

## **Gender, economics and culture: diversity and the international evolution of smoking prevalence**

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### **Key words**

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### **Abstract**

**Aims:** To examine whether the observed diversity between national patterns of smoking prevalence could require modification of the World Health Organization (WHO) linear model for an international 'smoking pandemic' (a worldwide epidemic) to address data from non-western countries.

**Method:** We conducted secondary research using current measures in three publicly available databases: Globalink, the International Labour Organization and the World Bank (all internet-accessible). The measures we used are the separate percentage data for men and women on: smoking and employment and national income per capita (US\$) and percentage growth per annum.

**Results:** Regression analysis showed that women smokers were more frequent in countries with higher national income, but women were less likely to smoke in countries of rapid growth. Men were less likely to smoke in countries with higher national income, but more likely to smoke in countries of rapid growth. Two principle components together explained 62% of all the variance in the international data. The largest factor was positively correlated with the percentage of employed females, the percentage of female smokers and national income per capita, but negatively correlated with the percentage of male smokers and percentage annual growth. The effect of female employment was not continuous, but above a threshold of 51%, was associated with a higher prevalence of female smoking. The smaller, second factor was only weakly correlated with any smoking variables.

**Conclusions:** In his 1994 model (subsequently adopted by the WHO) Lopez looked at historical trends in 'stages' of smoking prevalence. These have been associated with 'stages' of economic development. We extended this analysis to look at a dynamic change (% annual growth) and a social indicator (employment). Male and female smoking is affected differentially by economic change and by level of income. These are also strongly related to the percentage of women in employment. This has implications for workplace policies on smoking.

### **Introduction**

Most national research on smoking behaviour is restricted to developed countries with European cultures (including North America, Australia and New Zealand). This research indicates that smoking by school-aged children is more likely if either parents<sup>1</sup> or peers<sup>2,3</sup> smoke. A 'social epidemic probability model' has been used to model family influences, but this is based on a single, large-scale US study.<sup>4</sup> Two Cochrane reviews have indicated that

smoking prevention programmes based on close relationships have no significant impact on preventing habitual smoking.<sup>5</sup> This evidence suggests that it is necessary to identify additional socio-economic factors, beyond conformity to the expectations of immediate family or peers, which could affect smoking take-up at the national population level.

The WHO has supported the collation of national smoking data, and in its 2003 comparative review of international data on tobacco prevalence uses the paradigm of a progressive 'pandemic'<sup>6</sup> or global disease outbreak to classify national smoking patterns. A pandemic is normally considered as a disease causing serious illness within a population, with human-to-human transmission, that spreads rapidly across countries, the difference in this instance is that the transmission agent is not by infection. The WHO interpretation is based on the Lopez *four-stage* linear model, which identifies smoking as an epidemic.<sup>7</sup> The Lopez model derived from historical data of male and female smoking over the last century when mass-production was introduced into industry, significantly affecting tobacco consumption and smoking-related mortality rates in developed western nations. These data have been used to predict future patterns of smoking-attributable mortality (e.g. emphysema and lung cancer). Lopez assumed his model was progressive and extrapolated from European and North American data to countries with very different economies and cultures. The only non-western data cited are from Singapore. International smoking behaviour has been shown to have regional patterns.<sup>8</sup> The subsequent WHO review placed individual nations within Lopez stages, and this classification is used in other studies of developing nations to indicate the stage of 'evolution' of smoking prevalence.<sup>9,10</sup> The common assumption across this literature is that developing countries will evolve similar patterns of male and female smoking to the historical trends in the developed nations. Lopez postulated that public health interventions might be more effective in the initial stages. This 'evolution' does not take into account the global marketing of tobacco and the fact that international companies strategically target regions and groups of consumers for increased uptake of smoking. There are also many socio-economic and cultural variables that might influence different male or female smoking patterns measured, between nations. These variations are found between countries within the same Lopez stage of progression.

Explanatory factors proposed in the past included:

- relative cost and affordability for low-income consumers;<sup>11,12</sup>
- political factors such as ideological diversity<sup>13</sup> and commitment to public health measures.<sup>14, 15</sup>

The authors were struck by marked gender differences in smoking reported in Southern Asian countries, and in some cases (e.g. China) these have not 'progressed' over time.<sup>16</sup> Cultural and religious influences on the position of women in each society could affect smoking decisions. In the 21<sup>st</sup> century, interest has arisen in the potential influence of Islam on smoking by believers, given modern knowledge of its damaging effect,<sup>17</sup> and differential economic effects on female and male smoking between the Canadian provinces.<sup>18</sup>

We aimed to investigate the influences of economic development on men and women using the most diverse international data accessible.

## Methods

### **Data sources**

Smoking prevalence statistics were derived from Globalink<sup>19</sup> in 2005, based on national data collected up to 2002 for a total of 134 countries (note: data sets were sometimes incomplete). For 121 nations, separate figures were given for the current percentage of adult male and of adult female smokers. For 12 nations, an aggregate percentage for male plus female smokers was provided. Employment statistics for men and women in these countries, where available (56 nations), were obtained from the International Labour Organization.<sup>20</sup> Figures for gross national income (US dollars per capita: 78 nations, range \$530–\$37,750) and for percentage annual growth (105 nations, range -11.0% – 15.2%) were taken from World Bank data.<sup>21</sup> Following external statistical scrutiny of our preliminary findings, we added national data on population size from the CIA's *The World Factbook*.<sup>22</sup>

### **Statistical analysis**

The existing model described historical trends in male and female smoking prevalence related to different 'stages' of national economic development. An initial exercise with 2002 prevalence data from Globalink was unable to fit many individual countries' levels of smoking (especially for women) with their 'stage' of national development. As an indicator of socioeconomic context, we added the dimensions of women in employment and rate of recent annual economic growth. Data were entered into an SPSS statistical database. An exploratory analysis using bivariate correlations (Pearson's  $r$ ) across all pairs of variables identified the strength and direction of possible relationships. This analysis was followed by linear regression of the parameter-pairs most strongly related to male or female smoking, and by a factor analysis (principle components) across all the complete data available (46 sets). Inspection of scatter-gram plots confirmed the general nature of inter-relationships and the variable of female employment appeared to separate into strata on such plots. Therefore we conducted a one-way analysis of variance across groups of nations banded by percentage female employment (20%-wide bands produced four distinct strata). These bands began at 12% employment (Jordan reported this lowest figure, with the highest rate at 80% for China). External advice had raised concerns about potential inhomogeneity of variance (heteroscedasticity<sup>23</sup>), so we repeated the inter-group comparisons using the nonparametric Kruskal-Wallis test. Because we were aware of potential threshold effects in cultural norms for female employment, we also performed t-tests on mean percentages of male and female smokers, for a range of female employment cut-offs. Percentage male employment varied much less than female employment, and as it did not prove an important variable for smoking, will not be detailed in the results below. Our statistical advice had queried the potential confounding effects of using nations with different size populations, but with multiple tests using all data or stratifications, no significant impact was detectable on any smoking variable, nor on female employment. Full data sets (e.g. annual percentage growth) were rarely present for the very smallest populations (only 2/17 nations with under 2 million inhabitants).

### **Results**

Income and percentage growth had different effects on male and female smoking. Women were more likely to smoke in countries with higher national income ( $n=72$ , standardized regression slope Beta  $\pm 0.293$ ,  $p=0.012$ ), but less likely to smoke in countries of rapid growth ( $n=97$ , Beta  $-0.371$ ,  $p < 0.001$ ). Men were less likely to smoke in countries with higher national income ( $n=72$ , standardized regression slope Beta  $-0.553$ ,  $p < 0.001$ ), but more likely to smoke in countries of rapid growth ( $n=97$ , Beta  $\pm 0.246$ ,  $p=0.015$ ). Figure 1 shows the national relationships with income and growth for men and Figure 2 for women.

Correlations suggested that percentage female employment related significantly to at least three other variables. Using a factor analysis (without rotation) reduced our six relevant variables to two principle components that together explained 62% of all the variance in the international data. The largest factor was positively correlated with the percentage of employed females ( $r=0.716$ ), the percentage of female smokers ( $r=0.427$ ) and national income per capita ( $r=0.800$ ), but negatively correlated with the percentage of male smokers ( $r=-0.833$ ) and percentage annual growth ( $r=-0.435$ ). The second, smaller component was positively correlated with percentage annual growth and negatively correlated with male employment, but only weakly correlated with the smoking variables. We also analyzed smoking in those countries that only reported aggregated data from both men and women and found no significant relationships with any other variables. The inclusion of population as a further variable in factor analysis confirmed that it had no relationship to the smoking variables.

The effect of female employment may not have been continuous across the observed range from 12% to 80%. Using four groups in 20% bands of female employment, one-way analysis of variance showed significant divergence between groups in terms of percentage female smokers. This stratified relationship with female smoking was confirmed with a test that is not sensitive to heteroscedasticity in data distributions ( $n=55$ , Kruskal-Wallis test  $df3$ ,  $p=0.034$ ). The highest levels of female smoking were in the group with employment between 52% and 61%, and the lowest levels in the employment stratum 32% to 51%.

Figure 1

National relationships of per capita income and growth to frequency of male smokers

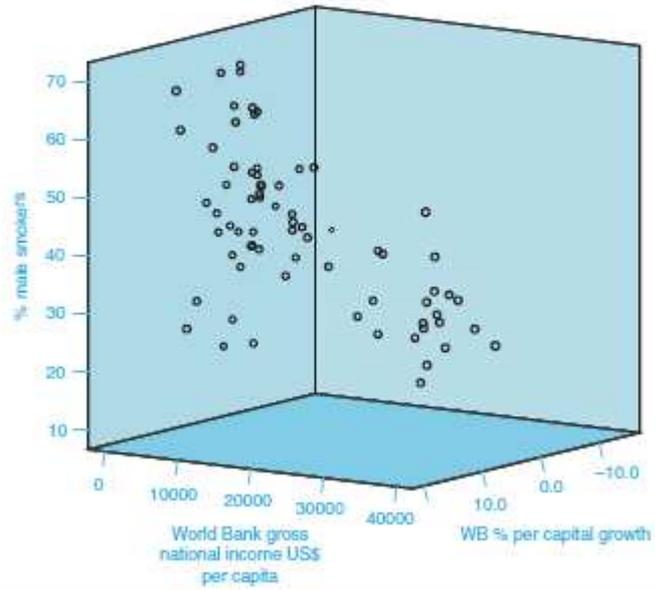
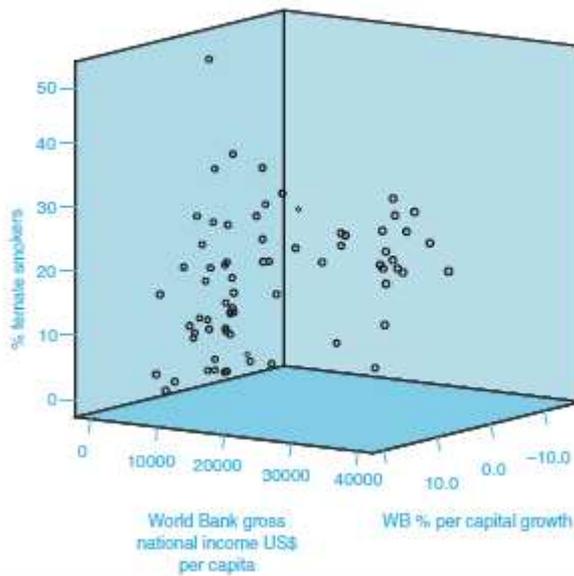


Figure 2

National relationships of per capita income and growth to frequency of female smokers



Using 51% as the employment cut-off point there were significant differences in the prevalence of female smoking (mean difference 8.02%, CI 2.21–13.82%, t-test  $p=0.008$ ) across 55 countries with complete data. At this 51% threshold for female employment, there was no significant difference in male smoking (t-test).

## **Discussion**

The Lopez model remains valuable in describing trends based on historical western records. However, we postulated that cultural factors such as restrictions on women's economic and social roles may influence smoking behaviour at the population level. Cross-sectional data were used to examine the relationship between smoking and other variables. We found that the percentage of women in employment helps explain some of the variation in both female and male smoking in relation to measures of economic development. The impact of female employment is greatest for smoking in women, but there may be a threshold for this effect at around 51% employment. Female employment is only an *indicator* of freedom or restriction within a society: a full description would include educational opportunities, family structures, religious norms and both group and individual behaviours. Female employment will also expose non-smoking women to additional (passive smoking) risk. We were unable to include measures of advertising and marketing strategies by international tobacco companies, but these are likely to vary with disposable income, social interactions and legal constraints. In poor countries with rapid economic growth, this manipulation of new markets may multiply our observed effect of growth on male smoking.

### ***Strengths and weaknesses***

The strength of this study is that we have used independent data sets to gain a fuller explanation of international patterns of smoking. These data derived from a wide range of cultures and all geographical regions. Our cross-sectional study explored patterns across different populations, not trends over time. These data have also been used with graphic effect in global mapping of smoking-related activities.<sup>7</sup> Future research should combine longitudinal and cross-sectional dimensions.

A limitation of this investigation is that many nations did not provide a complete data set. For example, countries reporting only aggregate prevalence of smoking across all adults did not show any consistent pattern. Internationally, the very poorest countries or those disrupted by war or political instability have not contributed data to our sample. There are other factors such as economic inequalities within a population that could influence the validity of our averaged economic measures between countries. We have used two economic measures and only a single socioeconomic indicator. Future studies might extend this to other measures such as literacy or regulatory structures.

## **Policy Implications**

Our study suggests that it is unwise to rely on a linear progressive model to predict the 'evolution' of smoking across diverse populations. More than one factor may determine growth in smoking prevalence, and there may be interactions between social and economic development variables. It has been suggested that re-evaluation of the damaging effects of smoking could dramatically impact on the cultural context for smoking in religious communities with prohibitions on the use of other drugs, such as alcohol. Although tobacco is not mentioned in any primary sources of Islamic law, some authorities have declared it either 'prohibited' or 'discouraged'. South Asian scholars, influential with British Muslims, have yet to declare prohibition.<sup>16</sup>

Changes in female employment could potentially amplify the uptake of smoking, especially in an environment of targeted marketing. The implication of this is that workplace 'no smoking' policies could play an important part in inhibiting the evolution of the 'pandemic' for employees, particularly women in developing countries where the majority of people live.

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