

# Job Strain Predicts Survey Response in Healthcare Industry Workers

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**Objectives** *To examine the effect of job strain on survey response.*

**Methods** *1,613 health care workers received a self-administered questionnaire. Thirty percent of them completed the survey on personal time without any personal monetary compensation. Working conditions were extracted by job title from the national database O\*NET 6.0. Job strain was defined as the ratio of job demands to job control. Two complementary models (multi-level logistic and binomial pseudo Poisson regressions) were used to model individual survey response as a function of individual level demographic variables (age and gender), job-level socioeconomic status (SES) and job strain, and facility type (third level).*

**Results** *Survey response was associated with higher SES and with less job strain. The association of SES and survey response was mediated by job strain.*

**Conclusion** *Employees' exposure to job strain may be an important influence on survey response, at least for workers who are not compensated for their time in completing a survey.* Am. J. Ind. Med. 51:281–289, 2008. © 2008 Wiley-Liss, Inc.

**KEY WORDS:** *job strain; healthcare industry; survey response; socio-economic status; non-response bias*

## INTRODUCTION

During the last decades, questionnaire survey responses have been steadily declining [Astroic et al., 2001; Steeh

et al., 2001]. The cause for this is not known [Warriner et al., 1996] and the main obstacle to studying it is the absence of information about non-respondents. Studies in cohorts have compared respondents to the second wave using information collected in the first wave, finding that in comparison to non-respondents to the second wave, respondents were older, white, more educated, married or female; decision latitude, skill discretion, and job demands were found not significantly associated with survey response [Goodman and Blum, 1996]. A qualitative study in UK links lack of response from general practitioners to being too busy at work [Kaner et al., 1998]. Other studies have established that response probability is related to gender and occupation (with females over-represented in faculty jobs and male over-represented in clerical jobs) [Richman et al., 2004], varied by attitudes toward surveys or workplace and personality [Rogelberg and Luong, 1998; Rogelberg et al., 2000, 2003] and, in particular, is lower in low socioeconomic groups [Vernon et al., 1984; Goldberg et al., 2001; Goyder et al., 2002].

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The relationship between socioeconomic status (SES) and working conditions is one possible explanation of low survey response in low SES employees. Low SES employees work more overtime [Golden and Wiens-Tuers, 2005] and have worse working conditions in terms of physical workload, low decision latitude, and chemical exposure [Lipscomb et al., 2006]. Thus, people in low SES jobs may have less time, more fatigue and/or less motivation to participate in additional work-related activities, including answering surveys. According to the Demand/Control model, such deleterious psychosocial working conditions may impact employees' behaviors through decreased learning and social participation [Karasek and Theorell, 1990]. For example, Lindstrom [2005] found a positive association between high SES and low job strain with high participation in fourteen different social activities.

Specifically in healthcare personnel, absence of non-response bias has been reported in a study likely affected by social desirability and lack of statistical power [Thomsen, 2000] and in other that does not compare respondents with non-respondents [Bourbonnais et al., 1999]. With the current situation of financial pressures and understaffing of the healthcare industry [Nicholson et al., 2005], research based on surveys can be affected if there is differential survey response by levels of job strain. The immediate consequence would be over-representation in the findings of low strain employees at the expenses of under-representing employees highly exposed to stressful jobs. If non-respondents have worst mental [Vink et al., 2004] and cardiovascular [Hoeymans et al., 1998; Barchielli and Balzi, 2002] health than respondents, another important consequence would be an underestimation of the association between job strain and ill health.

We have conducted a study on healthcare workers in which survey response showed a negative gradient by SES. We hypothesized that this might be the consequence of a SES gradient in exposure to stressful working conditions, with the lowest SES workers being exposed to the most stressful jobs.

## METHODS

### Sample

A total of 1,613 adult healthcare employees at three facilities in Massachusetts, USA, received a confidential questionnaire with informed consent and postage-paid return envelope at their work or home addresses during the period from May, 2003 to April, 2004. Non-response to the first distribution was followed up by checking employment status and postal address (if applicable) and re-sending the questionnaire. The facilities also distributed publicity about the survey. The survey asked about occupational history, current work schedule, working conditions (exposure to physical, chemical, postural, and psychosocial hazards),

health status (injuries and diseases), and demographic information (race, gender, date of birth, etc.). There was a lottery with five \$100 cash prizes for those who returned the survey. All questionnaires had to be completed on personal time.

Each facility provided its personnel roster including each employee's identification number, job title, hourly wage, gender, and date of birth. All job titles listed were coded by a trained expert using U.S.2000 Standard Occupational Classification (SOC) codes. Each SOC code was double-checked and matched to its Nam-Powers score [Nam and Terrie, 1988] as well as to the corresponding O\*NET code [What is O\*NET, 2005] (see below).

This study was approved by University of Massachusetts Lowell Institutional Review Board to protect Human subjects.

### SES Measures

Hourly wage information was available at the employee level from the roster. The Nam-Powers score is a U.S. nationally representative index derived from the most recent U.S. census data. Each SOC-coded occupational title is assigned the national percentiles of median income and education of all incumbents in that category [Nam and Terrie, 1988]. The Nam-Powers score is the average of these two values and ranges from 1 (lowest) to 100 (highest). It was divided by 10 to allow the regression coefficients represent 10-point change in the original scale. "PHASE SES" was developed by the study team based on the occupation's relative level of responsibility within the institutional hierarchy and the minimum required education for the incumbent. It has five levels: semi-skilled (level 1), skilled (2), semiprofessional (3), professional (4), and administrator (5).

### Working Conditions and Job Strain

O\*NET [Production database O\*NET 6.0NET, 2005] is a national database containing occupation-level descriptors, some of which were used as indicators of exposure to psychosocial working conditions. O\*NET variables were merged with the questionnaire-roster database, assigning to each job title its corresponding O\*NET scores. Forty-four individual SOC codes that had none or more than one match in the O\*NET database were individually reviewed and a single O\*NET code was selected for each.

The indicators of working conditions selected for analysis corresponded to the domains of psychological demands and control (decision authority plus skill discretion) and job rewards. All selected items were expressed as the percentage of their maximum value of their original scale. Psychosocial job strain was taken as the ratio of demand to control, as a proxy for the demand-control model [Karasek

et al., 1998]. A proxy effort reward ratio was computed as the ratio of demand on rewards [Institut fur Medizinische Soziologie University of Duesseldorf, 2002; Siegrist et al., 2004].

O\*NET psychosocial scales had a high level of absolute agreement with scales based on individual survey responses [Cifuentes et al., 2007] as well as predictive validity for injuries in this same population of healthcare workers [d’Errico et al., 2007].

### Statistical Analyses

The dependent variable was survey response (yes/no) at the individual level, where non-respondents were all employees on work-force rosters from whom questionnaires were not received.

Independent variables were grouped in three categories. First, demographic variables included age (years), gender (male/female), and type of facility (hospital/nursing home). Second, SES included PHASE SES (ordinal), Nam-Powers score (continuous), and hourly wage (continuous). The third category included O\*NET based job strain (continuous) and other O\*NET based psychosocial working condition indicators.

For multi-level modeling, the three levels of analyses were worker, job, and facility. Using MLWin 2.0 [Rasbash et al., 2005], models were fit using these three levels with binomial distribution and logit as the link function to obtain odds ratios in logistic regression. Iterative generalized least squares and 2nd order linearization with penalized quasi-likelihoods for linear approximation transformation were utilized to obtain initial values used as input to perform Monte Carlo Markow Chain estimation (50,000 iterations), which was needed because the third level in the multilevel analyses had only three facilities. Bayesian deviance indicator criteria (DIC) were used to compare models.

Although the focus was on evaluating the simultaneous effect of SES and working conditions on survey response, a second series of models was also computed using as effect indicator prevalence ratios instead of odds ratios to obtain a more conservative estimate. Odds ratios can overestimate the magnitude of the effect when the occurrence of the outcome is higher than 10% [Adams et al., 1998]. With this purpose, all the models were reproduced using PROC GLIMMIX in SAS 9.1; there was no third level in this series and it also did not have Monte Carlo Markow Chain estimation. -2 residual log pseudo-likelihood was used as model fit indicator.

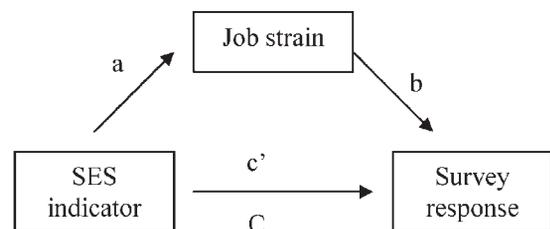
The first multilevel model included only the three demographic variables (demographic model). The second set of models included the significant ( $\alpha \leq 0.05$ ) demographic variables plus one SES indicator at a time. The third set of models added O\*NET job strain (or the other psychosocial variables) to every second models. Interactions within and

between levels were explored. The intercept was defined as random; independent variables were defined as fixed. Variables stayed in the model if they changed other variables’ coefficients by at least 15% of their values, were statistically significant ( $P < 0.05$ ), were the main effect of a significant interaction term [Nelder, 1998], or had descriptive relevance for the interpretation.

### Mediation Analyses

After checking for interaction between SES (primary exposure) and exposure variable (mediator) on survey response, two mediation models (one for each SES indicator that included education among its components: Nam-Powers and PHASE-SES) were tested using the joint significance of the “a” and “b” regression coefficients (Fig. 1) [MacKinnon et al., 2002]. “SES-survey response” and “working conditions—survey response” regression coefficients were obtained from the multilevel analyses. A job-level linear regression (using generalized linear models) tested the SES-working conditions association assuming that the education component of the two selected SES indicators preceded the employment and through this was partially the cause of job strain.

The magnitude of the mediated proportion (range 0–100%) was estimated as the difference between the odds ratios (OR) of SES indicator as precursor of survey response (“C” in Fig. 1) and the same OR adjusted for job strain exposure ( $c'$ ) all divided by the raw OR “C” minus 1 and multiplied by 100 [Ditlevsen, 2004]. An estimation of mediated proportion variability was computed using the OR 95% confidence limits instead of the central OR values. The same process was used with prevalence ratios from the second series of models. Because of the utilization of three levels and Monte Carlo Markow Chain estimation, the relative size of the different values from the series of logistic regression models was considered more precise than those obtained from the binomial Poisson regression models; therefore, the former were given priority over the last for the computation of the mediated proportion.



$$\text{Mediated proportion} = [ (C - c' / C) ] * 100$$

**FIGURE 1.** Formal testing of mediation effect model [adapted from MacKinnon et al., 1995].

## RESULTS

Of the entire target population, 29.5% answered the questionnaire. The study population consisted primarily of white, middle-aged women, most working as nurses and nursing assistants but including 86 different jobs under the O\*NET coding system. In general, non-respondents had lower indicators of SES and more stressful working conditions than respondents (Table I). The overall response rate was similar in the nursing homes (32.3%) and the hospital (28.8%) and was progressively higher in the high SES jobs.

The three indicators of SES were highly correlated with each other at the occupational level: Nam-Powers score with PHASE SES (Spearman correlation coefficient = 0.77,  $P < 0.001$ ); Nam-Powers with hourly wage ( $r = 0.80$ ,  $P < 0.001$ ); and PHASE SES with hourly wage ( $r = 0.84$ ,  $P < 0.001$ ).

The two dimensions of the demand-control model were correlated in the expected direction ( $r = 0.377$ ,  $P < 0.0001$ ). All three indicators of SES had consistent associations with each of the psychosocial scales (Table II), with psychosocial conditions being improved, except for psychological demands, at higher SES levels and the strongest such correlation for job control.

## Multilevel Analyses of Survey Response

Survey response increased with age and was similar for gender and type of facility (see Table III). Age and gender represented the base model where the effect of SES and working conditions on survey response was studied. The effect of age and gender in the basic model was unchanged across all subsequent models.

The effect of SES on survey response was similar among the three indicators, although the hourly wage gave the best fit according to the BDIC (last row in Table III).

Job strain had a very strong inverse association with survey response when added to the base multilevel model (OR = 0.12,  $P = < 0.0001$ ). Its effect was almost as large when added to any of the models with SES included. The odds ratio for SES was reduced and not longer statistically significant in each of the three models when job strain was added. Bayesian deviance information criteria showed a better fit of the data when job strain was included in the models.

Using the combined criteria of OR confidence interval and BDIC, all three models were judged to have a similar good fit. No other component of job strain was statistically significant when added to the model containing SES.

**TABLE I.** Univariate Multilevel Logistic Regression Models

Demographic and occupational characteristics	Non-responders (n = 1,137)	Responders (n = 476) 29.5%	Significance of difference
			between both columns (two sides <i>P</i> -value) <sup>a</sup>
Age (years): mean	41.7 (18.1–74.8)	44.9 (18.5–77.4)	<0.001
Gender (% women)	78.0	82.5	0.045
Non-white or latino (%)	11.6	5.1	<0.001
Weekly hours at work (scheduled) <sup>b</sup> : mean	25.0 (0.0–40.0)	26.8 (0.0–40.0)	0.069
Hired as per diem <sup>b</sup> (%)	25.4	20.3	0.038
Work in a nursing home (not hospital) <sup>b</sup> (%)	19.0	21.6	0.244
PHASE SES category (%)	1 (low), 10.3%	1 (low), 7.4%	0.004
	2, 37.7%	2, 30.1%	
	3, 20.9%	3, 23.7%	
	4, 27.5%	4, 33.8%	
	5 (high), 3.6%	5 (high), 5.0%	
Job hourly wage (US\$): mean	\$19.7 (8.0–120.0)	\$20.9 (8.7–102.0)	0.222
Nam-Powers score: mean	53.3 (2–100)	59.1 (2–100)	<0.001
Job strain ratio <sup>c</sup> : mean	0.45 (0.18–0.67)	0.42 (0.18–0.67)	<0.001
Psychological demands <sup>c</sup> : mean	57.1 (28.3–76.0)	57.5 (28.3–73.0)	0.565
Decision authority <sup>c</sup> : mean	50.2 (29.1–89.1)	53.8 (29.1–85.7)	<0.001
Skill discretion <sup>c</sup> : mean	64.0 (22.4–95.0)	67.8 (22.4–92.4)	0.003

Descriptive data on 1,613 healthcare employees (one hospital and two nursing homes) recruited for survey.

<sup>a</sup>From univariate multilevel logistic models for continuous independent variables; Chi-square statistic for categorical variables.

<sup>b</sup>From facility personnel rosters.

<sup>c</sup>Derived from O\*NET 6.0.

**TABLE II.** Spearman Correlation Coefficients Between Job-Level Indicators of Age, Gender (Proportion of Men), O\*NET Based Variables and SES Indicators

	Gender	Age	Psychological demands	Job control	Job rewards	Job strain	Effort reward imbalance
Age	0.051, <i>P</i> = 0.5884						
Psychological demands	0.016, <i>P</i> = 0.8760	-0.221, <i>P</i> = 0.0217					
Job control	-0.087, <i>P</i> = 0.3837	-0.066, <i>P</i> = 0.5107	0.377, <i>P</i> < 0.0001				
Job rewards	-0.067, <i>P</i> = 0.5036	-0.104, <i>P</i> = 0.2954	0.437, <i>P</i> < 0.0001	0.874, <i>P</i> < 0.0001			
Job strain	0.087, <i>P</i> = 0.3822	-0.107, <i>P</i> = 0.2803	0.189, <i>P</i> = 0.056	-0.779, <i>P</i> < 0.0001	-0.600, <i>P</i> < 0.0001		
Effort reward imbalance	-0.004, 0.9642	-0.232, <i>P</i> = 0.0183	0.709, <i>P</i> < 0.0001	-0.212, <i>P</i> = 0.031	-0.218, <i>P</i> = 0.027	0.643, <i>P</i> < 0.0001	
PHASE SES	0.036, <i>P</i> = 0.7006	0.030, <i>P</i> = 0.7503	0.345, <i>P</i> = 0.0003	0.826, <i>P</i> < 0.0001	0.739, <i>P</i> < 0.0001	-0.619, <i>P</i> < 0.0001	-0.142, <i>P</i> = 0.152
Nam-Powers	-0.070, <i>P</i> = 0.4596	-0.037, <i>P</i> = 0.6913	0.385, <i>P</i> < 0.0001	0.838, <i>P</i> < 0.0001	0.828, <i>P</i> < 0.0001	-0.559, <i>P</i> < 0.0001	-0.154, <i>P</i> = 0.121
Hourly wage	0.023, <i>P</i> = 0.8065	-0.057, <i>P</i> = 0.5472	0.280, <i>P</i> = 0.003	0.616, <i>P</i> < 0.0001	0.592, <i>P</i> < 0.0001	-0.443, <i>P</i> < 0.0001	-0.076, <i>P</i> = 0.447

The results using prevalence ratios were qualitatively similar to the odds ratios although the prevalence ratios values were more conservative (not shown).

There was no significant interaction between SES measures and job strain in logistic regression models. Job strain mediated about 30.8–100.0% of the effect of a SES indicator on survey response (Table IV).

In the series of binomial modified Poisson regression models, the mediated proportions were slightly higher than in the logistic regression models with a range from 39.1% to 100% (not shown).

**DISCUSSION**

In this population of healthcare workers, three different measures of SES were highly positively correlated with each

other, as anticipated. Survey response was positively associated with SES. In addition, survey response decreased with the increase in psychosocial job strain (demand/control ratio). There was evidence that the relationship between SES (using the two indicators which included education) and survey response was mediated by job strain. The results were the same using two different types of regression models. The components of job strain were not associated with survey response.

These findings emphasize the importance of considering how job strain can affect research performed in industrial settings and based on surveying workers. Those who are most affected by job strain will have lower representation in the survey results and, eventually, the association between job strain and the health outcome will be underestimated.

**TABLE III.** Multilevel Modeling of Survey Response on Demographics, Socioeconomic Status, and Job Strain

Variable (unit or reference)	Model 1, OR (95% CI)	Model 2, OR (95% CI)	Model 3, OR (95% CI)	Model 4, OR (95% CI)	Model 5, OR (95% CI)	Model 6, OR (95% CI)
Age (10 years)	1.28 (1.16, 1.42)	1.27 (1.15, 1.40)	1.27 (1.15, 1.40)	1.26 (1.14, 1.39)	1.28 (1.16, 1.42)	1.25 (1.11, 1.40)
Gender (ref: women)	0.98 (0.72, 1.35)	1.06 (0.76, 1.49)	1.01 (0.74, 1.39)	1.05 (0.75, 1.47)	1.07 (0.78, 1.46)	1.06 (0.76, 1.49)
PHASE SES (1 category)	1.18 (1.05, 1.32)	0.95 (0.82, 1.10)				
Nam-Powers score (10 points)			1.10 (1.04, 1.15)	0.99 (0.93, 1.07)		
Hourly wage (US \$1)					1.01 (1.00, 1.02)	1.01 (0.99, 1.02)
Job strain (1 point)		0.10 (0.04, 0.29)		0.12 (0.04, 0.36)		0.16 (0.06, 0.43)
Bayesian deviance information criteria value	1,813.13	1,671.06	1,801.64	1,672.86	1,799.20	1,672.81

Multilevel logistic regression (n = 1,613 healthcare workers).

**TABLE IV.** Adjusted for Age and Gender Analysis of Job Strain as Mediator Between SES Indicators and Individual Survey Response (n = 1,613 Healthcare Employees)

SES indicators	Odds ratio for response rate on SES (95% confidence interval) C <sup>a</sup>	Regression coefficient for job strain on SES (P-value) a <sup>a</sup>	Odds ratio for response rate on job strain, adjusted for SES (95% confidence interval) b <sup>a</sup>	Odds ratio for response rate on SES, adjusted for job strain (95% confidence interval) c <sup>a</sup>	Mediated proportion (%) (range of possible values)
PHASE SES	1.18 (1.05, 1.32)	-0.07 (<0.0001)	0.10 (0.04, 0.29)	0.95 (0.82, 1.10)	100.0 (42.7, 100.0)
Nam-Powers score (10 points)	1.10 (1.04, 1.15)	-0.03 (<0.0001)	0.12 (0.04, 0.36)	0.99 (0.93, 1.07)	100.0 (30.8, 100.0)

<sup>a</sup>See Figure 1.

The results of this study partially support Karasek's hypothesis that active learning (and thus social participation) results from higher job control (skill discretion and decision authority), since control was associated with survey response. Although psychological demands were not associated with survey response, there was a significant multi-level linear association between job strain (psychological demands divided by job control) and survey response. This implies support for the strain hypothesis, that is, that job strain produces fatigue or other health effects that might reduce participation. Surprisingly, despite the strong association between the components of job control and survey response, when controlling for SES this association was no longer significant. This finding decreases the partial support for the active learning hypothesis.

The positive association between SES and community survey response has been well documented; it is also known that SES predicts higher response to surveys performed within organizations [Brennan, 1992]. There is no clear understanding of why this SES trend occurs so systematically. In the past, illiteracy has been mentioned as a reason, but telephone interviews show the same SES gradient [Goyder et al., 2002].

Although the association between job strain and survey response could be the mechanism that associates SES to survey response, it deserves further investigation. Kohn and Schooler [1983] showed that working conditions affected the way that employees feel, believe, and behave. The Demand/Control model introduced a theory to evaluate the impact of working conditions on employees' participation on social activities beyond the workplace [Karasek and Theorell, 1990]. Alternate explanations may include confounding or other intermediate variables between job strain and survey response, such as fatigue or ill-health caused by exposures other than job strain. There is evidence that those employees who are exposed to high job strain are also exposed to worse physical, chemical, or other deleterious working conditions (e.g., biomechanical load, dust or vapors, workplace discrimination, work-family imbalance, etc.) [MacDonald et al., 2001]. It is possible that one or more of those other

exposures influence the willingness or the ability of a high strain job worker to answer a survey.

In this study, job strain components from O\*NET were examined individually and none of them was significantly associated with survey response when SES, which remained significant, was included. This negative finding reinforces the theoretical foundation of the demand control model that emphasizes the importance of the combination of high psychological demands and low control over the job.

Within this sample, two employees of the same age (median value = 43.3 years old), one with the lowest and the other with the highest observed values of job strain but with the same Nam-Powers SES (median value = 57.44), have different survey response probability. The employee in the lowest strain job would have a probability of answering the survey equal to 0.60 and the employee in the highest strain job will have a probability equal to 0.23. Thus, the observed range of job strain has the potential to reduce the probability of survey response to one-third. However, even with the most extreme cases used in these exercises, the maximum survey response is about 60%, indicating the limits of the predictive power of our model.

Our results provide support for a significant association of job strain with survey response when controlling for either SES indicator and also provide a rationale for formally testing for the mediation effect of job strain. If there is interaction between both precursors (SES and exposure to work stress) this process of estimating mediation is not reliable [MacKinnon, 2000; MacKinnon et al., 2002; Ditlevsen, 2004], but our analyses ruled out such interactions. Additionally and because SES indicators that included education are assumed to be precursors of job strain, the models do not assess a confounding effect but a mediation one [MacKinnon et al., 2000, 2002]. Although the causal association between the SES indicators used in the mediation analyses and job strain is tenuous, education has time precedence over job strain and both SES indicators could be considered proxies for education. Further studies specifically using attained educational level would be desirable in order to elucidate better the true causal pathway.

## Internal Validity

Job strain is most often studied using the Job Content Questionnaire [Karasek et al., 1998]. The O\*NET based measure is a novel indicator of job-level exposure to high demands relative to control. There are two main potential sources of misclassification in this measure of job strain. First, the O\*NET database has information about job titles regardless of economic sector [What is O\*NETONET, 2005]. This implies misclassification of exposure if the same job titles have very different characteristics in different sectors, in which case any association with job characteristics would likely be biased towards the null. Just 30 of the 86 job titles in our sample are classified as specific healthcare jobs by O\*NET. Thus it is possible that misclassification secondary to between-sector variability impacted these results.

The second eventual source of misclassification is related to the fact that the reliability of the O\*NET ratings have yet to be evaluated. All O\*NET scores used in this study were assigned by expert analysts. Also, the composite O\*NET job strain scale was built from data gathered to describe jobs for the job market instead of to evaluate exposure [Production database O\*NET 6.0NET, 2005]. O\*NET analysts or survey respondents might have had different issues in mind, modeled by the context in which each individual question was presented. If any of these resulted in misclassification, the true associations would likely have been reduced by non-differential error. As referenced in the Methods Section, the validity of O\*NET in this population has been already tested [Cifuentes et al., 2005; d'Errico et al., 2007].

The study findings refer to job-level exposure to job strain, not individual level exposure. Therefore, although theoretically inconsistent, it is possible that within each job title those workers with higher levels of strain could have had higher survey response rates. These findings did not demonstrate either that individual exposure to job strain decreases survey response, although it is the most likely mechanism. These two multilevel fallacies would be a misunderstanding from these findings that refer to job level exposure.

## External Validity

The three participant facilities are all non-unionized facilities in Massachusetts, USA. More than two thirds of the targeted employees were hospital workers. There were non-significant differences in overall survey response among type of facility. The Bayesian approach was useful to include facilities as the third level of analysis, but generalization of these results to other healthcare facilities should be done with caution. Similarly, this sample was rather homogenous in terms of gender, age, and ethnicity; the effects reported here may vary in other populations. In addition, the

healthcare sector is known to be experiencing extreme financial and staffing pressures [Albion et al., 2005], which might lead to particularly strong effects of job strain on employees.

On the other hand, the fact that there are varied sources of data is an important strength of this study. The utilization of O\*NET as a nationally wide database enhances the generalizability of our findings. In addition, the demographic and dependent variables are unlikely to be misclassified and the findings were rather consistent across the SES indicators.

## Additional Aspects of Low Survey Response

This study does not address issues that could have decreased survey response to the same extent in all of the target population. For example, there was no possibility to determine whether the study design, the quality or the length of the questionnaire, the survey topics, or the high level of financial pressure in the healthcare sector could have resulted in a low response rate. This unexplained portion of survey non-response could explain why our simulation of optimal conditions for response does not reach a probability higher than 0.60. In other words, an intervention to improve response would not be sufficient if it only addressed job strain. In particular, response would likely have been higher with surveying workers on paid work time or offering monetary incentives or time compensation for participation [Warriner et al., 1996].

## CONCLUSION

This study is one of the firsts to measure working conditions by using the new, nation-wide O\*NET database and introduces a new operational tool to measure job strain from that database. Despite likely misclassification, job-level strain from this database predicted response to a workplace survey and mediated the effect of SES on response. The selection bias produced by low response of the most exposed workers might weaken the external validity of an occupational health survey and it could also affect the internal validity of the study by decreasing the observed association between exposure to job strain and ill health (i.e., bias toward the null). This study finding also allows a rethinking of strategies to improve response rate, by taking into account job strain (and by extension working conditions in general) when planning to survey a working population. It is possible to argue that under different general conditions, as for example monetary compensation for on work site survey participation, the survey response could be higher and the relative impact of job strain could be different.

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