JOURNAL OF SCHOOL OF NURSING USP
REVISTA DA ESCOLA DE ENFERMAGEM DA USP

ORIGINAL ARTICLE

DOI: 10.1590/S0080-623420150000700016

Atypical secretion of cortisol in Nursing professionals*

Padrão atípico de secreção de cortisol em profissionais de Enfermagem

Estándar atípico de la secreción de cortisol em profissionales de Enfermería

Siomara Tavares Fernandes Yamaguti[1], Amanda Roca Blasques de Mendonça[1], Daniela Coelho[1], Amanda Luiz Machado[1], Juliana Nery de Souza-Talarico[2]

* Extracted from the dissertation entitled "Padrão atípico de secreção de cortisol em profissionais de enfermagem", Escola de Enfermagem, Universidade de São Paulo, 2014.

[1] Universidade de São Paulo, Escola de Enfermagem, Programa de Pós-Graduação em Enfermagem na Saúde do Adulto, São Paulo, SP, Brazil.

[2] Universidade de São Paulo, Escola de Enfermagem, Departamento de Enfermagem Médico-Cirúrgica, São Paulo, SP, Brazil.

ABSTRACT

Objective: To describe the frequency with which nursing staff in hospitals presents an altered diurnal pattern of cortisol secretion. **Method:** These findings were based on results obtained from 56 randomly selected professional nursing staff working in outpatient clinics, medical clinics, surgical clinics, operating theaters, pediatric and adult emergency units, adult and pediatric intensive care units of a university hospital. The analysis of the diurnal cortisol pattern was based on saliva samples collected over two consecutive working days. **Results:** 42.5% of these nursing staff members presented an atypical pattern of cortisol secretion. Furthermore, the longer the period of exercising this profession, the higher the cortisol concentration (r=0.346; p=0.020). **Conclusion:** Over one-third of nursing staff samples displayed atypical cortisol secretion patterns. This suggests that these professionals are exposed, not only to a mental, but also to a biological, overload and thus, to a risk of contracting stress-related illnesses.

DESCRIPTORS

Nursing; Stress, Psychological; Hydrocortisone; Occupational Diseases; Occupational Health.

Correspondence Addressed to:
Juliana Nery de Souza-Talarico
Av. Dr. Enéas de Carvalho Aguiar,
419 - Cerqueira César
CEP 05403-000 – São Paulo, SP, Brazil
junery@usp.br

Received: 04/08/2015
Approved: 04/20/2015

INTRODUCTION

Nursing is recognized by the International Labor Organization as one of the most taxing professions due to its working hours, the type of work carried out, and the implicit risks of the profession, and is also associated with inadequate responses to stress [1].

Nursing staff susceptibility to stress is associated with chronic exposure to daily work stress circumstances and, thus, to stress hormones. This situation is capable of overloading stress reaction adaptation capacity and such individuals can become vulnerable to illness [1-2].

Upon encountering a stressful event, the autonomic nervous system is activated by the release of catecholamines (adrenalin and noradrenalin) by the modular portion of the suprarenin adrenalin gland and of the adrenal pituitary hypothalamic (APH) axis with the release of glucocorticoids (cortisol in humans) in the suprarenin gland. The role of these hormones is to release a chain of physical, cognitive, and emotional reactions in the organism, in an attempt to counter or control a given stress situation[3-4].

Prolonged or recurrent exposure to the intensely catabolic role of glucocorticoids leads to insulin concentration and blood pressure alterations. These events increase the risk of developing diabetes, arterial hypertension, and atherosclerosis. The APH axis system suppresses immune functions, an event that, in chronic situations, is associated with increased risk of infection[4]. Such repetitive and prolonged exposure to stress reactions can overburden the organism's function maintenance system (allostatic load), and lead to illness (allostatic overload).

In physiological circumstances, i.e., when an individual is not exposed to stress situations, cortisol secretion is regulated by the circadian rhythm. Cortisol concentrations are high in the morning, peaking thirty minutes after awakening, and progressively dropping throughout the day to lower concentrations in the early evening. This typical secretion pattern is crucial to the functions of all other systems of the human organism[5-6].

Authors describe some atypical patterns of cortisol secretion associated with chronic stress, which they have classified as flat pattern and inconsistent pattern. In flat pattern, cortisol concentrations remain elevated, not only in the morning, but all day long, with no gradual drop, as normally occurs throughout the day. In inconsistent pattern, the individual alternately presents the two types of cortisol secretion pattern, i.e., on one day, the pattern will be standard and, on the next day, will be flat[5-6].

A number of studies have identified increased cortisol levels in the morning in individuals suffering from work-related burnout, in addition to increased cortisol levels on working days as opposed to weekends[7-9].

Although several studies have described elevated stress levels in nursing staff based on behavioral and emotional reactions to daily work circumstances[1-2,10], there is little information available on stress-related neuroendocrine activity alterations.

Despite being only at the hypothetical stage, the identification of chronic stress-related atypical cortisol secretion patterns can reveal the potentially damaging effects to which these individuals are exposed. However, within the limits of our knowledge, no evidence is available regarding the frequency with which nursing staff suffer from alterations in their diurnal cortisone secretion pattern, nor whether such alterations are associated with the subjective perception of suffering from stress.

This doubt becomes pertinent given the ratio of chronic stress to development of cardiovascular, immunological, and psychiatric disturbances. An investigation of alterations in stress-related neuroendocrine activity in nursing staff could contribute to identifying groups of individuals vulnerable to this disturbance. Moreover, considering that, in addition to the technical knowledge, feelings, and emotions involved in the care process, stress is damaging not only to the care professional, who is susceptible to emotional damage and to psychosomatic disturbances caused by stress overload, thereby reducing the quality of the assistance given, but, especially, is harmful to the patient he/she is treating, who could be indirectly affected by the stress and the possibility of receiving less effective treatment[1].

The aim of the study was to describe the frequency with which nursing staff in hospital environments show an altered diurnal cortisol secretion pattern.

METHOD

Design and location of the study

This is a prospective observational study carried out at the University Hospital of the *Universidade de São Paulo* (*HU-USP*).

Ethical aspects

The study was approved by the committees in charge of Ethics in Research by the Faculty of Nursing of the *Universidade de São Paulo* (*CEP-EEUSP* - report no. 403.390) and of *HU-USP* (*CEP-HU-USP* - report No. 415.986). All parties involved and/or respective legal counsel signed the Free and Defined Term of Consent authorizing their inclusion in the study.

Participants

Fifty-six randomly selected morning and afternoon shift nursing staff members (nursing aides, nursing technicians, and nurses), allocated to the following medical-hospital units: Adult Emergency (AE) and Pediatric Emergency (PE) Rooms, Medical Clinic (MC), Surgical Clinic (SC), Operating Theater (OT), Pediatric Unit, Adult (ICU-A) and Pediatric (ICU-P) Intensive Care, and Outpatient Department of *HU-USP*.

One hundred and six professionals were evaluated, of whom 50 were excluded for the following reasons: medical leave of absence for a period in excess of fifteen days over the preceding thirty days; smokers or history or smoking over the last five years; abusive use of alcoholic beverages

or prior history over the last five years; use of medications that influence the APH axis (glucocorticoids, steroids, beta-blockers, antidepressants, or any other psychoactive drugs); use of glucocorticoids over the last three months; medically diagnosed neurological or psychiatric illness; night shift working activity in another institution.

Diurnal cortisol secretion pattern evaluation

This was analyzed based on saliva samples obtained in the home by each participant all of whom had received prior orientation. These samples were obtained by using a cotton-covered saliva dipstick chewed by the participant for approximately three minutes. It was then removed from the mouth and placed in a dry 05ml tube. Immediately after obtaining the sample, each participant refrigerated the material at home until the conclusion of the collection when he/she returned the samples to the researcher. The saliva samples were collected over two consecutive working days, immediately upon awakening, 30 minutes later, at 1400h, at 1600h, and before bedtime. The cortisol concentrations obtained during the first hour after awakening evidenced the glucocorticoid circadian peak, and were considered to be a reliable basal APH axis activity indicator[11]. The additional cortisol concentrations obtained in the afternoon and at night were considered to be reliable markers of diurnal cortisol secretion rhythm[11]. The decision to collect material over two working days was due to the fact that a single sample could potentially evidence an atypical pattern arising from an isolated event occurring during the collection day, but not necessarily evince the individual's cortisol secretion rhythm[6].

Since cortisol concentrations can be influenced by an ongoing depressive state, the Beck Depression Inventory (BDI)[12] was applied to control depressive conditions which had not been previously medically diagnosed. Additionally, a general characterization questionnaire was also applied; it consisted of queries relating to personal identification, economic classification[13] and individual health history.

Data collection procedure

At the outset, the research project was submitted to the heads of nursing of the *HU-USP* attendance units, and to the representatives of the nursing technician and aide categories of each unit in a meeting with the administrative council of the hospital's Nursing Department. The objective of this presentation was to enable nursing staff heads and representatives to disclose the study and announce that *USP* Faculty of Nursing researchers would be present in the units carrying out the research. Subsequently, each nursing professional selected for the study was approached in his/her own work unit in a reserved and private location. An explanation of all the stages of the research was made to the individuals who met the inclusion and exclusion criteria, and a Free Consent and Comprehension Agreement (FCCA) was signed. Immediately thereafter, the participants commenced the study protocol which was divided into three stages (Figure 1):

Stage 1 – Individual Interview: Gathering of socio-demographic data (age, sex, education, economic analysis, monthly income) relating to the individuals' work (professional category, length of time in profession, length of time working at the *HU-USP*, diurnal double shift in another institution, last vacation taken) and to their health history (chronic illnesses, medications currently in use, menstrual period). During this same interview, which lasted approximately forty minutes, the participants' anthropometric measurements (weight, height, abdominal and hip circumference) were taken, their arterial pressure measured (three times: at the beginning of the interview, 30 minutes later, and 50 minutes later, with digital measurement equipment), and they received instructions regarding the saliva collection (Stage 2) and the other stages of the study. After receiving these guidance instructions, each participant received a saliva collection kit to be utilized over two consecutive working days. This kit consisted of a three-liter polystyrene box, two receptacles (small plastic bottles), labeled "Day 1" and "Day 2", recyclable ice to be used for the delivery of the saliva samples, in addition to a saliva collection diary. This diary contained written instructions regarding the procedure, days and times for saliva collection, and the requirement for strict compliance with the established times, their registrations in the saliva collection diary, and non-collection on non-working days, weekends, or absence from work. The researcher made his/her telephone contact information available should the need arise for any further explanation during the saliva collection process and made a note of the participant's cell phone number. The researcher also advised each participant that, prior to each saliva sample collection, he/she would receive a reminder SMS text message about the collection and the time it should be made. Each participant was instructed to collect the saliva samples during the week of the first interview and to refrigerate them until the date of their delivery to *HU-USP*.

Stage 2 – Saliva Collection: On the day after the interview, unless this fell on a weekend or public holiday, the participants collected the saliva samples over a period of two consecutive days at the times established during the research project (upon awakening, 30 minutes later, at 1400h, at 1600h, and at bedtime).

Stage 3 - Conclusion: Within no more than seven days after the collection process had elapsed, each participant met once again with the researcher in the former's workplace to deliver these saliva samples.

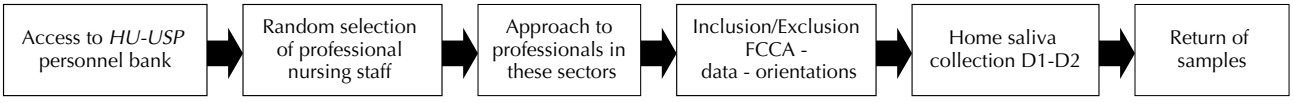


Figure 1 - Data collection flowchart.

Statistical analysis

The data were analyzed based on descriptive statistics to obtain averages, standard deviations, and distribution frequency. For the hypothetical analysis purposes, normal distribution variables were examined at first. The cortisol concentrations did not display normal distribution and, thus, were logarithmetically transformed prior to being submitted to the appropriate statistical treatment. For the analysis of the diurnal cortisone secretion rhythm, the ANOVA system was applied for repeated measures with Greenhouse-Geisser correction in the absence of sphericity in the variables distribution pattern. Multiple comparisons (*post hoc*) were made using the Bonferroni test. The variables of age, education, use of oral contraceptives, and menstrual cycle stage when the saliva sample was collected and the BDI score were inserted into the statistical model and, in the absence of any effect or significant interaction, were excluded (p>0,05). Classification of the cortisol secretion patterns commenced with calculation of the cortisol concentration curve inclination via the Excel® slope software function for each day of saliva collection. Subsequently, the difference between the first day slope, the second collection day slope, and the respective standard deviation was obtained. A participant whose absolute slope difference was greater than the standard deviation was classified as inconsistent and lower amounts was classified as typical. For flat pattern classification, the average slope of the two days was obtained. Participants showing more positive averages were classified as flat[5-6]. Frequency analysis (cortisol pattern x professional category, or x work sector) was based on the Chi-squared test or Fisher's Exact Test. To analyze the quantity of cortisol secreted throughout the day, and the cortisol awakening response (CAR), the area under the curve (AUC) was calculated. This cortisol analysis method has previously been described and validated and is based on various AUC trapezoid method fragmentations[14]. This area represents the cortisol concentrations obtained at different times throughout the day. Thus, it is calculated that the area of each trapezoid and the sum of these areas represents an average global cortisone secretion method. The multiple comparisons (*post hoc*) were carried out using the Bonferroni test. Pearson correlation coefficients were calculated to analyze the quotient between cortisol concentration, length of time in the profession, and at the *HU-USP*. These data were stored and analyzed using the SPSS statistics program, version 14.0 and the significance level applied was 5%.

RESULTS

Socio-demographic features

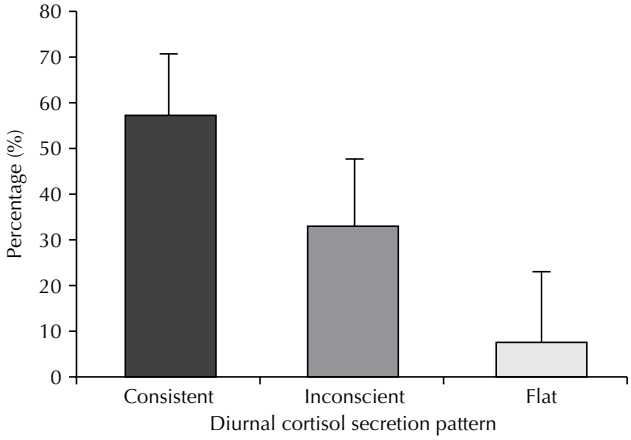
The sample study consisted of 56 nursing staff, the majority female (n=48 85.7%) most of them married (n=39, 70.9%), of an average age of 23 and 15.7 years of education. Economic classification: 41.5% (n=22) were members of class B1, followed by 39.6% (n=21) of class B2, and the remainder distributed between classes A and C. The BDI levels varied from zero to 28 points, with an average equivalent to 10.6 (±6.7).

Work shifts: 53.6% (n=30) worked the morning shift and 46.4% (n=26) the afternoon shift. All participants worked a 36-hour week and only one individual had a second employment bond, and worked a 72 hour week.

Personal health history: The majority suffered from no chronic disease. Of those who did, arterial hypertension was the most common complaint.

Diurnal cortisol secretion pattern

We noted that 34% (n=16) of nursing staff showed an inconsistent pattern and 8.5% (n=4) a flat pattern (Figure 2).



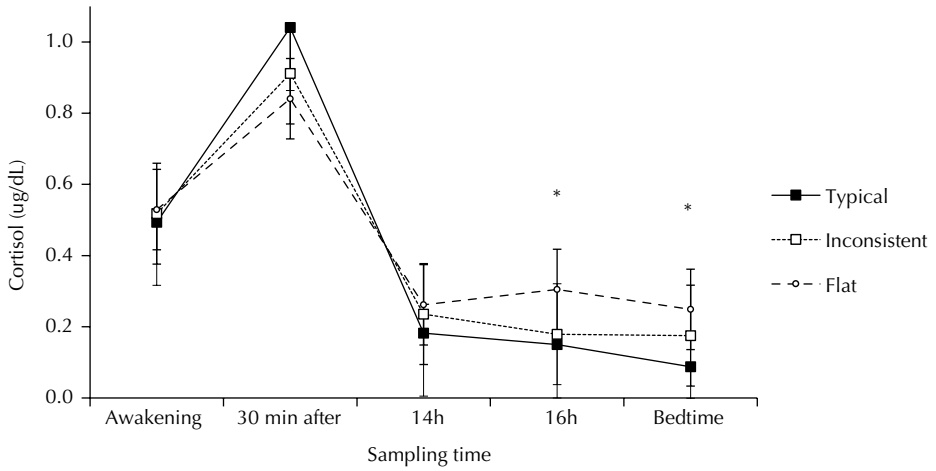
The bars represent standard error. Chi-squared test.

Figure 2 - Classification of the nursing staff of *Hospital Universitário da USP* according to diurnal cortisol secretion pattern - São Paulo, SP, Brazil, 2014.

With regard to cortisol secretion rhythm, we noted a Time x Group interaction (typical, inconsistent, and flat) in cortisol concentration throughout the day (F(6.166)=2.9; p=0.005). In other words, cortisol concentration varies throughout the day depending on the cortisol secretion pattern. The inconsistent (p=0.008) and flat (p=0.004) pattern participants presented higher cortisol concentrations at night than those of the typical group (*post hoc* Bonferroni F (2.46)=9.1; p=0.001, Figure 3). No effect on cortisol concentrations was identified in terms of age (p=0.464), sex (p=0.414), use of oral contraceptive (p=0.540), or saliva sample collection during the luteal phase of the menstrual cycle (p=0.256).

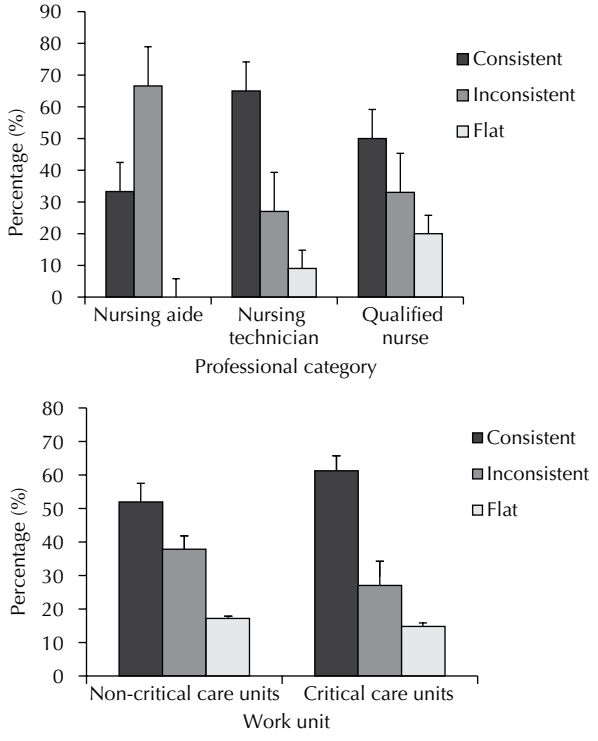
The AUC total revealed an average cortisol secretion of 354.5 μg/dL throughout the day (average for the two days), with an average of 22.3 μg/dL in the morning period only (AUC reactivity), representing an increase of 137.83% in cortisol concentration 30 minutes after awakening in relation to the concentration identified upon awakening (CAR).

Regarding the features of the study, no effect was identified in cortisol secretion pattern in either the professional category (χ^2=4,5; p=0.346) or the service unit (χ^2=0.484; p=0.785) (Figure 4).



* indicates a significant difference in the cortisol average at bedtime between the groups (p=0.001). The bars represent standard error. ANOVA for repeated measures, *post hoc* Bonferroni.

Figure 3 - Diurnal cortisol secretion rhythm of nursing staff of the *Hospital Universitário da USP* according to typical, inconsistent, and flat pattern - São Paulo, SP, Brazil, 2014.



The bars represent standard error. Chi-squared test.

Figure 4 - Percentage of nursing staff and service units showing typical, inconsistent, and flat pattern diurnal cortisone secretion - São Paulo, SP, Brazil, 2014.

Given that both the length of time the profession is exercised and the time worked at *HU-USP* could influence cortisol concentration, the decision was taken to analyze the association between these variables. We noted that the long time the profession is exercised, the greater the total concentration secretion throughout the day (r=0.346; p=0.020). The length of time worked in the *HU-USP* did not significantly correlate with cortisol concentration levels.

DISCUSSION

Based on the premise that nursing staff present chronic work-related stress, which can manifest itself in altered cortisol concentrations, we noted that over one-third of the nursing staff samples presented atypical cortisol secretion patterns. We also noted that, the greater the length of time in the profession, the greater the concentration of this glucocorticoid, suggesting that stressful work demands can influence the cortisol secretion rhythms of these professionals.

The atypical pattern most frequently identified in this study was the inconsistent pattern, followed by the flat pattern. This means that these workers are exposed to an altered cortisol secretion rhythm, distinguished by the constant presence of elevated cortisol concentration levels throughout the day (for at least two days) or alternate days (present on one day and not the next). While substantiating these findings, some authors noted that, among young participants, most of them female, with an average age of 36, the percentage of individuals with inconsistent patterns was equal to 31% and 17% of the flat pattern[6]. Of the older individuals, only 2% presented flat pattern while 48% showed inconsistent pattern[5]. Regardless of the age group, the occurrence of greater variability in cortisol secretion rhythmicity throughout the day causes us to reflect on its potential consequences on an individual's health. This altered rhythm arising from the individual's exposure to elevated cortisol concentrations, at least, for a short period of time, raises the possibility that it could influence other systems that are equally exposed to prolonged elevated cortisol concentration levels and, thus, to the negative impact of such exposure. Further to this, a study carried out of, predominantly female, adults of an average age of 68, showed that those presenting flat pattern cortisol secretion also displayed reduced cognitive performance (verbal fluency). Moreover, most of these participants showed a subjective decline in memory, with no medical diagnosis of pathological cognitive malfunction[15]. A trend was al-

so noted in women with breast cancer and who presented flat pattern cortisol secretion, to reduced survival rates than those observed for women with typical cortisol secretion pattern[16]. Although, in the present study, the frequency of atypical patterns differed between nurses' aides, nursing technicians, and fully qualified nurses, among professionals working in intensive and non-intensive units, this difference was not significant.

In addition to the atypical cortisol secretion pattern, we also identified an increase of over 130% in cortisol concentrations in the morning, which represents a substantially higher increase than that described in related literature. On average, in the morning, cortisol concentrations increase by 50% to 75% during the first thirty minutes after awakening, regardless of the respective participant's age [7] and even on working days [9,17]. The cortisol response on awakening has been considered a crucial marker for evaluating the performance of the APH axis[11]. It has been claimed that morning cortisol peaking represents a synchronizing factor for the circadian rhythm of the APH axis[11] and that adrenocorticotropic hormone (ACTH) and cortisol secretion pulsing occur in most individuals. Although no consensus exists on the precise role of the cortisol awakening response (CAR), it has been suggested that the increase in cortisol upon awakening is associated with prospective memory representation mechanisms (forecasting) thereby enabling the individual, upon awakening, to adjust himself/herself in time and space, and also to anticipate the demands of the dawning day. Confirming this possibility, some authors have already seen evidence of increased CAR on working days as opposed to weekends [17-18] and on normal days as opposed to competitive days[19]. Thus, the CAR analysis is a positive indicator for APH axis performance. Individuals whose CAR remains elevated, even on non-working days, present elevated levels of stress, neuroticism, and are not very content[20]. CAR is also associated with stress-related work, burnout, fatigue, and exhaustion[8-9,21-22]. Accordingly, a significant increase in CAR in nursing staff reinforces the idea that they could be exposed to the negative effects of elevated cortisol levels and consequently, susceptible to developing stress-related disease.

Curiously, we noted no difference in the cortisol secretion patterns between nursing aides, nursing technicians, and qualified nurses, nor among professionals working in intensive or non-intensive units. Similarly[23], no significant association has been identified between cortisol concentrations and the working environment of nursing staff with socio-demographic features similar to that of the present study, and who also worked in a university hospital[23]. However, several studies have noted that nursing staff working in intensive care environments present a higher level of stress in relation to those working in non-intensive areas[1,24-25]. According to these authors, the difference lies in the specificity of the sector, technological complexity, assistance complexity, and the psychological demands associated with assistance work. Furthermore, intensive care professionals are more exposed to suffering, the pain of loss, and emotional conflict involving beliefs and values.

Certain factors could explain the discrepancies between the findings of the present study and those described in professional literature. The reduced proportions of the findings in this study have led us to reflect on whether the results obtained in relation to frequency of atypical cortisol secretion patterns were not under-estimated, and on the absence of any statistical significance found in the associations between cortisol concentration and work environment characteristics. Also, the data represent the stress patterns of the nursing staff of one hospital. This undermines the external validity of the study and, consequently, of the ability to generalize the data for the general nursing staff population. Further to this point, and minimizing, albeit only partially, this limitation, the results herein were obtained on a probability sample basis, with socio-demographic features similar to those described in other studies carried out with nursing professionals. Specifically, the singular nature of the matters relating to the *HU-USP* work dynamic, allied to its structure as a teaching, research, and assistance institution, highlight the need to interpret results within a more favorable scenario in the context of the work of, and value attached to, the individual as compared with other public and private hospitals. Counter to this argument is the fact that, in a hypothetically more favorable scenario, one that strives to protect its staff from burnout, stress-related neuro-endocrine alterations were found, which leads us to reflect on the wellbeing of the professionals in other hospitals and health assistance institutions of a less favorable environment. Other, no less important, factors as sleep patterns and caffeine consumption, also affect cortisol concentration[26] and must be investigated in further studies to analyze the correlation between stress in the workplace and alterations in diurnal cortisol secretion concentrations.

CONCLUSION

The findings described reveal that nursing professionals present alterations in their diurnal cortisol secretion patterns, in their cortisol response to awakening, and, thus are likely to be more susceptible to stress-related disease. However, personal confrontation resources, allied to the presence of social support, could temper the negative impact of stress and, thus, should be included in future analyses.

RESUMO

Objetivo: Descrever a frequência de profissionais de enfermagem de unidades hospitalares com alteração no padrão diurno de secreção de cortisol. **Método:** Foram incluídos 56 profissionais de enfermagem randomicamente selecionados, alocados nas unidades ambulatório, clínica médica, clínica cirúrgica, centro cirúrgico, pronto socorro infantil e adulto, unidade de terapia intensiva adulto e pediátrica de um hospital universitário. Para avaliação do padrão diurno de secreção de cortisol foram coletadas amostras de saliva em dois dias úteis consecutivos de trabalho. **Resultados:** 42,5% dos profissionais de enfermagem apresentaram padrão atípico de secreção de cortisol. Além

disso, quanto maior o tempo de trabalho na profissão, maior a concentração de cortisol (r=0,346; p=0,020). **Conclusão:** Mais de um terço da amostra de profissionais de enfermagem apresentou padrões atípicos de secreção de cortisol, sugerindo que estes profissionais podem estar expostos a uma sobrecarga não apenas mental, mas biológica, estando expostos ao risco para o adoecimento por doenças relacionadas ao estresse.

DESCRITORES
Enfermagem; Estresse Psicológico; Hidrocortisona; Doenças Profissionais; Saúde do Trabalhador.

RESUMEN
Objetivo: Describir la frecuencia de profesionales de enfermaría de unidades hospitalarias con cambio en el patrón diurno de la secreción de cortisol. **Método:** Se han incluido 56 profesionales de enfermaría aleatoriamente seleccionados, ubicados en las unidades ambulatorio, clínica médica, clínica quirúrgica, centro quirúrgico, emergencias adulto y pediátrica, unidades de cuidados intensivos adulto y pediátrica de un hospital universitario. Para evaluación del patrón diurno de secreción de cortisol se recolectaron muestras de saliva en dos días laborables consecutivos, y para las manifestaciones psicológicas. **Resultados:** 42,5% de los profesionales de enfermaría presentaron estándar atípico de secreción de cortisol. Además, cuanto mayor sea el tiempo de trabajo en la profesión, mayor la concentración de cortisol (r=0,346; p=0,020). **Conclusión:** Más de un tercio de las muestras de profesionales de enfermaría presentaron estándares atípicos de la secreción de cortisol, sugiriendo que estos profesionales pueden estar expuestos a una sobrecarga no sólo mental, pero biológica, estando expuestos al riesgo de enfermarse por enfermedades relacionadas al estrés.

DESCRIPTORES
Enfermería; Estrés Psicológico; Hidrocortisona; Enfermedades Profesionales; Salud Laboral.

REFERENCES

1. Montanholi LL, Tavares DMS, Oliveira GR de. Estresse: fatores de risco no trabalho do enfermeiro hospitalar. Rev Bras Enferm. 2006;59(5):661-5.
2. Ferrareze MVG, Ferreira V, Carvalho AMP. Percepção do estresse entre enfermeiros que atuam em terapia intensiva. Acta Paul Enferm. 2006;19(3):310-5.
3. Mason JW. A review of psychoendocrine research on the sympathetic adrenal medullary system. Psychosom Med. 1968;30(5):631-53
4. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: links to socioeconomic status, health, and disease. Ann NY Acad Sci. 2010;1186:190–222
5. Ice GH, Katz-Stein A, Himes J, Kane RL. Diurnal cycles of salivary cortisol in older adults. Psychoneuroendocrinology 2004;29(3):355-70.
6. Smyth J, Ockenfels M, Gorin A, Catley D, Porter L, Kirschbaum C, et al. Individual differences in the diurnal cycle of cortisol. Psychoneuroendocrinology. 1997;22(2):89-105.
7. Schulz P, Kirschbaum C, Prübner J, Hellhammer D. Increased free cortisol secretion after awakening chronically stressed individuals due to work overload. Stress Med. 1998;14(2):91-7.
8. Pruessner JC, Hellhammer DH, Kirschbaum C. Burnout, perceived stress and cortisol responses to awakening. Psychosom Med. 1999;61(2):197-204.
9. Schlotz W, Helhammer J, Schulz P, Stone AA. Perceived work overload and chronic worrying predict weekend-weekday differences in the cortisol awakening response. Psychosom Med. 2004;66(2):207-14.
10. Versa GLGS, Murassak ACY, Inoue KC, Melo WA, Faller JW, Matsuda LM. Estresse ocupacional: avaliação de enfermeiros intensivistas que atuam no período noturno. Rev Gaúcha Enferm. 2012;33(2):78-85.
11. Clow A, Hucklebridge, Stalder T, Evans P, Thorn L. The cortisol awakening response: More than a measure of HPA axis function. Neurosci Biobehav Rev. 2010;35(1):97-103.
12. Goreinstein C, Andrade L. Inventário de depressão de Beck: propriedades psicométricas da versão em português. Rev Psiquiatr Clin. 1998;25(5):245-50.
13. Associação Brasileira de Empresas de Pesquisa. Critério Padrão de Classificação Econômica Brasil/2008 [Internet]. São Paulo: ABEP; 2007 [citado 2012 abr. 21]. Disponivel em: http://www.aba.com.br/wp-content/uploads/content/7727632a373615b34f2a5726fcc5c9e2.pdf
14. Pruessner JC, Kirschbaum C, Meinlschmid G, Hellhammer DH. Two formulas for computation of the area under the curve represent measures of total hormone concentration versus time-dependent change. Psychoneuroendocrinology. 2003;28(7): 916-31.
15. Fiocco A, Wan N, Weekes N, Pim H, Lupiem SJ. Diurnal cycle of salivary cortisol in older adult men and women with subjective complaints of memory deficits and/or depressive symptoms: relation to cognitive functioning. Stress. 2006;9(3):143-52.
16. Sephton S, Sapolsky R, Kraemer H, Spiegel D. Diurnal cortisol rhythm as a predictor of breast cancer survival. J Natl Cancer Inst. 2000;92(12):994-1000.
17. Thorn L, Hucklebridge F, Evans P, Clow A. Suspected non-adherence and weekend versus week day differences in the awakening cortisol response. Psychoneuroendocrinology. 2006;31(8):1009-18.
18. Kunz-Ebrecht SR, Kirschbaum C, Steptoe A. Work stress, socioeconomic status and neuroendocrine activation over the working day. Soc Sci Med. 2004;58(8):1523-30.
19. Rohleder N, Beulen SE, Chen E, Wolf JM, Kirschbaum C. Stress on the dance floor: the cortisol stress response to social-evaluative threat in competitive ballroom dancers. Pers Soc Psychol Bull. 2007;33(1):69-84.

20. Quoidbach J, Berry EV, Hansenne M, Mikolajczak M. Positive emotion regulation and well-being: comparing the impact of eight savoring and dampening strategies. Pers Individ Dif. 2010;49(5):368-73.

21. Steptoe A, Brydon L, Kunz-Ebrecht SR. Changes in financial strain over three year, ambulatory blood pressure, and cortisol responses to awakening. Psychosom Med. 2005;67(2):281-7.

22. Chida Y, Steptoe A. Cortisol awakening response and psychosocial factors: a systematic review and meta-analysis. Biol Psychol. 2009;80(3):265-78.

23. Rocha MCP, Martino MFF, Grassi-Kassisse DM, Souza AL. Stress among nurses: an examination of salivar cortisol levels on work and day off. Rev Esc Enferm USP. 2013;47(5):1187-94.

24. Salomé GM, Martins MFMS, Espósito VHC. Sentimentos vivenciados pelos profissionais de enfermagem que atuam em unidade de emergência. Rev Bras Enferm. 2009;62(6):856-62.

25. Menzani G, Bianchi ERF. Stress dos enfermeiros de pronto socorro dos hospitais brasileiros. Rev Eletr Enferm [Internet]. 2009 [citado 2012 abr. 21];11(2):327-33. Disponível em: https://www.fen.ufg.br/fen_revista/v11/n2/pdf/v11n2a13.pdf

26. Kudielka BM, Hellhammer DH, Wüst S. Why do we respond so differently? Reviewing determinants of human salivary cortisol responses to challenge. Psychoneuroendocrinology. 2009;34(1):2-18.

Financial Support: Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP. Process number: 2013/01637-2.