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Association of occupational stress, markers of inflammation and oxidative stress in intensive care unit professionals: a cross-sectional study

Associação entre estresse ocupacional, marcadores
de inflamação e estresse oxidativo em profissionais
de unidade de terapia intensiva: um estudo transversal

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Association of occupational stress, markers of inflammation and oxidative stress in intensive care unit professionals: a cross-sectional study

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Abstract

Introduction: Health professionals working in Intensive Care Units have a strong propensity to develop burnout syndrome. **Objective:** This study aimed to evaluate the relation between the occupational stress and the markers of oxidative stress and inflammation in health professionals in Intensive Care Units. **Methods:** A total of 133 intensivists from Colatina, Espírito Santo, Brazil consisted of the sample. The Maslach Inventory Burnout Survey was applied to evaluate burnout syndrome. Oxidative stress in proteins and lipids were measured and cytokines levels were evaluated by ELISA assay. **Results:** The results of the study showed that the highest levels for burnout syndrome (emotional exhaustion dimension) were more significant among nurses and physiotherapists and showed greater alterations in the markers of protein damage and inflammation. In the emotional exhaustion dimension, it was higher in the professionals who consume some type of alcoholic beverage at least 2 times a week and some type of stimulant, whether caffeine, tea or soft drinks. There was a positive relation in the development of burnout syndrome, in the dimension of low personal involvement at work, with oxidative data in lipids (TBARS). **Conclusions:** There is evidence of relationship between occupational stress and oxidative stress in professionals with low personal involvement in their work.

Keywords: burnout; occupational stress; health professional; oxidative stress; inflammation.

Resumo

Introdução: Os profissionais de saúde que atuam em Unidades de Terapia Intensiva apresentam forte propensão a desenvolver a síndrome de *burnout*. **Objetivo:** Este estudo teve como objetivo avaliar a relação entre o estresse ocupacional e os marcadores de estresse oxidativo e inflamação em profissionais de saúde em Unidade de Terapia Intensiva. **Métodos:** A amostra foi composta por 133 profissionais intensivistas de Colatina, Espírito Santo, Brasil. O Maslach Inventory Burnout Survey foi aplicado para avaliar a síndrome de burnout. O estresse oxidativo em proteínas e lipídios foi medido e os níveis de citocinas foram avaliados pelo ensaio ELISA. **Resultados:** Os resultados do estudo mostraram que os níveis mais elevados para síndrome de *burnout* (dimensão exaustão emocional) foram mais significativos entre enfermeiros e fisioterapeutas e apresentaram maiores alterações nos marcadores de dano proteico e inflamação. Na dimensão exaustão emocional, foi maior nos profissionais que consomem algum tipo de bebida alcoólica pelo menos 2 vezes por semana e algum tipo de estimulante, seja cafeína, chá ou refrigerante. Houve relação positiva no desenvolvimento da síndrome de Burnout, na dimensão de baixo envolvimento pessoal no trabalho, com dados oxidativos em lipídios (TBARS). **Conclusões:** Há evidências de relação entre estresse ocupacional e estresse oxidativo em profissionais com baixo envolvimento pessoal em seu trabalho.

Palavras-chave: esgotamento profissional; estresse oxidativo; estresse ocupacional.

INTRODUCTION

The globalization process has characteristics that are present in different landscapes of society, including occupational health. The quality of new high load functions in an environment of business continuity and technological capability. In view of the demands and the search for changes in the organizational environment, the adaptation of this new scenario has a significant impact on the health of workers, triggering psychological disorders, cognitive wear and tear, psychological suffering and suffering with work¹.

Stress has been studied in several professions, and it has been highlighted that health professionals are more prone to exhaustion generated by physical and emotional factors. These professionals are under constant pressure in terms of their productivity, especially when there is an imbalance between the work activities and the expectations from those who perform these activities^{2,3}.

Among the factors highlighted as triggering stress in health professionals, is the requirement to deal with suffering, pain, and death, along with low remuneration, unsafe employment, excessive hours of work and night shifts, risk of occupational diseases, lack of resources to carry out their work, and other issues⁴.

Worker health and occupational stress

Work must be recognized as a source of individual satisfaction. In this context, it is necessary to balance professional activities so that well-being is achieved. The quality of life is directly linked to the life of man and his work environment and that joint efforts are needed for better occupational life conditions to preserve the physical and mental health of workers⁵.

Faced with such circumstances, the word 'stress' has been frequently used in daily life, associated with the intensification of work order problems, and becomes more frequent in health environments. In a Chinese study with more than 650 medical teams, it was observed that professional burnout is very high in health professionals and among the factors that intensify stress are related, the work environment, aspects related to the personality of

professionals, mainly referring to the low level of self-esteem and the way they deal with daily problems⁶.

In the last decades, studies were developed focusing on the occupational health of professionals in several areas. Among these studies, a syndrome was identified, characterized as an occupational disease called burnout syndrome. An English denomination that refers to something that no longer works after exhaustion. Some authors report the term to burn out as becoming exhausted after excessive demand for energy or strength⁷⁻⁹.

In the new International Statistical Classification (ICD-11, 2022) the syndrome gains a more specific definition, being allocated in the section problems associated with employment or unemployment and has a specific code, QD85 with the spelling Burn-out, referring to it as a conceptualized syndrome generated by phenomena in the occupational context, which has three components conceptualized in a multidimensional way of the burnout syndrome¹⁰. The 72nd World Assembly Health in Geneva, at the end of May 2019, confirmed that burnout is a syndrome resulting from chronic stress at work and that the new classification establishes a standardization of language to facilitate the exchange of information between health professionals around the planet on the subject¹¹.

Burnout, oxidative stress and inflammation

The stressors of work that guide pathological signs and symptoms are important aspects in identifying burnout syndrome or professional exhaustion syndrome. These are synonymous and present with psychosomatic, psychological, and social manifestations, resulting from an excessive workload over a long period of time¹². The most cited definition for this disease is from Maslach & Jackson¹³ who attribute burnout to a syndrome of emotional exhaustion, depersonalization, and reduced professional achievement that affects individuals who work with people.

Psychic alterations can cause damage to the body, and the oxidative damage induced in cells and tissues has been related to the etiology of various diseases, including degenerative diseases such as ischemic heart disease and diabetes. Inflammatory processes cause increased production of reactive oxygen species (ROS), leading to problems such as endothelial dysfunction¹⁴. Oxidative stress can induce an inflammatory process and excess inflammation

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can cause oxidative stress, inducing excessive cellular damage and destruction of tissues. Thus, we evaluate the relationship between occupational stress and inflammation and oxidative in professionals working in intensive care units (ICUs).

METHODS

This study carried out with health professionals working in the ICUs of hospital in Colatina - ES, Brazil. Thus, the research first used a qualitative approach to identify the sociodemographic profile, professional characteristics, and lifestyle of the participants.

The characteristics of occupational stress identified through the burnout syndrome were evaluated using the *Maslach Burnout Inventory and Human Services Survey* (MBI-HSS)¹³. In addition, a quantitative evaluation of oxidative stress markers for lipid damage (TBARs), protein damage (carbonyl), and inflammation markers interleukin 6 (IL-6) and interleukin 10 (IL-10) was performed. The sample size was calculated for a power of 80 and an alpha error of 0.05, resulting in sample size of 133.

The inclusion criteria were: professionals working in ICUs with adult patients of hospitals with larger flows of people, those who have been employed for at least 6 months, and those with an employment history with more than one job. The exclusion criteria were: professionals working in other sectors of the same hospital, those who participated in only one of the research aspects (interview or blood collection), ICU staff away from work on sick leave, death, and those who refused to participate. Thus, 33 professionals were excluded; 22 disengaged from the service or sector during the study, 3 were excluded due to maternity leave, 7 due to their withdrawal during blood sampling, and 1 death occurred during the study period.

A cross-sectional epidemiological survey was conducted in two parts. The first was through interviews using two data collection survey instruments: 1) to identify the sociodemographic profile of professionals, their professional characteristics, and lifestyle, and 2) to identify the presence of burnout syndrome and its extent according to its dimensions and levels. The second part of this study consisted of blood collection for the evaluation of inflammation and oxidative stress.

The burnout assessment scale, the *Maslach Burnout Inventory and Human Services Survey*⁵, was used to evaluate burnout syndrome. The Brazilian version of the questionnaire contains 22 items divided into three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. The inflammatory response markers, IL-6 and IL-10 levels, were measured using a commercial kit (R&D Systems). Oxidative damage was analyzed by lipid peroxidation in the formation of reactive substances to thiobarbituric acid (TBARS)¹⁵. Oxidative damage to the proteins was evaluated by determining the carbonyl groups of the sample content, based on the reaction with dinitrophenylhydrazine¹⁶.

Continuous variables are presented as the mean \pm standard deviation and were compared using the Kruskal-Wallis test because they were not normally distributed. The qualitative variables are presented as number (percentage) N (%) and were compared using the chi-square test followed by residual analysis. All tests were analyzed using Statistical Packages for the Social Sciences (SPSS) version 21. In all analyses, a value of $p < 0.05$, was adopted as the level of statistical significance. The research was approved by the Research Ethics Committee of UNESC – Colatina – ES (nº 61075716.4.0000.5062).

RESULTS

The sociodemographic profile of the health professionals in the ICUs studied included a total of 133 intensivists from the two public hospitals with ICUs for the treatment of adult patients, who were included in the study between February 2017 and June 2018. Five professional categories participated in this study: 19 nurses, 13 physiotherapists, 3 speech therapists, 26 physicians, and 72 nursing technicians. Nursing technicians made up the majority of participants (54.1%), followed by physicians, nurses, physiotherapists, and speech therapists.

The nursing team was composed of two types of professionals (nurses and nursing technicians) and constituted 68.4% of the sample. The minimum age of participants was 21 years and the maximum were 72 years, mean \pm standard deviation (35.1 ± 9.5). The majority of the participants were female (64.6%), married (49.6%), aged between 26–41 years (63.9%), and had lived in the municipality for more than 15 years (46.6 %). Half of them had children (51.1%), and 42.9% of this group had one or two children.

Table 1 shows the sociodemographic profile of the ICU professionals by category and their relationship with the three dimensions and the levels of burnout syndrome: emotional exhaustion, depersonalization, and reduced personal accomplishment. High levels of burnout syndrome were found in the emotional exhaustion dimension of the sample, which was statistically significant for nurses (78.9%) and physiotherapists (76.9%). The nursing technicians presented the lowest levels of emotional exhaustion and depersonalization (54.2% and 77.8%, respectively).

Table 1. Socio-demographic profile of ICU professionals according to the dimensions and levels of burnout syndrome

Variables	Dimensions and Levels of Burnout Syndrome									
	Emotional Exhaustion			Depersonalization			Personal Accomplishment			p
	Low N (%)	High N (%)	P	Low N (%)	High N (%)	p	Low N (%)	High N (%)	p	
Professional	Nursing	39 (54.2)	33 (45.8)	0.008	56 (77.8)	16 (22.2)	0.082	56 (77.8)	16 (22.2)	0.526
	Technician	4 (21.1)	15 (78.9)		10 (52.6)	9 (47.4)		10 (52.6)	9 (47.4)	
	Nurse	13 (50.0)	13 (50.0)		15 (57.7)	11 (42.3)		15 (57.7)	9 (47.4)	
	Physician	3 (23.1)	10 (76.9)		8 (61.5)	5 (38.5)		8 (61.5)	11 (42.3)	
	Physiotherapist	0 (0.0)	3 (100.0)		1 (33.3)	2 (66.7)		1 (33.3)	2 (66.7)	
	Speech Therapist									
Gender	Male	17 (36.2)	30 (63.8)	0.160	28 (59.6)	19 (40.4)	0.140	28 (59.6)	19 (40.4)	0.532
	Female	42 (48.8)	44 (51.2)		62 (72.1)	24 (27.9)		62 (72.1)	24 (27.9)	
Age	18-25	10 (47.6)	11 (52.4)	0.639	18 (85.7)	3 (14.3)	0.312	18 (85.7)	3 (14.3)	0.160
	26-33	17 (37.8)	28 (62.2)		30 (66.7)	15 (33.3)		30 (66.7)	15 (33.3)	
	34-41	17 (42.5)	23 (57.5)		24 (60.0)	16 (40.0)		24 (60.0)	16 (40.0)	
	42-50	10 (52.6)	9 (47.4)		13 (68.4)	6 (31.6)		13 (68.4)	6 (31.6)	
	> 50	5 (62.5)	3 (37.5)		5 (62.5)	3 (37.5)		5 (62.5)	3 (37.5)	
Marital Status	Not married	28 (53.8)	24 (46.2)	0.095	36 (69.2)	16 (30.8)	0.494	36 (69.2)	16 (30.8)	0.805
	Married	28 (42.4)	38 (57.6)		45 (68.2)	21 (31.8)		45 (68.2)	21 (31.8)	
	Divorced	3 (21.4)	11 (78.6)		9 (64.3)	5 (35.7)		9 (64.3)	5 (35.7)	
	Widower	0 (0.0)	1 (100)		0 (0.0)	1 (100)		0 (0.0)	1 (100)	
Years of current residence	<1	2 (22.2)	7 (77.8)	0.434	7 (77.8)	2 (22.2)	0.670	7 (77.8)	2 (22.2)	0.044
	1-5	15 (48.4)	16 (51.6)		22 (71.0)	9 (29.0)		22 (71.0)	9 (29.0)	
	6-10	13 (56.5)	10 (43.5)		17 (73.9)	6 (26.1)		17 (73.9)	6 (26.1)	
	11-15	3 (37.5)	5 (62.5)		6 (75.0)	2 (25.0)		6 (75.0)	2 (25.0)	
	>15	26 (41.9)	36 (58.1)		38 (61.3)	24 (38.7)		38 (61.3)	24 (38.7)	
Children	No	33 (48.5)	35 (51.5)	0.322	50 (73.5)	18 (26.5)	0.139	50 (73.5)	18 (26.5)	0.383
	Yes	26 (40.0)	39 (60.0)		40 (61.5)	25 (38.5)		40 (61.5)	25 (38.5)	
Number of Children	None	34 (48.5)	34 (51.5)	0.478	50 (74.6)	17 (25.4)	0.211	50 (74.6)	17 (25.4)	0.602
	1-2	23 (34.8)	34 (51.5)		35 (61.4)	22 (38.6)		35 (61.4)	22 (38.6)	
	>2	3 (4.5)	6 (9.09)		5 (55.6)	4 (44.4)		5 (55.6)	4 (44.4)	

Regarding the professional characteristics of the intensivists participating in the study and their relationship with the three dimensions of burnout syndrome, depersonalization manifested as low average values in professionals who did not have a specialization. (Table 2).

Table 2 - Characteristics of ICU Professionals according to dimensions and levels of burnout syndrome (N = 133)

Variables		Dimensions and Levels of Burnout Syndrome								
		Emotional Exhaustion			Depersonalization			Personal Accomplishment		
		Low N (%)	High N (%)	P	Low N (%)	High N (%)	P	Low N (%)	High N (%)	P
Years of formation	<1	1 (50.0)	1 (50.0)	0.725	1 (50.0)	1 (50.0)	0.193	1 (50.0)	1 (50.0)	0.029
	1-5	22 (51.2)	21 (48.8)		34 (79.1)	9 (20.9)		34 (79.1)	9 (20.9)	
	6-10	15 (45.5)	18 (54.5)		20 (60.6)	13 (39.4)		20 (60.6)	13 (39.4)	
	11-15	11 (42.3)	15 (57.7)		19 (73.1)	7 (26.9)		19 (73.1)	7 (26.9)	
	>15	10 (34.5)	19 (65.5)		16 (55.2)	13 (44.8)		16 (55.2)	13 (44.8)	
Years of ICU	<1	6 (30.0)	14 (70.0)	0.380	13 (65.0)	7 (35.0)	0.435	13 (65.0)	7 (35.0)	0.325
	1-5	28 (45.2)	34 (54.8)		46 (74.2)	16 (25.8)		46 (74.2)	16 (25.8)	
	6-10	18 (51.4)	17 (48.6)		22 (62.9)	13 (37.1)		22 (62.9)	13 (37.1)	
	11-15	6 (40.0)	9 (60.0)		8 (53.3)	7 (46.7)		8 (53.3)	7 (46.7)	
	>15	1 (100)	0 (0.0)		1 (100)	0 (0.0)		1 (100)	0 (0.0)	
Shift	Morning	2 (33.3)	4 (66.7)	0.577	6 (100)	0 (0.0)	0.028	6 (100)	0 (0.0)	0.503
	Evening	1 (20.0)	4 (80.0)		5 (100)	0 (0.0)		5 (100)	0 (0.0)	
	Night	14 (50.0)	14 (50.0)		18 (64.3)	10 (35.7)		18 (64.3)	10 (35.7)	
	Integral	42 (44.7)	52 (55.3)		61 (64.9)	33 (35.1)		61 (64.9)	33 (35.1)	
Weekly working hours	20 to 40h	13 (43.3)	17 (56.7)	0.420	21 (70.0)	9 (30.0)	0.274	21 (70.0)	9 (30.0)	0.623
	> 40	46 (44.7)	57 (55.3)		69 (67.0)	34 (33.0)		69 (67.0)	34 (33.0)	
Hours of rest on duty	0 to 1	14 (40.0)	21 (60.0)	0.761	26 (74.3)	9 (25.7)	0.219	25 (74.3)	9 (25.7)	0.674
	1 to 2	24 (48.0)	26 (52.0)		36 (72.0)	14 (28.0)		36 (72.0)	14 (28.0)	
	> 2	21 (43.8)	27 (56.3)		28 (58.3)	20 (41.7)		28 (58.3)	20 (41.7)	
Specializ ation	No	42 (49.4)	43 (50.6)	0.119	65 (76.5)	20 (23.5)	0.004	65 (76.5)	20 (23.5)	0.722
	Yes	17 (53.4)	31 (64.6)		25 (52.1)	23 (47.9)		25 (52.1)	23 (47.9)	
Type of specializ ation	None	42 (49.4)	43 (50.6)	0.119	65 (76.5)	20 (23.5)	0.017	65 (76.5)	20 (23.5)	0.333
	Lato	17 (37.0)	29 (63.0)		24 (52.2)	22 (47.8)		24 (52.2)	22 (47.8)	
	Sensu	0 (0.0)	2 (100)		1 (50.0)	1 (50.0)		1 (50.0)	1 (50.0)	
	Stricto Sensu									
Worked in other ICUs	No	39 (45.3)	47 (54.7)	0.756	58 (65.2)	31 (34.8)	0.381	63 (73.3)	23 (26.7)	0.901
	Yes	20 (42.6)	27 (57.4)		32 (72.7)	12 (27.3)		27 (57.4)	20 (42.6)	
Time worked in other ICUs	None	39 (45.3)	47 (54.7)	0.987	63 (73.3)	23 (26.7)	0.315	63 (73.3)	23 (26.7)	0.309
	< 1	3 (50.0)	3 (50.0)		3 (50.0)	3 (50.0)		3 (50.0)	3 (50.0)	
	1 to 5	10 (41.7)	14 (58.3)		13 (54.2)	11 (45.8)		13 (54.2)	11 (45.8)	
	6 to 10	3 (37.5)	5 (62.5)		6 (75.0)	2 (25.0)		6 (75.0)	2 (25.0)	
	11 to 15	4 (44.4)	5 (55.6)		5 (55.6)	4 (44.4)		5 (55.6)	4 (44.4)	
Works in other ICUs	No	39 (43.8)	50 (56.2)	0.858	58 (65.2)	31 (34.8)	0.381	58 (65.2)	31 (34.8)	0.038
	Yes	20 (45.5)	24 (54.5)		32 (72.7)	12 (27.3)		32 (72.7)	12 (27.3)	
Other activities	No	27 (45.8)	32 (54.2)	0.771	45 (76.3)	14 (23.7)	0.058	45 (76.3)	14 (23.7)	0.671
	Yes	32 (43.2)	42 (56.8)		45 (60.8)	29 (39.2)		45 (60.8)	29 (39.2)	

Table 3 presents the characteristics of the health professionals' responses and the dimensions of burnout. It was observed that the propensity to higher levels of occupational stress, in the dimension emotional exhaustion, was more significant for professionals who consumed alcohol at least twice a week. It was further shown that the ICU professionals who consumed stimulants had elevated levels of burnout. Regarding the depersonalization dimension, it can be observed in Table 3 that a low degree of burnout was registered for those who declared that they did not consume alcoholic beverages. Respondents who drank alcohol once or twice weekly presented a high degree of burnout. Those who did not consume stimulants had lower levels of burnout.

Table 3 - Lifestyle of ICU Professionals according to dimensions and levels of burnout syndrome

Variables		Dimensions and Levels of Burnout Syndrome								
		Emotional Exhaustion			Depersonalization			Personal Accomplishment		
		Low N (%)	High N (%)	P	Low N (%)	High N (%)	P	Low N (%)	High N (%)	P
Physical activity	No	30 (42.9)	40 (57.1)	0.713	49 (70.0)	21 (30.0)	0.545	49 (70.0)	21 (30.0)	0.336
	Yes	29 (46.0)	34 (54.0)		41 (65.1)	22 (34.9)		41 (65.1)	22 (34.9)	
Weekly physical activity	None	30 (42.9)	40 (57.1)	0.790	49 (70.0)	21 (30.0)	0.552	49 (70.0)	21 (30.0)	0.345
	1 a 2	5 (41.7)	7 (58.3)		8 (66.7)	4 (33.3)		8 (66.7)	4 (33.3)	
	2 a 4	16 (43.2)	21 (56.8)		22 (59.5)	15 (40.5)		22 (59.5)	15 (40.5)	
	> 4	8 (57.1)	6 (42.9)		11 (78.6)	3 (21.4)		11 (78.6)	3 (21.4)	
Diet balanced	No	24 (41.4)	34 (58.6)	0.543	41 (70.4)	17 (29.3)	0.513	41 (70.7)	17 (29.3)	0.130
	Yes	35 (46.7)	40 (53.3)		49 (65.3)	26 (34.7)		49 (65.3)	26 (34.7)	
Hours of sleep at home	< 6h	19 (51.4)	18 (48.6)	0.600	27 (73.0)	10 (27.0)	0.230	27 (73.0)	10 (27.0)	0.003
	6 - 8h	14 (41.2)	20 (58.8)		19 (55.9)	15 (44.1)		19 (55.9)	25 (44.1)	
	> 8h	26 (41.9)	36 (58.1)		44 (71.0)	18 (29.0)		44 (71.0)	18 (29.0)	
Recreation	No	14 (41.2)	20 (58.8)	0.665	24 (70.6)	10 (29.4)	0.673	24 (70.6)	10 (29.4)	0.363
	Yes	45 (45.5)	54 (54.5)		66 (66.7)	33 (33.3)		66 (66.7)	33 (33.3)	
Alcoholic	No	43 (54.4)	36 (45.6)	0.005	61 (77.2)	18 (22.8)	0.004	61 (77.2)	18 (22.8)	0.015
	Yes	16 (29.6)	38 (70.4)		29 (53.7)	25 (46.3)		29 (53.7)	25 (46.3)	
Frequency of beverages	Do not consume	42 (53.8)	36 (46.2)	0.027	60 (76.9)	18 (23.1)	0.025	60 (76.9)	18 (23.1)	0.010
	1-2 times	15 (30.0)	35 (70.0)		27 (54.0)	23 (46.0)		27 (54.0)	23 (46.0)	
	3 or more times	2 (40.0)	3 (60.0)		3 (60.0)	2 (40.0)		3 (60.0)	2 (40.0)	
Smoker	No	59 (45.0)	72 (55.0)	0.124	89 (67.9)	42 (32.1)	0.603	89 (67.9)	42 (32.1)	0.168
	Yes	0 (0.0)	2 (100)		1 (50.0)	1 (50.0)		1 (50.0)	1 (50.0)	
Caffeine or stimulants	No	26 (56.5)	20 (43.5)	0.040	39 (84.8)	7 (15.2)	0.002	39 (84.8)	7 (15.2)	0.388
	Yes	33 (37.9)	54 (61.2)		51 (58.6)	36 (41.4)		51 (58.6)	36 (41.4)	
Frequency of stimulants (week)	Do not consume	25 (55.6)	20 (44.4)	0.236	38 (84.4)	7 (15.6)	0.003	38 (84.4)	7 (15.6)	0.571
	1 to 2	12 (42.9)	16 (57.1)		20 (71.4)	8 (28.6)		20 (71.4)	8 (28.6)	
	2 to 4	9 (42.9)	12 (57.1)		14 (66.7)	7 (33.3)		14 (66.7)	7 (33.3)	
	> 4	13 (33.3)	26 (66.7)		18 (46.2)	21 (53.8)		18 (46.2)	21 (53.8)	
Drugs	No	58 (45.0)	71 (55.0)	0.415	89 (69.0)	40 (31.0)	75	89 (69.0)	40 (31.0)	0.587
	Yes (12 once or twice a day)	3 (5.0)	3 (5.0)		3 (25.0)	3 (75.0)		3 (25.0)	3 (75.0)	

Table 4 shows the mean values of inflammatory markers (IL-6 and IL-10) and oxidative stress (carbonyl and TBARS), as a function of the dimensions of burnout syndrome and their levels (low and high) in professionals of the ICUs studied. There were no statistically significant signs of inflammation in any of the categories between the levels of burnout syndrome and its dimensions, but there was positive relationship for development of burnout syndrome and reduced personal accomplishment that was associated with the oxidative data in lipids (TBARS) ($p < 0.05$).

Table 4 - Levels of inflammation markers (IL-6 and IL-10) and Oxidative Stress (TBARS and CARBONYL) according to the dimensions of the burnout syndrome (Emotional Exhaustion, Depersonalization and Personal Accomplishment in Health Professionals of UTIs (N = 133).

Variables	Emotional Exhaustion			Depersonalization			Personal Accomplishment		
	Mean \pm Standard Deviation			Mean \pm Standard Deviation			Mean \pm Standard Deviation		
	Low	High	P	Low	High	P	Low	High	P
IL-6	380.377 \pm 2 50.039	419.405 \pm 4 10.021	0.697	413.152 \pm 4 03.133	379.704 \pm 1 92.220	0.575	386.063 \pm 3 67.899	428.814 \pm 3 15.115	0.200
IL-10	757.009 \pm 5 87.101	886.068 \pm 8 84.210	0.357	831.090 \pm 8 72.482	825.780 \pm 4 94.578	0.365	799.799 \pm 8 17.968	877.841 \pm 6 83.301	0.360
TBARS	0.031 \pm 03 8	0.024 \pm 0.0 41	0.213	0.030 \pm 0.0 47	0.020 \pm 0.01 6	0.329	0.027 \pm 0.04 8	0.026 \pm 0.0 20	0.015
CARBONYL	0.003 \pm 0.0 6	0.005 \pm 0.0 08	0.230	0.004 \pm 0.0 9	0.004 \pm 0.0 04	0.541	0.004 \pm 0.0 09	0.004 \pm 0.0 05	0.978

Table 5 shows the mean values of inflammatory markers (IL-6 and IL-10) and oxidative stress (carbonyl and TBARS), as a function of the dimensions of burnout syndrome by categorized by profession. With regard to the category-wise values of the markers of inflammation and oxidative stress alone, it was verified that there were statistically significant changes ($p < 0.05$) for IL-6, IL-10, and carbonyl. In the comparison between the categories (two-to-two evaluation of the Kruskal-Wallis test), nurses had high mean values of IL-10 (mean = 1380.781; \pm 700.096; $p < 0.05$) when (mean = 823,850; \pm 878.225; $p < 0.05$), physicians (mean = 625,618; \pm 455.797; $p < 0.05$) and with physical therapists (mean=503.530; \pm 144.804; $p < 0.05$), that is, in this sample. Nurses presented high mean values of markers of inflammation, suggesting that they were more likely to become ill. Regarding the protein damage marker, it was possible to observe the largest changes in carbonyl in the comparison of nurses (mean = 0.009, \pm 0.06, $p < 0.05$) with physicians (mean = 0.004, \pm 0.008, $p < 0.05$), nursing technicians (mean=0.03; \pm 0.008; $p < 0.05$), and physiotherapists (mean = 0.002; \pm 0.003; $p < 0.05$).

Table 5 - Inflammation Markers (IL-6 and IL-10). Oxidative Stress Markers (TBARS and Carbonil) by Professional Category (N = 133). Different underscores in the columns indicate significant difference

Professionals category	IL6	IL10	TBARS	CARBONIL
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Nurses	534.482 \pm 319.036	1380.781 \pm 700.096 ^a	0.016 \pm 0.012	0.009 \pm 0.006 ^a
Physiotherapists	288.353 \pm 82.681	503.530 \pm 144.804 ^b	0.014 \pm 0.004	0.002 \pm 0.003 ^b
Speech therapists	268.448 \pm 145.260	579.039 \pm 167.141	0.013 \pm 0.002	0.006 \pm 0.005
physician	318.082 \pm 95.437	625.618 \pm 455.797 ^b	0.027 \pm 0.047	0.004 \pm 0.008 ^b
Nursing Technicians	422.732 \pm 427.058	823.850 \pm 878.225 ^b	0.033 \pm 0.045	0.003 \pm 0.008 ^b
P	0.035	0.000	0.058	0.002

DISCUSSION

The analysis of the burnout syndrome and the levels of its three dimensions revealed that the nursing team presented the most relevant statistical information. Nurses presented high levels of emotional exhaustion stress. In a literature review of publications from 2010 to 2015 across three databases by Moraes Filho & Almeida¹⁷ identified that nursing care comprised services of high and medium complexity and those in the Unit of Intensive Therapy, presented a higher degree of occupational stress.

From the literature, burnout has several variables that can evidence the development of the syndrome. There is no reference to training time and experience, some sectors and job categories are more conducive to psychological, professional training at the beginning of the career, since there is a decision to make the best decision, challenges related to the search for a position in the labor market, guarantees of well-being and financial security¹⁸⁻²⁰.

Our study showed low levels of reduced personal accomplishment in professionals aged over 21 years and those residing in the municipality between 1 and 5 years. The variables of age and duration of working time are controversial; however, our results, in agreement with previous studies that argue that burnout syndrome can be found in professionals with more labor market experience, since there is a decline in their health,

physical limitations, saturation, and exhaustion due to long-term work within the same area^{21,22}.

According to Kluger et al.²³ doses of stress may be associated with involvement with different hospitals and the workload required of health professionals. Who evaluated health professionals from the Neonatal ICU identified that work in intensive care generates a great relationship of affective involvement and if the worker does not know how to manage the involvement with professional routines, feelings of disappointment with the service can be generated, worsening the human relationship with their patients, in addition to emerging stress in the face of the overload response presented in front of their work²⁴.

According to a study carried out with 7,288 American physicians, which classified respondents into 3 groups according to career time (0 to 10 years: early career, 11 to 20 years: mid-career moment, and over 20 years: late career) identified the prevalence of burnout in physicians with a median career, resulting in approximately 60% of the respondents, who showed greater frustration regarding the choice of their specialty and the relationship of their personal life²⁵.

The low work relationship dimension of the syndrome reveals factors such as low interest in professionals regarding the development of their work; the lower scores show high characteristics for burnout syndrome¹³. In addition to presenting the results of related occupational stress, when considering those with the longest service time (associated with their length of residence), other studies also revealed that professionals working in other ICUs have high levels of burnout syndrome, confirming the overload of work activities because of time constraints.

The respondents of this study presented high levels of burnout in the depersonalization dimension, which presented more evidence among undergraduate professionals and those who declared to have at least one *latu sensu* specialization in the intensive care area, either through postgraduate or residency programs. In the study by Nascimento Sobrinho et al.²⁶ with more than 300 Brazilian physicians working in ICUs, they pointed out that the prevalence of burnout was lower among physicians who did not have a specialization degree in the field of intensive medicine. In a systematic review and meta-analysis of burnout among French physicians, Ziad et al.²⁷ reported that the highest rates of

professional exhaustion were among medical specialists, especially those with medical residency.

The sleep time and lifestyle are directly linked to the quality of life, and professionals who reported having less than 8 hours of sleep per night presented statistically significant results showing high levels for burnout in the low dimension. These results showed the reality of health professionals, especially nurses and physicians, who have insufficient sleep hours. It is recommended that adults sleep from 7 to 8 hours a day; sleep deprivation can cause demotivation, cognitive deficits, reduction of professional effectiveness, and impaired quality of life^{27,28}.

Observation of the study sample's lifestyle highlighted a propensity for high levels of burnout syndrome in terms of emotional exhaustion, in professionals who consumed alcoholic drink and in those who consumed stimulants (caffeine, tea, or soda). In the depersonalization dimension, we found that most professionals, especially those who did not consume alcohol, presented a low propensity for burnout. Alcohol consumption causes disorders that result in significant impairments in the social and occupational areas of the consumers. Thus, alcohol consumption by health professionals can affect their skills and the safety of the procedures performed. This can cause mental health problems and evolve into psychiatric disorders or professional burnouts that increase the risk of errors in care³⁰.

An international study that investigated the relationship between dimensions of burnout syndrome, depersonalization and emotional exhaustion, alcohol and fast food consumption, physical exercise and self-medication in 2.623 professionals working in university hospitals in Portugal, Greece, Romania, Bulgaria, Turkey, Macedonia and Croatia, identified that one in five health professionals had high scores of burnout and were significantly associated with fast food, lack of exercise, use of analgesics, and more frequent consumption of alcohol¹⁰.

A study on the risks of alcohol use in Danish physicians associated with the burnout syndrome showed high burnout for professionals who consumed alcohol and depersonalization was the dimension that most highlighted in this study³¹.

According to Shirom³² when faced with a problem situation, some people use behaviors that harm their health as a coping strategy to relieve suffering in the short term.

This type of behavior works as a potentiator of mechanisms that can develop burnout syndrome³³. The behavioral process related to occupational stress can be seen as part of a situation underlying the damage caused by burnout, which was generated by work stressors and works as a mental and physical escape resource that can intensify the development of burnout and the other health problems^{34,35}.

This study also sought to correlate the values of oxidative stress and inflammation markers with the dimensions of burnout syndrome. Oxidative stress is evaluated through markers that identify and quantify the imbalance of the antioxidant action overcome by the production of reactive oxygen species, which favor the oxidation of biomolecules and generate specific metabolic products mainly derived from the oxidation of lipids, proteins, and deoxyribonucleic acids^{29,30}. The greatest expression of oxidative damage occurs in lipids and proteins, and in this study, carbonyl and TBARS were used. IL-6 and IL-10 inflammation markers were also evaluated. During the collection of information and blood samples for the study, none of the participants reported being ill or showed visible signs of pathologies.

In the cross-checking of burnout syndrome dimensions with the mean values of inflammation markers (IL-6 and IL-10) and oxidative stress (carbonyl) of ICU professionals, statistical evidence was not obtained when collectively assessed mean values were used. However, for TBARS, a significant correlation was observed between the development of burnout syndrome and oxidative stress. In our study, we identified the mean values of TBARS in the burnout syndrome dimension of reduced personal accomplishment, characterizing the relationship between occupational stress and oxidative stress for this marker. Therefore, the results indicate a relationship between oxidative stress and occupational stress in ICU professionals who have more experience and working time in this sector, ratifying data from similar studies with emergency Spanish health professionals³¹⁻³³.

When categorized, the inflammation markers and markers of oxidative data in proteins (carbonyl) showed differences between the categories. Comparing the categories, it was possible to identify significant differences in the two-to-two evaluation of the Kruskal-Wallis test in the levels of IL-10 and carbonyl between nurses and physiotherapists, and nurses and physicians. The mean values of IL-10 and carbonyl indicated that the nurses presented the highest values of inflammation and protein damage, respectively, when

comparing the categories that stood out. There were no significant changes among other categories.

The biomarker of the lipid peroxidation product is malondialdehyde (MDA), which is a derivative of the endocyclization breakdown of polyunsaturated fatty acids, such as linoleic, arachidonic and docohexaenoic acids³⁶⁻³⁸. For the ICU professionals surveyed, the mean values of MDA were identified in the dimension of low personal involvement with work, which refers to the burnout syndrome, characterizing the relationship between occupational stress and oxidative stress for this marker

These data suggest that the inflammatory response was present in the study population, but there was no significant difference in the IL-6 and IL-10 levels, since the values were averaged for the whole sample. This can be considered a limitation of the study in that only the collection and dosage of the markers occurred, and we did not have data comparing the process of evolution of possible pathology. It can be affirmed that nurses presented higher mean values of IL-10 and carbonyl, that were statistically significantly ($p < 0.05$) higher than physicians, physiotherapists, and nursing technicians, showing that there are greater inflammatory responses and increased oxidative stress in nurses. Consequently, there appear to be greater possibilities for the development of morbidities in the face of increased oxidative stress.

Health professionals working in ICUs have a strong propensity to develop burnout syndrome. Among the three dimensions of the syndrome, it was possible to identify that low personal involvement with work was related to oxidative stress, as observed by alterations of the mean values of TBARS in the study population. These aspects stood out amongst the professionals with the professional association with ICUs, showing that a longer duration of work was associated with a greater the stress triggering stimuli, causing losses reflected in the physical and mental health of these intensivists.

CONCLUSIONS

In conclusion, the health professionals of the human study who work in ICUs have a strong propensity to develop the burnout syndrome in view of the stressors involved in the work activities of health care. Among the three dimensions of the syndrome, it was possible to identify that the low personal involvement with work is related to the oxidative stress observed by the changes in the average values of MDA in the studies studied. These stand out in the professional aspects, showing that the more longitudinality at work, the greater the triggering stimuli of stress, highlighting that they stand out more in the physical and mental health of intensivists.

Finally, the findings pointed to the stress associated with an environmental stress associated with the environmental conditions of work, mainly the risks of risk of oxidative stress associated with environmental conditions of work, especially the risks that present environmental risks associated with the environmental conditions of work, environmental conditions environmental conditions in the work area, environmental conditions in the protection of the health and life of these professionals, and consequently established assistance for a pre-eminent health.

Ethics approval

The research was approved by the Research Ethics Committee of UNESC – ES and it's in compliance with the criteria developed by the National Commission of Ethics in Research of Brazil, resolution no. 510, on April 7, 2016, (Presentation for Ethical Appraisal nº 61075716.4.0000.5062 and approval opinion nº 1.934.066).

LIMITATIONS

The fact that there was no significant difference between the inflammatory markers, it can be considered a limitation of the study in that only the collection and dosage of the markers occurred, and we did not have data comparing the process of evolution of possible pathology.

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