Neighbourhood deprivation, smoking, and race in South Africa: A cross-sectional analysis

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ABSTRACT

Research on the role of neighbourhood-level deprivation in low- and middle-income countries with respect to tobacco use is relatively nascent. In South Africa, where race and deprivation are closely linked due to the history of apartheid, smoking disparities exist by individual risk factors such as gender, race, and socioeconomic status. However, less is known about how community-level factors affect smoking disparities in the country, or how the relationship between deprivation and smoking differs by race. We used data from the 2008 South African National Income Dynamics Study (NIDS) and Poisson generalised estimating equations to assess the relationship between neighbourhood deprivation and current smoking for individuals nested within neighbourhoods, while controlling for individual-level and household-level covariates. Subgroup analyses for racial categories Black and Coloured were performed. We found that the relationship between neighbourhood deprivation and smoking prevalence was non-linear: the smoking prevalence ratio was highest among those in the middle range for our deprivation index, and lower at extremely high and low levels of deprivation. Both Black and Coloured subsamples exhibited this inverted U-shape, although the relationship was weaker in the latter group. That the relationship between neighbourhood deprivation and smoking is non-linear contrasts with what has been found in high-income countries, where the relationship between neighbourhood deprivation and smoking is linear. Moreover, these findings are relevant to assess the potential differential impact of smoking interventions as a function of socioeconomic and environmental context.

1. Introduction

South Africa is an upper-middle income country with a population of 55.9 million in 2016 (Statistics South Africa, 2016). Most of the population is Black (80.7%), followed by Coloured (8.8%; ethnic classification of persons with mixed ancestry), White (8.1%), and Indian/Asian (2.5%) (Statistics South Africa, 2016). The policy of apartheid in South Africa from 1948 to 1994 enforced segregation with the most resources allocated to Whites and the least to Blacks (Posel, 1991). Coloured and Asian/Indian groups were also subject to discriminatory practices that gave preferential treatment to Whites; however, they were conferred social and economic advantages over Blacks (Erasmus, 2001). These practices produced extreme disparities in education, employment, housing, living conditions, access to healthcare, and health outcomes along racial lines, which continue today (Kon and Lackan, 2008; Moller, 1998). In fact, South Africa is ranked as one of the most unequal nations in the world (Central Intelligence Agency (CIA), 2016).

While smoking prevalence has declined nationally from 30.2% in 1995 to 17.6% in 2012 (Reddy et al., 2015; Reddy et al., 2013; van Walbeek, 2004), disparities by race have persisted despite South Africa's implementation of progressive tobacco control policies, including: the Tobacco Products Control Act in 1993, the ratification of the WHO Framework Convention on Tobacco Control in 2005, and amendments to the original act in 2007 and 2008 (Reddy et al., 2013; van Walbeek, 2004). The 2012 South African National Health And Nutrition Survey reported that men having a considerably higher smoking prevalence (29.2%) than women (7.3%) (Reddy et al., 2015). In addition to gender, smoking disparities based on race, socioeconomic status, and geographic location (urban/rural), are also present. For example, Coloured men have a much higher smoking prevalence than other racial groups: 47.0% compared to 28.5% among Black men, 18.0% among White men, and 36.8% among Asian/Indian men (Reddy et al., 2015). Similarly, Coloured women have the highest smoking prevalence with 34.4%, followed by 12.9% among White women, 7.5% among Asian/Indian women, and 3.3% among Black women (Reddy et al., 2015). Corresponding disparities in lung cancer mortality have persisted since the

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1970s, where Coloured men die disproportionately more from lung cancer than any other group (Bradshaw and Harington, 1975; Sitas et al., 2013).

Although several individual-level predictors for adult smoking behaviours in South Africa have been established (Peer et al., 2009; Reddy et al., 2015; Strebel et al., 1989; Vellios and van Walbeek, 2016), less is known about how community-level factors affect smoking disparities in the country. Neighbourhood environments can contribute to health disparities through pathways that involve the physical environment, local institutions, cultural norms, and behavioral mediators related to stress (Diez Roux and Mair, 2010). As one marker of the neighbourhood environment, neighbourhood deprivation might encourage smoking through social norms, lack of institutional resources to support healthy decisions, or weak enforcement of existing tobacco control and other health regulations (Diez Roux and Mair, 2010). Previous research in high-income countries (HICs) has shown that neighbourhood economic and social deprivation are associated with higher levels of tobacco use, including higher smoking prevalence and earlier ages of smoking initiation (Baumann et al., 2007; Blakely et al., 2014; Duncan et al., 1999; Kleinschmidt et al., 1995; Lakshman et al., 2011). However, to our knowledge only one study has explored the relationship between neighbourhood deprivation on smoking behaviours in a low- or middle-income nation (Fleischer et al., 2015). In contrast to findings from the literature on HICs, Fleischer et al. found that higher levels of neighbourhood deprivation in Mexico was associated with better smoking outcomes, such as lower smoking intensity and increased number of quit attempts (Fleischer et al., 2015). The extent to which this pattern of higher deprivation and better smoking outcomes is true in the context of sub-Saharan Africa is unknown. Sub-Saharan Africa is an important area for tobacco control intervention because smoking rates are still quite low in the region overall. Such nations are in the early stages of the tobacco epidemic, but are expected to experience substantial increases in smoking due to increased marketing by tobacco companies and increased affordability of cigarettes with rising incomes (Blecher, 2010; Blecher and Ross, 2013; Blecher and van Walbeek, 2004). The case of South Africa is especially worthy of examination because of stark differences in neighbourhood environments by race (Gradín, 2012).

Using data from the National Income Dynamics Study (NIDS) (Southern Africa Labour and Development Research Unit, 2016), we conducted the first analysis of the relationship between neighbourhood-level deprivation and smoking in South Africa. We used the first wave of NIDS from 2008 as this was around the same time when the amendments of the Tobacco Products Control Act took place in response to the ratification of the FCTC (Reddy et al., 2013; van Walbeek, 2004); that is, we could reasonably study the association of neighbourhood deprivation and smoking prior to significant changes in the tobacco control policy environment. We hypothesised that higher neighbourhood deprivation would be associated with increased smoking, regardless of race.

2. Materials and methods

2.1. Population

NIDS is a nationally representative panel study of South Africa conducted biennially by the Southern Africa Labour and Development Research Unit. The survey assesses population demographics, levels of education, income dynamics, health, well-being, social cohesion, and household socioeconomic status. NIDS used a stratified, two-stage cluster design to sample households included in the base wave in 2008. Data were collected from a nationally representative sample of 7305 households belonging to 400 Primary Sampling Units (PSUs), which were derived from 2001 Census Enumeration Areas (EAs). The PSU is the smallest geographical unit in the NIDS dataset, containing between one to four EAs such that a PSU will have a minimum of 74 households;

we use PSUs as a proxy for neighbourhoods. Further details regarding the questionnaire, survey design, and sampling methodology have been described elsewhere (Leibbrandt et al., 2009). Here, we use the 2008 NIDS Adult (ages 15+) and Household questionnaires to provide a baseline description of the possible association between neighbourhood deprivation and smoking.

2.2. Smoking status

Current smoking status was determined by a "Yes" or "No" response to the question "Do you smoke cigarettes?" For those who answered "No", the follow-up question was "Did you ever smoke cigarettes regularly?" where former smokers are those who answered "Yes" and never smokers are those who answered "No". For our analysis, we excluded former smokers to make the comparison between current smokers and never smokers.

2.3. Neighhourhood deprivation

To assess the level of neighbourhood deprivation, we used the validated 2007 South African Index of Multiple Deprivation (SAIMD) (Wright and Noble, 2009). The SAIMD considers four domains: income and material, employment, education, and living environment deprivation (see Table 1 for details on specific measures). We extracted the relevant information from NIDS to compute the SAIMD domain scores for each of the neighbourhoods in our data. We then followed the procedures developed for the SAIMD to combine the domain scores (Noble et al., 2006; Noble et al., 2013Noble and Wright, 2013). First, we standardised the domain scores by ranking them, then scaling the ranks to a range between 0 and 1 by R, where $R = 1/N$ for the least deprived, and $R = N/N = 1$ for the most deprived neighbourhood. The ranks were then transformed by the following truncated exponential distribution:

$$Score_{Domain} = -\delta ln\left\{1 - R\left[1 - e^{-\frac{100}{\delta}}\right]\right\}$$

where δ is a constant that stretches out the distribution such that approximately 25% of the neighbourhoods have a score of 50 or higher (Noble et al., 2013). This transformation ensured that when the scores from the 4 domains were combined, lack of deprivation on one domain

Table 1
Description of deprivation domains.

Deprivation domains	Domain components
Income and material	Number of people living in a household: - with income below 40% of the mean equivalent household income (1167 ZAR/146 USD in 2008), OR - without a refrigerator OR neither a television nor radio ***divided*** by the total number of people in the neighbourhood
Employment	Sum of the number of people who are unemployed and the number of people who are not working due to health reasons in the neighbourhood ***divided*** by the sum of the totally economically active population (aged 18–65) and those not working for health reasons in the neighbourhood
Education	Number of adults aged 18–65 with no secondary education ***divided*** by all adults aged 18–65 in the neighbourhood
Living environment	Number of people in the neighbourhood - Living in a shack, OR - In a crowded household, OR - In a household **without** either piped water inside their dwelling or yard, - OR without a pit latrine with ventilation OR flush toilet, - OR without use of electricity for lighting ***divided*** by the total number of people in the neighbourhood.