

# Trends and diversity in the empirical use of Karasek's demand-control model (job strain): a systematic review

## *Tendências e diversidade na utilização empírica do Modelo Demanda-Controle de Karasek (estresse no trabalho): uma revisão sistemática*

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## **Abstract**

**Introduction:** Karasek's demand-control model has been used to investigate association between job strain and health outcomes. However, different instruments and definitions have been utilized to assess the exposure 'high strain at work', which makes difficult the comparison of results across studies. **Objective:** To describe the measurement instruments and the definitions adopted for the exposure variable 'job strain', according to the demand-control model, by observational studies published until 2010. **Methods:** Systematic review of observational studies published until December 2010, addressing the exposure 'job strain', measured according to the demand-control model and used the JCQ or its derivatives, since explicit. **Results:** Among 877 selected abstracts, 496 (57%) met the inclusion criteria. It identified a trend towards the increasing production literature on the subject. Most studies were sectional; found no relevant differences among study populations of men and women. Sweden, USA, Japan and Canada accounted for 57% of publications, mostly including more than 1000 participants and diverse occupations. Cardiovascular outcomes and their risk factors were the most studied (45%), followed by those related to mental health (25%). In 71% of the studies used the Job Content Questionnaire (from 2 to 49 items) and 19% of the total, the Swedish version (Demand-Control Questionnaire Swedish). Quadrants of the demand-control exposure were used in 51% of the work, but with different cutoff points; scores of the two dimensions were analyzed separately in 27%, and its ratio in 14% of the total. Social support at work was assessed in 44% of the studies. **Conclusion:** Karasek's model should continue to raise epidemiological studies and we hope that researchers face these theoretical and methodological issues outstanding.

**Keywords:** Psychosocial stress. Demand-control model. Work environment. Social determinants of health. Occupational health. Systematic review.

## Resumo

**Introdução:** O modelo demanda-controle de Karasek tem sido utilizado para investigar a associação entre estresse no trabalho e desfechos de saúde. Entretanto, diferentes instrumentos e definições têm sido adotados para aferir a exposição “alta exigência no trabalho”, o que dificulta a comparação de resultados entre estudos. **Objetivo:** Descrever os instrumentos e as definições adotadas para a variável de exposição “estresse no trabalho”, avaliada segundo o modelo demanda-controle, nos estudos observacionais publicados até 2010. **Métodos:** Revisão sistemática de estudos observacionais publicados até dezembro de 2010, que avaliaram a exposição “estresse no trabalho”, aferido segundo o modelo demanda-controle de Karasek e utilizaram o JCQ ou seus derivados, desde que explicitado nos textos. **Resultados:** Entre 877 resumos selecionados, 496 (57%) preencheram os critérios de inclusão. Identificou-se tendência à produção bibliográfica crescente no tema. A maioria dos estudos foi de natureza seccional; não encontramos diferenças relevantes entre as populações de estudo masculinas e femininas. Suécia, EUA, Japão e Canadá concentraram 57% das publicações, em sua maioria incluindo mais de 1.000 participantes e ocupações diversificadas. Desfechos cardiovasculares e seus fatores de risco foram os mais estudados (45%), seguidos por aqueles relacionados à saúde mental (25%). Em 71% dos estudos foi utilizado o *Job Content Questionnaire* (com 2 a 49 itens) e, em 19% do total, a versão sueca (*Demand Control Swedish Questionnaire*). Quadrantes de exposição demanda-controle foram utilizados em 51% dos trabalhos, mas com variados pontos de corte; escores das duas dimensões foram analisados em separado em 27%, e sua razão em 14% do total. Apoio social no trabalho foi avaliado em 44% dos estudos. **Conclusão:** O modelo Karasek deverá continuar a suscitar pesquisas epidemiológicas e esperamos que os pesquisadores enfrentem essas questões teóricas e metodológicas ainda pendentes.

**Palavras-chave:** Estresse psicossocial. Modelo demanda-controle. Ambiente de trabalho. Determinantes sociais da saúde. Saúde do trabalhador. Revisão sistemática.

## Introduction

Work-related stress has been identified as an important exposure in the development of adverse health outcomes among workers. One of the existing theoretical models, introduced by Robert Karasek in 1979<sup>1</sup> and developed over the subsequent decades, has already been tested in various countries with different economic and social characteristics. Its main hypothesis is that adverse health outcomes occur as a result of psychological strain stemming from increased psychological demands and scarce decision latitude regarding the work process (control) in high-strain work environments (job strain).<sup>1,2,3,4</sup> A third dimension – social support from work colleagues and superiors – was added to the model.<sup>5,6</sup> Its scarcity would be negative for health; in addition, it would increase the adverse effect of high-strain jobs (iso-strain).<sup>6</sup> The model's second hypothesis arises from a “positive effect” of stress: according to the author, active, motivated behavior, acquisition of knowledge, and a pattern of coping positively under conditions that are both psychologically demanding and that require high decision latitude (active jobs). On the other hand, the absence of psychological demands and decision authority results in a state of lack of motivation, reduced knowledge acquisition or even gradual loss of previously acquired skills (passive jobs).<sup>1,2,3,4</sup> The instrument initially proposed to measure social and psychological characteristics of the work environment was the Job Content Questionnaire (JCQ)<sup>1,2,3,4</sup>, which contains 49 items distributed across five dimensions, three of which pertained to the demand-control model: 9 items about psychological demands; 18 items about control in the work process (7 about skill discretion; 3 about decision latitude; and 8 about macro-level decision authority); 5 items about social support from colleagues and 6 about support from superiors in the work environment. Other dimensions are related to different work constructs: physical demands (5 items) and the lack

of job security (6 items). This instrument continues to be used and re-evaluated in collaborative research, including various countries around the world.<sup>7</sup>

There are other questionnaires with scales closely consistent with the theoretical model, although with small differences regarding the number of items, their content, and the answer options; such models include the questionnaire used by Theorell in Sweden (17 items)<sup>8,9</sup>, the Whitehall Study in England (10 items)<sup>9,10</sup>, the MONICA study used in Denmark<sup>9</sup>, and the Copenhagen Psychosocial Questionnaire (COPSOQ)<sup>9</sup>, which have been utilized because they are easily applied to multidimensional studies and large samples of the working-class population.<sup>11</sup> According to Kristensen et al.<sup>12</sup> and Pejtersen et al.<sup>13</sup>, the COPSOQ was designed to evaluate the psychosocial work environment, without, however, being limited to one theoretical model.

The empirical definitions of “high-strain job” are fairly diverse. The first step consists of calculating scores from the model’s dimensions that are obtained by use of algorithms<sup>4,9,14</sup> or by simple summation of scores obtained in each component item of a particular dimension<sup>8,10,14</sup>. Scores from the psychological demands and control dimensions are calculated separately. These scores can be used as continuous variables<sup>14,15,16</sup>, or categorized into quantiles (e.g. tertiles, quartiles, quintiles) of the scale scores of demand, control, and social support at work.<sup>16</sup> Various cutoff points are applied to the dimensions (categorized as medians or quantiles) to define Karasek’s quadrants, classifying individuals’ jobs as high-strain (high demands and low control), passive (low demands and low control), active (high demands and high control), and low-strain (low demands and high control), which establishes a gradient of highest to lowest exposure.<sup>1,2,3</sup> Another common way to define this exposure consists of calculating the ratio between the two scores<sup>8,14</sup>; similarly, this quotient can be evaluated as a continuous variable or categorized into quantiles.<sup>14,16</sup> Other authors even highlight

the use of a multiplicative interaction term (demand times control), adjusted by demand and control<sup>14,15</sup>; subtraction (demand minus control)<sup>14,15,16</sup>, by its log ratio<sup>14,15,16</sup>, by defining an arbitrary threshold<sup>14,15,17</sup>; and by excluding the portion of the population that is closest to the mean dimension scores.<sup>9,14</sup>

Despite the growing use of the demand control model in various countries, the results of review articles have been inconclusive, primarily for cardiac disease.<sup>18,19,20</sup> A systematic review (33 articles) showed moderate evidence between high psychological demands and lack of social support, as an isolated effect or in combination with high strain jobs (iso-strain), in the association with ischemic heart disease.<sup>19</sup> A meta-analysis of 14 prospective studies identified an association between high-strain jobs and coronary disease, when adjusted for age and sex (summary relative risk RRs 1.4; 95% CI 1.2-1.8), which was not confirmed in multiple models (RRs 1.2; 95% CI 0.9-1.4).<sup>20</sup> With respect to mental health, however, findings from the demand-control model have been shown to be more consistent, even among heterogeneous studies. The meta-analysis conducted by Stansfeld and Candy<sup>21</sup> showed evidence that high-strain (combined odds ratio, ORc 1.8; 95% CI 1.1-3.1) and low social support at work (ORc 1.3; 95% CI 1.2-1.4) are primarily associated with common mental disorders.

Using a literature review (1990-2008) on the demand-control model, Sultan-Taïeb et al.<sup>22</sup> estimated the prevalence of cardiovascular diseases, mental and musculoskeletal disorders and their association with high-strain job among 24,486 French workers. They reviewed 13 studies on cardiovascular disease (RR varied from 0.63-2.45 for morbi-mortality), seven on mental disorders (RR of 1.2-3.3), and 11 on musculoskeletal disorders (RR of 0.94-2.3). The estimated combined prevalences of the three classes of disorders were 19.6% among men, 28.2% among women, and 23.2% among women and men combined. The fractions attributable to cardiovascular morbidity were 4.9-21.5% for men, 0-15.9%

for women, and 6.5-25.2% for women and men combined; fractions attributable to cardiovascular mortality were 7.9-21.5% for men, 2.5% for women, and 6.5-25.2% for men and women combined. Fractions attributable to mental disorders were 10.2-31.1% for men, 5.3-33.6% for women, and 6.5% for men and women combined. Finally, fractions attributable to musculoskeletal disorders ranged from 0-19.6% for men, 0-26.8% for women, and 3.4-19.9% for men and women combined. All together, these reviews underscore substantial heterogeneity among methods.

To our knowledge, only two studies investigated the different ways of operationalizing the job strain exposure variable in the association with health outcomes. The first study showed that, independently of the cutoff point or the way in which demand and control were combined, high-strain jobs were associated with higher levels of systolic blood pressure but not with diastolic blood pressure, although the magnitude of association varied with respect to the method utilized.<sup>15</sup> Another study evaluated the construct validity of different ways to operationalize the high-strain variable and determined that, among hospital workers, the variable most associated with occupational characteristics and the best predictor of health outcomes (e.g., physical and mental health) was the subtraction term between demand and control.<sup>2,16</sup>

In this article, a systematic review of studies published up to December 2010 was conducted to describe the instruments and definitions used for the job strain exposure variable when measured according to the demand-control model. In addition, this study aimed to evaluate the frequency with which the dimension "social support at work" was used, either as an exposure variable, confounder, or effect modifier – called iso-strain – as postulated theoretically.

## Methods

This is a systematic review of articles indexed in PubMed up to December 2010.

The search strategy included the following terms restricted to the "title" and "abstract" fields, as well as these MESH terms: ("job stress" OR "work stress" OR "work-stress" OR "job strain" OR Karasek) AND (demand OR control OR "social support") AND "Case-Control Studies"[Mesh] OR "Cohort Studies"[Mesh] OR "Cross-Sectional Studies"[Mesh] OR "Health Surveys"[Mesh] OR "Longitudinal Studies"[Mesh] OR "Epidemiologic Studies"[Mesh] OR "Retrospective Studies"[Mesh] OR "Prospective Studies"[Mesh] OR Surveys or survey). The retrieved summaries were evaluated independently by two of the authors (MGMA and YMHM) and discordances were resolved by consensus. Inclusion criteria were as follows: a) full-text articles published in English, French, Spanish or Portuguese; b) descriptive or analytic observational studies that evaluated the association between job strain (exposure variable) and health outcomes; c) explanation in the text (abstract or the full text) about the use of Karasek's demand-control model to analyze the exposure; and d) use of the Job Content Questionnaire (JCQ) or similar versions of this instrument for the "work stress" variable. All articles that met these criteria were included, regardless of the number of items analyzed by dimension or the evaluation of only one dimension. When abstracts did not contain all of the required information, the full-text articles were read to determine whether they should be included or not. Exclusion criteria were as follows: a) "work stress" as an outcome, a confounding or intervening variable; b) studies in which the model or instrument used to measure the variable "work stress" was not clearly defined, neither in the abstract nor in the full article; c) qualitative studies; and d) studies conducted on animals. The following variables were extracted from the selected articles: time and place of publication; study design; socio-demographic characteristics of the study population (sex, age and occupation); outcomes; measurement instrument (such as JCQ, DCSQ, and others; size: number of items); dimensions

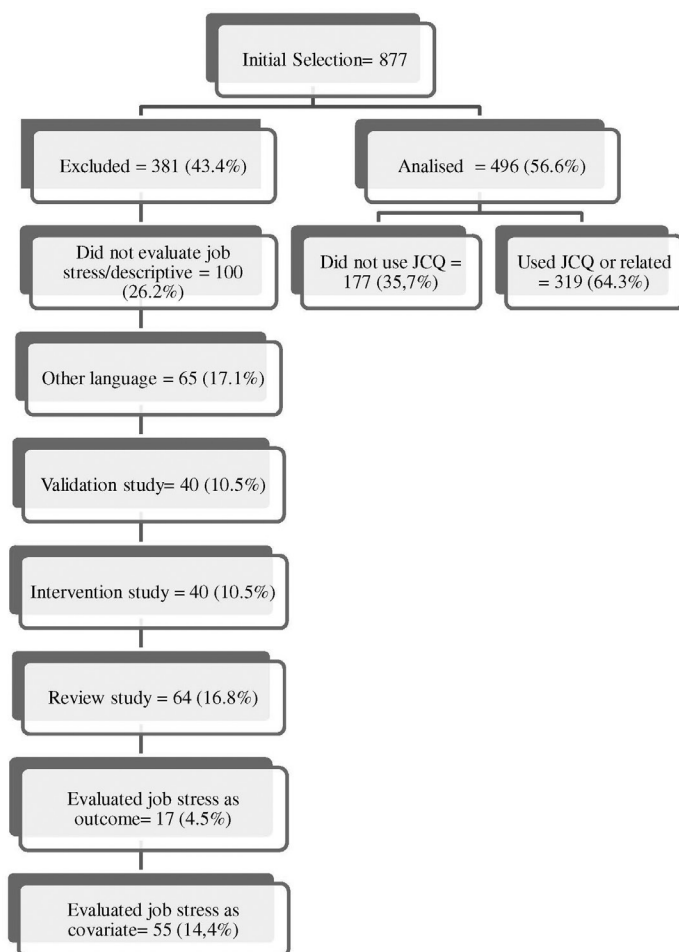
evaluated (demand, control, or social support at work) and the definition used for the exposure (demand-control model) variables (isolated or combined dimensions; cut-off points). Data extraction was carried out by the same authors (MGMA and YMHM) and consolidated into a database in the SPSS, version 13.0.<sup>23</sup> References were stored in Endnote, version X.<sup>4</sup>

With respect to ethical considerations, there was no conflict of interest in the present study. As this study dealt with bibliographic research that used only public databases and did not involve human subjects in accordance with Resolution 196/96<sup>25</sup>, it was not submitted to the Research Ethics Committee.

## Results

The search strategy yielded 877 articles, of which 381 (43.4%) did not fit the inclusion criteria: 165 did not evaluate work stress or were published in other languages; 144 were not association studies and 72 studies analyzed “work stress” as an outcome variable or a confounder. Of the 496 remaining studies (56.6% of the initial selection), 319 (64.3%) evaluated the demand-control model as proposed by Karasek (Figure 1) and were thus used in the final sample included in this review.

With respect to the period of publication, it was observed that, starting in the 1980s – just after Karasek proposed his



**Figure 1** - Scheme of the Selection's Process of Papers on Demand-Control Model.

**Figura 1** – Representação Esquemática do Processo de Seleção de Artigos sobre Modelo Demanda-Controle.

theoretical model –, the production of articles continued to grow: 2% by 1989, 18% in the 1990s, and 80% in the 2000s. The majority of these articles were published in European countries (51%), the United States (17%), Japan (12%), and Canada (8%). Brazil contributed with 2% of the analyzed studies (data not shown). Cross-sectional study designs were the most frequent (62%), as were cardiovascular outcomes (40%), including their risk factors such as hypertension (8%; data not shown) (Table 1).

Sample sizes varied from 31 to 48,066 individuals and approximately one-third of the articles included samples with fewer than 500 individuals. Most samples included individuals of both sexes (65% of included articles) and those aged under 50 years (73%); 15.4% of the studies did not provide information about workers' ages. Only one-fifth of the studies were restricted to a single occupational group, but it was more common to find studies with samples based on general populations of workers (not restricted to a single occupational category) (44%) (Table 2).

With regard to the work stress measurement instrument, the most common was the Job Content Questionnaire (73%); however, the number of items varied considerably (2 to 49 items; data not shown). Of the evaluated articles, 49% used only one way to define the exposure (data not shown). In many studies (46%), the principal exposure variable was defined according to Karasek's quadrant term, emphasizing the high strain quadrant, where high demand and low control are simultaneously present, compared to the "low strain" quadrant, where low demand and high control coexist. The second most frequent exposure definition was the dimension score as a continuous variable, followed by the demand-control ratio (16%). Among the studies that evaluated more than one way of defining the exposure variable, 18% evaluated quadrant terms and separate score dimensions, while 6% used ratios and the score of each dimensions. The cut-off point most frequently used to define Karasek's quadrants (47%) and dimensions (18%) was the median. Social support at work was evaluated in 49% of

**Table 1** - Characteristics of published studies (n = 319) in Pubmed until December 2010.

**Tabela 1** - Características dos estudos publicados (n = 319) no Pubmed até dezembro de 2010.

Variables	n	%
<b>Period of publication</b>		
1980 – 1989	6	1.9
1990 – 1999	58	18.2
2000 – 2010	255	79.9
<b>Region</b>		
Europe	163	51.1
North America	80	25.1
Asia	59	18.5
Oceania	11	3.4
Latin America	6	1.9
<b>Study design</b>		
Sectional	199	62.4
Cohort	79	24.8
Case-control	41	12.9
<b>Outcomes</b>		
Cardiovascular	127	39.8
Mental health	78	24.5
General health status	47	14.7
Osteomuscular	20	6.3
Other	47	14.7



**Table 2** - Sociodemographic characteristics of published studies (n = 319) in Pubmed until December 2010.

**Tabela 2** - Características sociodemográficas dos estudos publicados (n = 319) no Pubmed até dezembro de 2010.

Variables	n	%
<b>Sample size</b>		
<500	104	32.6
500 – 999	45	14.1
1000 - 4999	93	29.2
5000+	77	24.1
<b>Sex</b>		
Both	208	65.2
Men	55	17.2
Women	49	15.4
Not stated	7	2.2
<b>Age (years)</b>		
< 50	232	72.7
50+	38	11.9
Not stated	49	15.4
<b>Occupational group</b>		
Unrestricted	141	44.2
2 + groups	106	33.2
1 group	64	20.1
Not stated	8	2.5

the studies, either as a separate exposure variable, confounder or an effect modifier, but the combined effect of high strain and low social support at work – iso-strain (an effect modifier according to Johnson et al) – was evaluated in only 10% of the studies (Table 3). Some studies that evaluated social support at work as an exposure variable did so with instruments other than the JCQ (data not shown).

When the use of the two principal instruments – the JCQ and the DCSQ – were compared, the JCQ was found to have been utilized primarily in the United States (21%), Japan (15%), and Canada (9.9%), while the DCSQ has been used mostly in Sweden (75%).

With regard to study design, both instruments were more commonly used in cross-sectional studies (67% JCQ; 50% DCSQ). Case-control studies used the DSQ (27%) more frequently than the JCQ (7%). Males, with or without the female populations, were more commonly evaluated in studies

that used the JCQ or DCSQ. With respect to occupation, the JCQ was more frequently used to investigate groups with two or more occupations such as public servants (39%), while the DCSQ was more frequently used in samples without occupational restrictions (59%). Among groups that had only one occupation, the JCQ was more frequently used (23%) than the DCSQ (17%). The principal outcomes studied were consistent with the group of selected studies: cardiovascular disease, followed by mental disorders and general health status.

For both instruments, the most common way to evaluate the principal exposure were the quadrants; when the JCQ was applied, however, the quadrant term was followed by dimensions as continuous or quantile variables (32%) and demand-control ratio (12%). With the DCSQ, the second most common evaluation tool was the ratio (31%), followed by dimensions assessed as continuous variables or quantiles (22%). Regarding the number of items, the

**Table 3** - Exposure variables used in published studies (n = 319) in Pubmed until December 2010.

**Tabela 3** - Variáveis de exposição utilizadas nos estudos publicados (n = 319) no Pubmed até dezembro de 2010.

Variables	n	%
<b>Instrument</b>		
JCQ	234	73.4
DSCQ	64	20.1
Occupational Matrix	11	3.4
Whitehall	10	3.1
<b>Main Exposure</b>		
Quadrants	146	45.8
Dimensions	102	32.0
Demand-control ratio	50	15.7
Other	18	5.6
Not stated	3	0.9
<b>Secondary exposure</b>		
Dimensions	83	26.0
Quadrants	42	13.2
Demand-control ratio	18	5.6
Other	12	3.8
Did not evaluate	164	51.4
<b>Cut-off points (quadrants)</b>		
Median	150	47.0
Tertile	16	5.0
Quartile	8	2.5
Mean	6	1.9
Other	10	3.1
Not stated	6	1.9
<b>Cut-off point (dimension)</b>		
Median	58	18.2
Tertile	56	17.6
Quartile	25	7.8
Mean	8	2.5
Other	9	2.8
Not stated	2	0.6
<b>Evaluated social support at work</b>		
No	163	51.1
Yes	155	48.6
<b>Evaluated "iso-strain"</b>		
No	285	89.3
Yes	33	10.3

JCQ ranged from 2 to 49 items, when the study included all of the five instrument's dimensions; while the DCSQ was more often measured with 11 items (52%) or 17 items (24%), when the "social support at work" dimension was included.

To define the quadrant term as the

principal exposure when using the JCQ, the main cut-offs were the median (34%), tertiles (26%), and quartiles (15%). When separate dimensions were used as the principal exposure, tertiles and the median were equally common (35%). It was not possible to define cut-offs implemented



with the DCSQ due to lack of sufficient information.

## Discussion

There is compelling evidence that the prevalence of many non-communicable chronic diseases – such as cardiovascular, mental, and musculoskeletal diseases, among others – is associated with chronic exposure to stress.<sup>26</sup> This, on the other hand, is increasingly associated with the modern economic and social development in organizations and society at large.

In this article, it was possible to identify increasing scientific production related to psychosocial exposures at work, involving researchers in several countries, as part of an effort to solve knowledge gaps in the field – for example, the option to study both male and female populations of workers, as well as specific occupational groups. The articles concentrate on two instruments: the JCQ and DCSQ. Challenges remain, however: confronting important methodological questions, such as the multiple ways of utilizing these instruments and the definition and analysis of exposure.

Many researchers have used the Job Content Questionnaire, whether it has been adapted and trans-culturally validated or not, demonstrating that they recognize it as a more accepted instrument to evaluate social and psychological characteristics of the work environment.

Research on this topic has been greater in countries considered to be developed (e.g., the United States, Canada, Sweden, the United Kingdom, and Japan), characterized by an important process of deindustrialization and growth of the service sector in their economies since the 1990s; but these publications have also begun to appear in countries in various stages of industrialization. Longitudinal observation of these studies shows that in the initial decade (1980s), researchers addressed this topic in Sweden, the United States, and Japan exclusively (with just one study); in the last decade (2000s), however, all continents were doing so, with

the former countries and Canada producing most of the work (data not shown).

The frequent assertion about the lack of studies among female populations in the specialized literature could not be confirmed<sup>27,28,29,30</sup>, as a similar proportion of studies was found among exclusively female (15%) and male populations (17%). Regarding studies that investigated both men and women, men were slightly overrepresented (55%). Additionally, the proportion of studies including women has increased over the decades: 9% in the 1980s, 35% in the 1990s, and 56% in the last decade. Overcoming this limitation is especially important, considering the complex interactions between gender and social class as well as the marked gender gap in existing jobs in many countries, giving rise to a different work load for women, particularly with respect to increased domestic tasks.<sup>27,28,30</sup>

There are still few approaches to specific occupational groups, perhaps because these studies are directed at the psychosocial aspects of the work environment, and, therefore, have potential applications for various occupations.<sup>28</sup> More recently, however, an increasing number of studies address specific occupations.

Although studies selected for this review aimed to evaluate the “work stress” construct as per the model proposed by Karasek<sup>1,2,3,4</sup>, there were great differences in the instruments used (even when the JCQ and its substitutes were used): the number of items included, cut-off points used to define the exposure categories, and their analytical framework, which may indicate how difficult it is to identify a model related to certain outcomes. This variability makes it difficult to synthesize results for studies that used the DCSQ, but especially for those that used the JCQ, which shows greater variability in its use.

In addition, there was a lack of references about the standardization of measuring instruments in many texts, because few published studies have reported on the evaluation of the psychometric properties of these instruments.

It is of concern that the analytic strategy becomes an attempt to “harmonize” conceptual differences as though they were only differences between instruments, as seems to have been the attempt of Fransson et al.<sup>31</sup> According to the authors, after the “harmonization” based on five items of the psychological demand scale and six items of the control scale of the JCQ and DCSQ, the data from 70,751 participants of six cohorts were combined for analyses. A total of 14 different instruments were used to generate complete and abridged scales (with removal of items). The goal was to evaluate the comparability of different measures of psychological demand, control, and high-strain job (depending on the variability of items in each scale) with the “complete scale” (DCSQ). According to the authors, there were high correlations among the complete and the abridged scales of psychological demand and control, which should include a minimum of three items.

The “social support” dimension has been rarely studied as an effect modifier of the combined exposure of high-strain jobs (iso-strain), as suggested.<sup>29</sup> It is thus important that new research be performed in this direction, given the relevance of social support to a conceptually broader evaluation of the psychosocial work environment.<sup>32</sup>

The more comprehensive review that researchers of this study chose to conduct enabled them to gain perspective on the scientific production resulting from the use of the demand-control model, at the expense of summarizing the present findings by outcome measures.

Another limitation of this study is that the search was restricted to the PubMed database. However, given the large number of publications that use the demand-control model to measure the exposure variable in the association with various health outcomes, it was possible to assess the diversity and lack of standardization of this evaluation.

Results from this review confirm, to some extent, the interest of researchers

from all continents in a significant subset of chronic diseases and in the relevance of the demand-control model in their research. It is possible that multiple factors contribute to this interest. In particular, there are factors that lead to adverse conditions in the work environment and that have health repercussions for workers<sup>33</sup>, such as profound changes in the working world (nature of work; increasing substitution of processes oriented toward computerization; greater number of jobs in the service sector: changes in employment relations that are occurring throughout the world<sup>3,26</sup> and that are driven by the global economy. The author of the demand-control model has modified his theoretical assumptions of expanding the idea of control to the work process and life in general; he has also updated his own theory of stress upon which the model is based.

Despite the limitations of this study and those identified in the literature on the subject, authors of this study hope that the results will encourage other researchers to confront the new theoretical and methodological issues raised by the use of Karasek's theoretical model as well as his measurement instrument, the JCQ, now in its 2.0 version.<sup>26</sup>

As a suggestion, an explanation of the results according to different ways of evaluating the job strain variable and its dimensions could contribute to a better understanding of which dimensions of job stress are associated with different outcomes. In this way, it would be possible to identify the most appropriate interventions to prevent these different outcomes.

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