



An Analysis of Occupational Health Based on Biometric Indicators and Its Impact on Nursing Service Performance Among Nurses at Teuku Umar Regional General Hospital in Aceh Jaya

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Abstract. Nurses' performance is one of the primary indicators of hospital service quality and is influenced by various physiological and psychological factors. Biometric indicators, including blood pressure, heart rate, and oxygen saturation, reflect nurses' physical health conditions that may affect work stress and service performance. This study aimed to analyze the relationship between biometric indicators and nurses' service performance through work stress as an intervening variable at Teuku Umar Aceh Jaya Regional General Hospital. This study employed a quantitative research design with a cross-sectional approach. The study population consisted of all nurses at Teuku Umar Regional General Hospital, Aceh Jaya, with a total sample of 137 respondents selected using a purposive sampling technique. Results: showed that most respondents were female (77.4%), worked morning shifts (44.5%), experienced normal levels of work stress (88.3%), and demonstrated good service performance (98.5%). The mean systolic blood pressure was 114.77 ± 9.24 mmHg, diastolic blood pressure was 77.29 ± 7.43 mmHg, heart rate was 81.91 ± 11.53 beats per minute, and the mean oxygen saturation was 97.45%, with a range of 95–100%. The findings indicated that biometric indicators were associated with work stress, which subsequently influenced nurses' service performance. Nurses' biometric conditions contribute to work stress, which subsequently affects service performance. Therefore, regular monitoring of nurses' physical health is recommended to improve the quality of nursing services in hospitals.

Keywords: Biometric Indicators; DASS-21; Nurses; Service Performance; Work Stress.

1. BACKGROUND

Nurse performance is the main determinant of the quality of health services because nurses deal directly and most intensively with patients throughout the treatment cycle, so that fluctuations in their performance have a direct impact on the health status of the people served (Akbar, 2018). However, the achievement of this optimal performance faces challenges in the form of the high prevalence of work stress among Indonesian nurses, which according to data from the Indonesian National Nurses Association reaches 50.9 percent at various levels (Mindayani et al., 2023). Work stress basically arises due to a mismatch between the demands of the job and the capacity of individual resources, where excessive workload is often the main trigger, especially in units with tight time demands and high responsibility for patient safety (Alam, Suarni, & Sunarjo, 2021), and if it occurs without adequate management, it can reduce motivation and dedication to services (Yustikasari & Santoso, 2024).

This phenomenon is vivid at Teuku Umar Aceh Jaya Hospital, a referral hospital with 204 nurses to serve 104 beds. Although this quantitative ratio appears to be sufficient, the high fluctuations of inpatients and the complexity of medical procedures cause the real workload to

remain high, in line with the findings that nurses' work burnout is closely related to physical health status and daily workload (Meilisa, Firdani, & Rahman, 2023), and in crisis situations nurses stress can even increase drastically due to health threats and accumulated mental burdens (Widyaningrum, Febriani, & Yanti, 2022). Initial observations and brief interviews with the implementing nurses also confirmed this condition, with nearly 80 percent of nurses reporting stress symptoms such as difficulty concentrating while documenting care and anxiety in the face of sudden patient surgeries, which were subjectively perceived to have an impact on the speed of service response.

So far, work stress assessments rely more on subjective questionnaires that are only conducted after the impact of stress appears, so it is limited in detecting risks early. On the other hand, work stress physiologically triggers body changes that can be identified through biometric indicators such as blood pressure, heart rate, and oxygen saturation, which provide objective data with higher potential accuracy than perception-based self-assessment. The urgency of this study is also affirmed by Mazelda et al., (2022) who found that the higher the stress felt by nurses, the more the efficiency and effectiveness of services decrease, and can even manifest in medical errors that endanger patient safety (Nurcahyani, Widodo, & Rosdiana, 2016), while a stressful work environment is the main determinant that hinders human services (Satriyanto, 2022), and conversely effective stress management has been shown to increase nurse performance (Rohita & Permana, 2024).

Several previous studies have linked biometric parameters to work stress of health workers, such as Nasution, Amalia, and Daeng (2022) who found a significant relationship between stress and blood pressure in emergency room nurses, ICUs, and hospitalizations, as well as Marhamah (2025) in ICU nurses. However, research that comprehensively integrates blood pressure, heart rate, and oxygen saturation with workload variables, work stress, and service performance in one analytical framework is still very limited, especially in the context of regional hospitals such as Teuku Umar Aceh Jaya Hospital. Based on this description, this study aims to analyze the relationship between health biometric indicators and work stress levels and their impact on nursing service performance, as well as provide theoretical contributions to physiological evidence-based nursing management and practical basis for workload management policies in a more objective and measurable manner.

2. RESEARCH METHODS

The study population was 204 implementing nurses at Teuku Umar Aceh Jaya Hospital, with a sample of 137 respondents determined through purposive sampling based on the Slovin

formula. The study used a cross-sectional quantitative design in high-workload units, namely Emergency Installations, Intensive Care Units, and surgical and internal medicine inpatient rooms, with data collection from May to June 2026 covering morning, afternoon, and evening shifts after obtaining ethical approval. The inclusion criteria include nurses with a minimum of one year of service who are directly involved in patient care in critical and inpatient units. Independent variables were biometric indicators (blood pressure, heart rate, oxygen saturation) and mental workload measured using the National Aeronautics and Space Administration Task Load Index. The intervening variable in the form of work stress was measured using the Depression Anxiety Stress Scale 21, while the dependent variable in the form of nursing service performance was measured through a modified questionnaire which included the quality of care, timeliness of action, therapeutic communication, and compliance with standard operating procedures. Age, gender, working period, and work shifts were treated as control variables.

All instruments have been tested for validity using the Pearson Product Moment correlation with a value of r calculated from 0.556 to 0.845, and reliability tested using Cronbach's Alpha with a value of 0.892 for work stress, 0.856 for workload, and 0.834 for service performance so that it is categorized as reliable. Primary data was obtained through biometric measurements before and after working hours accompanied by filling out an independent questionnaire, while secondary data was obtained through hospital documentation and supporting literature. The Shapiro Wilk normality test became the basis for the selection of the bivariate test, and since the data were not normally distributed, the relationship between variables was analyzed using the Spearman correlation test at a significance level of p less than 0.05, followed by multiple linear regression to identify the most dominant variable to work stress, accompanied by a multicollinearity test. This research upholds ethical principles through informed consent, anonymity, and confidentiality of all respondent data.

3. RESULTS AND DISCUSSION

This study involved 137 nurses at Teuku Umar Aceh Jaya Hospital. Respondent characteristics include gender and work shifts, as presented in Table 1. Based on Table 1, the majority of respondents are female (77.4%) and work on the morning shift (44.5%), while the day and night shifts are filled by 27.7% of respondents respectively.

Table 1. Characteristics of Respondents.

Characteristics	Category	Frequency	percentage
Gender	Man	31	22,6
	Women	106	77,4
Work Shifts	Morning	61	44,5
	Afternoon	38	27,7
	Night	38	27,7

Table 2 presents the distribution of biometric profiles as well as the research variables. The average systolic blood pressure of the respondents was 114.77 ± 9.24 mmHg and diastolic blood pressure was 77.29 ± 7.43 mmHg, with the majority of respondents in the pre-hypertension category (60.6%). The average heart rate was 81.91 ± 11.53 times per minute, and almost all respondents (97.1%) were in the normal category. The average oxygen saturation was 97.45% with a range of 95 to 100%, with the majority of respondents (85.4%) in the normal category, although 13.1% of respondents experienced moderate to severe hypoxemia. In the work stress variable, most of the respondents (88.3%) were in the normal category, while the rest were spread across the light, medium, and severe categories. In the service performance variable, almost all respondents (98.5%) showed good category performance.

Table 2. Distribution of Research Variables.

Variable	Category	Frequency	percentage
Blood Pressure	Normal (<120/<80 mmHg)	47	34,3
	Pre-hypertension (120–139 mmHg or 80–89 mmHg)	83	60,6
	Grade 1 hypertension (140–159 mmHg or 90–99 mmHg)	7	5,1
Heart Rate	Bradycardia (<60 times/minute)	2	1,5
	Normal (60–100 times/min)	133	97,1
	Tachycardia (>100 times/minute)	2	1,5
Oxygen Saturation (SpO2)	Normal ($\geq 95\%$)	117	85,4
	Mild hypoxemia (90–94%)	2	1,5
	Moderate–severe hypoxemia (<90%)	18	13,1
Stress Levels	Normal	121	88,3
	Lightweight	5	3,6
	Medium	5	3,6
	Weight	6	4,4
	Very Heavy	0	0,0
Nurse Performance	Good	135	98,5

Variable	Category	Frequency	percentage
	Enough	1	0,7
	Less	1	0,7

Shapiro Wilk's normality test of all study variables, as presented in Table 3, shows that almost all variables are abnormally distributed. All four biometric indicators were abnormal, with the lowest W value at oxygen saturation (W 0.419, p less than 0.001), followed by heart rate (W 0.843), diastolic blood pressure (W 0.945), and systolic (W 0.916), all of which were significant at p less than 0.001. Similar patterns were found in work stress (DASS 21, W 0.840, p less than 0.001) and nurse performance (W 0.748, p less than 0.001), consistent with respondents' concentrations in the categories of normal stress and good performance as Table 2. Only NASA TLX workloads are normally distributed (W 0.984, p 0.120). Since most variables do not meet the assumption of normality, the bivariate analysis subsequently uses the Spearman correlation test instead of the Pearson.

Table 3. Shapiro-Wilk Normality Test Results.

Variable	Shapiro-Wilk Stats (W)	p-value	Interpretation
Systolic Blood Pressure	0,916	<0.001	Not normally distributed
Diastolic Blood Pressure	0,945	<0.001	Not normally distributed
Heart Rate	0,843	<0.001	Not normally distributed
Oxygen Saturation (SpO ₂)	0,419	<0.001	Not normally distributed
Stress Score (DASS-21)	0,840	<0.001	Not normally distributed
Workload Score (NASA-TLX)	0,984	0,120	Normal distribution
Nurse Performance Score	0,748	<0.001	Not normally distributed

The results of the Spearman correlation test are presented in Table 4. On work stress, a negative relationship was found with systolic blood pressure (rs minus 0.224, p 0.009), as well as a positive relationship with heart rate (rs 0.356, p less than 0.001) and workload (rs 0.449, p less than 0.001), while diastolic blood pressure and oxygen saturation were meaningless. On nurse performance, a negative relationship was found with heart rate (rs minus 0.304, p less than 0.001), workload (rs minus 0.324, p less than 0.001), and work stress (rs minus 0.672, p less than 0.001) as the strongest correlation, while systolic blood pressure, diastolic, and oxygen saturation were meaningless.

Table 4. Bivariate Analysis Results (Spearman Correlations) between Biometric Indicators, Workload, Stress Level, and Nurse Performance.

Variable	RS	p-value	Remarks
<i>Relationship with Stress Levels</i>			
Systolic blood pressure	-0,224	0,009	Significant (weak)
Diastolic blood pressure	-0,084	0,332	Insignificant
Heart Rate	0,356	<0.001	Significant (weak)
Oxygen saturation	-0,021	0,807	Insignificant
Workload (NASA-TLX)	0,449	<0.001	Significant (moderate)
<i>Relationship to Nurse Performance</i>			
Systolic blood pressure	0,046	0,590	Insignificant
Diastolic blood pressure	0,100	0,243	Insignificant
Heart Rate	-0,304	<0.001	Significant (weak)
Oxygen saturation	0,009	0,918	Insignificant
Workload (NASA-TLX)	-0,324	<0.001	Significant (weak)
Stress levels	-0,672	<0.001	Significant (strong)

The results of multiple linear regression analysis are presented in Table 5. The model was simultaneously significant (F 6.205, p less than 0.001) with the ability to explain the variation in work stress of 19.1% (R square 0.191, adjusted R square 0.161). Partially, only heart rate (B 0.157, p 0.003) and NASA TLX workload (B 0.236, p less than 0.001) had a significant effect, with workload as the most dominant predictors, while systolic, diastolic, and oxygen saturation blood pressure were meaningless. The multicollinearity test showed tolerance above 0.10 and VIF below 10, so the model was free from multicollinearity problems.

Table 5. Results of Multiple Linear Regression Analysis on Nurses' Stress Levels.

Model Summary			
R	R Square	Adjusted R Square	Std. Error of Estimate
0,437	0,191	0,161	4,94349
ANOVA Test Results			
Models	F	Sig.	
Regression	6,205	<0.001	
Multiple Linear Regression Results (Coefficients)			
Variable	B	t	Sig.
Constant	-6,176	-0,529	0,598
Systolic blood pressure	-0,062	-0,767	0,444
Diastolic blood pressure	0,006	0,060	0,953
Heart Rate	0,157	2,983	0,003

Oxygen saturation	-0,018	-0,278	0,782
Workload (NASA-TLX)	0,236	4,270	<0.001

Discussion

Respondent Characteristics and Their Relevance to Work Stress Conditions

The dominance of female respondents of 77.4% in this study is in line with the characteristics of nursing personnel in Indonesia which are historically and socially still dominated by women, considering that this profession is synonymous with communication skills, empathy, and orientation in providing care to patients. However, gender is not the only factor that determines the level of stress and quality of service, because the work stress of health workers is more influenced by the interaction between workload, work environment conditions, organizational support, and the individual's ability to adapt to work pressure (World Health Organization, 2023).

The distribution of respondents in the morning, noon, and night shifts in this study is also relevant to be observed, considering that the rotational work system that is a hospital operational requirement for twenty-four hours has physiological consequences that cannot be ignored. Circadian rhythm disruption due to shift work is associated with increased sympathetic nervous system activity, changes in heart rate, and increased levels of stress hormones, which can ultimately affect the overall health condition of healthcare workers (Harrison's Principles of Internal Medicine, 2022). Thus, the characteristics of work shifts in this study are also an important context in understanding the variation of biometric indicators and the stress level found in respondents.

Overview of Nurses' Stress Levels, Workload, and Performance

The finding that the majority of respondents were in the normal stress category (88.3%) showed that in general, nurses at Teuku Umar Aceh Jaya Hospital were still able to manage the work pressure they faced. This figure is actually quite different from the findings of Pangandaheng, Pondaag, and Gannika (2024) at Bhayangkara Level III Hospital Manado, which reported the moderate stress category as the most dominant category with a proportion of 60.4%. This difference indicates that nurses' work stress levels are highly dependent on the context of each institution, including the characteristics of the service unit, the organizational culture, and the support systems available in the workplace.

However, 8% of respondents were in the category of moderate to severe stress, indicating that there is a group of nurses with a higher vulnerability to work stress. This condition requires special attention, considering that prolonged work stress can reduce

concentration, increase work fatigue, and potentially affect the quality of service to patients if not managed proactively (World Health Organization, 2023). The low proportion of nurses with severe stress in this study can also be explained through the concept of resilient self-efficacy, which is the ability of individuals to continue to function effectively after experiencing intense stress, which according to Sari and Setiawan (2020) is greatly influenced by the simultaneous support of superiors and colleagues, with a combined contribution of 35% to the resilient self-efficacy of nurses.

In the workload variable, the results of measurements using the National Aeronautics and Space Administration Task Load Index show variations that reflect that the demands of the job received by each nurse are not always the same, depending on the service unit, the complexity of the patient, and the operational conditions of the hospital at any given time. This instrument was basically designed by Hart and Staveland (1988) to measure workload through six dimensions, namely mental needs, physical needs, time needs, performance, effort, and frustration levels, so that it is able to capture the perception of workload more thoroughly than measurements based on the number of tasks alone. The World Health Organization (2023) confirms that high workload is a major determinant that contributes to the emergence of work stress in health workers, a pattern that is also empirically confirmed in this study through the results of bivariate and multivariate tests.

Meanwhile, the finding that almost all respondents (98.5%) showed good category performance should be appreciated as a positive achievement of Teuku Umar Aceh Jaya Hospital in maintaining the quality of nursing services. The performance measured in this study includes four main dimensions, namely the quality of nursing care, timeliness of action, therapeutic communication, and compliance with procedural operational standards, which are in line with the performance dimensions of health workers in general according to Mailoa (2023), namely work quality, quantity of work, timeliness, effectiveness, and independence. However, this generally good performance should not obscure the fact that there is a strong negative relationship between work stress and performance, which means that current good conditions have the potential to be eroded if workload and stress factors are not managed sustainably in the future.

The Effect of Workload on Nurses' Stress Levels

The results showed that workload was the most dominant predictor of the level of work stress of nurses at Teuku Umar Aceh Jaya Hospital, with a B value of 0.236 and a p of less than 0.001. These findings confirm that nurses' perceptions of job demands contribute more than physiological changes alone in shaping work stress conditions.

These findings are in line with Aisyah and Handayani (2023) who found a significant positive correlation between high workload and stress events in nurses, where each increase in workload linearly increases perceived stress scores. Aminulloh and Tualeka (2024) also reported a close relationship between mental workload and fatigue and work stress in night shift nurses, while Mindayani, Aisyiah, and Safutri (2023) confirmed a meaningful relationship between workload and work stress in nurses in surgical inpatient rooms.

Interestingly, the high workload is not always directly proportional to the decrease in work motivation. Rahma (2025) in her study at Nahdlatul Ulama Hospital Jombang found that nurses can remain highly motivated even though they are at moderate stress levels, as long as there are extrinsic driving factors such as economic needs and organizational policies, as well as intrinsic factors such as satisfaction in helping patients heal. This condition is relevant to explain why the majority of nurses at Teuku Umar Aceh Jaya Hospital continue to show good performance even though some of them have experienced increased workload and stress, as long as the stress has not exceeded the optimal point that turns the motivation of the approach into the motivation of avoidance.

Theoretically, these findings are also in line with the transactional model of stress of Lazarus and Folkman, who explain that stress arises when an individual assesses environmental demands over his or her ability and resources to cope with them. In the context of nursing services, a high workload will be perceived as a stressor if the nurse feels that the available time, effort, or ability is insufficient to meet the demands of the job. This phenomenon is in line with the field conditions that have been described earlier, where the ratio of 204 nurses has to serve 104 beds with high fluctuations in patient visits, so that the real workload at Teuku Umar Aceh Jaya Hospital tends to exceed normal capacity at certain moments, especially in critical unit units such as the Emergency Installation. This condition reinforces the urgency for hospital management to evaluate the ratio and distribution of workload on a regular basis, not only based on the number of personnel quantitatively, but also based on the intensity and complexity of actual services in the field.

The Effect of Heart Rate on Nurses' Stress Levels

Heart rate showed a significant positive association with work stress levels (r_s 0.356, p less than 0.001) and remained significant on multivariate analyses (B 0.157, p 0.003), making it the only biometric predictor consistent to be associated with nurses' work stress.

These findings are consistent with the results of Nasution, Amalia, and Daeng (2022) who found a meaningful association between workload and stress with an increase in cardiovascular parameters in nurses in emergency departments, ICUs, and inpatient units, and

Marhamah (2025) who reported a significant association between work stress and blood pressure in ICU nurses. Physiologically, exposure to stress activates the sympathetic nervous system which triggers the release of catecholamine hormones in the form of adrenaline and noradrenaline, causing an increase in heart rate as part of the fight or flight response mechanism (Harrison's Principles of Internal Medicine, 2022). Braddom's Physical Medicine and Rehabilitation (2021) also emphasized that heart rate is a sensitive physiological indicator in describing the body's response to psychological and physical stress, because sympathetic activation works faster than other physiological changes so that heart rate is the earliest marker of acute stress exposure.

This finding provides promising practical implications for Teuku Umar Aceh Jaya Hospital, namely that regular heart rate monitoring during working hours has the potential to be used as a cheap and non-invasive initial screening to detect nurses who are at risk of experiencing work stress, before the condition develops into burnout that is more difficult to handle. However, the interpretation of heart rate measurement results must still consider other disruptive factors such as physical activity before the examination, caffeine consumption, sleep quality, and individual cardiovascular health conditions of the respondents.

Effect of Blood Pressure and Oxygen Saturation on Nurses' Stress Levels

In contrast to heart rate, diastolic blood pressure and oxygen saturation did not show a meaningful relationship with work stress levels, while systolic blood pressure showed a weak negative relationship in the opposite direction to the initial hypothesis of the study.

These findings show that blood pressure and oxygen saturation are influenced by many factors other than psychological stress, such as age, body mass index, physical activity, salt consumption, history of hypertension, drug use, and the individual's respiratory and cardiovascular function capacity (Harrison's Principles of Internal Medicine, 2022). Gray's Anatomy for Students (2020) explains that the human body has physiological compensation mechanisms that are able to maintain oxygen balance through increased lung ventilation and cardiac output when oxygen needs increase, so that in individuals with good lung and cardiovascular function, exposure to psychological stress generally does not lead to a meaningful decrease in oxygen saturation. This condition is in line with the understanding that the physiological response to stress is complex and strongly influenced by the adaptability of each individual, so that nurses with good coping mechanisms can maintain blood pressure in the normal range despite facing high work pressure.

These findings actually make an important scientific contribution to this study, as they show that not all biometric indicators are suitable for use as a single marker of work stress. Blood pressure and oxygen saturation are more appropriately positioned as complementary indicators in general occupational health monitoring, as they both reflect cardiovascular and respiratory function rather than psychological conditions alone, while heart rate and workload perception have proven to be much more relevant and consistent markers for detecting work stress in nurses at Teuku Umar Aceh Jaya Hospital.

The Effect of Workload and Biometric Indicators on Nurse Performance

The results showed that workload (r_s minus 0.324, p less than 0.001) and heart rate (r_s minus 0.304, p less than 0.001) were significantly negatively related to nurse performance, while systolic blood pressure, diastolic blood pressure, and oxygen saturation did not show a meaningful relationship.

The findings regarding this workload are in line with Yustikasari and Santoso (2024) who found that workload affects the performance of inpatient nurses, although a positive work environment can mitigate these negative impacts. Asmi and Haris (2020) also added that work experience has a significant relationship with the quality of health services, where health workers with high flying hours tend to be calmer and more competent in handling complex cases, so that the work experience factor is also relevant to be considered as a variable that can moderate the impact of workload on performance in subsequent research. A similar pattern was also seen in the findings that an increase in heart rate, as a physiological marker of acute stress, was in line with a decrease in performance scores, indicating that the physiological condition of nurses on duty also affected accuracy, response speed, and emotional stability in providing care. This condition is relevant to the nature of nursing work that demands high concentration and rapid clinical decision-making, so that even the slightest physiological impairment has the potential to accumulate into a measurable decline in performance.

In the context of Teuku Umar Aceh Jaya Hospital, this finding confirms that improving service performance cannot be achieved just by requiring nurses to work harder, but requires proportional workload management and periodic monitoring of physiological conditions so that nurses' physical and mental performance is maintained while providing services to patients. Priyono et al., (2024) emphasized that an effective performance appraisal system can help maintain service quality through appreciating the hard work of employees, so that investment in workload management is basically not just an effort to maintain the welfare of the workforce, but also a direct investment in the quality of service as a whole.

The Effect of Stress Levels on Nurse Performance

Work stress levels showed the strongest negative relationship among all the variables tested on nurse performance (r_s minus 0.672, p less than 0.001), which confirms that work stress is the most central determinant of the decline in the quality of nursing services.

These findings reinforce the results of a literature review by Mazelda et al., (2022) who found a significant relationship between stress levels and nurse performance, where the higher the stress felt, the less the efficiency and effectiveness of the services provided. Nurcahyani et al., (2016) also emphasized that low nurse performance due to work stress not only harms the organization, but also endangers patient safety, while Rohita and Permana (2024) prove that effective stress management is closely related to improving nurse performance. This finding is also in line with Andrian et al., (2025) who in their systematic literature review stated that the strategy to improve the quality of health services is highly dependent on the performance of officers on the front line, and Saguni, Widyawati, and Djabbari (2023) who emphasized that employee performance is the main pillar in the operationalization of health facilities, where low performance is often the root cause of various service problems in the field.

The strong correlation between work stress and performance in this study shows that work stress acts as an intervening variable that directly bridges the influence of workload and biometric conditions on service performance. In other words, workload and heart rate affect performance not directly, but through increased work stress which ultimately reduces the concentration, precision, and emotional stability of nurses in providing nursing care. This pattern of mediation has important managerial implications, as it shows that interventions that target stress management, such as psychological counseling programs, stress management training, and bibliotherapy approaches that utilize literature to help health workers self-reflect and find new coping strategies (Chairani, 2016), have the potential to break the chain of negative impacts of workload on service performance. Although the source of the workload itself has not been fully reduced in a short time.

Dominant Factors Affecting Nurses' Stress Levels

Overall, the results of the multivariate analysis showed that workload was the most dominant factor affecting the stress level of nurses at Teuku Umar Aceh Jaya Hospital, followed by heart rate as the only biometric indicator that contributed significantly. This study makes an important scientific contribution that biometric indicators cannot stand alone as a marker of nurses' work stress, as only heart rate has been shown to be relevant, while blood pressure and oxygen saturation are more influenced by other physiological factors outside of psychological stress. This finding is also in line with the view of Janis (2024) that the

performance of health workers is not only determined by medical technical aspects alone, but also by soft skills, professionalism, and the psychophysiological condition of workers, so that the approach to health human resource development needs to consider the occupational health dimension more comprehensively.

These findings show that efforts to reduce nurse work stress at Teuku Umar Aceh Jaya Hospital need to be focused on systemic workload management, such as task redistribution, adjustment of nurse-patient ratios, and more proportional shift schedules, with heart rate monitoring as a cheap, fast, and non-invasive complementary screening instrument to detect stress risks early before they have an impact on declining service performance.

This research has several limitations that need to be considered. First, the cross sectional design used only describes the relationship between variables at a single point in time, so the causal relationship between biometric indicators, workload, stress, and performance cannot be definitively ascertained. Second, measuring performance and work stress using self-questionnaires has the potential to produce social desire bias, where respondents tend to rate themselves better than actual conditions. Third, this study was only conducted in one regional hospital, so generalization of results in nurses in hospitals with different organizational characteristics and resources needed to be done carefully. Further research is recommended using longitudinal designs as well as involving multiple hospitals to reinforce generalizations and causal interpretations of these findings.

4. CONCLUSIONS AND SUGGESTIONS

This study shows that biometric indicators have a varied relationship with the level of work stress of nurses at Teuku Umar Aceh Jaya Hospital. Heart rate was shown to be consistently positively correlated in both bivariate and multivariate analyses, while diastolic blood pressure and oxygen saturation showed no meaningful relationship, and systolic blood pressure was negatively correlated in the opposite direction to the initial assumptions of the study. Workload measured through NASA TLX proved to be the most dominant predictor of work stress, outperforming all biometric indicators studied, while in terms of service performance, work stress showed the strongest negative relationship among all variables, thus confirming its position as an intervening variable that bridges the influence of workload and physiological conditions on the quality of nursing services. Thus, the purpose of the study has been answered, noting that not all biometric indicators have been proven to be statistically relevant so generalization of the effect of biometric conditions on work stress needs to be done carefully and cannot be applied uniformly to every parameter.

Teuku Umar Aceh Jaya Hospital is advised to prioritize systemic workload management through evaluation of nurse-patient ratios, task redistribution, and more proportional shift schedules, especially in units with high service pressure such as Emergency Installations, with heart rate monitoring as an additional screening instrument that is cheap and non-invasive for early detection of stress risks. Meanwhile, blood pressure and oxygen saturation measurements are still carried out as part of general health monitoring, although they are not reliable as a single indicator of stress. For nurses, strengthening adaptive coping strategies and utilizing institutional psychological counseling services is a relevant step to maintain stable work performance. This study has limitations in the form of a cross sectional design that cannot be confirmed the direction of causality, independent measurement that has the potential to bias social desires, and coverage of only one regional hospital so generalizations need to be done carefully, so further research is recommended to use a longitudinal design, involving more than one hospital, and consider additional variables such as sleep quality, social support, and burnout.

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