RESEARCH ARTICLE

Socioeconomic inequality in tobacco use in Kenya: a concentration analysis

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Abstract
This paper aims at assessing and exploring socioeconomic inequalities in tobacco use in Kenya. Using the theory of fundamental causes, and concentration index, we investigate the determinants of tobacco use, and whether it disproportionately affects the poor. All data used in this study emanated from the 2014 Global Adult Tobacco Survey implemented in Kenya on a nationally representative sample of men and women aged 15 years and older. Our results suggest a link between tobacco use and socioeconomic inequality. Overall, poorer households are more affected by tobacco use than richer households. This socioeconomic inequality is more evident among men and households living in urban areas. The decomposition of the concentration index indicates that the overall socioeconomic inequality for current tobacco smokers is explained by 69.11% of household wealth. To reduce the prevalence rate of smoking in Kenya, policymakers could design and implement tobacco control programs through the equity lens. Community health workers could be used to promote non-smoking behaviors among the poor.

Keywords Theory of fundamental causes · Tobacco consumption · Socioeconomic inequalities · Concentration index

JEL Classification D · C2 · I14 · L66

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Introduction

Tobacco use is one of the four major risk factors for non-communicable diseases (NCDs). It is a major public health problem, a preventable cause of disability and premature death. It increases the risk of various cancers (US Department of Health Human Services 2004), lung diseases, cardiovascular diseases (Boffetta and Straif 2009), low birth weight, stillbirth and is, therefore, a major contributor to premature death worldwide. In 2015, smoking caused more than one in ten deaths worldwide (Britton 2017). Tobacco use also has negative economic effects due to smoking-attributable healthcare costs, productivity loss, and healthcare expenditures on consequent illnesses. Globally, it is estimated that total tobacco-attributable deaths are projected to rise from 5.4 million in 2005 to 6.4 million in 2015 and 8.3 million in 2030 (Mathers and Loncar 2006). In 2004, among adults aged 30 years and over, tobacco use was estimated to be responsible for 3% of deaths in Africa (WHO 2012).

Sub-Saharan Africa (SSA) countries are already burdened by infectious diseases and are currently facing the weight of NCDs. Between 1990 and 2017, all-age total disability-adjusted life years (DALYs) due to NCDs increased by 67% and cardiovascular diseases were the second leading cause of NCDs burden in 2017, resulting in 22.9 million DALYs (Gouda et al. 2019) in SSA countries. Despite the well documented negative impact of smoking on health, there is still scant evidence on whether tobacco use evenly affects the poor and rich in sub-Saharan African (SSA) countries. However, given the high level of inequality in income in SSA countries, there could be large differences and disparities in tobacco use between individuals in some SSA countries.

Socioeconomic inequality in tobacco use refers to the extent to which the prevalence of tobacco differs between more and less socially and economically advantaged groups. Exploring socioeconomic inequality in tobacco use is important for several reasons. First, it allows policymakers to identify the population most affected by tobacco use. In the Kenyan context, this is so important since so far no studies had been done to explore the most affected group by tobacco use. Hence, the current study will therefore provide strong evidence on socioeconomic inequality in tobacco use in Kenya. Second, this will be useful in designing effective policies to reduce inequities in tobacco use in Kenya. In some developed nations such as Australia (Purcell et al. 2015), policymakers had been successful in reducing smoking rates but inequities in tobacco use still persist with a high smoking prevalence among the disadvantaged group. Hence, in this paper, we argue that for an effective reduction in tobacco use in Kenya, health policy should be designed and implemented through the equity lens.

The theory of fundamental causes (Phelan et al. 2010, 2004; Phelan and Link 2005; Mackenbach et al. 2017) posits that the social position of individuals within a community or country can be a good predictor of poor health. This theory is useful in understanding why health disparities persist even when risk factors that were known to affect low-income individuals have been resolved (Willson 2009), and why individuals’ socioeconomic position could be a fundamental cause of disparities in health and health behaviors. This theory has been used to investigate inequalities in HIV/AIDS mortality (Rubin et al. 2010), surgical (Qasim 2016), violence, and property crime disparities (Barkan and Rocque 2018).

We expand this theory to examine socioeconomic inequalities in risky health-related behaviors such as tobacco use in Kenya. We argue that the most-advantaged households may have more knowledge about the dangers of smoking and how to avoid them, better access to smoking cessation and counseling programs, and are less likely to smoke.
than the most-disadvantaged households. Hence, in societies such as Kenya where there is more competition of resources and inequality (Stewart 2010), the most-advantaged households are likely to have more access to knowledge, healthcare services and this may contribute to the avoidance of smoking behavior. Thus, they are likely to spend more time in healthy activities such as acquiring more knowledge about the dangers of tobacco use and buying medicines that could help them quit smoking. This can also be explained by the fact that the most-disadvantaged households are more present-oriented, less likely to feel personally concerned with anti-tobacco sensitization campaigns (Peretti-Watel et al. 2013). We, therefore, hypothesize that the most-advantaged households may be less inclined to tobacco use than the most-disadvantaged households, and this inequality in tobacco use is mainly explained by wealth inequality.

The current study is the first to explore the socioeconomic inequality in tobacco use in Kenya. The paper contributes to the existing literature in many ways. First, the paper contributes to scant evidence on socioeconomic inequality in tobacco use in African countries. Despite several policies adopted to curb tobacco use, African countries are still experiencing tobacco’s fastest-growing markets. Second, research on gender and tobacco use has been extensively studied (Amos et al. 2011; Wang et al. 2005; Morrow and Barraclough 2010; Waldron et al. 1988b; Leventhal et al. 2007; Kauffman et al. 1997; Prescott et al. 1998; Legleye et al. 2011). However, little attention has been given to socioeconomic inequality in tobacco use with respect to gender. As compared to females, men could be short-sighted and more exposed to stressful jobs or events that increase their likelihood of smoking. But, this smoking behavior could be unequally distributed among men because rich males put major efforts to quit smoking. Exploring socioeconomic inequality in tobacco use could, therefore, help policymakers design effective policies that have an inequality perspective which could decrease the prevalence of tobacco use and also shrink socioeconomic inequality in tobacco use among gender. Third, we provide empirical evidence about factors that mostly explain the socioeconomic inequality in tobacco use. Thus, we are able via a decomposition analysis of the concentration index (CI) to provide evidence about the factors that generate inequalities in tobacco use. Investigating socioeconomic inequality in tobacco use is not enough since inequalities in tobacco use could be a result of inequalities in wealth, gender, or education. Decomposition analysis of the CI (O’Donnell et al. 2007) helps researchers to investigate the inequalities in the variable being studied. Policymakers could, therefore, be keen to know the contributions of each of these inequalities in observed inequalities in tobacco use. Hence, we examine the relative contribution of each explanatory factor in explaining socioeconomic inequality in smoking and smokeless tobacco in Kenya. To the best of our knowledge, this is the first study of its kind to provide empirical evidence on socioeconomic gradients of different types of tobacco use in Kenya but also on main factors that could explain them.

The overall objective of the article is to investigate socioeconomic inequality in tobacco use in Kenya. The results of the study suggest that smoking and smokeless tobacco are more concentrated among the poor. This socioeconomic inequality is more evident among poorer Kenyan men, and poorer Kenyan households living in urban areas. The decomposition of the CI indicates that the overall socioeconomic inequality for current tobacco smokers is explained by 69.11% of the household wealth.

The following section presents the data and methods while Sect. 3 outlines the results of the study. Section 4 discusses the findings while Sect. 5 concludes with some policy recommendations.
Methods

Data

All data used in this study emanate from the 2014 Global Adult Tobacco Survey (GATS). The GATS is a survey conducted in several countries. It aims at monitoring adult tobacco use (smoking and smokeless) and tracking key tobacco control indicators. The 2014 GATS for Kenya is the first of its kind asking rich questions on background characteristics, tobacco use, cessation, economic indicators, knowledge, attitudes, and perceptions towards tobacco use to a nationally representative sample of men and women aged 15 years and older (KNBS 2014). Most of the questions asked to individuals correspond to the World Health Organization MPOWER strategies which aim at monitoring tobacco use, protecting people from tobacco smoke, offering help to quit tobacco use, warning about the dangers of tobacco use, enforcing bans on tobacco advertising, and raising taxes on tobacco.

The survey design is a multistage clustered sampling covering 47 counties in Kenya. Respondents were selected using a three-stage cluster sampling. At the first stage, 192 clusters or enumerations areas were selected while at the second stage, 28 households were selected in each cluster using an equal probability systematic sampling method. At the last stage, eligible individuals were randomly selected. Overall, 4408 respondents completed the interview and the overall response rate was 87.1%. The response rate was 85.6%, 88.8% in urban, rural areas, respectively (KNBS 2014). Given the study design, sampling weights and clustering are used in the univariate analysis, multivariate analysis, and CI estimates. The inclusion of the sampling weight was done to adjust for sample selection, non-response at the cluster, household, and individual levels, and to align the data to current population estimates (KNBS 2014).

In tobacco literature, there is a major difference between combusted tobacco/cigarettes and smokeless tobacco. The latter is less harmful than combusted tobacco and it refers to tobacco products that are not smoked but used in other forms such as sniffing or chewing. In Kenya, smokeless tobacco involves chewing tobacco, kuber, snuff, and betel quid. Combusted tobacco/cigarette is tobacco that is burned during consumption.

In the current study, the main dependent variable is current tobacco smokers which includes both daily and occasional (less than daily) use of tobacco within the past 30 days. Hence, current tobacco smokers is a binary variable which takes the value one if the respondent currently smokes tobacco daily or occasional within the past 30 days preceding the survey, and zero otherwise. We also explore the robustness of our findings focusing on the daily use of tobacco (binary variable taking the value one if the respondent currently smokes tobacco daily within the 30 days preceding the survey, and zero otherwise), daily cigarette smokers (this includes respondents who had smoked at least one manufactured or hand-rolled cigarette per day within the 30 days preceding the survey). This means that daily cigarette smokers is a binary variable which takes one if the respondent currently smokes manufactured cigarettes or hand-rolled cigarettes daily within the 30 days preceding the survey. Another variable is daily smokeless tobacco users, a binary variable taking one if the respondent currently uses smokeless tobacco daily within the 30 days preceding the survey, and zero otherwise.
Measures of socioeconomic inequality

We first use a simple measure of socioeconomic inequality in tobacco use: the inter-quintile range ratio (IQRR). Since tobacco use is an adverse health outcome, the IQRR is the ratio of the prevalence of tobacco use of the poorest 20% of the respondents in the sample to the prevalence of tobacco use of the richest 20% of the respondents in the sample. The corresponding 95% confidence intervals (CIs) are constructed using the Delta method. Hence, the IQRR is considered to be statistically significant if the 95% CIs do not include one.

The CI is another measure of socioeconomic inequality. It provides the extent to which a health indicator is concentrated among the disadvantaged or the advantaged respondents. The calculation of the CI is straightforward. First, respondents are ranked by wealth quintiles beginning with the poorest in the population. The concentration curve then plots the cumulative percentage of the population ranked by wealth quintiles against their cumulative percentage of tobacco use (O’Donnell et al. 2007). The CI is between (−1, 1); a value of −1 signifies that tobacco use is entirely concentrated among the poorest while a positive higher index value indicates that tobacco use tends to be concentrated among richer households. When there is no inequality, the index will be zero. The CI is given by the following formula:

$$CI = \frac{2}{\bar{y}} \text{cov}(y_i, r_i)$$  \hspace{1cm} (1)

where $\bar{y}$ is the mean of tobacco use, $r_i$ the fractional rank of the $i$th respondent, and $y_i$ is the tobacco use variable. When the variable is binary, we assess the CI following Erreygers (2009). The problem with the binary variable is that the CI is no longer bounded between −1 and +1; it is rather bounded between $\bar{y} − 1$ and $1 − \bar{y}$ which affects the interpretability of the inequality measure since it is impacted by the mean of the binary variable ($\mu_f$). Erreygers (2009) suggested the corrected concentration index to account for the bounded nature of binary variables. Thus:

$$CI_E = \frac{4\bar{y}}{y_{\text{max}} − y_{\text{min}}} CI$$  \hspace{1cm} (2)

with $y_{\text{max}}$ and $y_{\text{min}}$ the maximum and minimum levels of tobacco use, respectively.

The household ownership of durable goods is used to measure the wealth variable. This approach is often used in the literature when collecting accurate households’ income is difficult. Wealth index based on households’ assets is most often used in demographic and health surveys, and other settings to analyze poverty and inequalities (McKenzie 2005; Filmer and Scott 2012; Filmer and Pritchett 2001; Howe et al. 2009; Lindelow 2006). It is noteworthy to emphasize that the wealth index is constructed using the polychoric principal component analysis (pPCA) on 13 questions on household assets. Applying PCA on binary variables seems inappropriate because the assumption of normality with discrete variables is conceptually unappealing. To circumvent this issue, Kolenikov and Angeles (2009) suggested that there are normal latent distributed continuous variables underlying the observed binary variables. The correlation matrix of these latent variables is estimated and a standard PCA is then applied to this matrix. We follow this procedure known as the pPCA and use the first component as the measure of the wealth index. The sample household is then classified into wealth quintiles from the poorest to the richest. Table 6 provides the household assets used to construct the wealth index.
Decomposition of the concentration index

The decomposition of the CI into the underlying determinants which explain the socioeconomic inequality in tobacco use is interesting from a policy perspective. It allows the impact of each determinant and its contribution to be estimated. It also provides policymakers with a better understanding of why observed socioeconomic inequality in tobacco use is rampant and instruments that could be used to curb socioeconomic inequality. We follow Van Doorslaer and Jones (2003), Wagstaff et al. (2003) by disaggregating the CI into contributions of individual factors to socioeconomic inequality. Hence, in the equation below, tobacco use \( y_i \) is explained by a vector of covariates \( x_{ki} \):

\[
y_i = a_i + b_kx_{ki} + \epsilon_i
\]  

then the CI can be written as:

\[
CI_E = 4 \left( \sum_k (b_k \bar{x}_k)CI_k + GCI \right)
\]

with \( CI_k \) the CI for each covariate, \( b_k \) is the coefficient or partial effect for each covariate, \( GCI \) is the generalized CI for the residual \( \epsilon_i \). The term \( b_k \bar{x}_k \) is the elasticity of tobacco use with respect to the covariate, i.e. the impact of each determinant on tobacco use, and the following term \( (b_k \bar{x}_k)CI_k \) is the absolute contribution of each covariate to the socioeconomic inequality in tobacco use. A negative (positive) absolute contribution indicates that, if inequality in tobacco use was determined by that variable alone, then it would favor the better-off (worse-off). The percentage contribution is obtained by dividing the absolute contribution by the overall CI.

Determinants of tobacco use

The notable theory of triadic influence is used to explain Kenyan adults’ tobacco use behaviors. The theory was developed to explain the main driver of tobacco used which is summarized in three levels (see for instance Kabir and Goh 2014): individual, neighborhood/family environment, and societal levels. Applying to adults’ tobacco use, the theory could be adapted to help understand the health-related behavior of individuals. The selection of covariates is, therefore, guided by this theory (Kabir and Goh 2014; Flay et al. 1995). We use the gender, age, wealth index, and education to capture the individual level. The second level (neighborhood/family environment) could be peer groups, friends, parental influence, place of residence, etc. Some of these variables are inexistent in the 2014 GATS for Kenya. The place of residence is used for the second level. Households living in urban settings could be more prone to tobacco use as compared to their counterparts in rural settings. This is because urban settings may have more permissive norms towards tobacco use or it could be more stressful to individuals who will eventually incline to tobacco use to relieve the stress (Idris et al. 2007; Shohaimi et al. 2003). The third level is the societal factor such as mass media, smoking in public places, knowledge, and perceptions about the dangers of tobacco use, easy access, promotion and marketing, social attitudes and norms, enforcement of tobacco control law and policies, etc. Very few of these variables are found in the dataset. Thus, we use mass media and knowledge about the dangers of tobacco use. All these three levels are interwoven with each other (Flay et al. 1999). A Probit model is used
to investigate the factors that could influence tobacco use among Kenyan. Table 1 presents the different variables for the analysis.

| Variables                              | Definition                                                                 |
|----------------------------------------|-----------------------------------------------------------------------------|
| **Dependent variables**                |                                                                             |
| Current tobacco smokers                | 1 if the respondent currently smokes tobacco daily or less than a daily within the past 30 days; 0 otherwise |
| Daily tobacco smokers                  | 1 if the respondent currently smokes tobacco daily within the past 30 days; 0 otherwise |
| Daily cigarette smokers                | 1 if the respondent currently smokes manufactured cigarettes or hand-rolled cigarettes daily within the past 30 days; 0 otherwise |
| Daily smokeless tobacco users          | 1 if the respondent currently uses smokeless tobacco daily within the past 30 days; and 0 otherwise |
| **Independent variables**              |                                                                             |
| Gender                                 | 1 if male; 0 otherwise                                                     |
| Age1 (years), 15–24                    | Age of the respondent, 1 if the respondent belongs to the age range 15–24; 0 otherwise |
| Age2 (years), 25–44                    | Age of the respondent, 1 if the respondent belongs to the age range 25–44; 0 otherwise |
| Age3 (years), 45–64                    | Age of the respondent, 1 if the respondent belongs to the age range 45–64; 0 otherwise |
| Age4 (years), 65 years and above        | Age of the respondent, 1 if the respondent is aged 65 years and above; 0 otherwise |
| Wealth-Q1                              | 1 if the respondent belongs to the first wealth quintile; 0 otherwise       |
| Wealth-Q2                              | 1 if the respondent belongs to the second wealth quintile; 0 otherwise       |
| Wealth-Q3                              | 1 if the respondent belongs to the third wealth quintile; 0 otherwise       |
| Wealth-Q4                              | 1 if the respondent belongs to the fourth wealth quintile; 0 otherwise       |
| Wealth-Q5                              | 1 if the respondent belongs to the fifth wealth quintile; 0 otherwise       |
| No formal schooling                    | 1 if the respondent has no formal schooling; 0 otherwise                    |
| Less than primary school completed     | 1 if the respondent has not completed primary school; 0 otherwise           |
| Primary school completed               | 1 if the respondent has completed primary school; 0 otherwise               |
| Less than secondary school completed   | 1 if the respondent has not completed secondary school; 0 otherwise         |
| More than secondary school completed*  | 1 if the respondent has more than completed secondary school; 0 otherwise   |
| Urban                                  | 1 if the respondent resides in an urban area; 0 otherwise                   |
| Media                                  | 1 if the respondent has noticed information in newspapers/magazines about the dangers of use or that encourages quitting cigarettes/smokeless tobacco, or has seen any information on TV/radio/billboards about the dangers of use or that encourages quitting smokeless cigarettes/tobacco; 0 otherwise |
| Knowledge                              | 1 if the respondent knows that tobacco use causes serious illness; 0 otherwise |

*This means that the respondent has either completed secondary school or tertiary education (college/university)
Results

Descriptive results

Table 2 and 7 provide the descriptive results of the study. The overall proportion of current tobacco (daily tobacco) smokers is 8% (6%) (Table 2), representing 15.08% (11.60%) of males and 0.77% (0.60%) (Table 7). Focusing on our main dependent variable which is current tobacco smokers, across the wealth quintiles the frequency (proportion) is 95 (9.38%), 62 (7.14%), 91 (11.83%), 58 (6.54%), 35 (4.02%) for the poorest, poor, middle, rich, and richest respondents, respectively. Results of the study indicate that current tobacco, daily tobacco, and daily cigarette smoking is statistically and significantly higher among men than females since their respective confidence intervals do not overlap (Table 7). Concerning smokeless tobacco users, the overall proportion for the whole country is 3%, with 3.51% males and 3.19% females (Table 7). Table 7 shows that respondents aged between 45 and 64 years have the highest proportion of current tobacco smokers (14.99%), daily tobacco smokers (12.68%), daily cigarette smokers (12.64%), and daily smokeless tobacco users (7.33%). Furthermore, results displayed in Table 7 and Fig. 1 provide evidence of socioeconomic inequality in tobacco use although it is not monotonic for current tobacco, daily tobacco, and daily cigarette smokers.

Table 2 Summary statistics of the variables

| Variables                                      | Mean | Std. Dev | Min | Max |
|-----------------------------------------------|------|----------|-----|-----|
| Current tobacco smokers                       | 0.08 | 0.27     | 0   | 1   |
| Daily tobacco smokers                         | 0.06 | 0.24     | 0   | 1   |
| Daily cigarette smokers                       | 0.06 | 0.24     | 0   | 1   |
| Daily smokeless tobacco users                 | 0.03 | 0.18     | 0   | 1   |
| Gender                                        | 0.49 | 0.50     | 0   | 1   |
| Age1 (years), 15–24                           | 0.36 | 0.48     | 0   | 1   |
| Age2 (years), 25–44                           | 0.42 | 0.49     | 0   | 1   |
| Age3 (years), 45–64                           | 0.16 | 0.37     | 0   | 1   |
| 65 years and above                            | 0.06 | 0.24     | 0   | 1   |
| Wealth-Q1                                     | 0.23 | 0.42     | 0   | 1   |
| Wealth-Q2                                     | 0.20 | 0.40     | 0   | 1   |
| Wealth-Q3                                     | 0.18 | 0.38     | 0   | 1   |
| Wealth-Q4                                     | 0.20 | 0.40     | 0   | 1   |
| Wealth-Q5                                     | 0.20 | 0.40     | 0   | 1   |
| No formal schooling                            | 0.14 | 0.34     | 0   | 1   |
| Less than primary school completed            | 0.25 | 0.43     | 0   | 1   |
| Primary school completed                      | 0.21 | 0.41     | 0   | 1   |
| Less than secondary school completed          | 0.12 | 0.32     | 0   | 1   |
| More than secondary school completed          | 0.29 | 0.45     | 0   | 1   |
| Urban                                         | 0.35 | 0.48     | 0   | 1   |
| Media                                         | 0.60 | 0.49     | 0   | 1   |
| Knowledge                                     | 0.93 | 0.26     | 0   | 1   |

Sampling weights are used to account for the sampling design of the survey
We also report the IQRR. For current tobacco smoking, the IQRR is 2.33 (95% CIs = 1.41; 3.24), implying that the prevalence of the current tobacco smokers for the poorest respondents is two times higher than that of the richest respondents. Similarly, results suggest that the IQRR of daily tobacco smokers is 3.95 (95% CIs = 1.71; 6.19), implying that the prevalence of the daily tobacco smokers for the poorest respondents is almost four times higher than that of the richest respondents. Concerning smokeless tobacco, the IQRR is 6.28 (95% CIs = 1.86; 10.71), indicating that the prevalence of smokeless tobacco use among the poorest respondents is six times higher than that of the richest respondents. The proportion of daily smokeless tobacco users decreases monotonically from the poorest to the richest quintile (Fig. 1 and Table 7).

In Figs. 2 and 3, we inspect the socioeconomic inequality in tobacco use with respect to the place of residence and gender. Figure 2 shows that socioeconomic inequality in tobacco use is more pronounced in urban areas if tobacco smoking is measured as current tobacco smokers, daily tobacco smokers, and daily cigarette smokers. However, daily smokeless tobacco use disproportionately affects the poor respondents in urban and rural areas as well (Fig. 2). Similarly, Fig. 3 also shows that socioeconomic inequality in tobacco use is not an issue for female respondents but mainly plagued the poor males when we focus on current tobacco smokers, daily tobacco smokers, and daily cigarette smokers. A different picture, however, emerges for daily smokeless tobacco users: the poorest females and males are more affected by tobacco use than the richest.

These results are substantiated when we estimate the CI. Results in Table 3 suggest that overall wealth-related inequality in tobacco use is negative, statistically significant,
and favors the better-off irrespective of the measure of tobacco use. This means that inequality in tobacco use is more prevalent among the poor than the wealthy. The findings also confirm that tobacco use is more concentrated among poor males, urban areas except for daily smokeless tobacco.

We also explore the main brand used by respondents. In Kenya, Sportsman is manufactured by British America Tobacco. It is the most popular brand in Kenya. Supermatch is manufactured by a local tobacco company called Mastermind Tobacco Kenya, the second-largest tobacco company in Kenya. About the last purchase, the main brand of cigarettes purchased is Sportsman (55.16%) followed by Supermatch (22.94%). Across the wealth quintiles, the percentages for Sportsman are 21.33%, 15.72%, 27.41%, 19.83%, and 15.71% for the poorest, poor, middle, rich, and richest respondents, respectively. However, results suggest that rich respondents often consume expensive brands such as Dunhill Lights: 0%, 0%, 0%, 61.04%, and 38.96% for the poorest, poor, middle, rich, and richest respondents, respectively.

Econometric results

In Table 4, concerning current tobacco smokers, daily tobacco smokers, and daily cigarette smokers, results suggest that tobacco use is significantly higher among males, poorest, middle-wealthy respondents, less educated respondents. Results indicate that being male increases the probability of being current tobacco smokers (daily tobacco smokers/daily cigarette smokers) by 0.11 (0.08), and daily smokeless tobacco users by 0.01. Furthermore,
being aged between 45 and 64 years increases the probability of being current tobacco smokers by 0.03, but decreases the probability of being daily smokeless tobacco users by 0.01. Being ranked as the poorest respondent increases the probability of being current tobacco smokers (daily tobacco smokers/daily cigarette smokers) by 0.04 (0.04).
Concerning daily smokeless tobacco users, being the poorest respondent increases the probability of using smokeless tobacco daily by 0.08 if we include only the wealth quintiles in the model. But, the wealth quintiles lose statistical significance when other covariates

### Table 4 Marginal effects of determinants of smoking, Probit model

| Variables                  | Current tobacco smokers | Daily tobacco smokers | Daily cigarette smokers | Daily smokeless tobacco users |
|----------------------------|-------------------------|-----------------------|-------------------------|-----------------------------|
| Gender                     | 0.11***                 | 0.08***               | 0.08***                 | 0.01**                      |
| (0.01)                     | (0.01)                  | (0.01)                | (0.004)                 |                             |
| Age1 (years), 15–24        | −0.04***                | −0.03***              | −0.03***                | −0.03***                    |
| (0.01)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| Age2 (years), 25–44        | 0.01                    | 0.002                 | 0.003                   | −0.02***                    |
| (0.01)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| Age3 (years), 45–64        | 0.03*                   | 0.02                  | 0.02                    | −0.01**                     |
| (0.02)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| 65 years and above         | Base                    | Base                  | Base                    | Base                        |
| Wealth-Q1                  | 0.04**                  | 0.04**                | 0.04**                  | −0.0002                     |
| (0.02)                     | (0.02)                  | (0.02)                | (0.01)                  |                             |
| Wealth-Q2                  | 0.03                    | 0.03*                 | 0.03                    | 0.01                        |
| (0.02)                     | (0.02)                  | (0.02)                | (0.01)                  |                             |
| Wealth-Q3                  | 0.05***                 | 0.06***               | 0.06***                 | −0.002                      |
| (0.02)                     | (0.02)                  | (0.02)                | (0.01)                  |                             |
| Wealth-Q4                  | 0.02                    | 0.03*                 | 0.03*                   | −0.002                      |
| (0.01)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| Wealth-Q5                  | Base                    | Base                  | Base                    | Base                        |
| No formal schooling        | −0.005                  | −0.002                | −0.002                  | 0.08                        |
| (0.01)                     | (0.01)                  | (0.01)                | (0.06)                  |                             |
| Less than primary school completed | 0.03**                | 0.02**                | 0.02**                  | 0.02                        |
| (0.01)                     | (0.01)                  | (0.01)                | (0.02)                  |                             |
| Primary school completed   | 0.01                    | 0.01                  | 0.01                    | 0.01                        |
| (0.01)                     | (0.01)                  | (0.01)                | (0.02)                  |                             |
| Less than secondary school completed | −0.001                | −0.001                | −0.001                  | 0.02                        |
| (0.01)                     | (0.01)                  | (0.01)                | (0.03)                  |                             |
| More than secondary school completed | Base                  | Base                  | Base                    | Base                        |
| Urban                      | 0.01                    | 0.0003                | 0.0001                  | −0.004                      |
| (0.01)                     | (0.004)                 | (0.004)               | (0.005)                 |                             |
| Media                      | −0.004                  | −0.01                 | −0.01                   | −0.01*                      |
| (0.01)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| Knowledge                  | −0.03                   | −0.01                 | −0.01                   | −0.02                       |
| (0.02)                     | (0.01)                  | (0.01)                | (0.01)                  |                             |
| Observations               | 4407                    | 4407                  | 4407                    | 4407                        |

Standard errors in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. The model is estimated with the Probit. Sampling weights and clustering are used to account for the sampling design of the survey.
are included in the model (see the last column of Table 4). Respondents who have been exposed to media regarding the dangers of tobacco use are less likely to daily smoke tobacco and cigarettes though not significant.

According to the main results, socioeconomic inequality in tobacco use is mainly explained by the direct effect of the wealth, which accounts for 69.11% of the CI (sum of all percentage contributions of the wealth index found in Table 5, last column). This finding suggests that most of the socioeconomic inequality in tobacco use in Kenya is due to inequality in wealth. This also implies that inequality in tobacco use would decrease if the wealth was equally distributed across Kenyans. Results also indicate that 28.48% of the inequality in tobacco use is explained by unobserved heterogeneity (Table 5 and Fig. 4). Furthermore, Tables 8, 9 and 10 present the same findings for daily tobacco smokers, daily cigarette smokers, and daily smokeless tobacco users, respectively.

We also explore whether the price of cigarettes could be an economic determinant of tobacco use. In the GATS, respondents were asked how much money was paid for the last purchase of cigarettes. We use this information by estimating the price per 20 cigarettes (one pack). However, the price information is not entirely independent of respondents’ decisions and how much to smoke (Ciecierski and Chaloupka 2001). Respondents could have control over the choice of cigarette brands and cigarette quality (Liu et al.

### Table 5: Decomposition of the concentration index, current tobacco smokers

| Variables                              | Elasticity | Concentration index | Absolute contribution | Percentage contribution |
|----------------------------------------|------------|---------------------|------------------------|-------------------------|
| Gender                                 | 0.22       | 0.05                | 0.010                  | −25.22                  |
| Age1 (years), 15–24                    | −0.06      | 0.005               | −0.0003                | 0.71                    |
| Age2 (years), 25–44                    | 0.02       | 0.08                | 0.001                  | −3.38                   |
| Age3 (years), 45–64                    | 0.02       | −0.03               | −0.001                 | 1.70                    |
| 65 years and above                     | Base       | Base                | Base                   | Base                    |
| Wealth-Q1                              | 0.04       | −0.71               | −0.03                  | 67.85                   |
| Wealth-Q2                              | 0.02       | −0.27               | −0.006                 | 16.82                   |
| Wealth-Q3                              | 0.04       | 0.02                | 0.001                  | −2.02                   |
| Wealth-Q4                              | 0.02       | 0.33                | 0.01                   | −13.54                  |
| Wealth-Q5                              | Base       | Base                | Base                   | Base                    |
| No formal schooling                     | −0.003     | −0.27               | 0.001                  | −1.99                   |
| Less than primary school completed     | 0.03       | −0.22               | −0.007                 | 17.50                   |
| Primary school completed               | 0.01       | −0.003              | −0.00002               | 0.06                    |
| Less than secondary school completed   | −0.0005    | 0.035               | −0.00002               | 0.04                    |
| More than secondary school completed   | Base       | Base                | Base                   | Base                    |
| Urban                                  | 0.01       | 0.49                | 0.01                   | −17.66                  |
| Media                                  | −0.01      | 0.29                | −0.003                 | 7.26                    |
| Knowledge                              | −0.11      | 0.08                | −0.01                  | 23.39                   |
| Residual                               | −0.01      |                    | −0.01                  | 28.48                   |
| Total                                  | −0.04      |                     | 100                    |                         |

Sampling weights and clustering are used to account for the sampling design of the survey.
2015; Wasserman et al. 1991), implying that the self-reported price of consumers is an endogenous variable. To account for this endogeneity, we construct a market level average price for all smokers reporting prices at the cluster level. However, the coefficient of the log of the price is negative (−0.01) and insignificant (p-value = 0.292) if we use the current tobacco smoker as the dependent variable. The same result is found for daily tobacco (coef. = −0.004, p-value = 0.43) and daily cigarette smokers (coef. = −0.004, p-value = 0.41). This finding implies that the price of the cigarette is not associated with the prevalence of tobacco use.

Discussions

The findings suggest that tobacco use is high among males and the less educated which is in line with previous evidence (Giovino et al. 1995, 2012; Chockalingam et al. 2013; Higgins et al. 2015; Waldron et al. 1988a; Waldron 1991). Several hypotheses could explain these gender differences in the prevalence of tobacco use in Kenya. Among existing hypotheses, it was stated that women are more likely to feel sick during the first use of tobacco, and they are therefore less likely to use tobacco (Kaplan et al. 1990; Silverstein et al. 1980). Social norms and customs in many African societies also discourage women from smoking and this may explain why tobacco use is more prevalent among men than women in Kenya.
We also find that less-educated respondents are more likely to smoke as compared to more educated respondents. This finding is consistent with existing studies (Gilman et al. 2008; Koning et al. 2015; Sander 1995). This could be because more educated individuals learn and know more about the health risks associated with tobacco use more than less-educated individuals. However, Maralani (2014) stated that educational disparities in adult smoking are explained by choices made in early adolescence.

More importantly, results from the concentration indices suggest a significant socioeconomic inequality in tobacco use in Kenya irrespective of how tobacco use is measured. Results from this study suggest that tobacco use in Kenya is more prevalent among the poor than the wealthy. The findings are consistent with Thakur et al. (2015) who found evidence of socioeconomic inequality in smoking tobacco in India though this socioeconomic inequality is irrelevant to smokeless tobacco. There is also evidence of socioeconomic inequality in tobacco use among Kenyan males and respondents living in urban areas. All these findings are consistent with our expectations since poverty tends to make poor individuals make bad decisions such as engaging in crime (Fajnzylber et al. 2002; Dong et al. 2020; Demombynes and Özler 2002; Valdez et al. 2007) and smoking (Flint and Novotny 1997; Bobak et al. 2000; Cambron et al. 2019). Results from the current study are likely to be explained by the fact that wealthier individuals have better access to many resources that allow them to avoid smoking. This is substantiated by our empirical results. For instance, results suggest that the poorest respondents (proportion = 85.44%, 95% CIs = 83.49, 87.40) have significantly less knowledge about the dangers of tobacco use as compared to the richest respondents (proportion = 96.09%, 95% CIs = 94.70, 97.49). In the same vein, the poorest respondents are significantly less informed (proportion = 33.72%, 95% CIs = 31.10, 36.34) via the media about the dangers of cigarettes or smokeless tobacco than the richest respondents (proportion = 69.87%, 95% CIs = 66.57, 73.18). Furthermore, the fact that tobacco use is more concentrated among poor Kenyan men in urban areas is not surprising since poverty is more pronounced in urban Kenya and mainly concentrated among the poor with the majority of them living in the urban slums. Hence, the Kenyan urban poor could be more inclined to tobacco use in order to cope with the hardships and stress in urban areas. The findings suggest that the concentration of tobacco use in Kenya among the poor should be a policy concern.

Our study could be related to Ngaruiya et al. (2018) who also studied tobacco use in Kenya. However, the two studies differ in several ways. First, in the Kenya WHO STEPS survey used by Ngaruiya et al. (2018), criteria for inclusion were individuals aged 18–69 years old while in the GATS used by the current study it is 15 years and older. Thus, the sample size differs. Furthermore, Ngaruiya et al. (2018) did not quantify the magnitude of the socioeconomic inequality in tobacco use in Kenya using the concentration index, and also did not investigate the factors that could explain this socioeconomic inequality in tobacco use (decomposition of the concentration index).

**Conclusions**

There is ample evidence in the literature about the factors influencing tobacco use among adults and youths in Africa. However, there is a yawning evidence gap in socioeconomic inequalities. This paper attempts to fill this gap by assessing and exploring socioeconomic
inequalities in tobacco use in Kenya. The current study is the first to explore the socioeconomic inequality in tobacco use in Kenya. Overall, results demonstrate socioeconomic inequality in tobacco use. This socioeconomic inequality is stronger among males and households in the urban setting. The results of the study suggest that health interventions aimed at curbing smoking in Kenya should focus mostly on the most disadvantaged households. Hence, to reduce the prevalence rate of smoking in Kenya, policymakers and NGOs could design health interventions that include an inequality perspective. For instance, sensitization campaigns could be increased in areas where the poor live such as slums in the urban setting. Health workers such as doctors, nurses, and other players such as community health workers (CHWs) could also be used to promote non-smoking behaviors among the poor. Another effective tool that could be used is to integrate tobacco control prevention initiatives in the Kenya community health strategy. In this devolved health system, the CHWs could be used as agents in curbing tobacco use in their communities. Hence, they could be trained, equipped to promote tobacco cessation programs (counseling, sensitization campaigns, etc.) in the community by mainly focusing on the most disadvantaged households.

However, the study has three limitations. One possible limitation of the study is the lack of exploration of the trends in tobacco use and trends in tobacco control policy in Kenya. Though the GATS is the most used data set in the economics of tobacco, it has not been consistently implemented in Kenya maybe due to the high cost of data collection. Thus, the longitudinal pattern of the data cannot be exploited. Furthermore, ignoring the impact of taxation on tobacco products on the poor is another limitation. The potential effect of price increases on tobacco products in Kenya on the poor could be a good avenue for future research. Third, though we have controlled for more relevant variables in our different models, other variables could have been left out (depression, mental health, government and workplace policies, etc.). We acknowledge this as a limitation.

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Appendix

See Fig. 5

See Tables 6, 7, 8, 9 and 10
Fig. 5 Construction of the wealth index using principal component analysis, number of components, and percent explained variance. Since these variables are binary outcomes, we use the polychoric principal component analysis (PCA). We choose a total number of two components which explained approximately 65% of the total variance. Sampling weights are used to account for the sampling design of the survey.

Table 6 Household assets used to construct the wealth quintiles

| Assets variable                              | Weighted proportion |
|----------------------------------------------|---------------------|
| Respondent has electricity                   | 28.78               |
| Respondent has flush toilet                 | 12.93               |
| Respondent has fixed telephone              | 1.18                |
| Respondent has cellphone                     | 79.69               |
| Respondent has TV                           | 30.25               |
| Respondent has radio                        | 73.24               |
| Respondent has refrigerator                  | 7.80                |
| Respondent has car                          | 7.80                |
| Respondent has flush scooter/motorcycle      | 8.82                |
| Respondent has washing machine              | 1.44                |
| Respondent has clock/watch                   | 37.70               |
| Respondent has bicycle                       | 24.05               |
| Respondent has computer                      | 7.79                |

For the 13 items, the respondent was given three choices: Yes, No and Don’t know. Sampling weights are used to account for the sampling design of the survey.
### Table 7 Univariate analysis

| Variables                    | Current tobacco smokers | Daily tobacco smokers | Daily cigarette smokers | Daily smokeless tobacco users |
|------------------------------|-------------------------|-----------------------|-------------------------|-------------------------------|
|                              | Percentage (95% CI)     | Percentage (95% CI)   | Percentage (95% CI)     | Percentage (95% CI)           |
| Male                         | 15.08 (13.54, 16.62)    | 11.60 (10.22, 12.96)  | 11.58 (10.20, 12.96)    | 3.51 (2.72, 4.30)             |
| Female                       | 0.77 (0.41, 1.12)       | 0.60 (0.29, 0.91)     | 0.56 (0.26, 0.86)       | 3.19 (2.48, 3.90)             |
| Age1 (years), 15–24          | 2.17 (1.28, 3.07)       | 1.31 (0.61, 2)        | 1.31 (0.61, 2)          | 0.79 (0.24, 1.34)             |
| Age2 (years), 25–44          | 9.78 (8.54, 11.02)      | 7.27 (6.18, 8.36)     | 7.27 (6.18, 8.36)       | 2.19 (1.58, 2.81)             |
| Age3 (years), 45–64          | 14.99 (12.56, 17.44)    | 12.68 (10.41, 14.96)  | 12.64 (10.37, 14.91)    | 7.33 (5.55, 9.11)             |
| 65 years and above           | 7.83 (5.12, 10.54)      | 6.94 (4.37, 9.50)     | 6.58 (4.08, 9.09)       | 15.91 (12.22, 19.60)          |
| Wealth-Q1                    | 9.38 (7.77, 10.99)      | 7.19 (5.76, 8.63)     | 7.15 (5.73, 8.58)       | 7.08 (5.66, 8.50)             |
| Wealth-Q2                    | 7.14 (5.32, 8.96)       | 5.63 (4.01, 7.26)     | 5.64 (4.01, 7.26)       | 4.08 (2.69, 5.48)             |
| Wealth-Q3                    | 11.83 (9.49, 14.17)     | 10.42 (8.20, 12.64)   | 10.31 (8.10, 12.51)     | 2.29 (1.21, 3.38)             |
| Wealth-Q4                    | 6.54 (4.93, 8.16)       | 5.02 (3.60, 6.44)     | 5.02 (3.60, 6.44)       | 1.42 (0.65, 2.19)             |
| Wealth-Q5                    | 4.02 (2.61, 5.44)       | 1.82 (0.86, 2.78)     | 1.82 (0.85, 2.78)       | 1.13 (0.36, 1.89)             |
| No formal schooling           | 6.01 (4.49, 7.52)       | 5.46 (4.01, 6.91)     | 5.32 (3.89, 6.74)       | 15.51 (13.21, 17.82)          |
| Less than primary school     | 11.14 (9.16, 13.13)     | 8.53 (6.76, 10.29)    | 8.49 (6.73, 10.25)      | 2.53 (1.54, 3.53)             |
| completed                    |                         |                       |                         |                               |
| Primary school completed     | 8.82 (6.95, 10.68)      | 7.13 (5.44, 8.82)     | 7.13 (5.44, 8.82)       | 1.13 (0.44, 1.82)             |
| Less than secondary school   | 5.09 (2.94, 7.24)       | 3.80 (1.93, 5.67)     | 3.80 (1.93, 5.67)       | 1.50 (0.31, 2.68)             |
| completed                    | 5.97 (4.64, 7.31)       | 4.02 (2.91, 5.14)     | 4.02 (2.91, 5.14)       | 0.6 (0.18, 1.08)              |
| Urban                        | 7.11 (6.05, 8.17)       | 4.52 (3.66, 5.37)     | 4.49 (3.64, 5.34)       | 1.56 (1.05, 2.08)             |
| Rural                        | 8.10 (6.94, 9.25)       | 6.74 (5.68, 7.81)     | 6.71 (5.65, 7.77)       | 4.30 (3.44, 5.16)             |
| Media-Yes                    | 7.50 (6.46, 8.54)       | 5.48 (4.58, 6.37)     | 5.48 (4.58, 6.37)       | 1.35 (0.9, 1.80)              |
| Media-No                     | 8.13 (6.90, 9.35)       | 6.69 (5.57, 7.81)     | 6.61 (5.51, 7.73)       | 6.30 (5.22, 7.39)             |
| Knowledge-Yes                | 7.36 (6.55, 8.17)       | 5.67 (4.96, 6.39)     | 5.67 (4.95, 6.38)       | 12.04 (8.83, 15.26)           |
| Knowledge-No                 | 12.73 (9.45, 16.02)     | 9.64 (6.73, 12.55)    | 9.34 (6.47, 12.21)      | 2.66 (2.16, 3.16)             |

Sampling weights are used to account for the sampling design of the survey.
Table 8  Decomposition of the concentration index, daily tobacco smokers

| Variables                              | Elasticity | Concentration index | Absolute contribution | Percentage contribution |
|----------------------------------------|------------|---------------------|------------------------|-------------------------|
| Gender                                 | 0.16       | 0.05                | 0.01                   | −18.46                  |
| Age1 (years), 15–24                    | −0.04      | 0.005               | −0.0002                | 0.53                    |
| Age2 (years), 25–44                    | 0.003      | 0.08                | 0.0003                 | −0.68                   |
| Age3 (years), 45–64                    | 0.01       | −0.03               | −0.0004                | 1.14                    |
| 65 years and above                     | Base       | Base                | Base                   | Base                    |
| Wealth-Q1                              | 0.04       | −0.71               | −0.03                  | 68.29                   |
| Wealth-Q2                              | 0.02       | −0.27               | −0.01                  | 16.93                   |
| Wealth-Q3                              | 0.04       | 0.02                | 0.001                  | −2.44                   |
| Wealth-Q4                              | 0.02       | 0.33                | 0.01                   | −20.44                  |
| Wealth-Q5                              | Base       | Base                | Base                   | Base                    |
| No formal schooling                     | −0.001     | −0.27               | 0.0003                 | −0.80                   |
| Less than primary school completed     | 0.02       | −0.22               | −0.004                 | 11.74                   |
| Primary school completed               | 0.01       | −0.003              | −0.00002               | 0.06                    |
| Less than secondary school completed   | −0.0005    | 0.03                | −0.00002               | 0.04                    |
| More than secondary school completed   | Base       | Base                | Base                   | Base                    |
| Urban                                  | 0.0004     | 0.49                | 0.0002                 | −0.53                   |
| Media                                  | −0.024     | 0.29                | −0.01                  | 18.27                   |
| Knowledge                              | −0.04      | 0.08                | −0.003                 | 7.85                    |
| Residual                               | −0.01      | 18.49               | −0.04                  | 100                     |

Sampling weights and clustering are used to account for the sampling design of the survey.

Table 9  Decomposition of the concentration index, daily cigarette smokers

| Variables                              | Elasticity | Concentration index | Absolute contribution | Percentage contribution |
|----------------------------------------|------------|---------------------|------------------------|-------------------------|
| Gender                                 | 0.16       | 0.05                | 0.01                   | −18.66                  |
| Age1 (years), 15–24                    | −0.04      | 0.005               | −0.0002                | 0.54                    |
| Age2 (years), 25–44                    | 0.01       | 0.08                | 0.0004                 | −1.03                   |
| Age3 (years), 45–64                    | 0.01       | −0.03               | −0.0004                | 1.15                    |
| 65 years and above                     | Base       | Base                | Base                   | Base                    |
| Wealth-Q1                              | 0.04       | −0.71               | −0.03                  | 69.02                   |
| Wealth-Q2                              | 0.02       | −0.27               | −0.01                  | 17.11                   |
| Wealth-Q3                              | 0.04       | 0.02                | 0.001                  | −2.47                   |
| Wealth-Q4                              | 0.02       | 0.33                | 0.01                   | −20.65                  |
| Wealth-Q5                              | Base       | Base                | Base                   | Base                    |
| No formal schooling                     | −0.001     | −0.27               | 0.0003                 | −0.81                   |
| Less than primary school completed     | 0.02       | −0.22               | −0.004                 | 11.87                   |
| Primary school completed               | 0.01       | −0.003              | −0.00002               | 0.06                    |
| Less than secondary school completed   | −0.0005    | 0.03                | −0.00002               | 0.04                    |
| More than secondary school completed   | Base       | Base                | Base                   | Base                    |
| Urban                                  | 0.0001     | 0.49                | 0.0001                 | −0.18                   |
| Media                                  | −0.02      | 0.29                | −0.01                  | 18.47                   |
| Knowledge                              | −0.04      | 0.08                | −0.003                 | 7.93                    |
| Residual                               | −0.01      | 17.62               | −0.04                  | 100                     |

Sampling weights and clustering are used to account for the sampling design of the survey.
Table 10  Decomposition of the concentration index, daily smokeless tobacco users

| Variables                                | Elasticity | Concentration index | Absolute contribution | Percentage contribution |
|-------------------------------------------|------------|---------------------|-----------------------|-------------------------|
| Gender                                   | 0.02       | 0.05                | 0.001                 | 1.59                    |
| Age1 (years), 15–24                      | −0.04      | 0.005               | −0.0002               | 0.37                    |
| Age2 (years), 25–44                      | −0.03      | 0.08                | −0.003                | 4.67                    |
| Age3 (years), 45–64                      | −0.01      | −0.03               | 0.0002                | −0.39                   |
| 65 years and above                       | Base       | Base                | Base                  | Base                    |
| Wealth-Q1                                | −0.0002    | −0.71               | 0.0001                | −0.23                   |
| Wealth-Q2                                | 0.01       | −0.27               | −0.002                | 3.88                    |
| Wealth-Q3                                | −0.001     | 0.02                | −0.0003               | 0.06                    |
| Wealth-Q4                                | −0.002     | 0.33                | −0.001                | 0.94                    |
| Wealth-Q5                                | Base       | Base                | Base                  | Base                    |
| No formal schooling                      | 0.04       | −0.27               | −0.012                | 21.99                   |
| Less than primary school completed       | 0.02       | −0.22               | −0.004                | 8.06                    |
| Primary school completed                 | 0.01       | −0.003              | −0.00002              | 0.04                    |
| Less than secondary school completed     | 0.01       | 0.03                | 0.0003                | −0.60                   |
| More than secondary school completed     | Base       | Base                | Base                  | Base                    |
| Urban                                    | −0.01      | 0.49                | −0.003                | 4.88                    |
| Media                                    | −0.02      | 0.29                | −0.01                 | 12.55                   |
| Knowledge                                | −0.07      | 0.08                | −0.01                 | 10.78                   |
| Residual                                 | −0.02      | 0.03                | −0.02                 | 34.61                   |
| Total                                    | −0.06      | 100                 |                       |                         |

Sampling weights and clustering are used to account for the sampling design of the survey

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