REVIEW ARTICLE OPEN ACCESS

Psycho-Neuro-Autonomic Aspect Of Burnout Syndrome: A Literature Review

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ABSTRACT

Background: Burnout syndrome are symptoms resulting from stress due to burden and stressors of high workload, as seen in health workers. Burnout syndrome can trigger psychological and physiological disorders, mainly related to the autonomic nervous system and the Hypothalamus-Hypophysis Axis pathway. Psychological disorders could be assessed using Maslach Burnout Inventory (MBI), while physiological disorders of the neuro-autonomic imbalance could be assessed using Heart Rate Variability (HRV). **Aim**: To study about the psycho-neurological aspect of burnout syndrome. **Methods**: A systematic literature review using the PRISMA method, through four stages, namely identification, screening, feasibility, and accepted results. **Results:** Literature search was performed using PubMed and Google Scholar databases. Seven articles fulfilled the inclusion criteria. Five out of seven articles showed association between HRV and burnout score, while two articles showed no association between HRV and burnout score. **Discussion:** In the presence of stress, the autonomic nervous system activates the amygdala and hypothalamus, which subsequently triggers response from the adrenal gland to produce noradrenaline, which in turn affects the autonomic nervous system. A low HRV signifies inflexibility of the sympathetic and parasympathetic nervous system. Contradicting results may be caused by difference in sample and HRV confounding factors such as difference of physical activity, exercise, underlying disease, medication. **Conclusion:** There is an association between burnout score and HRV, which implies the presence of neuro-autonomic dysfunction in burnout patients. Further research is needed to rule out confounding factors.

Keywords : Burnout syndrome, Maslach Burnout Inventory, Heart Rate Variability, neuro-autonomic, psychological

INTRODUCTION

Burnout was first used by a psychoanalysis named Freudenberger in the year 1970, which was then known globally as one of the overarching problems in working health. Burnout is defined as response to emotional and interpersonal stress encountered in the workplace, which can trigger an array of signs and symptoms and subsequently could be referred to as Burnout Syndrome (BOS). (1) Burnout syndrome is an array of symptoms caused by physical and or psychological stress due to pressure and stressor from high workload. Burnout syndrome can be described in three dimensions: emotional exhaustion (EE), depersonalization (DP), and personal accomplishment (PA). (2)

Burnout syndrome is commonly encountered in groups with high workloads, such as healthcare workers. (3) Before the pandemic, a systematic review and metanalysis by Woo *et al* (4) showed a prevalence of burnout syndrome as high as 11.23% in nurses globally. While in doctors, there was an increase from 40% to 51% from the year 2013 to 2017. (4) The Coronavirus disease 2019 (COVID-19) pandemic increases stress in professional healthcare workers globally. (5) A post-pandemic study by Ahmed Al-Haddad et al (6) found that 24.3% healthcare workers in Al Ahsa, Saudi Arabia showed a high score of Burnout syndrome. The same study also showed a high score in the age group of 35 – 45 years, working period of more 5 years, predominantly women, taking overtime and lower salary. According to Critical Care Societies Collaborative (CCSC), severe burnout syndrome was found in 45% of healthcare workers in the intensive care unit. In Indonesia, a study by Aly Lamuri and Hamzah Shatri et al found that 37.5% of healthcare workers experienced Burnout syndrome, wherein 48.2% experienced emotional exhaustion and 51.8% experienced personalization. (8)

Burnout syndrome can take the form of psychological or physiological disorder. This syndrome is mainly linked to 2 stress-responding systems: the autonomic nervous system and the *Hypothalamus-Hypophysis Axis* (HHA) pathway. (9). Both systems will then influence the body in various aspects, including psychological, neuro-autonomic, immunological, and or endocrinal (PNIE) aspects. (10)

Psychological disorder in Burnout syndrome can be measured using the *Maslach Burnout Inventory* (MBI), which is designed to assess the 3 dimensions of burnout. MBI is widely considered a gold standard in assessing *Burnout syndrome*. (10) Several versions of the MBI can be used to measure Burnout syndrome in an occupation. The MBI used for healthcare worker is the MBI Human Services Survey.

Other PNIE, such as neuro-autonomic aspects are also influenced by Burnout syndrome, mostly through the direct activation of the autonomic nervous system and or the HHA pathway. Autonomic nervous system can usher in physiological changes through synapse transmission of the sympathetic and parasympathetic nervous system. Stress can trigger sympathetic nervous response, and inhibit parasympathetic nervous system, which in turn trigger noradrenaline release. This hormone causes neuro-autonomic changes by increasing pulse, which can be assessed using Heart Rate Variability (HRV). HRV is a physiological variation of heart rate intervals. HRV represents a complex interaction between sympathetic and parasympathetic influence on the sinus node automatization in the central and peripheral nervous system. HRV is used to assess autonomic nervous activity and is a non-invasive marker of cardiovascular dysautonomia. A high HRV implies good adaptive response to stressor, while reduced HRV implies otherwise. (11) Further research is needed to study about the psycho-neuro-autonomic aspects of patients with Burnout syndrome and its effects to those two aspects.

MATERIAL AND METHODS

This study is a systematic literature review using PRISMA (Preffered Reporting Items for Systematic Reviews and Meta Analyses) method through 4 steps: identification, screening, eligibility and inclusion. Literature search was done in online databases such as Pubmed, Cochrane Library and Google Scholar using keywords: burnout syndrome, autonomic nervous system, psychological, neurological, and heart rate variability. Journals and articles studying the psycho-neuroautonomic aspect of Burnout syndrome published from January 2018 – December 2023 were included in this search. Doubles and incomplete texts were excluded. Study results were then verified based on adequate sample sizes, bias anticipation, comparison groups as well as suitability of statistical tests from the literature list.

RESULTS

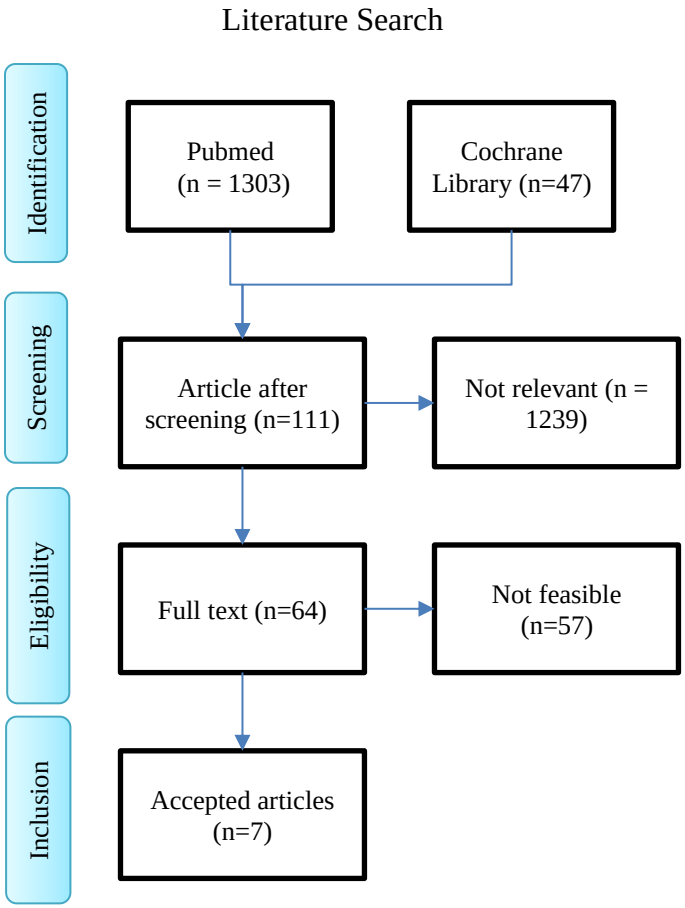

Image 1. PRISMA Method

A total of 1350 journals and articles were obtained from the systematic literature review. Doubles, as well as incomplete texts were removed. Study results, such as sample sizes, bias anticipation, comparison groups, study designs and statistical tests, were then verified from the list of studies. Seven literatures were obtained with complete text and in accordance with the established criteria.

DISCUSSION

In 2018, Min Zhang et al conducted a study on patients with the first attack of acute coronary syndrome and found significantly different results between burnout scores and HRV, both SDNN ($p<0.20$), HF ($p = 0.043$), LF ($p = 0.024$), VLF ($p < 0.001$), ULF ($p < 0.001$) and TP ($p < 0.001$). HRV values represented autonomic nervous system activity, in which lower HRV implies inflexibility of the sympathetic and parasympathetic nervous system. The presence of stressor in patients with Burnout syndrome triggers the amygdala to signal the hypothalamus, which subsequently triggers a response from the coeruleus nucleus to activate the adrenal gland to produce noradrenaline, which in turn triggers the parasympathetic activity. (12)

A similar study was conducted by Yunke Shi et al in 2021. The study revealed that burnout score was inversely proportionate to HRV (including SDNN, TP, HF, LF, ULF, dan VLF), with all p-values < 0.05. (13) This result was in line with another study by Magdalena K et al performed in 2020. Magdalena K et al found a significant linear regression analysis in which HRV was inversely

proportionate with 12-months predicted burnout symptoms (p=0.03). However, only emotional exhaustion was associated with the 12-months predicted HRV decrease. (14).

Another study by Magdalena K et al in 2018 showed a significant effect of emotional exhaustion to changes in RMSSD, during a vein punction, recovery and at rest, using multiple regression (p=0.001). However, this study did not find the effect from MBI total score, depersonalization, and personal achievement to RMSSD. Similar results were observed in a study by Lauren K et al in 2022, in which the study found significant association between HRV with emotional exhaustion (p=0,01), however no significant association was found with depersonalization (p=0,28) and personal achievement (p = 0.24).(15)

A study by Magdalena et al in 2022 found that high values of RMSSD and HF could be utilized to predict milder emotional exhaustion symptoms. However, this study also found contradicting results, in which emotional exhaustion could not predict changes in RMSSD and HF. (16)

Insignificant results were also found in a study by Ei-Wen et al in 2020, in which there were no significant association between burnout scores and HRV ($p<0.05$) (17) This result contradicts previous studies by Min Zhang et al and Yunke Shi et al. This may be explained by confounding factors during the HRV assessment, including difference in physical activity, exercise, underlying disease, medication, as well as a significant difference in sample sizes.(12,13)

CONCLUSIONS

Burnout syndrome is an array of symptoms caused by physical and psychological stress due to burden and stressor from high workload, which can trigger psychological and physiological distress. Psychological aspect of burnout syndrome can be assessed using MBI-HSS, while its neuroautonomic aspect can be assessed using HRV. Burnout scores are associated with HRV values which implies the presence of neuroautonomic dysfunction in burnout syndrome patients. Further research is needed to discard confounding factors by performing a complete history taking, physical examinations and psychological examinations. In addition, it is necessary to adjust the number of samples and data collection periods that can represent the general population.

ARTICLE REVIEW

Burnout Syndrome is an array of symptoms caused by both physical and mental stress due to high workload and stressors. Here are some study results which were used as references in this study,

Table 1. Chosen Research Articles

No	Researchers (Tahun)	Title	Study place, Methods, Sample Size and Instruments	Results	Limitations
1	Min Zhang *et al* (2018) (1)	Longitudinal associations of burnout with heart rate variability in patients following acute coronary syndrome: A one-year follow-up study	Place: Yunnan, China Method: cohort Sample size: 208 samples Instrument: Copenhagen Burnout Inventory (CBI) questionnaire, Hospital Anxiety and Depression Scale, ECG, and BMS Century 3000 HRV analysis software package	There was significant association between burnout and reduced HRV in post first Acute Coronary Syndrome patients.	Follow-up was only done in 1 year. Samples were mostly patients with mild clinical symptoms.
2	Yunke Shi *et al* (2021) (2)	High Job Burnout Predicts Low Heart Rate Variability in the Working Population after a First Episode of Acute Coronary Syndrome	Place: China Method: cross sectional Sample size: 120 sampel Instrument: Copenhagen Burnout Inventory (Chinese Version), ECG Holter	There was significant association between burnout score and HRV SDNN, TP, HF, LF, ULF, and VLF, with inversely proportional value.	Small sample size. The use of questionnaires leaned towards subjectivity. Confounding factors were recognized in HRV measurement, such as: exercise, physical activity, respiration and medication.
3	Magdalena K *et al* (2019) (15)	The Longitudinal Association of Reduced Vagal Tone with Burnout	Place: Dresden, Germany Method: Cross sectional Sample size: 167 samples Instrument: MBI-GS German Version, a wireless chest transmitter and a wrist monitor recorder (Polar RS800CX)	There was significant association between burnout and decreased HRV. HRV can be used to predict more severe symptoms of burnout syndrome.	Plenty of confounding factors. Research time was too short to draw conclusions about the impact of burnout on HRV.
4	Magdalena *et al* (2022) (16)	Determining the direction of prediction of the association between parasympathetic dysregulation and	Place: Dresden, Germany Method: cross sectional Sample size: 378 samples Instrument: MBI-GS, Wireless Chest	Dimension of emotional exhaustion was associated with vmHRV. However, cynicism and personal	Burnout and psychological disorders were not diagnosed medically. Plenty of confounding factors for HRV, such as difference in physical

		exhaustion symptoms	Transmitter and a wrist monitor recorder	accomplishment dimensions could not be predicted with vmHRV.	activity, exercise and medications.
5	Lauren K *et al* (2022) (17)	Impact of autonomic regulation on burnout and performance in thoracic surgery residents	Place: Missouri, Amerika Method: cohort Sample size: 7 samples Instrument: A wearable biometric device, MBI-HSS, and Accreditation Council for Graduate Medical Education Milestones (ACGME)	There was significant association between HRV and emotional exhaustion, however not with depersonalization and personal accomplishment dimension.	The presence of confounding factors which influenced HRV value. Too small sample size. No control group.
6	Ei-Wen *et al* (2020) (18)	Association between occupational burnout and heart rate variability: A pilot study in a high-tech company in Taiwan	Place: Taiwan Method: cross sectional Sample size: 6000 samples Instrument: Copenhagen Burnout Inventory (Chinese Version), a wrist monitor	There was no significant association between C-CBI score and HRV, however HRV and work overcommitment were associated, hence the recommendation of HRV as an evaluation tool for burnout.	Cross-sectional studies merely assessed a limited period. The use of questionnaires leaned towards a more subjective perspective. Confounding factors such as noise and environment were not recorded.
7	Magdalena K *et al* (2018) (14)	Autonomic dysregulation in burnout and depression: evidence for the central role of exhaustion	Place: Dresden Method: cross sectional Sample size: 410 samples Instrument: MBI-GS German Version, Polar RS800 CX system with corresponding chest belt	There was no significant association between MBI total score with HRV triggered by vagal activity, however emotional exhaustion dimension was associated with vagal function depression.	Cross-sectional studies merely assessed a limited period. Confounding factors, such as psychological distress, chronic diseases, and medications, were not recorded.

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