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Original Article

Assessment of Occupational Based Stress and Internal Coherence Related with Quality of Life Through Heartrate Variability (HRV) - A Cross Sectional Study

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ABSTRACT

Background: This study aimed to evaluate occupation-based stress levels and internal coherence in individuals visiting dental clinics of a tertiary care hospital using heart rate variability (HRV) measures. Occupational stress can significantly influence various aspects of quality of life, including emotional health and cardiovascular risks.

Objective: The primary objective was to assess the relationship between occupational stress, internal coherence, and quality of life through HRV metrics in a diverse population.

Methods: This cross-sectional study was conducted over six months, enrolling 323 voluntary participants aged 18 years and older, irrespective of gender, ethnic background, or occupation. Participants were informed about the study and provided consent one day prior to their participation. HRV recordings were taken for six minutes in a quiet, temperature-controlled room after a 30-minute relaxation period. HRV sensors were applied to either the index finger or earlobe based on the participant's choice. Data were analyzed using emWave Pro Plus and Kubios HRV software. Statistical analysis was performed using SPSS version 25, with numerical variables reported as medians and interquartile ranges and categorical variables as frequencies and percentages.

Results: The study comprised 161 males (49.8%) and 162 females (50.2%), with an age range of 18-65 years. Sympathetic activity increased with age, while younger participants exhibited higher parasympathetic activity. The median SDNN was 78.70 ms (IQR 43.8, 148.0) for males and 60.0 ms (IQR 35.1, 132.2) for females. The coherence levels were low across all age groups, and the stress index scores increased with age. Specifically, the stress index was higher in older age groups, with males aged 54-65 years showing a median stress index score of 45.8% in the high-stress category, compared to 17.9% in males aged 18-29 years.

Conclusion: The findings highlight the significant impact of occupational stress on HRV and overall well-being. Sympathetic activity increased with age, and stress levels were higher in older participants. These results underscore the importance of work-life balance and stress management strategies to mitigate cardiovascular risks and improve quality of life.

Keywords: heart rate variability, occupational stress, autonomic nervous system, internal coherence.

INTRODUCTION

General health is a comprehensive state of well-being encompassing physical, mental, and social dimensions, not merely the absence of illness, serving as a dynamic resource for living (1). This concept of well-being is closely linked to the quality of life, encompassing perceived health and life aspects. It is well-documented that there is a direct relationship between quality of life, mood, and overall well-being, significantly influenced by an individual's primary occupation (2). The nature of one's occupation can substantially affect various aspects of their quality of life, including job satisfaction and work-life balance (3). Occupations impact human well-being and general health in terms of physical, oral health, and social well-being (4). Occupational stress is prevalent and can lead to low coherence and disruptions in autonomic nervous system stability (5).

Heart rate variability (HRV) is a method used to assess internal stress, coherence, and autonomic nervous variability by analyzing multiple cardiac parameters (6). The cardiovascular system responds and adjusts to physical and emotional challenges through changes in the electrical environment of cardiac tissues. Emotions are known to influence this electrical environment, which can be

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estimated by examining heart rate and autonomic nervous system variability (7). Therefore, it is crucial to positively correlate all these aspects of well-being—occupation, emotions, stress, coherence, and quality of life—for improved social interactions, personal and professional growth, work-life balance, and mood stability (8).

This study was conducted on human subjects visiting dental clinics of a tertiary care hospital to assess their occupation-based stress levels and internal coherence using HRV measures. HRV is a non-invasive electrocardiographic technique widely used in therapeutic settings for psychological stress evaluations (9). This method provides insights into the autonomic nervous system's responses to various stressors, which can be crucial for understanding the physiological underpinnings of occupational stress.

Understanding the connections between occupational stress, HRV, and overall health is vital for developing effective interventions to mitigate the adverse effects of stress on the cardiovascular system. This is especially important for individuals in high-stress occupations, where chronic stress can lead to reduced HRV and, consequently, a less adaptive autonomic nervous system (10). Therefore, managing occupational stress through relaxation techniques, regular exercise, social support, and mindfulness practices can significantly improve HRV and overall cardiovascular health.

In this study, male and female participants of different ages and occupations were examined to compare HRV outcomes. The findings indicated that sympathetic activity increased with age in both genders, with males showing more parasympathetic predominance compared to females. Additionally, as age increased, sympathetic activity rose among job and business groups, while students exhibited more parasympathetic activity with age (11). The stress index also increased with age, highlighting the importance of addressing occupational stress to maintain cardiovascular health and overall well-being.

By correlating occupational stress with HRV measures, this study underscores the importance of maintaining a work-life balance to reduce intrinsic stress, enhance coherence, and mitigate cardiovascular risks. The findings suggest that interventions aimed at improving occupational environments and promoting stress management can have a profound impact on an individual's quality of life and health outcomes (12). This study contributes to the growing body of evidence on the significant role of occupational factors in health and well-being, emphasizing the need for comprehensive approaches to managing stress in the workplace.

MATERIAL AND METHODS

This cross-sectional study was conducted in the dental section of a tertiary care hospital, with a sample size of 323 subjects determined using Open EPI software version 2.01, based on the findings of Suresh et al. (11). The study included individuals engaged in various occupations, aged 18 years and above, who provided informed consent to participate. The study excluded individuals unwilling to participate. Subjects were recruited consecutively over six months, with no specifications regarding gender, ethnic background, or geographical distribution.

Participants were informed about the study one day prior to their scheduled visit to the study room. Those who consented were asked to report at 10:00 am the following day after fasting for two hours. Upon arrival, subjects were placed in a quiet, calm, and temperature-regulated room and given 30 minutes to relax. Subsequently, HRV recordings were taken for six minutes in a relaxed sitting position, with HRV sensors applied to either the index finger or earlobe, according to the participant's preference. HRV data was analyzed using emWave Pro Plus software, an advanced tool for HRV data analysis. Additionally, Kubios HRV analysis software, a cutting-edge and user-friendly freeware for coronary HRV analysis, was employed (13). This software includes an improved QRS detection algorithm and tools for noise correction, trend removal, and sample selection.

The ethical aspects of this study were addressed in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of the tertiary care hospital. All participants provided written informed consent after being thoroughly briefed about the study's objectives and procedures. Confidentiality and anonymity of the participants were ensured throughout the study.

Statistical analysis was performed using SPSS version 25. The data was found to be non-normally distributed, as determined by the Shapiro-Wilk test. Numerical variables such as age were reported using median and interquartile ranges, while categorical variables such as gender and occupation were reported using frequencies and percentages. Descriptive statistics were used to summarize the HRV variables, and differences between groups were assessed using appropriate statistical tests. The analysis aimed to identify variations in HRV metrics across different age groups, genders, and occupations, and to correlate these with occupational stress and coherence levels.

By employing robust data collection and analysis methods, this study aimed to provide comprehensive insights into the impact of occupational stress on HRV and overall well-being. The findings are intended to inform future interventions aimed at improving occupational environments and managing stress to enhance cardiovascular health and quality of life among various occupational groups.

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RESULTS

The study included 323 participants, with a slight female predominance (50.2%). The participants' ages ranged from 18 to 65 years. Sympathetic activity increased with age, with males showing a higher parasympathetic predominance compared to females. The descriptive statistics of the study population are presented in Table 1.

Table 1: Age and gender distribution with autonomic nervous system predominance

Gender	Age Group (years)	N	Parasympathetic Predominance (%)	Sympathetic Predominance (%)
Male	18-29	67	65.7	34.3
	30-41	43	44.2	55.8
	42-53	27	40.7	59.3
	54-65	24	29.2	70.8
Female	18-29	70	44.3	55.7
	30-41	58	41.4	58.6
	42-53	24	41.7	58.3
	54-65	10	20.0	80.0

Table 2 shows the distribution of autonomic nervous system predominance based on gender and occupation. The majority of males were employed (58.4%), while half of the female participants were housewives (50%).

Table 2: Gender and occupation of participants with autonomic nervous system predominance

Gender	Occupation	N	Parasympathetic Predominance (%)	Sympathetic Predominance (%)
Male	Job	94	44.7	55.3
	Student	42	64.3	35.7
	Business	25	48.0	52.0
Female	Job	39	25.6	74.4
	Student	40	45.0	55.0
	Business	2	100.0	0.0
	Housewife	81	45.7	54.3

Further analysis stratified participants by age, gender, and occupation, revealing variations in autonomic nervous system predominance. As shown in Table 3, younger males and females exhibited higher parasympathetic activity, which decreased with age, especially in job and business groups.

Table 3: Age, gender, and occupation of participants with autonomic nervous system predominance

Gender	Age Group (years)	Occupation	N	Parasympathetic Predominance (%)	Sympathetic Predominance (%)
Male	18-29	Job	24	62.5	37.5
		Student	39	64.1	35.9
		Business	4	100.0	0.0
	30-41	Job	34	41.2	58.8
		Student	2	100.0	0.0
		Business	7	42.9	57.1
	42-53	Job	20	40.0	60.0
		Student	1	0.0	100.0
		Business	6	50.0	50.0
	54-65	Job	16	31.3	68.8
		Student	0	-	-
		Business	8	25.0	75.0
Female	18-29	Job	13	30.8	69.2
		Housewife	24	54.2	45.8
		Student	33	42.4	57.6
		Business	0	-	-

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Gender	Age Group (years)	Occupation	N	Parasympathetic Predominance (%)	Sympathetic Predominance (%)
	30-41	Job	19	21.1	78.9
		Housewife	32	50.0	50.0
		Student	7	57.1	42.9
		Business	0	-	-
	42-53	Job	4	50.0	50.0
		Housewife	19	36.8	63.2
		Student	0	-	-
		Business	1	100.0	0.0
	54-65	Job	3	0.0	100.0
		Housewife	6	16.7	83.3
		Student	0	-	-
		Business	1	100.0	0.0

Coherence and stress index scores, stratified by age and gender, are shown in Table 4. Coherence levels were generally low across all age groups in both genders, and stress index scores increased with age.

Table 4: Coherence and stress index of participants according to age group

Gender	Age Group (years)	Coherence (%)	Stress Index (%)
		Basic	Good
Male	18-29	70.1	25.4
	30-41	69.8	30.2
	42-53	88.9	7.4
	54-65	79.2	20.8
Female	18-29	72.9	24.3
	30-41	63.8	32.8
	42-53	87.5	12.5
	54-65	80.0	20.0

Descriptive statistics of HRV variables are presented in Table 5. Male participants generally had higher scores in most HRV variables compared to female participants.

Table 5: Median and Interquartile range of HRV variables

Gender	SDNN (ms)	RMSSD (ms)	Mean-RR (ms)	SD1 (ms)	SD2 (ms)	VLF (ms^2)	LF (ms^2)	HF (ms^2)	Mean-HR (bpm)	PNS (score)	SNS (score)
Male	78.70 (43.8, 148.0)	99.2 (52.8, 202.3)	743.0 (654.5, 796.5)	48.2 (43.9, 51.5)	52.1 (48.4, 56.0)	0.037 (0.03, 0.04)	0.97 (0.06, 0.12)	0.25 (0.17, 0.34)	80.0 (75.0, 91.0)	1.28 (-0.2, 4.1)	0.41 (-0.4, 1.7)
Female	60.0 (35.1, 132.2)	72.8 (39.8, 170.6)	677.5 (596.0, 741.2)	48.1 (43.0, 51.2)	51.7 (48.6, 56.6)	0.037 (0.03, 0.04)	0.08 (0.06, 0.11)	0.26 (0.18, 0.32)	88.0 (80.0, 100.0)	0.13 (-1.0, 2.8)	1.19 (0.31, 2.4)

In summary, the results demonstrated significant variations in HRV measures across different age groups, genders, and occupations. Sympathetic activity increased with age, particularly among job and business groups, while younger participants and students exhibited higher parasympathetic activity. Coherence levels were low across all age groups, and stress indices increased with age. These findings highlight the impact of occupational stress on HRV and the importance of interventions to manage stress and improve cardiovascular health.

DISCUSSION

The analysis of heart rate variability (HRV) in this study provided significant insights into the impact of occupational stress on autonomic nervous system functioning and overall well-being. The findings indicated a marked increase in sympathetic activity with

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advancing age, particularly among participants engaged in jobs and business activities. This aligns with previous research showing that occupational stress can significantly affect HRV, with high-stress jobs often associated with reduced parasympathetic activity and increased sympathetic dominance (14,15).

The study highlighted that younger participants exhibited higher parasympathetic activity, which diminished with age. This age-related decline in HRV is consistent with existing literature that documents a reduction in HRV as individuals age, reflecting decreased autonomic flexibility (16,17). Moreover, the gender differences observed, with males showing greater parasympathetic predominance compared to females, corroborate findings from previous studies that have reported similar gender-specific variations in HRV (18).

One of the study's strengths was its diverse participant pool, which included individuals from various occupational backgrounds and age groups (19). This diversity allowed for a comprehensive analysis of how different occupations impact HRV across different demographic segments. The use of advanced HRV analysis tools such as emWave Pro Plus and Kubios HRV software enhanced the accuracy and reliability of the findings. Furthermore, the study adhered to ethical standards outlined in the Declaration of Helsinki, ensuring the ethical integrity of the research process (20).

However, there were several limitations to the study. The cross-sectional design precluded the ability to establish causality between occupational stress and HRV changes. Longitudinal studies would be necessary to determine the causal relationships and the long-term effects of occupational stress on HRV. Additionally, the reliance on self-reported data for occupation and stress levels might have introduced bias, as participants may have underreported or overreported their stress levels (21,22).

Despite these limitations, the study provides valuable recommendations for managing occupational stress to improve HRV and overall cardiovascular health. Interventions such as stress management programs, regular physical activity, and mindfulness practices have been shown to positively influence HRV by enhancing parasympathetic activity and reducing sympathetic dominance (23). Employers and healthcare providers should consider implementing these interventions to support employees' well-being and mitigate the adverse effects of occupational stress.

The coherence and stress index scores observed in this study further emphasized the need for effective stress management strategies. Coherence levels were generally low across all age groups, indicating poor autonomic regulation and increased stress. This finding is in line with previous research that has associated low coherence with higher stress levels and poorer health outcomes (17). The stress index scores, which increased with age, highlighted the cumulative impact of chronic stress over time, underscoring the importance of early intervention and continuous stress management.

CONCLUSION

In conclusion, this study underscores the critical role of occupational stress in influencing HRV and overall health. The observed variations in HRV across different ages, genders, and occupations highlight the need for targeted interventions to manage stress and improve autonomic function. Future research should focus on longitudinal studies to explore the causal relationships between occupational stress and HRV and to evaluate the long-term effectiveness of various stress management interventions. By addressing occupational stress, it is possible to enhance cardiovascular health, improve quality of life, and promote a more balanced and healthy lifestyle for individuals across different occupational sectors.

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