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Tobacco use in sub-Sahara Africa: Estimates from the demographic health surveys*

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Abstract

Despite the growing problem of global tobacco use, accurate information on the prevalence and patterns in the world's poorest nations remains sparse. For sub-Sahara Africa, in particular, a weak knowledge base limits the targeting of strategies to combat the potential growth of tobacco use and its harmful effect on future mortality. To describe the prevalence and social patterns of the use of cigarettes and other tobacco in Africa, this study examines population-based data from 16 Demographic Health Surveys (DHS) of men aged 15–54 years and women aged 15–49 years in 14 nations. Descriptive statistics show the highest cigarette use among men in several nations of east central Africa and Madagascar, lowest use in nations of west central Africa, and medium use in nations of southern Africa. Multinomial logistic regression results for men show highest cigarette use among urban, less educated, and lower status workers. Results for women show much lower prevalence than men but similar social patterns of use. The DHS results thus give new and comparable information about tobacco use in low-income nations, disadvantaged social groups, and an understudied region of the world.

Keywords

Smoking; Tobacco; Sub-Saharan Africa; Socioeconomic status (SES)

Introduction

As use of cigarette and other tobacco products declines in high-income countries, increasing attention has turned to the growth of cigarette use in middle- and low-income countries (Jha & Chaloupka, 2000; World Bank, 1999). From 1970 to 2000, per capita cigarette consumption fell by 14% in developed countries and rose by 46% in developing countries (Guindon & Boisclair, 2003). The increase occurred primarily among men but, given marketing efforts of tobacco companies, use by women appears primed to move upward (Ernster, Kaufman, Nichter, Samet, & Yoon, 2000; Mackay, 1998). Largely because of the growth in low- and middle-income nations, the number of smokers worldwide has now risen to 1.3 billion and may well reach 1.5 billion by 2025 (Mackay, Eriksen, & Shafey, 2006: 72).

Globalization of tobacco use represents a major threat to worldwide public health (Mackay, 1998; Yach & Bettcher, 2000). With premature smoking-related deaths currently numbering about 5 million per year worldwide (about 1 in 10 adult deaths), they may plausibly number 10 million (about 1 in 6 adult deaths) by 2020 (WHO, 2007a), of which 70% will occur in middle- and low-income nations (Warner, 2005). These changes will exacerbate worldwide

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health disparities and the divide between nations of the first and third worlds (Yach, 2005). On another level, the spread of tobacco use across large parts of the globe counters some success in high-income nations to combat cigarette use and restrict the power of the tobacco industry. The experience gained over recent decades by the tobacco industry in global marketing and the development of new markets has contributed to the worldwide expansion of tobacco consumption (Warner, 2000). In response, global public health efforts aim to provide consistent anti-smoking policies across the world (Satcher, 2001; Sugarman, 2001). One promising strategy, the creation of an international treaty, has moved forward with the WHO Framework Convention on Tobacco Control (WHO, 2005).

Other strategies to combat the globalization of tobacco include the goal of better describing the extent and social distribution of the problem (Corrao, Guindon, Cokkinides, & Sharma, 2000; Jha, Ranson, Nguyen, & Yach, 2002; World Bank, 1999). Surveillance of smoking prevalence can aid in developing locally grounded actions for tobacco control (Lando et al., 2005; WHO, 1997). Thus, regional groups of researchers, policymakers, and anti-tobacco advocates have identified the lack of standardized and comparable data as a problem and called for regional surveillance of tobacco use by sex, age, and risk group (Baris et al., 2000). Improving the global knowledge base, an important first step in identifying targets for change, can come from better measures of the prevalence of tobacco use across developing nations and of the social groups within nations most at risk for tobacco use.

Such needs may be particularly important in sub-Saharan Africa (Sasco, 1994). Valuable efforts to compile information on tobacco use across the world offer much insight on global patterns (Guindon & Boisclair, 2003; Mackay et al., 2006; Shafey, Dolwick, & Guindon, 2003; WHO, 1997). However, African nations, often among the world's poorest, have less complete and likely less accurate statistics than other regions of the world. Figures reported on cigarette use in the African region by the WHO (1997) for circa 1990 cover 33% of the population, and more recent data cover 68.3% of the African region population (Guindon & Boisclair, 2003). More problematic, the comparability of the figures is suspect. Reported prevalence figures for African nations (Mackay et al., 2006; Shafey et al., 2003) sometimes refer to any tobacco smoking, sometimes to cigarette smoking, and sometimes to regular or daily cigarette smoking. Moreover, the figures sometimes use non-representative samples such as hospital inpatients (Rwanda) or residents of major cities and suburbs (Tanzania). Figures on cigarettes consumed are better standardized (Guindon & Boisclair, 2003) but do not distinguish users by gender, residence, and SES. More comparable figures on tobacco use for even a small subset of sub-Saharan African nations would improve on what is now available.

Sub-Saharan Africa appears to differ from other regions of the world in having reached only the early stages of the cigarette epidemic. Estimates suggest that deaths from smoking-attributed causes reach only 5–7% for men and 1–2% for women (Ezzati & Lopez, 2004). By comparison, smoking deaths reach at least 15% for males in developing regions of the Americas, the Eastern Mediterranean, the Western Pacific, and Southeast Asia. The smoking deaths for females in other developing parts of the world seldom exceed 5% but still double or triple the percentage in Africa. The relatively low prevalence of smoking and high rates of deaths from AIDS, starvation, and violence that more immediately threaten the health of citizens in Africa (Zuberi, Sibanda, Bawah, & Noubissi, 2003) may suggest that the consequences of cigarette use are not serious. Yet this could change quickly. Combined with weak government restrictions on tobacco use or sales, intensified advertising and promotions directed at young people in Africa (e.g., the “Taste the Adventure” campaign) has produced a fast rate of growth from the small base (Oluwafemi, 2003). Better knowledge about tobacco use at the early stages of the epidemic can help public health officials intervene before the problem peaks. Widespread tobacco use otherwise may block future improvements in longevity (Yach, McIntyre, & Saloojee, 1992).

Studies of smoking by socioeconomic status (SES) in developing nations have found that cigarette use is highest among urban men and women who are less educated and economically disadvantaged (Blakely, Hales, Kleft, Wilson, & Woodward, 2005; Bobak, Jha, Nguyen, & Jarvis, 2000; Mackay & Mensah, 2004: 89–90; Pampel, 2005). In high-income nations, cigarette use began among high SES males, spread to females and lower SES males, abated among high SES males and females (Lopez, Collishaw, & Piha, 1994), and is now concentrated among low SES groups (Barbeau, Krieger, & Soobader, 2004). However, the adoption of cigarettes in low- and middle-income nations has emerged in a world context that has changed substantially. Diffusion across the world of scientific knowledge about the harm of smoking may lead high SES persons in low-income nations, particularly those with high education, to avoid tobacco. Tobacco companies are also more knowledgeable and sophisticated in their sales practices. Perhaps recognizing that low SES groups comprise their largest and most viable markets, transnational tobacco companies may target their ad campaigns to appeal to potential new smokers with lower income. Examining SES-based patterns in African nations with low national income and low tobacco usage can help in understanding the nature of cigarette diffusion today.

This study aims to describe the prevalence and distribution of tobacco use among men and women in 14 sub-Saharan African nations between 2000 and 2006. The data come from 16 Demographic Health Surveys (DHS), which use the same questions and cover representative samples of the nation's adult population. The DHS have been used to study tobacco use once before but only for two nations; Pampel (2005) found higher use of cigarettes by males than females, urban than rural residents, and low educated than high educated groups in Malawi and Zambia. An analysis of available data for other nations can provide new and more extensive information on this understudied region and, given the representative samples and comparable measures of tobacco from the DHS, improve on prevalence figures currently available for many African nations.

Methods

Data

The DHS aim to provide reliable and nationally representative data on fertility, family planning, health, and nutrition of populations in developing nations (Measure DHS, 2007). Since the mid-1980s, hundreds of surveys have been conducted in 79 countries across the world. The most recent surveys have been carried out by national statistical offices with funding from the U.S. Agency for International Development and with financial and technical assistance from ORC Macro of Calverton, Maryland, and Johns Hopkins University. However, given the focus on human reproductive health, most surveys either include only women or do not ask questions about tobacco use.

Sixteen surveys in 14 African nations follow the Measure DHS + sample design, include both men and women, and obtain information on tobacco smoking. The nations and years of the surveys include Namibia (2000), Malawi (2000), Uganda (2000/2001), Zambia (2001/2002), Ghana (2003), Kenya (2003), Mozambique (2003), Nigeria (2003), Madagascar (2003/2004), Tanzania (2004/2005), Malawi (2004), Lesotho (2004), Ethiopia (2005), Rwanda (2005), Zimbabwe (2005), and Uganda (2006). Malawi (2000 and 2004) and Uganda (2000/2001 and 2006) have two surveys, which can give information on changes over a short period. With few exceptions, the surveys use stratified two-stage cluster designs that oversample low-populated provinces, identify clusters within provinces, and choose households randomly within clusters. The surveys thus select nationally representative samples that appropriately include rural as well as urban residents and low SES groups as well as high SES groups. The sample sizes differ across nations, and for men range from 1962 in Uganda to 7171 in Zimbabwe and for women range from 5690 in Ghana to 14,059 in Ethiopia.

For sampled households, one member answers questions about the household in general and provides a list of household residents. Then, all women aged 15–49 years in the household are interviewed, and for most countries men aged 15–59 years (sometimes aged 15–49 or 15–54 years) are interviewed in approximately every third household. Some nations interview all men in every household or every other household. Interviews of household representatives were completed for 97–99% of selected households, but response rates were a bit lower for household members. In Zambia, for example, interviews of adult men were completed for 88.7% of those eligible, and interviews of adult women were completed for 96.4% of those eligible (Measure DHS, 2003). Interviewers received training and guidance in identifying and interviewing sample respondents, and supervisors followed guidelines to ensure quality control, minimize non-response, and monitor interviewers (Measure DHS, 2002).

The age ranges of the samples are limited to women aged 15–49 years and men aged 15–54 or 15–59 years because the DHS are designed to study fertility, which may bias estimates of tobacco use among all adults. The low end of the age range begins at age 15 years, by which time a small but meaningful percentage of youth has already started (Mackay et al., 2006). The high end of the range misses older smokers. Furthermore, variation in age ranges for males might affect the results. Since six nations include males only 15–54 years and one nation includes males 15–49 years, the analysis aims for comparability by limiting the ages to 15–54 years. Tanzania has males only through age 49 years, which will affect direct comparisons across nations, but multivariate models of tobacco use that adjust for age will control for differences in the sample populations.

Variables

The DHS have the advantage of using nearly identical questions (excepting issues of translation) for the smoking items. The surveys ask respondents four questions, each with yes or no responses available, on whether they smoke cigarettes, pipes, other tobacco, or nothing. With two exceptions, separate items on use of chew and snuff are not available from the DHS, and it is unclear to what extent responses mix use of these forms of non-smoking tobacco use with use of non-cigarette smoking tobacco. The exceptions, Uganda (2006) and Zimbabwe, add questions on use of chew and snuff that seem to have the effect of lowering estimates of non-cigarette smoking. The other tobacco items thus prove less reliable than the cigarette item. For those smoking cigarettes, all but a few of the surveys asked one more question on the number of cigarettes they smoked in the last 24 h. The tobacco smoking questions consider only current behavior, and the surveys contain no information on age of adoption, former smoking, or age of cessation. For the analysis, the respondents can be divided into three categories: current non-smokers, users of pipe or non-cigarette smoking tobacco, and users of cigarettes (including those who use both cigarettes and other tobacco). Among cigarette smokers, the number of cigarettes used in the last day measures intensity (ranging from 0 to 20). Although U.S. studies find that self-reported smoking is generally accurate (Patrick et al., 1994), the validity of such items in low-income nations is less clear, and the items may reflect differential reporting by SES. Lacking physiological measures, survey responses remain the commonly accepted source of nearly all data on global patterns of tobacco prevalence.

The analyses examine the association of tobacco smoking with the following SES and demographic variables. Age in single years ranges from 15–49 years for women and 15–54 years for men. All other variables are treated as dummy variables. Urban residence equals one for those living in cities and zero otherwise. Education has four categories: (1) no school (reference category), (2) completed primary school, (3) completed secondary school, and (4) post-secondary schooling. Occupation includes: (1) not working (reference category), (2) agricultural self-employed workers and employees, (3) household, domestic, service, and skilled or unskilled manual workers, and (4) professionals, technicians, managers, and clerical

and sales workers. Note that some national idiosyncrasies exist in coding occupation. For example, Zambia and Madagascar appear to group sales workers with service workers in category 3, whereas Uganda groups service workers with sales workers in category 4. These differences create error in measurement that will weaken the influence of occupation on smoking. Religion includes (1) Catholics, (2) Protestants, (3) Muslims, and (4) others (a residual category that combines those with no religion and those adhering to traditional, local, or other religions and serves as the reference group).

Statistical analyses

Means for smoking prevalence and number of cigarettes smoked for each nation and gender are calculated using appropriate sampling weights within nations. Confidence intervals for the means are calculated from standard errors adjusted for strata and cluster membership designated in the sample design (e.g., Measure DHS, 2003). The SVY command in STATA 9.2 (2005) corrects for the deviation from simple random sampling in calculating standard errors. For comparison with the means calculated from the DHS, figures on smoking prevalence from the Tobacco Control Country Profiles (TCCP) (Shafey et al., 2003) and *The Tobacco Atlas* (TA) (Mackay et al., 2006) are reported along with DHS means in Tables 1 and 2.

The social distribution of smoking prevalence is examined with multinomial logistic regression, a technique appropriate for the three discrete, unordered smoking categories. Tables 3 and 4 present odds ratios for belonging to the two tobacco smoking categories (cigarettes and pipe/other) relative to the baseline category of non-smokers. The number of cigarettes smoked in the last 24 h among those classified as cigarette smokers is an ordered, continuous variable and is examined with linear regression. Both models include dummy-variable controls for nation of residence and use within-nation sample weights. In addition, the cases are weighted to give each nation the same sample size and similar influence on the estimates. For men, the weighted sample size for each nation of approximately 3371.1 equals the total sample size for all nations combined ($N = 53,938$) divided by the number of surveys (16); for women, the weighted sample size for each nation of approximately 9253.9 equals the total sample size for all nations combined ($N = 148,063$) divided by the number of surveys (16). The multivariate models also use the SVY command to adjust for the stratified two-stage cluster design in estimating standard errors.

The multivariate models allow for more precise comparisons of smoking across nations. To keep the results manageable, the models assume that the effects of the sociodemographic variables (other than gender) do not differ across nations. However, with controls, the coefficients for the nation dummy variables reflect differences in smoking after adjusting for sociodemographic composition. When assigning mean values to the sociodemographic determinants, the predicted smoking probabilities calculated for each nation from multinomial logistic regression show the expected prevalence as if the nations all had the same age structure, degree of urbanization, religious composition, educational levels, and occupational distribution. Nations can then be compared on adjusted as well as raw tobacco smoking.

Results

Tobacco smoking prevalence

Table 1 presents the percent smokers of cigarettes and other tobacco (and confidence intervals) among all men and the number of cigarettes smoked in the last day (and confidence intervals) among male cigarette smokers. Nations are ordered from low to high cigarette prevalence. The two west central African nations of Nigeria and Ghana have low cigarette smoking of 8.0 and 8.8%, respectively, as does the eastern nation of Ethiopia (8.3%). The southern African nations of Mozambique (14.1%), Lesotho (15.6%), Zambia (15.6%), and Namibia (17.5%) rank next

(but Zimbabwe is an exception with 22.1%). The eastern nations of Rwanda (14.2%), Uganda (18.1 and 18.7%), Tanzania (21.0%), and Kenya (22.9%) generally have higher cigarette prevalence. Malawi has moderate to high prevalence but experienced a small decline of 18.7 to 16.6% from 2000 to 2004. The island nation of Madagascar stands out as having the highest cigarette prevalence of all the nations (27.3%). The range of values from 8.0 to 27.3% demonstrates considerable diversity.

The ranking of the nations on the use of pipes and other forms of smoking tobacco differs from that for cigarettes. Zambia (10.4%), Namibia (10.6%), Mozambique (11.9%), Madagascar (17.7%), and Lesotho (25.1%) have the highest usage, while Ghana, Nigeria, Ethiopia, Kenya, Zimbabwe, and Tanzania have usage under 2%. Uganda shows a large drop, but that may result from a formatting change in questions that separates use of chew and snuff from non-cigarette smoking tobacco. Calculations treating the 16 nations as cases and the percentages as variables find that the correlation coefficient between the two types of tobacco smoking equals 0.214; the modest positive correlation provides no evidence that one form substitutes for the other.

The DHS figures on smoking prevalence generally match those reported elsewhere. The last columns report figures from two other sources. The older figures from the TCCP appear high for several nations such as Zambia, Uganda, Zimbabwe, Namibia, and Kenya. The more recent figures reported by the TA come closer to those for the DHS.

The nations also differ in the intensity of cigarette use. The mean number of cigarettes used per smoker varies from a low of 3.7 in Ghana to a high of 8.0 in Namibia. The average cigarettes per smoker is moderately correlated to the prevalence of cigarette use across nations ($r = 0.438$) – the greater the percent of men who smoke, the more cigarettes each smokes per day.

The figures for females in Table 2 show considerably lower prevalence of all forms of tobacco smoking. Cigarette use exceeds 2% of the female population only in Namibia (5.9%). Among smokers, the number of cigarettes used ranges from less than 1 (Ghana) to 11.9 (Nigeria), but the small number of smokers in the surveys makes the estimates less than reliable. Use of other forms of tobacco is slightly more common but still rare. It exceeds 3% only in Namibia (4.2%), Rwanda (4.3%), Mozambique (5.6%), and Madagascar (6.0%). Other sources likewise reflect the low cigarette smoking of women in these nations but in some cases (Kenya, Uganda, Zimbabwe, and Namibia from the TCCP) substantially exceed the DHS estimates.

Individual determinants of tobacco smoking

Table 3 examines the individual determinants of male smoking averaged across all nations and with dummy-variable controls for each nation, while Table 4 does the same for females. Given gender differences in prevalence and a statistically significant improvement in the chi-square value for gender-specific models compared to a pooled model, the results are presented separately for men and women.

As shown by coefficients for the quadratic polynomial of age and age squared, use of cigarettes by men increases to a peak age of 39.8 and then declines. Cigarette smoking is higher in cities than rural areas (odds ratio 1.14) and lower among those with higher education than no education (odds ratio 0.52). For occupation, the reference group of those without jobs smokes the least (perhaps because they can least afford the cost). Among workers, those with service or manual jobs smoke the most (odds ratio 2.11) and those with non-manual jobs smoke the least (1.29). By religion, Protestants (odds ratio 0.51) smoke the least, followed by Catholics, Muslims, and the reference group of others.

Use of other tobacco products is concentrated in agricultural areas and among agricultural workers. Urban residents are 60% less likely than rural residents to use other tobacco products.

Compared to non-workers, agricultural workers are most likely to use other tobacco products (odds ratio 1.96), while non-manual workers are least likely (0.39). Much as for cigarettes, education reduces use of other tobacco products, and Catholics (odds ratio 0.76), Protestants (0.46), and Muslims (0.27) use other tobacco less than others.

Among smokers, however, the number of cigarettes smoked has different relationships with sociodemographic variables. For example, education raises number of cigarettes smoked while reducing the prevalence of smoking. Educated people may smoke less because they know the dangers, but among those who smoke, educated people are likely to have more income to spend on cigarettes.

The results for women in Table 4 are limited by the small numbers who use cigarettes and other tobacco. However, the general patterns of use are similar to those for men. Women in urban areas are more likely to use cigarettes (odds ratio 2.04) and less likely to use other tobacco products (odds ratio 0.47) than women in rural areas. Education lowers use of other tobacco but less clearly lowers cigarette use. Manual workers use cigarettes more and non-manual workers use other tobacco less than those not working. Religion has little influence on female use of tobacco. In the linear regression equation, education and non-manual occupations increase the number of cigarettes smoked.

Standardized comparisons of nations

Table 5 compares smoking prevalence across nations after controlling for sociodemographic composition. The coefficients in Tables 3 and 4 are used to obtain predicted probabilities for each nation after assigning the overall means to the other independent variables. Comparison of observed values (from Tables 1 and 2) with predicted values (centered to have the same grand mean as the observed values) reveal the impact of national socioeconomic differences on smoking differences. The results indicate substantial similarity between the observed and predicted values. For cigarette smoking, the correlations equal 0.907 for men and 0.992 for women. For men, Tanzania shows cigarette smoking to be 4.4% points higher than expected given its sociodemographic composition, while Lesotho shows smoking lower than expected by 5.8% points. For women, the only nation with more than negligible cigarette use, Namibia, has somewhat higher use than predicted by the model.

Table 5 also presents observed and predicted proportions of other smoking. Again, the rankings of nations by prevalence change little with controls. The correlations of observed and predicted values equal 0.916 for men and 0.876 for women. Fewer men use other forms of tobacco than predicted in nations of eastern Africa such as Kenya, Tanzania, and Ethiopia, while more men use other forms of tobacco than predicted in southern African nations such as Mozambique, Madagascar, and Lesotho. For women, use of other forms of tobacco in most nations is low whether adjusted or unadjusted. However, more women use other forms of tobacco than expected in Mozambique and Madagascar.

Discussion

Although based on only 14 sub-Saharan African nations (from a universe of more than 40), the results from the Demographic Health Surveys, nonetheless, reveal new and more accurate information on regional and social patterns of tobacco smoking. For cigarette prevalence among men, the range of national values from 8.0 to 27.3% demonstrates considerable diversity. Two west central African nations, Nigeria and Ghana, and one eastern nation, Ethiopia, have the lowest smoking. The southern African nations of Mozambique, Lesotho, Zambia, Malawi, and Namibia rank next (but Zimbabwe has relative high levels). The eastern nations of Uganda, Tanzania, and Kenya generally have higher smoking prevalence, while the island nation of Madagascar stands out as having the highest level. Smoking of non-cigarette

tobacco by men is lower than cigarette use in most of the nations, but reaches high values of 11.9% in Mozambique, 17.7% in Madagascar, and 25.1% in Lesotho. In contrast to men, cigarette use remains negligible among women in all nations but Namibia. Smoking of other forms of tobacco by women is slightly more common than cigarette use but still rare.

The results identify the social groups most likely to use cigarettes and other forms of tobacco, and identify the importance of SES for risk of cigarette smoking. Male cigarette smokers are more likely to be older, live in cities, have less education, and work in service or manual occupations. Consistent with previous studies (Blakely et al., 2005; Bobak et al., 2000; Mackay & Mensah, 2004: 89–90; Pampel, 2005), low SES urban residents are most at risk for cigarette use. Less clearly defined patterns of female tobacco cigarette use appear, in part because the low level of usage makes the results less reliable. Yet, urban women in service occupations smoke cigarettes more, while rural women with less education smoke other forms of tobacco more. Interestingly, differences across nations in urban population, levels of education, types of jobs, and religious composition do not account for the differences across nations in tobacco smoking of men or women. Rather, national factors that similarly affect all residents must account for the differences. SES has importance for individuals within nations but other factors most account for national differences.

What might explain the observed national differences in cigarette use? The small number of nations prevents formal analysis of variation in national levels of tobacco smoking, but a few insights come from the figures. The limited ability of controlling for compositional characteristics related to national development – urban residence, education, occupation – to explain the differences suggests that the source of variation lies elsewhere. Similarly, GDP per capita in U.S. dollars (from Norwegian UN Association, 2007) has a correlation of only -0.059 with male cigarette prevalence, and it does not account for the modest cigarette use in the nation with the highest national income, Namibia, or the high tobacco prevalence of a nation with relatively low income, Madagascar. It appears that cultural factors outweigh economic ones in determining prevalence. Also, economic factors may have counteracting effects. On one hand, higher income and greater education lead to greater awareness and concern with the harm of tobacco and tend to reduce prevalence. On the other hand, higher income allows people to afford more cigarettes. That GDP has a higher positive correlation with number of cigarettes used per smoker ($r = 0.523$) than with cigarette prevalence ($r = -0.059$) fits this interpretation. Otherwise, the availability of locally produced tobacco has little influence on cross-national differences in cigarette use. Malawi is the only nation with more than a tiny percentage of its farmland devoted to tobacco (from Mackay et al., 2006), but several other nations have higher cigarette prevalence.

Although economic position of nations has clear importance in broader worldwide comparisons (World Bank, 1999), the national differences within the low-income nations of sub-Saharan Africa appear to stem from other causes. Factors that affect all residents of nations such as cultural histories of tobacco use, access of tobacco companies to sales, tobacco control policies, the cost of cigarettes, and inequality in the distribution of income may prove important. These factors might be studied with aggregate data and multilevel models once data on more African nations become available from the DHS or other surveys. Ethnographic research on individual countries might also help understand the cultural underpinnings of differences in tobacco use.

Tobacco use among women in the DHS remains quite low and is less clearly associated with education and occupation than among men. The weaker results may be an artifact of the low proportion of female smokers – it is hard to identify relationships when so few women smoke (the effects for females are more similar to males in Namibia, the only country with more than 5% prevalence among females). It appears that the cigarette epidemic has yet to affect African women in large numbers. Studies have suggested that the low power and independence of

women in African nations limit their opportunity to smoke (Kaplan, Carriker, & Waldron, 1990; Waldron et al., 1988). However, concerns about the worldwide spread of tobacco to women and the use of western advertising to appeal to the new market of potential female smokers (Ernster et al., 2000; Yach & Bettcher, 2000) apply as well to Africa (Oluwafemi, 2003). Efforts to prevent women from following men in adoption of cigarette use should be a central goal of tobacco control efforts. Such efforts may be all the more important as a means to counteract advertising approaches now common in Asia that link smoking with desires for independence among young women.

The DHS estimates indicate that tobacco smoking in the sub-Saharan African nations remains low compared to other nations across the world. With cigarette prevalence among men below 10%, Ghana, Nigeria, and Ethiopia rank at the bottom in worldwide comparisons. With prevalence above 20%, Tanzania, Zimbabwe, Kenya, and Madagascar rank near the United States and other high-income nations that have experienced substantial declines in prevalence over the past several decades. Most of the African nations studied have prevalence lower than other regions of the developing world. According to figures from Guindon and Boisclair (2003), the region of the Americas had male prevalence of 32.0%, the Eastern Mediterranean region 35.3%, the Southeast Asia region 48.1%, and the Western-Pacific region of 61.2%.

Across the 14 African nations, about 14.0 million men and women smoke. This figure comes from multiplying the proportion of cigarette smokers by the population size of each nation (obtained from Shafey et al., 2003). The contribution of nations to the total depends more on population size than cigarette prevalence. The nation with the largest number of smokers (2.7 million), Nigeria, has low cigarette prevalence but by far the largest population. Despite relatively high prevalence, Namibia, has relatively few smokers (114,000) because of its small population.

Despite low levels compared to other regions of the world, the African nations are positioned on the upslope rather than the downslope of the curve representing smoking prevalence during stages of the cigarette epidemic. The decline in smoking prevalence in Malawi between 2000 and 2004 is encouraging but may not represent a long-term trend (Uganda shows stability or a slight increase from 2000/2001 to 2006). Instead, African nations remain vulnerable by virtue of low prevalence to further penetration of markets by multinational tobacco corporations through price cuts, widespread advertising, escalating competition for sales, and the promotion of positive images of smokers that encourage cigarette purchases and smoking.

The Framework Convention for Tobacco Control, signed by 168 WHO Member States and in effect since February 27, 2006, aims to control the international spread of tobacco (WHO, 2007b). Treaty provisions include a ban on tobacco advertising, promotions, and sponsorships within five years; requirements for large health warning labels on packages; implementation of effective measures to protect non-smokers from secondhand smoke in public places; and encouragement of tobacco tax increases (WHO, 2005). Of the nations with DHS smoking data, nine have signed and ratified the treaty (Ghana, Kenya, Lesotho, Madagascar, Namibia, Nigeria, Rwanda, Uganda, Tanzania), two have signed but not yet ratified (Ethiopia, Mozambique), and three have not signed (Malawi, Zambia, Zimbabwe) (WHO, 2007b).

Despite the value of its comparable and representative data, the DHS have several limitations. Excluding women over age 49 years and men over age 54 years may affect the DHS estimates. If women age 50 years and over and men age 55 years and over have higher smoking than those 15–49 or 15–54 years, it would downwardly bias the DHS estimates. If the opposite pattern occurs, if smoking is lower at older ages, then excluding older men and women would upwardly bias the estimates. The age restrictions of the DHS prevent any inferences about the direction of any bias, however.

The DHS questions on current tobacco smoking exclude information on past smoking. Such information would give more insight into the life course patterns of tobacco use, historical changes in smoking prevalence, and current stages of the cigarette epidemic. The cross-sectional relationships suggest, but cannot confirm, that smoking begins in these nations among less advantaged urban residents rather than among higher SES groups (as in high-income nations decades ago). It would also be helpful to have information on other forms of non-smoked tobacco. Use of chew and snuff may occur in African nations where smoking tobacco is common and therefore reflect much the same pattern found here. Yet some places with low smoking may have higher use of other forms of tobacco; for example, tobacco companies may market non-smoking tobacco where smoking restrictions are strongest.

The DHS are also limited by the number of surveys with data on tobacco use. The 14 nations studied here extend current knowledge but do not allow for detailed analyses of the sources of the national differences. The inclusion of tobacco use questions in other African surveys done by the DHS would help overcome this limitation. With more surveys, researchers could better examine the macro-level sources of variation in tobacco use and its social distribution across African nations.

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Table 1

Means and 95% confidence intervals for measures of male tobacco use

Nation	N	% Smoking cigarettes	% Smoking other tobacco	# Cigarettes per smoker	TCCP ^a % smokers	TA ^a % smokers
Nigeria	2220	8.0 6.2–9.7	1.6 1.0–2.2	5.6 4.8–6.4	15.4	15.4
Ethiopia	5808	8.3 7.2–9.5	0.2 0.0–0.5		4.7	5.9
Ghana	4815	8.8 8.0–9.6	1.3 0.8–1.7	3.7 3.3–4.0	10.8	7.4
Mozambique	2670	14.1 12.4–15.8	11.9 10.0–13.9	4.7 4.1–5.3		
Rwanda	4673	14.2 13.0–15.5	6.9 6.0–7.7	4.2 3.8–4.7	7.0	7.0
Zambia	2071	15.6 13.7–17.5	10.4 8.9–12.0	4.5 4.0–5.1	40.0	16.0
Lesotho	2656	15.6 13.7–17.4	25.1 22.5–27.7	6.0 5.2–6.9	38.5	38.5
Malawi 2004	3261	16.6 14.8–18.4	4.5 3.5–5.5		20.0	20.5
Namibia	2866	17.5 15.2–19.9	10.6 8.9–12.3	8.0 7.2–8.8	65.0	22.8
Uganda 2000/2001	1962	18.1 15.9–20.3	7.1 5.5–8.6	4.0 3.6–4.5	52.0	25.2
Uganda 2006	2503	18.7 16.8–20.6	1.1 ^b 0.6–1.7	4.7 4.2–5.2	52.0	25.2
Malawi 2000	3092	18.7 17.1–20.4	5.2 4.3–6.2	4.8 4.5–5.1	20.0	20.5
Tanzania	2635	21.0 18.7–23.3	1.0 0.6–1.4	4.3 4.0–4.7	23.0	23.0
Zimbabwe	7171	22.1 20.7–23.5	0.8 ^b 0.6–1.0	6.7 6.4–7.0	46.0	20.0
Kenya	3575	22.9	1.8	7.7	66.8	21.3

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Nation	N	% Smoking cigarettes	% Smoking other tobacco	# Cigarettes per smoker	TCCP ^a % smokers	TA ^a % smokers
Madagascar	2349	21.2–24.6 27.3 24.5–30.1	1.2–2.4 17.7 14.4–21.0	7.2–8.2 6.3 5.8–6.8		

^aFigures from the Tobacco Use Country Profiles (TCCP) and Tobacco Atlas (TA).

^bMeasurement of other smoking differs from that used in other surveys.

Table 2
Means and 95% confidence intervals for measures of female tobacco use

Nation	N	% Smoking cigarettes	% Smoking other tobacco	# Cigarettes per smoker	TCCP ^a % smokers	TA ^a % smokers
Ghana	5690	0.1 0.0–0.2	0.1 0.0–0.2	0.4 0.0–1.3	4.0	0.7
Ethiopia	14,059	0.2 0.1–0.3	0.04 0.0–0.1	4.1 3.2–5.0	1.8	0.3
Lesotho	7093	0.2 0.1–0.4	0.4 0.2–0.6	4.0 1.8–6.1	1.0	1.0
Malawi 2004	11,651	0.3 0.2–0.4	0.2 0.1–0.3		9.0	4.8
Rwanda	11,308	0.3 0.2–0.4	4.3 3.8–4.8	2.9 1.8–4.0	4.0	4.0
Zimbabwe	8896	0.4 0.2–0.6	0.1 ^b 0.0–0.2	6.5 2.7–10.2	13.0	2.2
Nigeria	7611	0.5 0.3–0.7	0.6 0.3–0.8	11.9 9.0–14.8	1.7	0.5
Tanzania	10,325	0.5 0.3–0.7	1.0 0.7–1.3	3.3 2.7–4.0	1.3	1.3
Zambia	7656	0.5 0.3–0.7	2.2 1.7–2.7	3.9 2.4–5.5	7.0	1.0
Kenya	8191	0.7 0.4–0.9	1.9 1.3–2.4	4.3 2.7–6.0	31.9	1.0
Uganda 2006	8528	0.9 0.6–1.2	0.5 ^b 0.3–0.7	2.7 1.8–3.5	17.0	3.3
Malawi 2000	13,217	1.0 0.8–1.2	1.4 1.2–1.7	3.5 3.0–4.0	9.0	4.8
Uganda 2000/2001	7243	1.2 0.8–1.6	2.1 1.4–2.7	2.2 1.8–2.6	17.0	3.3
Mozambique	12,407	1.6 1.1–2.1	5.6 4.9–6.2	2.8 2.2–3.5		
Madagascar	7946	1.8	6.0	5.1		

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Nation	N	% Smoking cigarettes	% Smoking other tobacco	# Cigarettes per smoker	TCCP ^a % smokers	TA ^a % smokers
Namibia	6752	1.4–2.1	4.6–7.5	4.2–6.0	35.0	9.6
		5.9	4.2	6.9		
		4.9–7.0	3.2–5.1	6.0–7.8		

^aFigures from the Tobacco Use Country Profiles (TCCP) and Tobacco Atlas (TA).

^bMeasurement of other smoking differs from that used in other surveys.

Table 3

Odds ratios and *t*-values for multinomial logistic regression of cigarette and other tobacco smoking, and unstandardized coefficients and *t*-values for linear regression of cigarettes smoked, DHS male respondents^a

Independent variables ^b	Mean	Multinomial logistic regression ^c				Linear regression			
		Cigarettes		Other tobacco		# Cigarettes ^d			
		b	t	b	t	b	t	b	t
Age (logged)	29.2	1.33***	25.78	1.37***	17.73	0.20***			4.50
Age (logged) ²		0.996***	-21.98	0.996***	-14.08	-0.002**			-3.22
Urban resident	0.28	1.14**	2.83	0.40***	-8.17	0.98***			5.16
Education									
Primary	0.52	1.02	0.37	0.61***	-7.08	0.15			0.81
Secondary	0.30	0.84**	-2.82	0.22***	-15.53	0.17			0.79
>Secondary	0.05	0.52***	-6.70	0.05***	-8.08	1.55**			3.19
Occupation									
Agriculture	0.42	1.80***	10.53	1.96***	7.32	0.00			0.01
Service-manual	0.21	2.11***	12.76	0.82	-1.90	0.63**			2.87
Non-manual	0.12	1.29**	3.45	0.39***	-5.31	0.66*			2.23
Religion									
Catholic	0.31	0.79***	-4.05	0.76**	-2.81	-0.60***			-2.86
Protestant	0.46	0.51***	-11.98	0.46***	-7.58	-0.53*			-2.53
Islam	0.13	0.84*	-2.35	0.27***	-6.35	0.09			0.36
LR χ^2 , R^2					11,418				0.114

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

^aWeighted $N = 53,938$ for multinomial logistic regression and 7855 for linear regression.

^bCoefficients for nation/survey dummy variables not listed.

^cNon-smokers as reference category.

^dSmokers only.

Table 4

Odds ratios and *t*-values for multinomial logistic regression of cigarette and other tobacco smoking, and unstandardized coefficients and *t*-values for linear regression of cigarettes smoked, DHS female respondents^a

Independent variables ^b	Mean	Multinomial logistic regression ^c				Linear regression			
		Cigarettes		Other tobacco		# Cigarettes ^d			
		b	t	b	t	b	t	b	t
Age (logged)	28.2	1.06 [*]	2.08	1.22 ^{***}	6.52	0.30 ^{**}	6.52	0.30 ^{**}	3.13
Age (logged) ²		1.00	0.56	0.998 ^{***}	-3.83	-0.003 [*]	-3.83	-0.003 [*]	-2.27
Urban resident	0.28	2.04 ^{***}	6.54	0.47 ^{***}	-6.77	0.69	-6.77	0.69	1.81
Education									
Primary	0.49	0.53 ^{***}	-6.61	0.47 ^{***}	-13.85	0.04	-13.85	0.04	0.14
Secondary	0.25	0.78 [*]	-2.20	0.18 ^{***}	-9.99	1.21 [*]	-9.99	1.21 [*]	2.29
>Secondary	0.02	0.63 [*]	-2.14	0.10 ^{***}	-5.23	2.87 ^{**}	-5.23	2.87 ^{**}	3.03
Occupation									
Agriculture	0.38	1.06	0.58	1.08	0.64	-0.62	0.64	-0.62	-1.76
Service-manual	0.11	1.30 ^{**}	2.46	1.08	0.51	-0.76	0.51	-0.76	-1.73
Non-manual	0.14	1.16	1.55	0.52 ^{***}	-3.64	1.70 ^{**}	-3.64	1.70 ^{**}	2.62
Religion									
Catholic	0.30	1.27	1.26	1.30 [*]	2.24	-0.42	2.24	-0.42	-0.67
Protestant	0.52	0.78	-1.19	0.74 [*]	-2.06	0.03	-2.06	0.03	0.05
Islam	0.13	1.27	1.18	1.00	0.03	-0.15	0.03	-0.15	-0.22
LR χ^2 , R^2					9467				0.274

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

^aWeighted $N = 148,063$ for multinomial logistic regression and 1392 for linear regression.

^bCoefficients for nation/survey dummy variables not listed.

^cNon-smokers as reference category.

^dSmokers only.

Table 5
Observed and predicted values of cigarette and other tobacco smoking by nation, DHS males and females

Nations	Males				Females			
	Cigarettes		Other tobacco		Cigarettes		Other tobacco	
	Observed	Predicted	Observed	Predicted	Observed	Predicted	Observed	Predicted
Nigeria	0.080	0.080	0.016	0.044	0.005	0.005	0.006	0.012
Ethiopia	0.083	0.072	0.002	0.034	0.002	0.003	0.000	0.010
Ghana	0.088	0.085	0.013	0.039	0.001	0.002	0.001	0.011
Mozambique	0.141	0.118	0.119	0.069	0.016	0.012	0.056	0.029
Rwanda	0.142	0.154	0.069	0.054	0.003	0.004	0.043	0.025
Zambia	0.156	0.165	0.104	0.090	0.005	0.006	0.022	0.023
Lesotho	0.156	0.214	0.251	0.201	0.002	0.004	0.004	0.012
Malawi 2004	0.167	0.165	0.045	0.050	0.003	0.005	0.002	0.011
Namibia	0.175	0.214	0.106	0.131	0.059	0.049	0.042	0.045
Uganda 2000	0.181	0.176	0.071	0.058	0.012	0.012	0.021	0.018
Uganda 2006	0.187	0.164	0.011	0.037	0.009	0.009	0.005	0.012
Malawi 2000	0.187	0.182	0.052	0.053	0.010	0.011	0.014	0.016
Tanzania	0.210	0.166	0.010	0.036	0.005	0.006	0.010	0.013
Zimbabwe	0.221	0.221	0.008	0.038	0.004	0.009	0.001	0.013
Kenya	0.229	0.232	0.018	0.042	0.007	0.007	0.019	0.020
Madagascar	0.273	0.267	0.177	0.099	0.018	0.014	0.060	0.035
Total	0.167	0.167	0.067	0.067	0.010	0.010	0.019	0.019