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PATH ANALYSIS MODEL OF FACTORS AFFECTING WORK PRODUCTIVITY THROUGH WORK STRESS AMONG EMPLOYEES OF PT. APEXINDO BALIKPAPAN

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ABSTRACT

Nutritional status, workload, and sleep quality are key factors influencing job stress and employee productivity, especially in the physically and mentally demanding oil and gas industry. This study aimed to analyze how these three factors affect job stress and productivity, both directly and indirectly through stress as a mediating variable, at PT. Apexindo Balikpapan. Using a quantitative cross-sectional design, 100 respondents were selected via total sampling. Data collection involved questionnaires and physiological stress assessments using a Cocorometer (salivary alpha-amylase enzyme analysis). The variables included nutritional status, workload, sleep quality, subjective and objective stress, and productivity. Data were analyzed using Partial Least Square–Structural Equation Modeling (PLS–SEM). Results showed that nutritional status significantly affected stress ($p = 0.006$) and productivity ($p= 0.006$), both directly and indirectly ($p=0.049$). Workload had a significant positive effect on stress and a negative effect on productivity directly ($p=0.012$) and indirectly ($p= 0.008$; $p=0.014$). Sleep quality influenced subjective stress ($p<0.05$) and indirectly affected productivity ($p=0.006$), but had no significant effect on objective stress ($p=0.426$). It was concluded that the nutritional status, workload, and sleep quality significantly impact job stress and productivity, with stress

acting as a key mediating factor.

KEYWORDS Nutritional Status; Workload; Sleep Quality; Productivity; Job Stress

1. INTRODUCTION

In the professional world, productivity serves as a key indicator of both individual and organizational success. Productivity encompasses efficiency, effectiveness, and the quality of output produced within a given period. Employees with high productivity levels contribute significantly to the optimal achievement of company goals (Hsb & Fitriyanti, 2020). One of the critical factors influencing a company's success is employee work productivity (Darmasari, 2022). Productivity can be achieved when the workload is aligned with employees' educational background, experience, and working hours (Padriansyah, 2020). Supervision and motivation from supervisors have also been proven to positively impact employee productivity (Pasulu, 2023). However, data from the International Labour Organization indicate that labor productivity in Indonesia remains relatively low compared to other ASEAN countries. In 2020, Indonesia's productivity reached only 74.4%, below the ASEAN average of 78.2%. The main contributing factors include inadequate human resource quality and infrastructure. Productivity is influenced by various factors, both individual and environmental. Individual factors include age, physical condition, motivation, and nutritional status. Environmental factors encompass workload, rest periods, and workplace atmosphere (Partuti, 2019). Sleep quality is also an important factor that directly affects workers' physical and mental conditions. Adequate and high-quality sleep can enhance focus and work fitness (Permatasari, 2020; Ulfiana et al., 2023). Conversely, sleep deprivation leads to fatigue, concentration disorders, and decreased productivity (Thayeb et al., 2015). Research has shown a significant relationship between sleep quality and work stress (Agustina, 2022). Excessive workload can cause both physical and mental pressure, and may even harm workers' health. Workload that exceeds employees' capabilities can lead to boredom, fatigue, and prolonged stress (Ilmi et al., 2024). This ultimately results in reduced productivity and affects workers' personal lives (Aprilia et al., 2024; Pratama, 2021). In addition, nutritional status also plays a crucial role in supporting productivity. An imbalanced Body Mass Index (BMI), whether due to obesity or underweight, can cause physical limitations and increase the risk of work-related stress (Hasibuan & Palmizal, 2021; Nayee & Vaghasiya, 2023; Sethi et al., 2011). Studies show that workers with moderate to severe obesity face limitations in completing physical tasks and are more vulnerable to productivity decline (Bustillos et al., 2015; Kudel et al., 2018). Work stress itself is a physical and psychological response to job demands that exceed an individual's capabilities. Unaddressed stress can disrupt concentration, mental health, and work productivity (Akrimah et al., 2023). Studies indicate that work

stress has a significant negative impact on productivity (Aryani & Atmaja, 2023; Safitri, 2019). Although moderate stress can enhance performance, excessive stress tends to have adverse effects (Putri et al., 2023). PT. Apexindo Balikpapan, an oil and gas company operating in remote areas, demands high productivity from its employees to maintain operational continuity. Employees are expected to remain innovative and efficient, yet individual and job-specific characteristics can pose distinct challenges.

Therefore, it is important to examine how nutritional status, sleep quality, and workload influence work productivity through work stress. Based on the above explanation, the researcher is interested in conducting a study entitled "Path Analysis of Factors Influencing Work Productivity (Nutritional Status, Sleep Quality, Workload) through Work Stress among Employees of Apexindo Balikpapan in 2024."

2. Materials and Methods

This a cross-sectional analytical study was conducted between November to December 2024.

2.1 Population and Sample

The population is the generalization area consisting of objects or subjects that possess specific qualities and characteristics defined by the researcher to be studied and from which conclusions are drawn. The population in this study includes all employees of PT. Apexindo Balikpapan, totaling 100 individuals. The sampling technique used in this study is total sampling. In this case, the entire population of 100 employees at PT. Apexindo Balikpapan will serve as the research sample.

2.2 Research Instrument dan Tools

The data collection instruments used in this study are as follows:

2.2.1 Questionnaire

The questionnaire is a research instrument used to present several questions related to respondents' characteristics. In this study, the questionnaire includes questions related to the variables under investigation, such as:

a. Productivity measurement questionnaire

b. Sleep quality questionnaire using the Pittsburgh Sleep Quality Index (PSQI)

c. NASA-TLX workload questionnaire

d. Work stress questionnaire

2.2.2 Cocorometer

The Cocorometer is used to measure the level of α-amylase, which can indicate an individual's stress level—whether psychological or psychosocial—with an accuracy rate of 94% when conducted within one minute. The tool is used by placing a strip (used to collect saliva) in the mouth for 10–30 seconds.

The strip is then inserted into the Cocorometer device, which will display the amylase concentration in the saliva. There are four classification levels: low stress (0–30 kU/l), normal stress (31–45 kU/l), stress (46–60 kU/l), and high stress (≥ 61 kU/l).

2.2.3 Microtoise

A microtoise is a measuring instrument used to measure the respondents' height, taken after the observation of working posture and the completion of questionnaires. The measurement method used in this study refers to the Decree of the Minister of Health of the Republic of Indonesia No. HK.01.07/MENKES/51/2022 concerning Anthropometric Standards.

2.2.4 Digital Scale

A digital scale is a measuring tool used to assess the respondents' body weight, also measured after the observation of working posture and the completion of questionnaires. The measurement method in this study refers to the Decree of the Minister of Health of the Republic of Indonesia No. HK.01.07/MENKES/51/2022 concerning Anthropometric Standards.

2.3 Statistical Analysis

The researcher conducted a multivariate analysis to examine the influence between two variables by controlling for other variables and determining the magnitude of their effect using the Partial Least Squares–Structural Equation Modeling (PLS–SEM) method. This analysis presents causal relationships among variables in graphical form, making them easier to interpret and useful for identifying both direct and indirect relationships, including mediating variables.

2.4 Ethical Consideration

This study obtained ethical approval from the Ethics Commission, Faculty of Public Health, Hasanuddin University, with protocol number 13125092013.

3. Results and Discussion

3.1 Characteristics of Respondents

The characteristics of the respondents in this study are viewed based on gender, age, and length of employment. Additionally, the distribution of factors influencing productivity—such as nutritional status, workload, sleep quality, and work stress—is also presented. Based on Table 1, the characteristics of the 100 respondents who participated in this study at PT. Apexindo Balikpapan are as follows. In terms of gender, the majority of respondents were male, totaling 84 individuals (84%), while female respondents numbered only 16 (16%). This indicates that the workforce in this company is male-dominated. In terms of age, the largest age group was 31–40 years, comprising 35 individuals (35%), followed by the 41–50 age group with 33 individuals (33%). A total of 23 respondents (23%) were under the age of 31, and only 9 individuals (9%) were over the age of 50. This suggests that the majority of respondents are within the productive age range, namely between 31 and 50 years. Meanwhile, based on years of service, 50 individuals (50%) had been working for 1–years, indicating a predominance of relatively new or mid-level employees. A total of 34 individuals (34%) had been employed for 5–8 years, 14 individuals (14%) for 9–12 years, and only 2 individuals (2%) had worked for more than 12 years. This shows that most employees are in the early to middle stages of their careers at the company. Furthermore, it was found that the majority of respondents had a normal nutritional status. A total of 82 individuals (82%) fell into the normal nutrition category, indicating that most employees were in good health in terms of weight and height. The majority of respondents also reported good sleep quality. A total of 89 individuals (89%) were categorized as having good sleep quality, and 78 individuals (78%) reported experiencing a light workload. Regarding work stress levels measured using the Cocorometer, most respondents were found to have mild stress. A total of 88 individuals (88%) experienced mild stress, 5 individuals (5%) had moderate stress, and 7 individuals (7%) experienced no stress at all. In terms of work productivity, 25 individuals (25%) were found to fall into the low productivity category.

Table 1: (a) Characteristics of Respondents (n=100)

CHARACTERISTICS	N (%)
GENDER	
MALE	84 (84.0)
FEMALE	16 (16.0)
AGE	
<31 YEARS	23 (23.0)
31-40 YEARS	35 (35.0)
41-50 YEARS	33 (33.0)
>50 YEARS	9 (9.0)

Table 1: (b) Characteristics of Respondents (n=100)

CHARACTERISTICS	N (%)
YEARS OF SERVICE	
1-4 YEARS	80 (80.0)
5-8 YEARS	20 (20.0)
9-12 YEARS	23 (23.0)
>12 YEARS	77 (77.0)
NUTRITION STATUS	
UNDERWEIGHT	5 (5.0)
NORMAL	82 (82.0)
OVERWEIGHT	13 (13.0)
SLEEP QUALITY	
BAD	11 (11.0)
GOOD	89 (89.0)
WORKLOAD	
LIGHT	78 (78.0)
MODERATE	22 (22.0)
JOB STRESS (WITH COCOROMETER)	
NO STRESS	7 (7.0)
MILD STRESS	88 (88.0)
MODERATE STRESS	5 (5.0)
JOB STRESS (WITH QUESTIONNAIRE)	
MILD STRESS	83 (83.0)
MODERATE STRESS	17 (17.0)
WORK PRODUCTIVITY	
LOW	25 (25.0)
ADEQUATE	75 (75.0)

3.2 Path Analysis

The following is an illustration of the path analysis model construction. In this model, work stress functions as a mediating variable in modeling the influence of nutritional status, sleep quality, and workload on work productivity.

Based on Figure 1, work productivity (Y) is influenced by several factors, both directly and indirectly through the mediating variable of work stress. The three independent variables examined are nutritional status (X1), sleep quality (X2), and workload (X3). These variables are associated with two mediating variables: work stress measured through a questionnaire (Z1) and work stress measured using the Cocorometer (Z2), both of which subsequently influence

work productivity.

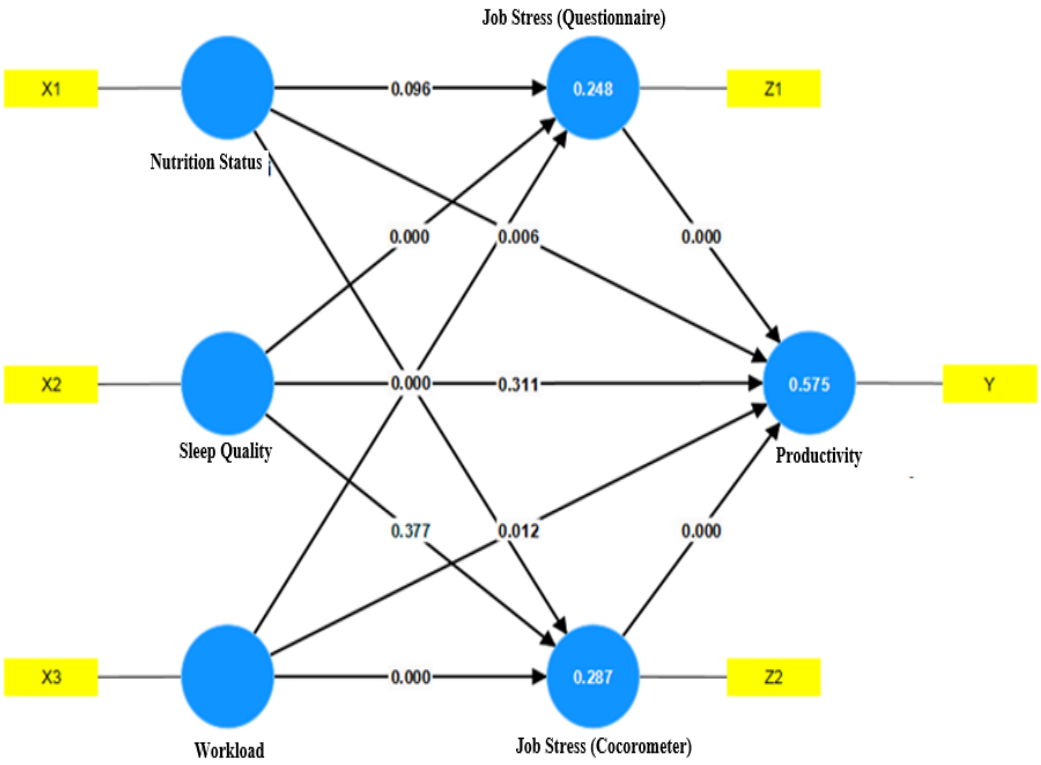

Figure 1: Path Analysis Model

In detail, nutritional status (X1) has a very minimal direct effect on work stress (Z1 and Z2), as well as a very weak influence on work productivity. In contrast, sleep quality (X2) shows a significant effect on physiological stress (Z2) and also contributes to improving work productivity, although the impact is not substantial. Workload (X3) emerges as the strongest factor, as it significantly affects both types of work stress (Z1 and Z2), and also has a direct and significant impact on productivity. In addition, both indicators of work stress subjective stress measured through questionnaires (Z1) and objective stress measured using the Cocorometer (Z2) were found to have a significant influence on work productivity, with path coefficient values of 0.248 and 0.287, respectively. This indicates that work stress serves as an important mediating variable in the relationship between personal and work environment factors and productivity. Overall, the model explains 57.5% of the variability in work productivity ($R^2 = 0.575$), which means that the combination of nutritional status, sleep quality, workload, and work stress makes a substantial contribution in explaining employees' productivity levels.

3.3 Discussion

The research findings indicate that nutritional status, workload, and sleep quality affect work productivity through work stress among employees at

PT. Apexindo Balikpapan. Regarding nutritional status, a study by Wijayanthi et al. (Wijayanthi et al., 2024) found that dietary quality was significantly correlated with stress levels among industrial workers ($p = 0.030$); workers with poor eating habits reported higher levels of stress and anxiety. Although conducted in a different context, these findings affirm that nutritional patterns do influence the perception of work-related stress. Malnutrition increases stress hormones such as cortisol and lowers tolerance to job-related pressure, particularly among heavy industry workers. This supports the biological framework that poor nutritional status exacerbates the body's stress response, which may explain why up to 40% of underweight individuals experience moderate levels of stress. Additionally, from a psychological perspective, adequate sleep plays a critical role in maintaining mood, emotional regulation, and cognitive function. Nutritional status also influences employee productivity. A study by Shafitra (Shafitra et al., 2020) demonstrated a significant relationship between nutritional status and work productivity among factory workers, where those with good nutritional status tended to exhibit higher productivity. These findings reinforce the results observed in the PT. Apexindo work environment, which also demands high levels of physical endurance and concentration. Workers with optimal nutritional status exhibit higher levels of workplace presence (presenteeism), along with fewer complaints related to fatigue and health issues. Statistically, nutritional status shows a significant positive correlation with daily work effectiveness. This supports the interpretation that nutrition not only has long-term impacts but also directly manifests in day-to-day performance. The sleep quality variable also demonstrates a positive relationship with work stress. A systematic review by Frontiers in Public Health (Health, 2024) consistently concluded that workers with poor sleep reported higher levels of stress and lower productivity, with this pattern observed across professions and countries. These findings reinforce the notion that sleep quality is a strategic lever for reducing stress and, through that pathway, improving productivity among Apexindo employees. Beyond sleep quality, workload also significantly influences work stress and productivity. This finding aligns with the study by Agustin et al. (Agustin et al., 2025), which identified excessive workload as one of the most dominant sources of work stress, particularly among employees in the public service sector. Their research showed that high workloads lead to psychological pressure, emotional exhaustion, and a decline in job performance. This explains how, when individuals are expected to complete tasks within limited time frames and with constrained resources, their stress levels increase significantly. Another study by Widyastuti Titis et al. (Widyastuti et al., 2024) in the manufacturing sector found workload to be a primary predictor of work stress and burnout. They concluded that employees consistently assigned high workloads struggled to maintain work-life balance, ultimately increasing stress levels. The positive correlation found also highlights the need for organizational management to reevaluate task distribution and

work schedules to avoid creating a toxic work environment. Research by Husaeni Amrah & Febrian Desty in the industrial sector indicated that excessive workload reduces work effectiveness and efficiency (Husaeni & Febrian, 2023), especially under time pressure and tight deadlines. Their findings support the current study, in which high workloads were found to impair employees' ability to complete tasks on time and with high quality. Another study by Pratama et al. in the oil and gas sector also identified a negative correlation between workload and productivity (Pratama et al., 2022), particularly among field employees. They observed that physically demanding tasks carried out over extended periods without adequate rest increased the risk of fatigue and workplace accidents, directly affecting daily output and long-term productivity. These findings are particularly relevant to the working context at PT. Apexindo, which operates in a similar industry. Overall, these findings indicate that poor workload management significantly impacts productivity decline. Therefore, creating a healthy, fair, and well-organized work environment should be a strategic priority for the company to support optimal performance and ensure organizational sustainability. A study by Omair et al. further revealed that workers with high levels of physiological stress are more likely to experience reduced motivation, increased error rates (Omair et al., 2019), and lower time-use efficiency. They even recommended routine monitoring of physiological stress as a form of real-time occupational health surveillance, as it can detect performance decline before it becomes visibly apparent.

4. Conclusion

This study concludes that nutritional status, workload, and sleep quality have a significant impact on the work productivity of employees at PT. Apexindo Balikpapan, both directly and indirectly through work stress as a mediating variable. Workload emerged as the most dominant factor affecting stress levels and productivity decline, followed by sleep quality and nutritional status. Work stress, whether measured subjectively or objectively, has been proven to be a critical mediating variable in explaining the relationship between individual and environmental factors and work productivity. Based on the research findings, it is recommended that the company implement more proportional workload management, promote better sleep quality through healthy work-hour arrangements, and improve employees' nutritional status by providing nutritious meals and offering nutrition education. In addition, regular monitoring of work stress both subjectively and physiologically should be conducted as part of an integrated occupational health strategy to support optimal productivity

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