Financial strain mediates the relationship between socioeconomic status and smoking

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ABSTRACT

INTRODUCTION Smoking is the leading cause of preventable death accounting for about 0.48 million deaths in the US every year. Across the socioeconomic status (SES) gradient smoking prevalence differs greatly, with those of lower SES smoking at much higher rates than those of higher SES. Previous studies have shown relationships between socioeconomic status, financial strain, and smoking. However, little research has explored the possibility that financial strain might mediate the relationship between socioeconomic status and smoking. Thus, the goal of the current study was to determine whether financial strain was a mediating factor in the relationship between socioeconomic status and smoking.

METHODS Participants (N=238) were primarily female (67.6%) and African-American adults (51.7%) from the Dallas metropolitan area. The majority of the sample reported that they did not currently smoke (n=164). Participants who reported currently smoking at baseline (n=74) smoked an average of 9.96 (SD=10.79) cigarettes per day.

RESULTS Analyses revealed that financial strain partially mediates the relationship between socioeconomic status and smoking status. Additionally, financial strain was found to significantly partially mediate the relationship between socioeconomic status and cigarettes smoked prospectively over the next 7 days.

CONCLUSIONS Overall, findings suggest that greater financial strain may be one factor that links SES with current smoking and smoking level among those who smoke.

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INTRODUCTION

Smoking is consistently found to be the leading cause of preventable death in the US, killing roughly 0.48 million people in 2014[1], and an estimated 20 million people over the last 50 years[2]. Smoking is associated with a number of diseases and health problems such as cancer, stroke, coronary heart disease, rheumatoid arthritis, chronic obstructive pulmonary disease, cataracts, and diminished immune functioning[2]. Currently, smoking costs the United States approximately 300 billion dollars per year due to loss of productivity and health care expenditures[1]. The overall prevalence of smoking has declined over the last twenty years due to different factors including increased anti-smoking advertisement, access to cessation interventions, and taxes on cigarettes[2]. While the overall prevalence of smoking has declined, evidence suggests that smoking disproportionately affects individuals of lower socioeconomic status. In 2014, a reported 15.2% of adults living at or above the poverty line reported current smoking, compared to 26.3% for those living below the poverty line[1]. In addition, cessation rates are extremely low among socioeconomically disadvantaged smokers, with rates ranging from 2–4% at follow-up at 6 months[3-6]. Kotz and West[7] reported that low SES smokers are just as likely to quit as higher SES individuals, even though they are half as likely to achieve long-term abstinence. Additional research is needed to understand and potentially address the reasons why socioeconomically

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disadvantaged individuals are more likely to continue smoking.

A stressor commonly associated with lower socioeconomic status is financial strain. The relationship between financial strain and smoking is circular, smoking can alleviate the burden of financial stress but at the same time smoking increases the amount of financial stress as funds that could be used otherwise are spent on tobacco products. Siahpush et al.[8] determined that across all classifications of income, increased spending on smoking products was associated with increased financial strain. In regards to smoking cessation, Siahpush and Carlin[9] found that smokers with greater financial stress had poorer treatment outcomes and those who were ex-smokers experiencing financial strain were more likely to relapse. In studies looking at women in the working class[10], or who were receiving income support[11], the most prevalent reason for not quitting or having difficulty quitting was financial stress. Additionally, Kendzor et al.[12] found greater financial strain to be associated with poorer cessation outcomes among racially/ethnically diverse smokers compared to Caucasian smokers of approximately the same socioeconomic status.

The literature provides evidence for a strong relationship between financial strain and smoking. However, financial strain has not been examined as a potential pathway linking socioeconomic status and smoking. While there has been a proliferation of research focused on socioeconomic status and health, we are just beginning to understand the underlying mechanisms by which socioeconomic status affects health behaviors and outcomes. The current study examined financial strain as a mediator of the relationship between socioeconomic status and smoking. The current study consisted of two specific aims. The first aim looked to identify if financial strain mediated the relationship between socioeconomic status and smoking status. The second aim looked to identify if financial strain mediated the relationship between socioeconomic status and cigarettes smoked per week among a group of weekly smokers. Findings will improve our understanding of how financial strain contributes to socioeconomic disparities in smoking.

METHODS

Statistical procedure

The PROCESS Macro developed by Hayes[13] was employed to conduct all mediation analyses through SPSS. The simple mediation model, model 4 as outlined by Hayes[14], was the most parsimonious available to identify if financial strain mediates the relationship between socioeconomic status and smoking. Model 4 uses an ordinary least squares (OLS) regression-based path analysis to identify indirect effects of an independent variable (X) on an outcome variable (Y) through a mediating variable (M)[14]. In the current study we were looking to assess the indirect effect of socioeconomic status (X) on smoking (Y) through financial strain (M). For Aim 1, a cross-sectional design was used to determine if financial strain mediated the relationship between socioeconomic status and smoking status (e.g. smoker vs non-smoker). For Aim 2, a longitudinal design was used to determine if financial strain mediated the relationship between socioeconomic status and cigarettes smoked per week. Bias-corrected bootstrapped confidence intervals (5000 bootstrap samples) were implemented to determine significance of the indirect effect in all mediation analyses conducted. Bias-corrected bootstrapping is the process of repeated resampling (in the current study 5000 samples) with replacement from the original sample, which allows for the *a* path and *b* path in a mediation model to be estimated from this built sampling distribution[15].

Participants

Participants were recruited through flyers posted on the University of Texas Southwestern campus (Dallas, TX) and local advertising circulars from the Dallas metropolitan area. Individuals were eligible for the study if they: 1) earned a score ≥45 on the Rapid Estimate of Adult Literacy in Medicine (REALM) indicating better than 6th grade English literacy level, 2) were 18 years of age or older, and 3) possessed a valid home address and a functioning home telephone number.

Procedure

At the first visit, details of the study were reviewed with participants and consent was obtained. Participants who had any questions were allowed to discuss them

with the researcher in a private room prior to deciding if they wanted to participate. If eligible, participants were then asked to complete study questionnaires at the UT Southwestern School of Health Professions building and to undergo a measurement of exhaled carbon monoxide, as verification of being a smoker or non-smoker. Participants were then given a smart phone and were instructed on how to use the device. Upon completion of the initial visit eligible participants then received a $50 gift card.

The Ecological Momentary Assessment (EMA) procedure following the work of Shiffman et al.[16,17] was employed whereby smart phones were distributed at the initial visit and returned several days later at the final visit. Participants were asked to record the number of cigarettes smoked every day on the smart phone. Participants returned to the UT Southwestern School of Health Professions for their final visit to return their smart phone, complete several questions on their EMA participation experience, and collect a final compensation up to $80, depending on how many of the EMA assessments were completed.

Information regarding the study procedure and participant recruitment was obtained from the University of Texas Southwestern Medical Center (UTSW) IRB protocol #STU 042012-054.

Measures

Socioeconomic status

Education, occupation and income are all well established traditional indicators of socioeconomic status and each provides distinct information[18]. In the current study, years of education was the primary indicator of socioeconomic status. Using years of education as an indicator of socioeconomic status has advantages as individuals do not need to be currently working, it is less likely to be inaccurately reported, and occurs prior to the onset of health problems thus limiting the likelihood of reverse causation[18]. Limitations of using other indicators, such as occupation and income, include exclusion of participants based on occupation if they are unemployed, while based on income there is the possibility of under- or over-reporting[18]. There are also some limitations in using education as a socioeconomic status indicator, including fewer categories while the quality of education can vary but is not documented[18]. However, a clear socioeconomic status gradient has been identified between education attainment and health factors, including smoking, compared to occupational status and income as alternative indicators[19]. For the current study education (e.g. highest grade of school completed) was used as a continuous variable to determine socioeconomic status. Education as a categorical variable is potentially problematic due to few categories available. For that reason the current study evaluated education as a continuous variable. Additionally, our measure of financial strain was a continuous variable, which strengthens the argument to use education as a continuous variable so that the final mediation model coefficients can be more easily interpreted.

Financial Strain Questionnaire

The Financial Strain Questionnaire is a 9-item self-report questionnaire with a rating scale 1–3. The score range is 9–27, with higher scores indicating greater financial strain. Pearlin et al.[20] reported confidence in the reliability and validity of the Financial Strain Questionnaire through a confirmatory factor analysis (CFA). Since no Cronbach's alpha could be found in past literature for the Financial Strain Questionnaire, we calculated the internal consistency of this measure and found excellent internal reliability (α=0.917).

RESULTS

Aim 1 participant characteristics

Participants (N=238) were adults from the Dallas metropolitan area. The sample was primarily female (67.6%) and African-American (51.7%). The majority of the sample reported being non-smokers (n=164, 68.9%). Participants who identified themselves as current smokers at baseline (n=74) reported smoking 9.96 (SD=10.79) cigarettes per day. Overall participants reported an average of 13.75 (SD=2.42) years of education and the majority reported at least part-time employment (57.1%). Participant-reported income ranged from $0 to $250000, with an average total annual household income of $36259.31 (SD=$39353.61). See Table 1 for participant characteristics for Aim 1.

Aim 2 participant characteristics

On average participants who were weekly smokers (n=73) reported smoking 49.23 (SD=41.67) cigarettes per week. Participants who were daily

Table 1. Participant characteristics for Aim 1: Smokers vs Non-Smokers (N=238)

Characteristics	Smokers (n=74) % or Mean (SD)	Non-Smokers (n=164) % or Mean (SD)	Smokers and Non-smokers (N=238) % or Mean (SD)
Gender (Female)	58.1	72	67.6
Age, years	47. 42 (11.49)	42.30 (13.46)	43.89 (13.07)
Education, years	12.49 (1.91)	14.32 (2.41)	13.75 (2.42)
Employment (at least part-time)	33.8	67.7	57.1
Annual family income (US$)	17334.56 (23792.91)	44928.07 (42007.70)	36259.31 (39353.61)
Race			
White	13.5	38.4	30.7
Black/African American	78.4	39.6	51.7
American Indian/Alaska Native	1.4	.6	.8
More than one race	2.7	1.2	1.7
Hispanic	4.1	15.2	11.8
Asian	0	4.9	3.4

smokers (n=51) reported smoking 8.66 (SD=6.09) per day. Overall participants reported an average of 12.71 (SD=1.85) years of education and the majority reported less than part-time employment (63%). Participant-reported income ranged from $0 to $110000, with an average total annual household income of $17317.64 (SD=$23245.67). See Table 2 for participant characteristics for Aim 2.

Aim 1 correlations among study variables

Socioeconomic status was negatively correlated with financial strain (r= -0.457, p<0.001) and smoking status (r= -0.351, p<0.001). Sociodemographic variables including age (r=0.182, p<0.01), race (r=0.250, p<0.001), and gender (r= -0.137, p<0.05) were all significantly correlated with smoking status. Correlations are presented in Table 3.

Aim 1 mediation analyses

Analyses revealed a significant indirect effect of socioeconomic status on smoking status through financial strain (b = -0.092, 95% CI [-0.167, -0.030]). Specifically, lower socioeconomic status predicted greater financial strain, which in turn predicted greater probability of current smoking. Furthermore, when covariates (age, race, gender) were included into the model, financial strain was still a significant mediator of this relationship (b = -0.073, 95% CI [-0.147, -0.013]). Results of the mediation model for Aim 1 are presented in Table 4.

Table 2. Participant characteristics for Aim 2: Weekly smokers (n=73)

Characteristics	Weekly smokers (n=73) % or Mean (SD)
Cigarettes smoked per week	49.23 (41.67)
Gender (Female)	58.9
Age, years	47. 68 (11.44)
Education, years	12.71 (1.85)
Employment (at least part-time)	37
Annual family income (US$)	17317.64 (23245. 67)
Race	
White	11
Black/African American	78.1
American Indian/Alaska Native	1.4
More than one race	1.4
Hispanic	6.8
Asian	1.4

Table 3. Aim 1 correlations among study variables (N=238)

	1	2	3	4	5
Age	-	-	-	-	-
Race[a]	0.093	-	-	-	-
Gender[b]	0.016	0.046		-	-
Education	**-0.281*** **	**-0.356*** **	0.065	-	-
Financial strain	**0.247*** **	**0.203** **	-0.053	**-0.457*** **	-
Smoking status[c]	**0.182** **	**0.250*** **	**-0.137***	**-0.351*** **	**0.325*** **

a Non-Hispanic White=0, Hispanic/Non-White=1. b Male=0, Female=1
c Non-Smoker=0, Smoker=1. *p< 0.05, **p<0.01, ***p<0.001.

Table 4. Mediation model linking SES with smoking status

	X>M (a path)			M>Y (b path)			X>Y (c path/direct effect)			X>M>Y (ab path/indirect effect)		
Mediator	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI
Financial strain	-1.379	0.221	[-1.815, -0.943]	0.053	0.021	[0.012, 0.094]	-0.236	0.087	[-0.406, -0.065]	-0.073	0.034	[-0.147, -0.013]

X=independent variable (education), M=mediator (financial strain), Y=dependent variable (smoking status; Non-Smoker=0, Smoker=1), B=unstandardized coefficient. Bolded values indicate statistically significant relationships (p<0.05). Model is adjusted for age, race and gender. *Bias corrected bootstrapped confidence intervals (5000 bootstrap samples).

Aim 2 correlations among study variables

Socioeconomic status was negatively correlated with financial strain (r= -0.339, p<0.01). Additionally, socioeconomic status was not found to be correlated with cigarettes smoked per week. Age (r=0.292, p<0.05) was the only demographic variable that was significantly correlated with cigarettes smoked per week. Correlations among study variables for Aim 2 are presented in Table 5.

Table 5. Aim 2 correlations among study variables (n=73)

	1	2	3	4	5
Age	-	-	-	-	-
Race[a]	-0.043	-	-	-	-
Gender[b]	0.063	-0.204	-	-	-
Education	-0.131	-0.103	0.082	-	-
Financial strain	0.198	-0.213	-0.029	**-0.339****	-
Cigarettes per week	**0.292***	-0.224	0.153	-0.141	**0.285***

a Non-Hispanic White=0, Hispanic/Non-White=1. b Male=0, Female=1
*p<0.05, **p<0.01, ***p<0.001.

Aim 2 mediation analyses

Analyses revealed a significant indirect effect of socioeconomic status on cigarettes smoked per week through financial strain (b= -2.049, 95% CI [-5.222, -0.321]). Specifically, lower socioeconomic status predicted greater financial strain, which in turn predicted an increased number of cigarettes smoked per week. Furthermore, when age was included into the model as a covariate, financial strain was still a significant mediator of this relationship (b= -1.621, 95% CI [-4.167, -0.154]). Results of the mediation model for Aim 2 are presented in Table 6.

Table 6. Mediation model linking SES with cigarettes smoked per week

	X>M (a path)			M>Y (b path)			X>Y (c path/direct effect)			X>M>Y (ab path/indirect effect)		
Mediator	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI	B	SE	95% CI
Financial strain	-1.320	0.463	[-2.244, -0.396]	1.228	0.656	[-0.082, 2.537]	-0.743	2.688	[-6.105, 4.618]	-1.621	1.026	[-4.167, -0.154]

X=independent variable (education), M=mediator (financial strain), Y=dependent variable (cigarettes smoked per week), B=unstandardized coefficient. Bolded values indicate statistically significant relationships (p<0.05). Model is adjusted for age. *Bias corrected bootstrapped confidence intervals (5000 bootstrap samples).

Additionally, we employed the same mediation procedures as described for Aim 2, but in a subgroup of daily smokers (n=51). For this set of analyses we used daily smoking rate as the outcome variable. These analyses were conducted to determine if financial strain mediated the relationship between socioeconomic status and cigarettes smoked per day differently within in a sample of daily smokers compared to weekly smokers. However, financial strain was not found to mediate the relationship between socioeconomic status and cigarettes smoked per day in the subgroup of daily smokers.

DISCUSSION

The purpose of the current study was to determine whether financial strain mediated the relationship between socioeconomic status and smoking status/level of smoking. Analyses indicated that financial strain significantly mediated the relationship between socioeconomic status and smoking status (smoker vs non-smoker) such that lower socioeconomic status was associated with greater financial strain, which

was in turn, associated with an increased likelihood of current smoking. Additionally, financial strain significantly mediated the relationship between socioeconomic status and cigarettes smoked per week such that lower socioeconomic status was associated with greater financial strain, which was prospectively associated with smoking a greater number of cigarettes during the following week. Both of these findings remained significant even when covariates (e.g. age, race and gender) were included into the models. Findings suggest that financial strain may be an underlying mechanism by which socioeconomic status exerts an influence on smoking status and smoking level.

The mediating role of financial strain in the relationship between socioeconomic status and smoking is consistent with previous research[8,9,12]. Intuitively, individuals of lower socioeconomic status tend to have lower gross annual incomes, which can lead to increased financial strain compared to their higher socioeconomic status counterparts. Spending on tobacco products increases financial stress for individuals across the socioeconomic status gradient[8]. Greater financial strain has been determined to be associated with poorer cessation outcomes[9,12] and has even been found to mediate the relationship between withdrawal symptom severity and cessation[21]. Additionally, research has shown that ex-smokers experiencing financial burden are more likely to relapse[9]. Lastly, among women of lower socioeconomic status, the most prevalent reason for not quitting or having difficulty quitting is financial stress[10].

The findings of the current study provide evidence for the role of financial strain as an underlying mechanism by which socioeconomic status influences cigarette use. While the relationship between socioeconomic status and cigarette use is multidimensional and complex, there are clinical implications for the findings of our study. The inclusion of financial strain, as a component to be taken into account in cessation interventions, may lead to increased cessation rates for individuals of lower socioeconomic status. Notably, Kendzor et al.[22] determined that the addition of financial incentives in a cessation program, in exchange for biochemically verified abstinence for socioeconomically disadvantaged individuals, significantly increased abstinence rates. Courtney et al.[23] proposed that the inclusion of financial education (e.g. learning how to manage finances) in conjunction with a pharmacological treatment was potentially beneficial for increasing cessation rates among Australian smokers. Incorporating both the inclusion of financial incentives for biochemically verified abstinence and a financial education component within usual cessation treatments (e.g. group therapy and pharmacological treatment) might be particularly effective for this population. To our knowledge no study has looked at the incorporation of this type of contingency management and financial education based cessation program. Future research should look to incorporate a component of cessation treatment that covers financial accountability and budgeting as a way to reduce financial burden for lower socioeconomic status individuals.

There are several limitations to the current study. First, the database used for the current study was archival and for this reason the methodological procedures for executing our aims were limited. Data for Aim 1 were collected during one session and were cross-sectional. For this, the results of Aim 1 support financial strain as being a significant mediator between socioeconomic status and smoking status, but causality cannot be determined. For Aim 2, a subset of the overall sample was used to look if participants, who reported smoking at least one cigarette over a week, completed their EMA daily dairy responses. The required sample size is 71 participants[24] in order to run a simple mediation having the adequate power (0.80) to find a medium-size effect. Aim 2 included 73 participants who completed this longitudinal part of the study and then a subset of 51 participants who were daily smokers within this group. Our exploratory analyses using only daily smokers for Aim 2 were underpowered as our subgroup of daily smokers had only 51 participants, which may have led to inconclusive results.

CONCLUSIONS

Greater financial strain significantly mediates the relationship between socioeconomic status and smoking status such that lower socioeconomic status is associated with greater financial strain, which in

turn, is associated with an increased likelihood of current smoking. A similar effect was found when looking at financial strain mediating the relationship between socioeconomic status and cigarettes smoked per week. Lower socioeconomic status was found to be associated with greater financial strain, which in turn, was associated with an increased number of cigarettes smoked per week. Our findings support the importance of addressing financial strain within cessation programs for lower socioeconomic status individuals. Future research should determine further evidence for this relationship in a larger sample. Cessation programs for lower socioeconomic status individuals should include some component that explicitly addresses financial strain as a significant factor in the perpetuation of smoking related behavior as well as its ability to act as a barrier to successful cessation. Financial strain is an important factor in the maintenance of smoking behaviors for lower socioeconomic status individuals and addressing it as an important component of interventions may help reduce the disparity in smoking prevalence seen across the socioeconomic status spectrum.

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CONFLICTS OF INTEREST
Authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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