ORIGINAL ARTICLE

Salivary cortisol concentrations in hematogy/oncology nurses on working days and days off

Concentração de cortisol salivar de enfermeiros de hemato-oncologia nos dias de trabalho e folga

Concentración de cortisol salival en enfermeras de hemato-oncología en días laborales y días libres

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ABSTRACT

Objective: to assess salivary cortisol concentrations in hematology/oncology nurses on working days and days off. **Methods:** a cross-sectional study carried out with 28 nurses from a university hospital. A sociodemographic, employment and health profile questionnaire was applied. For saliva collection, Salivette® tubes were used. Descriptive and analytical analysis was used. **Results:** there was no significant difference in cortisol concentrations between working days and days off (p>0.05). The high cortisol concentration was associated with not having children (0.621±0.340; p=0.046), not using medication (0.623±0.133; p=0.017) and birth control pills (0.556 ± 0.228; p=0.047) and intention to leave work (0.951±0.154; p=0.001). A positive correlation was identified between cortisol and absence from work due to health issues (0.72; p=0.05) and weight gain (0.935; p=0.02). **Conclusion:** in general, cortisol concentration is within the reference parameters, with no significant difference in its secretion on working days and days off.
Descriptors: Hydrocortisone; Oncology Nursing; Occupational Health; Nurses; Hospitals.

RESUMO

Objetivo: avaliar a concentração de cortisol salivar em enfermeiros de Hemato-Oncologia nos dias de trabalho e de folga. **Métodos:** estudo transversal, realizado com 28 enfermeiros de um hospital universitário. Aplicou-se questionário sociodemográfico, laboral e perfil de saúde. Para coleta de saliva, foram utilizados tubos Salivette®. Empregou-se análise descritiva e analítica. **Resultados:** não houve diferença significativa na concentração de cortisol entre os dias de trabalho e de folga (p>0,05). A concentração de cortisol elevada esteve associada a não possuir filhos (0,621±0,340; p=0,046), não fazer uso de medicação (0,623±0,133; p=0,017) e de anticoncepcional oral (0,556±0,228; p=0,047) e ter a intenção de deixar o trabalho (0,951±0,154; p=0,001). Identificou-se correlação positiva entre cortisol e afastamento do trabalho por problemas de saúde (0,72; p=0,05) e aumento de peso (0,935; p=0,02). **Conclusão:** em geral, a concentração de cortisol está dentro dos parâmetros de referência, não apresentando diferença significativa na sua secreção no dia de trabalho e folga.
Descritores: Hidrocortisona; Enfermagem Oncológica; Saúde do Trabalhador; Enfermeiros; Hospitais.

RESUMEN

Objetivo: evaluar la concentración de cortisol salival en enfermeras de Hemato-Oncología en días laborales y días libres. **Métodos:** estudio transversal realizado con 28 enfermeras de un hospital universitario. Se aplicó un cuestionario de perfil sociodemográfico, laboral y de salud. Para la recolección de saliva se utilizaron tubos Salivette®. Se utilizó análisis descriptivo y analítico. **Resultados:** no hubo diferencia significativa en la concentración de cortisol entre los días laborables y los días libres (p> 0.05). La alta concentración de cortisol se asoció con no tener hijos (0.621±0.340; p=0.046), no usar medicación (0.623±0.133; p=0.017) y anticonceptivos orales (0.556±0.228; p=0.047) y tener la intención de dejar el trabajo (0.951±0,154; p=0.001). Se identificó una correlación positiva entre cortisol y absentismo laboral por problemas de salud (0.72; p=0.05) y aumento de peso (0.935; p=0.02). **Conclusión:** en general, la concentración de cortisol se encuentra dentro de los parámetros de referencia, sin diferencia significativa en su secreción el día de trabajo y tiempo libre.
Descriptores: Hidrocortisona; Enfermería Oncológica; Salud Laboral; Enfermeros; Hospitales.

INTRODUCTION

The Brazilian nursing workforce tripled over the first decade of the 21st century, being essential for the provision and maintenance of health care[1]. Nurses are at the head of nursing staff, in charge of both the work and care process, which are different, depending on the specific field of work in health[2].

One of the sub-fields of activity is the specialty in oncology, which is increasingly necessary and important, since cancer is the second leading cause of death in the country[3]. In Brazil, an estimated 600,000 new cases of cancer are estimated between 2018 and 2029, with an upward trend in the coming years[4].

The nursing routine in the oncology sectors demands a lot from all team members, who are susceptible to several occupational risks, one of them being stress. Occupational stress comes from disorders and psychological and physiological instability due to external stimuli and causes symptoms such as musculoskeletal pain, fatigue and exhaustion, sleep difficulties, among others, leading to illness[5-6].

In the face of stress, the body triggers processes that involve hormonal action to return to physiological balance. It is called the General Adaptation Syndrome (GAS), which occurs in three phases. In the first, alert, the body, facing imbalance, faces the stressor through the sympathetic autonomic nervous system, which acts in the release of neurotransmitters and catecholaminergic hormones by the adrenal glands[7]. The second phase, of resistance, is mediated mainly by cortisol, in order to restore the stability of the organism. In the last phase, of exhaustion, the individual cannot neutralize the stressor in the previous phase, but the organism remains responding to the stimulus[7].

To identify stress some indicators are used, such as psychometric scales and immunochemical measurement using cortisol, which is one of the most important and reliable indicators of occupational stress, since the amount of this substance can increase in a few minutes after a stressful event[8-10]. Cortisol is a glucocorticoid hormone produced by the adrenal glands and activated by the hypothalamic-pituitary-adrenal (HPA) axis[11], which can be quantified by collecting blood, urine or saliva[12]. Normally, the most used cortisol is salivary, as it is a non-invasive and easily collected procedure[12]. The physiological concentration of salivary cortisol has a circadian cycle and, under normal conditions, decreases throughout the day[13]. In the morning, it has high concentrations, peaking in the 30 minutes after waking up, progressively decreasing during the day, with lower concentrations in the early evening. This pattern of secretion is essential to keep the body's systems in good working order[14].

Different studies have demonstrated changes in cortisol concentrations on weekdays, in the morning and at night, and in female individuals with longer professional practice, emotional overload[6,14] and less quality of life[15]. Other studies involving cortisol often investigate diseases due to deficiency or excess secretion of this hormone in order to assess the physiological response to any stressful event[16-17]. However, searches in the literature have shown that research on the subject with nurses from oncology sectors is still scarce, especially in Brazil, and mostly carried out with hospitalized patients in different hospital units[18-20].

These particularities are related to the routine of health professionals who experience difficult situations in care, such as patients diagnosed with cancer and with no therapeutic possibility of cure. This overview of oncology sectors can cause suffering to nurses and make them face a grieving process with families on a daily basis, which contributes to the increase in occupational stress levels and makes these places important for investigation[21].

OBJECTIVE

This study aims to assess salivary cortisol concentrations in hematology/oncology nurses on working days and days off.

METHODS

Ethical aspects

The research was approved by the local Research Ethics Committee on December 19, 2017. The ethical precepts of Resolution 466/12 were respected[22].

Design, period, and place of study

This is a cross-sectional study carried out between April and August 2018. The research took place in hematology/oncology sectors of a university hospital in southern Brazil, which provides highly complex assistance. Hematology/Oncology encompasses five sectors, three of which are hospitalization, one for children, one for adults and the other for bone marrow transplantation in adults, all with 24-hour operation. There are also two outpatient sectors: one for chemotherapy and one for radiotherapy, both for adults, which operate during the morning and afternoon from Monday to Friday, on working days. This study was conducted based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[23].

Population and sample; inclusion and exclusion criteria

The population was composed of 37 nurses working in hematology/oncology sectors. Nurses working day shift, who do not have a diagnosis of a disease that affects cortisol production (identified by self-report, such as Cushing syndrome, Addison's disease, among others), not using medications that influence the HPA axis functioning (glucocorticoids, steroids, beta-blockers, antidepressants or any psychoactive medication), who do not have periodontological disease or gingival/oral bleeding and, in the case of women, not being pregnant were included, as these conditions interfere with cortisol production in the body.

Nurses who smoked, who had abused alcoholic beverages or had a previous history in the last five years, and those who did not reach a minimum of 1ml of saliva after collection in two attempts were excluded due to laboratory specifications. Of the 37 nurses initially selected, four did not accept to participate in the research, three were using glucocorticoids, one had Cushing's syndrome and the other did not reach a minimum of 1 ml of saliva for analysis in two attempts. Thus, the final sample comprised 28 nurses.

Instrument and Procedures

Each participant received an Informed Consent Term, guaranteeing privacy and the right to withdraw from participation in the research at any time, with no public exposure of any person or their information. Data collection took place through self-completed questionnaires prepared by the authors of this research, namely: instrument for sociodemographic, work and health profile, consisting of 16 items (age, sex, marital status, children, academic degree, time passed after graduation, working time at the institution and sector, weekly workload, days off, have another job, work sector, satisfaction in working at this unit and intention to leave work, health issues diagnosed by a physician, use of medications, and, in the case of women, birth control pills and if they had a good night's sleep prior to collection).

Saliva collection was done through tubes (cotton oral swab) provided by the laboratory that performed the analysis, identified with participants' initials, date of birth, sex, date and time of collection. The tubes are from the Salivette® brand and were supplied by Sarstedt LTDA of the city of Porto Feliz, São Paulo State, Brazil.

The kit used to detect cortisol was electrochemiluminescence (ECL), a method for detecting hormones. Participants received the tubes (oral cotton swab), which could be chewed or kept in the oral region, stimulating salivation for 3 minutes, ensuring a higher saliva concentration for analysis in laboratory. They also received a field diary that contained a type of sample (collection carried out on working days or days off), collection days and times, as well as the need to strictly follow the pre-established collection times and fill in this information. At the end, the diary was delivered to the researcher along with the cortisol sample.

To ensure collection time accuracy, participants received verbal and written instructions for collection, in addition to mobile phone messages. The guidelines included 24 hours before collection were: not drinking alcohol and undergoing dental treatments; two hours before, avoiding brushing the teeth and eating (except water) and immediately before collection, making a light mouthwash with water; not presenting, during the procedure, oral lesions with active or potential bleeding and not having fever and/or acute illness. To keep the samples cool during transport, each participant received a polystyrene box and a reusable ice. The time between handing over the material to the researcher and the laboratory was approximately one and a half hours, respecting the maximum period of three hours in the box, according to the laboratory guidelines. The researcher made her telephone contact available for any clarifications during saliva collection.

The procedure for collecting saliva was performed by nurses, who received five Salivette® tubes each, and occurred over two days on working days, upon awakening, at the beginning and end of duty, with tolerance of one hour after the beginning and one hour before the end, and on the day off at the times corresponding to the beginning and end of duty. To remind them of collection time, they received, one hour before carrying out the procedure, an alert containing the time and instructions on how to proceed, by SMS text message. For better control, after each collection, they were instructed to send an SMS text message to the study researcher informing them of the procedure.

After collection, participants handed the device over to the researchers, who started processing and analyzing the samples. Thus, saliva was extracted from Salivette® tubes by centrifugation for five minutes at 2,500 rpm; afterwards, it was kept under refrigeration from 2 to 8ºC. The measurement of cortisol in saliva was performed by immunoassay by ECL according to the manufacturer's instructions, and the results were expressed in µg/dL. The comparison of salivary cortisol values with the reference in the scientific literature considered between 6 a.m. and 10 a.m., less than 0.736 µg/dL; between 4 p.m. and 8 p.m., less than 0.252 µg/dL; between 11:30 p.m. and 00:30 p.m., less than 0.274 µg/Dl[13].

Due to the circadian rhythm, cortisol concentrations in the morning show the peak of this hormone, being considered a reliable indicator of baseline activity of the HPA axis. During the day, concentration levels tend to decrease, showing the lowest peak at night[24].

Analysis of results, and statistics

Data were analyzed using PASW Statistics® (Predictive Analytics Software, from SPSS Inc., Chicago - USA) 17.0. Qualitative variables were presented by distribution of relative and absolute frequency, and quantitative variables by means of position and dispersion measures. When the results did not respond to the normal distribution, it was decided to use median and interquartile range, depending on the data distribution verified using Shapiro-Wilk normality test. Student's t test and ANOVA for symmetric distribution and Mann Whitney and Kruskal-Wallis for asymmetric distribution were used to assess the difference between means and medians.

To verify differences between cortisol values on working days and days off, the Wilcoxon test was used. Correlations were performed by Spearman and Pearson tests, with the following values being used for classification: 0.1 to 0.29, weak correlation; 0.3 to 0.49, moderate correlation; above 0.5, strong correlation[25]. The level of significance used was 5% ($p < 0.05$).

RESULTS

Of the 28 participating nurses, 96.4% (n=27) were female, mean age 39.18 (SD=7.60) years old, graduated 14.45 (SD=6.42) years, working in average for 9.75 (SD=7.22) years in the institution and 5.86 (SD=5.47) years in the sector. No participant had another job, as shown in Table 1.

All (100%; n=28) were satisfied with working in this sector, where they worked around 32.28 (SD=3.99) hours a week and had been off for 3.24 (SD=1.81) days. Participants stated that they needed an average of 8.03 (SD=0.90) hours of sleep daily, but actually slept 6.74 (SD=1.21) hours/day, which were considered sufficient by 50% (n=14) sample.

Regarding workers' health profile, 46.4% (n=14) had some health issue diagnosed by the physician, especially diseases related to the musculoskeletal system and connective tissue (13.8%; n=4). Moreover, 53.57% (n=15) used birth control pills and 71.43% (n=20) rated the night's sleep prior to collection as good.

With regard to salivary cortisol values, it was evidenced that 10.7% of nurses had levels above the reference values upon awakening, 3.6% at the end of duty and 8.3% at the end of time off, according to Table 2.

Table 1 - Sociodemographic, employment and health profile (N=28), Santa Maria, Rio Grande do Sul, Brazil, 2018

Variables	n	%
Sex		
Female	27	96.4
Male	1	3.6
Marital status		
With a partner	21	60
Without a partner	7	40
Children		
Yes	22	78.6
No	6	21.4
Academic degree		
Undergraduate degree	2	7.1
Specialization degree	14	50
Master's degree	12	42.9
Hematology/oncology work sector		
Inpatient units	13	46.4
Outpatient units	15	53.6
Intend to leave work		
Yes	2	7.1
No	24	85.8
Did not know/did not think about it	2	7.1
Away from work due to health issues in the year		
Yes	10	35.7
No	18	64.3
Gained weight in the last six months		
Yes	7	25
No	21	75
Lost weight in the last six months		
Yes	9	32.1
No	19	67.9

A comparison test was performed between the cortisol values collected on working days and days off (beginning of duty x beginning of duty and end of duty x end of duty), but no statistically significant difference was found (p> 0.05).

The cortisol concentration values at the beginning and end of duty on a working day and the values corresponding to these times on days off are shown in Table 3.

Table 3 shows that 92.9% (n=26) of nurses had higher salivary cortisol levels at the beginning of duty and 79.2% (n=19) at the beginning of time off, meeting expectations according to the circadian cycle.

With regard to the association between cortisol concentration levels and sociodemographic, labor and health profile variables based on appropriate comparison tests for each variable according to the number of groups and normal distribution, there was a statistically significant difference (p <0.05) with higher cortisol values upon awakening with the variables: not having children (0.621 ± 0.340; p=0.046); not using medication (0.623 ± 0.133; p=0.017); not using birth control pills (0.556 ± 0.228; p=0.047); showing intention to leave work (0.951 ± 0.154; p=0.001). Furthermore, there was a statistically significant difference between elevated cortisol values at the end of time off and performance in the hematology/oncology inpatient sector (15.92; p=0.018).

Correlations were strong, significant and positive between: cortisol concentrations upon awakening and absence due to health issues in the last year (0.72; p=0.05) and cortisol concentrations at the beginning of time off and weight gain (0.935; p=0.02).

Table 2 - Descriptive statistics of salivary cortisol in hematology/oncology nurses (N=28), Santa Maria, Rio Grande do Sul, Brazil, 2018

Time	Mean± Standard Deviation	**Median (interquartile range)	Above reference values***%(n)
Upon awakening	0.47 ± 0.21	-	10.7(3)
Beginning of duty	-	0.25 (0.17-0.38)	-
Beginning of time off*	0.27 ± 0.13	-	-
End of duty	-	0.12 (0.10-0.14)	3.6(1)
End of time off*	-	0.13 (0.77-0.20)	8.3(2)

Note: *sample of 24 nurses, as four of them gave up collecting cortisol on days off. **In cases where the data did not respond to normality, median and interquartile range were calculated. ***Cortisol reference values: 6 a.m. to 10 a.m., <0.736 µg/Dl and 4 p.m. to 8 p.m., <0.252 µg/dL.

Table 3 - Cortisol concentration values at the beginning and end of duty on working days and days off, from the Wilcoxon test (N=28), Santa Maria, Rio Grande do Sul, Brazil, 2018

Time	n	%	Beginning Median (Interquartile range)	End Median (Interquartile range)	Z†	p
Work	26‡ 02§	92.9 7.1	0.25(0.17-0.38)	0.12(0.10-0.14)	-4.418	0.000
Time off*	19‖ 05¶	79.2 20.8	0.23(0.19-0.37)	0.13(0.08-0.20)	-3.143	0.002

Note: *sample of 24 nurses; †Wilcoxon test; ‡cortisol values at the beginning of duty> end of duty; §Beginning of duty <end of duty; ‖Beginning of time off> end of time off; ¶Beginning of time off <end of time off.

DISCUSSION

Despite hematology/oncology sectors present delicate situations of patient care, often weakened by the news of disease diagnosis, the long and exhausting treatment, the team conflicts concerning decision-making, and even patients with few therapeutic possibilities of cure, which require specific procedures, nurses showed satisfaction in working in this place. The feeling of satisfaction is essential for coping with difficult situations at work and stress, which may be related to factors such as professional recognition by patients, good relationship between the team and professional autonomy[26-27].

With regard to hours of sleep, half of participants rated it as sufficient, reporting a good quality of sleep on the nights before saliva collections. Sleep disorders and chronic stress favor dysregulation of the HPA axis and this can result in more serious problems to workers' health, such as emotional exhaustion[28-29], which reiterates the importance of good sleep quality for adequate cortisol secretion.

In physiological circumstances, cortisol levels are elevated in the morning, according to the findings of this study, in which 10.7% of nurses had peak secretion upon awakening, however with values above the reference, which may be indicative of some sleep disorder[30]. Studies have identified that increased cortisol secretion may indicate occupational stress chronification[14,31] with greater activation of the HPA axis[29], and that, in chronic stress, atypical patterns of cortisol secretion may occur, as the flat pattern, in which the secretion of this hormone remains high during the day[14]. Additionally, they presented levels above reference values at the end of duty (3.6%) and at the end of day off (8.3%). This can be justified by exposure of workers to a hostile

and highly demanding environment, in which they must face difficult situations such as death of children and suffering of family members in the face of this situation[21].

A Spanish study carried out in palliative care units indicated an association between high levels of cortisol concentration during the day and exposure of workers to emotional exhaustion. This exposure can keep them away from colleagues and patients, with the risk of experiencing feelings of low achievement, which impair their psycho-emotional state[29].

In this regard, cumulative exposure to stressors that demand greater professional performance can affect cortisol levels during the day and night[31-32]. Most nurses had higher cortisol secretion at the beginning of duty and time off, which is expected according to the circadian cycle, with a reduction throughout the day.

It was observed that participants who did not have children had significant higher cortisol concentrations upon awakening. Studies consider the fact that having children is a reason for emotional stability for workers, which contributes to better coping strategies and the solution of conflicting situations at work[33]. In other words, they are generally more resilient people in the face of stressors, who are better able to deal with problems, compared to professionals who do not have children[34].

Nurses who did not use medication or birth control pills had high levels of cortisol upon awakening. This result can be attributed to the action of some medications that can alter the activity of the HPA axis, more specifically birth control pills, since using estrogen promotes an increase in corticosteroid-binding globulin, causing a decrease in free circulating cortisol[35].

Moreover, nurses intending to leave work showed high levels of cortisol upon awakening, which may be related to the work process, the conditions of this job or lack of support for decision-making amidst difficult situations to be faced[21]. Although everyone reported job satisfaction, it is believed that the fact that the level of satisfaction has not been investigated may have influenced this finding. In a study carried out in oncology units, although nurses considered themselves satisfied with their work, 28% intended to leave the unit, 29.3% of whom had a high prevalence of burnout and 50% of traumatic stress[36].

In the present study, nurses who worked in inpatient units obtained higher significant values of cortisol concentration at the end of time off, compared to outpatients in oncology sectors. One of the main differences between these sectors is workload, as employees in inpatient sectors can work on weekends, while those in outpatient departments work only during weekdays at this institution. Thus, as workers have reduced cortisol secretion on days off[37], it is possible that outpatient workers feel less tired and stressed because they enjoy a longer consecutive period of time off.

Situations in which nurses perform hard work, under pressure to perform activities in a short time, may affect the stress biomarker, i.e., favor the circadian rhythm disorder[8], which is harmful to health[38]. This finding is in line with this study, which identified a strong, significant and positive correlation between cortisol concentration upon awakening and leave due to health issues in the last year. After leave, returning to work can be configured in a situation that favors the appearance or worsening of stress, due to factors such as anxiety, expectations of acceptance,

acceptance and learning. To improve this return, often permeated by insecurity, spaces for welcoming and discussing between staff can be provided[39].

Furthermore, there was a strong and positive correlation between cortisol concentration at the beginning of time off and weight gain. This may be related to the nursing work process in oncology with regard to an emotional bond that exceeds the limits of the therapeutic relationship between nurses and patients, in the face of recurrent admissions, leaving professionals more susceptible to stress[40] and anxiety[21]. In stressful situations, people tend to consume foods with a high glucose and fat index more frequently, characterized by emotional eating, which is excessive intake due to negative emotional states and uncontrolled food, resulting in increased body weight[41].

It is noted, therefore, that investment in strategies to support nurses is essential when facing critical or bad experiences in the researched institution's oncology sector. It is also possible to observe the importance of programs that foster resilience, which is an effective way to reduce team wear and secondary traumas from this sector. It is a necessary support, which can contribute to making workers healthier and less intent on quitting their jobs, as well as patients more satisfied with care and assistance with higher levels of quality. Patients with cancer with great vulnerability need a team that is not only qualified, but also psychologically prepared to support them in the face of diagnosis and throughout treatment[42].

Study limitations

They are related to the necessary controls for the collection of salivary material, which were carried out by participants themselves, and the lack of analysis of cortisol responsiveness upon waking, which would require, at least, two more collections at times close to waking up. However, it was decided to perform the collections at other times, which corresponded to the beginning and end of duty, based on the determination of salivary cortisol values at different times already validated for the day, as described in the method. It is suggested to carry out studies to investigate occupational stress using instruments with psychometric validity and its association with salivary cortisol concentration level including a greater number of participants in hematology/oncology sectors.

Contributions to nursing

This study contributes to fill a research gap in as it identified some changes in cortisol concentrations of hematology/oncology nurses on working days and days off. The peculiarity of this sector is highlighted, as it is a complex work environment, with consequences for nurses' health.

Moreover, the results provide information that not only helps in understanding how stress can interfere with workers' health, but can support the hematology/oncology management of the researched institution to develop actions capable of improving the sector and reducing stressors among its employees. The results also point to the importance of building healthier work environments for nurses and staff, so that they do not need another job,

have a good night's sleep, adequate workload and week time offs and, thus, maintain up with cortisol values within standards.

CONCLUSION

Hematology/oncology nurses from the researched institution showed levels of salivary cortisol concentration within the reference parameters, with no significant difference in the secretion of this hormone during working days and days off. This suggests that most nurses working in this sector are effectively facing the stressors that arise in their daily work. This may be related to satisfaction in working at the unit and reiterates the importance of performing activities in fields of greater affinity. It is considered opportune that those who secreted cortisol outside the reference values and presented symptoms of chronic stress should be monitored by a professional specialized in mental and occupational health, so that they can have their cortisol concentration normalized and work with greater satisfaction.

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