Depression in high voltage power line workers

Depressão em trabalhadores de linhas elétricas de alta tensão

Abstract

Objective: To investigate the association between effort-reward imbalance and depressive symptoms among workers in high voltage power lines. **Methods:** A cross-sectional study among 158 workers from an electric power company in Northeast Brazil. The main independent variables were the Effort-Reward Imbalance Model (ERI) dimensions and the main dependent variable was the prevalence of depression, as measured by the Center for Epidemiologic Studies Depression (CES-D) scale. Data were analyzed by multiple logistic regression techniques. **Results:** The group of low reward workers presented a depression prevalence rate 6.2 times greater than those in the high reward group. The depression prevalence rate was 3.3 greater in workers in the situation of imbalanced effort-reward than in those in effort-reward equilibrium. **Conclusions:** The prevalence of depression was strongly associated with psychosocial factors present in the work of electricity workers.

Keywords: Mental Health. Depression. Psychosocial Factors. Occupational Health. Energy Supply.

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Resumo

Objetivo: Investigar a associação entre desequilíbrio esforços-recompensas no trabalho e sintomas depressivos em trabalhadores de linhas elétricas de alta tensão. **Métodos:** Estudo de corte transversal realizado em 158 trabalhadores de uma empresa de energia elétrica no Nordeste do Brasil. As dimensões do modelo esforço-recompensa (ERI) constituíram as variáveis independentes principais e a variável resposta foi depressão, medida pela escala *Center for Epidemiologic Studies Depression* (CES-D). Os dados foram analisados com técnicas de regressão logística múltipla. **Resultados:** Trabalhadores no grupo de baixa recompensa apresentaram prevalência de depressão 6,2 vezes maior em relação àqueles no grupo de alta recompensa. A prevalência de depressão foi 3,3 vezes maior entre os trabalhadores em condição de desequilíbrio esforço-recompensa do que entre aqueles em situação de equilíbrio. **Conclusões:** A prevalência de depressão estava fortemente associada às dimensões de esforços e recompensas presentes no trabalho dos eletricitários.

Palavras-chave: Saúde Mental. Depressão. Fatores Psicossociais. Saúde do Trabalhador. Abastecimento de Energia.

Introduction

Work has an important role in the health and life of individuals, because it is an instrument of socialization and an opportunity for growth, personal development and construction of the individual and group identity, in addition to being a source of income. However, the conditions and forms of the work process organization may create positive situations for individuals or become risk factors for their mental and physical health.

The organizational restructuring process that the world is going through has led to greater demands on workers, especially those of a psychological nature. In this context, psychosocial work factors have been emphasized as they are occupational stressors with important repercussions on the health of individuals[1,2].

According to the International Labour Organization (ILO)[3], psychosocial work factors result from the interaction between the work environment (the work organization, conditions and content) and workers' individual conditions (their adaptability, culture, abilities and out-of-work personal needs) which may influence their health status, according to their perception and experiences. Several studies[4,5,6,7,8,9] have reported that psychosocial aspects, such as the effort involved in work activities and the rewards provided by work can influence the mental health status of populations of workers.

The Effort-Reward Imbalance Model (ERI)[10] stands out among the theoretical models proposed to study psychosocial work factors. This model includes the assessment of two components related to effort and reward, one of which is intrinsic and the other extrinsic. Work conditions (demands, requirements, responsibilities), which are an indication of effort, and rewards (support, salary, safety, career development opportunities) comprise the extrinsic component. The intrinsic component refers to the personal style of adjustment and it is known as overcommitment. The latter

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dimension assesses the set of attitudes and types of behavior that result in overcommitment, combined with the great need for recognition and approval. Consequently, overcommitted workers would respond to the effort-reward imbalance with a higher level of stress, when compared to workers not overcommitted to work[11].

The model emphasizes the importance of the social role of work, enabling workers to feel recognized and valued and emphasizing their sense of belonging to a group[12]. In addition, the model predicts that the lack of reciprocity between the effort made and the reward received causes stress reactions with consequences for physical and mental health[10,11].

The ERI has been used to assess the relationship between psychosocial factors and health status in several countries: Germany[8], Brazil[11], England[13], Belgium[14], Japan[15], Finland[16] and Norway[17].

The present study aimed to investigate the association between effort and reward at work and the prevalence of depressive symptoms among high voltage power line and equipment maintenance workers.

Methods

Study design and population

A cross-sectional epidemiological study was conducted with male workers (n=161) of the high voltage power line and equipment maintenance sectors of an electric power company of the states of Bahia and Sergipe, in Northeast Brazil. This company serves industrial consumers and distributors, has a total installed capacity of 10,618 MW (10.9% of the Brazilian production), generates 49,596 GW/h and transmits electric energy to the South, Southeast, North and mainly Northeast regions of Brazil, serving approximately 50 million inhabitants. Workers are responsible for preventive maintenance and repairing of electric equipment in electric sub-stations, power plants and transmission lines. All workers who belonged to the maintenance sector were included in this study.

Of the 161 workers included, 158 (98.2%) accepted to participate in the study, two refused and one was absent during data collection. Participation was voluntary and data were collected using a questionnaire designed for this investigation and applied through individual interviews, which were conducted by the company's occupational physician, during working hours, between April and July 2008. Research objectives were explained to workers of each sector in a previous meeting and an informed consent form was read and signed at the beginning of each interview.

Data collection

A standardized questionnaire was used, including questions about socio-demographic characteristics; lifestyle; workers' occupational activities; psychosocial work factors, assessed by the Effort-Reward Imbalance Questionnaire (ERI-Q); general health aspects; mental health, assessed by the Center for Epidemiologic Studies Depression scale (CES-D to assess depression) and abusive alcohol use, assessed by the CAGE questionnaire.

Effort-Reward Model

The questionnaire used to evaluate Effort-Reward Imbalance (ERI-Q) is comprised of 23 questions, including three scales: effort (six items), reward (11 items) and overcommitment to work (six items).

The effort scale assesses the quantitative workload (three items); qualitative workload (one item); one item measures the increase in total workload with time and one item measures the physical workload (used only with occupations in which physical activity is a relevant component, such as manual tasks). The reward scale can be subdivided into three subscales: recognition, job promotion and work safety[18]. The effort and reward scales are assessed through responses that vary in level of agreement or disagreement, with scores from 1 to 5. Thus, the effort scores in the scale with six items

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vary from 6 to 30. The higher the score, the greater the effort made and the higher the perception of demands as stressors. The reward scale varies from 11 to 55; the lower the score, the lower the perception of job rewards[18].

The overcommitment scale includes six items, with positive responses that vary from "completely disagree" to "completely agree", with scores between 1 and 4[18]. Items identify the difficulties in ignoring or avoiding work duties, and disproportionate impatience and irritability. The higher the score, the greater the possibility of an individual experiencing overcommitment to work.

The ERI was adequate to assess aspects of effort and reward imbalance at work in Brazilian contexts. Internal consistency, as assessed by Cronbach's alpha coefficient, was good for the three scales, varying from 0.76 to 0.86 in a study conducted with health professionals and university workers[11] and from 0.70 to 0.90 in a study with bank workers[19]. The structure of factors, obtained through factorial analysis, was consistent with the components of the theoretical model construct in both studies[11,19].

CES-D Scale

The depressive state of workers was assessed by the Center for Epidemiologic Studies Depression scale (CES-D)[20]. This tracking instrument, designed by the National Institute of Mental Health (NIMH) of the United States, aim to identify depressive mood in population studies. It measures the presence of current depressive symptoms, with an emphasis on the affective component and depressive mood[17]. The CES-D scale was validated in different populations[21,22] and used in several countries such as Germany[8], Japan[9], Holland[23], Luxemburg[24] and Brazil[25].

The CES-D scale was designed from a set of items of previously validated depression scales. The main components of depressive symptoms were obtained from the clinical literature, including depressive mood,

feelings of guilt and low self-esteem, abandonment, hopelessness, psychomotor retardation, loss of appetite and sleep disorders. It is a self-applied instrument comprised of 20 items, which are related to depressive mood, behavior and perception[20]. The responses to each of these items were given according to the frequency with which each type of behavior or symptom was present in the week prior to questionnaire application. The total score varies from zero to 60 and scores equal to or higher than 16 points are considered to be suggestive of depression[25].

CAGE

Studies that use the CAGE concluded that this was a good instrument to detect disorders associated with alcohol abuse. It is a widely used instrument because of its easy application and wide acceptance[26,27]. In addition, it has only four yes/no questions. The cut-off point adopted – two or more positive responses – defines alcohol abuse.

Data analysis

Psychosocial work aspects were the main independent variable, comprised of the Effort-Reward Model dimensions (overcommitment to work, effort, reward and effort-reward imbalance).

Initially, the distribution of scores of each scale with a descriptive purpose was analyzed. Next, the analysis of the association between the effort-reward model dimensions and depression was performed. The effort, reward and overcommitment scales were dichotomized for this analysis to form two groups in each dimension: high and low effort, high and low reward, and high and low overcommitment. The cut-off point used for this dichotomization was the mean value obtained in each scale.

The main predictive variable was the Effort-Reward Imbalance ratio, calculated as follows: effort / (reward x correction factor) (available at: http://www.uniduesseldorf.de/MedicalSociology/fileadmin/Bilder_Dateien/download/

ERI_Texte_und_Grafiken/Eriquest_Psychometric_information.pdf. Accessed on December 26th, 2010). Values close to zero indicate a favorable condition (related to low effort and high reward) and values higher than one indicate a greater effort made and lower reward received. The score was used as a binary measure (presence or absence of imbalance), based on the continuous variable (with logarithmic transformation), and the cut-off point was in the highest tertile. The ERI ratio was used as a dichotomous variable (presence or absence of imbalance), with the cut-off point in the highest tertile, following the example of certain studies that used this type of stratification[9].

The response variable was determined by the presence of depressive symptoms, assessed by the CES-D scale.

The following covariables were analyzed as potential confounding variables: age (categorized as less than 40 years/40 to 49 years/50 years or more); level of education (categorized as primary education/secondary education/higher education); alcohol use (does not drink or casual drinking/drinks one time per week or more); physical activity practice out of work (yes/no); leisure activity (yes/no); general health conditions (good/average/poor), monthly income (up to R$ 2,500.00 / higher than R$ 2,500.00); length of time working for the company (categorized into quartiles); length of time working in the job (categorized into quartiles); length of time working in the sector (categorized into quartiles); marital status (married or cohabitating/other status); report of first degree relatives (parents or siblings) who work or have worked in the same company; and place of residence (capital city/countryside).

Data were processed with Statistical Package for the Social Sciences (SPSS: applications guide. Version 9.0. Chicago: SPSS, 1991). Multiple logistic regression analyses were performed to analyze the association between the main independent variable (dimensions and situation of Effort-Reward Imbalance analyzed in different models) and the dependent variable (Depression), adjusting for variables considered to be relevant.

Covariables were pre-selected individually, adopting the following as criteria: the epidemiological importance and a p-value lower than 0.25 in the maximum likelihood test for the coefficient significance. Logistic regression analysis was applied to the set of pre-selected variables and the final model was obtained according to the Wald test, with a p-value equal to or lower than 0.20 to include each variable in the model. In the analysis of effect modification, the terms-products of the main exposure variable with the potentially changing variables were excluded one by one, provided that they showed a p-value higher than 0.10 in the Wald test[28]. The Odds Ratios (OR) obtained from the logistic regression analyses were converted into Prevalence Ratios (PR) and their respective confidence intervals were estimated using the Delta method[29].

The previously described procedures of analysis of association between the model dimensions and depression were performed separately for each of the three scales (effort, reward and overcommitment to work) and for the effort-reward ratio. Thus, researchers sought to obtain the best model for each dimension separately. All previously described covariables were tested for each model.

The present study was approved by the Research Ethics Committee of the Climatério de Oliveira Maternity Hospital of the *Universidade Federal da Bahia* (process number 026/2008 of February 27th, 2008).

Results

Characteristics of the population studied

All 158 workers studied had a mean age of 45 years with a standard deviation (sd) of 8.6; 37.3% were in the 50 to 68 year age group and 70.0% had worked for ten years or more in the company. The mean length of time working in the job was 14.4 years (sd= 9.8) and the mean length of time working in the sector was 12.6 years (sd= 9.3). The most

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frequent work shift was the 8-hour shift, although 86.7% of employees worked on-call shifts. With regard to task assignment, 39.9% worked in transmission line maintenance, 41.1% in the sub-station maintenance, 15.8% in power plant maintenance, and 3.2% performed technical-administrative tasks. In terms of monthly income, 57.6% earned up to R$ 2,500.00 (approximately US$ 1,500.00) and 42.4% earned more than R$ 2,500.00. Current or previous work of relatives (parents or siblings) in the company was reported by 25.3% of the population and 14.6% had already provided services to the company before being permanently employed.

Alcohol use was reported by 86.1%, of which 49.5% were regular drinkers (drinking three times per week or more). Alcohol abuse as measured by the CAGE questionnaire was found in 39.6% of the 136 workers who mentioned alcohol use. Smoking was reported by 13.3% of workers, of which 30.4% had previously smoked. Physical activity practice (regular or not) was reported by 55.1% of participants. With regard to level of education, 49% had completed secondary school or less. In terms of marital status, 80.4% reported they were cohabiting and 92.4% had children.

With regard to psychosocial factors associated with the situation causing occupational stress, as assessed by the ERI, 48.7% of workers were in the high effort group, with a mean score of 14.93; 39.9% were in the low reward group, with a mean score of 46.54; and 53.2% were categorized as overcommitted to work. The imbalance between effort made and rewards received was experienced by nearly 1/3 of the population studied (32.3%) (Table 1).

The prevalence of depressive symptoms, as estimated by the CES-D, was 18.4%. Current use of anxiolytic drugs was reported by 3.8% of workers and 11.4% had previously used them.

The prevalence of depression was particularly higher in individuals aged less than 40 years, who had worked for five to nine years in the company, earned up to R$ 2,500.00, did not practice regular physical activities and reported their health was "poor" (Table 2).

The highest prevalence of depression

Table 1 - Distribution of the effort-reward model scales among High Voltage Power Line Workers, Bahia-Sergipe, Brazil, 2008.

Tabela 1 - Distribuição das escalas do modelo esforço-recompensa entre os trabalhadores de linhas de energia elétrica de alta tensão, Bahia-Sergipe, Brasil, 2008.

ERI model scales	n	%	Minimum value	Maximum value	Mean (SD)
Effort			6	28	13.73 (5.07)
Low	81	51.3			
High	77	48.7			
Reward			17	55	46.54 (7.48)
Low	95	60.1			
High	63	39.9			
Overcommitment to work			9	23	14.93 (2.15)
Yes	84	53.2			
No	74	46.8			
Effort-reward ratio			-	-	-
< 1	107	67.7			
> 1	51	32.1			

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Table 2 - Prevalence of Depression, according to selected characteristics, among High Voltage Power Line Workers, Bahia-Sergipe, Brazil, 2008.
Tabela 2 - Prevalência de Depressão, segundo características selecionadas, em trabalhadores de linhas de energia elétrica de alta tensão, Bahia-Sergipe, Brasil, 2008.

Depression	Depression		
	N	n	%
Age group (years)			
< 40	38	13	34.2
40-49	61	12	19.7
50 or more	59	4	6.8
Length of time working in the company (years)			
< 5	19	2	10.5
5-9	28	12	43.0
10 or more	111	15	13.5
Monthly income			
Up to R$ 1,000.00 (US$ 600.00)	05	01	20.0
Between R$1,001.00 and R$ 2,500.00 (US$ 601.00 - 1,500.00)	86	17	20.0
More than R$ 2,500.00 (>US$ 1,500.00)	67	11	16.4
Close relatives in the company			
Yes	40	8	20.0
No	118	21	17.8
Physical activity			
Regular	87	11	12.6
Irregular	71	18	25.4
Self-reported health			
Good	67	11	16.4
Average	88	16	18.2
Poor	3	2	66.7

was found in workers with low reward (35.5%) and in situations of imbalance between effort and reward (39.2%) (Table 3).

The prevalence of depression was strongly associated with low reward work, even when adjusted for the effects of covariables selected in the final model of analysis, age and income (PR = 6.16; 95%CI 2.09; 18.22). In addition, depression was also found to be associated with high effort and high overcommitment to work, although not statistically significant, after adjusting for age and income (Table 3).

The prevalence of depression was 3.35 times higher in conditions of imbalance of the Effort-Reward Imbalance model, after adjustment for age and commitment to work (Table 3).

Discussion

There was an association between the effort-reward model dimensions and depression among workers of the equipment and transmission line maintenance sector of an electricity generation and transmission

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Table 3 - Prevalence (%) of Depression and crude and adjusted Prevalence ratios (PR) and confidence intervals (95%) according to the dimensions of Effort-Reward, among High Voltage Power Line Workers, Bahia, Sergipe, Brazil, 2008.
Tabela 3 - *Prevalência (%) de Depressão e Razões de Prevalência (RP) bruta e ajustada com respectivos intervalos de confiança (IC 95%) segundo dimensões do Modelo Esforço-Recompensa, em trabalhadores de linhas de energia elétrica de alta tensão, Bahia-Sergipe, Brasil, 2008.*

Modelo esforço-recompensa	Prevalência de depressão			RP bruta	IC95%	RP ajustada	IC95%
	N	n	%				
Esforço							
Baixo	81	5	6.2				
Alto	77	24	31.2	5.05	(2.03 ; 12.56)	2.62*	(0.88 ; 7.84)
Recompensa recebida							
Alta	95	6	6.3				
Baixa	63	23	35.5	5.78	(2.50 ; 13.39)	6.16*	(2.09 ; 18.22)
Comprometimento							
Baixo	74	6	8.1				
Alto	84	23	27.4	3.38	(1.45 ; 7.84)	2.31*	(0.80 ; 6.62)
Razão desequilíbrio esforço-recompensa							
Equilíbrio	107	9	8.4				
Desequilíbrio	51	20	39.2	4.66	(2.29 ; 9.61)	3.35**	(1.48 ; 7.62)

* Ajustada por idade e renda. *[Adjusted by age and income]*
** Ajustada por idade e comprometimento excessivo com o trabalho. *[Adjusted by age and excessive commitment to work]*

company of the states of Bahia and Sergipe. Low rewards and experiencing a situation of effort-reward imbalance maintained a statistical association with the occurrence of depression, even after adjustment for potential confounders selected in the final analysis model.

The profile of the workers in this study revealed that this is a population with stable jobs who have worked for this electric power company for a long time. The fact that some workers have already provided services before being permanently employed and that close relatives have worked or still work for the company reveals the existence of a positive relationship between workers and the company. On the other hand, the long length of time working in the same sector and job, which shows the lack of professional development throughout the years of work, may act as potential risk factors for mental health. The prevalence of depressive symptoms observed in the workers studied (18.4%) was lower than the results found in studies with Japanese workers (43.2%[9] and 39%[30]) and those found among male workers aged between 41 and 56 years of a national electricity and gas company in France (24.9%)[31]. However, it should be emphasized that the cut-off point used for the CES-D in the French study[31] was 17, whereas the present study used a cut-off point of ≥16, using the same scale of 20 items with a maximum score of 60 points. National studies that adopted the CES-D scale are mainly aimed at elderly individuals and other population groups not suitable to be compared with the population of this study. The three dimensions of exposure of the Effort-Reward Imbalance Model (high effort, low reward and overcommitment to work) had a high prevalence and overcommitment was the

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one that stood out the most (53%). The prevalence of the situation of effort-reward imbalance was high (32.0%) and similar to that reported in other studies[9, 32].

The presence of depressive symptoms was closely associated with low reward at work and the situation of effort-reward imbalance. This result is similar to that observed in a study conducted with a general German population, which found a strong association between depression and the effort-reward imbalance, even when adjusted for several covariables[8].

One limitation of the present study was its cross-sectional design, which prevented the assessment of cause-and-effect relationships between exposure to the risk (ERI) and outcome (depressive symptomatology), as the measures of interest of exposure and effect are evaluated simultaneously, not enabling clear cause-and-effect relationships to be established.

In the present study, the occurrence of the healthy worker's effect is unlikely, as few cases were lost, due to depression being a rarely fatal chronic disease and to this population having stable jobs. Nonetheless, the possibility of loss of information about workers who had retired, died from other diseases or left the company in a previous period should be taken into consideration.

Another methodological limitation was the reduced number of individuals in this study, despite the high rate of responses obtained (near 100% with only two refusals). Data analysis was hindered by the small number of stratified groups, resulting in excessively wide confidence intervals that reduce the accuracy of estimates.

In addition, it should be emphasized that the instrument (CES-D) used to assess the prevalence of depression is not a means of diagnosis, although being widely used in epidemiological studies. However, it is possible that this instrument has under- or overestimated the effect, as its validation for the specific purposes of the present study was not performed.

The studies that used the CES-D in populations of workers did not mention the validation of this instrument either. A study conducted with 284 Brazilian university students aged between 17 and 39 years, using the same cut-off point of the present study ($\geq$16), found a sensitivity of 100%, specificity of 75% and incorrect classification index of 24%[24]. Studies conducted with Hispanic patients, cared for in primary health centers of the United States, found a sensitivity of 73-92% and specificity of 72-74%, with a cut-off point of $\geq$21[33].

The value of 39.6% of positive CAGE (alcohol abuse) found is very high and could be associated with cultural and work aspects of this population that need to be analyzed. Alcohol abuse may reflect the workers' strategy to cope with depression, delaying the outcome. In this context, the actual prevalence of depression would be masked by alcoholism, reducing the possibility of its being identified by the cross-sectional design adopted in this study. Despite the methodological limitations, the results found confirm the adequacy of the Effort-Reward Imbalance model to assess the association between psychosocial work factors and the effects on workers' mental health electric transmission and equipment maintenance.

Authors declared there were no conflicts of interest.

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