Online ISSN 2623-2723
Print ISSN: 2338-0373
Jurnal Widya Medika Vol. 10 No 1 April 2024
https://doi.org/10.33508/jwm.v10i1.5439

ASSOCIATION BETWEEN HEART RATE VARIABILITY AND BLOOD PRESSURE IN ELDERLY WORKER

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ABSTRACT

Life expectancy increases along with improving health. This has an impact that there are still many workers in old age who are still needed. The effect of age and work environment will affect the normal range of time domain heart rate (HRV) variability in the elderly. Heart Rate Variability Test might detection autonomyc nervous system which influenced by blood pressure level, stress and working environment. A low HRV value is considered an independent marker of risk of death. However, age-related decline in HRV may limit its predictive value, especially in older workers. It was found that the decrease in HRV decreased with age and length of service.

Keywords: *Heart Rate Variability; Hypertension; Elderly Worker*

ABSTRAK

Usia harapan hidup meningkat seiring dengan peningkatan kesehatan. Hal ini berdampak masih banyaknya tenaga kerja di usia lanjut yang masih dibutuhkan. Pengaruh usia dan lingkungan kerja akan mempengaruhi variiasi dari nilai denyut jantung pada lansia. Uji Variabilitas Denyut Jantung / Heart Rate Variability Test (HRV) dapat mendeteksi sistem saraf otonom yang dipengaruhi oleh tekanan darah, stress dan lingkungan kerja. Nilai HRV yang rendah dianggap sebagai penanda independen risiko kematian. Namun, penurunan HRV terkait usia dapat membatasi nilai prediktifnya, terutama pada pekerja yang lebih tua. Ditemukan bahwa penurunan HRV menurun dengan usia dan lama pelayanan.

Kata kunci: Variabilitas Denyut Jantung; Hipertensi; Pekerja Lansia

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INTRODUCTION

Blood pressure (BP) is regulated by the autonomic nervous system, but it is not yet fully understood how autonomic activity affects blood pressure at work. The autonomic nervous system plays an

important role in the regulation of blood pressure (BP).1 Autonomic dysfunction can cause hypertension associated with decreased sensitivity of the baroreceptor reflex .2 Hypertension monitoring is recommended in some workers to prevent cardiovascular events. Given the pathological mechanisms that can increase blood pressure. Sympathovagal imbalance has an important effect on blood pressure at work.4

The heart is controlled by the autonomic nervous system (ANS) which has 2 branches of the ANS called the sympathetic and parasympathetic branches. The sympathetic branch of the ANS is active when there is stress in the work environment, thus alerting all systems. In contrast, the parasympathetic branch is the part that is more relaxed when the work environment is relaxed. When the sympathetic branch is more active, your heart rate usually increases, and your heart rate is in a more regular rhythm - meaning HRV is reduced.5

On the other hand, when the parasympathetic branch is more active, the heart rate will decrease and you quickly meet the body's needs (HRV increases). Because of these characteristics, HRV is an indicator of the balance between the activity of the 2 branches of the autonomic nervous system, and is therefore an indirect measure of stress. Higher HRV means lower stress. Indeed lower HRV means higher stress and tend to got hypertension.6

Heart rate variability (HRV) is regulated primarily by cardiac vagal tone, and lower HRV is associated with an increased risk of diabetes, hypertension, and cardiovascular disease (CVD) in epidemiological studies.7-10 Decreased HRV is associated with insulin resistance,11 metabolic syndrome,12 and increased concentrations of C-reactive protein.13 Impaired parasympathetic function is associated with diastolic blood pressure but not systolic blood pressure on medical examination.14 This is explained to some extent by baroreflex sensitivity, which is inversely related to mean arterial pressure (MAP) and diastolic blood pressure than systolic blood pressure

Autonomic dysfunction based on the standard HRV index obtained during a medical examination can be associated with an increase in MAP at work. HRV assessment can also help manage blood pressure in the workplace15

Autonomic function assessment

HRV was measured with a fingertip pulse wave sensor (TAS9; YKC, Co., Ltd., Tokyo, Japan®). In evaluation of electrocardiography, RR interval power spectrum analysis was performed every 5

minutes for 24 hours.The pulse was recorded for 5 minutes and determine standard deviation of the normal-to-normal RR interval (SDNN) and mean square root of the successive differences in the RR interval (RMSSD). Power spectral analysis of pulse recordings was also used to obtain a measure of the HRV frequency domain.16

National Instruments (2009) developed two methods of Heart Rate analysis Variability (HRV), namely time-based analysis (time domain analysis) and -based analysis frequency (frequency domain analysis). Time domain analysis is a Heart Rate analysis Time-based variability (HRV). While the frequency domain analysis is an analysis of frequency-based Heart Rate Variability (HRV). Generally, the frequency domain analysis is divided into several frequency ranges, namely High Frequency (HF), Low Frequency (LF), and Very Low Frequency (VLF). High Frequency (HF) is evaluated at ranges from 0.15 to 0.4 Hz and reflects the nature and changes of the parasympathetic leads to respiratory function. Low Frequency (LF) is evaluated in the range of 0.04 to 0.15 Hz and reflects sympathetic and partially parasympathetic properties. Very Low Frequency (VLF) is evaluated in the range 0 to 0.04 Hz and reflects some of the properties sympathetic.17

The power spectrum is decomposed into its frequency components and quantified in terms of the relative intensity (power) of each component. The power spectrum is divided into frequency bands. Define the high frequency band (HF) as 0.15–0.40 Hz and the low frequency band (LF) as 0.04–0.15 Hz. HF and LF power and LF/HF ratio were used for further analysis. For each 5-minute interval, LF, HF, and their ratio (LF/HF) are calculated in the same frequency band. 18

Relationship HRV with high blood pressure

Heart rate variability (HRV) is associated with blood pressure levels; however, very few studies have correlated HRV to lifestyle in the general population. Individuals with hypertension have decreased heart rate variability at baseline. On the other hand, low heart rate variability also predicts a greater risk of hypertension. Increase heart rate can increase without any change occurring in your blood pressure. As your heart beats faster, healthy blood vessels will expand in size to allow increased blood flow, which helps your blood pressure remain relatively stable. 19

Essential hypertension itself is caused not only by decreased parasympathetic nerve tone but also by severe sympathetic nervous overdrive, which results in an increase in resting heart rate. Heart rate variability (HRV) is

influenced by autonomic nervous control of heart function. HRV reflects the response of the autonomic nervous system to external stimuli. HRV assessment using a 24-hour Holter is a simple and reliable way to assess autonomic imbalance in hypertensive patients. Analysis of HRV data obtained from Holter 24 hours with seven time domain variables: SDNN, SDANN, ASDNN, rMSSD, pNN50, BB50; and four frequency domain variables: VLF, LF, HF, LF/HF.20,21

The decrease in HRV value was significantly associated with an increase in BP. Impaired autonomic nervous function in hypertensive patients is strongly associated with uncontrolled BP. Hypertensive patients had significantly lower SDNN (reflecting vagal function) as well as meanNN, ASDNN, rMSSD (reflecting vagal function), pNN50 (reflecting vagal function), and BB50, VLF (reflecting vagal function), HF (reflecting vagal function), LF/HF ratio (reflecting sympathovagal balance) compared with non-hypertensive patients. SDNN, SDANN, ASDNN, VLF, LF (reflecting sympathovagal balance), and HF were significantly lower in the hypertension group with uncontrolled BP. Hypertensive patients have greater disturbances in cardiac autonomic nervous activity than non-hypertensive patients. More severe disturbances were seen in the hypertensive group with uncontrolled blood pressure.22

HRV exhibits heart rate oscillations reflecting the sympathetic and vagal functions that regulate the heart rate response to any stimulus. In addition to external stimuli, HRV is also affected by internal stimuli, including circadian rhythm, core body temperature, metabolism, sleep cycle, and the renin-angiotensin system. The 24-hour HRV recording itself is the "gold standard" of HRV assessment because it provides greater predictive power than short-term measurements. HRV deviation from the normal range is associated with various cardiovascular diseases.23

HRV monitoring, which reflects cardiac sympathetic and vagal function, can be useful for evaluating the autonomic nervous function status of hypertensive patients and optimizing therapeutic efficacy to improve balance of autonomic nervous function. There has also been a casual association between decreased autonomic nervous function and new-onset hypertension or cardiovascular disease, particularly in Asian populations. HRV may also predict future risk of hypertension at an early stage as well as prognosis during hypertension treatment.24

Evaluation of HRV in Elderly Worker

The American Conference of Governmental and Industrial Hygienists states that the Threshold Value (TLV) of high stress levels may be experienced by all workers repeatedly with adverse health effects. Evaluation of heart rate variability (HRV) in moderate to strenuous work carried out continuously or according to different TLV work rest (WR) allocations in healthy and physically active elderly workers.25

By including rest during moderate to heavy work in elderly workers can reduce autonomic stress and prolong the time the work is done. The comparison of TLV: WR = 1:1 will provide increased cardiac protection for older workers, compared to TLV and WR 3:1.26

The working room temperature also affects the HRV value. Physically demanding work in a hot environment, especially in elderly workers (50–65 years), will have an effect on heart rate variability (HRV) and increased cardiac autonomic modulation. While HRV can also reflect the physiological aspects of cardiac autonomic stressors. Stress and hot work environment can worsen in older workers during consecutive work shifts and will affect HRV and blood pressure of workers.27

Heart rate variability (HRV) was used to measure neural cardiac control, and its variability and predict mortality in patients after myocardial infarction. Reduction of the time domain measure and 24-hour frequency of HRV identified increased cardiovascular morbidity.28 Otherwise no convincing evidence was provided for routine clinical use, possibly due to methodological and technical limitations.29 It is recommended that short-term laboratory recordings using controlled breathing avoid artifacts in the low frequency range (LF) from physical activity and irregular slow breathing.30

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