NIH Public Access
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Int J Comp Sociol. Author manuscript; available in PMC 2011 August 24.

Published in final edited form as:
Int J Comp Sociol. 2006 December ; 47(6): 466–487. doi:10.1177/0020715206070267.

Global Patterns and Determinants of Sex Differences in Smoking

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Abstract

The worldwide spread of tobacco use in recent decades raises questions about the relative prevalence of smoking among men and women. Does the degree of gender equality in nations promote equality in cigarette use? Does rising use of cigarettes by women stem from the stage of cigarette diffusion and earlier increases among men? Or have changes in economic factors and smoking policy affected the sexes differently? This study uses aggregate data for 106 nations, measures of smoking prevalence circa 2000, and lagged measures of gender equality, cigarette diffusion, and tobacco access to address these questions and evaluate the underlying theories. With the logged ratio of female to male prevalence as the dependent variable, regression results reveal that gender equality has inconsistent effects on women's smoking relative to men, cigarette diffusion has more consistent and moderately strong effects, and economic factors have weak effects. Global patterns of adoption of cigarettes by women appear most closely associated with the early adoption by men and then movement through a regular pattern of cigarette diffusion.

Keywords

cigarette diffusion; gender; global patterns; smoking

GLOBAL PATTERNS OF SMOKING

Although cigarette use has declined in high-income, more-developed countries, it has grown substantially in middle- and low-income, less-developed countries, and the potential for future growth remains high (Jha and Chaloupka, 2000; World Bank, 1999). To illustrate, cigarettes consumed per adult age 15 and over fell from 1970 to 1990 by nine percent in high-income nations and rose by 64 percent in middle- and low-income nations – a net increase in world consumption of 18 percent (World Health Organization [WHO], 1997). The pattern of change has continued since then. Today, about 82 percent of the world's 1.1 billion smokers reside in middle- and low-income countries (Sorensen et al., 2005).

However, these general trends hide considerable gender diversity in cigarette use across the world. In many high-income nations, smoking of men and women has moved toward parity (Forey et al., 2002). By contrast, smoking among women in middle- and low-income nations has generally remained uncommon (WHO, 1992). Today, about 35 percent of men in developed countries smoke and 50 percent in developing countries smoke (Mackay and Eriksen, 2002). For women, the pattern is reversed: about 22 percent in developed countries smoke and nine percent in developing countries smoke. These figures highlight a much larger sex gap in developing countries. To give a few examples, the percentages of male and female smokers equal, respectively, 51 and 18 in Mexico, 40 and seven percent in Zambia, 22 and two in Iran, and 29 and two in India (Mackay and Eriksen, 2002).

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The global spread of cigarettes obviously has implications for world health. The trends in the developing world will limit the benefits for longevity of other forces of development, medicine, and public health (Ezzati and Lopez, 2003a, 2003b). By some estimates, tobacco kills five million people each year, with about half the deaths occurring in developing nations (WHO, 2004). Even the relatively low rates of smoking among women in developing nations worry experts (Ernster et al., 2000) because of the potential for large future increases – and for harm to health. Such changes have begun to show, with recent trends suggesting that by 2025 smoking of women worldwide will rise from eight to 20 percent (Mackay, 1998).

Along with highlighting a serious public health problem, patterns of smoking among men and women across the world raise theoretical questions. Sex differences in smoking may relate to a variety of social and economic forces – gender equality, cigarette diffusion, economic development, trade, and public policy. However, previous research has done more to describe smoking prevalence of men and women across the world than to address questions about national sources of the differences (Ezzati and Lopez, 2003a, 2003b; Mackay and Eriksen, 2002; Ramström, 1997; World Bank, 1999; WHO, 1992, 1997). Of those studies that do examine determinants of cross-national patterns of smoking, nearly all focus on high-income nations (Graham, 1996; Lopez, 1995; Molarius et al., 2001; Nathanson, 1995; Pampel, 2001, 2003; Waldron, 2000). Few studies have examined global patterns of sex differences in cigarette use and included middle- and low-income nations along with high-income nations in cross-national studies. Questions about the sources of these sex differences thus remain unanswered.

This study examines the determinants of sex differences in cigarette use across nations in all regions and at all income levels of the world. In so doing, it presents several theories of differences in cigarette use among men and women, evaluates the theories with data for a worldwide sample of nations, and searches for robust determinants that apply across diverse national contexts.

EXPLANATIONS

Gender Equality

A common explanation of gender differences in smoking focuses on the degree of gender equality. Traditional female norms define smoking as inappropriate or unfeminine, and women either internalize those norms or otherwise face sanctions against smoking under the close social and family monitoring in traditional societies (Kaplan et al., 1990; Waldron et al., 1988). However, changes that integrate women into the world of work and social life outside the family weaken the normative protection from harmful behaviors such as smoking. In addition, changes in gender-based norms lead some women to use smoking as a symbol of liberation, unconventionality, and the rejection of values of safety, carefulness, and conformity (Nathanson, 1995). As gender equality increases, the growing affluence of women and their opportunity to participate in male activities combine with increased attraction to newly allowed behaviors to make smoking of women more similar to that of men (Warner, 2005).[1]

Consistent with these claims, a review of ethnographic studies in Africa, Asia, the Pacific, and Latin America (Waldron et al., 1988: 1269) concludes, ‘Men have often had greater

[1]The harm to women’s health that, according to the argument, results from gender equality would counteract its more general benefits for female health. A large literature on development and demographic change views the improved status and empowerment of women as vital to the advancement of their health and well-being (see Mason, 1993, 1997, and Riley, 1997 for overviews of this literature). Yet, if gender equality leads to the adoption of cigarettes, it would also have negative health consequences.

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social power than women, and this has been expressed in greater restrictions on women's behavior, including social prohibitions against women's smoking … [and these restrictions] have been a major cause of gender differences in tobacco use.' Suggesting the importance of changes in women's status for changes in women's smoking, the volume *Women and Smoking* (Department of Health and Human Services [DHHS], 2001: 135) states, 'Social norms and customs have acted to discourage smoking among women and girls, and prevalence only begins to rise when these taboos are weakened.' If gender norms deter female adoption of the habit in many societies, then greater independence and desires for a cosmopolitan, autonomous lifestyle among women in other societies should increase their attraction and access to smoking (WHO, 1992).

Waldron (2000) offers a variant on this argument by suggesting that smoking among women in high-income nations rises because it is consistent with the importance of traditional gender roles in contemporary conditions. For example, use of smoking for weight control is compatible in modern societies with the contemporary social acceptance of female cigarette use and the traditional emphasis on appearance among females. She therefore predicts, like the gender equality hypothesis, an increase in relative female smoking with gender role modernization. In support of the hypothesis, she finds evidence that sex differences in mortality from lung cancer have declined over time in high-income nations.

Other tests of the gender equality argument in high-income nations have, however, offered less support. Pampel (2001) finds in an analysis of cross-national survey data for the European Union that smoking prevalence of men and women has little relationship to national measures of gender equality. Similarly, Pampel (2003) finds that relative rates of male and female lung cancer deaths in high-income nations from 1950–2000 have little relationship to measures of gender equality.

Given the mixed evidence for high-income nations, it may be that gender equality explains current differences among middle- and low-income nations better than differences among high-income nations. Nathanson (1995) argues that smoking emerges first among independent women working outside the home, but any association between female independence and smoking disappears as the habit spreads to large parts of the female population. Her review of the literature supports the argument, finding that gender equality is important as women first obtain the freedom to adopt cigarettes but is less important as both equality and smoking grow further. Based on this reasoning, a revised version of the argument suggests that gender equality will have greater influence in middle- and low-income nations at earlier stages of the movement toward gender equality and the adoption of smoking (Waldron, 1991). The influence will, in contrast, be smaller in high-income nations where equality has reached higher levels and smoking has become common.

Cigarette Diffusion

Another argument combines work from two literatures – the epidemiology of smoking and the diffusion of innovations – to explain gender differences in smoking (Borras et al., 2000; Ferrence, 1989; Lopez et al., 1994; Molarius et al., 2001; Pampel, 2001). The epidemiological literature describes a general process of change by noting that smoking spreads in a form analogous to an epidemic from relatively small parts of a population to other parts, and then eventually recedes. In the early stages, smoking emerges first among high status persons, who are most open to innovations. During middle stages of the process, smoking diffuses to other parts of the population, reaching peaks around 50–80 percent (Lopez et al., 1994). In the later stages, smoking declines first among high status persons, who become concerned with health, fitness, and the harm of smoking, and separate themselves from other groups by their rejection of smoking and adoption of healthy lifestyles. This descriptive pattern of adoption, diffusion, and abatement (referred to, in

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short, as cigarette diffusion) involves the rise, leveling off, and decline (but not disappearance) of smoking.

A large literature on diffusion of innovations likewise recognizes the tendency for high status groups to most quickly adopt new ideas and behaviors (Katz, 1999; Rogers, 1995; Strang and Soule, 1998). The diffusion of the use of manufactured cigarettes, both a technological and cultural innovation (Griswold, 1994), follows such a status-based pattern (Ferrence, 1989). High status groups (led, ironically, by physicians, Lopez et al., 1994) begin smoking earlier than the general public. Smoking spreads first within high status networks, but later patterns of imitation lead to diffusion of the practice and normative change across classes and down the status hierarchy. As smoking diffuses to lower status groups, however, new concerns about health emerge among higher status groups, who are among the first to reject smoking (again led by physicians and also speeded by the negative publicity about the harm of smoking). This process relates to the more general use of resources by high status groups to maintain health advantages over lower status groups (Link and Phelan, 1995). The later diffusion of smoking to lower status groups, and the adoption of innovative health-promoting behaviors by high status groups serve to concentrate smoking among low status groups (Pampel, 2005).

Gender plays a role in this diffusion process. Although a similar pattern of change fits women and men, the process of cigarette diffusion among women typically lags a decade or two behind men (DHHS, 2001; Lopez, 1995). The *difference* in smoking between men and women therefore follows a somewhat more complex pattern of cigarette diffusion. Since men adopt cigarettes before women, the earliest stage shows a rising gap between men and women. In the middle stage, smoking among men levels off while it rises more quickly among women (particularly young and high status women), and the gap stops growing. In later stages, smoking continues growing among women as it declines among men, and the gap narrows. Eventually, smoking will peak and then decline among women as it does for men. From this perspective, smoking of women is most closely associated with earlier adoption by men and an advanced stage of diffusion.

The diffusion argument applies similarly to high-, middle-, and low-income nations. High-income nations generally began the diffusion process earlier and have reached more advanced stages than middle- and low-income nations. The high-income nations therefore should show a smaller gap in smoking between men and women than middle- and low-income nations. In addition, differences exist within these groups of nations. Among high-income nations, the northern European nations and the United States adopted smoking and advanced further in the diffusion process than southern European nations and Japan (Pampel, 2001, 2003; Trovato and Heyen, 2003). The middle- and low-income nations also differ among themselves in the cigarette diffusion process. For example, Malaysia and Tunisia reached a level of 3.3 cigarettes consumed per person per day by 1970, while Cambodia and Egypt did not reach that level until 1990 (WHO, 1997). The variation in the stage of the epidemic both between and within these groups of nations should help explain gender differences in smoking.

Economic Factors

Besides gender equality and cigarette diffusion, more general economic factors related to development, trade, and tobacco production may affect the smoking of men and women. First, by raising disposable income, economic development may allow larger portions of the population to purchase cigarettes (Jha and Chaloupka, 2000). Second, urbanization may increase the ability to purchase cigarettes and the freedom from rural anti-smoking norms and traditions. Third, liberal trade policies that increase the entrance of multinational corporations to markets may increase the supply and reduce the price of cigarettes (Sklair,

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1998); conversely, local monopolies may restrict the supply of cigarettes, the competition for sales, the price of cigarettes, and the prevalence of smoking (Ayukawa, 2001; Taylor et al., 2000). Such trade ties may also reflect cultural ties to western nations through media, advertising, and entertainment that influence citizens to adopt smoking (DHHS, 2001; Sugarman, 2001). Fourth, access to handmade products in tobacco-producing nations will affect the propensity to smoke. In nations such as Zimbabwe, China, and Lebanon that devote relatively high percentages of agricultural land to tobacco, citizens may have easier access to tobacco and be encouraged to smoke as an aid to economic development.

Although applied most directly to the level of cigarette use in a nation, these arguments have some relevance to smoking of women relative to men. One might reason that the more limited the access of a population to cigarettes, the more the dominant group will keep control of the scarce resource and the more likely it will be that men smoke more than women. By making cigarettes more accessible to all the population, the forces of economic development, urbanization, world trade, and tobacco production will increase smoking more among less dominant groups such as women. For example, greater income and the ease of buying cigarette products in cities will most favor women, a group that traditionally has had less access to tobacco, and reduce the gap in smoking between males and females. Similarly, to the extent that foreign trade increases access of national populations to cigarettes, it will do most to change the low smoking rates of women and reduce sex differences in smoking. Still further, handmade products in tobacco-growing nations give greater access to women who lack personal income to buy manufactured cigarettes and should reduce sex differences.

Smoking Policies

Governments may restrict cigarette use through public policy. Legal restrictions on advertising and sales that take the form of bans on advertising, bans on sales to minors, restrictions on stores able to sell the products, restrictions on smoking in buildings, regulation of ingredients, and requirements for labels and packaging may reduce smoking (DHHS, 2000). High cigarette prices brought about largely through government taxes may also reduce smoking (Jha and Chaloupka, 2000; World Bank, 1999; WHO, 1997). These arguments again relate most closely to the absolute level of smoking in a nation but may also affect the sexes differently. Government restrictions on tobacco use and high cigarette prices may do more to discourage the already high smoking among males than among low smoking females and thereby reduce sex differences in smoking. Alternatively, they might prevent women from ever starting and help maintain a wide gap but even so are more likely to affect the higher rate of smoking among men.

Hypotheses

The theoretical arguments predict that, across nations throughout the world, gender equality, cigarette diffusion, economic development, trade, tobacco production, and government policy restrictions will raise the use of cigarettes among women relative to men. In addition, the influence of these factors may differ between high-income and other nations. A variant on the gender equality argument suggests that changes in women's status should most influence smoking at the early stages of movement toward independence and at low levels of female cigarette use. If so, the effects may emerge more strongly in middle- and low-income nations than high-income nations. The other explanations do not specify contingent hypotheses but predict similar effects across nations at all income levels and with diverse cultural backgrounds.

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METHODS

Nations

The aggregate data on nations of the world analyzed in this study come from published figures for (in most cases) the 106 nations listed by region in Table 1. Because this non-random sample is weighted toward nations with high income and established data-gathering procedures, the results may be biased toward relationships in the developing world. At the same time, however, the nations include all regions, levels of development, and levels of cigarette use, and contain 5.6 billion people, over 90 percent of the world's population.

Smoking Prevalence

Figures on the percentages of males and females who smoke come from the second edition of the Tobacco Control Country Profiles (TCCP) compiled by the American Cancer Association for the latest year available, usually the late 1990s or early 2000s (Shafey et al., 2003) and supplemented with data reported in Mackay and Eriksen (2002). The figures come largely from separate national surveys rather than from a single set of standardized instruments. The surveys may as a result differ in design, measures, samples, and quality, but three means exist to address national differences in methodology. First, comparing males and females deals with the problem to the extent that national biases and idiosyncrasies apply to both sexes and cancel out in measuring gender differentials. Second, the data contain information on the characteristics and questions of the surveys that can be used to control for measurement bias. Third, the results can be replicated with an alternative source. The WHO (1997) presents measures of male and female smoking prevalence around 1990 that, although less recent and available for only 72 nations, do more than the TCCP data to standardize and adjust the measures for comparability.

In most cases, the surveys measure current cigarette smoking of adults ages 18 and over for the complete population. However, some surveys deviate from this standard. Separate dummy variables are created from information provided by the TCCP to measure 1) if the sample is based on urban residents or those in a major city rather than the full population, 2) if the definition of smoking requires daily use rather than any recent use, and 3) if the definition includes use of other tobacco such as indigenous products, pipes, and chew. Also, a variable measures year of survey, since some of the data come from earlier years than others. Lastly, two variables measure the lower age and the upper age of the survey respondents. However, when all these variables are included in the models, only the dummy variable for inclusion of other tobacco in survey questions significantly influences sex differences in smoking: broadening the definition of tobacco reduces the gap in smoking between men and women, as women in agricultural areas are likely to use non-cigarette products (Waldron et al., 1988). This variable remains in the final models presented in the tables, while the other measurement variables with insignificant effects are not included.

Gender Equality

No consensus exists on a single best measure of gender role equality when making comparisons across the world and, if it did, ideal measures would likely remain unavailable for many nations. One measure, the total fertility rate, is available for nearly all countries (World Bank, 1983, 1993; World Resources Institute, 2003), relates to the independence of women from family duties and patriarchal family norms, and reflects changes in women's status. Although low fertility alone does not guarantee gender equality, it increases non-traditional opportunities for education, labor force participation, and other activities outside the family. It also has a correlation of −.85 with a gender equality index constructed for 2000 (United Nations, 2001) but is more easily measured and is available for more nations and previous decades. Other measures, although available for fewer years and nations, may

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also reflect gender equality: the female percentage share of the literate population (World Resources Institute, 2003), the female share of tertiary school enrollment (World Resources Institute, 2003), the female share of the non-agricultural labor force (World Bank, 2003), and the female share of the legislature (United Nations, 2001). Because the dominant religion in a nation may also proscribe traditional gender roles for women, a measure of Islamic influence gives nations a score of 3 if the religion comprises 75 percent or more of the population, 2 if it comprises 25–74 percent, and 1 if it comprises 0–24 percent (Nationmaster.com, 2003).

Cigarette Diffusion

Published sales-based figures on daily cigarette consumption per capita exist for the nations in 1970, 1980, 1990 (WHO, 1997), and 2000 (Shafey et al., 2003). The consumption of cigarettes rises and falls over time with diffusion, but, in regard to national comparisons, the absolute level of cigarette use may fail to correctly reflect the stage of diffusion. Because of differences in prices, laws, and culture, some nations will peak at higher levels of consumption than others, and measures need instead to focus on the timing of a nation's movement through the process of cigarette diffusion rather than on the level of cigarette use.

One useful measure focuses on changes in consumption. Those nations at early stages of the epidemic will show growth as cigarette use spreads to larger segments of a population; those at middle stages will show little growth as cigarette use comes close to its peak; and those at late stages will show negative change as cigarette use begins to abate. The specific measure thus equals the daily per capita cigarette consumption in 2000 minus the consumption in 1970. Large values on the measure reflect positive growth and an earlier stage in the spread of cigarettes, while small values reflect negative change and a late stage in the spread of cigarettes. Defining an inverse relationship, large values and growth should be associated with lower female smoking relative to males, and small values and decline should be associated with higher relative female smoking.

Although available for a diverse group of nations, the change in cigarette consumption certainly contains measurement error. For example, the pace of change in cigarette use may not correspond fully to the stage in cigarette diffusion. If some nations will peak at high levels of cigarette use, then large growth in consumption may not yet indicate movement to an advanced stage of diffusion and the spread of smoking to women; conversely, a small growth in consumption in nations that will peak at low levels of cigarette use may not yet indicate an early stage of diffusion. If so, the measurement error of the cigarette change measure will weaken the magnitude of the effects it can have, and the models using the measure will present a stringent test of its influence.

Economic Factors

Gross domestic product (GDP) per capita in thousands of US dollars, treated in logged form in the models, comes from the TCCP webpage (Shafey et al., 2003). Urbanization or the percentage of the population living in cities comes from the World Bank (1983, 1993). The level of trade is measured by the sum of imports and exports divided by gross national product (World Bank, 1983, 1993). Access to handmade products in tobacco-producing areas is measured by tobacco production in tons per capita (Mackay and Eriksen, 2002).

Smoking Policies

Government restrictions are measured by a scale constructed from nine items (alpha = .722) on the existence of advertising, sales, and indoor smoking bans and regulations (Shafey et al., 2003). The high cost of cigarettes is measured by the price of a pack of Marlboros relative to average wages (Mackay and Eriksen, 2002).

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Models

The models examine smoking of females relative to males in the form of logged ratios of the percentage female smokers to the percentage male smokers. With female rates in the numerator and male rates in the denominator, a high ratio indicates greater female smoking relative to male smoking. Taking the log eliminates the influence of choosing one denominator over the other. The logged ratio, unlike the unlogged ratio, gives identical coefficients (except in sign) when using female prevalence as the denominator. Otherwise, changing the denominator changes the implicit standard of comparison, can alter the scale of the ratio values, and makes results dependent on an arbitrary choice.[2]

With the dependent variable measured for adults circa 2000, the independent variables should be measured in earlier decades. Since adult smoking often depends on choices made to start tobacco use when young, current smoking among adults should depend on conditions that affected choices in earlier decades. Earlier conditions shape current prevalence because once youth start smoking, the habit typically continues for decades to come. Consistent with this reasoning, examining the effects of the total fertility rate in 1970, 1980, 1990, and 2000 showed that the measure for 1970 had the strongest relationship. Similarly, the change in cigarette consumption between 1970 and 2000 had a stronger relationship than changes over more recent time periods. Although the models ideally use independent variables lagged 30 years to 1970, the measures of female literacy share, tertiary education share, and labor force share are available beginning in 1980 and female legislative share is available only in 2000, thereby shortening or eliminating the lags. Otherwise, measures of GDP, urbanization, and trade are lagged to 1970, while tobacco production, regulations, and cost are available only for recent years.

It makes sense methodologically to examine models with some controls for regional, cultural, and historical differences that are not captured in the observed measures. That gender equality is on average higher and sex differences in smoking are on average lower in Europe and other high-income nations than elsewhere in the world is not surprising given the distinct backgrounds of these nations. Yet, not all of these differences can be measured directly. Without controls of some sort for background factors that might contribute to the differences between western and other nations, analysis of all nations combined may produce spurious relationships. One approach to reduce potential spuriousness is to simply include a dummy variable control for European and other high-income nations. Robust determinants of sex differences in smoking should have effects that hold with this control and show relationships within as well as between high-income nations and middle- and low-income nations.

Estimation

The models are estimated with ordinary least squares but calculate White-corrected, robust standard errors to adjust for possible heteroscedasticity (Greene, 1999) that in this sample may stem from the diverse sizes of the populations and economies. The unstandardized coefficients show the change in the logged ratio for a unit change in the independent variables, but the formula $100*(1 - e^{b})$ translates the coefficients into more meaningful units of the percentage change in the ratio of female smoking to male smoking. To compare the relative sizes of the effects of variables and the relative influence of the processes specified by the explanations, the tables present standardized coefficients along with unstandardized coefficients and robust standard errors.

[2]The correlation of the ratio of female smoking to male smoking with the ratio of male smoking to female smoking equals only −.72, but the correlation of the logged female to male ratio with the logged male to female ratio equals −1.00.

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RESULTS

Table 2 compares the central variables across regions. The means for percentage female smokers reach the highest levels in Western and Eastern Europe, while the mean for percentage male smokers is lowest in Western Europe. Taking the ratio of female to male smoking reveals the highest values in Western Europe and the lowest values in Asia and the Middle East. The mean logged ratios change the scale but reflect the same pattern. All values fall below zero because female percentages are smaller than male percentages, but the mean comes close to zero in Western Europe (indicating high female smoking relative to male smoking) and near –1.9 in Asia and the Middle East (indicating low female smoking relative to male smoking). Based on the means in Table 2 for the other variables, the regions with the smallest gap and highest relative percentage of female smokers also have the lowest fertility, greatest decline in cigarette consumption, and highest national income.

Table 3 examines the multivariate relationships of cigarette change and gender equality for all 106 nations. With a dummy variable control for nations that include non-cigarette forms of tobacco in their usage surveys, both cigarette change and fertility have significant and similarly strong effects.[3] The negative sign of cigarette change indicates that positive growth lessens female smoking relative to male smoking, as the adoption of cigarettes at the early stage of diffusion involves males more than females. Negative growth that occurs at later stages of diffusion, however, raises smoking of females relative to males. The negative effect of the total fertility rate indicates that involvement of women with childbearing and family roles lowers relative female smoking, while independence from childbearing and family roles raises relative female smoking. As revealed in the remaining columns in Table 3, other measures of gender equality – female tertiary enrollment share and female legislative share – raise relative female smoking, while the measure of Islamic religion lowers female smoking.

Table 4 evaluates the robustness of these results by adding a simple control variable equal to one for the western and high-income nations and equal to zero otherwise. If the effects of cigarette change and gender equality are real, they should have effects even when controlling for differences in smoking across these two broad groups of nations. Not surprisingly, the net effect of the dummy variable increases female smoking relative to male smoking. More tellingly, the effects of cigarette change remain, while those of gender equality weaken considerably. Only the measures of female membership in parliament and the measure of Islam remain significant. The total fertility rate and female share of tertiary education drop to near zero, and female literacy share and labor force share remain insignificant.

Table 5 tests the argument that the effects of gender equality may be stronger in middle- and low-income nations than in western and high-income nations. The models include interaction product terms between the dummy variable and each of the gender equality measures.[4] Most of the results show no difference in the effects across nations – they are small in both groups. One exception, the female share of the labor force, unexpectedly has a negative effect in high-income nations – contrary to predictions. Except for the measure of Islam, the influence of gender equality on smoking seems weak within both sets of nations rather than stronger in middle- and low-income nations.5

[3]Deletion of cases with large residuals or high influence and use of robust estimation to minimize the influence of these cases do little to change the results.

[4]No significant interaction exists between cigarette change and the dummy variable for western and high-income nations; the effects of cigarette change are statistically identical and equally influential across the two groups of nations.

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The last columns of Tables 3, 4, and 5 list coefficients for selected models based on 1990 data that have been adjusted to improve comparability. In Table 3, the effects of both cigarette change and total fertility are similar to the first model, although the sample size is smaller. In Tables 4 and 5, with additive and interaction coefficients to distinguish high-income nations, only cigarette change is significant. These results confirm those for the larger and more recent sample of nations.

Table 6 considers the influence of economic and policy variables with controls for cigarette change, the dummy variable for western and high-income nations, and the female share of parliament (the indicator of gender equality that proves strongest in the additive models). Of the coefficients for GDP, urbanization, foreign trade, local tobacco production, restrictions on smoking, and cigarette prices, none reaches statistical significance.[6] The influence of the variables thus appears similar for both males and females. Other evidence, however, suggests the possible importance of GDP. In the results for the sub-sample of cases with data for 1990 (column 7), the effect of GDP becomes significant, while the effect of cigarette change falls to insignificance. The results for the smaller sample and earlier period appear highly influenced by a few outlying cases and less reliable than for the larger sample and more recent time period. However, they provide some evidence for the importance of GDP and some evidence against the importance of cigarette change.

DISCUSSION

The analysis of sex differences in smoking across nations of the world reveals generally consistent effects of a measure of cigarette diffusion, mixed effects of measures of gender equality, possible effects of GDP, and limited effects of other economic and policy factors. Given measurement error inherent in aggregate data across a diverse set of nations and the potential for sensitivity to the nations and variables used in the models, the search for robustness in results becomes critical to the conclusions. First, gender equality increases smoking among women relative to men in a sample of all nations across the world but most indicators have little meaningful influence with a simple dummy variable control for western and high-income nations or within groups of nations defined by region and income level. Only the female share of parliament and a measure of Islam affect smoking with the control. Second, cigarette change remains influential with the dummy variable control and within groups of nations. The effect disappears in one model for a smaller sample of nations in 1990 and with controls for GDP. Third, the effects of GDP appear only in the smaller 1990 sample and may overlap with cigarette change in its influence on female smoking. Fourth, other variables such as foreign trade, tobacco production, government restrictions, and cigarette prices have little influence on relative levels of female smoking.

These findings cast some doubt on the causal impact of most components of gender equality. To the extent that relationships with female smoking exist for female childbearing, education, literacy, and work, they appear to reflect more general distinctions between western and high-income nations and all other nations. Due to a variety of historical and cultural background factors, western nations have both higher female smoking and higher gender equality, but within western and non-western nations, most indicators of gender equality do not lead to high smoking. Only the measures of female share of parliament and of Islam show consistent influence.

[5]Additional tests disclose much the same findings. Allowing the effects of the gender equality measures to vary across nations divided by low and high fertility (a way to examine if the effects of gender equality decline at high levels) also shows weak effects within groups of nations. Similarly, treating the gender equality variables as quadratics to test more directly for non-linearity does not support the variant nonlinear version of the gender equality arguments.

[6]The effects do not differ significantly between western, high-income nations and other nations.

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The findings offer more, though not complete, support for the cigarette diffusion argument that the more advanced the stage of diffusion, the higher the smoking of women relative to men. The cigarette epidemic begins among men but eventually spreads to women, thus producing a relationship in which rising cigarette consumption in the early stages increases smoking among men relative to women, while declining cigarette consumption in the late stages increases smoking among women relative to men. Cigarette diffusion, although based on a measure of consumption trends that does not distinguish between male and female cigarette use, nonetheless serves to raise female smoking while lowering male smoking. Social approval or disapproval of female smoking and enforcement of related restrictions no doubt affect women's adoption of the habit. More important, however, is the question of what drives changes that increase approval and reduce restrictions. The results found here indicate that diffusion of cigarette use and high levels of male smoking do more to ease restrictions on female smoking than movement toward gender equality in most other areas of social life. This suggests that women in developing nations are generally most at risk of increasing cigarette use when male use is high.

Despite the ability of these global comparisons to help identify the nations most vulnerable to rising relative levels of female smoking, the aggregate-level data are limited in several ways. Unlike individual-level data, they do not distinguish among the groups of women within nations most likely to adopt the habit. In addition, cross-national surveys of cigarette prevalence face problems of comparability. The analysis attempts to control for measurement error related to definitions and samples, minimize bias by comparing male and female smoking, and validate the results using alternative measures and searching for robust effects. Still, additional efforts are needed to improve the quality of global figures on smoking prevalence, particularly among low-income nations. Similarly, measures of women's status and cigarette diffusion are rudimentary, and measurement error no doubt weakens the observed relationships. The understanding of global patterns of sex differences in smoking would benefit from development of better indicators for a fuller sample of nations.

The models also face limitations in regard to timing of the effects. Starting to use cigarettes is a cohort-based behavior – most smokers begin as teens or young adults and carry the habit through adulthood. This means that the samples of all adults in a country encompass a variety of cohorts that began smoking during different time periods. Because most adults started smoking many years earlier, lagged variables help capture past conditions that influence the outcome of relative female smoking (indeed, the lagged variables work better than contemporaneous variables in the models). However, given the mix of ages and cohorts in the population, the lags used in the models offer only a crude summary; the lags might be longer for older cohorts and shorter for younger cohorts. Age-specific data, although not available for most middle- and low-income nations, would help rectify this problem.

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Biography

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Table 1

List of nations by region

Region	Nations
Western Europe and high income	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States
Eastern Europe (former communist)	Albania, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Macedonia, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine, Yugoslavia
Sub-Sahara Africa	Cote d'lvoire, Ghana, Kenya, Nigeria, Malawi, Mauritius, Rwanda, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe
Americas	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Trinidad, Uruguay, Venezuela
East Asia and Pacific Islands	Bangladesh, Cambodia, China, Fiji, Korean Republic, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam
Middle East and North Africa	Algeria, Armenia, Azerbaijan, Egypt, Iran, Iraq, Israel, Jordan, Kazakhstan, Kuwait, Morocco, Saudi Arabia, Syria, Tunisia, Turkey, Yemen

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Table 2

Means by region for smoking and determinants

Variables	Africa	Asia	Americas	Middle East	East Europe	West Europe	All nations
% female smokers	8.2	9.6	18.0	9.0	20.9	23.4	15.6
% male smokers	33.3	46.1	37.9	44.6	47.2	30.1	39.5
Ratio (% female/% male)	.252	.214	.476	.203	.474	.793	.428
Logged ratio	−1.70	−1.88	−.82	−1.93	−.88	−.27	−1.17
Total fertility rate 1970	6.74	5.43	5.36	6.09	2.71	2.47	4.65
Female share literacy 1980	36.4	40.4	47.9	35.2	48.4	49.7	43.7
Female share tertiary ed. 1980	21.0	31.1	40.8	35.5	50.5	43.8	37.6
Female share labor force 1980	30.8	32.4	36.2	23.9	44.5	37.6	34.7
Female share parliament 2000	12.5	12.0	13.2	5.6	11.3	25.0	14.3
Islam (l=low to 3=dominant)	1.46	1.44	1.00	2.62	1.12	1.00	1.40
Δ Cig. Cons. 2000 – 1970	−1.52	0.52	−4.91	−0.15	−4.80	−7.74	−3.51
GDP per capita 1970	1.69	2.63	4.38	6.66	6.50	14.6	6.54
% Urban 1970	20.3	27.9	51.0	48.4	47.4	70.2	46.3
Foreign trade/GDP 1970	53.8	32.1	42.9	41.4	26.3	53.1	41.9
Tobacco production/pop.	2.54	.97	1.04	.74	2.11	1.01	1.32
Smoking restrictions	−.67	−.17	.07	−.17	.40	.30	.00
Cigarette price/GDP	1.04	.90	.33	.46	.21	.25	.49
N	13	18	21	16	16	22	106

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Table 3

Unstandardized regression coefficients, standard errors, and standardized regression coefficients for determinants of the logged ratio of female to male smoking, circa 2000

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Definition: any tobacco	.861**	.705**	.799**	.659**	.747**	.630**	
	.144	.169	.190	.200	.201	.186	
	.234	.201	.222	.171	.186	.171	
Δ Cigarette consumption 2000–1970	−.045**	−.049**	−.049**	−.059**	−.049**	−.049**	−.047**
	.011	.013	.012	.013	.012	.012	.017
	−.302	−.334	−.338	−.383	−.341	−.326	−.273
Total fertility rate 1970	−.159**						−.228**
	.040						.032
	−.345						−.475
Female share literacy 1980		.026					
		.015					
		.234					
Female share tertiary education 1980			.023*				
			.009				
			.288				
Female share labor force 1980				.011			
				.008			
				.145			
Female share parliament 2000					.038**		
					.008		
					.387		
Islam (l=low to 3=dominant)						−.395**	
						.118	
						−.313	
Constant	−.651	−2.511	−2.221	−1.861	−1.906	−.883	−.101
R^2	.302	.254	.273	.214	.350	.289	.345

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Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
N	106	97	85	97	94	106	71

[a] Model using 1990 data for the dependent variable;

* $p < .05$,

** $p < .01$.

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Table 4

Unstandardized regression coefficients, standard errors, and standardized regression coefficients for determinants of the logged ratio of female to male smoking, circa 2000, with control for western and high-income nation dummy variable

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Definition: any tobacco	1.011**	.971**	1.008**	1.086**	.951**	.928**	
	.191	.178	.201	.220	.203	.181	
	.275	.277	.280	.282	.237	.253	
Δ Cigarette consumption 2000–1970	−.037**	−.037**	−.034**	−.038**	−.032**	−.031**	−.043**
	.010	.010	.010	.011	.011	.010	.014
	−.249	−.254	−.237	−.245	−.226	−.209	−.249
Western and high-income nation dummy variable	.991**	.866**	.932**	1.003**	.727**	.825**	.793*
	.241	.173	.203	.158	.154	.150	.381
	.521	.449	.487	.520	.394	.434	.441
Total fertility rate 1970	.017						−.059
	.061						.087
	.038						−.122
Female share literacy 1980		.006					
		.014					
		.054					
Female share tertiary education 1980			.005				
			.010				
			.061				
Female share labor force 1980				−.003			
				.008			
				−.037			
Female share parliament 2000					.025**		
					.008		
					.251		
Islam (l=low to 3=dominant)						−.241*	
						.115	
						−.191	

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Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Constant	−1.806	−1.917	−1.851	−1.670	−1.954	−1.303	−.155
R^2	.403	.400	.426	.413	.460	.433	.414
N	106	97	85	97	94	106	71

[a] Model using 1990 data for the dependent variable;

* $p < .05$,

** $p < .01$.

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Table 5

Unstandardized regression coefficients, standard errors, and standardized regression coefficients for interactive models of the logged ratio of female to male smoking, circa 2000

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Definition: any tobacco	1.011**	.972**	1.018**	1.019**	.951**	.926**	
	.191	.179	.193	.216	.210	.182	
Δ Cigarette consumption	−.037**	−.035**	−.030**	−.041**	−.032**	−.031**	−.043**
	.010	.011	.011	.011	.010	.010	.014
Western and high-income nations	1.017**	.610**	1.129**	1.179**	.727**	.861**	.537
	.205	.162	.180	.139	.155	.169	.409
Total fertility rate 1970	.014						−.030
	.073						.093
Western * total fertility rate	.018						−.207
	.100						.205
Female share literacy 1980		.005					
		.014					
Western * female share literacy		.048					
		.026					
Fem. share tertiary education 1980			.010				
			.012				
Western * female share tertiary			−.028				
			.018				
Female share labor force 1980				.004			
				.008			
Western * female share labor force				−.044**			
				.014			
Female share parliament 2000					.025		
					.017		
Western * female share parliament					−.000		
					.018		
Islam (l=low to 3=dominant)						−.245*	

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Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
						.120	
Western * Islam						.115	
						.325	
Constant	−1.721	−1.657	−1.639	−1.670	−1.601	−1.638	−1.434
R^2	.403	.401	.438	.447	.460	.433	.422
N	106	97	85	97	94	106	71

[a]Model using 1990 data for the dependent variable;

*$p < .05$,

**$p < .01$.

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Table 6

Unstandardized regression coeffcients, standard errors, and standardized coefficients for economic and policy determinants of the logged ratio of female to male smoking, circa 2000

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Definition: any tobacco	.968**	.955**	1.096**	.854**	.952**	1.082**	
	.201	.174	.176	.257	.201	.226	
	.241	.238	.259	.213	.237	.294	
Δ Cigarette consumption 2000–1970	−.028**	−.026*	−.042**	−.034**	−.032**	−.033**	−.009
	.011	.010	.010	.011	.011	.010	.014
	−.198	−.181	−.293	−.240	−.226	−.243	−.057
Female share parliament 2000	.024**	.023*	.020*	.027**	.025**	.027**	.017**
	.008	.009	.009	.008	.008	.009	.006
	.244	.233	.199	.271	.251	.279	.195
Western and high-income nation dummy variable	.649**	.670**	.728**	.688**	.719**	.817**	.298
	.195	.159	.171	.157	.172	.207	.179
	.352	.363	.397	.372	.390	.426	.170
GDP per capita 1970 (logged)	.078						.468**
	.133						.164
	.088						.474
% urban 1970		.005					
		.004					
		.123					
Foreign trade/GDP 1970			.001				
			.004				
			.035				
Tobacco production/population 2000				.034			
				.024			
				.118			
Smoking restrictions 2000					.016		
					.143		
					.010		

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Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)[a]
Cigarette price/GDP 2000						−.091	
						.181	
						−.048	
Constant	−2.016	−2.108	−1.979	−2.018	−1.951	−2.024	−2.255
R^2	.463	.470	.490	.473	.460	.578	.570
N	94	94	84	93	94	70	64

[a]Model using 1990 data for the dependent variable;

*p<.05,

**p<.01.