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ORIGINAL ARTICLE

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The psychometric properties of Karasek's demand and control scales within a single sector: data from a large teaching hospital

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Abstract ***Objective***: This paper reviews the psychometric properties of the core components from Karasek's job content questionnaire, the decision latitude and psychological job demands scales. ***Methods***: A self-reported survey was administered in 1995 (time 1), 1996 (time 2), and 1997 (time 3) to employees of a large teaching hospital. Analyses for this paper are based on data from the 484 employees who responded at times 1 and 2. ***Results***: Both scales demonstrated acceptable internal consistency as assessed by item-total correlations and Cronbach's alpha. In confirmatory factor analysis, the two-factor decision latitude model adequately fit the data. However, our findings suggest that a two-factor model may provide an improved fit over the original one-factor demands model, suggesting that this scale may be two distinct subscales. Lastly, the scales demonstrated acceptable discriminant validity. ***Conclusion***: Apart from some guarded uncertainty over what the demands scale may be measuring, overall, the two scales appeared to perform reasonably well in this sample of health care workers.

Keywords Job strain · Control · Psychological demands Measurement · Factor analysis

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Introduction

The job content questionnaire (JCQ) (Karasek 1985) is a widely used workplace environment questionnaire, which is now available in over 12 languages. The core format of the JCQ measures four constructs: decision latitude, psychological demands, physical workload, and job insecurity. Additional scales have also become available, most notably workplace social support, which is believed to act as a mediator of work stress. The best known scales of the original JCQ, decision latitude and psychological job demands, comprise the demand-control model of job strain as proposed by Karasek (1979). The demand-control model postulates that job strain is the result of an interaction between demand and control, meaning that a job with high demand and low control would be labelled as "high strain" while a job with low demand and high control would be viewed as "low strain". Somewhere between these two extremes lie "passive" and "active" jobs, with low demands/low control and high demands/high control combinations, respectively. Karasek's job strain model has now been examined in relation to several different health outcomes, most notably cardiovascular disease (Hallqvist et al. 1998; Landsbergis and Theorell 1999; Theorell et al. 1998). It is also now being used in studies of risk factors for work-related musculoskeletal disorders (Hoogendoorn et al. 2000; Shannon et al. 2001; Toomingas et al. 1997).

The majority of items in the original JCQ were taken from the 1977 Quality of Employment Survey, or QES (Quinn and Staines 1979). Using information obtained from an exploratory factor analysis of the QES data, Karasek developed the constructs that now comprise the JCQ. Since the scales were developed, the JCQ has been used in a wide variety of work settings; it is possible to compare mean scores for the scales from a given study population with US normative data for men and women, by occupation and industry. Despite this wide uptake, several concerns have been raised about the

demand-control model. For example, the applicability of the model across all sectors, especially those requiring extensive interaction with clients, such as health care workers, has been questioned (Soderfeldt et al. 1996). The psychometric properties of the psychological demands scale have also been questioned (Kerr et al. 1999; MacDonald et al. 2001). There has also been concern about the way in which the psychosocial work environment has been characterized and measured for women, which in turn, raises possible uncertainties about the psychometric properties of the scales in a largely female population (Hall 1989; Matthews et al. 1998). A recent review of 20 years of research with the demand-control model concluded that more empirical work was needed on this issue (Van der Doef and Maes 1999). Lastly, because the instrument was developed using data from people in a wide variety of occupations across multiple sectors and sites, there may be some concern that the instrument does not perform as well when used within a single site with limited occupational groups. In light of these uncertainties, the purpose of our study was to examine the psychometric properties of the model's main constructs using survey data from a largely female sample of acute care hospital employees.

Methods

Setting

Data for this analysis came from a study examining the effects of staff re-engineering at a large teaching hospital in Ontario, Canada. Details of the methodology and main results of this study are reported elsewhere (Brown et al. 1999, Brown et al., manuscript submitted; Shannon et al. 2001; Woodward et al. 1999; Woodward et al. 2001). The first phase of the design was a cross-sectional survey of a random sample of all hospital staff. A total of 900 employees was selected from the hospital's human resource file (approximately 21% of the work force). Eligible employees were all those who were working in the hospital in May 1995, including, but not restricted to those involved directly in patient care. Few physicians were eligible as most are paid on a fee-for-service basis and are therefore not hospital employees. The survey was repeated annually over 3 years to capture changes in the perception of employees' work environments before, during and after a re-engineering process was initiated. The first two surveys were administered during the planning phases of the re-engineering before re-engineering began. At time 1, senior managers in the hospital had begun to plan for re-engineering of services and care delivery processes. When the second survey was completed a year later, at time 2, many staff had been members of design teams or had contributed suggestions to the re-design of care and services. The third survey was administered after actual changes had begun to take place. With the exception of the comparison of years 1 and 2 responses, the data used for this analysis come from the baseline survey (time 1).

Questionnaire

The survey was 16 pages long and included 41 scales (225 items). The 14 core items from the JCQ (see Table 1) were included in the first section of the survey. Questions from other scales and instruments are not part of this analysis. The questionnaires were sent out in May of each year (1995, 1996, 1997) to the work address of each employee identified in the random sample chosen at time 1. A cover letter guaranteed confidentiality. A self-addressed envelope was included in the package and respondents were instructed to post the questionnaire in the university/hospital mail system. A thank-you/reminder post card was sent out 10–14 days later. Non-respondents received two subsequent notifications of the survey approximately 3 and 6 weeks after the initial mailing.

Table 1 Decision latitude and psychological job demands – items

Decision Latitude
Skill Discretion
1. My job requires that I learn new things. (Learn)
2. My job requires me to be creative. (Create)
3. My job requires a high level of skill. (Skill)
4. I get to do a variety of different things in my job. (Variety)
5. I have an opportunity to develop my own abilities. (Ability)
6. My job involves a lot of repetitive work.[a] (Repetitive)
Decision Authority
7. My job allows me to make a lot of decisions on my own. (Decision)
8. I have a lot to say about what happens on my job. (Say)
9. On my job, I have very little freedom to decide how I do my work.[a] (Freedom)
Psychological Job Demands
1. My job requires working very fast. (Fast)
2. My job requires working very hard. (Hard)
3. I am not asked to do an excessive amount of work.[a] (Excessive)
4. I have enough time to get the job done.[a] (Time)
5. I am free from conflicting demands that others make.[a] (Conflict)

Abbreviated variable name appears in parentheses
[a]Reverse ordering of the item for scoring

Decision latitude

As shown in Table 1, the decision latitude scale used in this study is the nine-item core version scale comprised of two subscales – skill discretion (six items) and decision authority (three items). These two subscales are weighted equally to create decision latitude. The subscale "skill discretion" has been referred to as "task variety" while "decision authority" has been referred to as "social authority over making decisions", or "autonomy" (Karasek and Theorell 1990). The overall scale is often referred to in the literature as a measure of job control. Although Karasek and Theorell (1990) only loosely refer to the decision latitude scale as "control", this label has become widely used and may convey a more readily comprehensible notion of the construct.

Psychological job demands

The psychological demands scale used in this study was the core JCQ version, originally proposed as a unidimensional construct made up of five items (see Table 1). It has been defined as "how hard you work" (Karasek and Theorell 1990, p. 63) and it is purported to assess mental arousal or stimulation necessary to accomplish job tasks. The psychological demands of the job may be difficult for respondents to conceptualize because the burdens of the work task can come from several sources. According to Karasek and Theorell (1990), "task requirements" or "workload" are the central components of psychological job demands for most workers.

Analysis

Data presented in this paper were analysed using SPSS Version 8.0 (1998) and EQS (Bentler 1995). Only times 1 and 2 data are used for this paper as the re-engineering commenced between times 2 and 3. All main analyses were conducted on time-1 data; time-2 data were used only for the purpose of assessing the stability of the responses between times 1 and 2. Inter-item correlations (Pearson's correla-

tions), item-total correlations, and Cronbach's coefficient alphas were examined to determine internal consistency or homogeneity of the items. For item-total correlations and coefficient alpha, reversed items were re-reversed to make the items additive in the same direction. The relative importance of the item-total correlation coefficients and Cronbach's alpha were interpreted according to recommendations proposed by Nunnally and Bernstein (1994) and Kline (1979), respectively. The scale scores were compiled according to the JCQ guidelines (Karasek 1985). A confirmatory factor analysis was conducted to test the measurement model proposed by Karasek (1985). Although we report the Sartorra-Bentler chi-square value which takes into account the non-normality of the data, the sensitivity of this measure to sample sizes larger than 200 (Schumacker and Lomax 1996) led us also to examine other fit statistics. As recommended by Hoyle and Panter (1995), the goodness-of-fit index (GFI), the non-normed fit index (NNFI), the incremental fit index (IFI), and the comparative fit index (CFI) were examined to describe the overall model fit. Values greater than 0.90 for these fit indices indicated an acceptable fit to the data (Bentler and Bonett 1980). Four models were requested. Initially, the original two-factor decision latitude and one-factor psychological demands model were requested. Based on findings from another study by one of the authors (Kerr et al. 2001), a two-factor demands model and a revised two-factor decision latitude model with the "repetitive" item removed were requested. Stability of responses between times 1 and 2 was assessed by an intra-class correlation (ICC) analysis using ANOVA techniques. The importance of the ICCs was interpreted according to recommendations proposed by Lohr et al. (1996). Discriminant validity was determined by examining the Pearson correlation coefficient between the scores for each scale.

Results

Response rate and demographic information

Of the original 900 employees, 881 were eligible to participate (Woodward et al. 1999). The 19 non-eligible employees had either left their employment at the hospital or were on sick leave or long-term disability leave during May 1995. Of the 881, 654 (74%) responded to the survey at time 1. At time 2 (1 year later), 528 of those originally eligible (60%) responded. Only those employees who completed the survey at both times 1 and 2 ($n = 484$) are included in this paper. Of these respondents, 89% were female and 80% were married/common law. The mean age of the sample was 40.7 years (SD 8.8 years). In terms of job classification, 64% of employees were health care professionals, 12% were service/technical employees, 19% were secretarial staff, and 6% were foundation services/business employees (those involved in the administration of the hospital).

Internal consistency

Table 2 is the correlation matrix for the 14 items. Negative correlations are a function of the reverse wording of certain items.

Over one-third of the correlations among the decision latitude items had a value of less than 0.3, indicating low inter-item correlation. As might be expected, we did find lower correlations between items across the *different* decision latitude subscales, and thus, slightly better correlations for the items within the subscales. The items

Table 2 Correlation matrix for decision latitude and psychological demands items (Pearson correlation coefficients)

	Learn	Create	Skill	Variety	Ability	Repetitive	Decision	Say	Freedom	Fast	Hard	Excessive	Time	Conflict
Learn	1.00													
Create	0.57	1.00												
Skill	0.56	0.48	1.00											
Variety	0.38	0.44	0.45	1.00										
Ability	0.39	0.42	0.37	0.39	1.00									
Repetitive	–0.15	–0.31	–0.23	–0.26	–0.22	1.00								
Decision	0.30	0.47	0.38	0.37	0.39	–0.20	1.00							
Say	0.11	0.36	0.17	0.37	0.37	–0.29	0.45	1.00						
Freedom	–0.12	–0.25	–0.08	–0.18	–0.27	0.32	–0.30	–0.34	1.00					
Fast	0.11	0.14	0.16	0.20	–0.01	0.14	0.14	0.09	0.07	1.00				
Hard	0.28	0.24	0.32	0.31	0.14	–0.04	0.18	0.17	–0.08	0.46	1.00			
Excessive	–0.09	–0.14	–0.12	–0.08	0.14	0.04	–0.04	–0.01	–0.02	–0.33	–0.32	1.00		
Time	–0.14	–0.18	–0.15	–0.13	0.15	0.25	–0.02	–0.10	0.04	–0.27	–0.36	0.48	1.00	
Conflict	–0.14	–0.11	–0.17	–0.09	0.06	0.08	0.00	0.06	–0.06	–0.16	–0.19	0.35	0.35	1.00

Table 3 Item-total correlations for decision latitude and psychological job demands

Scale	Item	"Corrected" item-total correlation
Decision latitude	Learn	0.50
	Create	0.65
	Skill	0.53
	Variety	0.55
	Ability	0.55
	Repetitive	0.38
	Decision	0.56
	Say	0.49
	Freedom	0.36
Psychological job demands	Fast	0.42
	Hard	0.44
	Excessive	0.55
	Time	0.50
	Conflict	0.37

"repetitive" and "freedom" correlated poorly with the other items in their respective subscales. For the psychological job demands scale, three out of ten correlations had a value of less than 0.3, indicating low inter-item correlations for this scale as well. Our results also showed that items from the decision latitude scale correlated better with items from within that scale than with items from the psychological job demands scale.

Values for all item-total correlations (see Table 3) for the decision latitude and psychological job demands scales were greater than 0.3, as recommended by Nunnally and Bernstein (1994), indicating that each of the scale items had at least modest correlation with the other items comprising the overall scale score. Values for item-total correlations were also greater than 0.3 for the skill discretion and decision authority subscales (results not shown here).

Cronbach's coefficient alpha was 0.81 for the decision latitude scale which consists of nine items, and 0.70 for psychological job demands which consists of five items. Thus, for both scales, alpha was within the recommended range (Kline 1979). Cronbach's alpha was also examined for the subscales skill discretion and decision authority. Alpha was 0.77 for skill discretion (six items) and 0.63 for decision authority (three items). These values are below that for the overall scale. Although this decrease in alpha may be due to a decrease in the number of items, it may also indicate that the subscales overlap. Cronbach's alpha for decision authority indicates lower-than-ideal internal consistency for this scale.

Confirmatory factor analysis

The hypothesized and final versions of the four models requested in the confirmatory factor analysis are shown in Table 4, and the standardized parameter estimates of the final models are presented in Figs. 1, 2, 3, 4, where the circles represent unobserved latent factors, the rectangles represent observed variables, and the single-headed arrows represent the impact of one variable on another. As depicted, some correlated error terms were specified, based on the modifications provided by the EQS output to improve the fit of the models. These correlated error terms reflect the assumption that the observed variables are measuring something in common.

Stability of the scores between time 1 and time 2

In examining the stability of the scores within our data between times 1 and 2, we assumed that employees remained in the same jobs from year to year of the study, and that their job tasks did not change. Given that the study site was about to undergo a major organizational change, this assumption may be unwarranted. However, the comparison does allow for an examination of perceptions of change in the psychosocial environment in a climate of uncertainty.

For decision latitude, the ICC was 0.68 (95% CI, 0.62–0.72). For psychological demands, the ICC was 0.57 (95% CI, 0.51–0.63). These ICCs fall short of the recommendation by Lohr et al. (1996) of 0.70 for group

Table 4 Goodness-of-fit indices for hypothesized and final models. Chi square = Sartorra Bentler scaled chi square. *df* degrees of freedom; *GFI* goodness-of-fit index, *NNFI* non-normed fit index, *IFI* incremental fit index, *CFI* comparative fit index

Model	Chi square	df	*P* value	GFI	NNFI	IFI	CFI
Two-factor decision latitude							
Hypothesized	156.44	26	0.000	0.92	0.82	0.87	0.87
Final	68.55	22	0.000	0.97	0.92	0.95	0.95
One-factor psychological job demands							
Hypothesized	49.31	5	0.000	0.95	0.75	0.87	0.87
Final	2.91	4	0.57	1.00	1.00	1.00	1.00
Two-factor decision latitude ("repetitive" item removed)							
Hypothesized	112.46	19	0.000	0.93	0.84	0.89	0.89
Final	36.82	15	0.001	0.98	0.95	0.97	0.97
Two-factor psychological job demands							
Hypothesized and final models	2.91	4	0.57	1.00	1.00	1.00	1.00

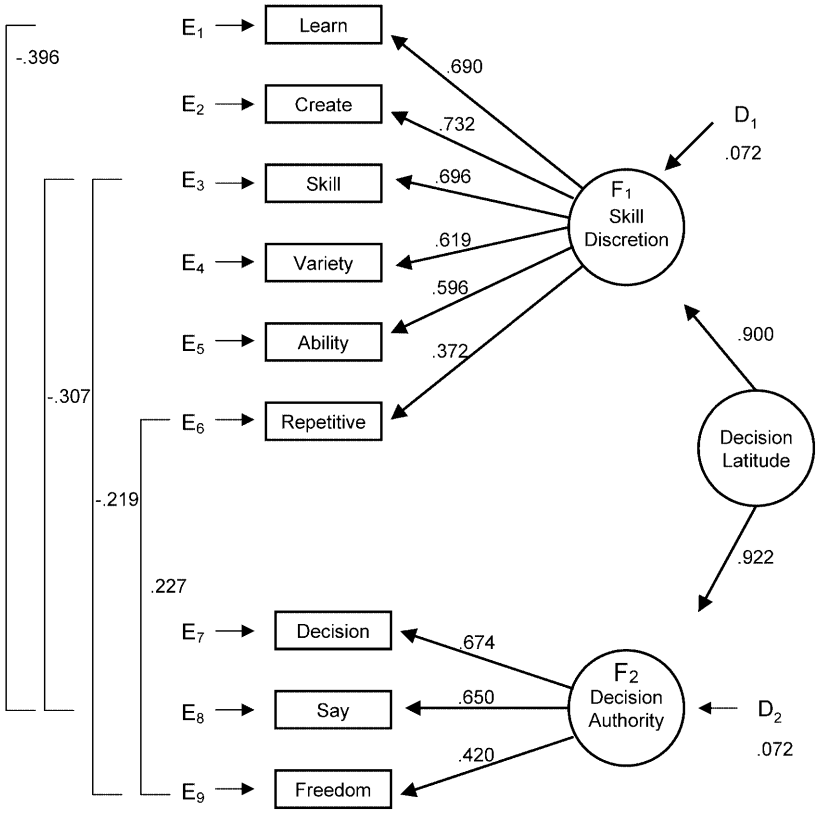

Fig. 1 Two-factor model of decision latitude with standardized parameter estimates

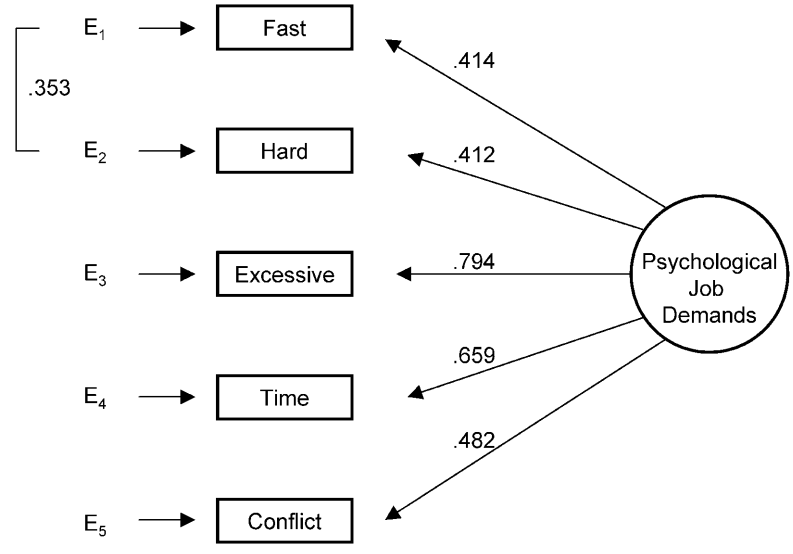

Fig. 2 One-factor model of psychological job demands with standardized parameter estimates

comparisons. Treating time as a fixed versus random factor did not seem to have an effect on the reliability coefficient (data not shown), indicating that the time of administration was not important.

Discriminant validity

The Pearson correlation between the scores for decision latitude and psychological job demands was only 0.18, indicating that these two scales were measuring different workplace constructs.

Discussion

Despite some low inter-item correlations, our results suggest that the scales have adequate psychometric properties. The Cronbach alpha results and the item-total correlations were satisfactory, with the exception of the marginal Cronbach's alpha for the subscale decision authority. The Cronbach alphas of 0.81 for decision latitude and 0.70 for psychological job demands from the hospital data are comparable to the Cronbach alphas from the 1969, 1972, and 1977 QES data which reported alphas of

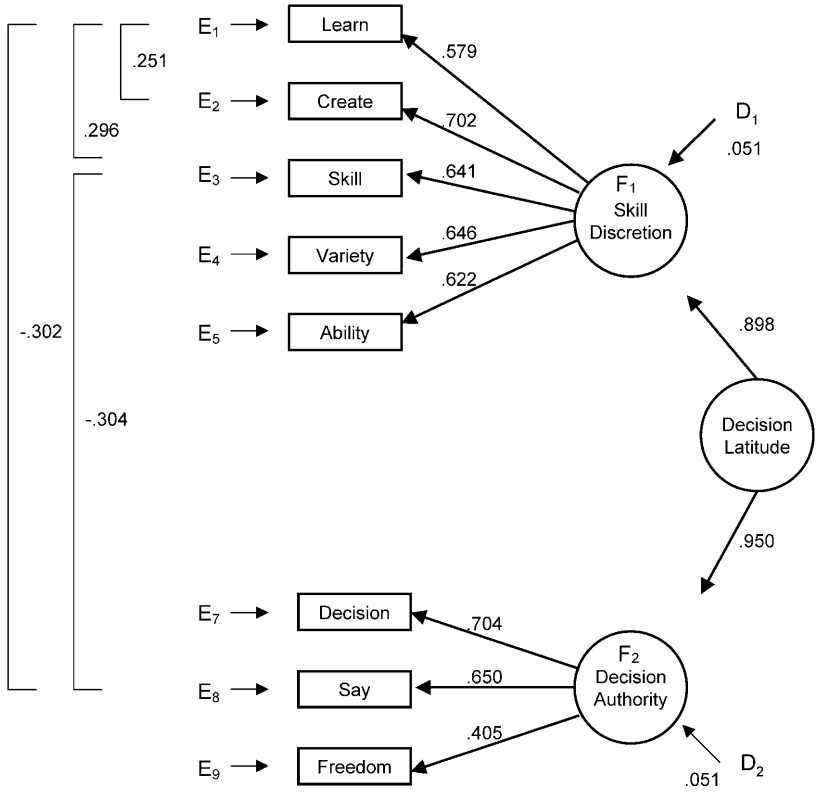

Fig. 3 Two-factor model of decision latitude ("repetitive" item removed) with standardized parameter estimates

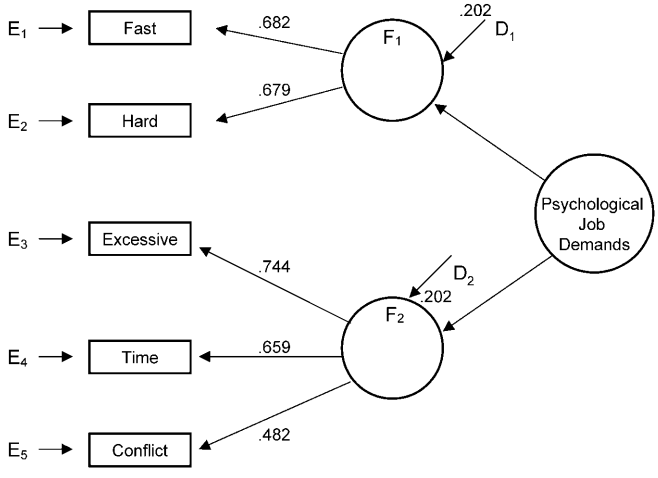

Fig. 4 Two-factor model of psychological job demands with standardized parameter estimates

0.70, 0.85, and 0.85 for decision latitude and 0.63, 0.59, and 0.62 for psychological job demands (Schwartz et al. 1988). The Cronbach alphas from the hospital data are also comparable to those of a recent national and international study which ranged from 0.68 to 0.86 for decision latitude and 0.51 to 0.72 for psychological demands (Karasek et al. 1998). Both sets of results are similar to those of other studies in the health care sector (Landsbergis 1988; Seago and Faucett 1997). Interestingly, many of the reported alpha coefficients for psychological job demands from the national/international study, as well as those from the quality of employment data, fall below the 0.70 recommendation by Kline (1979).

Our factor analysis results indicate an adequate fit of the data to the two-factor decision latitude and one-factor demands model. The revised two-factor decision latitude model ("repetitive" item removed) did not considerably improve the fit of this model. However, the fit of the demands model was considerably improved when a two-factor structure was requested. In a fairly recent national-international review of these scales (Karasek et al. 1998), results of factor analyses also raised questions about the psychological job demands scale; this scale split into two factors when more than one factor was requested in an exploratory factor analysis. Further, these researchers also found that within decision latitude, some items loaded on both subscales. These findings are similar to the findings of our confirmatory factor analysis (see Fig. 1) where the error terms across subscales are correlated.

In general, the stability of the scores for both scales (ICC = 0.68 and 0.57) was not very high. These ICCs are considerably lower than those found by Karasek and Theorell (1990), who used the QES data from 1969, 1972, and 1977 and reported 1-year "test-retest reliabilities" of 0.97 for decision latitude and 0.96 for psychological job demands. However, the use by Karasek and Theorell of the term test-retest reliability was not standard. They referred to it as "cross survey correlation". Further, they used occupation rather than the individual as their unit of analysis. To our knowledge, no other test-retest reliability studies have been reported

on these two scales so there appear to be no data with which to compare our results. It could be argued, though, that with today's changing working environments, particularly in health-care settings, it may be reasonable to assume that no measure of workplace psychosocial constructs is expected to be very stable over a 1-year period. Indeed, the interval of 1 year was longer than the recommended 14-day interval for assessing test-retest reliability (Streiner and Norman 1998).

In the context of our hospital setting, decision latitude and psychological demands appeared to show discriminant validity when correlated against each other. The correlation of 0.18 between the two scales is comparable to those found by Karasek et al. (1998), who reported correlations ranging from 0.04 to 0.35 in six national/international data sets, indicating only minimal overlap in what the two scales are measuring.

The workplace psychosocial environment has been receiving increasing attention of late, as there is now growing evidence for its relation to some important occupational health outcomes. Much of this evidence comes from the use of the demand-control model, particularly the JCQ, which has now been widely used in numerous occupational health settings. For example, a recent report from a large prospective study of nurses in the US has found that adverse psychosocial work conditions, as based on the job strain model, were the most important predictors of poor functional health status (Cheng et al. 2000). Some concerns have been raised, however, about the legitimacy of the instrument (Hall 1989; Matthews et al. 1998; Soderfeldt et al. 1996), especially the psychometric properties of the psychological job demands scale (Kerr et al. 1999; MacDonald et al. 2001). Our study specifically addressed these concerns with a thorough examination of these properties within a health sector setting. Based on our results, there is support for the widely used nine-item version of decision latitude (''job control'') in a largely female population in the health care setting. Our results also suggest that it might be better to treat the demands scale as two distinct subscales. Further work needs to be conducted to confirm and expand these findings, including an examination of the possibility that the existing demands scale may be addressing aspects of both the physical and psychological demands of work, rather than just the latter as originally conceived. Further work also needs to address the standard notion of test-retest reliability for these scales.

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