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Does workplace social capital buffer the effects of job stress? A cross-sectional, multilevel analysis of cigarette smoking among U.S. manufacturing workers

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Abstract

Objective—To investigate whether workplace social capital buffers the association between job stress and smoking status.

Methods—As part of the Harvard Cancer Prevention Project's Healthy Directions-Small Business Study, interviewer-administered questionnaires were completed by 1740 workers and 288 managers in 26 manufacturing firms (84% and 85% response). Social capital was assessed by multiple items measured at the individual-level among workers, and contextual-level among managers. Job stress was operationalized by the demand-control model. Multilevel logistic regression was used to estimate associations between job stressors and smoking, and test for effect modification by social capital measures.

Results—Workplace social capital (both summary measures) buffered associations between high job demands and smoking. One compositional item—worker trust in managers—buffered associations between job strain and smoking.

Conclusion—Workplace social capital may modify the effects of psychosocial working conditions on health behaviors.

INTRODUCTION

A dominant model linking work stress to poor health is the demand-control model (1). It posits that workers will experience different health-related effects based on the degree of demands and control their jobs entail. The model categorizes “low strain” jobs as those with low demands and high control, “passive” jobs as those with low demands and low control, “active” jobs as those with high demands and high control, and “high strain” jobs as those with high demands and low control. Workers with jobs characterized by high demands or low control are hypothesized to be at increased risk of psychological stress and related health outcomes, and those with high strain jobs, who experience these characteristics simultaneously, are at highest risk. Jobs characterized by high strain (also called “job strain”) have been repeatedly associated with a range of outcomes, most notably cardiovascular disease (2–7) and poor mental health

(8–11). The model's ability to predict other outcomes, including smoking, has been less consistent. However, few studies have been conducted in population-based or representative samples of workers (12–17).

Researchers have attempted to expand the demand-control model's applicability by adding dimensions. For example, Karasek refined his initial model by including social support as a third dimension, resulting in the demand-control-support model (18,19). Social support, as an independent construct, has been shown to buffer the effects of high demand jobs (20), and has been specified in this way in the demands-control-support model, which hypothesizes that a combination of high demands, low control, and low social support result in stress. Results from studies using the demand-control model versus the demand-control-support model have been similar, with about half of each supporting the model's hypotheses (see review (21)). Other researchers have combined the demand-control model with another dominant model of work stress—the effort-reward imbalance model. Others have integrated or supplemented the demand-control model with other psychosocial determinants of workers' health, such as workplace context.

A potentially important indicator of workplace social context that has received little attention is social capital, which has been defined as features of social structure (such as trust, norms, sanctions, informal social control), appropriable social institutions, and information channels that benefit groups or societies (22). While demands, control, and combinations thereof assess characteristics of workers' jobs, and social support assesses characteristics of workers' social interactions, social capital assesses more basic elements of the social structure in which these characteristics are operating (23). It is usually seen as a characteristic of social groups, born of shared experience which fosters mutual trust and reciprocity (24). Social capital, in communities or workplaces, may promote health through a variety of mechanisms, including stress-buffering (25,26), the provision of social support, and exertion of informal control over behaviors (27). In neighborhoods and other socially- or politically-defined areas, higher levels of social capital have been associated with a number of important health outcomes, including better self-rated health (e.g., (28–32)) and healthy behaviors (e.g., (33–35)).

Researchers have noted that it may be revealing to investigate social capital according to different dimensions of the construct, including horizontal—between individuals in the same hierarchical level (e.g., coworkers), and vertical—across individuals in different positions of power (e.g., supervisors and employees) (36–39). With regard to smoking outcomes specifically, low levels of vertical trust, often measured as trust in a political entity such as the government or healthcare system, have been associated with higher odds of daily smoking (40,41). Low levels of social capital's horizontal dimension, often measured as social participation and trust in others (e.g., neighbors) also have been associated with higher odds of daily smoking and higher smoking prevalence in some studies (13,41–46), but not all (47, 48).

In addition to neighborhoods, workplaces have been identified as an apt context for examining the relationship between social capital and health (37,49–51), since social capital is likely to arise wherever people spend much of their time (49). Some studies of workplace social capital have combined social capital's horizontal and vertical dimensions into a single measure, while others have investigated the dimensions separately. Of those employing a combined measure, two found that workplace social capital was associated with better worker health outcomes (38,39), whereas one found no association (52). With regard to smoking, Kouvonen et al., using a measure of social capital that included both horizontal and vertical dimensions, did not find an association between work unit-level social capital and smoking cessation (53). Among studies that have looked at the dimensions of social capital separately, one found that the vertical dimension was associated with better health outcomes, whereas the horizontal

dimension was not (54); another found that both dimensions were positively associated with health independently, but not together (in a combined measure) (55).

To date, just a few studies have investigated both social capital and job stress (13,54,56,57). Lindstrom et al. found that the horizontal dimension of social capital, measured as social participation (outside the workplace), was highest among workers with active and passive jobs (56). In another population-based sample, Lindstrom (13) found that among individuals with high strain jobs, low social capital (measured as social participation) was associated with increased odds of daily smoking. Chen and colleagues (54) analyzed work stress and workplace social capital separately, and found that lower levels of stressors and higher levels of the vertical, but not the horizontal, dimension of workplace social capital were associated with better self-rated health.

In the current study, we aim to contribute knowledge about smoking-related risk factors in the workplace by investigating the potential of social capital, as a contextual-level psychosocial working condition, to modify the associations, found previously in this sample, between high jobs demands and higher smoking prevalence, and between high strain jobs and higher smoking prevalence. We examine social capital reported at the individual level (by workers) and aggregated to the worksite level, as well as social capital reported at the worksite level (by managers). For each type, we examine the dimensions in combination (as social capital summary) and separately (as individual items). Based on literature regarding the potential for social capital to buffer stress and previous studies demonstrating the role of social capital in facilitating better health outcomes including smoking cessation (40,41,53), we hypothesize that social capital will buffer the positive association of smoking with job demands and with job strain among a sample of manufacturing workers.

METHODS

Study design

We conducted a secondary analysis of baseline data from the Healthy Directions Small-Business Study, one of two randomized, controlled intervention studies that were part of the Harvard Cancer Prevention Program Project (58). Manufacturing worksites were chosen as the unit of intervention because the trial's aim was to reach individuals at risk for cancer-related health behaviors and occupational exposures, and manufacturing worksites are more likely than other worksites, such as those in the service sector, to use potential carcinogens in work processes. Small manufacturing businesses (50–150 employees) were chosen because such businesses employ roughly 42% of all U.S. manufacturing workers (59), are less likely to offer health promotion programs (60–62), and have been largely understudied (63). Further, national survey data show that subgroups of the workforce, including nonprofessionals, blacks, and individuals with less education, were least likely to work for companies that offer health promotion programs to employees (64), highlighting the importance of conducting cancer prevention research in small worksites to address excess risk among workers of lower socioeconomic position and racial and ethnic minorities.

The Dun and Bradstreet database was used to identify small manufacturing worksites (Group D) located in Massachusetts. Worksite eligibility criteria included: (a) employing a multicultural/multiethnic population (defined as 25% of workers being first- or second-generation immigrant or people of color); (b) employing between 30 and 150 employees; (c) having a turnover rate of less than 20% in the previous year; and (d) being autonomous in decision-making power to participate in a study (if part of a parent company). Of 224 manufacturing worksites, 197 (88%) completed the pre-recruitment survey and 131 (66%) of these met the trial eligibility criteria. Of these, 26 worksites consented to participate in the trial, for an adoption rate of 20%. Participating worksites ranged in size from 32 to 137 workers,

and manufactured a range of product, including medical equipment, dog food, specialty pumps, textiles for the automobile industry, and electronics. Three of the worksites provided services to other businesses (laundry and printing). About half the workers in the sample had manual occupations, ranging 20% to 82% per worksite. Compared to worksites that declined to adopt the intervention, adopting worksites were not significantly different in terms of workforce composition, financial outlook, and interest in or history of health promotion activities (65). Additional details of the worksite recruitment process, and a comparison of participating versus non-participating worksites can be found elsewhere (65).

Participants

Within each worksite, workers were eligible to participate if they (1) were permanent employees, (2) worked 20 hours or more per week, (3) worked on site, and (4) spoke either English, Spanish, Portuguese, or Vietnamese. Data were collected between May and December, 2002 via two different surveys administered by interviewers during work time. The Health Behavior Survey measured individual-level social capital, job stress, sociodemographic characteristics, and a range of other factors specified in the conceptual model (66). It was completed by 1740 employees in 26 worksites (response rate: 84%). The Manager Survey was administered to employees at each worksite identified by company records as managers or supervisors. It assessed characteristics of worksite management practices and worksite social capital. A total of 283 managers in 26 worksites completed the survey (response rate: 85%), with an average of 11 managers per site (min=3, max=22, SD=4.35).

Smoking Status

Smoking status was assessed in the Health Behavior Survey. Respondents were asked whether s/he had smoked a cigarette, even a puff, in the last seven days. Respondents were coded as current smokers if they answered “yes” and nonsmokers if they responded “no.” Those who did not respond were coded as missing (n=3).

Job Stress

Job stress was operationalized with three constructs—high demands, low control, and high strain. These variables were assessed using a modified version of the Karasek Job Content Questionnaire (67). The questionnaire was abbreviated to reduce the number of questions, given the logistical concerns of the survey. Modifications were guided by expert consultations (with Jeff Johnson and Paul Landsbergis). The abbreviated measure included two items assessing job demands (job makes conflicting demands, and job requires working fast), one item assessing decision authority (lot of say about what happens on job), and two items assessing skill discretion (job requires learning new things, and job involves doing same things over and over). Job control was created as a weighted sum of decision authority and skill discretion. Values for job demands and job control ranged from 2 to 6, which we collapsed into three categories—low (2–3), moderate (4), and high (5–6). In accordance with the demand-control model, we used the values from the job demands and control variables to create a job strain variable containing four categories—low strain (low demands, high control), active (high demands, high control), passive (low demands, low control), and high strain (high demands, low control).

Workplace social capital

We measured workplace social capital in two different ways. One measure was based on aggregated individual-level responses from workers, and the other measure was based on contextual-level responses from managers. Following, we describe the construction of each.

Aggregated—The Health Behavior Survey assessed social capital, at the individual level, with three separate items: 1) “The people I work with are willing to help each other;” 2) “I trust the people I work with;” and 3) “The managers of this company look out for the people who work here.” Response options included “agree,” “disagree,” and “no opinion.” To create scores for each item, we computed the percentage of workers per site who reported “agree” versus “disagree” or “no opinion.” We then categorized each worksite as having a high or low level of the item based on overall worksite mean. To create the aggregated social capital summary score, we first averaged workers’ dichotomized responses to the social capital items, resulting in a social capital summary score for each respondent. Next, we averaged the social capital summary scores by worksite. Based on the overall worksite mean, we categorized each worksite as having a high or low level of aggregated social capital.

Contextual—The Manager Survey assessed contextual-level workplace social capital with four items: 1) “This is a close-knit workplace;” 2) “If there is a problem in this work-place, managers and employees work together to solve it;” 3) “How often do managers & employees socialize outside of work?” and 4) “How often do employees come to managers to seek advice?” Responses were measured on a 5-point Likert scale, ranging from “strongly agree” to “strongly disagree” (for questions 1 and 2) or “very often” to “never” (for questions 3 and 4). To create scores for each item, we averaged the responses by worksite. Based on the item’s overall mean, we categorized each worksite as having a high or low value of the item. To create the contextual social capital summary score, we averaged the items for each respondent, then computed the average of these values for each worksite, and used the overall mean as a cut point for a binary variable classifying each worksite as having high or low contextual social capital.

Analysis

We used multilevel statistical methods to model the individual and contextual variation in the outcome. Specifically, we estimated unadjusted and adjusted multilevel logistic regression models with random intercepts using MLwiN software (Version 2.02.0000) (68). Models were based on a logit-link function (69) with predictive/penalized quasi likelihood approximation and a second-order Taylor linearization procedure (70). First, we tested for an association between the job stress variables and smoking status in adjusted multilevel logistic regression models. Next, we built adjusted multilevel logistic regression models to test for effect modification of the significant associations (job demands and smoking, and job strain and smoking) by the social capital summary measures and each item composing them. Predictors in adjusted interaction models included a multiplicative interaction term between the job stress variable and social capital indicator, the root variables of the interaction term, and individual-level sociodemographic variables that may influence smoking status: age (18–35, 36–49, 50–64, 65+ years); gender; educational attainment (high school/GED or less, some post-high school education, or 4-year college completion); race/ethnicity (white vs. non-white, including Hispanic), language acculturation (low, moderate, or complete); and occupational status (manager/supervisor vs. non-manager). We present results as odds ratios (ORs), along with their 95% confidence intervals (CIs). Statistical significance, for all models, was assessed at a level of 0.05 (2-tailed). We excluded individuals who were missing observations of the outcome variable ($n=3$).

RESULTS

Table 1 shows the sample’s sociodemographic characteristics by the primary predictors—job demands, job control, job strain categories, and aggregated and contextual social capital. Table 2 shows the distribution of the primary predictors—overall, and by smoking status. Approximately 26% of the study participants were current smokers. About 40% had jobs

characterized by high job demands, 38% by low job control, and 14% by job strain. High aggregated workplace social capital was present in 9 of the 26 worksites ($n=1078$ —62% of workers). High contextual social capital was found in 12 worksites ($n=790$ —45% of workers). The two different measures of workplace social capital were discrepant for 7 worksites ($n=392$ —23% of workers). Smokers were more likely than non-smokers to experience high job demands, low job control, low strain work and high strain work. Smokers were not more likely than non-smokers to be categorized in a high (aggregated or contextual) social capital worksite.

In adjusted models assessing the relationship between smoking and job strain elements, odds of smoking were significantly higher for workers with high versus low job demands ($OR=1.35$, $p=0.02$, 95% $CI=1.06$ to 1.72) and for workers with high versus low strain jobs ($OR=1.63$, $p=0.01$, 95% $CI=1.13$ to 2.34). Job control was not independently associated with smoking status, so we did not test for effect modification by social capital.

The association between job demands and smoking status was modified by both aggregated and contextual workplace social capital summary measures. Among workers with high demands, those in high social capital worksites had significantly lower odds of being a current smoker (for aggregated social capital, as shown in Table 3, $OR=0.45$, $p<0$, 95% $CI=0.27$ to 0.74 ; for contextual social capital, as shown in Table 4, $OR=0.58$, $p=0.03$, 95% $CI=0.35$ to 0.95). In both models, high job demands remained independently associated with higher odds of smoking (aggregated social capital model $OR=2.15$, $p<0$, $CI=1.47$ to 3.16 ; contextual social capital model $OR=1.70$, $p<0$, 95% $CI=1.23$ to 2.30). Among the items composing the aggregated social capital summary measure (Table 3), worker trust in managers buffered the job demands-smoking association ($OR=0.51$, $p<0.00$, 95% $CI=0.34$ to 0.76) while co-worker trust and co-worker helpfulness did not. None of the items composing contextual social capital independently modified the association between job demands and smoking. Tables 5 and 6 show results from adjusted models assessing interactions between job strain categories and aggregated or contextual social capital measures, respectively. Neither the aggregated nor the contextual social capital summary measure modified the association between high strain work and higher odds of smoking, though the main effect remained significant in both models. The job strain-smoking association was modified by one aggregated social capital item—worker trust in managers. For workers with job strain, a high level of worker trust in managers was associated with lower odds of smoking ($OR=0.50$, $p=0.03$, 95% $CI=0.27$ to 0.93).

Active work, though not significant in the initial model testing for associations between job strain categories and smoking, became significant upon the addition of social capital. As shown in Tables 5 and 6, workers with active versus low strain jobs had higher odds of smoking ($OR=2.30$, $p<0$, 95% $CI=1.41$ to 4.09 for model containing aggregated social capital; $OR=1.88$, $p<0$, 95% $CI=1.22$ to 2.88 for model containing contextual social capital), and these odds were buffered by high workplace social capital, as shown in Table 5, Model 1 (aggregated social capital $OR=0.40$, $p=0.01$, 95% $CI=0.20$ to 0.78) and Table 6, Model 1 (contextual social capital $OR=0.47$, $p=0.02$, 95% $CI=0.25$ to 0.89). Tests of the items composing the social capital measures showed that the association between smoking and active work was buffered by high worker trust in managers (Table 5, Model 4) ($OR=0.52$, $p=0.02$, 95% $CI=0.30$ to 0.90), and by a closely-knit workplace, as perceived by managers (Table 6, Model 2) ($OR=0.56$, $p=0.02$, 95% $CI=0.34$ to 0.91). Worksite-level variance was not significant in any models.

DISCUSSION

This study sought to investigate whether workplace social capital modified associations between job stress and smoking. We found that two summary measures of workplace social capital buffered the association between high job demands and smoking. The summary measures did not modify the association between job strain and smoking, though this

association was buffered by worker trust in management, one of the items composing the aggregated social capital summary measure. This item also buffered the effect of high job demands on smoking.

Reasons why workplace social capital may buffer the association between high job demands and smoking include social capital's stress-reducing and social normative properties. With regard to the former, studies have indicated that individuals use smoking as a coping mechanism to deal with stress (71); most smokers cite smoking's calming or relaxing effects as one of the reasons they smoke (72). Social capital, manifested as feelings of trust and reciprocity among co-workers, may also serve as a mechanism through which to cope with stress. For workers in high demand jobs, who are more likely to experience higher levels of psychological stress than workers in low demand jobs, high levels of workplace social capital may supplant smoking as a coping mechanism. Social capital's ability to do so is likely bolstered by its promotion of social cohesion and norms, properties which could also act independently to buffer the high demands-smoking association (73,74). For example, if most workers have an anti-smoking attitude, and their workplace is rich in social capital, smokers—even those with highly demanding jobs—may respond to the anti-smoking climate by quitting, and non-smokers (both former and never smokers) may respond by not (re)starting. Low social capital workplaces, on the other hand, are less cohesive and fail to provide this type of social influence over workers' behaviors (75).

While we did not find that workers with active jobs were more likely to smoke than workers with low strain jobs, we did find that workers with active jobs in high social capital workplaces were less likely to smoke than those with active jobs in low social capital workplaces. Tests of the items composing the social capital summary measures produced similar findings for “worker trust in management” and “close-knit” workplaces, as rated by managers. The demand-control literature has produced few findings on the relationship between active jobs and smoking or other coping mechanisms, and these findings have been mixed, with some studies finding positive associations between active work and smoking (76–78) and others finding none (75,79,80). Perhaps workers with active jobs in low social capital workplaces perceive their jobs as more stressful than workers with active jobs in high social capital workplaces, and use smoking as a coping mechanism.

With regard to the individual items composing the aggregated social capital summary measure, just one item—worker trust in managers—modified the effects of job stress variables on smoking. Like the aggregated summary score, this item buffered associations between job demands and smoking, and between job strain and smoking. “Worker trust in managers” captures the vertical dimension of social capital, linking together individuals with different positions in the workplace hierarchy (managers and employees). The other items composing the aggregated social capital measure included co-worker helpfulness and co-worker trust, both of which capture the horizontal dimension of social capital, bonding similar individuals and bridging ties between dissimilar individuals within the same hierarchical tier (co-workers).

There are several possible explanations for why worker trust in managers acted as an independent modifier of the job demands-smoking association. Workers may have felt that managers looked out for them because their managers demonstrated concern for employees' health, and had encouraged (through attitudes, language, policies, and resources) smoking prevention and cessation. Managers may have focused these efforts on employees like machine operators and line workers (who compose the bulk of workers with high demands and job strain), whose productivity is management's responsibility and could be hampered by smoking (e.g., due to frequent smoking breaks or increased sickness absence). If workers felt that managers looked out for them, they may have been more likely to participate in voluntary smoking cessation programs. Other plausible explanations include smoking policies and role

modeling managers' smoking behaviors and attitudes. Workers in sites with high trust of managers may be more likely to role-model managers' behaviors (which, in this sample, usually did not include smoking, as only 13% of managers in this sample smoked), and/or to follow managers' policies regarding smoking. These explanations may not be viable in this sample, though, as managers in high social capital worksites were not less likely to smoke than managers in low social capital worksites, and formal smoking policies were not significantly different in high versus low social capital worksites. However, perhaps there were differences in managers' informal smoking policies and attitudes about smoking, and managers in worksites with high linking social capital were better able to exercise informal social control with regard to smoking among their employees.

Reasons why co-worker helpfulness and trust were not independent buffers of the associations between job strain elements and smoking may be because feelings of trust and reciprocity among individuals in the same hierarchical tier can reinforce smoking as much as deter it. Smoking may even give rise to bonding and bridging social capital if smokers spend break time with other smokers, and non-smokers with other non-smokers. Also, because workers do not create or formally enforce workplace smoking policies, it may seem out of line for workers to attempt to influence the smoking behavior of their peers.

Though co-worker helpfulness and trust did not buffer the association between smoking and social capital elements as individual items, when combined with worker trust in management in the aggregated social capital summary score, they bolstered its effect, as evidenced in the greater magnitude of the interaction term for the aggregated social capital summary measure versus the single item. As discussed, at sites where workers identified a strong sense of trust in managers, managers may have been more likely to encourage smoking prevention and cessation, especially among workers with stressful jobs, and workers may have been more likely to respect their managers' attitudes, policies, and requests regarding smoking prevention and cessation. In such workplaces, how workers responded to their managers was likely a social norm further reinforced by fellow co-workers who felt high levels of helpfulness and trust amongst themselves, as was the case in the workplaces categorized by the aggregated summary measure as having high social capital. Reciprocally, in workplaces with low levels of coworker trust or suboptimum relationships between managers and employees, workers may perceive that coworkers and managers don't care about their behaviors, and are thus less likely to make or succeed at a quit attempt. These explanations are supported by research demonstrating an association between lower social participation and higher rates of smoking (44,81–84).

Among the items composing the contextual social capital summary measure, none modified the effect of job demands or high strain work on smoking, as the summary measure did. One item—a highly close-knit workplace, as perceived by managers—modified the effect of active work and smoking, an association which became evident only when social capital was added to the model. Our finding that the summary measure, but not the individual items, acted to buffer the job demands-smoking association may support the notion that social capital is a property that emerges from several variables acting in tandem.

Strengths and Limitations

Even though the two social capital summary measures categorized about a quarter of the worksites differently, they had similar effects. This may mean that each measure, though composed of different items and measured among different populations, captured similar aspects of social capital. Alternatively, it may mean that each measure captured different aspects of social capital, and the different aspects (acting in similar or different ways) led to the same outcome.

A few issues surround the analysis of the social capital variables. First, we dichotomized them (low versus high), though we could have tested them as continuous variables, which may have produced stronger associations. However, a dichotomized measure of social capital can be more easily interpreted, and because dichotomized measures probably resulted in more conservative estimated associations, we can be more confident that these estimates are not spurious. Second, we examined social capital as a contextual variable, aggregating individual responses of workers and managers to the worksite level instead of using individuals' self-reported values. While the latter method may have produced a more sensitive measure, aggregation is appropriate for testing the theory of social capital as a group property. Third, considerable debate surrounds the measurement of social capital with regard to what items the measure should contain (24,85). Social capital has been measured by assessing, in various ways, interpersonal trust, social participation, reciprocity, other pro-social behaviors like organizational memberships, and combinations thereof. We operationalized aggregated workplace social capital as items assessing workers' perceptions of co-worker helpfulness, trust between coworkers, and worker trust in managers. We operationalized contextual workplace social capital as items assessing managers' perceptions of the degree to which the workplace is "close-knit," helpfulness between managers and employees, non-workplace socializing between managers and employees, and the frequency with which employees seek advice from managers. While we consider social capital a construct resulting from a combination of the items, we also tested the items individually. Although these tests did not yield much information about the importance of vertical vs. horizontal social capital, as we had hoped, they did support the notion of social capital as a property resulting from different aspects of the construct acting in combination.

Regarding the job stress instrument, only a reduced number of items were included due to practical constraints. It is possible that full application of the original Job Content Questionnaire (67) might contribute to a more adequate estimation of the effects of job stress. However, our reduced-question measure had strong face validity, and it is common for researchers to use abbreviated measures of job strain (86).

Another job stress measurement issue has to do with reporting. We measured job strain by self-report, though we could have obtained values from a job exposure matrix via occupational codes (87,88). While using job exposure matrix data may have advantages like eliminating the possibility of misclassification due to health status (86), self-reported job strain is advantageous in that it captures within-occupation variability (86,89). The demand-control model posits that job characteristics, not individuals' perceptions of those characteristics, induce stress and its consequent negative health effects. Analyzing individuals' self-reported perceptions of job characteristics, then, without accounting for clustering of characteristics by occupation violates statistical assumptions as well as the model's theoretical underpinnings. Even so, most studies use self reported job characteristics (89) and analyze these data using single-level regression models, as we did. While our findings may not be theoretically precise or methodologically ideal, they are consistent with and comparable to findings from the majority of studies using the demand-control model.

To create cutoff points for high and low values of job demands and control, we used the distribution of values from our sample, though we could have created these categories using the distribution of values from national surveys (90). This would have led to categorizing many more workers as experiencing job strain (13.51% using values from our sample versus 28.5% using values from the literature). Because sample values produced a more conservative estimate of job strain, we can be more confident in our findings than if we had used literature values. The cross-sectional design of this study prohibits causal inference due to lack of knowledge about temporal order of predictor and outcome variables. Likewise, unmeasured variables may have confounded our analysis. Such variables may include additional workplace

stressors, like shift work or overtime work, as well stressors outside the workplace, including lack of control in general life, multiple role obligations, and limited resources (78,91).

This study's generalizability—how well worksites that elected to participate in the trial represent all eligible worksites—was reported in detail by Barbeau et al. (65), who note the rate of adoption in this study (20%) is similar to other workplace cancer prevention studies (92–94). Additionally, there were no statistically significant differences between eligible worksites that adopted the trial and those that declined with regard to workforce composition, financial outlook, perceived importance of health promotion activities, or history of offering them. Findings from this study are likely generalizable to other small manufacturing businesses that are located in urban areas and employ multiethnic, low-wage workers (65).

Conclusion

We investigated two different measures of workplace social capital, composed of different items and measured among different populations, buffered the association between high job demands and increased odds of smoking. These summary measures did not modify the association between job strain and smoking. However, the job strain-smoking association was buffered by one of the items composing the aggregated social capital summary score—worker trust in managers, which captures the vertical dimension of social capital. This item had the same effect on the association between job demands and smoking. None of the other items composing the social capital summary scores acted as independent effect modifiers of the associations between job stress and smoking. These findings support the notion of social capital as a phenomenon created by different individual-level features of social structure acting synergistically.

While our study deals specifically with social capital's relationship to job stress and smoking, it touches on more general questions concerning social contexts relevant for assessing social capital. Most previous studies examined social capital in neighborhoods or other geographically-defined residential areas. We examined social capital in workplaces, thereby contributing to a growing literature that broadens conceptualizations of apt social contexts in which to consider the effects of social capital. To elucidate the importance of social capital in multiple social contexts, future studies should consider neighborhoods and workplaces simultaneously using cross-classified models. Such studies could improve knowledge about the pathways and mechanisms through which social capital influences behaviors, and inform health promotion interventions.

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Table 1
Sociodemographic characteristics of the sample by job strain elements and social capital (N=1740)

Sociodemographic characteristics	Total N (%)	High job demands N (%)	Low job control N (%)	High job strain N (%)	High aggregated social capital N (%)	High contextual social capital N (%)
Age group (years)						
18-35	445 (25.9)	188 (27.5)	169 (26.3)	68 (29.8)	307 (28.9)	230 (29.3)
36-49	758 (44.2)	328 (48.0)	274 (42.6)	105 (46.1)	455 (42.8)	342 (43.6)
50-64	451 (26.3)	156 (22.8)	169 (26.3)	51 (22.4)	265 (25.0)	190 (24.2)
65+	62 (3.6)	11 (1.6)	31 (4.8)	4 (1.8)	35 (3.3)	22 (2.8)
Gender						
Men	1170 (67.4)	479 (69.7)	410 (62.9)	144 (62.9)	722 (67.2)	534 (67.7)
Women	567 (32.6)	208 (30.3)	242 (37.1)	85 (37.1)	353 (32.8)	255 (32.3)
Race/ethnicity						
White (non-Hispanic)	1214 (69.8)	498 (72.4)	428 (65.6)	161 (70.3)	738 (68.5)	517 (65.4)
Nonwhite	526 (30.23)	190 (27.6)	224 (34.4)	68 (29.7)	340(31.5)	273 (34.6)
Education						
High school/GED or less	795 (46.3)	283 (41.5)	365 (56.9)	112 (49.6)	485 (45.6)	365 (46.6)
Associates or some college	578 (33.7)	228 (33.4)	215 (33.5)	82 (36.3)	360 (33.8)	273 (34.9)
≥4-year college degree	343 (20.0)	171 (25.1)	62 (9.7)	32 (14.2)	219 (20.6)	145 (18.5)
Language acculturation						
Low	299 (19.7)	110 (18.1)	140 (24.5)	42 (20.3)	210 (22.2)	159 (23.9)
Moderate	229 (15.1)	85 (14.0)	80 (14.0)	25 (12.1)	134 (14.2)	94 (14.1)
Complete	987 (65.2)	412 (67.9)	351 (61.5)	140 (67.6)	603 (63.7)	413 (62.0)
Occupational status						
Non-manager	1452 (83.5)	520 (75.6)	619 (94.9)	212 (92.6)	881 (81.7)	645 (81.7)
Manager	288 (16.5)	168 (24.4)	33 (5.1)	17 (7.4)	197 (18.3)	145 (18.4)

Table 2

Distribution of job strain and workplace social capital elements*, overall and by smoking status (n=1740)

Variables	Total N(%)	Smoke N(%)	<i>p</i> **
High job demands	688 (40.1)	195 (44.0)	0.05
Low job control	652 (38.2)	187 (42.2)	0.05
Job strain category			
Low strain	600 (35.4)	137 (31.1)	0.03
Active	447 (26.4)	116 (26.4)	0.28
Passive	419 (24.7)	109 (24.8)	0.25
High strain	229 (13.5)	78 (17.7)	<0.00
High aggregated (worker-rated) social capital	1078 (62.0)	265 (59.0)	0.14
Items composing aggregated social capital			
High co-worker helpfulness	913 (52.5)	217 (48.3)	0.04
High co-worker trust	890 (51.2)	208 (46.3)	0.02
High worker trust in management	1198 (69.0)	292 (65.0)	0.04
High contextual (manager-rated) social capital	790 (45.4)	195 (43.4)	0.32
Items composing contextual social capital			
Agree workplace is close-knit	727 (41.8)	168 (37.4)	0.03
Agree managers & employees solve problems together	724 (41.6)	186 (41.4)	0.90
Managers & employees frequently socialize out of work	794 (45.7)	204 (45.4)	0.89
Employees frequently seek advice from managers	884 (50.8)	206 (45.9)	0.01

* Social capital elements reflect N(%) of participants categorized by the constructed worksite-level measures, not N(%) of individual-level responses.

**
p-values from t-tests assessing differences between smokers and non-smokers

Table 3

ORs and CIs of smoking from multilevel adjusted* logistic regression models assessing the interaction between job demands and aggregated social capital

Model 1-Interaction with aggregated social capital (summary measure)	
Job demands	
Low	1.00
High	2.15 (1.47 to 3.16)
Aggregated social capital	
Low	1.00
High	1.35 (0.84 to 2.17)
Job demands × aggregated social capital	
High demands × low social capital	1.00
High demands × high social capital	0.45 (0.27 to 0.74)
Model 2-Interaction with co-worker helpfulness ("People I work with are willing to help each other.")	
Job demands	
Low	1.00
High	1.23 (0.95 to 1.60)
Co-worker helpfulness	
Disagree or no opinion	1.00
Agree	0.80 (0.54 to 1.19)
Job demands × co-worker helpfulness	
High demands × disagree/no opinion	1.00
High demands × agree	0.79 (0.55 to 1.14)
Model 3-Interaction with co-worker trust ("I trust the people I work with.")	
Job demands	
Low	1.00
High	1.18 (0.91 to 1.53)
Co-worker trust	
Disagree or no opinion	1.00
Agree	0.75 (0.51 to 1.11)
Job demands × co-worker trust	
High demands × disagree/no opinion	1.00
High demands × agree	0.86 (0.59 to 1.24)
Model 4-Interaction with trust in managers ("Managers look out for the people who work here.")	
Job demands	
Low	1.00
High	1.74 (1.24 to 2.44)
Trust in managers	
Disagree or no opinion	1.00
Agree	1.22 (0.85 to 1.75)
Job demands × trust in managers	

High demands × disagree/no opinion	1.00
High demands × agree	0.51 (0.34 to 0.76)

Odds ratios (ORs) and their 95% confidence intervals (CIs) from multilevel logistic regression models are shown. Number of workers=1737; number of worksites= 26.

* Adjusted for age, gender, race/ethnicity, education, language acculturation, and occupational status.

Table 4

ORs and CIs of smoking from multilevel adjusted* logistic regression models assessing the interaction between job demands and contextual social capital

Model 1-Interaction with contextual social capital (summary measure)		
Job demands		
Low		1.00
High		1.70 (1.23 to 2.30)
Contextual social capital		
Low		1.00
High		1.15 (0.74 to 1.79)
Job demands × contextual social capital		
High demands-low social capital		1.00
High demands-high social capital		0.58 (0.35 to 0.95)
Model 2-Interaction with close-knit workplace ("This is a close-knit workplace.")		
Job demands		
Low		1.00
High		1.24 (0.98 to 1.56)
Close-knit workplace		
Strongly disagree, disagree, or no opinion		1.00
Agree or strongly agree		0.91 (0.59 to 1.42)
Job demands × close-knit workplace		
High demands × disagree/no opinion		1.00
High demands × agree		0.70 (0.47 to 1.03)
Model 3-Interaction with manager-employee problem solving ("If there is a problem, managers & employees solve it together.")		
Job demands		
Low		1.00
High		1.21 (0.94 to 1.54)
Manager-employee problem solving		
Strongly disagree, disagree, or no opinion		1.00
Agree or strongly agree		1.14 (0.79 to 1.64)
Job demands × manager-employee problem solving		
High demands × disagree/no opinion		1.00
High demands × agree		0.78 (0.54 to 1.14)
Model 4-Interaction with manager-employee socializing ("How often do managers & employees socialize outside of work?")		
Job demands		
Low		1.00
High		1.27 (0.98 to 1.64)
Manager-employee socializing		
Never, almost never, or sometimes		1.00
Often or very often		1.25 (0.86 to 1.82)
Job demands × manager-employee socializing		

High demands × not often	1.00
High demands × often	0.72 (0.49 to 1.04)
Model 5 -Interaction with employee advice-seeking (“How often do employees come to manager to seek advice?”)	
Job demands	
Low	1.00
High	1.28 (0.99 to 1.66)
Employees seek advice from managers	
Never, almost never, or sometimes	1.00
Often or very often	0.98 (0.70 to 1.38)
Job demands × employees seek advice from managers	
High demands × not often	1.00
High demands × often	0.72 (0.50 to 1.04)

Odds ratios (ORs) and their 95% confidence intervals (CIs) from multilevel logistic regression models are shown. Number of workers = 1737; number of worksites = 26.

* Adjusted for age, gender, race/ethnicity, education, language acculturation, and occupational status.

Table 5

ORs and CIs of smoking from multilevel adjusted* logistic regression models assessing the interaction between job strain categories and aggregated social capital

Model 1-Interaction with aggregated social capital (summary measure)	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	2.30 (1.41 to 4.09)
Passive (low demands-low control)	1.18 (0.68 to 2.04)
High strain (high demands-low control)	2.26 (1.28 to 4.00)
Aggregated social capital	
Low	1.00
High	1.37 (0.76 to 2.50)
Job strain × aggregated social capital	
Low strain × high social capital	1.00
Active × high social capital	0.40 (0.20 to 0.78)
Passive × high social capital	1.01 (0.51 to 2.00)
High strain × high social capital	0.58 (0.27 to 1.24)
Model 2-Interaction with co-worker helpfulness ("People I work with are willing to help each other.")	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.34 (0.94 to 1.91)
Passive (low demands-low control)	1.17 (0.78 to 1.75)
High strain (high demands-low control)	1.41 (0.96 to 2.07)
Co-worker helpfulness	
Disagree or no opinion	1.00
Agree	0.84 (0.51 to 1.38)
Job strain × co-worker helpfulness	
Low strain × agree	1.00
Active × agree	0.75 (0.46 to 1.21)
Passive × agree	0.98 (0.56 to 1.70)
High strain × agree	0.73 (0.41 to 1.27)
Model 3-Interaction with co-worker trust ("I trust the people I work with.")	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.32 (0.93 to 1.88)
Passive (low demands-low control)	1.22 (0.82 to 1.82)
High strain (high demands-low control)	1.35 (0.92 to 1.97)
Co-worker trust	
Disagree or no opinion	1.00
Agree	0.81 (0.50 to 1.31)
Job strain × co-worker trust	
Low strain × agree	1.00

Active × agree	0.77 (0.47 to 1.24)
Passive × agree	0.89 (0.51 to 1.55)
High strain × agree	0.80 (0.46 to 1.40)

Model 4-Interaction with trust in managers (“Managers look out for the people who work here.”)

Job Strain

Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.85 (1.16 to 2.95)
Passive (low demands-low control)	1.15 (0.67 to 1.97)
High strain (high demands-low control)	1.89 (1.14 to 3.11)

Trust in managers

Disagree or no opinion	1.00
Agree	1.20 (0.76 to 1.91)

Job strain × trust in managers

Low strain × agree	1.00
Active × agree	0.52 (0.30 to 0.90)
Passive × agree	1.05 (0.56 to 1.97)
High strain × agree	0.50 (0.27 to 0.93)

Odds ratios (ORs) and their 95% confidence intervals (CIs) from multilevel logistic regression models are shown. Number of workers=1737; number of worksites= 26.

* Adjusted for age, gender, race/ethnicity, education, language acculturation, and occupational status.

Table 6

ORs and CIs of smoking from multilevel adjusted* logistic regression models assessing the interaction between job strain categories and contextual social capital

Model 1-Interaction with contextual social capital (summary measure)	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.88 (1.22 to 2.88)
Passive (low demands-low control)	1.40 (0.91 to 2.16)
High strain (high demands-low control)	2.09 (1.30 to 3.35)
Contextual social capital	
Low	1.00
High	1.39 (0.82 to 2.35)
Job strain × contextual social capital	
Low strain × high social capital	1.00
Active × high social capital	0.47 (0.25 to 0.89)
Passive × high social capital	0.64 (0.33 to 1.22)
High strain × high social capital	0.54 (0.25 to 1.16)
Model 2-Interaction with close-knit workplace ("This is a close-knit workplace.")	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.45 (1.06 to 1.98)
Passive (low demands-low control)	1.40 (0.98 to 2.00)
High strain (high demands-low control)	1.47 (1.04 to 2.08)
Close-knit workplace	
Strongly disagree, disagree, or no opinion	1.00
Agree or strongly agree	1.13 (0.72 to 1.77)
Job strain × close-knit workplace	
Low strain × agree	1.00
Active × agree	0.56(0.34 to 0.91)
Passive × agree	0.61 (0.34 to 1.07)
High strain × agree	0.61 (0.34 to 1.09)
Model 3-Interaction with manager-employee problem solving ("If there is a problem, managers & employees solve it together.")	
Job Strain	
Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.34 (0.92 to 1.96)
Passive (low demands-low control)	1.40 (0.97 to 2.02)
High strain (high demands-low control)	1.30 (0.85 to 2.00)
Manager-employee problem solving	
Strongly disagree, disagree, or no opinion	1.00
Agree or strongly agree	0.68 (0.42 to 1.10)
Job strain × manager-employee problem solving	
Low strain × agree	1.00

Active × agree	0.71 (0.40 to 1.23)
Passive × agree	0.69 (0.39 to 1.24)
High strain × agree	0.83 (0.67 to 1.04)

Model 4-Interaction with manager-employee socializing (“How often do managers & employees socialize outside of work?”)

Job Strain

Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.35 (0.92 to 1.99)
Passive (low demands-low control)	1.56 (1.07 to 2.28)
High strain (high demands-low control)	1.43 (0.92 to 2.22)

Manager-employee socializing

Never, almost never, or sometimes	1.00
Often or very often	0.62 (0.38 to 1.00)

Job strain × manager-employee socializing

Low strain × often	1.00
Active × often	0.71 (0.41 to 1.24)
Passive × often	0.55 (0.31 to 0.97)
High strain × often	0.83 (0.67 to 1.03)

Model 5-Interaction with employee advice-seeking (“How often do employees come to manager to seek advice?”)

Job Strain

Low strain (low demands-high control)	1.00
Active (high demands-high control)	1.30 (0.87 to 1.95)
Passive (low demands-low control)	1.43 (0.97 to 2.11)
High strain (high demands-low control)	1.09 (0.72 to 1.66)

Employees seek advice from managers

Never, almost never, or sometimes	1.00
Often or very often	0.61 (0.38 to 0.98)

Job strain × employees seek advice from managers

Low strain × often	1.00
Active × often	0.78 (0.45 to 1.37)
Passive × often	0.70 (0.40 to 1.23)
High strain × often	0.84 (0.67 to 1.04)

Odds ratios (ORs) and their 95% confidence intervals (CIs) from multilevel logistic regression models are shown. Number of workers=1737; number of worksites= 26.

* Adjusted for age, gender, race/ethnicity, education, language acculturation, and occupational status.