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Association between occupational stress, work shift and health outcomes in hospital workers of the Recôncavo of Bahia, Brazil: the impact of COVID-19 pandemic

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Abstract

The aim of this study was to ascertain the level of occupational stress before and during the COVID-19 pandemic, how it changed and its association with health outcomes of hospital workers in the Recôncavo of Bahia, Brazil. A longitudinal study was conducted with 218 hospital workers over 18 years old. A semi-structured questionnaire was used for collecting sociodemographic, occupational, lifestyle, anthropometric and health data. The main exposures were occupational stress, assessed through Job Content Questionnaire and classified according to the Demand-Control Model and reported shift work. Health outcomes considered were nutritional status assessed by BMI, waist circumference and body fat percentage, health self-perception and cardiovascular risk factors. We used McNemar χ^2 or Wilcoxon tests to compare the levels of exposure and outcome variables before and during the pandemic, and OR to evaluate associations between changes in occupational stress and shift work with health outcomes. During the pandemic, participants reported increased occupational stress and shift work and lower self-perceived health and had higher BMI and cardiovascular risk factors, compared with before the pandemic. No association was observed between change in occupational stress and health outcomes. However, increased amount of shift work was related to increased BMI in the overall sample (OR 3·79, 95 % CI (1·40, 10·30)) and in health workers (OR 11·56; 95 % CI (2·57, 52·00)). These findings support calls to strengthen labour policies to ensure adequate working conditions for hospital workers in context of the COVID-19 pandemic.

Key words: Occupational stress: Shift work: Obesity: Cardiovascular risk factors: COVID-19 pandemic

Work in the hospital environment has several characteristics that can impact the health of its workers, such as insufficient staff, low salaries, irregular work regimens and exposure to infections and other health hazards. These can result in work overload, sleep deprivation, sedentary lifestyle, inadequate nutrition, and, consequently, stress and occupational and chronic diseases[1,2].

In many settings globally, the COVID-19 pandemic has enhanced these characteristics. There has also been an emergence of situations that had previously been infrequently experienced by hospital workers, such as increased stress in patient care, a feeling of high risk in performing duties, concern for their own health and the health of family members, and self-isolation[3,4]. Moreover, the increasing number of hospitalisations due to COVID-19 has led to changes in the structure and organisation of hospital work, imposing on workers longer and more irregular working hours, a multiplicity of functions, and sometimes repetitive or more physically intensive work[5,6].

This scenario has been related to psychological distress and occupational stress in hospital workers. Zhou *et al.* found that psychological distress in professionals active in the fight against COVID-19 was significantly more severe than in the general population[6]. In addition, Tam *et al.* showed that 68 % of health professionals reported high levels of stress at work[7].

At the same time, there is an established association between occupational stress, that is, high psychological demands in the workplace, and reduced work capacity, lower self-perception of health, adverse lifestyle risk factors (eating behaviours, sedentary lifestyle, smoking and alcohol use) and chronic disease among workers[2,8–11].

Abbreviations: BF%, body fat percentage; WC, Waist circumference.

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However, there is limited longitudinal evidence documenting the effect of increased occupational stress during the COVID-19 pandemic on health and lifestyle outcomes of hospital workers, which may be particularly important for supporting the rapid implementation of protective strategies during the current crisis.

Therefore, this study aimed to ascertain changes in occupational stress before and during the COVID-19 pandemic and its association with health outcomes of hospital workers in the Recôncavo of Bahia, Brazil.

Methods

Study design and sample

This is a longitudinal study that used baseline data and the first follow-up study from one of the hospitals in the research study 'Evaluation of Food and Nutrition Services in three hospitals in the health network of Salvador, Bahia', which was expanded to additional institutions in another municipality of Bahia. Only one of the study hospitals was included in this study as the other sites withdrew consent to participate during the COVID-19 pandemic. The final follow-up of the larger study is planned for 2022, so it is not reported here.

The hospital in question is in the city of Santo Antônio de Jesus, Bahia, and in 2019, had a staff of 371 workers. Initially, all 371 workers were invited to participate in the study; however, according to the inclusion and exclusion criteria described below, as well as the losses that occurred during the study, the final sample included 218 workers from different sectors of the hospital (Fig. 1).

Eligibility criteria

Workers of both sexes over 18 years of age who agreed to participate in the research by signing the Free and Informed Consent Form were eligible. Individuals with problems that compromised the carrying out of anthropometric measurements were not included: those who went through recent abdominal surgeries, and who suffer from abdominal lesions, tumours, hepatomegaly, splenomegaly, ascites and amputees, as well as pregnant women or women who gave birth in the last 6 months, due to changes in body composition characteristic of these stages of life[12].

Data collection

Data collection was performed by a team of nutritionists duly trained in the research protocol. Sociodemographic, occupational, lifestyle and health variables, as well as anthropometric and occupational stress variables, were collected between May and October 2019 (before the pandemic baseline) and between October and November 2020 (during the pandemic first follow-up), considering the same instruments, techniques and procedures in both evaluation periods.

Sociodemographic, occupational, lifestyle and health variables. The variables in question were collected through a structured questionnaire. Sex, age, skin colour (self-reported), marital status, schooling and family income were sociodemographic variables. Considering that Brazil is a country with great miscegenation and that people identify themselves by the colour of their skin[13], we used the variable skin colour as a proxy of ethnicity.

The occupational variables included (1) occupation (health professional or other), (2) weekly workload and (3) shift work. Regarding lifestyle, the variables of habitual (1) smoking and (2) alcohol consumption were evaluated, as well as (3) level of physical activity. The latter was assessed through the reduced version and validated of the International Physical Activity Questionnaire, and workers were classified as having a low (< 600 metabolic equivalents – MET min/week), moderate (600 to 3000 MET min/week) and high (≥ 3000 MET min/week) level of physical activity[14]. In relation to health, the variables (1) family history for cardiovascular risk factors, (2) perception of one's own health and (3) self-report of chronic diseases that make up cardiovascular risk (arterial hypertension, dyslipidaemias and diabetes mellitus) were considered.

Anthropometric variables. Weight and height: weight was measured by means of a portable digital scale with platform bioimpedance (OMRON® Full Body Sensor Body Composition Monitor and Scale, model HBF-516b). Interviewees were weighed following techniques described in the literature WHO[15]. Height was measured using a portable stadiometer (Alturaexata®). The technique used was recommended by the WHO[15]. BMI, represented by the kg/m^2 ratio[15], was calculated from weight and height measurements. The cut-off point used to classify the nutritional status of workers according to BMI was that proposed by the WHO[16].

Waist circumference: waist circumference (WC) was measured using a flexible and inelastic measuring tape, following WHO recommendations[15]. This measurement was used to predict the risk of metabolic and cardiovascular complications for workers, considering the cut-off points also proposed by the WHO[17].

Body fat percentage: body fat percentage (BF %) was evaluated with the aid of a Biodynamics® tetrapolar bioelectric impedance device, according to the protocol described by Kyle *et al.*[18]. To classify the BF % of the workers, the parameters proposed by Guedes and Guedes were used[19].

Occupational stress variables. The instrument used to assess workers' occupational stress was the Job Content Questionnaire (JQC), in its reduced version, translated and validated for the Brazilian population[20]. The JCQ is composed of seventeen questions divided into the dimensions 'demand', 'control' and 'social support'. The 'demand' dimension consists of five questions that address pace, workload, time, conflicting demands and work effort. In the 'control' dimension, there are six questions about learning, skill, creativity, repeatability, responsibility and decision-making. The 'social support' dimension, on the other hand, has six questions about interpersonal relationships[20].

To classify occupational stress, we used the Demand-Control Model, which makes the theoretical assumption that the coexistence of great psychological demands and low control in the work process generate job strain, which results in increased

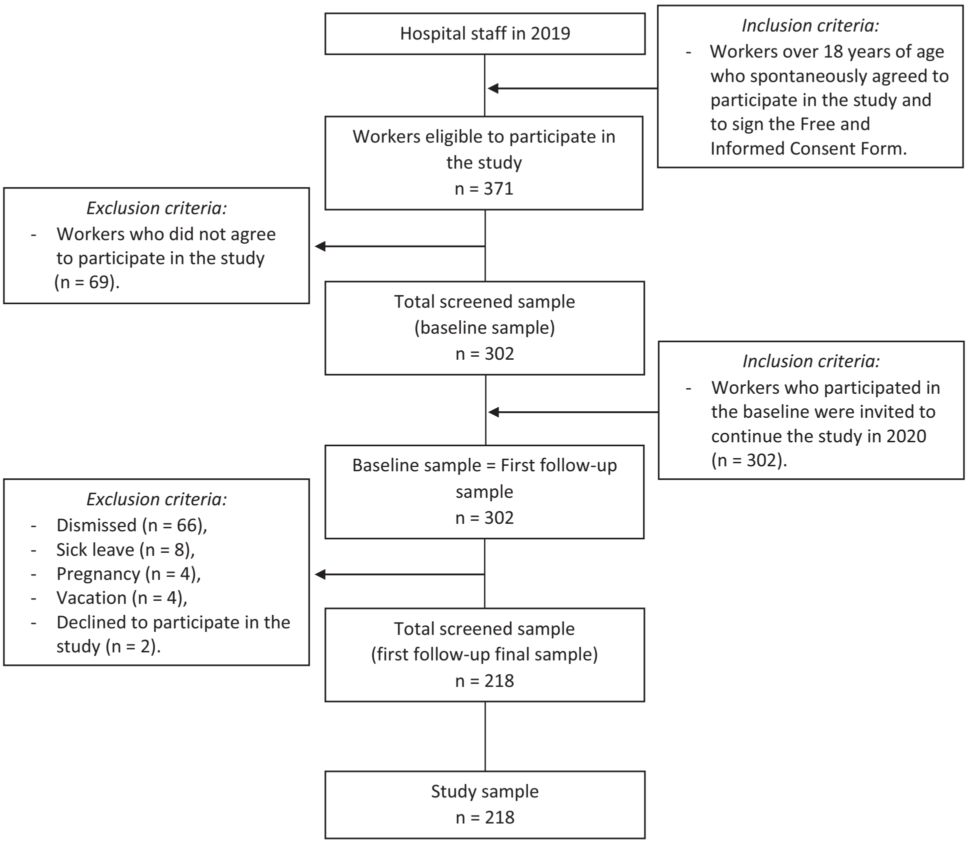

Fig. 1. Flow chart of the study design and sample.

stress at work[21]. Following this, participants were classified as having 'high occupational stress' if they report above the median score in the 'demand' dimension and below the median score in the 'control' dimension of the JCQ, and 'low occupational stress' otherwise[21].

Identification of variables

The health outcomes were nutritional status according to BMI, WC and BF %, health self-perception, and CVD factors (self-report of at least one cardiovascular risk factor such as hypertension, diabetes mellitus, dyslipidaemias or other). These measurements were evaluated at the beginning of the study and after a minimum interval of 12 months to assess their changes over time.

In the statistical analysis, all outcomes were considered in their categorical form and classified as 'better/same BMI, WC, BF %, health self-perception, and cardiovascular risk factors' (0) or 'worse BMI, WC, BF %, health self-perception, and cardiovascular risk factors' (1) in order to provide consistency across outcome measures and for ease of interpretation. Regarding the BMI, we considered as worse BMI the increase in weight to overweight or obesity as well as the decrease to underweight. In addition to these categorical forms, we also present the results of analyses using BMI, WC and BF % as continuous outcomes to demonstrate the absolute changes in these outcomes and for increased statistical power.

Change in occupational stress, measured at the beginning of the study and after a minimum of 12 months, was considered the main exposure in this study. To examine the association between the occupational stress-level changes and the health outcomes over time, we created a variable denoting change in exposure, categorised as 'decreased/equal job stress level' (0) and 'increased job stress level' (1). This same procedure was performed considering the work shift as an additional exposure in this study: 'decreased/maintenance amount of work shift' (0) and 'increased amount of work shift' (1).

The study's covariates included age, sex, educational-level, income, occupation, weekly workload, shift work (when the occupational stress was considered as the exposure), alcohol consumption, smoking status, physical activity level and family history of cardiovascular risk.

Statistical analysis

Descriptive statistical analysis expressed the categorical variables as absolute and relative frequencies, and the continuous variables as mean and standard deviation. Data normality was checked by the Shapiro–Wilk test. The McNemar χ^2 or Wilcoxon tests were used to compare the prevalence of occupational stress and other variables of interest before and during the COVID-19 pandemic. The Pearson χ^2 test or Fisher's exact test and Student's t test or Mann–Whitney test were used to verify the distribution of the outcomes of interest according to the study's covariates and changes in occupational stress levels.

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In addition, the OR was calculated to evaluate the association between the changes in health outcomes (BMI, WC and BF %; health self-perception; and cardiovascular risk factors), and changes in occupational stress (main exposure) and shift work (additional exposure) over time. Binomial logistic regression was employed to adjust the analysis for possible confounding factors (variables with $P \leq 0{\cdot}25$, biological plausibility and epidemiological relevance). The statistical analyses were performed by SPSS Statistics Software, version 28. The significance level for all tests was set at 5 % ($P < 0{\cdot}05$).

Ethical aspects

The protocol of the present study was approved by the Ethics Committee of the School of Nutrition of the Federal University of Bahia regarding ethical pertinence[22], under number 4 316 252. In addition, in compliance with ethical assumptions, all workers who presented significant changes in the indicators evaluated were referred to the local health service and kept in the study.

Results

At baseline, workers' mean age was 32·6 (8·3) years. The average length of hospital work experience was 45·96 (35·72) months. 41·7 % of the workers were health professionals, while the remainder occupied other positions such as administrator, cleaner, telephonist and labourer. Regarding educational level, 50·5 % of the participants attended high school and 34·4 % subsequently attended college or university courses. Most of the workers (52·3 %) were married or had a common law partner, while 42·2 % were single. Other characteristics of the workers at baseline are reported in Table 1.

During the COVID-19 pandemic, there was an increase in high-level rates of occupational stress, obesity (according to BMI, WC and BF %), self-perception of regular or poor health, and presence of cardiovascular risk factors, compared with before the pandemic period. At the first time point, 14·2 % of participants reported high occupational stress *v.* 29·4 % at the follow-up time point. Before the pandemic, 16·1 %, 53·2 % and 65·0 % of workers were obese according to BMI, WC and BF % *v.* 21·2 %, 60·6 % and 70·4 % during the pandemic period, respectively. At the first time point, 38·5 % of participants reported self-perception of regular or poor health *v.* 40·4 % at the follow-up time point. Before the pandemic, 12·4 % of workers reported the presence of cardiovascular risk factors *v.* 18·3 % during the pandemic. All these differences were highly significant (McNemar χ^2 test $P < 0{\cdot}05$), except for health self-perception ($P = 0{\cdot}708$). Differences among other workers characteristics are presented in Table 2.

Apart from the variation in occupational stress levels, which is considered the main exposure in this study, we also investigated other factors associated with outcome changes among study covariates. As shown in Table 3, only weekly workload and health self-perception were related, meaning that workers with a higher weekly workload had a worse health self-perception. Other characteristics with $P < 0{\cdot}25$ were considered for adjustment of the binomial logistic models between job stress and health outcomes over time.

Table 1. Descriptive analysis of the workers characteristics at baseline (Number and percentages; mean values and standard deviations)

Characteristics	%	*n*	Total (*n*)
Age (years)			218
Mean	32·6		
SD	8·3		
Sex			218
Women	75·2	164	
Men	24·8	54	
Educational level			218
Primary school	4·1	9	
High school	50·5	110	
College/university education	34·4	75	
Postgraduate education	11·0	24	
Skin colour			218
White	12·8	28	
Brown	48·6	106	
Black	35·3	77	
Other	3·3	7	
Marital status			218
Single	42·2	92	
Married/common law partner	52·3	114	
Divorced/separated	5·0	11	
Widowed	0·5	1	
Family history of cardiovascular risk			218
Yes	87·2	190	
No	12·8	28	
Occupation			218
Health professional	41·7	91	
Other	58·3	127	

Considering the changes in occupational stress level during the observed period, we tested its association with the changes in the outcomes. These variations, that is the increase in high-level rates of occupational stress, were not significantly associated with any changes in outcomes over time (Table 4). Binomial logistic regression unadjusted models confirmed this lack of significant association (Table 5).

In the sub-analysis by occupation, the increase in the job strain was greater among health professionals if compared with other hospital workers, 150 % (6·6 *v.* 16·5 %) and 96 % (19·7 *v.* 38·6 %), respectively. These differences before and during the pandemic were statistically significant (McNemar χ^2 test $P = 0{\cdot}049$ and $P = 0{\cdot}001$, respectively). Conversely, we found no interaction between the changes in occupational stress and the changes in health outcomes over time, neither for health professionals nor for other hospital workers.

Finally, as shift work is considered a kind of work stressor, we also performed binomial logistic regression between changes in shift work and changes in health outcomes. Unadjusted models showed that the increased amount of shift work was related only to the changes in BMI (OR 3·79; 95 % CI (1·40, 10·30)) (Table 6). This association was confirmed after considering socio-demographic, occupational and lifestyle confounding factors (OR 3·92; 95 % CI (1·37, 11·17)) (Table 6).

Furthermore, when we categorised the analyses by occupation, it showed that the increased amount of shift work was significantly associated with the changes in BMI in the health professionals:

Table 2. Workers characteristics before and during the COVID-19 pandemic
(Mean values and standard deviations)

	Before pandemic		During pandemic			
Characteristics	Mean	SD	Mean	SD	Test statistic*	*P*
Continuous form						
Weekly workload (hours)	44·8	11·4	46·2	11·4	2·204	0·028
Weight (kg)	69·2	14·0	70·8	14·4	6·850	<0·001
BMI (kg/m^2)	25·5	4·6	26·1	4·7	6·800	<0·001
WC (cm)	84·3	11·2	87·7	11·7	8·602	<0·001
Body fat (kg)	19·8	8·0	21·2	8·2	7·721	<0·001
Body fat %	28·2	7·5	29·5	7·3	7·291	<0·001
	%	*n*	%	*n*		
Categorical form						
Shift work					9·633	0·002
Yes	31·2	68	39·4	86		
No	68·8	150	60·6	132		
Occupational stress					15·754	<0·001
High	14·2	31	29·4	64		
Low	85·8	187	70·6	154		
Smoking status					2·250	0·125
Current smoker	0·9	2	1·8	4		
Ex-smoker	1·8	4	2·8	6		
Non-smoker	97·2	212	95·4	208		
Alcohol consumption					8·500	0·004
Yes	51·8	113	60·1	131		
No	48·2	105	39·9	87		
Physical activity level					5·438	0·020
Low	39·0	85	28·4	62		
Medium	44·0	96	59·2	129		
High	17·0	37	12·4	27		
BMI classification					5·786	0·013
Underweight/normal range	51·8	113	47·2	103		
Overweight/obese	48·2	105	52·8	115		
WC classification					7·500	0·006
Low risk	46·8	102	39·4	86		
Increased/high risk	53·2	116	60·6	132		
Body fat %					9·091	0·001
Acceptable	35·0	71	29·6	60		
Increased	65·0	132	70·4	143		
Health self-perception					0·141	0·708
Excellent/good	61·5	134	59·6	130		
Regular/bad	38·5	84	40·4	88		
Cardiovascular risk factors†					6·857	0·007
Yes	12·4	27	18·3	40		
No	87·6	191	81·7	178		

WC, waist circumference.
* McNemar χ^2 test or Wilcoxon test.
† Self-report of at least one cardiovascular risk factor (hypertension, diabetes mellitus, dyslipidemias or other).

health workers who work in shift had more chances to have changes in BMI (OR 11·56; 95 % CI (2·57, 52·00); $P=0{\cdot}001$), even after adjustments by sociodemographic, occupational and lifestyle characteristics (education level, occupational stress and physical activity level at baseline) (OR 10·96; 95 % CI (2·39, 50·19); $P=0{\cdot}002$). No association was found for the other hospital workers (OR 1·46; 95 % CI (0·30, 7·60); $P=0{\cdot}627$).

Another sub-analysis considering the increased amount of shift work was by sex, significantly associated with abdominal obesity in female workers (OR 3·17; 95 % CI (1·07, 9·40); $P=0{\cdot}037$), which was confirmed after adjustments by sociodemographic, occupational and lifestyle characteristics (sex, income, weekly workload, alcohol consumption and physical activity level at baseline) (OR 3·59; 95 % CI (1·12, 11·51); $P=0{\cdot}032$).

Discussion

The present study results suggest significant differences between the prevalence of health outcomes before and during the pandemic, revealing an increase in the number of cases of obesity and the presence of cardiovascular risk factors. There was no association between such outcomes and the increase of occupational stress level, even in the sub-analysis by occupation. On the other hand, the increased amount of shift work was related to changes in BMI in the overall sample, and in health workers, as well as to changes in abdominal obesity in women.

It is noteworthy that, by the time this study was finished, there were found no studies to evaluate such outcomes in hospital workers during the COVID-19 pandemic. However, studies on

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Table 3. Changes in the health outcomes over time, and their associations with the workers' characteristics at baseline
(Number and percentages; mean values and standard deviations)

	BMI					Waist circumference					Body fat %					Health self-perception					Cardiovascular risk factors				
	Better/same		Worse			Better/same		Worse			Better/same		Worse			Better/same		Worse			Better/same		Worse		
Characteristics	Mean	SD	Mean	SD	P*	Mean	SD	Mean	SD	P*	Mean	SD	Mean	SD	P*	Mean	SD	Mean	SD	P*	Mean	SD	Mean	SD	P*
Continuous form																									
Age	32·63	8·46	32·23	7·29	0·490	32·94	8·41	31·18	7·87	0·841	32·75	8·34	31·57	8·96	0·459	32·63	8·55	32·35	7·30	0·198	32·24	8·15	36·53	9·45	0·250
Weekly workload	45·11	11·76	42·15	8·02	0·272	45·15	12·21	43·27	7·50	0·078	45·25	11·87	44·43	11·09	0·882	44·14	10·13	47·50	15·73	<0·001	45·00	11·74	41·88	5·45	0·200
	%	n	%	n		%	n	%	n		%	n	%	n		%	n	%	n		%	n	%	n	
Categorical form																									
Sex					0·631					0·053					1·000					0·840					0·573
Male	90·7	49	9·3	5		88·9	48	11·1	6		78·8	41	21·2	11		83·3	45	16·7	9		94·4	51	5·6	3	
Female	87·2	143	12·8	21		76·2	125	23·8	39		78·0	117	22·0	33		81·1	133	18·9	31		91·5	150	8·5	14	
Educational level					0·144					0·738					0·733					0·082					0·456
< High school	85·0	102	15·0	18		78·3	94	21·7	26		79·4	85	20·6	22		85·8	103	14·2	17		90·8	109	9·2	11	
> College	91·8	90	8·2	8		80·6	79	19·4	19		76·8	73	23·2	22		76·5	75	23·5	23		93·9	92	6·1	6	
Occupation					0·527					0·499					0·863					0·723					0·620
Health professional	90·1	82	9·9	9		76·9	70	23·1	21		77·1	64	22·9	19		80·2	73	19·8	18		93·4	85	6·6	6	
Other	86·6	110	13·4	17		81·1	103	18·9	24		79·0	94	21·0	25		87·2	105	17·3	22		91·3	116	8·7	11	
Shift work					0·073					0·366					0·712					0·575					0·786
Yes	94·1	64	5·9	4		75·0	51	25·0	17		75·8	47	24·2	15		79·4	54	20·6	14		91·2	62	8·8	6	
No	85·3	128	14·7	22		81·3	122	18·7	28		79·3	111	20·7	29		82·7	124	17·3	26		92·7	139	7·3	11	
Income					1·000					0·213					0·718					0·853					0·190
< 3 minimum wages	88·4	129	11·6	17		76·7	112	23·3	34		79·3	107	20·7	28		82·2	120	17·8	26		90·4	132	9·6	14	
> 3 minimum wages	87·5	63	12·5	9		84·7	61	15·3	11		76·1	51	23·9	16		80·6	58	19·4	14		95·8	69	4·2	3	
Family history of cardiovascular risk					0·345					0·807					0·212					0·794					0·704
Yes	88·9	169	11·1	21		78·9	150	21·1	40		76·7	135	23·3	41		82·1	156	17·9	34		91·6	174	8·4	16	
No	82·1	23	17·9	5		82·1	23	17·9	5		88·5	23	11·5	3		78·6	22	21·4	6		96·4	27	3·6	1	
Alcohol consumption					1·000					0·244					0·612					0·486					0·451
Yes	88·5	167	11·5	13		76·1	86	23·9	27		79·8	83	20·2	21		79·6	90	20·4	23		93·8	106	6·2	7	
No	87·6	25	12·4	13		82·9	87	17·1	18		76·5	75	23·5	23		83·8	88	16·2	17		90·5	95	9·5	10	
Smoking status					0·401					1·000					1·000					0·558					1·000
Current/ex-smoker	88·3	189	11·7	25		79·4	170	20·6	44		77·8	154	22·2	44		81·8	175	18·2	39		92·1	197	7·9	17	
Non-smoker	75·0	3	25·0	1		75·0	3	25·0	1		100·0	4	0·0	0		75·0	3	25·0	1		100·0	4	0·0	0	
Physical activity level					0·788					0·337					0·832					0·495					0·097
Low	87·1	74	12·9	11		74·1	63	25·9	22		76·3	58	23·7	18		77·6	66	22·4	19		89·4	76	10·6	9	
Medium	87·5	84	12·5	12		82·3	79	17·7	17		80·0	72	20·0	18		84·4	81	15·6	15		91·7	88	8·3	8	
High	91·9	34	8·1	4		83·8	31	16·2	6		77·8	28	22·2	8		83·8	31	16·2	6		100·0	37	0	0	

* Pearson χ^2 test, Fisher's exact test or Student's *t* test.

Table 4. Changes in the workers' occupational stress levels over time and their associations with the changes in the health outcomes
(Number and percentages; mean values and standard deviations)

	Occupational stress level				
	Decreased/ equal		Increased		
Characteristics	Mean	SD	Mean	SD	*P**
Continuous form					
Weight gain (kg)	1·58	3·27	1·73	4·13	0·917
BMI gain (kg/m^2)	0·59	1·23	0·60	1·44	0·944
WC gain (cm)	3·44	4·97	3·43	5·11	0·971
Body fat gain (%)	1·48	3·88	1·72	2·31	0·186
Body fat gain (kg)	1·60	4·18	1·74	2·73	0·289
	%	*n*	%	*n*	
Categorical form					
Smoking status					1·000
Same	77·6	166	22·4	48	
Worse	75·0	3	25·0	1	
Alcohol consumption					0·134
Better/same	79·2	152	20·8	40	
Worse	65·4	17	34·6	9	
Physical activity level					1·000
Better/same	77·8	126	22·2	36	
Worse	76·8	43	23·2	13	
BMI classification					0·134
Better/same	79·2	152	20·8	40	
Worse	65·4	17	34·6	9	
WC classification					0·695
Better/same	79·6	133	23·1	40	
Worse	80·0	36	0·695	9	
Body fat classification					0·214
Better/same	80·4	127	19·6	31	
Worse	70·5	31	29·5	13	
Health self-perception					0·098
Better/same	79·8	142	20·2	36	
Worse	67·5	31	32·5	13	
Cardiovascular risk factors					1·000
Better/same	77·6	156	22·4	45	
Worse	76·5	13	23·5	4	

WC, waist circumference.
* Pearson χ^2 test, Fisher exact test or Student's *t* test/Mann–Whitney test.

Table 5. OR and 95 % CI of increased occupational stress level on nutritional status, health self-perception and cardiovascular risk factors of hospital workers, over time
(Odd ratio and 95 % confidence intervals)

	Unadjusted model			Adjusted model		
Output	OR	95 % CI	*P*	OR	95 % CI	*P*
Abdominal obesity*						
Worse	0·83	0·37, 1·86	0·642	0·74	0·36, 1·86	0·608
Obesity (BF %)†						
Worse	1·72	0·81, 3·66	0·161	1·74	0·81, 3·75	0·156
Obesity (BMI)‡						
Worse	2·01	0·84, 4·85	0·119	1·89	0·76, 4·72	0·172
Health self-perception§						
Worse	1·89	0·89, 4·02	0·100	2·02	0·93, 4·40	0·076
Cardiovascular risk factors‖						
Worse	1·06	0·30, 3·41	0·922	1·27	0·38, 4·22	0·701

BF, body fat.
* Model adjusted for sex, weekly workload, income, alcohol consumption and physical activity level at baseline.
† Model adjusted for sex, education level, family history of CVD and physical activity level at baseline.
‡ Model adjusted for education level, shift work and physical activity level at baseline.
§ Model adjusted for age, education level and weekly workload at baseline.
‖ Model adjusted for age, weekly workload and physical activity level at baseline.

Table 6. OR and 95 % CI of increased amount of shift work on nutritional status, health self-perception and cardiovascular risk factors of hospital workers, over time
(Odd ratio and 95 % confidence intervals)

	Unadjusted model			Adjusted model		
Output	OR	95 % CI	*P*	OR	95 % CI	*P*
Abdominal obesity*						
Worse	1·80	0·69, 4·67	0·230	2·15	0·78, 5·92	0·140
Obesity (BF %)†						
Worse	0·78	0·25, 2·43	0·665	0·83	0·26, 2·63	0·746
Obesity (BMI)‡						
Worse	3·79	10·30	0·009	3·92	1·37, 11·17	0·011
Health self-perception§						
Worse	0·18	0·02, 1·38	0·099	0·18	0·02, 1·47	0·111
Cardiovascular risk factors‖						
Worse	0·51	0·06, 4·00	0·922	0·54	0·07, 4·47	0·569

BF, body fat.
* Model adjusted for sex, income, weekly workload, alcohol consumption and physical activity level at baseline.
† Model adjusted for sex, occupational stress overtime, family history of CVD and physical activity level at baseline.
‡ Model adjusted for education level, occupational stress and physical activity level at baseline.
§ Model adjusted for age, education level, weekly workload at baseline and occupational stress overtime.
‖ Model adjusted for age, weekly workload and physical activity level at baseline.

the effect of the pandemic on the emergence of psychological disorders in health professionals have already been published. According to Zhou *et al.*[6], symptoms of depression, anxiety, insomnia and somatisation are more severe in health teams than in the general population. There is also an increase in the level of occupational stress in these individuals: Arafa *et al.*[23], when studying hospital workers from Egypt and Saudi Arabia, found that 55·9 % presented occupational stress, 36·6 % of which had mild to moderate and 19·3 % high to extremely high levels of it.

In the present study, an increase in occupational stress levels during the pandemic was also observed, with this increase being higher amongst health professionals. Zhou *et al.*[6] state that the COVID-19 pandemic is a stressor of great impact for individuals, especially those at the centre of the event, since, when caring for an infected patient, health workers experience great pressure and mental suffering. It can also be observed that other hospital workers are exposed to such pressure and suffering, due to overworking imposed by the rising rates of COVID-19 hospital admissions, as well as by the risk of infecting oneself and their relatives once one is in close contact with their working colleagues and inserted in the hospital environment. Thus, it is increasingly urgent to investigate the ratios and possible consequences of such work context to meet the needs of these professionals.

Many authors have identified positive associations between occupational stress and various types of diseases, especially non-transmissible chronic diseases[10,24–26]. Our results differed since there was no significant difference between high job strain and changes in nutritional status, self-perceived health and cardiovascular risk factors in the sample studied.

According to Kivimäki *et al.*[27], occupational stress is an important risk factor for obesity. However, these authors also did not find an association between high stress at work and the risk of weight gain or obesity in their systematic review and meta-analysis.

It is worth mentioning that the Control-Demand Model was originally developed to describe psychosocial factors affecting mental health[21]; such conditions, by definition, are related to an increase or decrease in food intake, which may cause weight gain in some individuals and weight loss in others. Thus, stress at work also leads, directly or indirectly, to weight loss, masking the general association between work stress and obesity[28].

As for the self-perception of health, Filha *et al.*[8], when studying its relationship with job strain in nursing professionals in Campo Grande, Brazil, found results contrary to the present study, that is, the self-perception of negative health was higher and significantly associated among workers who experienced stress at work. According to these authors, self-assessment of health has been an indicator widely used in epidemiological studies due to its proximity to the real health status of individuals and can consistently predict morbidity and mortality and the decline of functional health.

In regard to cardiovascular risk factors, Nyberg *et al.*[26] analysed individual data from 8 studies involving more than 40 000 participants to investigate the association between occupational stress and cardiovascular risk according to the Framingham risk score. They suggest that high-stress rates at work are associated with higher cardiovascular risk (Framingham > 20 %) and with diabetes, obesity, smoking and physical inactivity when evaluated individually. It is noticeable that the mediators of this link have been widely discussed, but there seems to be a consensus that occupational stress affects the risk of disease through harmful changes in lifestyle[10,11,26], which was also found in the present study, since hospital workers presented significant change in their alcohol consumption and levels of physical activity before and during the COVID-19 pandemic.

In addition to occupational stress, other functional risk indicators were evaluated in this study, specifically weekly workload and work shifts. In both cases, there was a significant difference before and during the pandemic, with an increase in the number of hours worked per week and a change to the shift and/or shift regimen. The change in the work shift indicator was statistically associated with a change in BMI in the overall sample, specifically in health workers, and WC in women.

It is known that there is a well-established relationship between shift work, defined as non-daytime work and/or irregular and/or rotating hours, and health problems such as obesity[29,30]. However, the mechanism involved in this relationship is not fully understood. It is believed that its main mediators, as well as those involved in occupational stress, are changes in the behavioural and lifestyle habits of these workers, which include reduction of leisure time and physical activity, increased consumption of alcoholic beverages, difficulty in maintaining a healthy diet and/or increased consumption of energetic foods, and reduction in the quality and number of sleep hours[29,31].

Kim *et al.*[29], when studying a representative sample of Korean nurses, have confirmed such positive association between shift work and overweight and obesity, after adjustments for lifestyle characteristics related to overweight. A similar result was also verified by Smith *et al.*[31] that has found a small but important increase in BMI among Canadian nurses on duty.

According to the meta-analysis carried out by Zhang *et al.*[32], the risk of obesity in health professionals working shifts was not statistically significant when compared with day workers. However, when considering only night working shifts, a significantly higher risk of obesity was found. Moreover, they have found that shift work was associated with a 36 % increased risk of obesity in America and 1 % in Europe and Australia.

Thus, the increase in obesity among hospital workers, especially amongst health professionals, becomes worrisome, because it represents a serious risk to the health and functional capacity of these individuals, especially in the current context of a pandemic. The findings of this study and other studies in the literature point to the need to establish strategies for a better organisation of routine and work in hospitals, to mitigate the impacts of shift work as well as occupational stress and to provide greater flexibility for workers to perform their day-to-day activities.

The main limitations of this study lie in its convenience sample and the self-report of cardiovascular risk factors by hospital workers. The first limitation is justified by the study being conducted during the pandemic, which made it difficult to lead face-to-face interviews due to the high demand for work and turnover of professionals and compliance with safety protocols. Nevertheless, the study's originality and innovative character are highlighted when comparing information before and during the pandemic, effectively reflecting the changes imposed by the pandemic context, as well as investigating health outcomes beyond psychosocial factors.

As for the self-report of cardiovascular risk factors, it is believed that the impact of this measurement on the results of the present study may be minimised, since the sample is composed of hospital workers who, due to their nature and that of their workplace, are assumed to have greater and more accurate knowledge about their health conditions when compared with the general population.

Finally, the COVID-19 pandemic significantly changed the functional, lifestyle and health characteristics of the hospital workers studied, resulting in an increase of occupational stress levels and the prevalence of obesity and cardiovascular risk factors in these individuals. Our findings represent an important source of information for the formulation of corrective and preventive measures that are appropriate to the reality of these workers, with the aim of including not only healthy lifestyle habits in their routine but also non-invasive interventions related to occupational stress, minimising the risk of health aggravation and, consequently, preventing clinical manifestations in later stages of life.

In addition, due to the high burden of chronic diseases in Brazil, especially obesity and other cardiovascular risk factors, more studies ought to be carried out in order to understand the social and health situation of individuals during and after the pandemic, verifying its effects in the long term, since critical contexts such as the COVID-19 pandemic may contribute to the obesity pandemic, which, in its turn, increases the risk of morbidity and mortality from chronic diseases.

Therefore, given the changes imposed by the COVID-19 pandemic and the relevance of hospital workers, mostly of health workers, in the fight against this disease, it is urgent to strengthen labour policies and practices to protect such individuals, ensure adequate working conditions for them and allow them to maintain good health and quality of life.

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