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ORIGINAL ARTICLE

Stress and cortisol levels among members of the nursing team

Estresse e níveis de cortisol capilar entre a equipe de enfermagem

Niveles de estrés y cortisol entre miembros del equipo de enfermería

Vanessa Augusto Bardaquim[I]
ORCID: 0000-0003-2179-552X

Sérgio Valverde Marques dos Santos[I]
ORCID: 0000-0001-9412-9515

Ernandes Gonçalves Dias[I]
ORCID: 0000-0003-4126-9383

Rita de Cássia de Marchi Barcellos Dalri[I]
ORCID: 0000-0002-6575-5426

Aida Maria de Oliveira Cruz Mendes[II]
ORCID: 0000-0002-1992-9632

Maria Cecília Gallani[III]
ORCID: 0000-0002-3418-9134

Maria Lúcia do Carmo Cruz Robazzi[I]
ORCID: 0000-0003-2364-5787

[I] *Universidade de São Paulo. Ribeirão Preto, São Paulo, Brazil.*
[II] *Escola Superior de Enfermagem de Coimbra. Coimbra, Portugal.*
[III] *Universidade Laval. Quebec, Canada.*

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Corresponding author:
Vanessa Augusto Bardaquim
E-mail: va.bardaquim@bol.com.br

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ABSTRACT

Objective: To analyze the characteristics of hospital nursing professionals with the presence of stress, and to associate this with capillary cortisol. **Method**: A cross-sectional, exploratory and correlational study, conducted in a hospital in São Paulo, Brazil. A total of 164 nursing professionals participated; the Perceived Stress Scale was administered, and hair samples were obtained for laboratory analysis. Data were entered into a Microsoft Excel spreadsheet (2010), and then into Microsoft Office and the R software, version 3.2.2. **Results**: High levels of capillary cortisol in 47% of participants suggest the presence of stress, but no statistical significance between cortisol and stress levels were found. **Conclusions**: Stress and capillary cortisol levels were indicative of stress among nursing professionals; however, no association between them was found, although the values found were above those recommended.
Descriptors: Hydrocortisone; Nursing Service, Hospital; Occupational Stress; Occupational Health; Nursing, Team

RESUMO

Objetivo: Analisar características de trabalhadores de enfermagem da área hospitalar com a presença de estresse e associar com o cortisol capilar. **Método**: Estudo de corte transversal, exploratório e correlacional, realizado em um hospital paulista, Brasil. Participaram 164 trabalhadores de enfermagem, nos quais foi aplicada a *Perceived Stress Scale* e obtidas amostras de cabelos para análise laboratorial. Os dados foram inseridos em planilha do MS-Excel (2010) e, após, no programa Microsoft Office e no *software* R, versão 3.2.2. **Resultados**: Elevados níveis de cortisol capilar em 47% dos participantes sugerem a presença de estresse, mas não houve significância estatística entre níveis de cortisol e de estresse. **Conclusões**: níveis de estresse e de cortisol capilar foram indicativos de presença de estresse entre trabalhadores de enfermagem; entretanto, não houve associação entre eles, embora estivessem acima dos recomendados.
Descritores: Hidrocortisona; Serviço Hospitalar de Enfermagem; Estresse Ocupacional; Saúde do Trabalhador; Equipe de Enfermagem.

RESUMEN

Objetivo: analizar las características de los trabajadores de enfermería hospitalarios con presencia de estrés y asociarlos con el cortisol capilar. **Método**: estudio transversal, exploratorio y correlacional, realizado en un hospital de São Paulo, Brasil. Participó un total de 164 trabajadores de enfermería, a quienes se aplicó la Escala de estrés percibido y se obtuvieron muestras de cabello para análisis de laboratorio. Los datos se ingresaron en una hoja de cálculo MS-Excel (2010) y luego en el software Microsoft Office and R, versión 3.2.2. **Resultados**: altos niveles de cortisol capilar en el 47% de los participantes sugieren la presencia de estrés, pero no hubo relevancia estadística entre los niveles de cortisol y el estrés. **Conclusiones**: el estrés y los niveles de cortisol capilar fueron indicativos de estrés entre los trabajadores de enfermería; sin embargo, no hubo asociación entre ellos, aunque estaban por encima de los recomendados.
Descriptores: Hidrocortisona; Servicio de Enfermería en Hospital; Estrés Laboral; Salud Laboral; Grupo de Enfermería.

INTRODUCTION

Psychosocial factors can affect professionals' health by means of psychological and physiological mechanisms, due to the interaction between work, professionals, environment, job satisfaction, and organizational conditions, which can also be described as psychophysical, psychophysiological, or psychoergonomic interactions[1].

Stress arising from work environments and the manner in which the work is organized affects many professionals; in the health area, nursing professionals are one of the groups that suffer most from stressful situations[2]. The stress among these Brazilian workers has been repeatedly proven[3-4]. Psychosocial stressors are as efficient of causing disease as the unhealthiness of microorganisms present in the environment; inadequate and tense working conditions that occur during the nursing work, such as prolonging working hours, facilitating the emergence of stressors in occupational environments[5].

Nursing professionals' show a high level of responsibility and low autonomy, which reflect stress and stress points[6]. The most common stressors present in nursing work environments are related to working conditions and processes[7].

In stressful conditions, the physiology of the body leads to the secretion of a large amount of cortisol[8], which is considered one of its central hormones[9]. It is the main endogenous human glucocorticoid (GC) secreted in response to adrenocorticotropic hormone (ACTH)[10], released by the pituitary-adrenal hypothalamic axis (HPA)[11]. The link between occupational stress, physical and mental health, and one of the pathways that potentially mediate these associations may involve the HPA axis, with this GC used as the final metabolite[12]. Long-term changes in the activity of this axis have shown that cortisol accumulates in the capillary wire[13], and can be considered a biomarker of chronic stress[14].

Measuring cortisol levels in hair is a recently developed method for measuring long-term GC levels[15]. While salivary and urine cortisol show the levels in real time, capillary cortisol analysis provides a complementary methods of monitoring stress, identifying systemic exposure to this GC for longer periods[16]. In contrast to "spot samples" obtained from plasma or saliva, obtaining hair samples provides an integrated measure of HPA system activity and, therefore, physiological stress during the period of hormonal incorporation. It can provide a retrospective measure of systemic cortisol secretion during the corresponding hair growth time[17].

Based on this context, given the possibility of cortisol obtained from the hair being considered a biomarker for measuring stress, in addition to the fact that nursing professionals are a group prone to stress at work, the importance of assessing cortisol levels among them is justified. Given this context, conducting the present study is justified, as it is expected to add to existing knowledge about the health of nursing professionals working in the hospital environment.

Thus, the following guiding question was developed: Are the cortisol levels obtained from the hair of nursing professionals related to the presence of stress and the characteristics of the work performed by them?

OBJECTIVE

To analyze the characteristics of the work performed by nursing professionals with the presence of stress, and to correlate this with capillary cortisol values.

METHODS

Ethical aspects

Based on Resolution 466 of 2012, this study was approved by the Research Ethics Committee.

Design, period and place of study

This was a cross-sectional, exploratory, quantitative correlational research study. The data collection was performed at a medium-sized hospital in the interior of São Paulo State, Brazil, between January and March of 2017.

Population and inclusion criteria

The population of this study consisted of 164 members of the nursing staff, represented by nurses, nursing technicians, and auxiliaries.

Professionals of both sexes, working in the following sectors were included: isolation (I), adult intensive care unit (ICU), adult coronary care unit (CCU), urgent care and emergency (UC/ER) and the medical clinic (MC). Those who were not found at the time of data collection were excluded, for any reasons of absence from work, including illness, accidents, vacation or time off.

The sample was obtained by using the stratified random sampling method, with proportional allocation by strata, formed by the ICU, CCU, UC/E, I, and MC sectors. Since the prevalence of the variables of interest in the target population was unknown, the criterion used recommended relative error parameters of 20, significance level of 5%, and a prevalence of 50% in each stratum[18]. Thus, in the end, 164 nursing workers became participants.

Study Protocol

In this study there was no control group; comparative analyses of the normal values of capillary cortisol were obtained by means of the median made between the sectors participants.

Data collection consisted of obtaining strands of hair and administering the instruments, during the work hours of the participants, on the morning, evening, and night shifts. Each participant underwent hair sampling and questionnaires, performed on the same day.

The instruments were administered in a private, air-conditioned room; participants were seated, and responded to self-administered instruments. The first author stayed by their side to answer questions, and to avoid communication between the respondents, and then to obtain the strands of hair.

Two instruments were used. The first was a personal and work characteristics questionnaire, adapted and developed in Brazil, and already used for this type of population[19], consisting of 19 structured and semi-structured questions, directed to

the variables that aim to identify the worker, as well as his/her professional activity.

The second instrument was the Perceived Stress Scale (PSS), which measures stress among professionals. This scale measures the degree of perceived stress of individuals during the month prior to the assessment[20]. It has 14 questions, with options for answers ranging from zero to four (0=never; 1=almost never; 2=sometimes; 3=almost always; 4=always), with questions having both positive and negative connotations. The total scale is obtained from the sum of the scores of these 14 questions, and the scores may vary from 0 to 56; the higher the scores, the higher the perceived stress[20]. The results of the validation of the scale for Brazilian Portuguese were satisfactory, with an internal consistency of r=0.82 and were effective to detect differences between groups[21]. The cutoff point was adopted with five (5) scoring intervals: ≤18 (low), 19-24 (normal), 25-29 (moderate), 30-35 (high), and >35 (very high)[22]. In this study, when assessing the internal consistency of the scale, the Cronbach's alpha coefficient obtained a value of 0.870.

To measure cortisol levels after hair collection, we followed the instructions contained in the specific saliva Cortisol ELISA (Enzyme-Linked Immunosorbent Assay) kit (KAPDB290), but validated for hair samples used in other studies[15,23-24]. The ELISA method has advantages over the others, has good sensitivity, and favors fast results[25].

A total of 164 hair samples were obtained for capillary cortisol measurement; the hair samples were cut with surgical scissors on the posterior vertex region of the head, as close as possible to the root, because it is the area with the lowest growth rate variability, and has the highest concentration of cortisol[26].

A lock of hair (about 0.5 cm) was separated, two centimeters (cm) below the base of the skull. In some cases, hair had to be cut at different locations in the same region, to obtain the same amount. According to recommendations, strands of 3cm in length were obtained[26-27].

Subtitle: 1. Separation of hair samples; 2.washing of samples; 3. cutting; 4. addition of isopropyl alcohol; 5. addition of chemical reagents; 6. time to read the plates.

Figure 1 - Laboratory steps performed for capillary cortisol extraction and measurement among hospital nursing professionals, 2017

The width of the strand was to be one (1) cm; an amount corresponding to at least 30 milligrams (mg) of hair per participant was obtained. The samples were then packed in specific envelopes and boxes to prevent contamination; afterwards, they were sent to a laboratory specialized in clinical evaluations for capillary cortisol analysis. The reference values used in this study were those of the clinical analysis laboratory[24] where the method for extracting capillary cortisol was similar to that of the present study. The values considered were: below normal cortisol - up to 16 picograms of cortisol/milligrams of hair (pg/mg), normal - 16 to 84 pg/mg, and above normal values - > 84 pg/mg.

The laboratory steps performed in the present study are shown in Figure 1.

Results analysis and statistics

The collected data were entered into an Excel spreadsheet, version 2010, to develop the database. Subsequently, double entry was performed to avoid transcription errors. For descriptive and inferential statistical analysis, the R software, version 3.2.2, was used. The Pearson chi-square, Kruskal-Wallis non-parametric hypothesis, Spearman correlation coefficient, and Mann-Whitney tests were performed, to verify possible relationships between the characteristic variables, stress, and capillary cortisol.

RESULTS

Descriptive analysis of the personal characteristics of the surveyed workers showed that, of the 164 participants: 132 (80.5%) were female; aged 30 - 39 years (41.5%) and 19 - 29 years (25.6%). Single, separated/divorced/widowed respondents accounted for 88 (53.7%); 76 (46.3%) were married/living with a partner.

Regarding work-related aspects, the prevalence of nursing technicians (102-62.2%) was identified, followed by nurses (35-21.3%), and nursing auxiliaries (27-16.5%); all the respondents were permanent employees (100%). Regarding the number of employment relationships, 139 (84.8%) held only one job, and 25 (15.2%) had two. Regarding the number of jobs in another area, other than nursing: 154 (93.9%) answered that they did not have another job, and nine (5.5%) worked in other types of jobs, and one person did not respond. With regard to the work shift, 86 participants (52.4%) worked during the day, 70 at night (42.7%) and only eight (4.9%) worked both shifts; 154 (93.9%) were still working on weekends. Regarding the sectors of work, 79 (48.2%) worked in the MC, followed by the ER/UC with 34 (20.7%), CCU with 24 (14.6%), adult ICU with 21 (12.8%), and six (3.7%) in the isolation unit.

Table 1 presents the classification of perceived stress among nursing professionals, according to the cutoff point established[22].

Table 2 describes the levels of cortisol present in the participants' hair. For the biological analysis of capillary cortisol, 161 participants were included, due to lack of material from three of them.

Almost half of the professionals (47%) had cortisol levels above the established level, indicating the presence of stress. However, 13.4% were below these levels (Table 2).

Table 3 shows the analysis of the correlation of the cortisol variable with perceived stress, age, work time, and sector of professional activity; with regard to the stress variable, correlations were obtained with age, professional performance, employment in nursing and non-nursing, professional category, and employment sector.

None of the variables analyzed (Table 3) showed a significant relationship with stress and cortisol; there was no significant relationship between stress and cortisol (p> 0.05).

Table 1 - Classification of the variable, perceived stress, among nursing staff in the hospital context, Sao Paulo, Brazil, 2017 (N = 164)

Classification	Interval	f	%
Low	<=18	35	21.3
Normal	19 - 24	36	22
Moderate	25 - 29	39	23.8
High	30 - 35	33	20.1
Very high	>35	21	12.8

Table 2 - Capillary cortisol levels among nursing staff in the hospital context, Sao Paulo, Brazil, 2017 (n = 161)

Level	f	%
Low	22	13.4
Normal	62	37.8
High	77	47.0
Total	161	98.2
Not analyzed	3	1.8
Total	161	100.0

Table 3 - Correlation tests of cortisol and stress variables with those related to work among nursing professionals in the hospital context, Sao Paulo, Brazil, 2017 (n = 161)

Variable 1	Variable 2	*p* value
Cortisol	Perceived stress	0.1043*
Cortisol	Age	0.9484*
Cortisol	Work time	0.4619*
Cortisol	Professional category	0.8526**
Cortisol	Sector of acting	0.0875***
Stress	Age	0.295*
Stress	Practice in the profession	0.4864*
Stress	Job in nursing	0.5671*
Stress	Job outside nursing	0.4304*
Stress	Professional category	0.3113**
Stress	Employment sector	0.9535***

*Note: * Spearman correlation coefficients; ** Kruskal-Wallis test; *** Mann-Whitney test.*

According to the Spearman correlation test, p-value at the 5% significance level, no significant difference was identified in the difference of identical stress distributions with the capillary cortisol level category. The variable, cortisol, showed an insignificant correlation with the other variables used (age, work time, professional category, and sector); i.e., the dosage of glucocorticoid in the hair was independent of the increase or decrease of the other five variables, including stress.

DISCUSSION

In the present study, data on nursing workers have similarities with those of other investigations. Most were female[28-30] and young adults (67.0%)[31]; the most prevalent professional category was nursing technician (62.2%)[32-33]; 84.8% had only one job[28]; 93.9% did not have jobs in other areas than nursing, although there were still professionals who worked even in different professions in this area[33]. Regarding the work shift, 52.4% worked during the day, and 93.9% on weekends, working 12 hours per shift for 36 hours per week[34].

Regarding employment sectors, the participants worked in MC, ED/UC, CCU, adult ICU, and I; health professionals are exposed to factors that can trigger stress in the workplace, which are similar in several health sectors[35]. In critical care units, psychosocial elements related to mental load affect the work of nurses[1]; those who work in inpatient units tend to have average stress levels[7]; emergency workers show physiological reactions to stress, such as low back pain, fatigue, exhaustion, neck stiffness and stomach acidity[28]. Also contributing to the presence of stress are poor working conditions, low salaries, lack of professionals, and difficulties in interpersonal relationships[32], in addition to high work demands, emotional pressure, and lack of professional recognition[33].

The Perceived Stress Scale is a psychological tool used to measure stress perception[20]. This scale has already been administered to several Brazilian populations, such as elementary and high school-teachers[36], university students[37], nursing students[38], seniors[21] and university teachers[39], among others. Similarly, it has also been administered in other countries, such as women with infertility[40] and patients with chronic headache[41] in Iran; adults in the Republic of Cyprus[42]; adolescents in China[43]; middle-aged and elderly women in Greece[44]; among nursing students in the Czech Republic and Slovakia[45]; hospital nurses in Jordan[46], among others.

Capillary cortisol studies are scarcer, although hair cortisol levels are increasingly used as a measure of stress in humans and mammalian animals[17]. In the present study, capillary cortisol levels were higher than recommended. The minimum value found was 0.59 pg/mg, while the maximum value was 1552.98 pg/mg. In addition, the mean capillary cortisol was 148 pg/mg, and the median was 76.45pg/mg; in other words, half of the survey participants showed a capillary cortisol concentration of up to 76.45 pg/mg. Similarly, in a study with capillary cortisol[47], the result was high (+43%) in groups with chronic stress.

However, according to the Kruskal-Wallis non-parametric hypothesis test, there was no significant difference (p value=57.4%, at 5% significance level) in identical distributions for perceived stress with the category of cortisol level.

Although cortisol is considered an important stress biomarker, and is more sensitive than the PSS, other studies related to cortisol and stress instruments also did not find statistical significance[12,47]. Findings[48] showed that self-reported stress related to capillary cortisol was higher in the sample when the work effort was high, reward was low, and the work commitment was excessive. In a prospective association between work stress and capillary cortisol, linear regressions revealed that an increase in work stress was related to an increase in capillary cortisol[12].

Capillary cortisol cannot always be correlated with simple stress indices, but can provide an overall assessment of chronic stress[14]. Studies with salivary cortisol also showed that perceived stress had no statistically significant effects on cortisol time trajectory throughout the day[49].

It is necessary to discuss the work organization and conditions to which nursing professionals are exposed, and to recognize that the profession is stressful[6]. The most frequent stressors are related to working conditions and personnel management[7], in addition to devaluation of work, lack of resources, few professionals, excessive workload, short time tasks, and conflict among functions[6]. Stress among nursing staff can lead to job dissatisfaction and turnover possibilities; such problems can affect the patient care and safety [46]. Valuation, motivation, and better planning of institutions are recommended factors[32]. Consequently, hiring new professionals can alleviate work overload and an increase in salary could decrease the need for other employment relationships[33].

Study Limitation

The limiting aspects of this study are related to the lack of a control group, and the sample of professionals being restricted to a single hospital in a city within the interior of São Paulo state. Another aspect refers to the fact that the hair samples in the laboratory were cut, because there are possibilities that the sprayed samples contain statistically higher cortisol concentrations when compared to those that were only perforated[26]. In addition, different research groups have used different methodologies for the measurement of GC, making it difficult to compare results[50]. There are also gaps regarding data collection protocols, extraction, and evaluation of hair cortisol, as well as an estimated standard value for its concentration in healthy individuals[26].

Regarding the perception of stress through the instrument used, this research was conducted in a single hospital in the interior of São Paulo state, which limited the findings to this specific group of professionals. The fact that no statistical significance was found between the PSS data and the capillary cortisol concentrations possibly occurred due to an insufficient sample of participants. Other aspects that have not been researched, and that can be corrected in future studies, such as asking workers questions about whether or not they have had hair treatments, and whether they have used anti-inflammatory or hormonal medications.

Contributions to the area

The contributions to advances in knowledge are related to the very method used in the investigation, which was not identified in national studies in which nursing workers and capillary cortisol were addressed. It was also found that stress is present among nursing professionals, and can affect their work, the care provided, and their personal life.

CONCLUSION

Capillary cortisol levels and the PSS administered to the nursing staff indicated the presence of stress, but there was no association between these measures; however, these levels were above those recommended in most of the professionals studied.

More studies related to the measurement of cortisol in the hair of nursing professionals can be done, using other recommended laboratory methods, as well as using other stress measurement instruments. It is a priority that employers introduce changes in the work environment of these professionals, recognizing the importance and complexity of their work, and providing them with adequate working conditions.

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