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Stress Level of Critical Care Nurses: Evaluation by Heart Rate Variability

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Abstract

Stress has long been considered one of the main health problems of the modern world, especially as it interferes in the quality of life and the individual's work. The heart rate variability (HRV) has been studied as a non-invasive way to evaluate the stress level for its relationship with cardiac autonomous regulation. In this work, we assess the relationship between HRV and the stress level of intensivists nurses. We analyse data from 31 nurses that work in critical care units of assistance to adults and pediatric patients. By proper analysing the HRV applied in this study, it was possible to observe that after working there was a decrease of components of variability. This allow us to claim that there is a high correlation between decreased heart rate variability and high- level occupational stress classified by Bianchi Stress Questionnaire.

Keywords: Stress level; Nursing; Heart rate variability; Sympathetic nervous system

Abbreviations: HRV: Heart Rate Variability; TXT: Text File Format; AR: Autoregressive; VLF: Very Low Bands Frequency; LF: Low Frequency; HF: High Frequency; ICU: Intermediate Care Unit; CCU: Critical Care Unit; ER: Emergency Room; BMI: Body Mass Index

Introduction

Stress has long been considered one of the main health problems of the modern world, especially by interfering in the quality of life and the individual's work. Therefore, the referred question is presented as the focus of studies of many researchers in universal scope, including the World Health Organization [1-5]. Analyzing the determinant factors and conditions, the stress is presented with multiple causes/effects and being experienced by health professionals involves a range of consequences that often extends to patients [1,3-5]. One of the main consequences of stress, experienced in the labor dimension of health professionals (also called "occupational stress"), are those related to the professional exhaustion and the risk of commitment of patient's safety [2-5]. In this sense, surveys indicate that nursing is one of the categories of health workers that offers sizeable propensity to have high load of stress, which is easily justifiable by the characteristics of activities that play [1,3,4,6]. Routine physical efforts, continuous mental-psychic wear and frequent mental mediations of conflict, coupled to the exhaustive journey labor that literally extends to 24 hours a day every day of the week, are some factors that are among the causes of occupational stress in nurses and their team [7,8].

Ratifies that occupational stress is triggered by exposure to high levels of professional tension, which is considered by the American nursing as a topic of public interest both among researchers and workers in the area [9].In Brazil, the validation of the Bianchi Stress Questionnaire (BSQ) aimed to consolidate coping strategies and its publication sparked national academic and scientific contributions on the subject. The BSQ consists on 51 items, and categorizes the occupational stress in levels (low; medium; high) according to the final score achieved by the individual [10]. By its good reliability and easy applicability, BSQ is used to evaluate the occupational stress among assistential and managerial nurses [11,12] being a tool employed in studies on nurses who work in critical hospital attention units [13-16]. It should be stressed that despite the BSQ present quantitatively measurable data, its original version, as it is, doesn't give us to infer if the stress level presents relationship with parameters and physiological responses of the organism. Because of this, the results from pure and unique application of BSQ can be considered to some extent subjectives. This because there's no way to understand the level of stress from explanations that go beyond the circumcision bounded by their domains. Despite this, it is known that in a physiological context stress presents relationship with cardiac response of the individual, more precisely with the heart rate variability (HRV) [17-19].

It is known that the autonomic nervous system (ANS) makes tonic and reflexively influence on blood pressure, peripheral resistance and cardiac output through the parasympathetic and sympathetic nerves that innervate the heart, promoting acceleration (nice influence) or decrease (parasympathetic influence) of cardiovascular activity [17,18,20,21]. Studies say that one of the most affordable and reliable sources of information of the effects of the ANS on the cardiovascular system is HRV, which is represented by the oscillations of the intervals between successive heartbeats, called R-R intervals [20-22]. Thus, the HRV has been studied as a non-invasive to evaluate the stress level for its relationship with cardiac autonomous regulation [23-28]. In this perspective, in various parts of the world researches that explain the level of stress and its relation with the HRV are developed both between individuals from the general population [23-25] as among health professionals [25-28]. However, there is still a gap in the Brazilian scientific literature surveys found aboutthis association.Thus, this work aims to evaluate the relationship between occupational stress level provided by BSQ and the HRV of nurses that work in critical care units of a publicuniversity hospital of Brazil. In this context, the decision tree J48 is used for combination with the variables obtained, which will be shown in subsequent sections. In this article, combined with the decision tree, the relationship of the HRV, Bianchi Questionnaire and other information obtained from the study participants.

Methodology

Research of quantitative nature, with analytical and exploratory design of transverse type. The study was carried out at the University Hospital of the West of Paraná (HUOP), which is characterized as an education center and public hospital that performs high-complexity care, being located in the southern region of Brazil. The study was approved by the Ethics Committee of the institution, number 1345333. This study follows all the ethical principles established internationally for the legal declaration of Helsinki and in Brazil by resolution 466/2012 of National Health Council [29]. 31 nurses participated in the research that work in critical care units of assistance to adult patients and children of that hospital, which fit together previously established criteria and signing the informed consent form certifying the voluntary and free participation. Inclusion criteria were: being female (which represents 93.94% of all nurses); has exclusively assistential function and time of work in the unit more than three months; not be the bearer of pacemaker, do not make use of beta blockers, don't have prior medical diagnosis of heart disease, not being pregnant and not be in frank menstrual cycle.

Protocol

The data were collected between the months of February and March 2016, with scheduled collections directly to the participants and, in conformity with the following protocol:

The Collections Room: The participants were allocated one at a time, in a room at the HUOP, in a quiet environment, air conditioned the 23 °C, free of noise and Visual and audio stimuli, which is called "the COLLECTIONS ROOM"

Completion of the Socio-Demographic Questionnaire: The questionnaire included the following variables: age; marital status; number of children; time of formation; time of work in the hospital unit in which she operates; employee ties; work shift; performing overtime; average of patients under the responsibility of the participant; medication; smoking; practice of physical activities.

Classification of stress level: Applying the Bianchi Stress Questionnaire (BSQ) [10] Where: BSQ-1 = low level of stress (final score between 1 and 119); BSQ-2 = medium level of stress (final score between 120 and the 238); EBS-3 = high level of stress (final score between 239 and 357).

Physical assessment: Held measuring by all participants, the following data: respiratory rate; heart rate; systolic-PAS diastolic-PAD and average-PAM; body temperature; body mass; height and body mass index-BMI.

Heart rate variability register (HRV): To obtain registers of the HRV, the volunteers were monitored by a frequency meter Polar® (Advanced RS800® and V800®)

Rr Intervals Time Series

The time series of RR intervals were collected using the Polar® occurred in two distinct steps:

STEP 1: 15 minutes before the work shift: With the physical evaluation ever made, the researcher has positioned the Polar® and guided each participant to lay on the gurney and remains supine, resting for a period of 15 minutes before the start of their shift. While gathering the participants were directed not to talk and does not move. The recording of the RR intervals time series was started by noting the time of beginning and end of the gathering.

Table 1: Schedule of the Data Collected.

Work shift	Work schedule	Approximate time of the first step	Approximate time of the second step
Morning	7:00 am to 1:00 pm	6:40 am to 7:00 am	1:05 pm to 1:20 pm
Afternoon	1:00 pm to 7:00 pm	12:40 pm to 1:00 pm	7:05 pm to 7:20 pm
Night	7:00 pm to 7:00 am	6:40 pm to 7:00 pm	1:05 am to 1:20 am

STEP 2: 15 minutes after work shift at the end of 6 hours of work each study participant underwent a new physical evaluation, this time ignoring the data regarding body weight, height and BMI (already collected in the previous step). The previous procedure was carried out for a period of 15 minutes. It was noted the start time and end of same. The choice for evaluation after 6 hours of work due, in particular, to get as close as possible to the level of stress caused by occupational activity and, at the same time, away

from the influence on the hormone cortisol in this stress, high levels of this hormone (whose peak is reached in the middle of the night) are directly related to high levels of stress [30,31]. In (Table 1), the approximate schedule of the collections, based on the start and end of shifts.

Signal Filtering

The time series of RR intervals captured by Polar were transmitted to a computer by *Polar's* own software, converted to a text file format (TXT) and soon after were filtered and extracted the variables. For filtration of time series was use the adaptive filter developed and hosted by [32]. The adaptive filter is intended to streamline the pre-processing of time series of RR intervals for later analysis, that rather than maintaining its parameters of rejection, gain and fixed band, it makes use of an algorithm able to adapting such coefficients according to the behavior of the signal.The adaptive filter is based on the adaptive values of average and standard deviation that vary according with the variabilitypresented by time series. Initially the algorithm deletes less than 350 ms intervals and over 1200 ms, once that such values are incompatible with the sinus rhythm [32]. The great advantage in the use of adaptive filter described lies in the ability to adapt spontaneously to the values of RR variability without occurring a distortion of the data (Figure 1).

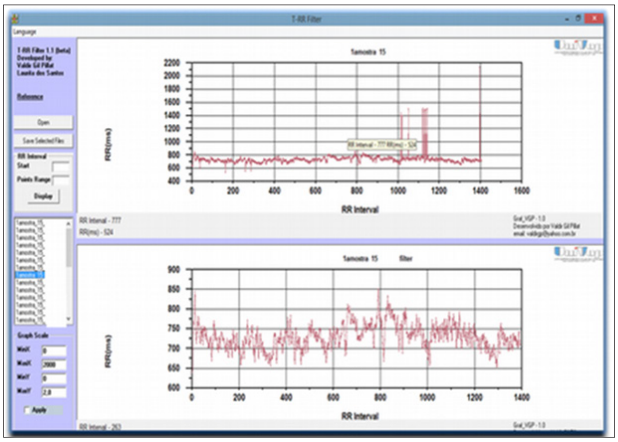

Figure 1: Computational tool interface *TRR Filter* [46], with an original time series (top) and filtered (bottom).

HRV Analysis Methods

After filtering, the signs were treated in KUBIOS HRV software (Physics Department University of Kuopio - Finland) [33]. The analysis methods providing information about the time series in the time domain as: average, standard deviation among others as the frequency domain using AR method [34-37]. The nonlinear method was used for HRV analysis, as the central tendency measure [38-40].

Frequency Domain AR: The autoregressive modeling method (AR) is based on the analysis of the spectrum dividing the estimates of oscillations in: low very low bands: frequency (VLF); low frequency (LF); high frequency (HF) and ratio of power between the bands LF and HF, given by LF/FL. The calculation of these variables will be held using the AR method [36].

Central Tendency Measure: The method of central tendency measure is commonly employed in modeling biological systems [39,40]. The CTM conducts a quantitative analysis of the variability of time series via graph and scattering is calculated using a circular region of ρ. ray that should be chosen according to the characteristics of the analyzed data, around the origin, the points contained in the circle are counted and divided by the total of points [39]. It should be noted that the evaluations of CTM were conducted considering an interval of 1000 RR intervals.

Decision Tree

To relate the BSQ, information obtained during the physical evaluation and/or socio demographic questionnaire and the variables obtained from the time series of RR intervals was used a decision tree classifier. This classifier is an algorithm able to combine and correlate various characteristics obtained from the same system. To this end, was used the J48 available in WEKA software [19]. Decision tree algorithms developed from a group of information structure (flowchart) in tree format on which the data can be used to sort new correlations [41] (Figure 2).

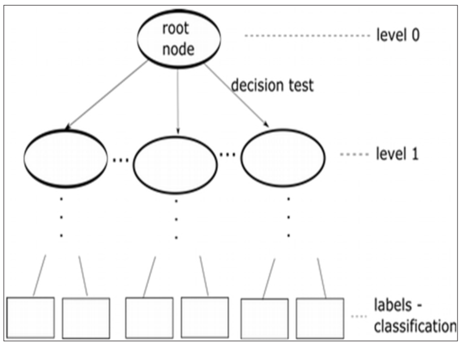

Figure 2: Decision tree example developed by J 48.

Statistical Analysis

For the data set collected and statistical comparison inter-groups (before the beginning of the work shift and after 6 hours of work) was used descriptive statistics (average, standard deviation, median and quartiles).Regarding the variables of HRV were applied the assumptions of normality (Shapiro-Wilk test) and equal variance (F test), being that in the inferential analysis was applied for paired samples t-test, this when data were in accordance with the assumptions. When it didn't the Wilcoxon test have adapted to the assumption. In all variables, was used a significance level of 5% ($p < 0.05$) with 95% confidence interval using the software R [42].

Results

Characterization of the Participants

It was found that of the 31 nurses participating in this study, two (6.5%) were up to 29 years old; 23 (74.2%) between 30 and 42 years old and six (19.3%) claimed to have more than 43 years old. About marital status, 23 (74.2%) reported being married; six (19.3%) being singles and only two (6.5%) said being divorced. In addition, eight (25.8%) claimed not to have kids, 17 (54.8%) have two children and six (19.3%) have three or more children.About the local (sector) in that act, found that eight (25.8%) participants played their activities in the critical care unit (CCU) for adults; eight (25.8%) in the emergency room (ER); six (19.3%) neonatal CCU and or pediatric; five (16.1%) on Pediatrics and four (13%) in the Intermediate Care Unit (ICU).About the data related to work, 20 (64.5%) professionals were for four years or more developing their labor activities in the unit; 28 (90.3%) indicated having only one employment link; 18 (58.1%) worked at night and 22 (71%) confirmed that perform overtime. With respect to the number of patients under the supervision of nurses, 18 (58.1%) noted that have up to 14 patients under their care; 12 (38.7%) more than 20 patients and only one (3.2%) between 15 and 20 patients.

Physical Assessments

About the physical assessment the nurses body mass got between 43 kg and 99 kg, height ranging from 1,52m to 1,78m. With that, the range of body mass index (BMI) of 18.21 to 34.28. Considering all the participants of the study, 19 (61.29%) nurses reported do not make use of medication; 29 (93.55%) said they are not smokers and 18 (58.1%) stated that they practice physical activities.With respect to vital signs, it can be observed from (Table 2) that the average values presented by participants in step 2 showed a statistically significant differencefor the variables HR (p-value = 0.013) and BR (p = 0.026), when compared in relation to measurements obtained in step 1 (Table2).

Table 2: (standard deviation) of vital signs measured in step 1 and 2

Vital signs	Average (standard deviation)	Average (standard deviation)	*p-value**
	in step 1	in step 2	
SBP (mmHg)	115.5 (14.10)	118.9 (13.08)	0.207
DBP (mmHg)	73.23 (9.45)	73.77 (8.50)	0.700
AAM(mmHg)	87.31 (10.76)	88.83 (9.12)	0.380
HR (bpm)	79.23 (11.71)	75.45 (11.68)	0.013**
BR (rpm)	17 (2.98)	17.81 (3.01)	0.026**
T° (°C)	36.3 (0.44)	36.3 (0.43)	0.525

*T test for paired sample; ** significantly different; SBP: systolic blood pressure; DBP: diastolic blood pressure; AAM: average arterial pressure; mmHg: millimeters of mercury; HR: heart rate; BPM: beats per minute; BR: breathing rate; rpm: respirations per minute; T°: body temperature;

°C: degrees Celsius.

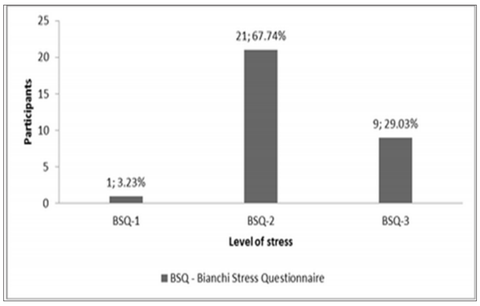

Figure 3: Stress level of the participants, according to Bianchi Stress Questionnaire.

Bianchi Stress Questionnaire

Analyzing the level of occupational stress of nurses, considering the results obtained by the application of BSQ, 30 (96.74%) nurses declared present medium or high level of stress (Figure 3).

HRV Assessment

(Table 3) shows average and standard deviation and the value of p, for frequency domain variables, obtained by the AR spectrum and considering the two steps of the time series collections of RR intervals. The (Table 4) presents average ± standard deviation and the value of p, for the variables of the CTM method, obtained by the spectrum of all radii and considering the two steps of the time series of RR intervals.

Table 3: Average ± standard deviation (μ ± σ) of the observed variability by frequency domain method, according to the time of assessment.

FrequencyDomainAR	μ ±σS1	μ ±σS2	p-value
LFpeak	0.04637±0.01894	0.04637±0.01894	1†
	0.00077 ± 0.00085	0.00125 ± 0.00133	0.003†
LF power (ms^2)			
LF power (nu)	67.32 ± 16.07	67.06 ± 11.45	0883*
HF peak	0.18650 ± 0.06886	0.17830 ± 0.06163	0666†
HF power (ms^2)	0.00042 ± 0.00055	0.00071 ± 0.00095	0.001†
HF power (%)	15.71 ± 10.45	16.40 ± 6.97	0504†
HF power (nu)	32.59 ± 16.05	32.83 ± 11.42	0889*
VLF peak	0 0.00390±0	0 0.00390 ± 0	1†
VLF power (ms^2)	0.00121 ± 0.00096	0.00175 ± 0.00174	0072†
VLF power (%)	53.68 ± 13.23	50.10 ± 12.53	0096*
LF/HF power (ms^2)	3.0359 ± 2.3246	2.5525 ± 1.7758	0281†
Total power (ms^2)	0.00242 ± 0.00218	0.00372 ± 0.00379	0.011†

μ ± σ: average ± standard deviation; S1: Step 1; S2: Step 2. †*Wilcoxon* test for paired samples.

**t Student* Test for paired samples.

Table 4: Average ± standard deviation (μ ± σ) of variability observed by the CTM method, according to the time of assessment.

Ray	Average ±standaRddeviation for CTM S1	S2	*p*-value	Ray	Averge ±standard deviation for CTM S1	S2	P-value
CTM1	0.00074±0.00112	0.00061±0.00092	0680†	CTM15	0.26313±0.22854	0.18453±0.13200	0.002†
CTM2	0.00559± 0.00778	0.00285±0.00353	0.030†	CTM16	0.28512±0.23576	0.20271±0.14132	0.001†
CTM3	0.01597± 0.02203	0.00878±0.01196	0.004†	CTM17	0.30660±0.22366	0.22120±0.14924	0.001†
CTM4	0.02774± 0.03767	0.01656±0.02177	0052†	CTM18	0.33035±0.25058	0.24281±0.15911	0.001†
CTM5	0.04146± 0.05520	0.02419±0.02891	0.031†	CTM19	0.35320±0.25599	0.26378±0.16715	0.001†
CTM6	0.06176± 0.07614	0.03761±0.04090	0.017†	CTM20	0.37499±0.26151	0.28386±0.17416	0.001†
CTM7	0.07905± 0.09374	0.04986± 0.04963	0.023†	CTM30	0.5711±0.27670	0.4681±0.22729	0.0001*
CTM8	0.09930± 0.11346	0.06488± 0.06258	0.019†	CTM40	0.7093±0.25525	0.6143±0.23913	0.0003†
CTM9	0.12323± 0.13504	0.08100± 0.07204	0.017†	CTM50	0.7973±0.22297	0.7170±0.22449	0.0001†
CTM10	0.14461± 0.15416	0.09560± 0.08140	0.015	CTM60	0.8573±0.18911	0.7893±0.20280	0.0001†
CTM11	0.16854± 0.17409	0.11114± 0.09052	0.011†	CTM70	0.8986±0.15649	0.8387±0.17840	0.0004†
CTM12	0.18892± 0.18802	0.12777± 0.10026	0.011†	CTM80	0.9273±0.12940	0.8745±0.15550	0.0004†
CTM13	0.21289± 0.20331	0.14598± 0.11152	0.006†	CTM90	0.9461±0.10460	0.9005±0.13279	0.0003†
CTM14	0.23935± 0.21783	0.16702 0.12309	0.003†	CTM100	0.9612±0.08256	0.9228±0.11015	0.0004†

†Wilcoxon test for paired samples; *t Student test for paired samples; CTM: Central Tendency Measures; S1: Step 1; S2: Step 2.

Relationship between HRV and Stress Level

The J48 algorithm was used to correlate the set of variables obtained directly from the participant, from the time series of RR intervals of Step 1 (before starting the work shift) and the classification of the stress level provided by BSQ. This is due, in particular, by the fact that BSQ assessing perception and therefore, presents subjective data in relation to stress. Thus, the time series of RR intervals help in identifying the physiological determinants of stress, which makes the data more objective and trustworthy without suffering interference of what would happen during the workday. 56 input attributes were provided to the decision tree in total: 15 variables obtained directly from the participant (through a questionnaire or physical evaluation), 13 frequency domain variables (Table 3) and 28 CTM values associated with different (in ms) (Table 4) added to the BSQ class 1 - low level stress, 2 - medium level of stress and 3- high level of stress. The parameters were used patterns using tree training set J48 implemented in Weka software [19]. It is known that how much more levels are present in the decision tree harder to establish rules for the data categorization input by the algorithm. Figure 3 presents the hierarchical classification obtained from the variables of the participant and the corresponding BSQ class with up to four levels to incorporate the entire set of participants in the study. The accuracy of instances sorted properly was 30 (96.77%) participants and only 1 (3.23%) not classified correctly, with Kappa index of 0928.

The decision tree root node, that is, the variable that has increased information gain compared to 56 input attributes was HF peak (Hz) [39,43,44]. This variable is related to respiratory modulation and also represents parameter for analysis of the function of the vague nerve on the heart [34-37,40]. It was needed 5 variables for hierarchical classification of 31 study participants according to the level of stress: 2 variables obtained directly from the participant (work shift and body temperature), 3 variables from the time series of RR intervals being 2 of the frequency domain (HF and LF) and 1 for CTM to radius of 1ms.This result suggests that these 5 variables are sufficient (of the total of 56 provided) to establish relationship with the BSQ classification considering data collection at the time prior to the beginning of the work shift. Here are no longer being considered possible changes caused by the activity developed during or immediately at the end of the work shift.

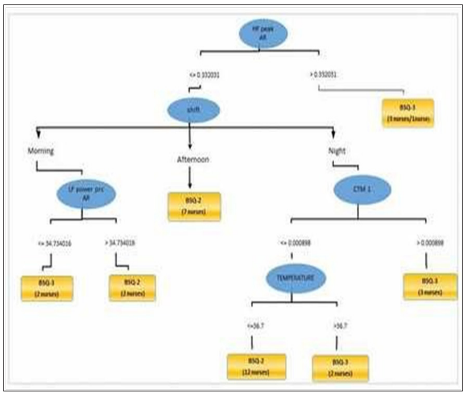

Figure 4: Results of the decision tree, the tool data J48.

The analysis of the association between HRV and stress level (given by BSQ) was performed by the tool J48, enabling check that, by the AR frequency domain method, three nurses presented BSQ-3 with high-frequency peak (HFpeak) greater than 0.332031, while other three participants presented BSQ-3 low frequency power (LFpower) less than or equal to 34.734016. It was noted, too, that seven voluntaries from vespertine shift presentedBSQ-2. It was found that three participants of the night showed BSQ-3 with

CTM for a millisecond longer than 0.000898. The branch targeted on the right presents data of individuals with CTM higher values and, therefore, less variability. Already in the field pointed to the left side, are individuals with the lowest data value of CTM and greater variability, being that these individuals were subdivided using the temperature variable (Figure 4).

Discussion

In this study, we assessed the level of stress among nurses who work in intensive care units and their relationship to the HRV. Based on the results obtained, we can verify that the profile of the participants and their socio-demographic characteristics are consonants to those presented by nurses who work in critical care units of various regions of Brazil [45,46] and, even when presented in research that sought to meet the profile of Brazilian Nursing [47]. As for the physical assessment conducted, the results showed that the participants are with maximum value of BMI to 34.28 and 25.11 medium, these values above the upper limit established by the Brazilian Association for the study of obesity and the Metabolic Syndrome (ABESO) for an eutrophic individual [48]. As the ABESO, an individual with a BMI over 25 has increased risk for developing cardiovascular disease (CVD)[48]. Although the majority (58.1%) of nurses has reported that perform physical activities, points out that such activities are carried out in a maximum of three times a week, while such periodicity is the minimum recommended to an individual who does not wish to have sedentary life pattern. In this sense, the sedentary condition is a factor that increases the risk for occurrence of CVD [48].

Associated with these two risk factors for CVD (high BMI and sedentary lifestyle) are heart rate levels that participants in the study are significantly higher in step 2 (Table 2), which favors the occurrence of important cardiovascular disorders [49,50]. With regard to occupational stress, 67.74% of participants rated their level of stress as moderate and 29.03% as high (Figure 3). These results are similar to what presentsitself in similar studies, which confirm that the complexity of the work of intensivist nurses generates increased stress level in these professionals [13-16]. Among the factors associated with the occurrence and level of stress among nurses, are issues of overload and working conditions, job satisfaction and devaluation of class [8,37]. In the midst of this discussion, surveys indicate that occupational stress experienced by nurses can also entail a range of organic reactions, which often culminate in important physiological imbalances, among which are the updates to HRV [44,51-54].

In this study, it was possible to observe that associated with the presentation of a profile with moderate/high stress level (Figure 2) results also suggest that the values of the LF power/ms2and HF power/ms2showed statistically significant differences in the evaluation of the medium between the moments (Table 3). In the assessment of HRV by CTM, in the first millisecond no statistical difference is observed between the values (Table 4). In this sense, it is reasonable to assume that the stressful workdays generates changes in the dynamics of running the SNA of nurses, which were expressed by the difference between the average values of HRV obtained at the beginning of the journey with those presented at the end (6 hours) of the workday.As exposed by the literature, LF components seem to be adjusting cardiac related by sympathetic and parasympathetic actions, whereas HF is associated with the respiratory modulation [34-37, 55].

Considering the roles of the aforementioned components in the body, it is possible to reaffirm the likely change of the SNA along the workdays in order to note differences in statistics also in the patterns of heart rate (p-value: 0.013) and respiratory rate (p-value: 0.026) (Table 2). Thus, Figure 3 presents the correlations between HRV, stress and other parameters. In this illustration, the results of which are from correlations made with data from S1, it sees that for the component HF peak three nurses were with BSQ-3 even with HRV values above 0.332, being a nurse presented high variability, but no high stress. About this professional, infers that her results (low variability and high stress) can be related to the issue that she had returned, after the period of one year, to their labor activities, due to maternity and medical license.The results from the correlations made by J48 note also that two professionals of the morning period also presented low HRV, expressed by LF values (power/%) less than or equal to the 34.734 and high stress level (BSQ-3).

Furthermore, showed that seven participants in the afternoon and, with HRV (expressed by HF (peak) below the above value), exhibited moderate level of stress(BSQ-2).Already among the professionals of the night, the relationship between HRV values and occupational stress was given especially by the CTM in the first millisecond. Note also in Figure 3, which three professionals with low HRV, expressed by CTM values greater than 0.000898, also report high stress levels present (BSQ-3). Thus, there is also that 12 professionals with HRV high (expressed by low values of CTM of a millisecond) and, with body temperature less than 36.7 presented BSQ-2. On the other hand, two professionals withtemperature above that Figure, had higher stress level (BSQ-3).Researchers from Israel are related to HRV with the variability of skin temperature, being these changes caused by increasing the stress. The study points out that such interaction are caused by vasomotor activities driven by the sympathetic nervous system [56].

These inferences are strengthened by the results obtained in a study conducted in Korea, in which researchers report increased average body temperature of individuals belonging to a sample group that had high levels of stress. In addition, the stress generated a fall of HF components of HRV and an increase in the LF components [43]. In addition, review study ratifies that reduction of HRV associated with tension and stress is a valid predictor for technical analysis of impairment of health professionals, especially with regard to vulnerability to DCVs. However, researchers of this study underline be required more research (especially longitudinal cohort) able to bring the light of knowledge in depth explanations about the physiological mechanisms involved [57-60].

Conclusion

The results of this research indicate that there is a relationship between decreased heart rate variability and high level occupational stress classified by BSQ. In this sense, it is suggested that such relationship can lead to a possible impairment of the health of nurses. Therefore, the assessment of HRV and their relationship with stress may subsidize the implementation of strategic management interventions that can mitigate the occupational stress experienced by professionals.

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