The demand-control model for job strain: a commentary on different ways to operationalize the exposure variable

Modelo demanda-controle de estresse no trabalho: considerações sobre diferentes formas de operacionalizar a variável de exposição

Modelo demanda-control de estrés en el trabajo: consideraciones sobre diferentes formas de operacionalizar la variable de exposición

Abstract
Demand-control has been the most widely used model to study job strain in various countries. However, researchers have used the model differently, thus hindering the comparison of results. Such heterogeneity appears in both the study instrument used and in the definition of the main exposure variable – high strain. This cross-sectional study aimed to assess differences between various ways of operationalizing job strain through association with prevalent hypertension in a cohort of workers (Pro-Health Study). No difference in the association between high job strain and hypertension was found according to the different ways of operationalizing exposure, even though prevalence varied widely, according to the adopted form, from 19.6% for quadrants to 42% for subtraction tertile. The authors recommend further studies to define the cutoff for exposure variables using combined subjective and objective data.

Psychological Stress; Hypertension; Occupational Exposure

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Resumo
O modelo demanda-controle tem sido o mais usado para estudar estresse no trabalho em diversos países. Entretanto, os pesquisadores o utilizam de forma heterogênea, o que tem dificultado a comparação dos resultados dos estudos. Essa heterogeneidade se expressa no instrumento usado e na forma de definir a principal variável de exposição – alta exigência. O objetivo deste estudo seccional foi o de avaliar diferenças entre variadas formas de operacionalização do estresse no trabalho por meio da associação com hipertensão arterial prevalente, numa coorte de trabalhadores (Estudo Pró-Saúde). Não foi encontrada diferença na associação entre alta exigência no trabalho e hipertensão arterial com as diferenças de operacionalização da exposição, ainda que sua prevalência tenha variado bastante, segundo a forma adotada (de 19,6% [quadrantes] a 42% [tercil da subtração]). Recomenda-se a realização de novos estudos que definam o ponto de corte para as variáveis de exposição por meio de dados subjetivos e objetivos combinados.

Estresse Psicológico; Hipertensão; Exposição Ocupacional
Introduction

Among the existing theoretical models to assess psychosocial strain in the workplace, the demand-control model proposed by Robert Karasek in 1979 has been the most widely used in various countries. The model's premises are: (a) adverse health reactions result from simultaneous exposure to heavy psychological demands and limited control over the work process (highly demanding work, or job strain) \(^1\,^2\,^3\); (b) there is a “positive effect” from stress in the face of elevated psychological demand and control (active jobs). On the contrary, the simultaneous scarcity of psychological demand and control would lead to demotivation, decreased learning, and gradual loss of acquired skills (passive jobs) \(^1\,^2\,^3\).

A recent review of the theme identified a wide variety of ways to use available instruments and to define and operationalize the target exposure, which could help explain the inconsistency in results between the various studies \(^4\). Exposure – high job strain – has been defined by quadrants (combining high demand and low control), the ratio between demand and control, the logarithm of the ratio, the interaction term between demand and control scores, and the subtraction between demand and control scores, among others \(^4\). The outcomes studied with this theoretical model feature cardiovascular diseases and their risk factors, such as arterial hypertension \(^4\). The results have also been inconclusive, since different meta-analyses have reached diverging conclusions \(^5\,^6\). One possible explanation lies in the great variation in the definition of exposure \(^4\,^7\).

This study thus aimed to assess potential differences resulting from various ways of operationalizing job strain, by analyzing the association between this exposure and arterial hypertension.

Methods

The current study was developed as part of the Estudo Pró-Saúde\(^8\), a cohort of technical and administrative employees at a university in Rio de Janeiro, Brazil, and included the employees that participated in phases 1 (1999) and 2 (2001) and had their blood pressure measured (n = 3,226) \(^9\).

The instrument used to measure job strain was the Demand, Control, Social Support Questionnaire (DCSQ), adapted to Portuguese within the project's scope \(^9\). The options for answers in the dimensions “psychological demand” and “control” were presented on a Likert scale (1-4), ranging from “often” to “never/almost never”. Each answer was scored from 1 to 4, classifying items with reverse scores on the two scales. The scores were obtained by adding the items in each dimension, and varied from 5-20 (demand) and 6-24 (control).

Continuous scores were transformed into exposure indicators using the most common approaches found in the literature. High demand was defined by the interval above the upper quantile of the median, tertile, and quartile, and low control as the interval equal to or below the lower quantile of the median, tertile, and quartile. The combination generated the four quadrants. High strain was also defined by the ratio, logarithm of the ratio, and subtraction of the demand and control scores and subsequent classification by quantiles.

The study outcome was arterial hypertension measured in 2001 \(^9\). We compared the estimates for the association between hypertension and the various ways of operationalizing exposure, as long as they combined the scores from the two dimensions. Hypertension was defined as systolic arterial pressure ≥ 140mmHg and diastolic ≥ 90mmHg or self-reported use of antihypertensive medication, with an affirmative answer to the question “Have you taken any medication in the last 7 days?” and referring to the complementary open question (“Which?”), categorized as antihypertensive by two independent coders.

Statistical analyses used robust Poisson linear regression. All analyses were performed in the R software version 2.13 (The R Foundation for Statistical Computing, Vienna, Austria; http://www.r-project.org).

Results

Table 1 shows prevalence rates for exposure that combine psychological demand and control on the job, varying from 19.6% (quadrants) and 42% (subtraction tertile). The same table shows the prevalence ratios for arterial hypertension according to the different ways of operationalizing exposure. The values are close or equal to one and show no difference between each other.
Table 1

Prevalence of exposure for different approaches to operationalizing job strain according to the demand-control model and prevalence ratio (PR) for job strain and arterial hypertension *, with 95% confidence intervals (95%CI).

<table>
<thead>
<tr>
<th>Operationalization</th>
<th>n</th>
<th>%</th>
<th>PR</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant **</td>
<td>3,108</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low strain</td>
<td>808</td>
<td>26.0</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>High strain</td>
<td>609</td>
<td>19.6</td>
<td>0.98</td>
<td>0.81-1.19</td>
</tr>
<tr>
<td>Active</td>
<td>592</td>
<td>19.0</td>
<td>1.01</td>
<td>0.83-1.23</td>
</tr>
<tr>
<td>Passive</td>
<td>1,099</td>
<td>35.4</td>
<td>1.14</td>
<td>0.97-1.34</td>
</tr>
<tr>
<td>Continuous ratio ***</td>
<td>3,108</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertile ratio</td>
<td>3,108</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High strain</td>
<td>1,041</td>
<td>33.5</td>
<td>0.96</td>
<td>0.84-1.10</td>
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<tr>
<td>Quartile ratio</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High strain</td>
<td>778</td>
<td>25.0</td>
<td>0.97</td>
<td>0.84-1.12</td>
</tr>
<tr>
<td>Logarithm of continuous ratio</td>
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<td>0.94</td>
<td>0.75-1.18</td>
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<tr>
<td>Logarithm of tertile ratio</td>
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<td></td>
<td></td>
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<tr>
<td>High strain</td>
<td>1,041</td>
<td>33.5</td>
<td>0.98</td>
<td>0.86-1.12</td>
</tr>
<tr>
<td>Logarithm of quartile ratio</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High strain</td>
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<td>0.97</td>
<td>0.84-1.12</td>
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<td>Continuous subtraction #</td>
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<tr>
<td>Subtraction tertile</td>
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<td></td>
<td></td>
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<tr>
<td>High strain</td>
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<td>0.83-1.07</td>
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<tr>
<td>Subtraction quartile</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High strain</td>
<td>980</td>
<td>31.5</td>
<td>0.97</td>
<td>0.85-1.11</td>
</tr>
</tbody>
</table>

* Obtained by robust Poisson linear regression;
** Obtained by median demand plus median control;
*** Obtained by division of demand by control;
# Obtained by difference between demand and control.

Discussion

Quadrants are the most traditional way of operationalizing exposure. The categories obtained with this method can present discrepancies due to the cutoff for the psychological demand and control scores. Some authors use the means for the study population or national means. Others set the percentage arbitrarily (most commonly 20%) for the high-risk group (high job strain), but the most widely used way is still the median, all defined as a function of distribution in the population.

Use of the ratio may also fail to adequately classify exposure, since division of the two numbers may produce the same result when it actually represents different demand and control situations. For example, an individual that scores 10 for demand and 6 for control, both considered low – or conceptually a passive job – shows a ratio of 1.67, while another individual that scores 20 for demand and 12 for control – conceptually a high strain job – obtains the same ratio of 1.67. The logarithm of the ratio inherits all the possible errors from the ratio. Likewise, subtraction can also produce an exposure classification error, since there are different values for each dimension that produce the same result when the values are equidistant.

Courvoisier & Perneger and Campos considered subtraction the measure that best represents high and low job strain. Schnall et al. did not indicate the best form of operationalization and stated that all forms were associated with the outcome.

Differences reported in the literature on prevalence of job strain suggest the need to assume some classification error in defining exposed versus unexposed and the relationship between the two groups. A possible explanation would be issues related to the instrument's validity, as identified in other studies in Brazil.

Studies on the relationship between job strain and arterial hypertension have been inconclusive as to the association's statistical significance. The threshold for strain may not be high enough to
Resumen

El modelo demanda-control ha sido el más usado para estudiar el estrés en el trabajo en diversos países. No obstante, los investigadores lo utilizan de forma heterogénea, lo que ha dificultado la comparación de los resultados de los estudios. Esa heterogeneidad se expresa en el instrumento usado y en la forma de definir la principal variable de exposición -alta exigencia-. El objetivo de este estudio seccional fue el de evaluar las diferencias entre las variadas formas de operacionalización del estrés en el trabajo, mediante la asociación con la hipertensión arterial prevalente, en una cohorte de trabajadores (Estudio Pro-Salud). No se encontraron diferencias en la asociación entre alta exigencia en el trabajo e hipertensión arterial con las diferentes formas de operacionalizar la exposición, pese a que su prevalencia haya variado bastante, según la forma adoptada de 19,6% (cuadrantes), a 42% (tercil de la sustracción). Se recomienda la realización de nuevos estudios que definan el punto de corte para las variables de exposición por medio de datos subjetivos y objetivos combinados.

Contributors

M. G. M. Alves y V. M. Braga participaron en la conceptualización, análisis y interpretación, y deciden la versión final para publicación, y fueron responsables por todas las facetas del trabajo para garantizar la precisión y integridad de sus componentes. E. Faerstein y C. S. Lopes participaron en la conceptualización y en la versión final para publicación. W. Junger participaron en la conceptualización, análisis y interpretación, y deciden la versión final para publicación.

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Estrés Psicológico; Hipertensión; Exposición Profesional
References


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