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THE RELATIONSHIP BETWEEN PHYSICAL WORKLOAD AND WORK FATIGUE WITH THE IMPLEMENTATION OF OCCUPATIONAL SAFETY AND HEALTH (OSH) AMONG WORKERS OF THE SEKOLAH RAKYAT CONSTRUCTION PROJECT BY PT. BRANTAS ABIPRAYA (PERSERO)

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ABSTRACT

The construction sector has one of the highest rates of occupational accidents worldwide. Excessive physical workload can reduce workers' alertness and compliance with Occupational Safety and Health (OSH) procedures, increasing the risk of workplace accidents. This study aimed to analyze the relationship between physical workload and OSH implementation among workers of the Sekolah Rakyat construction project by PT. Brantas Abipraya (Persero) in Madiun, Indonesia. A quantitative observational analytic design with a cross-sectional approach was used. The population consisted of 183 field workers, with a sample of 65 respondents selected through proportional simple random sampling. Physical workload was measured objectively using the working pulse rate (beats/minute) with a pulse oximeter, while OSH implementation was measured using a validated questionnaire. Data were analyzed univariately and bivariately using the Spearman Rank correlation test at a significance level of 0.05. Most workers had a moderate physical workload (41.5%), and 66.2% rated OSH implementation at their workplace as poor. The Spearman Rank test showed a significant relationship between physical workload and OSH implementation ($p = 0.000$; $r = -0.456$), with a moderate strength and negative direction, meaning that higher physical workload corresponded to lower OSH implementation. It is concluded that physical workload is significantly related to OSH implementation. Companies are advised to manage workload through job rotation, periodic working-pulse-rate monitoring, and strengthened field supervision to prevent occupational accidents among construction workers.

Keywords: physical workload; OSH implementation; construction workers; working pulse rate; cross-sectional study

INTRODUCTION

The construction industry is globally recognized as one of the most hazardous sectors, with the International Labour Organization (ILO) reporting that it accounts for approximately 20% of all fatal occupational accidents worldwide (Ankamah-Lomotey et al., 2025). In Indonesia, the Employment Social Security Agency (BPJS Ketenagakerjaan) recorded 347,855 occupational accident cases among wage-earning workers, 19,921 cases among non-wage workers, and 2,971 cases in the construction services sector in 2023 (Eka et al., 2024). In 2024, the construction sector alone contributed approximately 31.9% of all occupational accidents, primarily caused by falls from height, being struck by hard objects, and being hit by construction materials (Mahyudin et al., 2025).

Occupational accidents in the construction sector can be influenced by several factors, one of the most prominent being high physical workload. Excessive physical workload may cause work fatigue, which in turn reduces workers' concentration and alertness, thereby increasing the risk of accidents. Weak implementation of Occupational Safety and Health (OSH) and low compliance with personal protective equipment (PPE) further contribute to the high accident rate in this sector (Malino, 2025). Physical workload refers to the burden received by a worker relative to their physical capacity; a workload exceeding this capacity leads to an increased pulse rate, greater energy expenditure, and the onset of fatigue (Tarwaka, 2014). Unmanaged physical workload can reduce workers' alertness and compliance with OSH procedures (Ardiansyah et al., 2022).

OSH is a set of efforts intended to promote and maintain the highest degree of physical, mental, and social well-being of workers across all types of occupations (Purnamawati & Damailita, 2025), functioning as a protective measure against risks that may endanger workers' health and safety while performing their duties (Simbolon et al., 2024). Effective OSH implementation is realized through the establishment of safety procedures and policies, regular training, workplace monitoring, and the provision of PPE (Wahyudi et al., 2025). In Indonesia, OSH implementation in construction projects is governed by Law No. 1 of 1970 concerning Work Safety and further regulated by Manpower Ministerial Regulation No. 5 of 2018 on Occupational Safety and Health in the Work Environment, which covers PPE provision, OSH training, installation of safety signage, and supervision of safe-work procedure implementation (Ketenagakerjaan et al., 2018).

PT. Brantas Abipraya (Persero), a state-owned construction enterprise, is currently undertaking the Sekolah Rakyat (People's School) construction project in Nglames Village, Madiun Regency, East Java. As a National Strategic Program with a strict completion schedule, the project involves highly physically demanding activities such as material handling, structural work, and the operation of heavy equipment. A preliminary study conducted by the researchers through brief interviews with five field workers found that 64% of respondents reported experiencing conditions requiring greater physical exertion, including prolonged standing or walking, bending or squatting for extended periods, and a noticeably faster heart rate during work. If not balanced with proper OSH implementation, such conditions may heighten the risk of occupational accidents and compromise worker safety at the project site.

High physical workload has been shown to reduce workers' concentration, alertness, and compliance with safety procedures (Rajab, 2024). Therefore, it is important to examine the relationship between physical workload and OSH implementation among workers, particularly on large-scale construction projects with tight completion targets such as the Sekolah Rakyat project undertaken by PT. Brantas Abipraya (Persero). This study aimed to analyze the relationship between physical workload and OSH implementation among workers of the Sekolah Rakyat construction project by PT. Brantas Abipraya (Persero) in 2026.

MATERIALS AND METHODS

This study used a quantitative method with an observational analytic design and a cross-sectional approach, in which the independent and dependent variables were measured at the same point in time (Sugiyono, 2023). The population consisted of all 183 field workers of the Sekolah Rakyat construction project by PT. Brantas Abipraya (Persero), including civil workers, mechanical-electrical-plumbing (MEP) workers, heavy-equipment operators, and architectural-finishing workers. The sample size was determined using the Slovin formula with a 10% margin of error, yielding a minimum sample of 65 workers, who were then proportionally allocated across job divisions using a simple random sampling technique.

Inclusion criteria were workers assigned to field-level construction activities, actively employed at the time of the study, and willing to participate as respondents. Exclusion criteria were workers absent during data collection, workers who were ill or unable to complete the questionnaire, and workers assigned to non-field duties.

The independent variable was physical workload, and the dependent variable was OSH implementation. Physical workload was measured objectively through the working pulse rate (beats/minute) using a pulse oximeter, then categorized as light (75-100 bpm), moderate (101-125 bpm), or heavy (126-150 bpm) (Tarwaka, 2014). OSH implementation was measured using a structured questionnaire covering PPE use, compliance with standard operating procedures, participation in safety briefings, hazard reporting and communication, and safe work behavior, categorized as good or poor based on the median total score.

Data were collected through direct pulse-rate measurement and questionnaire administration. Univariate analysis was used to describe the frequency distribution of each variable, and bivariate analysis was performed using the Spearman Rank correlation test to examine the relationship between physical workload and OSH implementation, with a significance level (α) of 0.05. This study adhered to research ethics principles, including respect for respondents' dignity, confidentiality of data, fairness, and consideration of the benefits and risks to all participants

RESULTS AND DISCUSSION

The study was conducted at the Sekolah Rakyat construction project in Nglames Village, Madiun District, Madiun Regency, East Java. Of the 65 respondents, workers aged 25-35 and 36-45 years each accounted for

21 people (32.3%), the largest proportion, followed by those aged 17-25 years (19 people; 29.2%) and those over 45 years (4 people; 6.2%). By job type, most respondents worked in the civil division (28 people; 43.1%), followed by architectural finishing (20 people; 30.8%), MEP (14 people; 21.5%), and heavy-equipment operators (dozer, excavator, and forklift, 1 person each; 1.5%).

Table 1 Frequency Distribution of Physical Workload among Sekolah Rakyat Construction Project Workers

No	Physical Workload	f	%
1	Light	13	20.0
2	Moderate	27	41.5
3	Heavy	25	38.5
	Total	65	100

Source: Primary data, 2026

As shown in Table 1, most workers had a moderate physical workload (27 people; 41.5%), followed by heavy (25 people; 38.5%) and light (13 people; 20.0%) categories. This finding indicates that most work activities remain within workers' physiological tolerance, although they still require considerable energy expenditure and sustained focus.

Table 2 Frequency Distribution of OSH Implementation among Sekolah Rakyat Construction Project Workers

No	OSH Implementation	f	%
1	Poor	43	66.2
2	Good	22	33.8
	Total	65	100

Source: Primary data, 2026

As shown in Table 2, most respondents rated OSH implementation at their workplace as poor (43 people; 66.2%), while 22 people (33.8%) rated it as good. This indicates that OSH implementation at the study site remains suboptimal, with more than half of the workers perceiving that safety and health aspects have not been adequately applied in the field.

Table 3 Spearman Rank Correlation between Physical Workload and OSH Implementation

Variable	N	r	p-value	Remarks
Physical workload and OSH implementation	65	-0.456	0.000	Significant

Source: Primary data, 2026

As shown in Table 3, the Spearman Rank test among 65 workers yielded a correlation coefficient of -0.456 with a p-value of 0.000. Since $p < 0.05$, there is a statistically significant relationship between physical workload and OSH implementation, with a moderate strength and negative direction, meaning that higher physical workload among workers corresponds to lower OSH implementation.

This finding is consistent with Tarwaka (2014), who stated that when workload exceeds a worker's physical capacity, it results in an increased pulse rate, greater energy expenditure, and the onset of fatigue. Although most workers' physical workload fell into the moderate category, sustained exposure without adequate rest may still reduce concentration, alertness, and compliance with OSH procedures. This result is also consistent with Rosadah et al. (2024), who found a very strong correlation between physical and mental workload and work fatigue ($r = 0.847$), and with Prameswari et al. (2022), who reported a significant relationship between physical workload and fatigue among 100 construction workers on the Serpong-Cinere toll road project ($p = 0.001$), where resulting fatigue was linked to reduced compliance with safety procedures.

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Field observations during data collection revealed that, despite a moderate physical workload based on pulse-rate measurement, sustained work without sufficient rest led some workers to report health complaints such as elevated blood pressure, malaise, and mild dizziness. Reduced concentration and alertness under these conditions caused some workers to neglect OSH procedures, particularly the incomplete use of PPE such as safety helmets and safety boots. Several workers reported discomfort wearing helmets while lifting materials because the helmets frequently slipped off, while others admitted forgetting or being reluctant to wear helmets during finishing work at height due to focus on meeting production targets. These findings suggest that poorly managed physical workload can undermine OSH implementation in the field. High target pressure also led some workers to disregard PPE use in order to complete tasks more quickly, and non-ergonomic, rushed working postures were still observed.

This result aligns with Rajab (2024), who found that physical workload was significantly associated with unsafe actions among construction workers ($p = 0.008$), indicating that higher physical workload corresponds to lower safety-related behavior. In line with Law No. 1 of 1970 concerning Work Safety, which aims to guarantee worker safety, high physical workload leading to fatigue has the potential to reduce compliance with OSH procedures.

Based on these findings, the researchers argue that improving OSH implementation cannot rely solely on PPE provision but must also address workload management. Management of PT. Brantas Abipraya (Persero) should prioritize this issue through job rotation, periodic working-pulse-rate measurement, and basic health screening for all workers rather than a limited sample. Investing in workload management is fundamentally an investment in improving the safety, health, and productivity of construction workers.

CONCLUSION

Most workers of the Sekolah Rakyat construction project by PT. Brantas Abipraya (Persero) had a moderate physical workload (41.5%) based on working pulse-rate measurement, and 66.2% rated OSH implementation at their workplace as poor. The Spearman Rank test showed a significant relationship between physical workload and OSH implementation ($p = 0.000$; $r = -0.456$), with a moderate strength and negative direction, indicating that higher physical workload corresponds to lower OSH implementation. Companies are advised to strengthen OSH discipline enforcement, reinforce direct supervision by OSH officers and foremen in high-workload areas, and schedule job rotation together with periodic working-pulse-rate monitoring to reduce physical workload and prevent occupational accidents. Future research is recommended to examine additional variables such as work motivation, OSH supervision, or the work environment, and to employ more diverse measurement methods for a more comprehensive assessment of physical workload

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