Validity and Reliability of a Work History Questionnaire Derived From the Job Content Questionnaire

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Job design risk factors for hypertension and heart disease have often been assessed by the Job Content Questionnaire (JCQ). Job characteristics are typically assessed only once, however, which can result in misclassification and bias results toward the null. Newer approaches, which assess job characteristics over a working life, are hampered by the need to ask numerous questions about each job, increasing survey length and potentially reducing response rates. Participants in the Work Site Blood Pressure Study, a prospective study of psychosocial factors and ambulatory blood pressure, completed the JCQ about their current jobs. At later dates, 213 employed men, a subset of the original cohort, retrospectively completed the Work History Questionnaire (WHQ), a short version of the JCQ, for each past job. The WHQ exhibited moderate validity for assessing past job characteristics, a weak association with systolic blood pressure, and expected patterns of change over time. Thus, it may be a valuable tool for measuring the health effects of historical job characteristics, which often change over time. (J Occup Environ Med. *2002; 44:1037–1047*)

Job strain, defined as the combination of high psychological job demands and low job decision latitude or low job control, has been shown to be a risk factor for cardiovascular disease (CVD), and for blood pressure (BP) elevation, when BP is measured with an ambulatory (portable) monitor.[1–3]

Many studies likely underestimate the effect of job strain since, in most studies, however, job strain was measured at only one point in time.[2,3] It is hypothesized that chronic biological arousal due to sustained job strain contributes to the development of essential hypertension.[4] Use of current exposure as a surrogate for lifetime exposure is inaccurate, in part, since people often gain skills with time and age, may be promoted, may select out of "high strain" jobs, or their job characteristics may change even within the same job title. Many participants with a lengthy history of job strain might thus be currently classified as having no job strain because of recent promotions or other job changes. Use of inaccurate measures of job strain exposure can result in nondifferential misclassification and bias results toward the null hypothesis.

Measurement of job characteristics over the course of a person's work life would reduce misclassification and allow us to test hypotheses about the temporal association between job strain and BP elevation. What is the effect of duration of exposure on job strain? Are induction periods long or short? After

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TABLE 1
Numbers of eligible subjects entering the WSBPS in New York City and participation in the work history sub-study

Time at entry	Year at entry	Work site blood pressure study Men	Women
Time 1	1985–1988	283	25
Time 2	1988–1991	7	54
Time 3	1991–1995	6	97
TOTAL		296	176
		Work history sub-study (1991–1995)	
Eligible subjects participating at Time 3		222	161
		Work History sub-study subjects with complete data (1991–1995)	
Time 1	1985–1988	201	20
Time 2	1988–1991	6	44
Time 3	1991–1995	6	93
Eligible subjects with complete data		213	157

removal of exposure, does BP return to baseline ("recovery") or is the process of elevation irreversible? If reductions are possible, how quickly do they occur?

There have been no intervention studies to date of job strain and BP, however, recent findings from the Work Site Blood Pressure Study (WSBPS) in New York City provide some indication of the effect of cumulative exposure as well as induction/recovery periods. Relative to men without job strain at either the first (Time 1) or second (Time 2) rounds of data collection, those with exposure at both Time 1 and Time 2, that is, "chronic exposure," had substantially higher systolic (11–12 mm Hg) and diastolic (6–9 mm Hg) ambulatory blood pressure (AmBP), an effect also much greater than the cross-sectional effects at Time 1 or Time 2 (6–7 mm Hg systolic and 2 to 5 mm Hg diastolic).[5] The two groups whose exposure changed over the 3-year follow-up period had intermediate levels of AmBP on both occasions.[5]

In contrast, prospective analyses do not provide evidence for the effect of cumulative exposure, ie, no significant or substantial change in AmBP in the chronic exposure group ($n = 15$) over 3 years. A possible explanation for the null results may be inferred from this group's high level of BP at entry into the study. If this group had been chronically exposed to job strain with resulting high BP levels at entry into our study, then additional job strain exposure may lead to little or no additional increase in AmBP, that is, a "saturation" effect.[5]

Therefore, to explain these conflicting findings, and to examine the effect of cumulative exposure to job strain on BP, we developed a Work History Questionnaire (WHQ) and administered it to participants in the WSBPS. Here, we report on the reliability and validity of the WHQ.

Methods

Participants in the WSBPS, a prospective study of psychosocial factors and AmBP, completed the Job Content Questionnaire (JCQ) about their current jobs.[6] At later dates, a subset of the original cohort retrospectively completed the shorter WHQ for their current job and all past jobs. The retrospective WHQ results are compared to the prospectively assessed JCQ results.

Sample

The WSBPS enrolled 472 initially healthy full-time employees from a wide variety of white-collar and blue-collar job titles in New York City.[5,7–9] Data are currently available for participants recruited during the first, second and third rounds of data collection (Table 1), from 10 New York City work sites, each employing at least 150 persons.

Sample selection procedures are described in detail elsewhere.[7,8] Briefly, after an initial casual BP screening of 3228 men at eight work sites, participants were eligible to be selected for the initial case-control study (before funding became available for the cohort study) if they were between 30 and 60 years old, were employed >30 hours/week, were able to read English, had a body mass index (BMI) (kg/m^2) <32.5, had no second job of 15 or more hours per week and had been at their current worksite for at least 3 years before being approached for this study and, if applicable, before being diagnosed as having high BP. Eligible cases were defined as participants with a mean casual diastolic BP (DBP) >85 mm Hg at both initial screening and recruitment or who were taking medication for hypertension. Those with a DBP ≤85 mm Hg on both occasions and not taking antihypertensive medication were eligible to serve as controls. Individuals at work sites 2 through 7 whose DBP crossed over (screening DBP >85 mm Hg and recruitment session DBP ≤85 mm Hg, or screening DBP ≤85 mm Hg and recruitment session DBP >85 mm Hg) were not invited to participate in the case-control study.[7]

Because the WSBPS was designed to assess predictors of BP in healthy adults, potential participants were excluded if they had a history of coronary, cerebrovascular, or peripheral vascular disease, electrocardiographic evidence of myocardial infarction, ischemia or atrial fibrillation, funduscopic changes, evidence of any secondary cause of hypertension, screening systolic BP (SBP) > 160 mm Hg or screening DBP > 105 mm Hg. From the screened sample, 1640 men were found to be eligible for the study,

165 cases and 1475 controls. Attempts were made to recruit all cases and a random sample of controls ($n = 297$). Some changes in the eligibility criteria were implemented at the eighth site.[5,8]

Few eligible screened men refused participation and, after excluding crossovers, 88 cases and 174 controls were enrolled in the case-control study. After the addition of 21 "crossovers," 283 male participants were eligible for cross-sectional analyses of BP at Time 1. An additional 7 men were recruited at Time 2 and 6 men at Time 3 (Table 1).

Ambulatory Monitoring and Medical Examination

At each round of data collection, participants wore an ambulatory BP monitor for 24 hours during a normal workday.[7] The monitor was programmed to take readings at 15 minute intervals during the day, and 30 to 60 minute intervals during the participant's normal hours of sleep. Each time the monitor inflated and recorded BP during waking hours, the participant was asked to remain as motionless as possible and then to record his or her activity, location, position, and mood in a diary. The diary information (ie, whether participants reported being at work, home, or sleep) was used to calculate average AmBPs for each location category. When fewer than five readings were obtained at work, at home or during sleep, the corresponding average was treated as missing data. Most averages, except during sleep, are based on many more than five readings.

Participants also received a routine medical examination, which included a full history, a physical examination, a 24-hour urine collection for electrolyte excretion, assessment of alcohol intake, current smoking history, and exercise habits. Height and weight were determined at the physical examination and BMI was calculated according to the formula—weight(kg)/height(m).[2]

Psychosocial Questionnaire

At each round of data collection, participants also completed a questionnaire packet, which included the JCQ to evaluate job strain, the Jenkins Activity Survey and a demographic questionnaire.

The JCQ is a widely used well-validated 49-item instrument based, in part, on questions drawn from the U.S. Quality of Employment Surveys (QES).[1,6,10] All JCQ items were scored on a Likert scale of 1 to 4. Value labels are "strongly agree," "agree," "disagree," "strongly disagree." The following JCQ job characteristics scales were utilized:

Job decision latitude (range 12–48), was the sum of two equally weighted subscales: (1) *skill utilization*, measured by six items (keep learning new things; can develop skills; job requires skill; task variety; repetitious (reverse scored); job requires creativity); and (2) *decision authority*, measured by three items (have freedom to make decisions; can choose how to perform work; have a lot of say on the job). Internal consistency reliability (Cronbach's alpha) was 0.83 and 3-year test-retest reliability was $r = 0.64$.

Psychological job demands (range 12–48) was defined by five items (excessive work; conflicting demands; insufficient time to do work; work fast; work hard). Internal consistency reliability was 0.74 for job demands, and 3-year test-retest reliability was $r = 0.64$.

Workplace social support (range 8–32) was the sum of 2 equal subscales: (1) *coworker support*, measured by four items (competent in doing their jobs; take a personal interest in me; friendly; helpful in getting job done); (2) *supervisor support*, measured by four items (concerned about the welfare of those under him; pays attention to what I am saying; helpful in getting job done; concerned about the welfare of those under him or her). Internal consistency reliability was 0.87 for supervisor support and 0.70 for coworker support. The 3-year test-retest reliability was only $r = 0.39$ for social support, however.

Job-related physical exertion was measured by a single JCQ item (job requires lots of physical effort). Three-year test-retest reliability was $r = 0.67$.

In addition, the following non-JCQ measures were also analyzed:

Demographic items included sex, race/ethnicity (White, Black, Hispanic and other), age (in years), education (in years), and job title.

The 52-item *Jenkins Activity Survey (JAS)*[11] was administered to evaluate type A behavior, and participants were classified as 'type A' if they scored above 0. The 3-year test-retest reliability was 0.70 (kappa).

Alcohol and smoking behavior was assessed by questionnaire at the time of the medical examination, with the responses reviewed by a nurse. Following the widely used survey of Cahalan et al,[12] alcohol consumption was based on two questions, representing frequency and quantity. *Regular drinking* was defined as binge drinking or drinking $\geq$4 to 6 days/week. Three-year test-retest reliability was 0.40 (phi coefficient). *Current smoking* was based on one question ("do you smoke cigarettes," yes/no) and was treated as a dichotomous measure. Three-year test-retest reliability was 0.66 (kappa).

Construction of Variable for Job Strain Exposure at Entry Into Cohort Study

The interaction between job demands and job decision latitude, which defines job strain, was modeled using the previously reported job strain "quadrant" term.[1,7,8] This is computed by dichotomizing demands and latitude at their respective sample medians for males. The dichotomous job strain variable was defined as job decision latitude <37 as well as job demands >32. Despite the relative stability of both continuous subscales, job strain is quite unstable over 3 years (kappa = .27).

Development of the Work History Questionnaire (WHQ)

To assess past job strain exposure, the first author developed a structured interview and questionnaire, the WHQ, which began by asking participants to list all previous full-time job titles that they have held, their employers, and the calendar years they held those positions. The interviewer then reviewed the list and questioned the participant about any inconsistent information or years not covered. It was felt that asking all 22 JCQ items for job demands, job decision latitude and social support for each past job would have been too time consuming. Thus, the participant then answered a set of six questions about each of the past jobs that he or she had held.

The set of six questions included two questions each on job demands, on decision latitude and on social support adapted from the JCQ. These six questions were chosen from the JCQ based on three criteria: content validity, criterion-related (predictive) validity, and construct validity. First, items chosen (in parentheses) clearly coincided in meaning with the original scale: job demands (work very hard, an excessive amount of work); job decision authority (a lot of say about what happened on the job); skill utilization (a high level of skill); supervisor support (a helpful supervisor); and coworker support (helpful coworkers). Second, demands and latitude items were chosen which correlated significantly with Time 1 systolic and diastolic blood pressure when a continuous (demands divided by latitude) job strain variable was utilized in correlations. Third, demands and latitude items were chosen which correlated highly with their original scale.

Work History Sample. Participants were recruited during the third round of WSBPS data collection (Time 3, 1991 to 1995). All Time 3 participants agreed to complete the WHQ, which included 210 eligible men initially enrolled in the cohort study at Time 1, 6 men enrolled at Time 2, and 6 men enrolled at Time 3 (Table 1). Due to errors in administration at the beginning of the work history sub-study, the WHQs of 9 men were incomplete and thus not useable. Therefore, there were 213 men with complete data available for the sub-study, 201 initially enrolled at Time 1, 6 enrolled at Time 2, and 6 enrolled at Time 3. The 213 men reported a total of 1040 past jobs, an average of 4.9 past jobs per man.

Work History Reliability. For the 213 men with complete data, internal consistency of the three two-item scales for all past jobs was high for job demands (Cronbach's $\alpha = 0.81$) but only borderline for job decision latitude ($\alpha = 0.62$) and workplace social support ($\alpha = 0.62$). To increase the reliability of the job decision latitude scale, two items were added after the first 94 men had completed the WHQ (based on the item selection criteria described above): "the freedom to decide how you do your work" was added to the decision authority subscale; "the chance to be creative" was added to the skill utilization subscale. Among the 119 men who answered all four latitude items, scale reliability increased to $\alpha = 0.84$. An additional 26 men were later re-interviewed with the expanded 8-item WHQ regarding the job they held at entry into the cohort study, to increase the sample size for assessing the validity of the WHQ. Therefore, 145 men had complete 4-item decision latitude scale data on the job they held at entry.

Construction of Job Strain Variable from WHQ scales. For *each* year of work life before entry into the WSBPS (43 years maximum), as well as for the job held at entry into the study, a job strain variable was constructed by dichotomizing job demands and job decision latitude at their respective medians. Thus, job strain was defined as decision latitude <6 ("disagree" with at least 1 of 2 decision latitude items; 44% prevalence for all jobs) and job demands >5 ("agree" with at least 1 of 2 job demands items; 52% prevalence for all jobs), resulting in a 19% prevalence of job strain for all jobs. For the job held at entry into the study, because the prevalence of latitude <6 had declined to 23%, however, the prevalence of job strain based on these cutpoints was only 9%. Therefore, for the purpose of validity testing, an additional version of the *job strain* variable was constructed, based on job demands >4 (77% prevalence for all jobs; 75% for the job held at entry into the study), resulting in a 15% prevalence of job strain for the job held at entry.

In addition, for men completing the four-item latitude scale, an additional two versions of the *job strain* variable were defined as job demands >5 or job demands >4 and decision latitude <12 ("disagree" with at least 1 of 4 decision latitude items). Finally, *high demands, low decision latitude,* and *low social support* measures were constructed for each past year of work life, based on the following cutpoints: demands >5, latitude <6, and support <6.

Work History Validity. First, *concurrent validity* was assessed by comparing (by correlation) the retrospective WHQ assessment of the job demands, decision latitude and social support in the job held by participants at entry into the study with the respective full JCQ scale completed by the participant at entry into the study. The Time 1 JCQ had been completed by most male participants between 1985 to 1988, approximately 6 years before they completed the WHQ. In addition, dichotomized versions of WHQ job demands, job decision latitude and workplace social support scales were compared (using the kappa statistic) to the respective dichotomized JCQ scales.

Second, the *predictive validity* of the WHQ measures of the job characteristics held by study participants at entry into the study were assessed by constructing dichotomous WHQ job strain measures as described ear-

lier. Linear regression analysis was used to determine the association between WHQ job strain measures and AmBP at entry into the study, controlling for age (years), education (years), race/ethnicity (White vs. other), BMI, current smoking status (yes/no), regular alcohol consumption (yes/no), and worksite. Analyses of systolic AmBP also control for a quadratic term of age.

Other potential confounders had near zero associations with AmBP [type A behavior ($r = 0.00$ to 0.06), job physical exertion ($r = 0.00$ to 0.02), and 24-hour urine sodium excretion ($r = -0.01$ to 0.04)], and thus these variables were not included as covariates.

Third, *construct validity* was examined in three ways:

(1) By comparing the *pattern of intercorrelations of the WHQ scales* to the pattern observed for the JCQ scales, that is, significant positive correlations between decision latitude and job demands, and decision latitude and social support, but not between job demands and social support.

(2) By examining the *pattern of change of job characteristics over the course of participants' work lives*. The mean level of job demands, decision latitude and social support for each past year of exposure (a maximum of 43 past years) was plotted over time. In a national survey of 2010 men conducted by the University of Michigan in the early 1970s,[13] age was positively associated with job demands (quantitative workload, $r = 0.26$) and job decision latitude (job complexity, $r = 0.17$; underutilization of skills, $r = -0.27$). Thus, we expect to observe an increase in decision latitude and job demands, and a decline in job strain over the course of participants' work lives. The observation of such expected patterns would indicate that participants' retrospective assessment of the characteristics of their past jobs was based, at least in part, on a valid recollection.

In addition, the pattern of change of job characteristics over time will be stratified by level of education dichotomized at the median ($\leq$14 years vs. $>$14 years.). Based on the positive association between job decision latitude and education, we expect to observe a greater history of low decision latitude among men with lower levels of education.

(3) By computing the *internal consistency reliability* of WHQ scales for each past job by the progression of jobs held by participants (first job through eighth job). If jobs earlier in participants' careers have poorer reliability than later jobs, this would provide evidence that poor or biased recall is affecting reporting of past job characteristics, thus limiting the validity of the WHQ.

Finally, to assess whether current exposure to job strain is a good or a poor proxy for past history of exposure, levels of agreement (by the kappa statistic) between current job strain and past job strain will be determined. Assuming that historical exposure information is valid, poor agreement would provide evidence for the utility of collecting historical information.

Missing Data

There are very few missing data for the participants included in this analysis. There are no missing data on Time 1 job strain or education. Those missing data on an AmBP measure or WHQ scale were excluded from the analyses of that measure. The modal category (or mean) was substituted for the few pieces of missing data on the categorical (or continuous) covariates.

Results

At entry into the study, the sample of 213 men with complete work history data averaged 43.1 year of age (range 30–60), 14.7 years of education (range 8–18), 22.6 years of employment (range 6–43), and 81.2% were White.

Concurrent Validity

Participants' retrospective assessment, using the WHQ, of their job demands and decision latitude at entry into the study, was moderately correlated ($r = 0.33$–0.57, $P < 0.01$) with the respective full JCQ scales and items they completed at entry into the study (Table 2). However, participants' retrospective assessment of workplace social support was more weakly correlated ($r = 0.22$–0.37, $P < 0.01$) with the JCQ social support scales and items.

Similarly, when demands and latitude were dichotomized, moderate agreement was observed between the WHQ and JCQ measures of these variables for the job held at entry into the study, with kappas ranging from 0.23–0.41 ($P < 0.001$) (Table 3). In addition, consistent with Table 2, the WHQ and JCQ measures of dichotomized social support were significantly but more weakly associated with each other (kappa = .16, $P < 0.01$). In contrast, when the dichotomous measures were combined to form a job strain variable, there was little agreement between job strain based on the full JCQ scales and job strain based on the WHQ scales for the job held by participants at entry into the study (Table 3).

Predictive Validity

Measures of job strain at entry into the study constructed from the shorter WHQ scales were weakly (and not significantly) associated with work and home systolic AmBP, with associations as high as 3.4 mm Hg (Table 4). This value is lower than the "gold standard" for this association (as measured by the full JCQ scales) for the 213 men in this study: 5.7 to 5.9 mm Hg work and home systolic AmBP ($P < 0.01$). However, job strain measures constructed from the WHQ were not associated with diastolic AmBP. In fact, those associations were primarily inverse.

TABLE 2
Concurrent validity: Pearson correlations between the retrospective assessment of job characteristics by the Work History Questionnaire of the job held by subjects at entry into the cohort study and corresponding scales and items from the Job Content Questionnaire at entry into the cohort study, 213 male employees from 9 work sites in New York City, aged 30 to 60

Job Content Questionnaire (JCO) N	No. of items	Work History Questionnaire (WHQ)	No. of items	Pearson correlations* (213)	(145)
Job demands scale	5	Job demands scale	2	.51	
Work very hard	1	Work very hard	1	.46	
Excessive work	1	Excessive work	1	.33	
Work hard + excessive	2	Job demands scale	2	.50	
Decision latitude scale	9	Decision latitude scale	2	.46	
A lot of say	1	A lot of say	1	.46	
High level of skill	1	High level of skill	1	.39	
Say + skill	2	Decision latitude scale	2	.44	
Freedom to decide	1	Freedom to decide	1		.43
Creative	1	Creative	1		.42
Say + skill + freedom + creative	4	Decision latitude scale	4		.54
Decision latitude scale	9	Decision latitude scale	4		.57
Social support scale	8	Social support scale	2	.35	
Supervisor support scale	4	Helpful supervisor	1	.22	
Coworker support scale	4	Helpful coworker	1	.37	
Helpful supervisor	1	Helpful supervisor	1	.22	
Helpful coworker	1	Helpful coworker	1	.26	
Helpful supervisor + coworker	2	Social support scale	2	.33	

* Correlations for 2-item WHQ demands, latitude and support scales based on all 213 men in the study. Four-item latitude scales (and additional items) at entry into the study available only for 145 men.

Note: Most retrospective assessments (WHQ) of jobs held at entry into the study were conducted six years after entry. All correlations are significant at $P < 0.01$.

TABLE 3
Concurrent validity: Measures of agreement (kappa) between the retrospective assessment of job characteristics by the WHQ at entry into the study and corresponding scales from the Job Content Questionnaire at entry into the study, 213 male employees from nine work sites in New York City, aged 30 to 60

Job Content Questionnaire N	prevalence	Work History Questionnaire	prevalence	kappa* (213)	(145)
Job demands > 32	.46	Job demands > 4	.75	.27***	
		Job demands > 5	.52	.41***	
Decision latitude < 37	.54	Decision latitude < 6	.23	.23***	
		Decision latitude < 12	.33		.38***
Social support < 23.5	.51	Social support < 6	.25	.16**	
Job strain:		Job strain:			
demands > 32		demands > 4 + latitude < 6	.15	.00	
+ latitude < 37	.23	demands > 5 + latitude < 6	.09	−.01	
		demands > 4 + latitude < 12	.23		.13
		demands > 5 + latitude < 12	.14		.10

* Kappa for 2-item WHQ demands, latitude and support scales based on all 213 men in the study. Four-item latitude scales at entry into the study available only for 145 men.

** $P < .01$; *** $P < .001$.

Construct Validity

The WHQ decision latitude scales for past jobs were positively and significantly correlated with both job demands and with workplace social support, similar to the magnitude of association between these variables using the full JCQ scales at entry into the cohort study (Table 5). The WHQ social support scale was not correlated with the job demands scale, however, also similar to the null association between these variables using the full JCQ scales.

Also as expected,[13] we observed a decrease in job strain and low decision latitude over the course of participants' work lives (Fig. 1, Appendix A).

TABLE 4
Predictive validity: Association between ambulatory blood pressure and measures of job strain based on the Work History and Job Content Questionnaires at entry into the study, adjusted for age, race/ethnicity, education, body mass index, alcohol use, smoking and work site, 213 male employees from nine work sites in New York City, aged 30 to 60

Work History Questionnaire N	Job strain prevalence	Ambulatory blood pressure (mm Hg) Work diastolic (213)	Work systolic (213)	Home diastolic (199)	Home systolic (199)
demands > 4 + latitude < 6	.15	−0.2	2.1	−0.4	1.7
demands > 5 + latitude < 6	.09	−0.5	3.4	−1.0	2.9
N		(145)	(145)	(137)	(137)
demands > 4 + latitude < 12	.23	−0.2	2.8	0.3	3.1
demands > 5 + latitude < 12	.14	−3.6#	−1.6	−2.6	2.0
Job Content Questionnaire					
N		(213)	(213)	(199)	(199)
demands > 32 + latitude < 37	.23	4.6***	5.7***	4.0**	5.9**
N		(145)	(145)	(137)	(137)
demands > 32 + latitude < 37	.22	4.9***	5.2*	4.9**	5.2*

# $P < .10$, * $P < .05$, ** $P < .01$, *** $P < .001$.

Note: Analyses of systolic blood pressure also control for a quadratic term for age. Regression analysis for 2-item WHQ demands and latitude scales based on all 213 men in the study. Four-item latitude scales at entry into the study available only for 145 men.

TABLE 5
Construct validity: Pearson correlations between Work History Questionnaire scales assessing past jobs and corresponding correlations between Job Content Questionnaire scales at entry into the cohort study, 213 male employees from nine work sites in New York City, aged 30 to 60

	Work History Questionnaire						Job Content Questionnaire*		
	All prior jobs			Job at entry			Job at entry		
Scales being correlated:	*N*	*r*	*p*	*N*	*r*	*p*	*N*	*r*	*p*
Demands, latitude (2-item)	1039	.34	<.001	213	.33	<.001	213	.28	<.001
(4-item)	594	.24	<.001	145	.26	.002			
Support, latitude (2-item)	1027	.31	<.001	211	.38	<.001	209	.23	.001
(4-item)	587	.39	<.001	143	.43	<.001			
Demands, support	1026	−.00	ns	211	.00	ns	209	−.06	ns

ns = $p > 0.10$

Note: The WHQ scale correlations are based on all past jobs held by the 213 male employees from the cohort study participating in the work history sub-study and having complete data.

* Job Content Questionnaire scales contain 5 items for job demands, 9 items for job decision latitude and 8 items for social support.

(Some fluctuation in the trend for job strain was observed during the period of >20 years in the past, however, this portion of the trend line is based on data from <55 men.) However, there was no clear pattern of change in job demands. In addition, as expected, men with lower levels of education reported a greater prevalence of low decision latitude. In addition, jobs early in participants' careers displayed only a slightly lower internal consistency reliability than later jobs (Appendix B). Thus, there is only very weak evidence for the hypothesis that poor or biased memory is differentially affecting reporting of distant past jobs.

Finally, job strain at entry into the cohort study was slightly but not, in most tests, significantly associated with higher levels of past job strain exposure (Appendix C). Assuming that the WHQ is a valid measure of past job strain, this provides evidence for the utility of the WHQ.

Discussion

Evidence is provided that the WHQ is a valid tool for assessing the nature of past job characteristics. Retrospective assessment of job demands and job decision latitude using scales with a limited number of items has a moderate correlation with longer JCQ scales when assessing the same job. A measure of job strain constructed from the WHQ had an elevated (although not significant) cross-sectional association with systolic AmBP. The WHQ scales display the expected patterns of intercorrelation and change over time. Choice of cut point for job demands or choice of decision latitude scale (two-item vs. four-item) made little difference in the overall pattern of results. Despite the potential bias introduced by poor or selective memory, these findings suggest that participants' retrospective assessments of their past jobs were based, at least in part, on a valid recollection. By providing data on past job strain exposure that is not captured by current assessment of job strain, the WHQ may be a valuable tool for reducing exposure misclassification caused by assuming that current exposure is a good proxy for past exposure. Therefore, the WHQ can help assess the effect of a changing historical exposure on current BP and other stress-related health outcomes.

On the other hand, the WHQ is a poor predictor of diastolic AmBP, and dichotomous job strain variables constructed from WHQ scales are not in close agreement with the job strain measure constructed from the JCQ when assessing the same job. There are undoubtedly inherent limits to the validity of retrospective assessment of job characteristics relative to assessment of the current work situation. In addition, the reli-

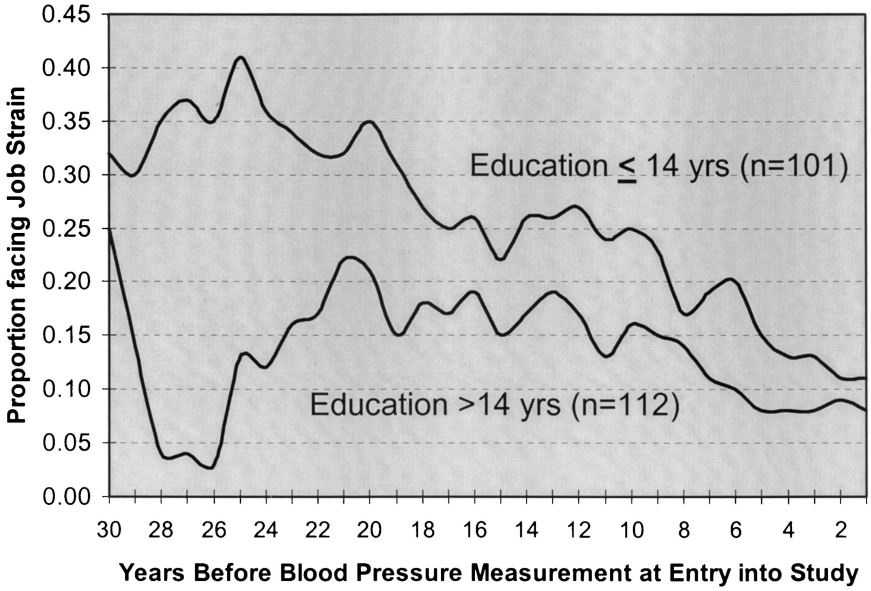

Fig. 1 Proportion of men facing Job Strain in prior jobs (Work Site Blood Pressure Study).

ability of the two-item social support measure is low and further items need to be added. Thus, a WHQ with high reliability will most likely need to contain 10 items, that is, 2 demands, 4 decision latitude and 4 social support items. Because 22 core JCQ items are needed to measure these constructs, the WHQ may remain an improvement in efficiency in situations where time and questionnaire space is limited, such as assessing all past jobs.

Validity of Retrospective Work Histories

Previous research suggests that self-reported retrospective job title histories have validity, ie, high levels of agreement with government, union and company records.[14–16] A self-administered occupational health history questionnaire showed high agreement with in-depth clinical interviews.[17] However, only one study (in Stockholm) has assessed the validity of retrospective psychosocial job characteristics data. Self-reported job demands and latitude on a job in 1969 to 70 showed only fair agreement with retrospective assessments of the same job 24 years later (kappas = 0.24–0.35), however, there was little evidence of differential misclassification. Associations between job characteristics and musculoskeletal symptoms were similar whether original or retrospective data was used.[18]

Validity of the Job Content Questionnaire

WHQ validity was primarily assessed by comparing it to Karasek's JCQ,[6] widely used in studies of job characteristics and CVD.[2,3,19] The JCQ, in contrast to some job stress questionnaires, does not ask about perceptions of stress, rather about objective job characteristics. Several studies which used expert ratings find high correlations ($r > 0.6$) with self-report measures of job decision latitude.[20–22] National U.S. surveys have shown high proportions of between occupation variance in self-reported job decision latitude and valid patterns of response, for example, much higher self-reported latitude for managers as compared to assembly-line workers.[23]

The potential remains for self-reported exposure to overestimate associations, particularly for psychological job demands, however, an inherently more subjective measure than decision latitude. Participants entering the study at Time 1 or 2 and completing the WHQ at Time 3 were aware of earlier AmBP levels. There is little evidence that hypertensives exaggerated their job demands, however. Job demands were not associated with case-control status, nor with Time 1 mean DBP, only with work SBP. Only the combination of job demands and low decision latitude, ie, job strain, was associated with case-control status and DBP as well as SBP.[7,9]

Comparison of Self-Reported Measures of Historical Exposure to Job Exposure Matrices

In a nested case-control study of a national sample of Swedish men, Johnson et al used a job exposure matrix based on national surveys to create lifetime histories of job characteristics for each occupational title. These histories were then assigned to study participants based on their self-reported occupational history.[21,24] Workers with low work control had an adjusted relative risk of 1.83 (95% CI 1.19–2.82) for CVD mortality.[25]

Such matrices have the advantage of a "relative lack of susceptibility to criticisms pertaining to self reports of job characteristics and the ability to use them in studies that contain information on individuals' occupations, but not on their detailed work characteristics."[26] However, use of such systems is limited by their availability and by the "loss of within-occupation variability in work characteristics," especially for job demands, which has much more within occupation variance than job decision latitude.[23,26] Other disadvantages include a "lack of precision of occupation means for small occupations, and the questionable generalizability of the occupation scores to subpopulations and other time periods."[26] The current method has the advantage of assessing variation on the level of the individual for jobs that study subjects actually held.

Conclusions

The measurement of work characteristics is a complex process. Often, due to time constraints, researchers may use a small number of questions to measure the current psychosocial work environment. It should be acknowledged that this "shortcut" can reduce associations with outcome not only due to reduced reliability but also due to limited construct validity—the relevant occupational stressors may simply not be assessed in enough detail. Even sophisticated instruments such as the JCQ or the Effort-Reward Imbalance questionnaire[27] are crude tools relative to assessment of other CVD risk factors, for example, body mass index, which can measured with great precision. Without thorough use of the psychosocial instruments available to us,[19] we bias our analyses toward underestimating the true effect of job stressors.

It is also important to obtain an adequate number of measurements over time. We observe a remarkable increase in predictive power in the WSBPS simply by adding a second assessment of job strain 3 years after the first assessment.[5] This may be due to increased reliability and/or better approximating a measure of chronic exposure. In addition, given that many study subjects have an extensive employment history, retrospective assessment of job characteristics, using the methods described in this paper, should increase the validity of our exposure measures and permit a less biased estimation of the association between job strain and health outcomes. In future analyses, we will utilize WHQ data to assess associations between duration of exposure to job strain and AmBP, as well as induction and recovery periods for the effect of job strain, among men and women.

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APPENDIX A

Construct validity: Proportion of past exposure to job strain by progression of jobs, 213 male employees from 9 work sites in New York City, aged 30 to 60

		Job strain (%)*			Job strain (%)†	
Work history Job number	*N*	demands > 4 latitude < 6	demands > 5 latitude < 6	*N*	demands > 4 latitude < 12	demands > 5 latitude < 12
1st	213	.50	.31	119	.55	.34
2nd	210	.39	.25	117	.48	.36
3rd	193	.24	.16	109	.30	.18
4th	160	.24	.15	91	.31	.16
5th	114	.18	.13	61	.20	.11
6th	73	.12	.07	39	.18	.13
7th	46	.17	.13	21	.29	.19
8th	22	.09	.05	8	.25	.13

* Job strain computed from the 2-item retrospective WHQ decision latitude scale based on all 213 men in the study.

† Job strain computed from the 4-item retrospective WHQ decision latitude scale based on the 119 men who completed the 4-item scale for all past jobs.

APPENDIX B

Construct validity: Internal consistency reliability (Cronbach's alpha) of scales measuring past exposure to job characteristics by progression of jobs, 213 male employees from 9 work sites in New York City, aged 30 to 60

		two-item			four-item
Work history Job number	*N*	Job demands	job decision latitude	*N*	job decision latitude
1st	213	.81	.52	119	.73
2nd	210	.79	.51	117	.77
3rd	193	.79	.62	109	.85
4th	160	.75	.41	91	.83
5th	114	.84	.55	61	.83
6th	73	.86	.51	39	.82
7th	46	.82	.52	21	.81
8th	22	.91	.74	8	.94

APPENDIX C

Association between current job strain and past exposure to job strain, 213 male employees from nine work sites in New York City, aged 30 to 60

Measure of past strain exposure	Current Job Strain	Cutpoints for past job strain measure: N	demands > 4 latitude < 6	demands > 5 latitude < 6	N	demands > 4 latitude < 12	demands > 5 latitude < 12
yrs of past strain[1]	Yes	49	7.12	4.90	26	9.54	6.35
	No	164	6.37	4.05	93	8.08	4.99
% of work life[1]	Yes	49	33.9%	22.9%	26	50.3%	31.4%
	No	164	28.4%	18.8%	93	37.1%*	24.1%

Measures of agreement between dichotomous current job strain and dichotomous past job strain:

Measure of past job strain exposure	N	demands > 4 latitude < 6 Kappa	demands > 5 latitude < 6 Kappa	N	demands > 4 latitude < 12 Kappa	demands > 5 latitude < 12 Kappa
strain 1 year ago[2]	213	−.01	−.02	119	.10	.14
strain 5 years ago	213	.13†	.08	119	.20†	.09
strain 10 years ago	202	.06	.10	114	.15*	.16*
strain 15 years ago	159	.06	.02	89	.10	.06
strain 20 years ago	126	.11	.11	66	.11	.04
strain 25 years ago	89	.03	.09	48	−.10	−.02

* $P < 0.10$, † $P < 0.05$

[1] Mean number of years and proportion of work life facing job strain by category of current job strain compared by t-test. None of the comparisons were significant at $P < 0.05$.

[2] Dichotomous job strain measure for a specific past year compared to current job strain by the kappa statistic.

Note: Job strain computed from the 2-item retrospective WHQ decision latitude scale based on all 213 men in the study. Job strain computed from the 4-item retrospective WHQ decision latitude scale based on the 119 men who completed the 4-item scale for all past jobs.

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