RESEARCH ARTICLE

Mortality Attributable to Second Hand Smoking in Morocco: 2012 Results of a National Prevalence Based Study

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Abstract

Purpose: To estimate the number of deaths attributable to second hand smoking (SHS) in Morocco in 2012. Materials and Methods: prevalence based study focusing on mortality from ischaemic heart disease (IHD) and lung cancer among non-smokers aged 35 and over. Prevalence of SHS among never smokers was gathered from a national cross sectional survey on tobacco and population attributable risk (PAR) was calculated by applying PARs to mortality. The analyses were stratified by sex, age and area of exposure. Results: Rates for exposure to SHS among men aged 35-64 years ranged from 20.0% at home to 57.4% at work. Among non-smoking Moroccans aged 35 and over, 233 (IC: 147 - 246) deaths were attributable to exposure to SHS; 156 (IC: 100 - 221) in women and 77 (IC: 44 -125) in men. A total of 173 (122 - 222) deaths were estimated to have been caused by exposure only at home, 34 (9 - 76) by exposure only at the work place and 26 (15 - 58) by exposure both at home and work places. Exposure to SHS could be responsible for 182 (128 - 237) deaths from IHD and 51 (19 - 109) from lung cancer. Conclusions: These data confirm that SHS needs urgent attention in Morocco.

Keywords: Second hand smoking - attributable risk - cancer and IHD mortality - Morocco

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Introduction

Harmful effects of second-hand smoke (SHS) have been recorded since 1928 (Schönherr, 1928). In the 1970s, scientific interest in potential adverse health effects of second-hand smoke expanded (Musk and De Klerk, 2003). Knowledge about the links between SHS and specific diseases has been summarized in comprehensive assessments or reviews by the International Agency for Research on Cancer, World Health Organization, the California Environmental Protection Agency, and the US Surgeon General (US Surgeon General, 2006).

SHS is causally associated with a variety of health effects such as lung cancer, ischemic heart diseases, respiratory effects and other diseases in adults (Schönherr, 1928). Meta-analyses suggest that non-smokers exposed to SHS have around 30% increased risk for developing lung cancer and ischaemic heart disease (IHD) (Law et al., 1997; He et al., 1999; Lee and Forey, 1996). Several studies have shown that relative risks (RR) associated with the exposure to SHS are lower than those associated with active smoking (Musk and De Klerk, 2003; Oberg et al., 2011). However, in most countries the prevalence of SHS exposure is very high. The large percentage of the population exposed to SHS makes this an important public health issue (Eriksen et al., 2008). For this reason, is important to assess the burden of illness and mortality as a result of exposure to SHS.

Worldwide, 40% of children, 33% of male non-smokers, and 35% of female non-smokers were exposed to second-hand smoke in 2004. This exposure was estimated to have caused 379 000 deaths from ischemic heart disease, 165 000 from lower respiratory infections, 36 900 from asthma, and 21 400 from lung cancer. 603 000 deaths were attributable to second-hand smoke in 2004, which was about 1.0% of worldwide mortality. 47% of deaths from second-hand smoke occurred in women, 28% in children, and 26% in men (Eriksen and Cerak, 2008; Oberg et al., 2011; Palvara et al., 2013). Estimates of the mortality attributable to passive smoking have been published in New Zealand (Woodward and Laugesen, 2001), United Kingdom (Jamrozik, 2005) and Anglo-Saxon populations at an advanced stage of the tobacco epidemic (Lopez and al, 1994). In New Zealand, deaths caused by past exposures to second hand smoke currently number about 347 per year. In United kingdomm, each year passive smoking at home might account for another 2700 deaths in persons aged 20-64 years and 8000 deaths among people aged ≥ 65. In Spain, deaths attributable to SHS ranged from 1228 to 2237 during the year 2002.

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In Morocco, a tobacco control law (law 15-91) was enacted in Morocco in 1996; it included a ban on advertising, a ban on sponsorship, and a ban on smoking in public transport and in educational and healthcare facilities (law 15-91). However, antismoking legislation had little impact on the prevalence of smoking. Proportion of current smoker's among adults has increased from 17.2% to 18.5% between 2000 and 2006 (Tazi et al., 2003; Nejjari et al., 2009). While tobacco burden has been monitored on expenditure and active smoking attributable mortality (Tachfouti et al., 2010; Tachfouti et al., 2014), passive smoking health effect has never been assessed in Morocco, to the best of our knowledge. The aim of this study was to assess the number of deaths attributable to exposure to environmental tobacco smoke among never smokers in Morocco during 2012.

Materials and Methods

Design

In this study, we included the two main diseases widely associated with SHS exposure: lung cancer (ICD-10, C33-34) and ischemic heart diseases (ICD-10, I20-I25) among persons aged 35 years and over. Data were stratified by age groups (35-64 and over 64) and sex.

Mortality attributable to SHS

The mortality attributable (AM) to SHS among non smokers was calculated applying the population attributable fraction to SHS (PAF). The PAF was estimated using the classic formula (Walter et al., 1976; Rockhill et al., 1998):

$$PAF = P_{shs} \times (RR - 1) / P_{shs} \times (RR - 1) + 1$$

Where Pshs is prevalence of exposure to SHS among non smokers and RR is relative risk of disease of SHS-exposed nonsmokers compared with that of unexposed nonsmokers. The relative risks (RR) for these diseases were selected from two published meta-analyses used in previous studies as shown in table 1 (Hackshaw et al., 1997; Steenland, 1999). Attributable mortality to SHS (AM) was estimated by multiplying PAF and total deaths among non-smokers $AM= D_{nons} \times PAF$.

In addition to sex and age, the analyses were stratified by setting of exposure: home, workplace and both combined. We followed conservative criteria in order to avoid overestimation of the number of deaths attributable to SHS exposure. Therefore, we did not use data about prevalence of exposure to SHS during leisure time, and we considered people exposed in more than one setting as having the same risk as people exposed in the setting with the higher risk.

Number of deaths among non smokers

Because separate mortality statistics for smokers and nonsmokers in Morocco are not available, we estimated the number of deaths among nonsmokers (D_{nons}). For the two adult conditions (lung cancer and IHD), we determined D_{nons} following the method used by Oberg (Oberg et al., 2011). First, we determined the number of excess deaths attributable to current smoking for each condition. Second, we subtracted these excess deaths from the total deaths among all adults for each condition to derive the total number of deaths that were not attributable to current smoking but that resulted from other (i.e. nonsmoking) risk factors that affect both smokers and nonsmokers (Gan et al., 2007). Third, we apportioned the total non-smoking-attributable deaths for each condition to smokers (those who die from the disease but whose death is not attributable to smoking) and nonsmokers according to the proportion of smokers and nonsmokers in the adult population. These steps are expressed by the following formula:

$$D_{nons} = [D - (D \times SAF)] \times (1 - P_{cs})$$

Where D_{nons} is the total number of deaths among nonsmokers, D is the total number of deaths among all adults, SAFcs is the smoking-attributable fraction from current smoking, and Pcs is the prevalence of adult (aged 35 and over) current smoking in Morocco. We derived SAFcs from the prevalence of smoking and the relative risk of death from smoking according to the standard epidemiological formula (Lilienfeld and Stolley, 1994):

$$SAFcs = [Pcs \times (RRcs - 1)] / [Pns + Pfs \times RRfs + Pcs \times RRcs]$$

Where Pcs is the prevalence of adult current smoking in the United States, Pns is the prevalence of never-smoking adults in the United States, Pfs is the prevalence of former-smoking adults in the United States, RRcs is the RR of death from current smoking, and RRfs is the RR of death from former smoking.

Sources of data

Mortality: The 2012 mortality data for 19 adult smoking-related diseases were drawn from the Mortality declaration registries in eight prefectures (administrative department) in Casablanca. Mortality data of Moroccan adult population was extracted from Health Ministry declaration system. It concerns number of death according to sex and age. Mortality profile of Casablanca region was extrapolated in Moroccan population. The Greater Casablanca district is the most populated area of Morocco and hosts 12% of the total population of the country; 63% of the population is under 35 years of age (HCP, 2013)). The Greater Casablanca population can, therefore, be considered as reasonably representative of the Moroccan population. The collection of mortality data was authorized by Health Ministry.

Smoking data: Data on current smoking, former smoking and exposure to SHS were obtained from MARTA survey data (El Rhazi et al., 2008; Berraho et al., 2010; El Fakir et al., 2011). MARTA is a cross-sectional study of randomly selected Moroccan people aged 15-90 years conducted in 2006 to study the prevalence and determinants of cigarette smoking. Data were collected using anonymous face-to-face questionnaire. Smoking habit was defined according to the International Union Against Tuberculosis and Lung Diseases guide (Slam, 1998). Respondents were defined as current smokers (daily and occasional smokers) if they were smoking at the time

Table 1. Proportion of the Never Smoking Population Exposed to SHS (Morocco 2006) and Relative Risks of SHS

At home only	Proportion of SHS		Relative Risk	
	N	%	Lung cancer (CI 95%)	Ischemic H D
Men				
35 - 64 years	509	20.0	1.34 (0.97-1.84)	1.30 (1.22-1.38)
≥64 years	53	15.1		
Women				
35 - 64 years	370	38.4	1.24 (1.13-1.36)	
≥64 years	12	25.0		
At work only				
Men				
35 - 64 years	956	57.4	1.39 (1.15-1.68)	1.21 (1.04-1.41)
≥64 years	73	38.4		
Women				
35 - 64 years	306	25.5	1.39 (1.15-1.68)	1.21 (1.04-1.41)
≥64 years	9	17.1		
At H and W				
Men				
35 - 64 years	1437	25.3	1.39 (1.15-1.68)	1.30 (1.22-1.38)
≥64 years	100	17.0		
Women				
35 - 64 years	620	17.7	1.39 (1.15-1.68)	1.30 (1.22-1.38)
≥64 years	19	21.1		

of the survey and had smoked more than 100 cigarettes in their lifetime; they were defined as former smokers if they had smoked more than 100 cigarettes in their lifetime, but stopped smoking during more than 3 months at the time of the survey; and they were defined as never smokers if they had never smoked or had smoked less than 100 cigarettes in their lifetime. The SHS exposure was defined using the following questions: ''Does some member of your family usually smoke at home?' and "Are you exposed to SHS in your work?" Proportion of exposition to SHS was estimated according to sex and age in work and at home. The survey was authorized by Ministry of interior affairs and oral consent was obtained from all participants.

Results

The proportion of exposure to SHS at home, at work and at home and at work among non smokers by sex and two age groups (35-64 years and ≥ 65 years) are shown in table 1. Among men's aged 35 - 64 years, it ranged from 20.0% at home to 57.4% at work. Among women's aged 35 - 64 years, proportion of exposure to SHS was higher at home then at work (38.4% versus 25.5%). Mortality relative risks due to exposure to SHS according to disease, sex and age are shown in Table 1. Population attributable fraction (PAF) for lung cancer deaths in men aged 35 - 64 years varied from 0.06 for persons exposed at home to 0.12 for those exposed at work. In women's at the same age category and exposed at home, it was 0.08. For ICD, in persons aged 35 - 64 years, PAF was 0.10 and 0.11 in women's exposed at home and men's exposed at work, respectively as shown in Table 2.

In 2012, 1851 deaths among Moroccan aged 35 years and over were from lung cancer from and 3059 were from IHD. Among non smokers, IHD and lung cancer were responsible for 2464 and 281 deaths respectively. Table 3 shows total deaths among non smokers (D_{nons}) and number of deaths attributable to SHS (AM) according to sex, age and disease in 2012. Overall 233 (IC: 147 - 246) deaths

Table 2. Population Attributable Fraction (PAF) According to Sex, Age and Diseases

	Lung cancer	Ischemic HD
At home only		
Men		
35 - 64 years	0,063 (0.006- 0.141)	0,056 (0.041 - 0.069)
≥64 years	0,048 (0.004 - 0.112)	0,043 (0.032 - 0.054)
Women		
35 - 64 years	0,083 (0.047 - 0.121)	0,102 (0.078 - 0.127)
≥64 years	0,056 (0.031 - 0.082)	0,069 (0.052 - 0.086)
At work only		
Men		
35 - 64 years	0,121 (0.080 - 0.280)	0,107 (0.022 - 0.190)
≥64 years	***	***
Women		
35 - 64 years	0,057 (0.037 - 0.147)	0,050 (0.0102 - 0.094)
≥64 years	***	***
At H and W		
Men		
35 - 64 years	0,057 (0.037 - 0.146)	0,061 (0.052 - 0.070)
≥64 years	***	***
Women		
35 - 64 years	0,040 (0.026 - 0.107)	0,060 (0.052 - 0.070)
≥64 years	****	***

were attributable to exposure to SHS among Moroccan's aged 35 and over; 156 (IC: 100 - 221) in women's and 77 (IC: 44 -125) in men. 182 (IC: 128 - 237) of these deaths were from IHD and 51 (IC: 19 - 109) from lung cancer. According to area of exposition to SHS, 173 (IC: 122 - 222) deaths would be caused by exposure only at home, 34 (IC: 9 - 76) by exposure only at work and 26 (IC: 15 - 58) by exposure at both home and the workplace.

From 156 (IC: 100 - 221) deaths occurred in women's, 78.9% were from IHD and 21.1% from lung cancer. In men's, 75.2% were from IHD and 24.7% from lung cancer and 63.6% in men's. For both sexes combined, exposure to SHS only at home in 2012 would be responsible for 173 (122 - 222) deaths representing 74.2% of mortality attributable to SHS; 79.5% in women's and 63.6% in men's. IHD was responsible for 87.9 % of deaths caused by exposition only at home.

Table 3. Estimated Deaths and Deaths Attributable to Exposure to SHS According to Sex, Age, Disease and Area of Exposure

	Lung cancer		Ischemic HD		Total	
	D_{nons}	PSAD (IC)	D_{nons}	PSAD (IC)	D_{non}	PSAD (IC)
At home only						
Men						
35 - 64 years	74	5 (0 - 10)	86	5(4 - 6)	160	10 (4 - 16)
≥64 years	12	1 (0 - 2)	880	38 (28 - 48)	892	39 (28 - 50)
Women						
35 - 64 years	172	14 (8 - 20)	127	13 (10 - 16)	299	27 (18 - 36)
≥64 years	23	1 (0 - 2)	1371	96 (71 -118)	1394	97 (71 - 120)
Subtotal	281	21 (8 - 34)	2464	152 (114 - 188)	2745	173 (122 - 222)
At work only						
Men						
35 - 64 years	74	9 (6 - 21)	86	9 (2 - 19)	160	18 (8 - 40)
≥64 years	12	***	880	***	892	***
Women						
35 - 64 years	172	10 (0- 25)	127	6(1 - 11)	299	16 (1 -36)
≥64 years	23	***	1371	***	1394	***
Subtotal	281	19 (6 - 46)	2464	15 (3 - 30)	2745	34 (9 - 76)
At H and W						
Men						
35 - 64 years	74	4 (0 - 11)	86	6 (4 - 8)	160	10 (4 -19)
≥64 years		***	880	***	892	***
Women						
35 - 64 years	172	7 (4 - 18)	127	9 (7 - 11)	299	16 (11 - 29)
≥64 years		***	1371		1394	***
Subtotal	281	11 (4 - 29)	2464	15 (11 -19)	2745	26 (15 - 58)
Total	281	51 (19 - 109)	2464	182 (128 - 237)	2745	233 (147 - 246)

Discussion

To our knowledge, this is the first study that assesses mortality attributable to SHS in Morocco using data on prevalence of exposure in non-smokers from national survey. Even under the most conservative assumptions, the number of deaths attributable to SHS in Morocco (year 2012) is estimated to 233 (IC: 147 - 246); 156 (IC: 100 - 221) in women's and 77 (IC: 44 -125) in men. Among non smokers, SHS was responsible for 18.1% for death by lung cancer (22.1% in women's and 16.4% in men's) and 7.4% of those by ischemic heart disease (8.3% in women and 6.0 % in men). Mortality attributable to SHS repents 0.63% of all death among Moroccan population aged 35 and over (1.02% in women and 0.37% in men). Our calculations suggest that SHS attributable deaths are similar to those killed from cirrhosis (0.60%) (Moroccan Ministry of health, 2013).

However, some limitations of the survey need to be discussed. First, Moroccan's adult mortality data was extrapolated from Casablanca system registration. The population of the Greater Casablanca district is mainly urban (91.6% *vs*. 8.4% rural). However, being the economic centre of the country, Casablanca attracts a lot of migrants from all regions of Morocco, including the rural regions and these results in a very large socio-economic heterogeneity. Second, our estimation do not formally take into account the well documented issue of a time lag between exposure to tobacco smoke and impact on health. Thus, the SHS attributable mortality estimates do not represent the past or cumulative SHS of the Moroccan population, but only reflect the current SHS profile (Stevens, 2008). The number of deaths nowadays would be higher since the prevalence of exposure to ETS in the past was even higher. To our knowledge, no data are available in morocco concerning prevalence of SHS in the past decades.

Another issue to be pointed out is that deaths attributable to SHS are derived from a single estimated relative risk. A more accurate estimate would have resulted from the use of age or country specific relative risks. However, no specific relative risks for exposure to SHS among never smokers are available in Morocco. This disconnect could affect the magnitude and direction of the results, but the use of established RR from the international literature may favor comparability with other studies.

Other limitations are the potential for confounding due to socio-economic and lifestyle differences in exposure groups, and possible misclassification bias arising from current- and ex-smokers who misreport themselves as never-smokers (Kawachi and Colditz, 1996) Furthermore, a number of studies have shown that special populations, such as hospitality workers, are exposed to higher SHS levels than either people living with smokers or office workers in places where smoking [Wells, 1998; Lopez, 2006).

This study is probably underestimating the real number of deaths because of the conservative criteria used. First, we only included lung cancer and ischemic heart disease in the main assessment of deaths attributable to SHS because they are the major diseases firmly linked to exposure to SHS. Lung cancer and IHD among non-smokers is classified as a level 1 outcome causally related to SHS both from spousal smoking and from exposure at work. Stroke was not included in the estimation since the causal relation with SHS has not been clearly established.

Stroke in relation to SHS exposure among non-smokers is biologically plausible, but there is currently inconsistent epidemiological evidence. It is classified as a Level 2 outcome. Breast cancer deaths were not included despite the conclusion that secondhand smoke caused breast cancer in younger women. The evidence from epidemiologic studies of secondhand smoke in 2005 for breast cancer in younger, primarily premenopausal women was stronger than for lung cancer in 1986 [Johnson and Glantz, 2008). Second, sudden infant death was discarded since our study was focused on the adult population (>35 years old) (WHO, 2010). Moreover, children of smoking mothers have an increased risk of premature birth, low birth weight, sudden infant death syndrome and respiratory diseases during infancy (Merritt, 2012). Third, the analysis focused on deaths among nonsmokers because of the difficulty in separating the impact of SHS exposure and active smoking on health among smokers. However, smokers are also negatively affected by exposure to SHS.

Our findings are lower than those reported in Taiwan, USA and UK. Two factors account for this difference. Our estimates are based on self reported SHS exposure, which underestimates exposure. The number of deaths from IHD and lung cancer are higher in these countries (Max et al., 2012; Jamrozik , 2005; Sung et al., 2014). Attributable risk estimates to SHS should be regarded as a guide to policy decisions rather than a precise prediction of the number of lives that will be saved by public health interventions. Comprehensive legislation to protect non-smokers from exposure to second-hand smoke in all indoor workplaces and public places has be n implemented in some countries and sub national jurisdictions, but 93% of the world's population is still living in countries not covered by fully smoke-free public health regulations (Oberg, 2011). Simply eliminating SHS exposure through regulatory policies immediately reduces morbidity and mortality from CVD. Hospital admission rates for acute myocardial infarction were reduced by 8% as a result of a comprehensive smoking ban in New York State after we controlled for other relevant factors (Harlan, 2007).

In Morocco, tobacco control law included very important measures such as bans on advertising, on sponsorship and on smoking in public transport and educational and health care facilities. The law has therefore had little impact on tobacco health and economic impact in a country where the average tobacco expenditure for households with a daily smoker is 30% of total income (Tachfouti et al., 2010). On the other hand, recent study shows that tobacco attributable mortality represents 9.7% of all death among adults aged 35 and over in Casablanca region (Tachfouti et al., 2014). A study on knowledge and attitude toward anti smoking legislation shows that only 38.7% of Moroccan smokers knew about the existence of antismoking legislation and among smokers who knew about the law, 56.7% knew about the ban on smoking in public areas (Tachfouti et al., 2011). Small proportions of smokers indicated their support for tobacco control measures; less than 37% of them are favored a ban on smoking in public places.

This again indicates a lack of efforts to inform the public and generate support for tobacco control measures including price policy. With Morocco now moving towards ratifying the WHO Framework Convention on Tobacco Control, which contains comprehensive anti-smoking policies (Gilmore and Collin, 2002), the need to adapt and enforce effective legislation becomes crucial. To implement tobacco control strategies successfully and to improve their effectiveness, knowledge about the impact of tobacco legislation and other tobacco control activities should be monitored regularly in terms of prevalence of use, public attitudes, socioeconomic patterns and health indicators.

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