Educational attainment & quitting smoking: A structural equation model approach[☆,☆☆]

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ABSTRACT

In the United States, disparities in smoking prevalence and cessation by socioeconomic status are well documented, but there is limited research on reasons why and none conducted in a national sample assessing multiple potential mechanisms. We identified smoking and cessation-related behavioral and environmental variables associated with both educational attainment and quitting success. We used a structural equation model of cross-sectional data from respondents ≥ 25 years from the United States 2010–2011 Tobacco Use Supplement-Current Population Survey. Quitting success was defined as former (n = 2607) versus continuing smokers (n = 7636); categories of educational attainment were ≤ high school degree, some college/college degree, and advanced degree. Results indicated that using nicotine replacement therapy (NRT) > 1 month and having a home smoking restriction were associated with both educational attainment and quitting success. Those with lower educational attainment versus those with an advanced degree were less likely to report using NRT > 1 month (≤ high school: $\beta = -0.50$, $p < 0.001$; college: $\beta = -0.24$, $p = 0.019$). Use of NRT > 1 month, in turn, was positively associated with quitting success ($\beta = 0.25$, $p < 0.001$). Those with lower educational attainment were also less likely to report a home smoking restriction (≤ high school: $\beta = -0.42$, $p < 0.001$; college: $\beta = -0.21$, $p = 0.009$). Having a home smoking restriction was positively associated with quitting success ($\beta = 0.50$, $p < 0.001$). Results were similar with income substituted for education. Using NRT > 1 month and having a home smoking restriction are two strategies that may explain the association between low education and lower cessation success; these strategies should be further tested for their potential ability to mitigate this association.

1. Introduction

Despite substantial progress against cigarette smoking in the United States about 16% of adults currently smoke (Jamal et al., 2018; National Center for Health Statistics, 2017). The prevalence of smoking is higher (Jamal et al., 2018; National Center for Health Statistics, 2017) and cessation rates are lower (Zhuang et al., 2015) among those with lower educational attainment compared to those with higher educational attainment.

The reasons for the education disparity in smoking cessation are unclear, though some possible factors have been identified. For example, smokers who are more tobacco dependent experience greater difficulty in quitting (Hymowitz et al., 1997); evidence suggests that those with less education are more tobacco dependent (Lund, 2015;

Siahpush et al., 2006). Moreover, smokers who live or work in environments where smoking is restricted are more successful at quitting (Fichtenberg and Glantz, 2002; Pizacani et al., 2004; Sorensen et al., 2004), and restrictions are less common in these environments for lower socioeconomic status persons (Dai and Hao, 2017; Gan et al., 2015; Homa et al., 2015). Support for quitting (e.g., quitline counseling or emotional support offered by family or friends) has also been associated with cessation (Westmaas et al., 2010) and those with more education are more likely to be influenced by members of their social network than those with less education (Christakis and Fowler, 2008). Smokers who receive advice from a clinician to quit smoking are more likely to quit and to use cessation aids (Fiore et al., 2008). However, people with lower educational attainment are more apt to delay or not seek medical care (National Center for Health Statistics, 2017).

Some previous studies have attempted to determine what may account for smoking-related socioeconomic disparities. One study assessed smoking cessation resources, exposure to smoke at work and home, and peer smoking behaviors (Honjo et al., 2006). Their results suggested that smokers from higher social class are more likely to use effective cessation resources and have a smoking-restrictive home environment (Honjo et al., 2006). However, this study was limited by its small sample size (n = 481), and because it was state-based the findings may not be generalizable to the United States. Another study incorporated social support, neighborhood disadvantage, stress, craving for nicotine and self-efficacy into their conceptual model to test pathways from socioeconomic status to smoking cessation (Businelle et al., 2010). That study found neighborhood and social support factors as well as stress and self-efficacy to be significant mechanisms in the socioeconomic-cessation relationship (Businelle et al., 2010). Although, the results are insightful, the study population was limited to treatment-seeking smokers (n = 424). To our knowledge, there has been no nationwide population-based investigation of the education-cessation relationship that simultaneously examined multiple potential mechanisms, including the duration of nicotine replacement therapy (NRT) use. The present study used structural equation modeling (SEM) of a large national cross-sectional dataset to identify smoking and cessation-related behavioral and environmental variables associated with both lower educational attainment and less quitting success.

2. Methods

2.1. Study population

Data from the 2010–2011 Tobacco Use Supplement (TUS) to the Current Population Survey (CPS), a household survey administered by the United States Census Bureau, were used (U.S. Department of Commerce and Census Bureau, 2012). The person-level nonresponse rates for the May 2010, August 2010, and January 2011 waves were 37.7%, 38.4%, and 40.2%, respectively (U.S. Department of Commerce and Census Bureau, 2012). Participants of interest were civilian, self-respondents age ≥ 25 years who were current or former smokers (n = 59,790; 10,243 who had made a recent quit attempt, as defined below). Analysis occurred in 2016 and 2017. Institutional review board approval was not required as deidentified publicly-available data were used (Health and Human Services and Office for Human Research Protections, 2016). Although more recent TUS-CPS data are available (2014–2015), that round did not include detailed questions regarding use of individual cessation methods as was necessary for the present study.

2.2. Measures

2.2.1. Outcome

The primary outcome, quitting success, was successful versus unsuccessful quitting, defined as former versus continuing smokers. Former smokers quit smoking 6–24 months prior to survey completion but were once daily smokers for ≥ 6 months (n = 2607). Six months was chosen as the lower limit to increase the likelihood that cessation was sustained; 24 months was chosen as the upper limit to reduce recall bias and is in accordance with previous research (Smith et al., 2017). Continuing smokers were current everyday smokers who made a quit attempt in the 12 months preceding survey completion (n = 7636). The 12-month timeframe was based on available data.

2.2.2. Primary independent variable

The primary independent variable, educational attainment, had three categories: high school degree or less ($\leq$ high school; n = 5463), some college/college degree (college; n = 4435), and graduate degree or higher (advanced; n = 345; reference). No participant was missing educational attainment data.

2.2.3. Demographic factors

Demographic variables included in the analyses were age (continuous), sex (male, female), and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other).

2.2.4. Tobacco dependence

Tobacco dependence was measured by elapsed time until first cigarette after waking (a Fagerstrom Test for Nicotine Dependence (Heatherton et al., 1991) item— ≤ 30 min, > 30 min), nighttime smoking (yes, no), and smoking initiation age (< 16 years, ≥ 16 years) (Baker et al., 2007; Bover et al., 2008; Breslau and Peterson, 1996; Scharf et al., 2008). These measures were used individually in descriptive analyses and used to form a latent tobacco dependence variable in SEM analyses. Cigarettes per day was not included in the measure of tobacco dependence as the TUS-CPS did not assess this for all former smokers for the time period immediately preceding cessation.

2.2.5. Smoking restrictions

Home smoking restriction was assessed as allowing home smoking "in some places/times" (reference) versus "not at all." Work smoking restriction was indicated by "work indoors/smoking restriction" (reference), "work indoors/no smoking restriction," "other work environment," and "retired/not working."

2.2.6. Cessation support

Cessation help from employer categories were "cessation help offered" (reference), "cessation help not offered," "self-employed/work in home," and "retired/not working." Additionally, support for quitting from friends and family was defined as "used" or "not used" (reference).

2.2.7. Healthcare utilization

Healthcare utilization categories were "visited a medical doctor" versus "not" (reference) (past 12 months for continuing smokers, or 12 months prior to the last quit attempt for former smokers).

2.2.8. Cessation aid utilization

Measurement of cessation aid use pertained to the last quit attempt for former smokers and the most recent quit attempt within the preceding year for continuing smokers. Use and duration of NRT was indicated by "not at all" (reference), "one month or less," or "more than one month." Behavioral counseling (quitline, individual or group counseling) was categorized as "use" versus "no use" (reference). Supplemental Table 1 presents pertinent survey questions.

2.3. Analytic plan

For descriptive statistics, weighted point estimates and 95% confidence intervals were generated using SAS-callable SUDAAN 11.0.1 (RTI International, 2016). To identify plausible mechanisms, bivariate analyses examined differences in the above-described smoking and cessation-related behavioral and environmental variables by educational attainment using F-tests.

For SEM, direct effects of the independent variable, educational attainment, on the dependent variable, quitting success, controlling only for demographic variables were modeled first. A subsequent model included variables significantly associated with educational attainment in bivariate analyses with direct paths both from educational attainment to each of these variables, and from these variables to quitting success. The direct educational attainment-quitting success relationship was also included in this model. Given the limitations of including "other work environment" and "retired/not working" categories for workplace variables, we ran the model excluding these categories. The resulting model had poor fit ($RMSEA = 0.062$, $TLI = 0.877$, $CFI = 0.911$). Considering the overall advantages and disadvantages of including or excluding the observations linked to these categories, we retained them and identified this as an area in need of further research.