Stressful work, sickness absence and turnover in truck drivers from etiology to prevention

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Chapter 3

Job stress, fatigue, and job dissatisfaction in Dutch truck drivers:
Towards an occupation-specific model of demands and control
Abstract

Objectives Building on Karasek's Job Demand-Control Model (JD-C Model), this study examined the effects of job control, quantitative workload (i.e. psychological job demands), and two occupation-specific job demands (physical demands and supervisor demands) on fatigue and job dissatisfaction in Dutch truck drivers.

Methods From 1,181 truck drivers (adjusted response 63%) self-reported information was gathered by questionnaire on the independent variables (job control, quantitative workload, physical demands and supervisor demands) and the dependent variables (fatigue and job dissatisfaction). Stepwise multiple regression analyses were performed in order to examine the main effects of job demands and job control and the interaction effect between job control and job demands on fatigue and job dissatisfaction.

Results The inclusion of physical and supervisor demands in the JD-C Model explained a significant amount of variance in fatigue (3%) and job dissatisfaction (7%) over and above job control and quantitative workload. Moreover, in accordance with Karasek's interaction hypothesis, job control buffered the positive relation between quantitative workload and job dissatisfaction.

Conclusions Despite methodological limitations, the results suggest that the inclusion of (occupation) specific job control and job demand measures is a fruitful elaboration of the JD-C Model. The occupation-specific JD-C Model gives occupational stress researchers better insight into the relationship between the psychosocial work environment and well being. Moreover, the occupation-specific JD-C Model may give practitioners more concrete and useful information about risk factors in the psychosocial work environment. Therefrom, this model may provide points of departure for effective stress reducing interventions in the work setting.

Introduction

In many sectors of industry, the nature of work has changed significantly over the last decades (International Survey Research, 1995; Paoli, 1997). Relevant changes concern the flexibilization of work, the entry of the 24-hours economy, mechanization, automation, and the appliance of information and communication technology. In general, these changes have resulted in a decreased exposure to physical and chemical agents and an increased exposure to psychosocial risk factors. In the road transport industry, for instance, the entry of the 24-hours economy has been accompanied by an increased demand for just-in-time deliveries leading to an intensification of the work of truck drivers (De Zwart and Frings-Dresen, 2000). Furthermore, the appliance of communication technology has led to a decreased feeling of job control for these workers (De Croon et al., submitted).

The above described changes in the nature of work have gone hand in hand with an increased attention in occupational health research directed at the investigation of the relationship between psychosocial work factors and health and well-being. A number of occupational stress models has been postulated that can serve as a theoretical frame for this category of studies. Without doubt, the most influential and successful model is Karasek's Job Demand-Control Model (JD-C Model) (Karasek, 1979; Karasek and Theorell, 1990).

Initially, the JD-C Model was based on the hypothesis that psychological job demands result in psychological strain and physical illness only when the level of decision latitude, later referred to as job control, is low (Karasek, 1989). Stated differently, Karasek assumed that decision latitude buffers the harmful effect of psychologically demanding jobs (stress buffering hypothesis of job control). Because the majority of studies that examined the JD-C Model favor an additive rather than an interactive effect of psychological job demands and decision latitude on health and well-being, Karasek revised the initial core hypothesis (Karasek, 1989). Presently, the JD-C Model posits that the most adverse reactions of psychological strain occur when the psychological demands are high and job control is low (Karasek and Theorell, 1990). This proposition is generally labeled the psychological strain hypothesis. Furthermore, Karasek and Theorell added a social support dimension to the JD-C Model (Karasek and Theorell, 1990). The extended Job demand-control-support Model (JD-CS Model) states that working situations which are characterized by high demands, low control and low social support have the most negative effects on employee health and well-being.
The JD-C(S) Model has been disputed frequently (Ganster, 1989; Kristensen, 1995; 1996; Jones et al., 1998). One topic of debate concerns the conceptualization of decision latitude. According to Karasek (1979) decision latitude (job control) consists of two sub concepts: decision authority and skill discretion. Decision authority is defined as the social authority over making decisions (Karasek and Theorell, 1990). Skill discretion refers to the breadth of skills usable on the job. Whereas decision authority is conceptually equivalent to job control, skill discretion represents a different concept. Consequently, there has been a lack of correspondence between the way job control is generally conceived and made operational in the field of occupational stress research and the way this work feature has been conceived and made operational in most JD-C(S) studies.

Over the last years, a growing number of studies have come to meet up to the above-described criticism. These particular studies (De Croon et al., 2000b; De Jonge et al., 1999; Wall et al., 1996; De Rijk et al., 1998) have attempted to improve Karasek’s control construct by omitting items concerned with the skill discretion sub concept and simultaneously enclosing items focused clearly on the opportunities provided by the job to exert influence over the work setting.

A second objection raised to the JD-C(S) Model involves the conceptualization and measurement of psychological job demands. According to Karasek and Theorell work load, measured at a general level with subjective items such as ‘work hard’ and ‘excessive work’, is the central component of this dimension. However, other job demands may be predictors of health and well being for certain occupations as well (Sparks and Cooper, 1999). Truck driving is an exemplary occupation in this respect. In addition to a high quantitative workload, the work of truck drivers is characterized by high physical job demands (e.g. prolonged sitting in a single body posture, loading and unloading of the goods) (Van der Beek et al., 1994) and unfavorable working hours (McDonald, 1984). In addition, truck driving is mentally demanding because it requires long periods of alertness and sustained attention. Finally, truck drivers often complain of an authoritative and punitive attitude from front-line supervisors (Bos et al., 1984; De Croon et al., 2000a; Orris et al., 1997), which suggests that not only the absence of positive relations (i.e. social support), but also the presence of negative relations (e.g. conflicts) may effect health and well being of these workers.

The above-described conceptual criticisms on the JD-C(S) Model bring about two restrictions. The first restriction relates to the stress-buffering hypothesis of job control. In general, the chance of identifying interaction effects between job demands and job
control, both measured at a general level, is small. The importance of employing distinctive, instead of generic, measures of job control and job demands when examining the stress-buffering hypothesis of job control was demonstrated by Sargent and Terry (1998) and Van der Doef and Maes (1999). These researchers showed that some aspects of job control (e.g. control over work pace and work method) may protect workers from the harmful effects of certain types of job demands (e.g. time pressure), whereas others do not. Stated differently, depending on the particular domain of job control under consideration, different job demands may be differentially related to health and well-being. Although the importance of employing specific and distinctive measures in this respect is a known topic in the stress literature (Cohen and Wills, 1985) most research workers examining the JD-C(S) Model have overlooked this topic.

The related issue of practical applicability is the second restriction that accompanies the conceptual comments on the JD-C(S) Model. A number of investigators argue that research findings based on the JD-C(S) Model give a rather abstract picture of the relationship between the psychosocial work environment and well-being (Jones et al., 1998; Sparks and Cooper, 1999). For this reason, researchers have recommended to incorporate a range of more concrete demanding work features in the JD-C(S) Model (Jones et al., 1998; Sparks and Cooper, 1999). This may explain more variance in employee well-being outcomes and is likely to provide practical points of departure for interventions. In view of the changing nature of work and the increased call upon evidence-based practice in occupational health care, concrete information about risk factors in the psychosocial work environment, based on specific occupational stress models, is badly needed.

The above-described restrictions that accompany the application of the JD-C(S) Model in occupational stress research and practice formed the incentive of this study. The aim of the present study was to evaluate a modified JD-C Model in which one focused measure of job control (control over work method and work pace), and, besides psychological job demands (i.e. quantitative workload), two job demands which are specific for truck driving (physical demands and supervisor demands) were included. In accordance with the psychological strain hypothesis, it was expected that job control and quantitative workload had additive effects on well-being in truck drivers. Furthermore, it was expected that the inclusion of physical and supervisor job demands would improve the predictive power of the additive JD-C Model. Finally, in view of the distinctiveness and greater specificity of the above measures, it was expected to detect interactive effects between job control and the included job demands on well-being in truck drivers.
Chapter 3 Towards an occupation-specific JDC Model

Methods

Subjects
In August 1998, self-completed questionnaires were sent to the home addresses of a random sample (n = 2,000) of the population of truck drivers in the Dutch road transport industry. Initially, 1,277 questionnaires were returned. Of these 1,277 questionnaires 52 were not completed because of a wrong address resulting in an adjusted response rate of 63% (1,225 / 1,948). All truck drivers with missing values on the essential study variables were excluded from the analyses, which reduced the number of participants to 1,181. Table 1 displays information regarding age, gender, and number of working hours of the study sample. The majority of the participants (98%) was male. Mean age of the participants was 39 years (SD = 10.1 years) and ranged between 19 and 68 years. Participants worked an average of 57 hours per week (SD = 11.7 hours; range 7-90 hours).

Table 1 Characteristics of the study sample (n = 1,181)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>39.1</td>
<td>10.1</td>
<td>19-68</td>
</tr>
<tr>
<td>Male %</td>
<td>98.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working hours per week</td>
<td>57.4</td>
<td>11.7</td>
<td>7-90</td>
</tr>
</tbody>
</table>

Questionnaire
All independent variables (job control, quantitative workload, physical demands and supervisor demands) were measured by means of the validated Dutch Questionnaire on the Experience and Assessment of Work (VBBA (Van Veldhoven and Meijman, 1994). This questionnaire has been widely used in the Netherlands in both research on occupational stress (Van der Weide et al., 1999a; Sluiter et al., 1999a; Beurskens et al., 2000; Van Yperen and Snijders, 2000; Elders and Burdorf, 2001) and in daily practice as a tool for occupational health services (Van Veldhoven and Broersen, 1999). The psychometric qualities of the VBBA scales are good (Van Veldhoven, 1996). During construction of the scales Rho varied between .82 to .95, and the Loewinger's H varied between .42 and .75. An external test indicated somewhat less favorable, but still convincing psychometric properties (Weel and Broersen, 1995).

Job control
Job control was measured by means of an 11-item scale, including items from the focused measure of timing control and method control developed by Jackson et al. (1993). Some examples of this scale are: "Can you decide on your own the order in which you carry out
your work?' and 'Can you interrupt your work for a short time if you find it necessary to do so?'. Items were scored on a four-point scale (1 = never, 2 = sometimes, 3 = often, 4 = always).

Job demands
Quantitative workload (i.e. psychological job demands) was assessed by an 11-item scale. Two example items are: "Do you work under pressure of time?" and "Do you have to work extra hard in order to complete something?". Physical job demands were assessed by a 7-item scale. Typical items of this scale are: "Does your work require physical strength?" and "In your work, are you seriously bothered by having to lift or move loads?". Supervisor job demands were measured by means of the relationship with your immediate boss scale of the VBBA comprising 9 items. Some examples of this scale are: "Do you have conflicts with your boss?" and "Do you experience aggressiveness from your boss?". All items were scored on a four-point scale (1 = never, 2 = sometimes, 3 = often, 4 = always).

Fatigue
Fatigue was measured by means of the Checklist Individual Strength (CIS) (Vercoulen et al., 1994). The CIS consists of 20 statements for which the person has to indicate on a 7-point scale to what extent the particular statement applies to him or her. The statements refer to four aspects of fatigue experienced during the previous two weeks, namely subjective fatigue (8 items—for example, I feel tired), reduction in motivation (4 items—for example, I feel no desire to do anything), reduction in activity (3 items—for example, I don't do much during the day), and reduction in concentration (5 items—for example, My thoughts easily wander). The CIS is well validated within the clinical setting (Vercoulen et al., 1996). Recently, the validity of the questionnaire was established also among working people (Beurskens et al., 2000). In this study a composite CIS total score (ranging from 20 to 140) was calculated by adding the individual's scores on the four factors.

Job dissatisfaction
Job dissatisfaction was assessed by the similarly named scale of the VBBA comprising 9 dichotomous items. Some examples of the job dissatisfaction scale are: "I have to continually overcome my resistance in order to do my work" and "I find the thought that I will have to do this job until I retire very oppressive".

Data analysis
In order to test the stated hypotheses, stepwise multiple regression analyses were conducted on both fatigue and job dissatisfaction. In the first step job control and
Karasek's central job demands component, quantitative workload, were entered into the equation. The two occupation-specific demands (physical demands, and supervisor demands) were entered into the equation in the second step. To test the hypothesized interaction between job control and job demands, three interaction terms (job control x quantitative workload, job control x physical demands, and job control x supervisor demands), computed as the product of the standard scores of the independent variables (Aiken, 1991), were entered into the equation in the final step three. In all the analyses effects were accepted as significant at $p < .01$.

Results

Preliminary analyses

Table 2 presents range, mean (M), standard deviation (SD), internal consistency (Cronbach's alpha), and zero-order Pearson correlations of all study variables. Inspection of Table 2 reveals that, with the exception of age, all the correlations between the study variables were significant ($p < .01$). Because the correlation analyses did not reveal any significant correlation between age and the other variables, there was no need to control for age in further analyses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
<th>$\alpha$</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Age</td>
<td>19-68</td>
<td>39.09</td>
<td>10.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Job control</td>
<td>0-100</td>
<td>53.47</td>
<td>21.22</td>
<td>.89</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Quantitative workload</td>
<td>6-97</td>
<td>44.89</td>
<td>16.40</td>
<td>.88</td>
<td>.08</td>
<td>-.43*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Physical demands</td>
<td>0-100</td>
<td>34.94</td>
<td>21.09</td>
<td>.88</td>
<td>.00</td>
<td>-.15*</td>
<td>.47*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Supervisor demands</td>
<td>0-100</td>
<td>27.68</td>
<td>20.21</td>
<td>.89</td>
<td>.02</td>
<td>-.40*</td>
<td>.46*</td>
<td>.37*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Fatigue</td>
<td>20-137</td>
<td>50.09</td>
<td>23.12</td>
<td>.90</td>
<td>.06</td>
<td>-.33*</td>
<td>.44*</td>
<td>.29*</td>
<td>.38*</td>
<td></td>
</tr>
<tr>
<td>7 Job dissatisfaction</td>
<td>0-100</td>
<td>15.97</td>
<td>24.79</td>
<td>.87</td>
<td>-.01</td>
<td>.32*</td>
<td>.50*</td>
<td>.38*</td>
<td>.45*</td>
<td>.49*</td>
</tr>
</tbody>
</table>

* $p < .01$

The results of the multiple regression analyses examining the main and interaction effects of job demands and job control on fatigue and job dissatisfaction are displayed in Table 3. With respect to fatigue, the results of the analyses indicated that the proportion of variance accounted for in fatigue increased from .00 to .22 with the addition of job control and quantitative workload (i.e. psychological job demands) in step one. The entry of physical job demands and supervisor job demands in step two accounted for another three per cent of variance in need for recovery. Introduction of the interaction terms in step three did not result in a further increase in $R^2$. At the final step three, job control ($\beta = -$.
.14), quantitative workload ($\beta = .26$), physical job demands ($\beta = .09$) and supervisor job demands ($\beta = .16$) were uniquely related to fatigue.

The stepwise multiple regression analyses of job dissatisfaction revealed a significant increase in $R^2$ (from .00 to .26 in step one) when job control and quantitative workload (i.e. psychological job demands) were entered into the equation. The entry of physical and supervisor job demands in step two accounted for seven per cent of additional variance in job dissatisfaction. Introduction of the interaction terms in step three resulted in a further increment of $R^2$ from .33 to .37. Job control ($\beta = -.10$), quantitative workload ($\beta = .27$), physical job demands ($\beta = .15$), supervisor job demands ($\beta = .20$), and the interaction between job control and quantitative workload ($\beta = .14$) were found to contribute significantly and uniquely to the variance in job dissatisfaction.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Fatigue</th>
<th></th>
<th></th>
<th>Job dissatisfaction</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$R^2$ change</td>
<td>$\beta$</td>
<td>$R^2$ change</td>
<td></td>
</tr>
<tr>
<td>Step 1: Job control</td>
<td>$-.14^*$</td>
<td>$.22^*$</td>
<td>$-.10^*$</td>
<td>$.26^*$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quantitative workload</td>
<td>$.26^*$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2: Physical demands</td>
<td>$.09^*$</td>
<td>$.03^*$</td>
<td>$.15^*$</td>
<td>$.07^*$</td>
<td></td>
</tr>
<tr>
<td>Supervisor demands</td>
<td>$.16^*$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3: Control x quantitative workload</td>
<td>$.04$</td>
<td>$.00$</td>
<td>$-.14^*$</td>
<td>$.04^*$</td>
<td></td>
</tr>
<tr>
<td>Control x physical demands</td>
<td>$.02$</td>
<td></td>
<td>$.04$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control x supervisor demands</td>
<td>$.01$</td>
<td></td>
<td>$.04$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .01$

Note. Regression values are standardized coefficients obtained at step 3.

In Figure 1 the interaction between quantitative workload and job control on job dissatisfaction is graphically represented following the method recommended by Jaccard (1990). As shown in Figure 1, quantitative workload is strongly related to job dissatisfaction at low levels of job control, whereas a weak relation between quantitative workload and job dissatisfaction is observed at high levels of job control.
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Figure 1 Interaction between quantitative workload (i.e. psychological job demands) and job control on job dissatisfaction

Discussion

The aim of the present study was to evaluate a modified Job Demands-Control Model including a focused measure of job control (control over work method and work pace) and two occupation specific job demands. The study brought about two meaningful findings. Firstly, the inclusion of physical and supervisor job demands into the JD-C Model improved the additive model's predictive power. Secondly, in accordance with Karasek's interaction hypothesis, job control attenuated the association between quantitative workload (i.e. psychological job demands) and job dissatisfaction.

In accordance with our expectation the inclusion of physical and supervisor job demands improved the predictive power of the additive JD-C Model. With respect to fatigue a moderate amount of variance was accounted for by the two occupation-specific job demands over and above that accounted for by quantitative workload and job control. A more substantial improvement of the Model's predictive power was observed when job dissatisfaction was regressed on the independent variables.

The above findings confirm other studies which show that a range of work features which are specific for a particular occupation should be considered for a full comprehension of the relationship between the psychosocial work environment and health and well-being (De Jonge et al., 1999; Sparks and Cooper, 1999; Demerouti et al., 2001). Although Karasek and Theorell themselves have suggested that more work dimensions are required
to capture the psychosocial work environment adequately, many researchers and practitioners still focus on only one global measure of job demands and job control. Consequently, other demanding work features that may influence health and well being in certain occupations are frequently overlooked in occupational stress research and practice.

Another aim of this study was to investigate the stress-buffering hypothesis of job control. In view of the available evidence (Sargent and Terry, 1998; Van der Doef and Maes, 1999), it was proposed that the employment of precisely defined, instead of globally defined, job demand and job control concepts would result in support for this hypothesis. The observed interaction effects between quantitative workload and job control on job dissatisfaction confirmed the stress-buffering hypothesis. However, the failure of finding any interaction between job control and the other job demands disproved the buffering hypothesis.

According to Cohen and Wills' stress-matching hypothesis (Cohen and Wills, 1985) there must be a reasonable match between the coping requirements of a certain stressor or demand and the available coping resources for buffering to occur. Interpretation of the present results in light of Cohen and Wills' hypothesis, then, leads to the suggestion that control over work method and work pace provides an effective resource for workers to cope with a high quantitative workload only. More specifically, as set forth by Sargent and Terry (1998), a worker who has too much work to do will handle the stress better if the job has some flexibility in terms of its allocation of time and energy to tasks (see also Frese, 1989). For instance, a truck driver who can determine oneself at what time and in what order to accomplish his route can adjust his work situation to his psychological needs and preferences and bring about a stress-reducing effect. In contrast, a truck driver in conflict with his front-line supervisor might benefit more from the support of a coworker (Frese, 1999).

This implies that confirmation of Karasek's interactive JD-C Model is not only dependent on the inclusion of more specific variables, but depends also on the extent to which the specific coping resource matches the specific type of job demand. Stated differently, depending on the specific demands posed by a particular occupation, certain aspects of control or other coping resources may bring about a stress-buffering effect whereas others may not. The inclusion of job demand and job control measures in the JD-C Model, which are specific to a certain occupation, then, is likely to result in a further improvement of the model's predictive power. Moreover, from a practical point of view, such an
approach will give practitioners more concrete and therefrom more useful information to realize effective interventions (Kasl, 1989; Jones et al., 1998; Sparks and Cooper, 1999).

Interestingly, job control buffered the positive effects of quantitative workload on job dissatisfaction whereas no buffering effect of job control was detected when fatigue was on target. A review of the literature shows that this finding does not constitute a solitary case. A large number of studies that examined the stress-buffering hypothesis of job control in relation to job (dis)satisfaction, (Sauter, 1989; Kushnir and Melamed, 1991; Dwyer and Ganster, 1991; Fox et al., 1993; Obrell and Gillies, 1993; Parkes and Von Rabenau, 1993; Wall et al., 1996; Mullarkey et al., 1997; Sargent and Terry, 1998; De Jonge et al., 1999) confirmed the hypothesis as well. In contrast, those studies that examined the stress-buffering hypothesis of job control in relation to fatigue (Kauppinen et al., 1983), or in relation to equivalent concepts, such as need for recovery (Schmidt et al., 1993) burnout (Landsbergis, 1988; Melamed et al., 1991) and emotional exhaustion (De Jonge et al., 1996; De Jonge et al., 1999) failed to confirm the hypothesis. The differential demand-control interaction effect on the outcome measures runs counter to the implicit assumption of the JD-C Model that the effects of job demands and job control on health and well-being are non-specific (Karasek and Theorell, 1996). In fact, they confirm Warr’s proposal (Warr, 1990) that different psychological outcomes may arise from a combination of separate sources.

The practical implication of the observed differential interaction effect is that interventions aimed exclusively at increasing control over work pace and work method in high quantitative workload jobs seem insufficient to prevent over-fatigue in truck drivers from advancing. Contrarily, these control increasing interventions, may, in view of the present results, be quite effective when the promotion of job satisfaction in truck drivers is intended.

Four aspects of the present study require some consideration. Firstly, it should be noted that the proposed modified JD-C Model was not intended to incorporate all the variables required to explain the relationship between the psychosocial work environment and well-being in truck drivers. The modified model gives a more comprehensive picture of the psychosocial work environment of truck drivers. However, other psychosocial work factors which were not considered in this study (e.g. job insecurity, long and irregular working hours, contacts with fractious customers, and work-home interference) may influence health and well-being of these workers as well.
Secondly, the response rate in the present study was high. Almost two thirds of the truck drivers who were asked to participate in the study returned completed questionnaires. This high response may be due to the publicity given to the research project (e.g. distribution of bulletins) as well as the increased value employers and employees in the road transport industry in recent years have started to attach to occupational stress (De Croon et al., 2000a).

Thirdly, in this study self-completed questionnaires were employed to assess both independent and dependent variables. Consequently, unmeasured self-report bias (e.g. negative affectivity, mood and social desirability) may have amplified the observed main effects of job demands and job control. Although Spector et al. (2000) recently showed that the inflating effect of self-report bias may be not so prominent, we attempted to minimize this potential influence by using descriptive measures of the independent variables. Furthermore, it should be noted that self-report bias results in an underestimation rather than an overestimation of interaction effects. As set forth by Wall et al. (1996) the influence of self-report bias would be to inflate main effects of job demands and job control at the expense of the underlying interaction effects.

Fourthly, both independent and dependent variables were measured at one point of time. Because of the cross-sectional design, no firm basis was available for causal ordering. Stated differently, whether the occurrence of negative psychosocial work factors precede lowered psychological well-being or whether lowered psychological well-being precedes the occurrence of negative psychosocial work factors, or both, is not elucidated in this study.

Evidently, longitudinal research is needed to obtain a clearer picture of possible causal relations among job demands, job control and health and well being. More importantly, more Job Demand-Control intervention studies are required as only these studies can tell us whether changing demand or control promotes employee health and well-being. As reported by Jones et al. (1998) the small number of JD-C intervention studies is in violent contrast with the vast amount of studies of the effects of demand or control. The small number of JD-C intervention studies questions the practical validity of this occupational stress model. In the authors' opinion the practical as well as the theoretical validity of the JD-C Model may be improved with the inclusion of a more precisely defined job control construct and job demand concepts which are useful in describing the psychosocial work environment which is specific to a particular occupation.