Public Health Nutrition: 24(2), 260–266 doi:10.1017/S1368980020004243

Relationship of work-related stress with obesity among Brazilian female shift workers

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Submitted 14 April 2020: Final revision received 4 September 2020: Accepted 21 October 2020: First published online 26 October 2020

Abstract

Objectives: To explore the relationship between work-related stress and obesity among female shift workers. Additionally, we also aimed to test the interaction between shift work and work-related stress in this association.

Design: A cross-sectional study was conducted among Brazilian female shift workers. Work-related stress was assessed through a demand–control questionnaire (Job Stress Scale). Work-related stress was defined by the presence of high psychological demands and low control at work. The obesity cases were defined as those with a BMI of 30 kg/m^2 or more. Multivariate Poisson regression with robust variance was used to obtain the prevalence ratios (PR) and their respective 95 % CI.

Setting: A group of industries located in southern Brazil in 2017.

Participants: Four hundred and twenty female workers aged 18–59 years.

Results: The overall prevalence of obesity was 30 % (95 % CI: 25·6, 34·4), and the presence of work-related stress was identified in 24 % (95 % CI: 19·9, 28·1) of the sample. We found an indication of interaction between work-related stress and night shift work on obesity ($P = 0·026$). After adjusting for confounding factors, work-related stress was associated with a 71 % greater probability of obesity (PR = 1·71; 95 % CI: 1·02, 2·87; $P = 0·042$) among female night shift workers.

Conclusions: In this study, we revealed that exposure to work-related stress and night shift work were associated with obesity among female shift workers. Furthermore, the prevalence of obesity was high among female shift workers.

Keywords
Job stress
Obesity
Shift work
Night work
Occupational health
Women

Obesity is a pandemic condition with several social and financial consequences. It has been characterised as a multifactorial health condition resulting from economic, social, behavioural, genetic, and environmental issues[1–3]. In addition, obesity has been associated with a higher prevalence and earlier incidence of other comorbid diseases, as well as a higher risk of death, especially among women[4,5].

Work-related stress is a consequence of the physical and emotional responses to a high level of job demands and little control over one's work[6]. The prevalence of occupational stress varies by country[7–9]. A number of studies suggest that individuals who experience this type of stress have physical and emotional problems including alterations in circadian rhythm patterns and increased body weight[10–12].

Relatively few studies have investigated the association between work-related stress and obesity in both general and worker populations, and the findings have been inconclusive[11,13–18]. Additionaly, a systematic review including eight cohort studies showed that only two reported a signficant association between occupational stress and weight gain in women; however, no study identified this relationship in men[14]. Stress seems to activate the allostatic system through chronic elevation of cortisol, which alters the responses of the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis. These changes cause important hormonal effects that justify the relationship between stress and obesity[10,13,19,20].

The shift work system is becoming increasingly common around the world owing to the continuous

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production process established by the industrial sector[21,22]. Shift work, especially at night, has been associated with increased health impairments, including work-related stress and obesity[23–26]. This aspect has not been sufficiently explored in literature; however, a study failed to identify a interaction between work-related stress and shift work for obesity in a group of female workers[27]. In the Brazilian context, evidence of this association is scarce. Thus, we aimed to explore the relationship between work-related stress and obesity among female shift workers. Additionally, we also aimed to test the interaction between shift work and work-related stress in this association.

Methods

A cross-sectional study was conducted among the female employees of a group of industries, functioning 24 h a day, located in southern Brazil. This group is principally engaged in the manufacture of plastic products for exportation and had approximately 2600 permanent employees in 2017. This was a consecutive sample of adult women aged 18 years or more. All women who had been working in the same shift for more than 3 months were considered eligible for inclusion in the present study (*n* 583). Women who reported being pregnant (at any gestational stage) and any physical or cognitive limitations that would interfere with the completion of the questionnaire were excluded. Data collection was performed by trained personnel during a face-to-face interview between June and August 2017.

We used the international classification of nutritional status, based on BMI (calculated by dividing body weight in kg by height in m^2), for the assessment of the dependent variable. Obesity cases were defined as those with a BMI of 30 kg/m^2 or more[28]. Body weight and height were measured for each participant. Weight measurements (in kg) were made using a digital anthropometric scale (Omron® model HN-289LA) that can accurately measure up to 150 kg, and a resolution of 100 g and height measurements (in cm) were obtained using a Seca Bodimeter 208 (Hamburg, Germany) portable stadiometer with scale increments of 1 mm and a capacity of 95 to 190 cm (Sanny® model Slim Fit). Both body weight and height were measured twice, and the mean value was computed and used to calculate individual BMI.

A standardised, pre-tested questionnaire was used to obtain data on work-related stress and demographic, socio-economic, reproductive, behavioural and occupational characteristics. Work-related stress was assessed using a validated Brazilian Portuguese version of the Job Stress Scale[29]. This scale is a Brazilian version of the Swedish Demand–Control–Support Questionnaire based on the Job Content Questionnaire that was designed to screen for psychological demands, intellectual discernment, decision-making authority and social support in the workplace[18,30]. This scale includes seventeen items scored on a four-point Likert scale, with response options ranging from 1 (never) to 4 (often). The JSS total score ranges between 0 and 44. The sum of the values of intellectual discernment and decision-making authority represent control over work. In this study, the social support dimension was not taken into account because it is not required for the determination of job stress. After confirming the normality of the distribution of the dimension scores, they were dichotomised into 'low' and 'high' based on the mean score identified in the sample. Work-related stress was defined using the quadrants proposed by Karasek[29,31]: high psychological demands (↑ D) and low control at work (↓ C). The cut-off points for high psychological demands and low control at work were 14·17 (SD 2·34) and 15·35 (SD 2·78), respectively. Cronbach's α for the overall scale was 0·679, indicating adequate internal consistency.

Data regarding age (18–30, 31–40 and > 40 years), skin colour (white or other), marital status (with partner or without partner), schooling (≤ 8, 9–11 and ≥ 12 years), income (family income categorised into tertiles), leisure physical activity (physically active or inactive), number of daily meals (≤ 3 or ≥ 4), use of sleep medicine (no or yes), hours of sleep (≤ 5 or > 5), menstrual cycle (normal, irregular or no menstruation), parity (nulliparas, one pregnancy or two or more pregnancies) and work shift (day or night) were also obtained for sample description and analysis of potential confounders. The work schedule, provided by the company and confirmed by the participants, was classified as: day shift (between 06.00 and 14.00) or night shift (22.00 onward).

Data were entered into Epidata software with double data entry. Data analysis was performed using Stata 12.0 (StataCorp). Modified Poisson regression with robust variance was used to estimate unadjusted and adjusted prevalence ratios (PR) with 95 % CI[32]. We used this approach because the estimated effect size based on OR derived from logistic regression models can be misleadingly high when the prevalence of the dependent variable is high. The following models were sequentially created, based on the conceptual determination model[33], to investigate the association between work-related stress and the occurrence of obesity: model I was unadjusted; model II was adjusted for socio-demographic variables; model III was adjusted for model II plus behavioural variables and model IV was adjusted for model III plus reproductive variables. Additionally, the analysis was stratified by work shift (day/night), and the Mantel–Haenszel test statistic was performed to estimate an interaction between shift work and work-related stress exposures on obesity. A value of $P < 0·05$ was considered significant in all tests.

Results

A total of 583 women were selected for the study. Subsequently, 133 women (22·8 %) were excluded

https://doi.org/10.1017/S1368980020004243 Published online by Cambridge University Press

according to the pre-established inclusion criteria, two (0·44 %) were excluded owing to incomplete data as well as 28 women (4·8 %) who were in menopause were also excluded. Finally, the data of 420 women aged 18–59 years (mean 35 (SD 8·3) years) were analysed. Considering 73 % statistical power and a 95 % CI, the final sample had the power to detect a 39 % of difference in the prevalence rate of obesity by occupational stress status.

Most of the participants were machine operators in the company's production sector (62·4 %). The employees had worked at the company for an average of 73·1 (SD 67·3) months (about 6 years). The participants' general characteristics are reported in Table 1. The majority of the participants were white (67·8 %), lived with a partner (56·2 %), had studied for 9 to 11 years (78·6 %), did not regularly engage in leisure time physical activity (77·4 %), ate four or more meals a day (59·8 %), obtained more than 5 h of sleep at night (79·4 %) and 29·3 % reported never having been pregnant. In addition, 75·7 % of the sample worked the day shift (Table 1).

Table 1 depicts the prevalence of obesity and work-related stress according to demographic, socio-economic, behavioural, reproductive and work shift characteristics. The prevalence of obesity in the entire sample was 30 % (95 % CI: 25·6–34·4), and work-related stress was identified in 24 % (95 % CI: 19·9, 28·1). A higher prevalence of obesity was observed in women who were older (especially among those aged 31 to 40 years), ate three or fewer meals a day, slept five or fewer hours and who had experienced two or more pregnancies. In addition, night shift work was significantly associated with the occurrence of obesity.

Table 2 describes the associations between work-related stress and obesity. After adjusting for confounding factors, work-related stress showed no significant association with obesity in the overall sample (PR = 1·14; 95 % CI: 0·83, 1·57; $P = 0·408$). Nevertheless, it was observed an indication of interaction between work-related stress and night shift work on obesity ($P = 0·026$). After adjusting for confounding factors, work-related stress was associated with a 71 % greater probability of obesity (PR = 1·71; 95 % CI: 1·02, 2·87; $P = 0·042$) among female night shift workers.

Discussion

This study investigated the association between work-related stress and shift work and the occurrence of obesity in a sample of Brazilian female workers. We found an indication of interaction between exposure to work-related stress and night shift work on obesity. Additionally, the prevalence of obesity was high among this sample of female shift workers.

The overall prevalence of obesity and work-related stress was 30 % and 24 %, respectively. Previous studies on women reported similar results in the context of obesity: 23·4 % in Asia and 23·9 % in Brazil[4,34]. On the contrary, the literature presents conflicting results regarding the prevalence of work-related stress[8,35,36]. Estimates have ranged from 7 % to 38·1 %[8,35] and have been based on different methods of assessment and identification of high psychological demands and low control over work[29,37,38]. We used a Brazilian version of the Swedish Demand–Control–Support Questionnaire based on the Job Content Questionnaire[29]. This was appropriate as the Job Content Questionnaire was originally developed for the industry sector context[39]. In this study, the scale's psychometric properties were satisfactory and similar to another Brazilian studies[29,40]; the internal consistency was slightly below the recommended level of 0·70.

In this study, we identified a significant association between work-related stress and the occurrence of obesity among night shift workers. Previous studies investigating this relationship in women have reported inconsistent results[16,17]. Work-related stress seems to be associated with increased body weight[17]. It also seems to have an independent association on metabolic syndrome[41]. In addition, a prospective study observed a positive and significant linear trend between high work demands or occupational stress and body weight gain[35]. However, in a recent systematic review, such an association was not identified[16].

The association between work-related stress and obesity may be explained by underlying biological mechanisms[13,15,17]. Research in this field has mainly explored chronic social stressors, including harassment at work, conflicts with colleagues and a lack of control and decision-making latitude, that lead to work-related stress,[17] as well as factors such as socio-demographic and genetic characteristics of workers[13]. The presence of work stress seems to activate the allostatic system that involves the sympathetic nervous system and hypothalamic–pituitary–adrenal axis[19,20]. This response may cause physiological changes in cortisol production, leading to an increase in body weight and the development of obesity. This process can also lead to increased glucose and insulin production, resulting in another homoeostatic series of hormonal disruptions involved in adipose tissue production (resistance to leptin: satiety hormone; increased action of ghrelin: appetite hormone and increased release of neuropeptide Y: production of adipose tissue)[10,13,19,20].

Night shift work was significantly associated with the occurrence of obesity as well as the interaction between work-related stress and obesity. These results are consistent with previous findings, where exposure to shift work, including night work, was demonstrated to be an important factor in the risk of certain health complications, including the development of obesity[24,25,42–44]. Working at night goes against the body's natural pattern, causing physiological changes related to circadian rhythm (sleep–wake cycle deregulation). Therefore, working at night may affect the metabolism, leading to weight gain, changes in dietary behaviour and physical activity and development of stress[43,45]. In addition, the physiological changes resulting

https://doi.org/10.1017/S1368980020004243 Published online by Cambridge University Press

Table 1 Sample characteristics and prevalence of obesity and occupational stress according to demographic, socio-economic, occupational and behavioural characteristics in female shift workers in southern Brazil, 2017 (*n* 420)

			Obesity (BMI ≥ 30 kg/m²)			Work Stress* (Job Stress Scale)		
Variable	*n*	%	*n*	%	*P*-value	*n*	%	*P*-value†
Age (years)					0·002†			0·481
18–30	141	33·6	27	19·1		33	23·4	
31–40	155	36·9	58	37·4		42	27·1	
41 or more	124	29·5	41	33·1		26	21	
Skin colour					0·331†			0·405
White	284	67·8	83	29·2		67	23·6	
Other	135	32·2	43	31·9		34	25·2	
Marital status					0·075†			0·093
Without partner	184	43·8	48	26·1		38	20·7	
With partner	236	56·2	78	33·1		63	26·7	
Schooling (years)					0·229‡			0·806
≤ 8	56	13·3	21	37·5		15	26·8	
9 a 11	330	78·6	98	29·7		77	23·3	
≥ 12	34	8·1	7	20·6		9	26·5	
Household income (minimum wages)					0·534‡			0·247
≤ 3	114	27·2	30	26·3		21	18·4	
4 a 5	169	40·3	55	32·5		45	26·6	
≥ 6	136	32·5	41	30·2		35	25·8	
Leisure physical activity					0·308†			0·532
Physically active	95	22·6	26	27·4		23	24·2	
Inactive	325	77·4	100	30·8		78	24·0	
Number of daily meals					0·010†			0·419
≤ 3	169	40·2	62	36·7		42	24·9	
≥ 4	251	59·8	64	25·5		59	23·5	
Use of sleep medicine					0·336†			0·026
No	382	91·0	113	29·6		97	25·4	
Yes	38	9·0	13	34·2		4	10·5	
Hours of sleep					0·038†			0·219
≤ 5 h	86	20·6	33	38·4		24	27·9	
> 5 h	332	79·4	92	27·7		77	23·2	
Menstrual cycles					0·300†			0·608
Normal cycles	252	60·0	69	27·4		63	25·0	
Irregular cycles	61	14·5	19	31·2		16	26·2	
Do not menstruate	107	25·5	38	35·5		22	20·6	
Parity					0·088‡			0·775
Nulliparas	123	29·3	29	23·6		27	22·0	
One pregnancy	140	33·3	41	29·3		36	25·7	
Two or more pregnancy	157	37·4	56	35·7		38	24·2	
Work shift					0·015†			0·396
Day	318	75·7	86	27·0		23	22·5	
Night	102	24·3	40	39·2		78	24·5	

BMI, body mass index.
*↑ D: High psychological demand; ↓ C: low control over work.
†*P*-value for Pearson's χ^2 test for proportional heterogeneity.
‡*P*-value for linear trend test.

from work stress seem to be similar to those resulting from night work exposure[43,46]. There is scarce evidence in the literature about the relationship between work-related stress and obesity in female shift workers. However, a recent prospective study conducted with nurses in the USA revealed that in the presence of job strain, night work led to an increase in body weight and BMI[27]. In addition, night shift duration had an inverted U-shaped association with weight gain[27].

The association of shift work with overweight or obesity was previously explored in the Brazilian context[47–50]. These studies showed conflicting results and most of them were conducted in healthcare workers[48,49]. Night work exposure seems to promote a greater increase in BMI in men than in women[47]; however, another studies suggested that night shift is related to BMI or overweight increases in both sexes[48,50]. Additionally, changing from day to night work seems to influence weight gain and BMI increase[49].

To the best of our knowledge, this is the first study to explore this relationship in a sample of Brazilian female shift workers. The strengths of this study include the use of a representative sample of women working in shifts for at least 3 months (the minimum exposure period required to produce adverse health effects)[27] Also, we used instruments that have been validated for use in the assessment of work-related stress in Brazilian population groups[29]. However, the results of this investigation must

https://doi.org/10.1017/S1368980020004243 Published online by Cambridge University Press

Table 2 Unadjusted and multivariate adjusted values for the association between work-related stress and obesity in the total sample and stratified by work shift (day *v.* night), of female shift workers in the Southern Brazil, 2017 (*n* 420)

Work stress	Obesity (BMI ≥ 30 kg/m²)		Model I			Model II			Model III			Model IV		
Job stress scale	*n*	%	PR	95 % CI	*P*-value	PR	95 % CI	*P*-value	PR	95 % CI	*P*-value	PR	95 % CI	*P*-value
Total sample (*n* 420)					0·349			0·405			0·418			0·408
Absent	92	28·8	1			1			1			1		
Present (↑D ↓C)	34	33·6	1·16	0·84, 1·61		1·15	0·83, 1·59		1·14	0·83, 1·57		1·14	0·83, 1·57	
Day shift (*n* 318)					0·750			0·673			0·703			0·713
Absent	66	27·5	1			1			1			1		
Present (↑D ↓C)	20	25·6	0·93	0·61, 1·43		0·91	0·59, 1·41		0·92	0·59, 1·42		0·92	060, 1·42	
Night shift (*n* 102)					0·008*			0·008*			0·038*			0·042*
Absent	26	32·9	1			1			1			1		
Present (↑D ↓C)	14	60·9	1·85	1·17, 2·92		1·83	1·17, 2·85		1·70	1·03, 2·80		1·71	1·02, 2·87	

BMI, body mass index.
↑D: High psychological demand; ↓C: low control over work; PR: prevalence ratio; model I: unadjusted analysis; model II: adjusted for age, skin colour, marital status, schooling and household income; model III: adjusted for model II + leisure physical activity, number of daily meals, use of sleep medicine and hours of sleep; model IV: adjusted analysis for model III + menstrual cycles and parity; *P*-value for Wald heterogeneity test of proportions.
*Statistically significant ($P < 0·05$).

be interpreted within the context of an important limitation. Owing to the cross-sectional design, we acknowledge that reverse causation cannot be completely ruled out; therefore, the association between work-related stress and obesity should be interpreted with caution. Another limitation is that male shift workers were not included in this study. For this reason, no comparison by sex could be performed. Despite these limitations, the present study explored important confounding factors in the multivariate analysis, and work shift was explored as a potential effect modifier.

The findings indicated coherence and consistency in the associations explored, including a high prevalence of obesity and work-related stress, especially among women aged 31 to 40 years, who experienced hormonal changes, did not get adequate sleep and worked in the night shift (factors that alter metabolic rate). Therefore, these results support the possibility of a biological mechanism underlying the association between work stress and obesity. However, bidirectionality in this relationship cannot be ruled out. Finally, this study included only women who worked in fixed shifts, which contributes to reinforcing the consistency of the association between work-related stress and obesity in female night shift workers.

Conclusion

In this study, we revealed that exposure to work-related stress and night shift work were associated with obesity among female shift workers. Furthermore, the prevalence of obesity was high among shift workers. These results demonstrate that efforts to reduce work-related stress should be a prevention strategy to reduce the risk of obesity in night shift workers.

Acknowledgements

Acknowledgements: MTO received research productivity grants from the Brazilian Council for Scientific and Technological Development – CNPq (process numbers 307257/2013-4 and 307175/2017-0). A.G. received a post-doctoral fellowship from CNPq (process n. 152923/2018-7), and J.C.S. received a master fellowship from the Brazilian Federal Agency for Support and Evaluation of Graduated Education – CAPES (Financing Code 001). *Financial support:* This work received financial support from the Social Service of Industry of Rio Grande do Sul – SESI-RS, Brazil. The funding service had no role in the study design, data collection and analysis, decision to publish or preparation or approval of the manuscript. *Conflict of interest:* The authors declare no conflicts of interest. *Authorship:* J.C.daS., H.T. and M.T.A.O. participated in all stages of the research, from project design, data

collection, analysis, construction and review of the article. A.G. participated in data analysis, construction and review of the article. G.H.C. participated in the review of the article. *Ethics of human subject participation:* 'This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Research Ethics Committee of the University of Vale do Rio dos Sinos, RS, Brazil (project number 2·057·810/2017). Written informed consent was obtained from all subjects.'

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