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Links between Socio-Economic Circumstances and Changes in Smoking Behavior in the Mexican Population: 2002–2010

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Abstract

While deleterious consequences of smoking on health have been widely publicized, in many developing countries, smoking prevalence is high and increasing. Little is known about the dynamics underlying changes in smoking behavior. This paper examines socio-economic and demographic characteristics associated with smoking initiation and quitting in Mexico between 2002 and 2010. In addition to the influences of age, gender, education, household economic resources and location of residence, changes in marital status, living arrangements and health status are examined. Drawing data from the Mexican Family Life Survey, a rich population-based longitudinal study of individuals, smoking behavior of individuals in 2002 is compared with their behavior in 2010. Logistic models are used to examine socio-demographic and health factors that are associated with initiating and quitting smoking. There are three main findings. First, part of the relationship between education and smoking reflects the role of economic resources. Second, associations of smoking with education and economic resources differ for females and males. Third, there is considerable heterogeneity in the factors linked to smoking behavior in Mexico indicating that the smoking epidemic may be at different stages in different population subgroups. Mexico has recently implemented fiscal policies and public health campaigns aimed at reducing smoking prevalence and discouraging smoking initiation. These programs are likely to be more effective if they target particular socio-economic and demographic sub-groups.

Keywords

smoking; smoking cessation; smoking onset; education; expenditure; Mexico

Introduction

Large fractions of adults smoke in many countries across the globe. For example, according to the WHO, more than one-third of adults in Bangladesh, Russia and India consume tobacco in one form or another on a regular basis (World Health Organization 2011). Since

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the 1970s, the fraction of the adult population that smokes has declined in the United States and most developed countries. However, in many parts of the rest of the world, the fraction of the population that smokes has increased over this period even as the deleterious consequences of smoking on health have been broadcast widely (Pampel 2010; Preston, Glei, & Wilmoth 2009). In response, over the last decade, many countries have sought to strengthen public policies intended to reduce the prevalence and incidence of smoking.

We examine changes in smoking behavior in Mexico following the same cohort of individuals between 2002 and 2010. During this time, public health and tobacco control programs were substantially strengthened with the real price of cigarettes increasing considerably as a result, at least in part, of higher rates of taxation (Jimenez-Ruiz *et al.* 2008; Olivera-Chávez *et al.* 2010; Sáenz-de-Miera *et al.* 2010). Over the same period, the fraction of men age 15 through 70 who were regular smokers rose by 25% in our study (from a base of 22%) and by 35% among women of the same age (albeit from a low base). To better understand these patterns, we investigate the characteristics that are associated with initiation of smoking and quitting, highlighting the roles of age, gender, education, economic resources, location of residence as well as changes in marital status, living arrangements and health status.

Background

The epidemic of smoking is in transition across the globe. The extent of smoking in a society in recent decades has been a good predictor of the pace of life expectancy improvement at older ages as well as differences in improvement in life expectancy by sex (Preston, Glei, & Wilmoth 2010). The early stage of the epidemic typically involves higher socio-economic status (SES) men being early adopters. As more men take up smoking, eventually the rate of increase slows, with higher SES men being on the vanguard of this trend. Lower SES men usually lag behind and women typically lag even further behind in the smoking transition (Lopez, Collishaw, & Piha 1994; Pampel 2010). Whereas this transition is well underway in the United States, Mexico is thought to be in the early stages of the trajectory (Wong *et al.* 2008).

To date, most studies of smoking in Mexico have examined the prevalence of smokers, non-smokers, and former smokers. Much of this research has focused on smoking status by sex, age, and socioeconomic status, as well as rural/urban differences in smoking (Buttenheim *et al.* 2010; Miera-Juárez *et al.* 2007; Villalobos and Rojas 2007). Results from these studies indicate that the prevalence of daily smoking among men is roughly four times higher than among women (Franco-Marina 2007). Evidence from the national surveys of addiction suggests that smoking prevalence may have declined between 1988 and 2008 although the comparability of the surveys over time is not clear since the earlier surveys covered only urban areas (Franco-Marina and Lazcano-Ponce 2010). This is important since smoking prevalence is higher in urban relative to rural areas (Kuri-Morales *et al.* 2006) and other studies do not indicate a secular decline in smoking rates (Franco Marina 2007). Smoking patterns also vary differentially by age and sex among urban and rural dwellers. For example, the prevalence of current smokers is highest among young people (aged 18–29) in urban places, while smoking is more common among both the young and old relative to those in middle ages in rural areas (Kuri-Morales*, et al.* 2006). Similarly, the rural/urban differences in smoking are much smaller among men than women: the proportion of urban women who smoke is five times higher than that of rural women (Buttenheim*, et al.* 2010).

In Mexico, evidence suggests there is considerable heterogeneity in the relationship between smoking and measures of SES status by sex, age, the particular measure(s) of SES employed and whether the area is rural or urban (Buttenheim*, et al.* 2010; Smith and Goldman 2007).

For instance, tobacco consumption at the households level is more common among those with higher income (Sáenz-de-Miera, *et al.* 2010; Vázquez-Segovia, Sesma-Vázquez, & Hernández-Avila 2002), but, at an individual level, the relationship is more complex. For example, Buttenheim and colleagues (2010) found that among both rural and urban women, education and assets were positively associated with smoking. Rural men with higher education and more assets were also more likely to smoke, but higher education was linked to less smoking among urban men. Among older adults, smoking was found to be positively associated with income in urban areas only, while in rural areas, those with greater wealth were less likely to smoke (Smith and Goldman 2007). Similarly, education has been shown to be positively associated with smoking among older adults (Wong, *et al.* 2008).

Part of the heterogeneity in the relationships between smoking and SES potentially lies in the variation in the measures of SES (Herd, Goesling, & House 2007). Many studies include education which likely reflects multiple factors including longer-run socio-economic position, earnings potential, cognitive capacity and information acquisition. Earnings or incomes are often used as shorter-term indicators of SES in studies of health and health behaviors. For many people, particularly in lower income and rural settings and those working in the informal sector, income varies substantially from month to month and from year to year. To the extent people save in anticipation of income fluctuations or borrow during bad times, income is likely to be a less reliable indicator of resource availability. Some studies have included wealth in models of smoking behavior although wealth is notoriously difficult to measure in health survey settings. Income and wealth are likely to be particularly poor measures of life time resource availability for young respondents who have not started earning income or are in the early stage of their working life; very few young adults have accumulated any financial wealth. This is important in the context of examining smoking transitions since many of the people who smoke during their lifetimes begin at early ages.

We rely on household expenditure to measure resource availability. Expenditure reflects spending on goods and services that are consumed by household members and is, therefore, a measure of their level of material well-being. It is generally believed that, relative to income, expenditure better reflects financial security and resource availability, at least in an environment in which there are formal and informal credit markets, transfers, insurance mechanisms and sales of assets (Deaton 1997). Moreover, in household surveys in developing countries, household expenditure is thought to be measured with less error than income or wealth.

Previous studies in Mexico show a high smoking incidence at young ages. For example, the highest incidence of smoking is between ages 10–19 (Menezes *et al.* 2009). Four-fifths of smokers have begun smoking by 18 years of age; and over time, the age at smoking initiation has decreased (Kuri-Morales, *et al.* 2006). The average age at which adolescents begin smoking is similar among men and women, but a larger number of men start smoking (Lotrean *et al.* 2005). In addition, more urban than rural adolescents aged 12–17 begin smoking (Kuri-Morales, *et al.* 2006). In contrast to what is observed in developed nations, adolescents and young adults of higher socioeconomic status are more likely to be smokers in Mexico (Arillo-Santillán *et al.* 2005; Bird *et al.* 2007; Ritterman *et al.* 2009). However, in a longitudinal study of Mexican adolescents, there was no difference in smoking initiation in a one-year period between public and private school attendees (a proxy for socioeconomic status) (Thrasher *et al.* 2009). Thus, more work is needed to shed light on factors that predict the onset of smoking, not just factors associated with smoking prevalence among adolescents.

Few studies have examined smoking cessation in Mexico and other developing countries. Cessation of smoking is one change that can result in improved health at older ages. Most research is confined to prevalence estimates of former smokers (Villalobos and Rojas 2007) or those who have attempted to quit (e.g., Villalobos and Rojas 2007). In the US, younger adults were more likely to successfully quit smoking (Messer *et al.* 2008), whereas in Malaysia and Thailand, older adults were more likely to quit (Li *et al.* 2010). However, the factors associated with smoking cessation may differ among younger versus older adults (Whitson, Heflin, & Burchett 2006). For example, older adults may be more likely to quit smoking because they have already experienced health problems related to smoking (Keenan 2009). In developed countries, higher SES is associated with a greater likelihood of attempting to quit and successfully quitting (Gilman, Abrams, & Buka 2003; Reid *et al.* 2010).

In addition to individual-level factors, public policies at various levels of government have been substantially strengthened in recent years. For instance, member States of WHO adopted the Framework Convention on Tobacco Control in 1999 (World Health Assembly 1999) which served as the basis from which tobacco control interventions were implemented in Latin America. In Argentina, for example, there is evidence suggesting that the implementation of a national tobacco control policy in 2011 could lead to significant reductions in deaths due to cardiovascular disease (Konfino *et al.* 2012). Similarly, Mexico has passed new legislation that bans tobacco advertising and mandates pictorial warning labels on tobacco cartons (Thrasher *et al.* 2008). Taxes on cigarettes have been substantially increased and the real price of cigarettes has similarly increased since 2000. After a tax increase in 2007, the price of cigarettes rose by about 10%; in that year, there was a 29% decline in the average number of cigarettes smoked per day (Sáenz-de-Miera*, et al.* 2010). Spending on tobacco products has declined over time and it is difficult to separate secular decline in tobacco consumption from the impact of the price increase. The longer-term responses, which may be quite different, have not been established. The short run effects were concentrated in households with heavy smokers and did not vary by socio-demographic group (Sáenz-de-Miera*, et al.* 2010). A ban on smoking in public enclosed places and workplaces in Mexico City was instituted in early 2008 and extended to the whole country later that year (Thrasher *et al.* 2010). These changes have potentially affected smoking behavior and have likely had a differential impact on initiation and cessation of smoking as well as differential impacts across socio-economic and demographic groups.

Since the literature has focused primarily on the prevalence of smoking in Mexico, the underlying dynamic processes of smoking initiation and cessation have received relatively little attention. Understanding these dynamic processes is important since demographic and socioeconomic differences in smoking prevalence can arise from heterogeneity in smoking initiation, continuation, or cessation. For example, Kenkel and colleagues (2009) attribute most of the higher prevalence of smoking among those with less education to differences in smoking initiation. In the US, the higher prevalence of smoking among those with low SES is explained in part by their lower rates of quitting smoking (Siahpush *et al.* 2010). As attitudes to smoking change, as prices change and as public health tobacco control programs are strengthened, it is of substantial interest to identify those groups in the population who are on the vanguard of changed behavior. More generally, the factors that contribute to smoking initiation may differ from those associated with quitting smoking (Kenkel*, et al.* 2009). Understanding these transitions will likely contribute to a better understanding of the factors that contribute to smoking prevalence and its trends. By examining changes in smoking behavior of Mexicans over the last decade, we directly address this gap in the literature.

Using population-representative longitudinal data that follow a large cohort of Mexican adults, we examine changes in smoking behavior between 2002 and 2010 to investigate the characteristics that are associated with the initiation of and quitting smoking. In addition to describing the influences of age, gender, education, household economic resources and location of residence, we highlight how changes in marital status, living arrangements and health status are associated with changes in smoking behavior. It is reasonable to suppose that as individuals learn about health problems, they are more likely to quit smoking; changes in marital status and having children are likely to have different associations with starting and quitting smoking. In addition, as public health programs have been strengthened and taxes on tobacco have recently been increased in Mexico (Jimenez-Ruiz*, et al.* 2008), we also hypothesize changes in smoking behavior will vary by education and economic resources, as well as by changes in socioeconomic conditions.

Methods

Study population

Data come from the first and third waves of the Mexican Family Life Survey (MxFLS), an ongoing longitudinal study of Mexicans of all ages designed to interview every household member. Details of the MxFLS have been reported previously (Rubalcava and Teruel 2006a, 2006b). The baseline survey, conducted in 2002, interviewed over 35,000 individuals in 8,440 households living in 150 communities. The third wave was conducted in 2009 through 2013; for simplicity we refer to the latter as the 2010 wave.

Questions about smoking behavior were administered to all respondents age 15 and older; to avoid mortality selection, we examine behaviors of those age 15 through 65 in 2002. Examining change in this age group should allow us to understand change in a behavior important to subsequent health at older ages while avoiding selectivity in the sample related to mortality. In sensitivity analyses, we also estimated models for respondents aged 15–70 and 15–60. After controlling for age, education, place of residence and urban/rural in 2002, in the 15–70 sample those who smoked in 2002 are significantly more likely to die. Smoking raises the probability of death by over 1 percentage point for men and women. Using the sample aged 15–65, the coefficient on smoking declines to less than 0.8 percentage points for both men and women and neither coefficient is significant. We conclude that, for this sample, mortality selection is unlikely to substantially contaminate coefficient estimates in our models of smoking behavior in this sample. Further restricting the sample to those aged 15–60 does not alter any of our substantive conclusions and so we report estimates for the sample age 15 to 65 at baseline.

There were 22 481 age-eligible household members at baseline, of whom 91% provided information on smoking. City and town dwellers were less likely to be interviewed, as were the most educated, oldest and men (Rubalcava and Teruel 2006a, 2006b). Every member of each household at baseline was eligible to be tracked and interviewed in the follow-up surveys, including those who moved away from the baseline location and those who moved to the United States. In the 2010 wave, 79% of the respondents who completed the smoking module at baseline were re-interviewed leading to a sample of 16 123 people. Males, younger respondents, city and town dwellers and the better educated were less likely to be re-interviewed. There were 296 missing values in marital status (about 1.8% of the sample) leading to a final analytical sample of 15 287 people.

We use weights throughout the analyses so that the sample is representative of the Mexican population in 2002. The sampling weights take into account the probability the household was sampled at baseline and the probability the respondent completed an individual assessment about smoking at the baseline interview. For these analyses, the sampling

weights have been adjusted to take into account attrition, that is, the probability the respondent completed an individual assessment in the 2010 survey. Data collection was approved by the UCLA, Duke University and CAMBS, Mexico City IRBs.

Conceptual framework

The analytical models are guided by a conceptual framework that places individual choice over the life course at the center of decisions to initiate, continue or quit smoking. Those choices take into account perceptions and beliefs about their impact on current and future well-being while also being constrained by the limits of information and financial resources at any point in time. Perceptions, beliefs and information all vary over the life course and reflect choices of the individual to acquire information, the role of peer and family networks and the role of policies including tobacco control initiatives. Given the addictive nature of tobacco, self-control is likely to be important as individuals trade-off current well-being at any age against the perceived well-being of their future selves. In the model, resources may serve two purposes: resources may be used to avoid unhealthy situations (such as providing the means to live in areas with low levels of pollution) or they may enable unhealthy behaviors (including smoking).

Measures

Changes in smoking behavior—Individuals were categorized by smoking status at baseline and in the 2010 wave (Figure 1, panel A). Using their smoking status at the two waves, each respondent belongs to one of four mutually exclusive groups (Figure 1, panel B): non-smoker (non-smoker in both waves), quitter (smoker in 2002 but non-smoker in 2010), starter (non-smoker in 2002 but smoker in 2010), and smoker (regular smoker in both waves). Our analysis will examine changes in smoking behavior among the two baseline groups, i.e. quitting smoking among those who smoke at the initial wave and the initiation of smoking among those who are initially non-smokers.

Traditionally, smoking status is derived from smoking histories distinguishing those who have never smoked from former smokers and current smokers. Our results using longitudinal data indicate that this classification is potentially contaminated in important ways by recall bias. Specifically, we have used the repeat observation dimension of the MxFLS data to evaluate the quality of retrospective information collected on smoking in the 2002 and 2010 surveys. In both surveys, we ask the same respondents whether they have ever smoked. We find that 95% of those who report having never smoked in 2010 also report having never smoked in 2002. However, 5% who report they had never smoked in 2010 reported being regular smokers in 2002 and they account for 37% of those who report being regular smokers in 2002. Relying on retrospective information would substantially misrepresent the dynamics of smoking behavior and understate the fraction of people who have ever smoked in the study population. This highlights a key advantage of longitudinal data for studying the dynamics of smoking behavior: we rely only on contemporaneous information on smoking behavior in this research.

SES and place of residence—We examine two complementary markers of SES, education and household expenditures. Education reflects the combined effects of knowledge, beliefs and expected life-time resources on smoking and estimated effects will depend on the relative strengths of all these factors. In the empirical models, education is categorized into three groups: primary schooling (0–6 years of schooling), junior high school (7–9 years), and high school or more (10+ years). For respondents younger than 22 years at baseline we use their completed level of education in the 2010 wave.

Our second SES marker is household expenditures, or consumption which is a measure of resource availability (Whitson, *et al.* 2006). MxFLS records spending on a broad set of goods and services purchased in the market and the imputed value of goods and services provided in kind or consumed out of own production. Following standard practice in consumption surveys, imputed values are estimated by the respondent. Questions are asked about 50 groups of goods that are intended to capture total household expenditure. There is no consensus in the literature on how to appropriately take into account needs of different individuals in a household; *faute de mieux*, we adjust household expenditure by total household size and use per capita household expenditure (PCE). Two indicator variables are defined: one for households in the top quartile of the distribution of PCE and another for households between the first and third quartiles of the PCE distribution. Adults living in the poorest quarter of households serve as the reference category. To take into account differences in price levels in rural and urban areas, as well as differences in the extent of information and impact of tobacco control policies, we also control for the size of the community of residence at baseline, identifying rural (less than 2500 people) and urban (more than 2500 people) areas. In additional analyses (see appendix) we included two measures of economic resources (PCE in 2010 and extended family PCE in 2010) and place of residence at the second wave to test for the effect of changes in these variables on smoking behavior. The results did not alter our main conclusions; thus, we only present results using PCE at baseline. Note that, to the extent PCE captures resource availability, the estimated effects of education on smoking behavior can be interpreted as net of the effects of resources.

Changes in marital status, household composition, pregnancy status, and chronic disease—We additionally examined the association between changes in marital status, household composition, pregnancy status, and chronic disease with smoking behavior. Becoming married, the presence of children in the household and, for women, being pregnant are all likely to increase the perceived current and future costs of smoking and so are likely to retard initiation and encourage quitting. Changes in marital states between the waves are categorized into four groups representing mutually exclusive categories: 1) people who remain married or partnered at both waves, 2) those who were always unmarried at both waves (i.e., separated, divorced, widowed or never married), 3) newly married or partnered (i.e., married or partnered between waves), 4) newly unpartnered (i.e., separated, divorced, widowed between waves). Change in household composition is indicated by having at least one child aged 10 years or younger in the household by the follow-up interview. Because there is an average of 8 years between baseline and follow-up, most of these children would have been added to the household between waves. We also added an indicator of pregnancy status at the second wave.

Finally, self-reports of the presence of four chronic conditions were included in the analysis: heart disease, cancer, diabetes, and hypertension. These self-reports reflect the respondents' own information about their current state of health, which may have been influenced by past smoking. We interpret the self-reported chronic conditions as providing descriptive evidence on the associations between respondents' knowledge of their health and changes in their smoking behavior. For each condition, we constructed two indicators representing presence at baseline (i.e., self-reported condition at wave I) and onset between waves (i.e., condition self-reported at follow-up but not at baseline). Due to the small number of self-reported cancers, it was coded as a dummy variable with one representing having cancer at either wave.

Statistical analysis

Two logistic regression models are fitted to estimate the association between changes in smoking behavior with the set of covariates (Figure 1) focusing on the main smoking behaviors, starting and quitting. The first model estimates the odds of quitting relative to continuing to smoke among persons who smoke at the first interview, while the second model estimates the odds of starting relative to non-smokers among those who do not smoke initially. In each of these cases we fitted three sequential models. First, we explore the association between smoking changes and the respondent's age and education (model A); second, we add household PCE and location, both of which are measured at baseline in 2002 (model B); and third, changes in marital status, household composition, pregnancy status, and chronic disease are added to the model (model C). All models are estimated separately for men and women because the relationships differ substantively by gender. Sample data are weighted that adjust for sampling probabilities and attrition to reflect the Mexican population in 2002, and standard errors and test statistics take into account the cluster design of the survey.

Results

Table 1 shows descriptive statistics of the study sample. The average age was 35 years in 2002 with about 45% being men. Smokers are slightly older at baseline, have higher level of education and more economic resources, live predominantly in urban areas and have fewer chronic conditions than non-smokers. There is a higher proportion of married men who smoke at baseline.

Table 2 and Figure 2 show smoking status at each wave and changes in status by age and gender. About 21% of men were smoking in 2002 and this had increased by 5 percentage points by 2010. The increase is particularly large among young adults with men having two times higher smoking prevalence in 2010 than in 2002. Underlying this increase is substantial change: 13% of men took up smoking while 8% quit with three times more smoking initiators than quitters among those aged 15–19. About one third (34%) of men report smoking in one or both survey waves across all ages and about half of those who smoked in 2010 also smoked in 2002. Smoking is much less prevalent among women of all ages with less than 10% of them smoking in either wave but the rate of increase is proportionately greater than among men, with almost twice as many women taking up smoking (4.1%) as quitting (2.3%) between the waves. Young women, however, show a rate three times higher for smoking initiation than smoking cessation.

Estimated odds ratios relating changes in smoking behavior to age, education, PCE, place of residence and changes in marital status, household composition, pregnancy status, and chronic health conditions for men and women are shown in Tables 3 and 4, respectively. Logit models are estimated separately for starting and quitting, and for men and women. Respondents aged 30–49, those with primary school, those in the bottom quartile of PCE, those living in rural areas, people married/partnered at both waves, and those who self-reported no chronic disease at both waves are the reference categories.

Smoking initiation

For women (panel I of Table 3), education shows a positive gradient with smoking initiation. Those with more education are more likely to start smoking relative to those with primary education (model A). These patterns are reduced when PCE is controlled indicating that part of the higher rates of initiation of smoking among this education group can be attributed to the role of resources (model B). For instance, controlling education and PCE, women with more economic resources are at least two times more likely to start smoking

relative to those at the bottom of the resource distribution. In addition, relative to 30–49 year olds, the youngest cohort (15 to 19 year olds) are the most likely to start smoking after controlling for PCE. The availability of economic resources is a powerful predictor of smoking initiation among young women with about two times higher likelihood than among middle-aged women. Adding changes in marital status between 2002 and 2010 shows that newly unpartnered women (e.g., separated, divorced or widowed by 2010) are twice as likely as those who remained married/partnered to start smoking (model C). Being pregnant at the time of the survey and living with young children are not associated with starting to smoke. None of the health indicators shows a significant association with smoking initiation.

As shown in panel I of Table 4, contrary to the results among women, education is not a strong predictor of smoking initiation among men. Nor is there a significant association between economic resources and smoking initiation. Men with junior high school are more likely to start smoking relative to those with primary education. Comparing odds ratios in models A and B indicates that a small part of the association between education and smoking reflects the role of resources. Changes in marital status and living with young children between waves do not appear to be significantly associated with smoking initiation (model C). However, men who self-report the onset of hypertension, heart disease and diabetes between 2002 and 2010 show a higher likelihood of smoking initiation than those who do not report having these conditions in either wave. These analyses cannot shed light on whether the onset of the condition resulted in men taking up smoking or whether smoking preceded the onset of the condition. Controlling all of these characteristics, both men and women in urban areas are much more likely to take up smoking than those living in rural areas.

Smoking cessation

Panel II of Tables 3 and 4 present results for models of smoking cessation for women and men, respectively. Smoking cessation is not predicted well in these models. None of the covariates in the models is a significant predictor of smoking cessation among women. Among men only three of the covariates are significant predictors of quitting. The fact that few covariates significantly link with quitting highlights smoking as a very addictive behavior that it is not easily predicted. First, men in their teens and twenties are the most likely to quit although this advantage is not significant after controlling education, economic resources, living arrangements and health conditions. Second, men with more economic resources who smoked at baseline are significantly less likely to quit by 2010. Third, men who reported being hypertensive in 2002 and were smoking at the time are three times more likely to have quit by 2010 than those who do not report being hypertensive. The temporal ordering suggests that information about hypertension may have encouraged men to quit smoking. Education, marital status, living arrangements and other health conditions are not predictive of smoking cessation for men or women.

Discussion

We find that socioeconomic indicators and urban or rural residence are more likely to predict the initiation of smoking than quitting smoking. Age and chronic disease are the only predictors of quitting behavior among men but not women. The onset of smoking is more than twice as likely among urban as rural women and 1.7 times as likely for urban as opposed to rural men. This indicates that urban residents are at a particularly high risk of smoking initiation.

Education has been shown to predict whether an individual smokes in Mexico as in many developing countries. However, this research indicates that the link between education and smoking in Mexico is, in fact, complex. First, it establishes that for women a substantial part

of the relationship between education and smoking onset reflects the role of economic resources. We find that for women, controlling PCE reduces the strong link between higher education and smoking onset. Second, the association of smoking onset with mid-level education remains significant among men even while controlling for PCE. For example, among men, those with junior high school are forty percent more likely to start smoking relative to those with primary school. Relative to women in the bottom quartile of PCE, those in the top quartile are 4 times more likely to start smoking. Third, newly unpartnered women show a significantly higher likelihood of smoking initiation but women who smoke and are pregnant are no more likely to quit than those who are not pregnant. This is a concern for the health of the next generation. Among men, living arrangements and partnering are not predictive of changes in smoking behavior. Fourth, men who report the onset of chronic health conditions between baseline and follow-up are also more likely to start smoking. The temporal ordering cannot be inferred in these cases and the associations cannot be given a causal interpretation. However, men who were smokers and hypertensive at baseline are three times more likely to have quit by follow-up than those who were not hypertensive suggesting that information about chronic conditions may have encourages cessation of smoking among these men. Few covariates significantly link with quitting smoking in this sample indicating that smoking is a very addictive behavior that it is not easily predicted. Finally, we document considerable heterogeneity in the effect of SES indicators on smoking initiation in Mexico suggesting that smoking behavior is likely to be at different stages in the transition for different population groups (Lopez*, et al.* 1994).

We find that among men, the relationship between education and smoking is not monotonic with those who completed junior high being the most likely to start smoking. In contrast, when economic resources are controlled, relative to men with less education, those with at least some senior high education are less likely to start smoking and less likely to quit; albeit not significantly so. One interpretation of these results is that better educated men are leading the way in changing their behavior in response to policies that limit smoking in public places, as in Mexico City (Thrasher*, et al.* 2010), or in response to the dissemination of information about the consequences of smoking. On the contrary, better educated women do not appear to have been so affected.

To date, most studies of smoking behavior in Mexico have examined the prevalence of smokers, non-smokers, and former smokers but there is less research on the association between economic resources and smoking. One study shows that households with the most economic resources are more than twice as likely to have at least one smoker compared to the poorest households (Li*, et al.* 2010). Other research concludes that tobacco consumption is more common in higher income Mexican households (Messer*, et al.* 2008; Vázquez-Segovia*, et al.* 2002) or in households with more assets (Buttenheim*, et al.* 2010). Our evidence indicates that these results are primarily driven by higher rates of smoking among women in higher income families. The research suggests that targeting higher resource individuals in tobacco control programs is likely to be effective and that, in the absence of effective control, smoking rates will increase as the economy grows, particularly among the better off.

In addition, our results show that once economic resources are controlled, smoking initiation is much more likely to occur among those under age 20. For example, controlling for education and PCE, relative to those aged 30–49, young women aged 15–19 and men aged 15–19 are about 2.5 and 1.6 times more likely to start smoking, respectively. It is also true that with these controls men in their 20s are more likely than middle aged or older men to quit. Clearly, tobacco control programs should be oriented to the adolescent and young adult age group.

In sensitivity analyses (not shown) we modeled smoking behavior based on a multinomial model which included all smoking categories with non-smokers as the reference group. Results were substantively similar from the narrative provided by the conditional models shown in Tables 3 and 4. For instance, coefficient estimates for smoking initiation are identical whether one uses a multinomial or a conditional logit model when non-smokers are the reference group. Nonetheless, with all their possible contrasts in a multinomial logit model, results obscure the main contributions of the research which center on starting and quitting smoking.

Our work has some limitations and strengths. By relying on prospective longitudinal survey data, we have provided new evidence on smoking transitions and their correlates without relying on retrospective data, which is prone to substantial recall error. However, we do not attempt to model the entire history of smoking behavior. Our measures of smoking are not sufficiently precise to isolate changes in intensity of smoking and we cannot identify the temporal ordering of changes in smoking behavior and other life course changes. An important strength of this study is the use of a nationally representative sample of the adult Mexican population that allows studying changes in smoking behavior at the individual level along with multiple indicators of socio-economic status and health. By only relying on contemporaneous information on smoking behavior in this research, we directly observed smoking onset and quitting thereby providing new insights into understanding of smoking behavior of adults age 15 through 65 years old in Mexico.

Conclusion

We show that smoking behavior in Mexico appears to be associated with education, economic resources, and changes in marital status and chronic disease but differentially for men and women. It shows that smoking behavior in Mexico is differently occurring across age, gender, and economic subgroups of the population. Mexico has recently implemented fiscal policies and public health campaigns aimed at reducing smoking prevalence and discouraging smoking initiation. These programs are likely to be more effective if they target particular socioeconomic and demographic sub-groups who are at risk of starting to smoke. Preventing smoking at this age will lead to improvement in health and increased life expectancy at older ages.

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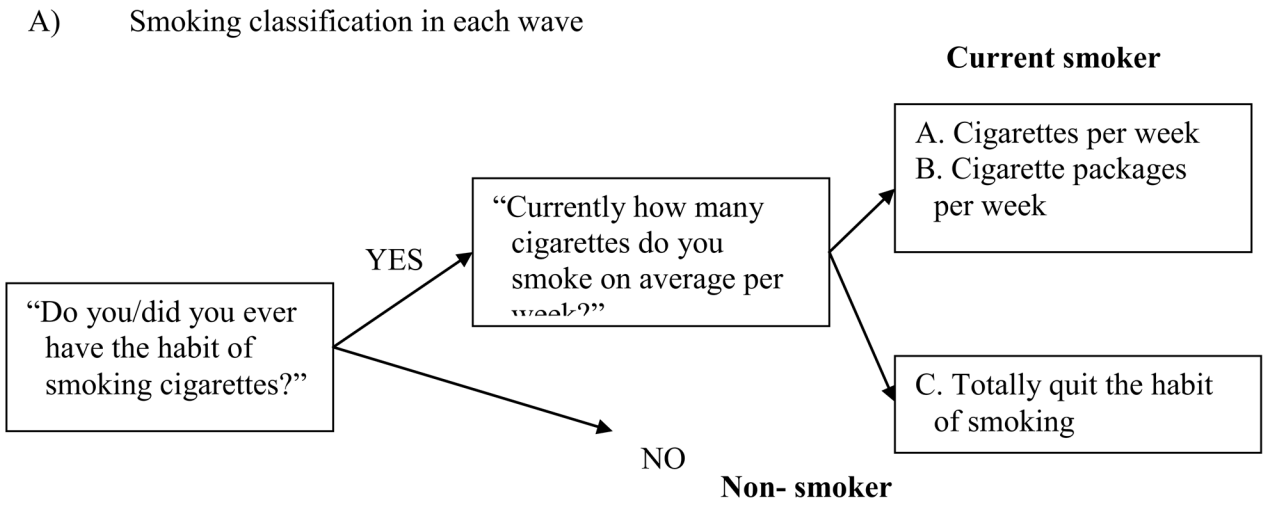

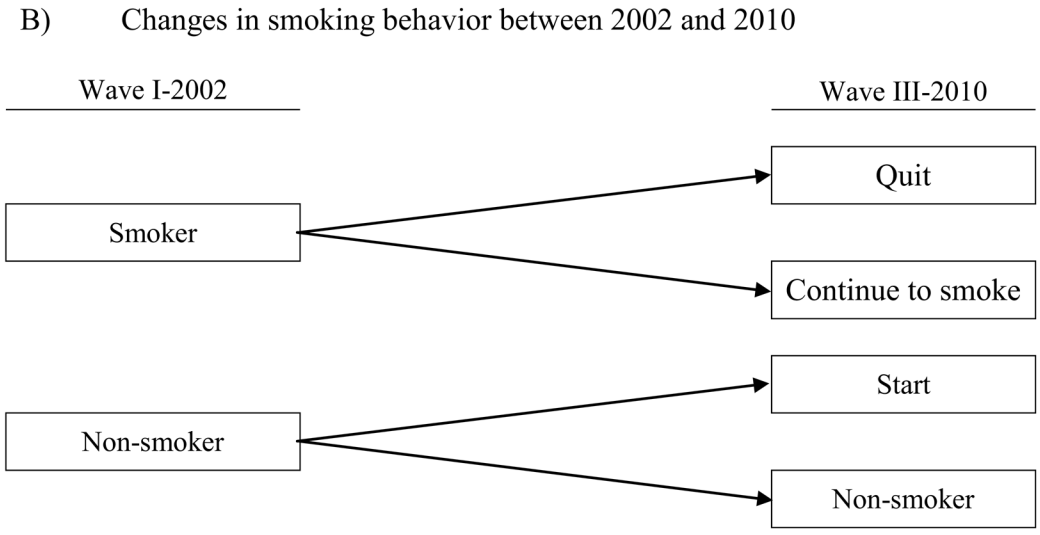

Figure 1.
Smoking classification (Panel A) and Changes in smoking behavior between 2002 and 2010 (Panel B).

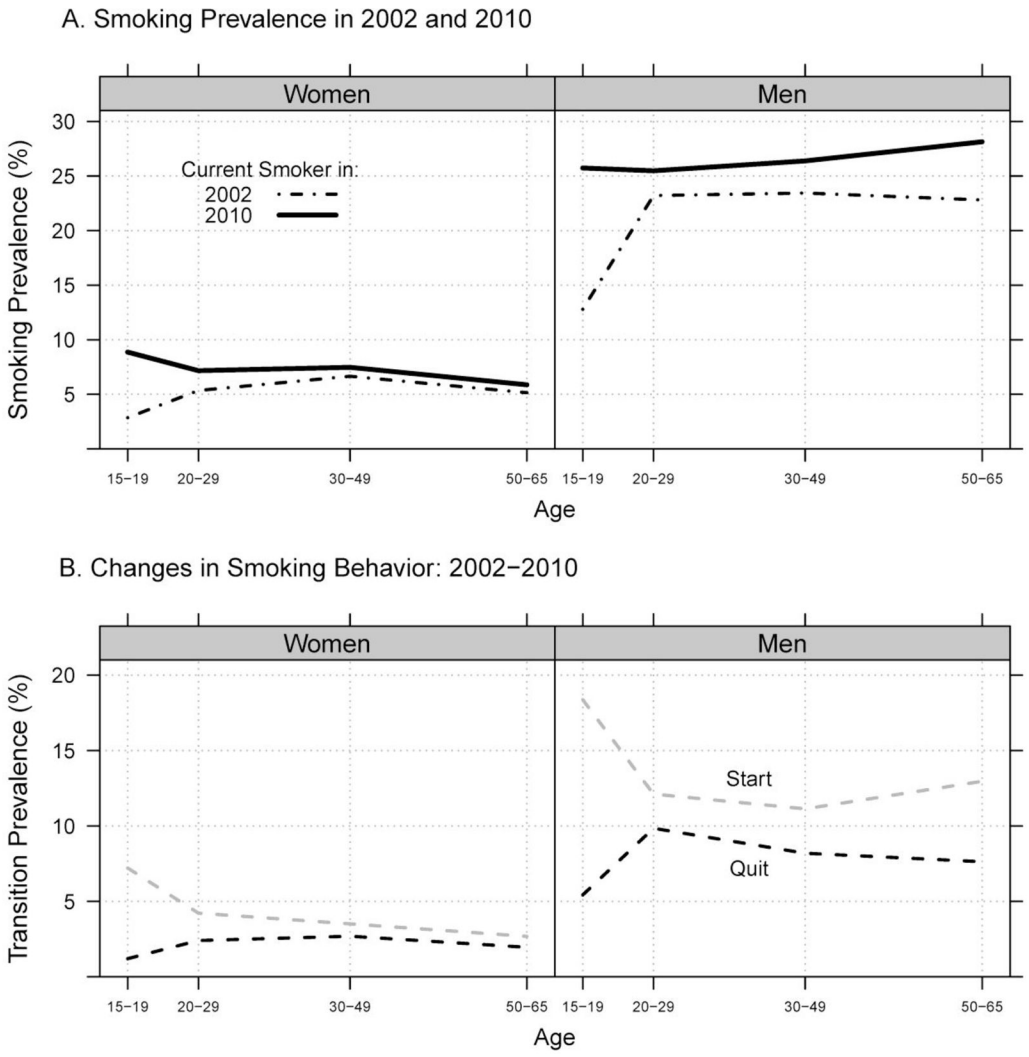

Figure 2.
Smoking Prevalence and Changes in Smoking Behavior by Age and Sex: 2002–2012
Notes: Unweighted estimates
Source: Table 2.

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Table 1

Sample means of covariates included in regression models. MxFLS adult respondents in 2002

	All respondents		Women		Men	
Covariates	**Women**	**Men**	**Smoker**	**Non-smoker**	**Smoker**	**Non-smoker**
Age						
Mean (years)	34.1	33.9	36.4	33.9	35.0	33.6
Std error	0.23	0.25	0.86	0.24	0.55	0.29
Education (%)						
Primary	46.4	37.5	28.5	47.9	35.4	38.1
Junior high/more	27.8	29.0	38.3	26.9	32.6	27.9
Senior high/more	25.8	33.5	33.2	25.2	31.9	34.0
Per capita expenditure (%)						
Bottom quartile	21.1	21.6	5.1	22.4	15.4	23.5
25–75 percentile	51.4	49.8	45.6	51.9	49.0	50.1
Top quartile	27.4	28.6	49.3	25.7	35.6	26.4
Location (% living in)						
Rural	21.1	20.1	6.1	22.3	13.9	22.1
Urban	78.9	79.9	93.9	77.7	86.1	77.9
Marital status (%)						
Married/partnered	59.6	62.9	58.7	59.7	67.7	61.4
Unmarried[a]	40.4	37.1	41.3	40.3	32.3	38.6
Pregnant[b] *(%)*	1.7	-----	2.4	1.6	-----	-----
Child aged<=10 in HH[b]	51.6	49.1	43.6	52.3	48.2	49.4
Chronic disease[c] *(%)*						
Diabetes	4.6	3.8	4.0	4.6	3.0	4.0
Hypertension	10.7	4.5	11.3	10.6	4.0	4.6
Heart disease	2.1	1.5	1.8	2.2	1.0	1.7
Cancer	0.71	0.12	1.34	0.66	0.05	0.14
Sample size[d]	8,282	7,005	453	7,829	1,493	5,512

Notes: All estimates are weighted to reflect sampling design.

[a] separated, divorced, widowed, never married;

[b] at follow-up in 2010;

[c] self-reported;

[d] Unweighted sample size corresponding to actual number of respondents in the analytic sample.

Source: Mexican Family Life Survey, wave I.

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Table 2

Smoking behavior and changes in smoking behavior by Age and Sex. MxFLS adult respondents in 2002 and 2010 waves

Smoking status in 2002 and 2010	Total		Age in 2002							
			15–19		20–29		30–49		50–65	
	N	%	N	%	N	%	N	%	N	%
	Women									
Smoke in 2002	453	5.5	38	2.9	109	5.3	235	6.7	71	5.1
Smoke in 2010	609	7.4	118	8.9	146	7.2	264	7.5	81	5.9
Changes in smoking behavior										
Non-smoker at both waves	4,600	90.4	888	68.8	1,084	64.7	1,845	65.4	783	64.2
Start: non-smoker in 2002 and smoker in 2010	912	4.1	237	18.4	203	12.1	314	11.1	158	13.0
Quit: smoker in 2002 and non-smoker in 2010	559	2.3	70	5.4	165	9.8	231	8.2	93	7.6
Continue: smoker in 2002 and smoker in 2010	934	3.2	95	7.4	224	13.4	430	15.2	185	15.2
TOTAL	7,005	100.0	1,290	100.0	1,676	100.0	2,820	100.0	1,219	100.0
	Men									
Smoke in 2002	1,493	21.3	165	12.8	389	23.2	661	23.4	278	22.8
Smoke in 2010	1,846	26.4	332	25.7	427	25.5	744	26.4	343	28.1
Changes in smoking behavior										
Non-smoker at both waves	4,600	65.7	888	68.8	1,084	64.7	1,845	65.4	783	64.2
Start: non-smoker in 2002 and smoker in 2010	912	13.0	237	18.4	203	12.1	314	11.1	158	13.0
Quit: smoker in 2002 and non-smoker in 2010	559	8.0	70	5.4	165	9.8	231	8.2	93	7.6
Continue: smoker in 2002 and smoker in 2010	934	13.3	95	7.4	224	13.4	430	15.2	185	15.2
TOTAL	7,005	100.0	1,290	100.0	1,676	100.0	2,820	100.0	1,219	100.0

Note: unweighted sample estimates. N corresponds to actual sample size and % represents the sample percentage.

Table 3

Changes in smoking behavior, adult SES, place of residence and changes in marital status, household composition and chronic disease: WOMEN, OR (95% CI)[+]

	I. Start smoking			II. Quit smoking		
Covariates	**Model A**	**Model B**	**Model C**	**Model A**	**Model B**	**Model C**
Age						
15–19	1.5 (1.0,2.3)	2.1 (1.4,3.3) ***	2.5 (1.4,4.2) **	1.2 (0.4,3.2)	1.1 (0.4,3.0)	0.8 (0.2,2.5)
20–29	0.9 (0.6,1.4)	1.1 (0.7,1.7)	1.3 (0.8,2.1)	1.0 (0.5,2.0)	1.0 (0.5,2.0)	0.8 (0.4,1.8)
30–49	1.0	1.0	1.0	1.0	1.0	1.0
50–65	0.8 (0.4,1.5)	0.6 (0.3,1.2)	0.5 (0.3,1.0)	0.6 (0.2,1.4)	0.6 (0.2,1.5)	0.4 (0.2,1.2)
Education						
0–6 yrs	1.0	1.0	1.0	1.0	1.0	1.0
7–9 yrs	2.5 (1.6,3.8) ***	1.7 (1.1,2.6) *	1.8 (1.2,2.7) **	0.7 (0.3,1.5)	0.7 (0.3,1.6)	0.8 (0.4,1.7)
10+ yrs	3.5 (2.4,5.2) ***	1.8 (1.2,2.8) **	1.9 (1.3,3.0) **	0.5 (0.2,1.0) **	0.6 (0.3,1.3)	0.5 (0.2,1.2)
Per capita expenditure (percentiles)						
1st		1.0	1.0		1.0	1.0
2nd–3rd		2.3 (1.3,3.9) **	2.1 (1.3,3.6) **		0.5 (0.2,1.5)	0.6 (0.2,1.6)
4th		4.7 (2.6,8.4) ***	4.3 (2.4,7.8) ***		0.4 (0.1,1.4)	0.5 (0.2,1.4)
Location						
Rural		1.0	1.0		1.0	1.0
Urban		2.6 (1.9,3.7) ***	2.6 (1.8,3.6) ***		1.1 (0.6,2.2)	1.1 (0.5,2.1)
Marital status						
Married/partnered[a]			1.0			1.0
Always unmarried[a]			1.1 (0.7,1.8)			1.5 (0.6,3.4)
Newly married/partnered[b]			1.2 (0.7,2.0)			1.1 (0.4,3.0)
Newly unpartnered[b]			2.1 (1.2,3.5) **			1.1 (0.5,2.6)
Household composition[c]						
Child aged <=10yrs			0.8 (0.6,1.2)			0.8 (0.4,1.5)
Pregnancy status[c]						
None			1.0			1.0

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	I. Start smoking			II. Quit smoking		
Covariates	**Model A**	**Model B**	**Model C**	**Model A**	**Model B**	**Model C**
Pregnant			0.8 (0.3,2.4)			0.3 (0.1,1.7)
Diabetes						
None[a]			1.0			1.0
Baseline			1.1 (0.5,2.5)			1.6 (0.5,5.2)
Follow-up			2.5 (1.1,5.4)*			0.7 (0.2,3.5)
Hypertension						
None[a]			1.0			1.0
Baseline			1.0 (0.5,1.8)			0.3 (0.1,0.9)*
Follow-up			1.2 (0.6,2.6)			0.2 (0.1,0.9)*
Heart disease						
None[a]			1.0			1.0
Baseline			1.0 (0.4,2.9)			2.6 (0.7,8.9)
Follow-up			2.3 (0.7,7.4)			3.6 (0.3,52.0)
Cancer						
None[a]			1.0			1.0
Baseline/Follow-up			2.0 (0.7,5.3)			0.1 (0.0,0.7)*
Sample size		N= 7,829			N= 453	

*** p<0.001,

** p<0.01

* p<0.05

+ Odds ratios (OR) from logistic regression analyses taking into clustering and weighting to reflect sampling design. Separate models are fitted for starting and quitting.

[a] at both waves;

[b] between waves;

[c] at follow-up

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Table 4

Changes in smoking behavior, adult SES, place of residence and changes in marital status, household composition and chronic disease: MEN, OR (95% CI)[+]

	I. Start smoking			II. Quit smoking		
Covariates	**Model A**	**Model B**	**Model C**	**Model A**	**Model B**	**Model C**
Age						
15–19	1.4 (1.0,1.9)*	1.5 (1.1,2.0)*	1.6 (1.1,2.4)*	1.7 (0.9,3.3)	1.7 (0.9,3.3)	1.2 (0.6,2.4)
20–29	0.9 (0.6,1.2)	0.9 (0.6,1.3)	0.9 (0.6,1.4)	1.6 (1.0,2.6)*	1.6 (1.0,2.5)*	1.3 (0.8,2.1)
30–49	1.0	1.0	1.0	1.0	1.0	1.0
50–65	1.1 (0.8,1.6)	1.1 (0.8,1.6)	1.1 (0.8,1.6)	1.1 (0.7,1.9)	1.2 (0.7,2.0)	1.2 (0.7,1.9)
Education						
0–6 yrs	1.0	1.0	1.0	1.0	1.0	1.0
7–9 yrs	1.5 (1.1,2.0)*	1.3 (1.0,1.9)	1.4 (1.0,1.9)*	1.1 (0.7,1.7)	1.2 (0.8,1.9)	1.2 (0.7,1.8)
10+ yrs	0.9 (0.7,1.2)	0.8 (0.6,1.1)	0.8 (0.6,1.2)	0.7 (0.5,1.2)	0.9 (0.5,1.6)	1.0 (0.6,1.7)
Per capita expenditure (percentiles)						
1st		1.0	1.0		1.0	1.0
2nd–3rd		1.1 (0.8,1.5)	1.0 (0.7,1.4)		0.7 (0.5,1.2)	0.7 (0.4,1.1)
4th		1.0 (0.7,1.5)	1.0 (0.7,1.5)		0.5 (0.3,0.9)*	0.5 (0.3,0.9)*
Location						
Rural		1.0	1.0		1.0	1.0
Urban		1.7 (1.4,2.2)***	1.7 (1.4,2.2)***		0.9 (0.6,1.3)	0.9 (0.6,1.3)
Marital status						
Married/partnered[a]			1.0			1.0
Always unmarried[a]			0.9 (0.6,1.4)			1.8 (1.0,3.4)
Newly married/partnered[b]			0.9 (0.6,1.4)			1.4 (0.8,2.5)
Newly unpartnered[b]			1.0 (0.6,1.7)			1.4 (0.7,2.9)
Household composition[C]						
Child aged <=10yrs			1.2 (0.9,1.6)			1.3 (0.9,1.9)
Diabetes						
None[a]			1.0			1.0

	I. Start smoking			II. Quit smoking		
Covariates	**Model A**	**Model B**	**Model C**	**Model A**	**Model B**	**Model C**
Baseline			0.7 (0.3,1.6)			1.2 (0.4,3.5)
Follow-up			1.7 (1.1,2.7)*			0.4 (0.2,1.0)*
Hypertension						
None[a]			1.0			1.0
Baseline			0.8 (0.4,1.7)			3.7 (1.4,9.7)**
Follow-up			1.7 (1.1,2.6)*			1.4 (0.6,3.2)
Heart disease						
None[a]			1.0			1.0
Baseline			1.9 (0.6,5.7)			0.1 (0.0,0.5)**
Follow-up			2.6 (1.1,6.6)*			0.7 (0.2,2.4)
Cancer						
None[a]			1.0			1.0
Baseline/Follow-up			1.8 (0.3,11.8)			1.2 (0.1,16.5)
Sample size		N= 5,512			N= 1,493	

*** p<0.001,

** p<0.01

* p<0.05

+ Odds ratios (OR) from logistic regression analyses taking into clustering and weighting to reflect sampling design. Separate models are fitted for starting and quitting.

[a] at both waves;

[b] between waves;

[c] at follow-up