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Determinants of Stress and Effects on Performance in Part of Lebanese University Medical Residents During Fourth Quarter of 2019

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Abstract

Background and Objective: Medical residents face challenges that expose them to high risk of developing stress. Stress could reach burnout levels and become harmful to residents and patients. This study aimed to determine the prevalence of stress in current Lebanese University (LU) residents and assessing correlations with some risk factors and consequences. Subjects and Methods: This cross-sectional study involved 130 current LU residents who filled out a questionnaire concerning their demographic data, residency specialty and year, workload, special habits, depression, stress, and frequency of medical errors. Depression and stress scores were obtained using DASS-21 scale. Collected data was analyzed using ANOVA and chi- Square tests in SPSS to find descriptive statistics and correlations. Results: Out of the enrolled residents, 70% had stress ranging between mild and extreme severity. The mean age of the residents was 27.2 years. Females had higher stress than males and gender accounted for 14.1% of variance in stress among residents. Our results implied that internal medicine specialty imposes higher stress than surgery specialty with a significant difference of 4.04 points and working more than 50 hours per week which accounts for 7.6% of variance in stress. Residents had, on average, 4.38 hours of sleep per night and a negative association was found between sleep and stress. Depression was prevalent; 18.5% had severe depression, 3.1% had extremely severe depression, and stress was significantly correlated with it. Similarly, stress was associated with medical errors. No significant correlation was detected between age, marital status, parenting, and residency year, on call duties, or special habits and stress. Conclusion: Stress among medical residents is high due to the different challenges at the personal and occupational level. Stress should be managed especially that it could lead to harmful consequences on the resident's health and patient's safety.

Keywords: Stress; Burnout; Depression; Medical residents; Risk factors; Medical errors.

1. Introduction

General Overview: Occupational stress involves the biological and mental response of individuals to workplace challenges that exceed their resources thus interfering with their coping ability [1]. Although occupational stress can sometimes be beneficial in increasing productivity and efficiency, it can also be in other instances very harmful on the person and on the organization or workplace [2]. Certain occupations impose higher risk of having elevated levels of stress such as the healthcare profession [3]. Chronic stress in the healthcare occupation is of high importance as it could lead to burnout syndrome. As such, the demanding and challenging work environment of medical residents exposes them to high stress level and subsequent burnout syndrome with adverse effects on the well-being of the residents [4]. A myriad of personal characteristics are thought to expose residents to higher stress risk such as demographics, inherent traits, and experiences [5]. Also, certain occupational characteristics are considered stress inducing mainly specialty and workload [6, 7]. However, published data shows conflicting results on the correlations of specific risk factors with stress especially those related to marital status, parenting, and residency specialty and year [8-10]. Moreover, detecting stress at early stages in medical residents is of utmost importance for proper intervention and management [11]. The effects of stress on the residents manifest in depression, substance abuse morbidities, and suicidal ideation. Also, stress can affect their work by increasing the frequency of medical errors and the quality of patients' care [12]. The correlation between stress and some outcomes are also controversial [13]. Although stress in medical residents is gaining a lot of research interest, little is known about this topic in the Middle East and in Lebanon [14]. This study aimed at finding out the prevalence of stress

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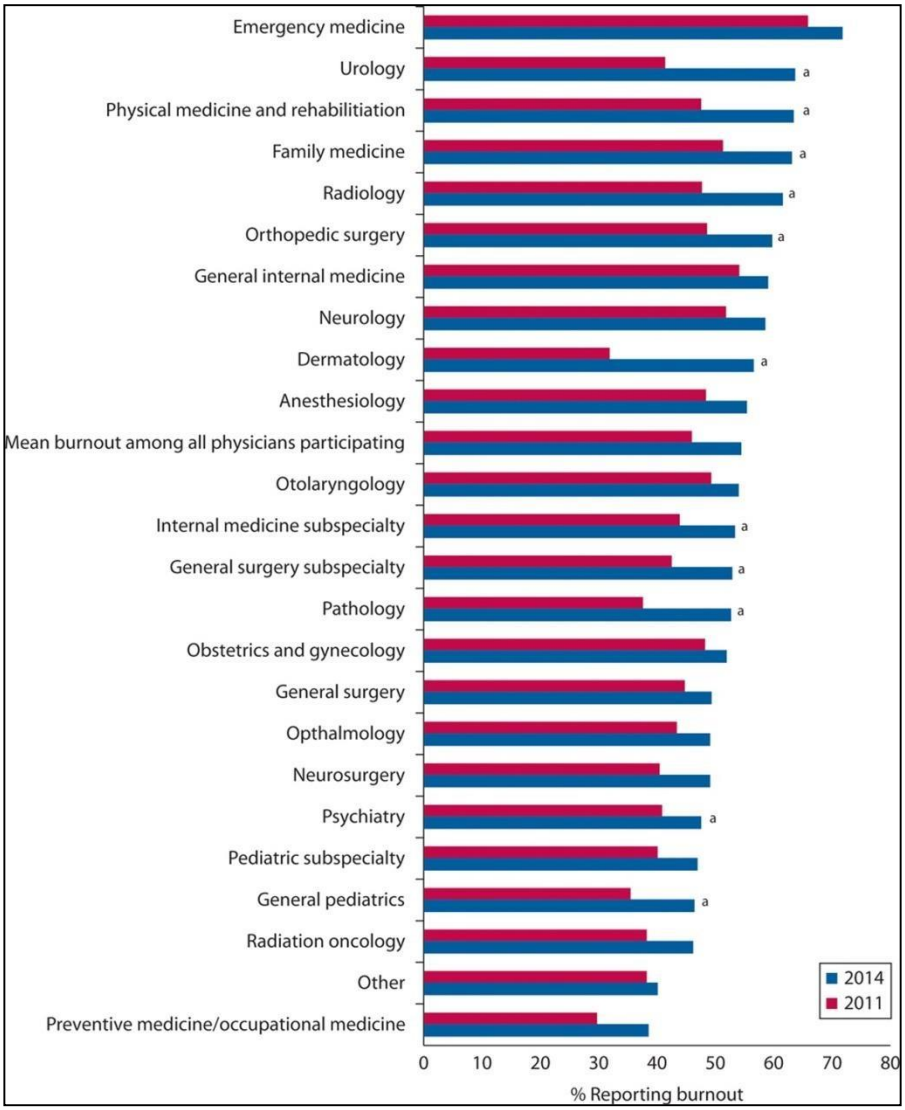
among current Lebanese University residents. It also investigated the correlation between some personal and workplace characteristics and stress, as well as the correlations between stress and certain outcomes on the resident and the patients.

2. Review of Literature

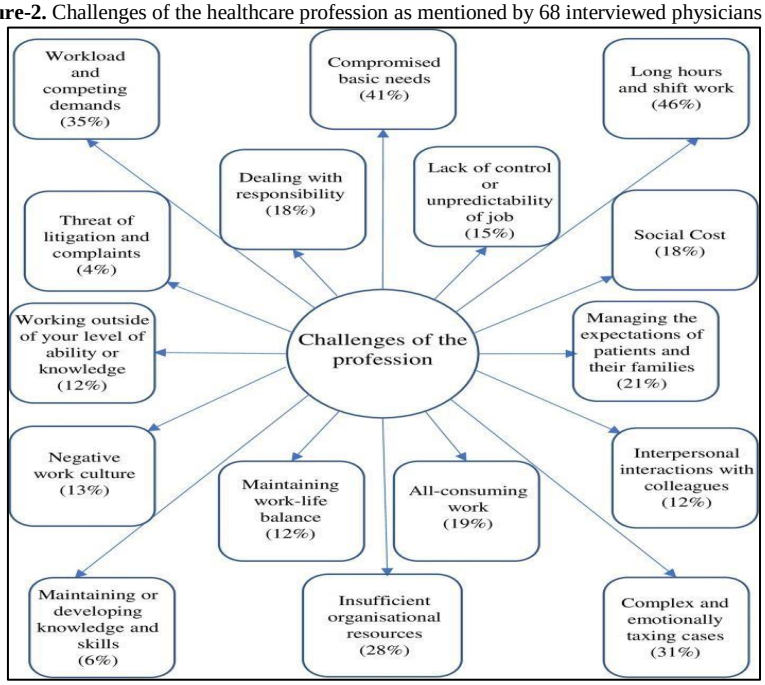
Occupational Stress: Stress is widely defined as the psychological and physiological process in which a person responds to experienced environmental threats [1]. Occupational stress is the stress in the workplace following the negative interaction between the individual's expectations and skills and the work conditions, thus interfering in the individual's ability to cope [15]. In other words, occupational stress is the outcome of the discrepancy between the demands within the workplace and the ability of the employees to meet or cope with these demands [16]. A unitary definition of occupational stress is hard to find due to the varied nature of stress and the diverse perception of stress experiences faced in the workplace resulting from the interplay of various factors: personal, work-related, social, and environmental factors [17]. Stress can be appraised as a positive response with beneficial outcomes and increased productivity where it is termed eustress, or as a negative response with harmful outcomes where it is termed distress [2]. Should the stressors persist, distress becomes a concern as the individual becomes at high risk of developing health and mental issues that manifest as amplified absenteeism, decreased productivity, and increased organizational dysfunction [18]. There are three levels of stress - acute, episodic, and chronic - whereby acute stress is imposed when new demands exceed the individual's adaptability with the effect lasting for a short duration, episodic stress is similar to the acute level but with stress experienced more frequently in multiple episodes, and chronic stress is the accumulation and persistence of stressors for long periods reflecting negative life situations [19]. The level of stress experienced by an individual depends on the type of occupation, the presence and extent of job stressors, the amount of compassion and support received at work and home, and the coping mechanisms utilized to manage occupational stress [3]. This means that stress response is not universal [20]. As such, different occupations have different levels of stress, and employees within the same occupation might face and respond to the same stressors differently [3]. Moreover, the outcome of chronic stress is currently a major topic being researched in sociology, psychology, and physiology in combination [20]. **Prevalence of Occupational Stress:** It has been reported in 2015 by the Health and Safety Executive (HSE) that around 440,000 people in the United Kingdom experienced illnesses related to occupational stress, anxiety and depression implying an incidence of 740 stressed workers per 100,000 workers [20]. Occupational stress imposes an economic burden where, for example, it costs the British economy a total of 14.3 billion Euros between 2013 and 2014 [21]. Moreover, the HSE report also stated that around 9.9 million working days were lost due to occupational stress, anxiety, and depression between 2014 and 2015 [21]. Moreover, in the United States, occupational stress has been allocated among the top ten health issues related to the workplace since the 1980s [22]. An epidemiological study showed that depression and anxiety related to occupational stress had affected a significant proportion of the American population, being as high as 10% [23]. It has been reported that the most stressful occupations are those of teachers, healthcare workers, social workers, ambulance service, police, and prison officers as they mostly involve work overload, threat of violence, and/or emotional labor [3]. **Burnout Syndrome:** The psychologist Herbert Freudenberger introduced the term "burnout" in 1974 and defined it as the physical and mental exhaustion associated with work or related to care-giving activities [24]. Burnout syndrome was later characterized as a triad of depersonalization, emotional exhaustion, and diminished personal accomplishments [25]. Depersonalization, also referred to as cynicism, it happens when a person becomes callous, negative, and detached to the extent of treating clients or patients as objects, emotional exhaustion happens when a person develops a feeling of depleted emotional resources and energy, while diminished personal accomplishments refer to the feelings of reduced achievements and incompetence [8]. This syndrome has been especially identified in teachers, social workers, and healthcare professionals as those occupations require devoting one's life to others thus imposing stress levels to the level of causing burnout syndrome [26]. In specific, burnout syndrome among healthcare professionals has reached epidemic levels especially that the work environment of physicians and medical residents exposes them to high risk of stress and burnout where the effects can be deleterious to patients and healthcare organizations as well Reith [4]. **Prevalence of Burnout in the Medical Field:** It has been reported that almost 50% of the physicians in the United States experienced burnout, being double the rate experienced in other professions [27]. A study comparing physician burnout rates across specializations between 2011 and 2014 showed that the rate dramatically increased from 45.5% to 54.4% being most pronounced in emergency medicine and least in preventive or occupational medicine as presented in Figure 1 [28].

Figure-1. Reported burnout rate among physicians by specialty in 2011 and 2014 (29) a indicates significant variation in percentage between 2014 and 2011 with a P-value less than 0.05



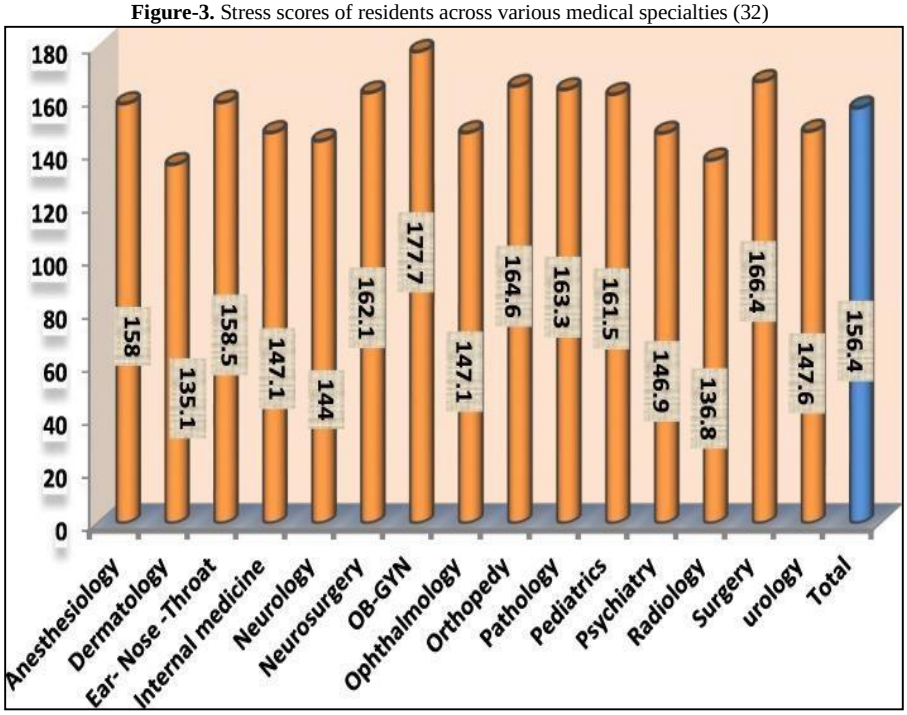
In a similar trend, worldwide burnout rate among physicians increased from 40% in 2013 to 51% in 2017, showing a rapid and alarming upsurge of 25% within four years [4]. Similarly, a high burnout rate has been reported among medical residents, where it reached 75% as indicated in a review conducted in 2009 [8]. A study conducted in 2016 concluded that the rate was also affected by the resident's specialty being 78% and 66% among surgical residents and non- surgical residents respectively [6]. Residents are more prone to stress and subsequent burnout than physicians and medical faculty members [29]. **Risk Factors:** The interplay between various personal and workplace-related factors places resident physicians at high risk of developing stress and burnout syndrome [12]. **Personal Risk Factors:** Studies indicate a gender imbalance as female residents experience higher rates of stress and burnout syndrome than males possibly for being more open to expressing their feelings than men [30]. Also, it is thought that younger age and being at early stages of residency increase the effect of stress which can be attributed to lower self-confidence and inexperience [9]. The effect of marital status of residents on stress and burnout is controversial with some studies reporting no correlation and others reporting higher rates among single residents [31]. Although one would hypothesize that having children is an added risk factor for burnout, it has been reported that parenting reduces the rate of depersonalization and promotes the humanizing effect on residents [32]. In addition to those demographic risk factors, some inherent traits and personal experiences are considered risk factors for experiencing stress and burnout [5]. Having experienced a negative personal life event increases the risk of burnout where such events include experiencing the death of a close person, personally suffering from a major illness, or having a close family member suffering from a major illness [33]. Moreover, being a perfectionist and an idealistic imposes high risks as those residents would submerse themselves and dedicate all their efforts and time to their work and subsequently exhaust themselves physically and emotionally [34]. It has been reported that the most susceptible individuals to burnout and stress are the ones that are most motivated, devoted, and responsible [35]. Growing evidence links trauma experienced during childhood to mal-adaptations later in one's life especially coping with stress, thus accumulating stressors increase the risk of developing chronic stress and burnout [36]. **Occupational Risk Factors:** Medicine is a demanding profession and a wide range of stressors exists in the medical workplace [7]. A study conducted on 68 physicians revealed the challenges in the healthcare profession that they have to face. Findings showed that 46% of the interviewed physicians consider shift work and long hours as the number one challenge as presented in Figure 2 [37].

Figure-2. Challenges of the healthcare profession as mentioned by 68 interviewed physicians (38)



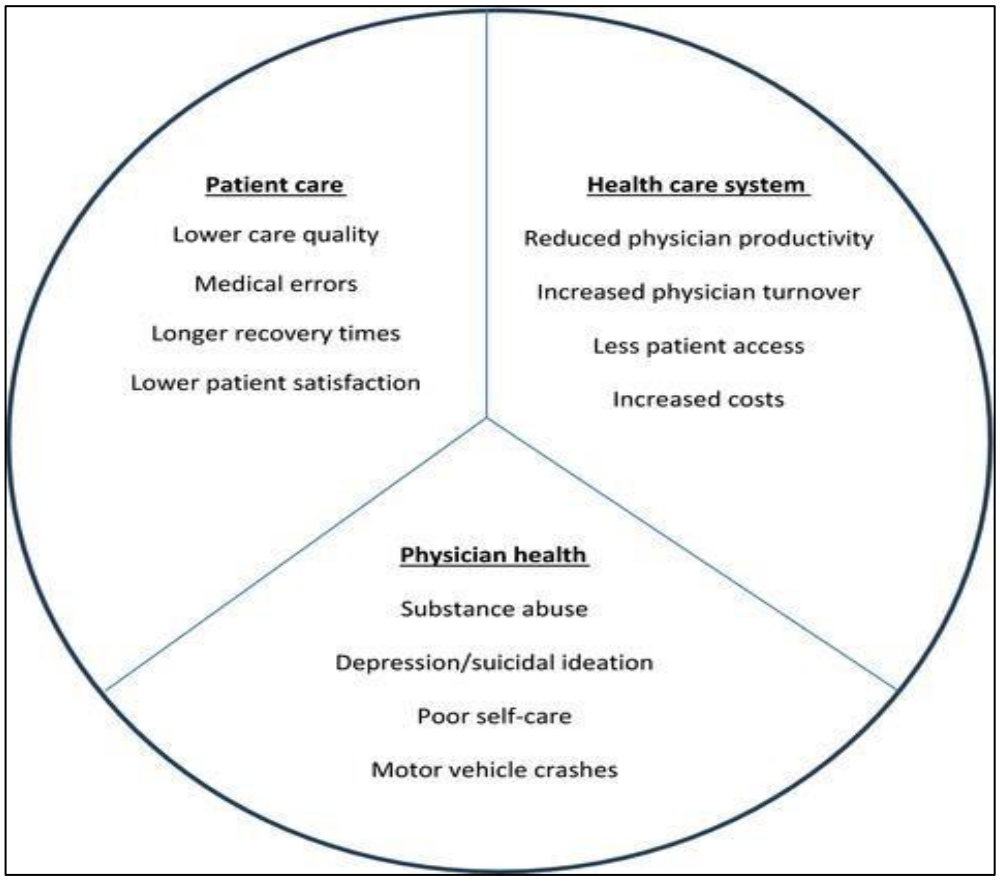
Long working hours and night duty are major contributing factors to burnout as residents have less time to rest and to spend with their families thus cutting down their leisure time and affecting their mental balance [31]. Accordingly, sleep deprivation and work-life imbalance exert stress on residents that could reach burnout levels [27]. Residents also report high levels of bullying and intimidation in the healthcare organization [38]. Burnout appears to be affected by the extent of social support received from other residents, hospital staff, and faculty members [39]. Medical schools in general involve high levels of competition among learners and low levels of cooperation especially between junior residents [40]. During their residency period, residents usually receive unsatisfactory and insufficient salaries in comparison to their workload, resulting in reduced personal accomplishment and burnout [41]. Moreover, stress level seems to be affected by medical specialty with surgical specialties being more stressful than non-surgical ones especially that residents in the former type interact with patients having critical illnesses, high mortality risk, and emergencies [6]. A study conducted on 350 residents from multiple specialties reported highest stress levels in gynecology residents, surgery residents, orthopedic residents, and pathology residents respectively while it reported lowest stress levels in dermatology residents as shown in Figure 3 [31].

Figure-3. Stress scores of residents across various medical specialties (32)



Consequences of Stress and Burnout in Residents: Stress and subsequent burnout are of utmost importance since they not only affect the physician's well-being, but also impact patient care and the healthcare system as summarized in Figure 4 [12].

Figure-4. Consequences of burnout on patient care, health care system, and physician health (12)



Effect on resident's health; Symptoms of stress and burnout include fatigue, headaches, appetite changes, digestive problems, insomnia, colds and chest pain [8, 19]. Additional symptoms, at the psychological level, include cynicism, irritability, negative mood, and lack of concentration [42]. It has been reported that burnout increases the odds of alcohol abuse by 25% and it has been associated as well with drug abuse and caffeine dependence [43, 44]. Also, suicidal thoughts are more prevalent among residents and physicians with burnout mainly linked to the increased rate of depression among them [45]. Chronic stress and burnout are strongly associated with increased risk of cardiovascular disease [46]. Having long working hours does not allow residents to exercise regularly, thus the imposed sedentary lifestyle increases the risk of obesity and its associated risk factors [36]. Due to the high level of fatigue, residents are at increased risk of life-threatening vehicle crashes and motor accidents [47]. **Effect on Patient Care:** The deteriorated well-being of the resident reflects badly on patient care practices [30]. One of the components of burnout is depersonalization that is associated with extended hospitalization periods and prolonged recovery duration after hospital discharge [48]. Moreover, burnout in residents has been associated with reduced patient satisfaction [49]. A study showed that medical errors increase tremendously with burnout; therefore, burnout in physicians and residents threatens patients' safety and could increase patients' morbidity and mortality [50]. Regardless, it has been reported that physicians with burnout tend to over-report their errors and that no correlation exists between burnout and incidence of medical errors [13]. **Effect on Healthcare System:** Burnout in physicians has been linked to elevated intention to leave medical practice for reasons not related to retirement [51]. Similarly, medical residents who experience high levels of stress and that have burnout tend to drop out of the medical program at early stages of their training [52]. Furthermore, burnout indirectly leads to higher healthcare expenses following the increase in the incidence of medical errors, the increase in physician turnover, and decreased efficiency and productivity of residents and physicians [9, 53]. **Intervention Methods:** Strategies to alleviate stress and burnout in residents are important to be implemented at both the personal level and the organizational level in order to be effective [11]. **Personal Level:** Residents are encouraged to seek support from their colleagues when facing challenging cases as peer support decreases anxiety and stress [54]. Practicing meditation improves the emotional status of healthcare providers and promotes a positive mood thus improving burnout [55]. Other stress and burnout relieving strategies include engaging in yoga and spiritual activities, going on vacations and reunions, spending time on reflective writing and listening to music [7]. Physical exercise is known to improve mental health and depression thereby reducing stress and burnout [56]. By working on time management skills, residents will be able to achieve work- life balance and subsequently reduce their chances of burning out [57]. Gaining resilience to stress can be achieved by seeking psychotherapy early upon sensing the symptoms of burnout [22]. **Occupational Level:** Residency training programs are incorporating emotional intelligence training to reduce burnout among residents and encourage teamwork [58]. Managing workload and work hours to reach reasonable levels as well as developing systems for the surveillance and detection of early warning signs of distress among residents and healthcare professionals is effective in limiting the incidence of burnout [59].

3. Situation in Lebanon

Though the topic of stress and burnout among healthcare workers is gaining importance and extensive studies related to this topic are being published, a small proportion of those studies focus on residents in comparison to nurses, physicians in practice and surgeons [52]. In the Middle East, such data are extremely scarce and limited [14]. In Lebanon, a study was conducted on 51 Lebanese oncologists where 47.1% reported a high burnout level [26]. Yet, there are no studies evaluating the prevalence of stress among medical residents in Lebanon.

4. Objectives

Primary Objective: The primary objective of our thesis was to determine the extent and prevalence of stress among the current LU residents. **Secondary objectives**: The secondary objectives of the study were: 1) - To determine the potential risk factors of stress among residents. 2) - To assess the consequences of stress on the quality of life of the residents. 3) - To evaluate the consequences of stress on the safety of their patients. 4) - To find correlations and strength of associations between risk factors and stress and between stress and some consequences.

5. Subjects and Methods

Ethical Information: In this study, residents were completely free to participate or not and they were asked to sign a letter of consent at the beginning of the questionnaire. Their identities remained confidential and no one other than us had access to any of the filled questionnaires. Respect for the dignity of participants and protection of privacy are prioritized. **Study Design:** This is a multi-centric, cross-sectional, descriptive study involving Lebanese University residents at Rafic Hariri university hospital (RHUH), Mount Lebanon hospital MLH, Sahel general hospital (SGH), and Zahraa hospital. **Study Population: Number of Residents:** A total of 130 residents filled the questionnaire and participated in this study. **Inclusion Criteria:** Residents were eligible to participate in this study and fill the questionnaire if they met the below criteria: 1) - Being a resident in any of the specialties: surgery, gynecology, internal medicine, and pediatrics. 2) - Aged between 25 and 29 years. 3) - Being an LU resident. **Exclusion Criteria:** Residents were excluded if they were: 1) - Non-LU residents. 2) - Less than 25 years old or more than 29 years. 3) - On medical therapy due to documented psychological illness **Data collection**: After receiving authorization to conduct this study in the previously mentioned hospitals, Data collection was done from 1 September 2019 till 1 December 2019. Residents were asked to fill the questionnaire. The questionnaire consisted of 24 questions distributed into three sections. The first section included 11 questions concerning the demographics: age, gender, specialty, residency year, relationship status (single, married, separated, or divorced), number of children if any, number of working hours per week, average amount of hours of sleep per night over the last week, average on-call days per week, number of hours studying during the day, and involvement in special habits like caffeine drinking, cigarette smoking, substance use (Tramadol, NSAIDS, Paracetamol), and physical exercise. The second section included 12 statements related to stress and depression whereby the resident should choose a number from 0 to 3 in order to rate how much the statement applied to them over the past week. A score of 0 indicated that the statement was inapplicable, a score of 1 indicated that the statement applied to some degree, 2 to a considerable degree, and 3 indicated that the statement was very applicable most of the time. The last section included one question concerning the accuracy of the residents in treating patients and doing their chores in which they have to rate the frequency of their estimated errors throughout the year.

6. Data Analysis

Data was analyzed using the IBM SPSS Statistics version 25. A descriptive analysis was carried on: the categorical variables were presented as frequency and percentage whereas for the continuous variables mean and standard deviation were additionally presented. Demographics and characteristics (stress risk factors and consequences) of the enrolled residents were determined. Depression, anxiety and stress scale – 21 items (DASS-21) was used to rate the extent of depression and stress of the residents as indicated in Table 1 [60].

Table-1. DASS-21 scale for classifying depression and stress according to the obtained score (adapted from (61))

Subscale	Depression	Stress
Normal	0-4	0-7
Mild	5-6	8-9
Moderate	7-10	10-12
Severe	11-13	13-16
Extremely Severe	14+	17+

Mean stress score was identified per each characteristic and was presented along with its standard deviation. Distribution of the studied population across the stress levels was also evaluated and was presented as frequency and percentage. Correlation between stress and each of the studied variables was determined using Univariate Analysis of Variance (ANOVA) and Pearson Chi-Square test. To assess the strength of association between variables, Eta coefficient was used for ANOVA correlation tests and PHI coefficient was used for Pearson Chi-Square correlation tests. Regression analysis was used for finding the relationship between stress scale and depression scale. For multiple comparisons of subtypes within the same characteristic, Post-Hoc Tukey HSD test was applied. Statistical significance was set at a P-value of 0.05 or less.

Table-2. Distribution of residents according to specialty and residency year

Specialty	Internal Medicine			Surgery					Pediatric				Obstetrics and Gynecology			
Year of Residency	1st	2nd	3rd	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
	22	26	17	10	4	5	3	2	6	6	7	5	4	5	4	4
Total Number	65			24					24				17			

7. Results

Stress Level among LU Residents: The mean stress score of the enrolled 130 LU residents turned out to be 10.35 ±4.01. Only 30% of the residents had a stress score within the normal range. 31.5% of the residents have severe stress and 4.6% have extremely severe stress as shown in Table 2.

Table-3. Distribution of the enrolled LU residents according to their stress score (N=130 residents)

Stress Range	Stress Classification	Frequency	Percent (%)
0 – 7	Normal	39	30
8 – 9	Mild	15	11.5
10 – 12	Moderate	29	22.3
13 – 16	Severe	41	31.5
17+	Extremely Severe	6	4.6

Risk Factors and Correlation with Stress: Age: The mean age of the 130 enrolled LU residents was 27.21 ±1.33 years. Minimum age was 25 years old and maximum age was 29 years old where the majority of the residents were 28 years old (29.2%). Highest mean stress score (10.92 ±3.75) was reported by residents aging 27 years old and lowest score was reported by those aging 29 years old. No correlation was found between age of the residents and stress (P-value = 0.433). Descriptive statistics and mean stress scores per age are shown in Table 3.

Table-4. Distribution of the enrolled LU residents according to their age along with the respective mean stress score (N=130 residents)

Age	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value
25	19	14.6	10.63	4.06	0.433
26	22	16.9	10.41	2.82	
27	26	20	10.92	3.75	
28	38	29.2	10.18	4.63	
29	25	19.2	9.76	4.32	

Gender: Out of the total 130 participants, 56.2% were males with a mean stress score of 9.03 ±3.84 and 43.8% were females with a mean stress score of 12.05 ±3.59 as shown in Table 4.

Table-5. Distribution of the enrolled LU residents according to their gender along with the respective mean stress score (N=130 residents)

Gender	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value	Partial Eta Squared
Male	73	56.2	9.03	3.84	0.00	0.141
Female	57	43.8	12.05	3.59		

The correlation between gender and stress was significant (P-value < 0.001) and 14.1% of variance in stress level is accounted for by gender. **Marital Status and Having Children:** Concerning the marital status of the residents, 84.6% were single with a mean stress score of 10.1 ±4.0 and 15.4% were married with a mean stress score of 11.75 ±3.89 as shown in Table 5.

Table-6. Distribution of the enrolled LU residents according to their marital status along with the respective mean stress score (N=130 residents)

Marital Status	Frequency	Percent (%)	Mean Stres Score	Standard Deviation	P-value
Single	110	84.6	10.10	4.00	0.091
Married	20	15.4	11.75	3.89	

Only 10 residents (7.7%) had children with a mean stress score of 11.7 ±3.65. The rest of the residents (92.3%) had a mean stress sore of 10.24 ±4.03 as shown in Table 6.

Table-7. Distribution of the enrolled LU residents according to whether they have children or not along with the respective mean stress score (N=130 residents)

Has Children	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value
No	120	92.3	10.24	4.03	0.271
Yes	10	7.7	11.70	3.65	

No correlation was found between either marital status of the residents and stress (P-value = 0.091) or between having children and stress (P-value = 0.271) **Residency Specialty:** Half of the participating residents in this study were specializing in internal medicine and those had the highest mean stress score followed by obstetrics and gynecology residents and pediatrics residents respectively. The lowest mean stress score was reported by surgery residents (7.5 ±3.67). Descriptive statistics and respective stress scores are shown in Table 7.

Table-8. Distribution of the enrolled LU residents according to their residency specialty along with the respective mean stress score (N=130 residents)

Residency Specialty	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value	Partial Eta Squared
Internal Medicine	65	50	11.54	3.42	0,00	0.14
Surgery	24	18.5	7.50	3.67		
Pediatrics	24	18.5	10.00	4.20		
Obstetrics and Gynecology	17	13.1	10.35	4.49		

The correlation between residency specialty and stress was significant (P-value < 0.001) and 14% of variance in stress level is accounted for by residency specialty. Moreover, significance was only detected between mean stress score of internal medicine residents and that of the surgery residents (P-value < 0.001) whereby the formers have higher stress scores by 4.04 points on average as shown in Table 8.

Table-9. Difference in mean stress scores between residency specialties

Residency Specialty (I)	Residency Specialty (J)	Mean Difference (I-J)	Standard Error	Significance
	Surgery	4.0385*	0.89928	0.00
Internal Medicine	**Pediatrics**	1.5385	0.89928	0.322
	Obstetrics and Gynecology	1.1855	1.02562	0.656
	Internal Medicine	-4.0385*	0.89928	0.00
Surgery	**Pediatrics**	-2.5	1.08685	0.103
	Obstetrics and Gynecology	-2.8529	1.1935	0.084
	Internal Medicine	-1.5385	0.89928	0.322
Pediatrics	**Surgery**	2.5	1.08685	0.103
	Obstetrics and Gynecology	-0.3529	1.1935	0.991
Obstetrics and Gynecology	**Internal Medicine**	-1.1855	1.02562	0.656
	Surgery	2.8529	1.1935	0.084
	Pediatrics	0.3529	1.1935	0.991

* indicates that the mean difference is significant at the 0.05 level.

Residency Year: The majority of the participants (32.3%) were in their first year of residency and only 2 (1.5% of the residents) were in their fifth residency year. The highest mean stress score (10.85 ±3.79) was for those in their second year and the lowest was for those in their fifth year. Descriptive statistics and mean stress scores are detailed in Table 9.

Table-10. Distribution of the enrolled LU residents according to their residency year along with the respective mean stress score (N=130 residents)

Residency Year	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value
1	42	32.3	10.19	3.68	0.606
2	41	31.5	10.85	3.79	
3	33	25.4	10.39	4.51	
4	12	9.2	9.33	4.23	
5	2	1.5	9	8.48	

No significant correlation was observed between residency year and stress score (P-value = 0.606). **Workload.**

A proportion of 55.4% of the residents reported working more than 50 hours per week and their mean stress score was 11.26 ±3.76. Another proportion of 32.3% of the residents reported working between 40 and 50 hours per week and those had the lowest mean stress score among this group reaching 8.83 ±4.16. Moreover, 83.8% of the residents reported having more than 2 on call duties yet they had lower stress score than their counterparts (10.09 ±4.14 versus 11.71 ±2.99). Detailed descriptive statistics and mean stress score according to workload are presented in Table 10.

Table-11. Distribution of the enrolled LU residents according to workload along with the respective mean stress score (N=130 residents)

Workload Criteria	Ranges	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value	Partial Eta Squared

Working Hours Per Week	30-40 hours	16	12.3	10.25	3.67	0.007	0.076
	40-50 hours	42	32.3	8.83	4.16		
	> 50 hours	72	55.4	11.26	3.76		
On Call Duties Per Week	< 2	21	16.2	11.71	2.99	0.09	0.022
	> 2	109	83.8	10.09	4.14		

The correlation between amount of working hours per week and stress was significant (P-value = 0.007) and 7.6% of variance in stress level is accounted for by the amount of working hours per week. However, no significant correlation was reported between on call duties and stress (P- value = 0.09). Moreover, residents working more than 50 hours had significantly higher mean stress score than those working between 40 and 50 hours (mean stress score difference of 2.43 with P-value = 0.005). Residents working between 30 and 40 hours per week had higher stress scores than those working between 40 and 50 hours; yet this difference was found to be insignificant as shown in Table 11.

Table-12. Difference in mean stress scores between residents according to the range of worked hours per week

Weekly Working Hours Range (I)	Weekly Working Hours Range (J)	Mean Difference (I-J)	Standard Error	Significance
30-40	**40-50**	1.4167	1.14194	0.432
	> 50	-1.0139	1.07431	0.614
40-50	**30-40**	-1.4167	1.14194	0.432
	> 50	-2.4306*	0.7547	0.005
> 50	**30-40**	1.0139	1.07431	0.614
	40-50	2.4306*	0.7547	0.005

***** indicates that the mean difference is significant at the 0.05 level.

Time Spent on Studying: Out of the enrolled residents, 62.3% reported spending less than 2 hours per day on studying and their mean stress score was 10.9 ±3.83 as shown in Table 12.

Table-13. Distribution of the enrolled LU residents according to time spent on studying daily along with the respective mean stress score (N=130 residents)

Time Spent on Studying per Day	Frequency	Percent	Mean Stress Score	Standard Deviation	P-value
< 2 hours	81	62.3	10.9012	3.83277	0.078
2 - 4 hours	42	32.3	9.6905	4.02121	
4 - 6 hours	7	5.4	8	5.09902	

No significant correlation was reported between time spent on studying and stress (P-value = 0.078). **Sleep:** The 130 LU residents enrolled in this study reported an average of 4.38 ±1.45 hours of sleep throughout the week preceding filling our questionnaire. Answers ranged between 1 hour of sleep per night and 7 hours of sleep per night as shown in Table 13.

Table-14. Descriptive statistics concerning the hours of sleep among the enrolled LU residents

	N	Mean	Standard Deviation	Minimum	Maximum
Hours of Sleep	130	4.3846	1.45413	1	7

The Pearson correlation test revealed a significant negative correlation between hours of sleep per night and stress (P-value = 0.007, coefficient= -0.236) as shown in Table 14.

Table-15. Pearson correlation results between hours of sleep per night and stress

		Stress Scale
Sleep	**Pearson Correlation**	-.236**
	Significance (2-tailed)	0.007
	N	130

Consequences of Stress on Resident's Health: Substance Abuse and Exercise: Out of the 130 enrolled residents, 79.2% drink caffeine, 33.8% smoke, 26.2% use drugs, and 56.2% engage in exercising as shown in Table 15.

Table-16. Frequency and percentage of different habits in residents within each stress classification

Stress Classification	Number of Residents	Caffeine Drinking	Drug Use	Smoking	Exercise
Normal	39	33 (84.6%)	14 (35.9%)	19 (48.7%)	18 (46.2%)
Mild	15	12 (80%)	5 (14.7%)	4 (26.7%)	10 (66.7%)
Moderate	29	23 (79.3%)	3 (10.3%)	9 (26.7%)	17 (58.6%)

Severe	41	31 (75.6%)	10 (24.4%)	11 (26.8%)	24 (58.5%)
Extremely Severe	6	4 (66.7%)	2 (33.3%)	1 (16.7%)	4 (66.7%)
Total	130	103 (79.2%)	34 (26.2%)	44 (33.8%)	73 (56.2%)
p-value	-	0.81	0.178	0.2	0.61

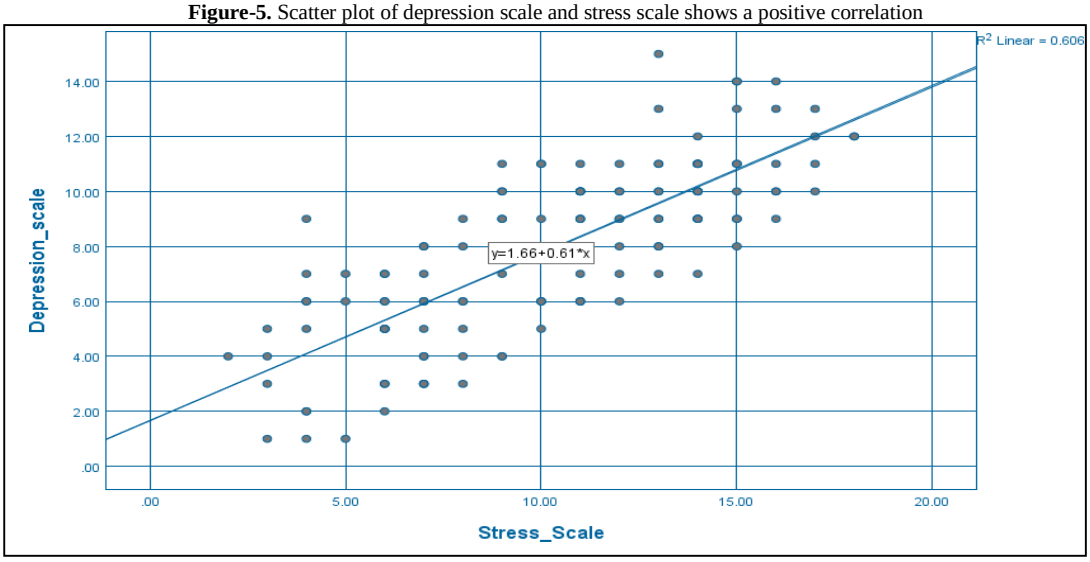
Table 15 also details the distribution of these habits among the residents within each stress classification. For example, caffeine drinking was reported as a habit by 66.7% of the residents with extremely severe stress. No significant correlation was observed between stress and any of the studied habits: caffeine drinking (P-value = 0.81), drug use (P-value = 0.178), smoking (P- value = 0.2), and exercise (P-value = 0.61). **Depression:** A proportion of 43.1% of the enrolled residents turned out to have moderate depression, 18.5% have severe depression, and 3.1% have extremely severe depression as shown in Table 16.

Table-17. Prevalence of depression among the enrolled LU residents (N=130 residents)

Depression Classification	Frequency	Percent (%)
Normal	13	10
Mild	33	25.4
Moderate	56	43.1
Severe	24	18.5
Extremely Severe	4	3.1

Using Pearson Chi-squared test, a strong correlation was observed between stress and depression (P-value < 0.001) where the resultant Phi coefficient (0.839) showed a high association between these variables. The scatter plot presented in Figure 5 shows that depression score increases with elevated stress score and that the score can be predicted using the formula (Y = 1.66 +0.61x) where y is depression score and x is stress score. A dot in the scatter plot represents each resident and is located with reference to the resident's stress score and depression score.

Figure-5. Scatter plot of depression scale and stress scale shows a positive correlation



Consequence of Stress on Patient's Care: Our results showed that 20% of the residents reported never committing medical errors and those had a mean stress score of 6.88±3.25, falling within the normal stress range. Residents committing medical errors more frequently reported higher stress scores as shown in Table 17.

Table-18. Distribution of LU residents according to frequency of committed medical errors with respective mean stress score (N=130 residents)

Frequency of Medical Errors	Frequency	Percent (%)	Mean Stress Score	Standard Deviation	P-value
Never	26	20	6.88	3.25	0.00
Very Rarely	31	23.8	13.43	2.36	
Rarely	31	23.8	11.32	3.11	
Occasionally	42	32.3	8.13	3.65	

Following Pearson Chi-square test, stress was significantly correlated with the frequency of medical errors (P-value < 0.001) and the Phi coefficient (0.798) showed a high association between these variables. **Effect of Depression:** Following the Tukey's Post Hoc test for multiple comparisons, residents never committing medical errors had significantly lower depression scores than those committing medical errors rarely or occasionally (P-value < 0.001 for both). Residents committing medical errors very rarely had significantly lower depression scores than

those committing medical errors rarely (P- value < 0.01) or occasionally (P-value < 0.001). These findings are presented in Table 18.

Table-19. Difference in mean depression scores between residents according to the frequency of committed medical errors

(I) Medical Errors	(J) Medical Errors	Mean Difference (I-J)	Std. Error	Sig.
Never	**Very rarely**	- 0.70	0.69	0.742
	Rarely	- 3.02*	0.69	0.00
	Occasionally	- 4.35*	0.65	0.00
Very rarely	**Never**	0.70	0.69	0.742
	Rarely	- 2.32*	0.66	0.003
	Occasionally	- 3.64*	0.62	0.00
Rarely	**Never**	3.02*	0.69	0.00
	Very rarely	2.32*	0.66	0.003
	Occasionally	- 1.32	0.62	0.144
Occasionally	**Never**	4.35*	0.65	0.00
	Very rarely	3.64*	0.62	0.00
	Rarely	1.32	0.62	0.144

***** The mean difference is significant at the 0.05 level

Effect of the Number of Working Hours per Week: Out of the 26 residents who claimed never committing any medical error, 23.10% of the residents worked between 30 and 40 hours per week, 38.5% worked between 40 and 50 hours per week, and another 38.5% worked more than 50 hours per week. Out of the 31 residents rarely committing medical errors, 9.7% worked between 30 and 40 hours per week, 38.7% worked between 40 and 50 hours per week, and 51.6% worked more than 50 hours per week. A similar trend was observed for those committing medical errors rarely or occasionally. To check whether the frequency of committed medical errors was affected by the number of working hours per week, Pearson Chi square test was applied and results showed no significant correlation (P-value = 0.22). Results are shown in Table 19.

Table-20. Distribution of residents within medical errors' categories and according to the number of working hours per week

			Errors			
			Never	**Very rarely**	**Rarely**	**Occasionally**
Working Hours per Week	**30-40h**	Frequency of residents	6	3	2	5
		% within Errors	23.10%	9.70%	6.50%	11.90%
	40-50h	Frequency of residents	10	12	11	9
		% within Errors	38.50%	38.70%	35.50%	21.40%
	> 50h	Frequency of residents	10	16	18	28
		% within Errors	38.50%	51.60%	58.10%	66.70%
Total		Frequency of residents	26	31	31	42
		% within Errors	100%	100%	100%	100%
P-value			0.22			

Effect of the Year of Residency: Out of the 42 residents, who occasionally committing medical errors, the majority were in their first year of residency (38.1%), followed by 35.71% in their second year, 23.81% in their third; while only 2.38 were in their fourth year and 0% were in their fifth year of residency. Almost a similar trend was observed for the other categories of the medical errors. For the category that never committed any errors, a high percentage of residents were in their third year of residency (34.62%). Pearson Chi square test showed significant correlation between residency year and frequency of medical errors (P-value =0.046). In specific, residents at higher residency years tend to commit less medical errors (Pearson's R = -0.235, P-value = 0.007). Results are shown in Table 20.

Table-21. Distribution of residents within medical errors' categories and according to the residency year

			Medical Errors			
			Never	**Very rarely**	**Rarely**	**Occasionally**
Residency Year	1	Frequency of residents	9	5	12	16
		% within Errors	34.62%	16.13%	38.71%	38.10%
	2	Frequency of residents	3	10	13	15
		% within Errors	11.54%	32.26%	41.94%	35.71%
	3	Frequency of residents	9	10	4	10
		% within Errors	34.62%	32.26%	12.90%	23.81%
	4	Frequency of residents	5	5	1	1
		% within Errors	19.23%	16.13%	3.23%	2.38%
	5	Frequency of residents	0	0	1	0
		% within Errors	0%	3.23%	3.23%	0%
Total			26	31	31	42

P-value		0.046
Pearson's R	Value	-0.235
	Sig.	0.007

8. Discussion

In this study involving 130 Lebanese University (LU) residents in surgery, gynecology, internal medicine, and pediatrics, only 30% of the enrolled residents had a normal stress score whereas the remaining others (70%) had stress ranging between mild and extreme severity. Our results showed that 22.3% of the residents had moderate stress, 31.5% had severe stress and 4.6% had extremely severe stress. The overall stress prevalence among residents in our study conforms to the overall 75.5% stress rate in residents as reported in another study in which moderate stress and high stress were reported in 42.2% and 57.8% of the residents respectively [25]. Studies have reported various personal and environmental factors for this elevated stress level among medical residents such as workload, work-life imbalance, decreased job satisfaction, insufficient salary, sleep deprivation, and other factors [37, 41]. This high stress prevalence among residents is alarming and should be managed especially that it could lead to burnout and that these residents are the future specialists that are going to treat patients [53, 61]. Therefore, this study aimed at finding the prevalence of stress among current LU residents and defining some risk factors and consequences of stress on the health of the residents themselves and on patients' care. The mean age of the residents participating in this study was 27.21 years with the youngest being 25 years old and the eldest being 29 years old. Those aging 29 years had the lowest stress scores (9.76±4.32) yet no significant correlation was observed between age and stress. Similarly, many studies could not find a significant correlation between high stress levels and age such as the study on Dutch medical residents by Prins, *et al.* [52]. Similarly, although the highest mean stress score (10.85 ±3.79) was for those in their second year (31.5% of the residents) and the lowest score (9 ±8.48) was for those in their fifth year (1.5% of the residents), no significant correlation was observed between residency year and stress score (P-value = 0.606). This could be due to the discrepancy in the number of residents across the residency years and age groups especially that it has been reported that younger age and being at early stages of residency increase the effect of stress that can be attributed to lower self-confidence and inexperience [9]. Mean stress score in females was much higher than it was in males (12.05 versus 9.03 respectively) and association strength test showed that 14.1% of the variance in stress level is accounted for by gender. This is consistent with other studies reporting higher stress in females as it was shown in Chaplin et al 2008, where women reported and displayed greater sadness and anxiety following stress than men (64). Females are usually more open to expressing their feelings and have different stress responses than men and that overall males rated their abilities to handle unexpected and difficult problems better than females [30]. In our study marital status and parenting have also been examined in relation to burnout, 84.6% of the residents were single and showed lower mean stress score than the married residents (mean scores of 10.10 versus 11.75 respectively); yet no significant correlation was found between marital status and stress. Likewise, no significant correlation was found between having children and stress. In the literature, it is controversial whether marital status and parenting are risk factors for stress and burnout among residents and physicians as studies show conflicting data. Martini, *et al.* [39] 2004 showed that 65.2% of single, divorced, or unmarried residents met the criteria for burnout compared with 40.0% of married individuals (P-value < 0.01). Other studies report no correlation between marriage and burnout [32, 62]. Although it could be assumed that having the added responsibility of caring for children would add to burnout, research has shown that parenting can act as a protective factor against burnout. Parenting has a possible humanizing effect on residents, resulting in less detachment and depersonalization. Collier, *et al.* [63] showed that having children during residency resulted in lower rates of depression as well as an increase in humanistic feelings. However, other studies showed that parenting has no effect on burnout [8, 64]. Residency specialty is known to impact stress [28]. Our results showed a significance correlation between specialty and stress with a 14% accountability of specialty in stress score variation. The majority (50%) of the enrolled residents in this study were specializing in internal medicine. Surprisingly, lowest mean stress score was detected in those specializing in surgery (7.5 ±3.67) when compared to those specializing in internal medicine, pediatrics, or obstetrics and gynecology. It has been reported that residents in surgical specialties have the highest stress scores [6]. Also, our results showed that internal medicine residents had higher stress scores than surgery residents with a difference of 4.04 points on average. This could be explained by the fact that internal medicine residents deal with high-risk patients that are acutely-morbid and who have high mortality risk [65]. It has been reported that residency year affects stress whereby residents in their first few years have stress that could reach burnout levels more than those in their fifth residency year as they have less self-confidence and are less experienced [9]. Yet, our results showed no significant association between residency year and stress. This was also reported by Schneider, *et al.* [32] and Holmes, *et al.* [6]. More than half of the participants reported working more than 50 hours per week with the highest stress score (mean score of 11.26 ±3.76). In Europe, all healthcare workers should fulfill a maximum of 48 working hours per week to guarantee efficiency and productivity while preventing exhaustion and stress [66]. Our results also showed that 7.6% of variance in stress was accounted for by the amount of worked hours per week. We also hypothesize that working for a high number of hours per week will impose high stress as the residents will not have enough time to study for their exams. Being on more than 2 on call duties per week was reported by 83.8% of the enrolled residents but this criterion was not significantly correlated with stress as was the case for the number of hours spent on studying per day. Furthermore, the residents reported having an average of 4.38 ±1.45 hours of sleep with answers ranging between 1 hour and 7 hours of sleep per night. Hours of sleep showed a significant negative association with stress. Long working hours and sleep deprivation increase the risk of stress since they do not allow residents to engage in leisure activities and have times with their families nor to rest

adequately [27]. Stress has deleterious effects on the residents' health and patient's care [12]. Our data suggest that stress had no correlation with caffeine drinking, drug use, or smoking habits among LU residents. Caffeine drinking seems very common among all residents whether they have stress or not as 79.2% of all residents have this habit and 84.6% of the residents with normal stress score drink caffeine. To note, some studies showed positive correlation between stress and other substance addiction or abuse like alcohol [43] while others concluded that caffeine consumption might reflect probably social tendencies rather than caffeine dependency [67]. No significant correlation was also detected between stress and exercise. This could explain the high prevalence of stress among residents especially that engaging in physical activity and sports is a stress intervention method [56]. Another way in which stress affects the well-being of individuals is through elevating depression [23]. Our results support this by showing that a high association exists between stress and depression. We found the linear positive correlation between stress scale and depression scale that can be used to extrapolate and predict values. Knowing the scores or levels of stress and depression is essential in managing the well-being of residents and preventing suicide [45]. In our study, 43.1% of the enrolled residents had moderate depression, 18.5% had severe depression, and 3.1% had extremely severe depression. These are alarming rates that necessitate intervention and management. Our results showed that 20% of the residents reported never committing medical errors and those had normal stress score. A high association was detected between stress and frequency of medical errors in this study. This comes in accordance with other studies stating that medical errors increase tremendously with elevated stress levels and burnout [8, 50]. Medical errors turned out to be significantly affected by the year of residency and depression scores (P-values < 0.01) but not by the number of working hours per week (P-value = 0.22). In specific, as the residents were at advanced residency years, they committed fewer errors probably since they would have gained more experience throughout their residency years that make them more accustomed to the workflow and the medical cases. In addition, residents with higher depression scores committed more medical errors as depression affects their well-being and reduces their performance [45]. This asserts the idea that intervention is essential to limit the consequences of stress and maintain a hospitable environment for residents, patients, and all the healthcare workers.

9. Study Limitations

This was a cross-sectional study based on self-reported data as filled by the enrolled residents in the distributed questionnaire form. This allows for bias in reporting information especially when these data are subjective like rating medical errors and answering questions related to stress, depression, and substance dependence. Also, this study only confers correlations and strength of association between stress and studied risk factors and consequences. It does not provide exact causation and effects. To note that during data collection period, Lebanon was facing a challenging economic situation with a series of civil protests. The questionnaire did not include any statement regarding economical or political issues. These finding belong to a small sample of LU medical residents specializing in internal medicine, surgery, pediatrics, and obstetrics and gynecology. A selection bias was present because the 4 chosen hospitals were central LU hospitals with the highest workload. Had a bigger sample of residents, at additional more diverse LU hospitals (central and peripheral) and additional specialties been included, better correlations could have been determined and stress level variations among different work environments could have been assessed. This study did not evaluate stress variation in residents with respect to hospitals, but rather assessed the residents' stress levels collectively. Another limitation in our study was that it did not distinguish between stress scores among LU residents and residents from other universities. Moreover, patients' satisfaction concerning the work of the resident was not assessed and the medical errors were not detailed to be able to check for the most frequently performed errors. Residents were not asked about their income that could have a great impact on their satisfaction and stress level.

10. Strengths

To the best of our knowledge, this kind of study has not yet been conducted in Lebanon. It is the first study to focus on stress among residents, in specific among LU residents. By pinpointing the risk factors correlated with stress, this study showed where the focus of stress management and intervention should be concentrated. Further studies should aim to solve the controversies of this topic and end the debate on whether certain characteristics are really risk factors or not, such as: age, marital status and parenting, residency year and number of on call duties. In specific, future studies should investigate the difference in stress levels between LU residents and residents from other universities and the difference in stress between residents working in public hospitals versus those working in private or university hospitals. The effect of workplace environment and social relations with peers and other healthcare workers and hospital staff should be investigated in order to allocate their effect on stress. Such studies are very limited where this topic is of high importance and should be addressed more frequently. This will lead to showing the possible measurements that can be taken to improve job satisfaction and productivity of LU residents. Studies should also assess the effect of the novel coronavirus disease pandemic on the stress level experienced by the residents. Additional research is also required to study the consequences of stress on patient safety and healthcare costs. More longitudinal studies are needed to be conducted in order to find causative factors and consequences rather than just assessing correlations between risk factors and stress or between stress and its consequences on the residents and their patients. Awareness campaigns in hospitals should be encouraged and some policies should be changed to reduce stress among residents and increase patient satisfaction. The high prevalence of stress and depression among residents highlights the need for incorporating preventive stress management and psychological counseling within the medical programs and institutions. Also, it shows the importance of establishing self-assessment and screening methods for identifying residents and healthcare workers with high stress and depression

risks at early stages. Our study shows a formula that can be used to correlate depression score with stress score and can be used to find their values in residents. Yet, more studies should indicate why the increase in depression is related to the increase in stress among LU residents. Further studies should identify the used intervention methods; both on the personal and occupational level, and inspect their efficacy in eliminating stress.

11. Conclusion

The present study aimed to determine the prevalence of stress in current Lebanese University residents and assessing the correlation between some demographic, personal, and work-related characteristics and stress as well as the correlation between stress and some consequences on the life of the resident and the frequency of medical errors. Out of the enrolled residents, 70% had stress ranging between mild and extreme severity. A proportion of 22.3% of the residents had moderate stress, 31.5% had severe stress and 4.6% had extremely severe stress. The mean age of the residents participating in this study was 27.21 years, 84.6% of the residents were single, and 7.7% of the married residents had children. No significant correlation was detected between either age, marital status or parenting and stress. Females had much higher stress than males and gender was significantly correlated with stress accounting for 14.1% of variance in stress among residents. Our results implied that internal medicine specialty imposes higher stress than surgery specialty with a significant difference of 4.04 points. Residency year showed no correlation with stress. More than half of the residents reported working more than 50 hours per week and 7.6% of variance in stress was accounted for by the amount of worked hours per week. Residents had an average of 4.38 ±1.45 hours of sleep per night and a negative association was found between amount of sleep and stress yet no correlation was found between on call duties and stress. Moreover, no correlation was found between stress and cigarette smoking, drug use, caffeine drinking, or exercise as their rates seemed consistent within residents regardless of their stress level. Depression had high prevalence in residents such that 18.5% had severe depression, and 3.1% had extremely severe depression, and stress was significantly correlated with it. Similarly, medical errors were prevalent among residents with stress and a strong association was found between these factors. The frequency of medical errors was in turn affected by the year of residency and depression. As such, the high stress prevalence among residents is alarming and should be managed especially that it could lead to bad consequences on the resident's heath and patients' safety.

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