaller at age 50 than at birth. For remaining life expectancy at age 50, the increase in the sex difference can almost completely be attributed to the increase in the sex difference in smoking-related mortality. After 1983, the decline in the sex difference in remaining life expectancy at age 50 is driven by the decline in the sex difference in smoking-related mortality but is slightly counterbalanced by the increase in sex difference for nonsmoking-related mortality, similar to what we observed for life expectancy at birth. This seems to imply that it is mainly smoking-related mortality from age of 50 onwards that is behind the sex difference in life expectancy and that—when controlled for age-gender specific survival factors at younger ages—smoking plays an even larger role in the increase in the gender gap up to 1983.

The comparison of the observed role of smoking in the gender gap in mortality with other studies is not straightforward, as it very much depends on the period examined, the characteristics of the country examined—like the time of the onset of the smoking epidemic and the popularity of smoking relative to, for example, alcohol [3]—and the overall extent of the mortality difference between the sexes. Similarly, we should be careful when we try to generalise a certain estimate of the role of smoking in the sex difference in mortality. We should also note that estimates for a single country can differ due to the methodology used. For example, Luy and Wegner-Siegmundt observed for Netherlands over the period 1955/1959–2005/2009 an average gender gap of 5.5 years, of which 62.5% (3.44 years) is due to smoking [7]. We find, however, an average contribution of smoking of 4.4 years out of 5.4 years (80%) over the same period. Additional analysis showed that this substantial difference can be mainly explained by the 50% reduction in excess risk to account for the confounding used in the original Peto-Lopez method [26], as applied by Luy and Wegner-Siegmundt and by our 30% reduction in excess risk using the more recent insights by Ezatti and Lopez [28]. The difference in results with Valkonen and van Poppel can as well be linked to the same issue, but also to the methodology to assess the role of smoking in the sex difference. Valkonen and van Poppel estimated that smoking contributed 3.8 years (72%) to the sex differences in life expectancy at age 35 in Netherlands in 1970–1974. In the period 1985–89, the contribution was 3.2 years (53%) [20]. However, our results indicate that smoking contributed 84% to the sex difference in life expectancy in 1972 and 90% in 1987. A comparison of the sex difference in life expectancy for nonsmoking-related mortality with the sex difference in life expectancy for all-cause mortality (their approach) is, however, bound to result in different outcomes than a decomposition (our methodology), because life expectancy for nonsmoking-related mortality is calculated based on the assumption that all smoking-related mortality would be eliminated.

Our results for smoking-attributable all-cause mortality proved to be similar to the recent results from the Global Burden of Disease (GBD) study in 2010, which applied the indirect Peto-Lopez method combined with epidemiological data to estimate lung cancer mortality in nonsmokers. This seems to validate both our approach and theirs.

A comparison of the trend over time in the sex difference in life expectancy proved to be more straightforward. The trend we observed for Netherlands since 1950 was similar to the trend observed in countries such as United Kingdom, Denmark, Norway, and Sweden [45]. For these countries as well smoking has been found to play an important role, albeit a smaller one than for Netherlands [7, 20]. In the middle of the 1960s, the prevalence of male smokers in Netherlands was much higher than that observed in the other European countries and at that time even one of the highest in the world. In the same period, the smoking prevalence among women was rather small in Netherlands, and lagged far behind the percentages found in the United Kingdom, where women's roles were affected by experiencing WWI, and Denmark, which was also one of the forerunner countries in terms of female smoking [46, 47].

3.3. Remaining Sex Differences in Life Expectancy at Birth. When examining the trend in the gender gap in nonsmoking-related mortality (Figure 3), we can see that from 1983 onwards the advantage of women in terms of nonsmoking-related mortality increased from 0.8 to 1.5 years. This slight increase is in line with the overall divergence between the sexes in nonsmoking-related mortality that Pampel observed for 21 high-income nations combined over the period from 1975 to 2000 [48]. Examining Table 1 shows the importance of an increasing sex difference in nonsmoking-related respiratory disease mortality and the disappearance of the male advantage for nonsmoking-related cancer mortality. Additional analysis revealed that the increases in the contribution of nonsmoking-related mortality over this period mainly took place at ages 50 and over. Behavioural factors, such as the larger uptake of preventive health behaviour among women than men and the more frequent uptake of new risky behaviour among men than among women, are postulated to be behind these trends [9, 10, 48, 49]. The recent stabilisation in the sex difference in nonsmoking-related mortality from approximately 2006 onwards could point to a new phase in which gender differences in preventive health behaviour are disappearing, although it first should be established whether this is a long-term and international phenomenon.

When we examine the contour map for nonsmoking-related mortality, next to the disappearance of the excess mortality among older men after 1950, some additional interesting patterns are brought forward which were previously offset by the effect of smoking, that is, (i) a very large amount of excess mortality among women aged 40–50, (ii) excess mortality among women aged 90+ between 1970 and 2010, and (iii) a small amount of excess mortality among men around ages 65–85, which emerged in 1970 and increased and expanded to the age group 50–90 over time. The large amount of excess nonsmoking-related mortality among women aged 40–50, particularly before 1980, seems to be largely a continuation of excess all-cause mortality among women aged 30–40 from 1850 to 1910 and among women aged 30–50 from 1910 to 1940, which can in large part be explained by maternal mortality [43]. For the higher ages, it is very likely that higher mortality among women from breast cancer and gynaecological cancers, such as cancer of the uterus and cancer of the ovaries, also plays a role [44]. This indeed seems in line with the, at that period, observed amount of excess mortality among women in nonsmoking-related cancer mortality.

Part of the remaining difference in nonsmoking-related mortality is due to biological factors. Previous estimates of the sex difference in life expectancy caused by biological factors amount to around two years at birth [50, 51], to maximum two years at age 25 [52], or, more generally, to approximately 25% when the sex difference in life expectancy is between 1.5 and 6 years [7]. This latter would indicate that for Netherlands the biological effect on the sex difference in life expectancy would be 1.66 years in 1983 and 0.92 years in 2012.

However, the remaining difference we found was less than the suggested 25% from 1948 to 1999 (e.g., for 1983, 0.82 years = 12%) and was larger than the suggested 25% from 2000 onwards (e.g., for 2012, 1.51 years = 41%). Because

Table 2: The six main cause-of-death groups used in the study and the related ICD9 codes.

Abbreviation	Description	Numbers within the 65-cause list [22]	ICD9
infect	Infectious diseases (based on the classification by Wolleswinkel-van den Bosch et al. [23])	8–12, 14, 15, 18–22, 24–28, 35–39, 43-44, 50–53, 58, 59	001–004, 006–018, 020–027, 030–057, 060–066, 070–075, 077–088, 090–104, 110–118, 120–139, 320–326, 380–392, 466, 480–487, 510-511, 532, 540–543, 555–558, 562, 567, 580, 670, 681-682
resp	Chronic respiratory diseases	29 + 30	415, 460–465, 470, 472–478, 490–496, 500–508, 512–529
cancer	Cancers	2–6	142, 150–165, 170–175, 179–185, 200, 202, 203
cvd	Cardiovascular disease = cerebrovascular diseases + diseases of circulatory system	13, 32–34	393–398, 401–405, 410–414, 416-417, 420–438, 445, 451–456, 458-459
extern	External causes of death = violence + suicide	61–64	005, 304-305, E800–807, E810–E838, E840–E848, E850–E876, E878–E888, E890–E903, E905–E978, E980–E999
other	Other diseases	rest (1–65)	rest (001–E999)

Table 3: Smoothed relative risks (RR) of dying for all-cause mortality and the selected causes of death after applying the correction factor of 30% to reduce the excess risk, plus some background information on the smoothing procedure.

(a)

	All causes M	All causes F	Cancers M	Cancers F	Vascular M	Vascular F	Respiratory M	Respiratory F	External M	External F	Other M	Other F
35–39	2.12	1.00	1.00	1.00	4.63	1.15	1.00	1.00	2.22	1.28	2.02	3.85
40–44	2.29	1.03	1.53	1.00	4.07	1.69	1.00	1.12	2.02	1.27	2.01	3.29
45–49	2.40	1.43	2.06	1.26	3.55	2.08	2.23	2.57	1.84	1.26	1.99	2.80
50–54	2.45	1.71	2.46	1.49	3.07	2.33	3.53	3.64	1.69	1.25	1.95	2.39
55–59	2.44	1.89	2.72	1.65	2.63	2.44	4.40	4.33	1.56	1.23	1.91	2.04
60–64	2.36	1.97	2.84	1.74	2.24	2.41	4.84	4.64	1.46	1.22	1.86	1.77
65–69	2.22	1.94	2.83	1.75	1.89	2.24	4.84	4.56	1.38	1.21	1.79	1.57
70–74	2.02	1.79	2.67	1.70	1.59	1.92	4.42	4.11	1.33	1.20	1.72	1.44
75–79	1.76	1.55	2.38	1.57	1.32	1.47	3.56	3.28	1.30	1.18	1.63	1.38
80+	1.44	1.19	1.96	1.37	1.10	1.00	2.27	2.06	1.30	1.17	1.54	1.40

(b)

Cause	Smoothing	Age selection regression Men	Age selection regression Women	RR < 1 → RR = 1 Men	RR < 1 → RR = 1 Women
All causes	Age + age squared	35+	40+; RR40–44 = 1		35–39
Cancers	Age + age squared	35+; RR35–39 = 1	40+; RR40–44 = 1	35–39	35–39, 40–44
Vascular	Age + age squared	35+	40+		80+
Respiratory	Age + age squared	40+	40+	35–39, 40–44	35–39
External	Age + age squared	35+	40+		

the overall sex difference largely depends on the scale of the smoking epidemic, which varies considerably across countries, it would seem that assessing the effect of biological factors based on nonsmoking-related mortality would give us a better estimate than based on all-cause mortality, at least for western European countries until the end of the 20th century.

Overall, however, the remaining sex difference amounts to between 0.1 years (1952) and 1.6 years (2007), which seems to indicate that biological factors play a smaller role than was previously estimated, given that other lifestyle factors also still have an effect.

4. Conclusion

The smoking epidemic in Netherlands, which started among men born around 1850 and among women from birth cohort

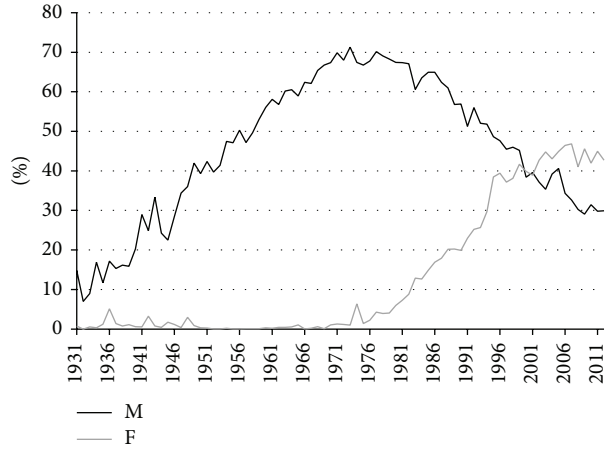

Figure 6: Estimated past smoking exposure aged 35 and over, Netherlands, 1931–2012, by sex. M = males; F = females.

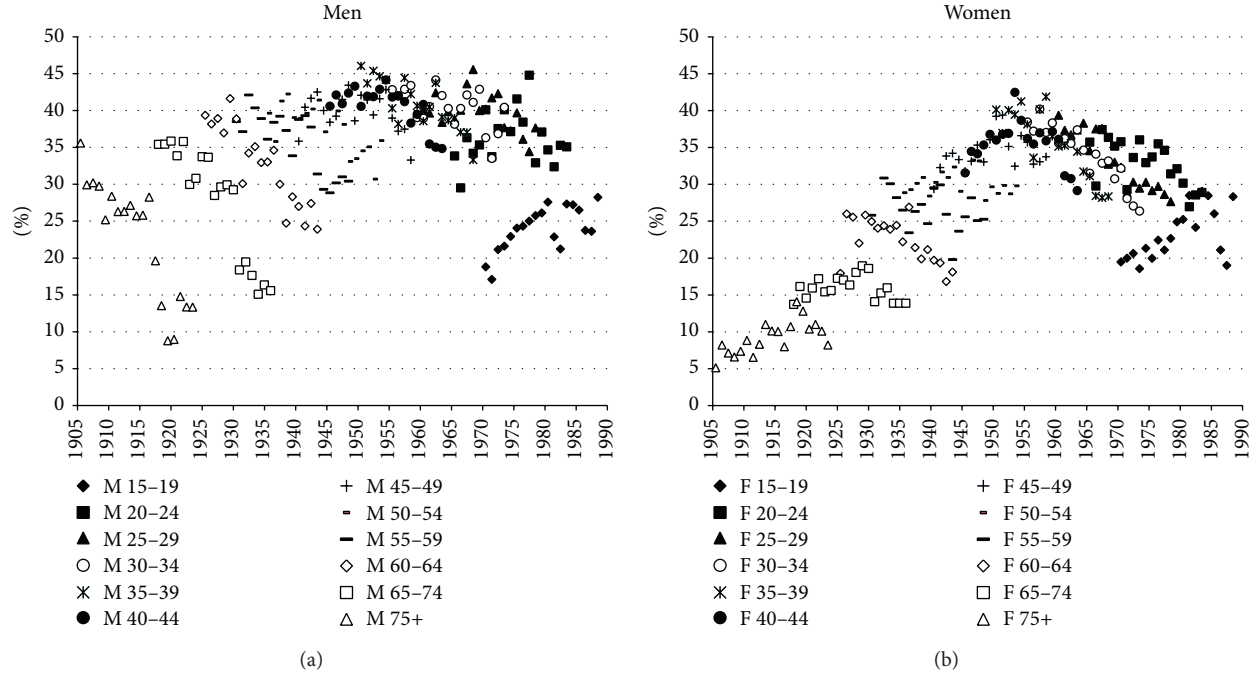

Figure 7: Smoking prevalence by five-year age groups and birth cohort (1905–1990), based on data from calendar year 1988 onwards. Source data: unpublished data Stivoro.

1900 onwards, contributed substantially to the increasing sex difference in life expectancy at birth from 1931 (1.3 years) to 1982 (6.7 years), the subsequent decline to 3.7 years in 2012, and the high excess mortality among Dutch men born between 1895 and 1910. Smoking-related cancer mortality was the main contributor to the increase in the sex difference, whereas smoking-related cardiovascular disease mortality was mainly responsible for the decline from 1983 onwards. Examining nonsmoking-related (cause-specific) mortality shed new light on the mortality gender gap. It revealed the continuation of excess mortality among women aged 40–50. But it also suggested that biological factors may play a smaller role in the sex difference than was previously estimated.

Assessing the effect of biological factors for nonsmoking-related cause-specific mortality would be an important step forward. To do so, it is important to control for the role of smoking in the gender gap in the general population when examining the biological effect and to estimate the biological effect for the different causes of death.

Appendix

(1) See Table 2.

(2) See Table 3.

(3) See Figure 6.

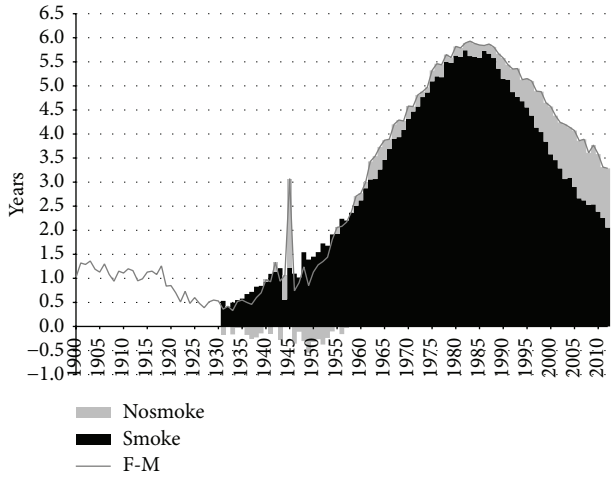

Figure 8: Contribution of smoking- and nonsmoking-related mortality to the difference between men and women in remaining life expectancy at age of 50, in years, Netherlands, 1931–2012. Nosmoke = nonsmoking-related mortality; smoke = smoking-related mortality. M = males; F = females.

(4) See Figure 7.

(5) See Figure 8.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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