



Effect of energy adequacy level and hydration status on occupational fatigue in fisherman

Pengaruh tingkat kecukupan energi dan status hidrasi terhadap kelelahan kerja pada nelayan

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Abstract

Fatigue is a risk factor that can reduce the health status of workers and cause accidents. Fatigue can be caused by inadequate energy and hydration levels. This study aimed to determine the relationship between the level of energy adequacy, hydration status, and work fatigue among fishermen in Puger Wetan Village in February to April 2024. This was a cross-sectional study of 106 fishermen. The data collected were fisherman's characteristics, Swedish Occupational Fatigue Index (SOFI), self-urine check card, and 2×24 hour food recall. Data were analyzed using Spearman's rank correlation test. The results showed that more than half (54,7%) of the fishermen experienced moderate fatigue and mild dehydration (41,5%). In addition, the level of energy adequacy ($p < 0,0001$; $r = -0,449$) and hydration status ($p = 0,003$; $r = 0,289$) were correlated to occupational fatigue. The conclusion is that there is a significant relationship between energy sufficiency and hydration status to occupational fatigue among fishermen. Fishermen are expected to focus on consuming a variety of foods with balanced nutrition and sufficient body fluid intake. Future research should explore other factors related to occupational fatigue, such as workload, job stress, shift work, and sleep quality.

Keywords: Energy adequacy, hydration status, work fatigue

Abstrak

Kelelahan merupakan salah satu faktor risiko yang dapat menurunkan status kesehatan pekerja dan dapat menyebabkan kecelakaan kerja. Kelelahan dapat disebabkan oleh asupan energi dan status hidrasi yang tidak mencukupi. Penelitian ini bertujuan untuk mengetahui hubungan antara asupan energi dan status hidrasi dengan kelelahan kerja pada nelayan di Desa Puger Wetan, Kabupaten Jember pada bulan February hingga April 2024. Desain penelitian ini menggunakan cross sectional dengan sampel sebanyak 106 nelayan. Data yang diambil adalah karakteristik nelayan, Swedish Occupational Fatigue Index (SOFI), kartu pemeriksaan urin sendiri dan food recall 2×24 jam. Data dianalisis menggunakan uji korelasi rank spearman. Hasil penelitian menunjukkan lebih dari 50% nelayan mengalami kelelahan sedang (54,7%) dan dehidrasi ringan (41,5%). Selain itu, tingkat kecukupan energi ($p < 0,0001$; $r = -0,449$) dan status hidrasi ($p = 0,003$; $r = 0,289$) berhubungan dengan kelelahan kerja ($p < 0,0001$; $r = -0,449$) dan status hidrasi dengan kelelahan kerja ($p = 0,003$; $r = 0,289$). Kesimpulan dari penelitian ini adalah terdapat hubungan signifikan antara tingkat kecukupan energi dan kelelahan kerja pada nelayan. Nelayan diharapkan dapat memperhatikan terkait konsumsi makanan beragam dengan gizi seimbang dan mencukupi kebutuhan cairan tubuh. Bagi peneliti selanjutnya diharapkan dapat meneliti faktor-faktor lain yang berhubungan dengan kelelahan kerja seperti beban kerja, stress kerja, shift kerja dan kualitas tidur.

Kata Kunci: Kelelahan kerja, kecukupan energi, status hidrasi

Introduction

Fatigue is a risk factor that can reduce the health status of workers, resulting in increased errors in performing work and work accidents (Hikmah, 2020). Data from the International Labour Organization (ILO) in 2018 shows that there are 2,78 million workers die annually due to work accidents and Occupational Diseases with 2 million of these deaths resulting from work accidents due to fatigue (Alfikri et al., 2021; ILO, 2018). Data from Social Security Agency Employment indicate an increase in cases of work accidents and PAK from 2019 to 2021, with a total of 23,581 cases (Kementrian Ketenagakerjaan RI, 2022).

Previous research has shown that fatigue can have serious implications for worker safety and lead to an increase in work-related accidents, although it is difficult to objectively measure fatigue levels. Fatigue occurring in the informal sector has been observed in prior studies, and the research samples experienced work fatigue at varying levels. The informal sector has significant potential for worker fatigue due to its unregulated nature, flexibility, and lack of attention to issues related to worker fatigue. One informal job at risk of experiencing fatigue is a fisherman (Santriyana et al., 2023). Research conducted by Papendang et al. (2022) showed that 70,3% of fishermen experienced work accidents, with 62,2% of these accidents caused by work fatigue (Papendang et al., 2022).

Fatigue in fishermen can result from monotonous fishing activities such as stretching, lowering, pulling, and lifting nets, which are performed repeatedly in unergonomic body positions, such as band posture (Lombonaung & Lihi, 2022). One of the factors contributing to work fatigue is the workload (Agustin et al., 2021). Heavy workloads can cause fatigue in fishermen (Kowaas et al., 2019). Work-field factors, work environment, and uncertain working hours can contribute to heavy workloads for fishermen (Kowaas et al., 2019). The physical demands on workers cause muscles to work harder, requiring greater calorie intake to produce energy (Agustinawati et al., 2019).

Adequate nutritional intake is essential for maintaining and increasing resilience and balancing nutritional and energy needs to meet work demands (Hartriyanti et al., 2020). Skeletal muscles use energy to perform physical

activities (Siwi & Paskarini, 2018). Fatigue occurs due to insufficient energy, which can reduce blood glucose levels, resulting in the breakdown of glycogen molecules into glucose. This process occurs through a chemical reaction and is anaerobic if oxygen levels in the body are low. The final products of this process are Adenosine Triphosphate (ATP) and lactic acid. Lactic acid production leads to muscle fatigue (Sandi, 2019). Research conducted by Khoiroh et al. (2022) reported a relationship between the energy adequacy and work fatigue. Workers with lower or higher energy adequacy levels are 3,14 times more likely to experience work fatigue than those with sufficient energy levels (Khoiroh et al., 2022).

In addition to nutrients, adequate fluid intake is crucial for maintaining hydration status and ensuring optimal body function. A low hydration status indicates dehydration (Samodra, 2020). Fishermen who work at sea during the day are at risk of dehydration owing to hot working conditions and heavy work activities (Alayyannur et al., 2023). A cold working environment can also cause dehydration because a person's physiological stimulus to drink decreases, cold temperatures can cause a person's perception of needing to drink, and the emergence of thirst is suppressed (Ratih & Dieny, 2017). Research conducted by Pellicer-Caller et al. (2023) showed an influence of hydration status on the occurrence of fatigue (Pellicer-Caller et al., 2023). A person with a low hydration status or dehydration can thicken blood such that the heart's work process to pump blood becomes harder and results in fatigue (Camelia et al., 2020).

Several studies on work fatigue among fishermen have been conducted. However, none has addressed the variables of energy adequacy and hydration status. For instance, a study conducted by Kowaas et al. (2019) investigated the relationship between nutritional status and workload and fatigue among fishermen in Uwuran Satu Village, Amurang District, and Minahasa Regency. In previous research, hydration status has mostly been linked to fatigue experienced by athletes, and there are relatively few studies examining hydration status among fishermen. It highlights the need for further investigation to better understand these interconnections and to inform strategies for improving the health and performance of fisherman.

The Jember Regency is one of the regions with the largest number of fishing households in East Java, ranking first with a total of 12,880 households involved in marine fisheries (Badan Pusat Statistik, 2017). Data from the Jember Regency Fisheries Service in 2023 show that the highest number of fishing households in the Jember Regency is in the Puger District, with a total of 10,312 people. Puger Wetan Village is one of the villages in the Puger District, with 2185 active fishermen. In a preliminary study of 15 interviewed fishermen, all complained of fatigue while working. Work fatigue includes drowsiness; pain in body parts such as the arms, shoulders, waist, and legs; and lack of concentration when doing work. Work fatigue reduces work productivity, and thus, work targets are not achieved (Krisdiana et al., 2020). Based on this background, researchers have examined the relationship between energy adequacy level, hydration status, and work fatigue in fishermen in Puger Wetan Village, Jember Regency.

Methods

This was an analytical, observational study with a cross-sectional design. This study was conducted among fishermen in Puger Wetan Village, Jember Regency, between February and April 2024. The study population consisted of 2185 individuals. The Inclusion criteria were individuals whose primary occupation was fishing and who were still actively working as fishermen, while the exclusion criteria were fishermen with a history of dementia and those who had consumed medications (such as rifampicin, vitamin B-complex, and vitamin C) in the last 24 h, as these may affect the color of urine. The sampling was performed using a simple random sampling technique.

The minimum sample size required for this study was 96 males. An additional 10% was added to account for potential non-responses, resulting in a total sample size of 106 individuals. Primary data collection involved interviews and observations of respondents, including their characteristics (age, education, and income), level of occupational fatigue, energy adequacy level, and hydration status. The Level of occupational fatigue was measured using the Swedish Occupational Fatigue Inventory (SOFI) questionnaire, which consists of 20 questions categorized as mild fatigue

(<1,13), moderate fatigue (1,13 – 4,87), and severe fatigue (>4,87). The energy adequacy level was measured using a 2 x 24 hour food recall questionnaire, and the data were analyzed using Nutri-survey and then categorized into severe deficit (<70% RDA), moderate deficit (70–89% RDA), normal (90 – 119% RDA), and excessive (>120% RDA). Hydration status was measured using the Self-Check Urine Card or the Kartu Periksa Urin Sendiri (PURI). The respondents collected their urine in a pot and compared it with the color scale of the urine on cards under sunlight or neon light. The color scale was categorized as normal hydration (1-3), mild dehydration (4-5), and severe dehydration (6-8).

Data processing techniques were performed by inputting data, cleaning the data, checking the data, coding, tabulating, and then performing data analysis. Data were analyzed using univariate analysis to produce frequency distribution data, and bivariate analysis using Spearman's rank correlation test. The test results were considered statistically significant at $p < 0,005$. The correlation coefficient (r) was used to determine the strength of the relationship between categories: very weak (0,00-0,19), weak (0,20-0,39), moderate (0,40-0,59), strong (0,60-0,79), and very strong (0,80-1,00) (Pratama, 2019).

Ethical clearance for this study was obtained from the Faculty of Dentistry, University of Jember (2519/UN25.8/KEPK/DL/2024). Before the interviews began, informed consent was distributed and signed by the respondents after an explanation of the study. Respondents were allowed to ask anything if they did not understand the study instructions. Confidentiality of the responses and data was ensured by the researcher.

Result and Discussion

The research was conducted through interviews with 106 fishermen in Puger Wetan Village, Jember Regency, using questionnaires. The results showed that most fishermen were in the late adulthood age category (32,1%), with their education level being predominantly elementary school graduates (41,5%). Based on the income earned, the majority of fishermen had low incomes (40,6%). The table below shows the distribution of the fishermen's characteristics.

Tabel 1. Distribution of fishermen's characteristic

Characteristics	n	%
Age		
Late teens	10	9,4
Early adulthood	25	23,6
Late adulthood	34	32,1
Early elderly	25	23,6
Late elderly	12	11,3
Education		
Never been to school	3	2,8
Elementary School	44	41,5
Junior High School	30	28,3
Senior High School	26	24,6
College	3	2,8
Income		
Very high	25	23,6
High	20	18,9
Medium	18	16,9
Low	43	40,6

The research findings indicate that a significant proportion of fishermen in Puger Wetan Village, Jember Regency, fall into the late adulthood category (36-45 years old), comprising 32,1% of the population. This aligns with a study conducted by Putranto et al. (2023), which found that the majority of fishermen were aged 35-45 years at the Fish Auction Place (TPI) Lengkong (42,22%) and TPI Menganti Kisik (35,56%) (Putranto et al., 2023). Another study by Yuniarti & Sukarniati (2021) also showed that fishermen in Gunung Kidul Regency were predominantly aged 36-50 years (60,0%) (Yuniarti & Sukarniati, 2021). Fishing occupations are often inherited from parents and carried on through generations, especially in coastal areas. Children, particularly boys, assist their parents in fishing or preparing equipment for fishing. As adults, many choose to continue their parents' occupations (Hasriyanti & Hendra, 2021).

In Puger Wetan Village, Jember Regency, fishermen are dominated by those in their productive years, aged 36-45, compared to those in non-productive age groups (>65 years). According to Suma'mur (2009) as cited in Bunga et al. (2021), aging is accompanied by organ degeneration that can lead to declining abilities. Physical and occupational performance decrease due to changes in bodily functions, such as hormonal and cardiovascular systems. Individuals over 40 years of age may experience declines in hearing, vision, and reaction speed. Despite being in the productive age range, work

capacity decreased by up to 80% compared to that of a 25-year-old child. Skeletal muscle complaints also increase starting around the age of 40 and continue to escalate with age (Darmayanti et al., 2021).

The research findings reveal that the majority of fishermen in Puger Wetan Village, Jember Regency, have completed elementary school, comprising 41,5% of the population. This is consistent with a study by Putranto et al. (2023) at the Fish Auction Places Lengkong and Menganti Kisik in Cilacap, where the primary education level among fishermen ranked highest, at 86,67% and 60%, respectively (Putranto et al., 2023). Another study by Falaq and Febriyanto (2021) on Derawan Island also showed that primary education (SD) was predominant among fishermen, accounting for 43,7% (Falaq & Febriyanto, 2021).

The low education level is attributed to poverty among fishing communities, leading children to prioritize work over continuing their education (Yulianda et al., 2021). Poverty is also prevalent in Puger Wetan Village, Jember Regency, as is evident from the high number of individuals earning low incomes (<1,500,000 IDR), which limits opportunities for pursuing higher education. Education is considered less crucial than acquiring fishing skills, which are primarily gained through courage and frequent sea trips (Putranto et al., 2023). Low education levels among fishermen have consequences such as difficulty finding alternative job opportunities and contributing to high unemployment rates during lean fishing seasons (Nainggolan et al., 2020). Individuals with lower levels of education tend to have shorter thinking times, potentially leading to carelessness in their work. By contrast, those with higher education levels tend to have longer-term perspectives, including comprehensive consideration of their work from various perspectives (Martiwi et al., 2017).

The research findings indicate that a significant proportion of fishermen in Puger Wetan Village, Jember Regency earn low incomes (<1,500,000 IDR), comprising 40,6% of the population. This is consistent with a study by Yuniarti & Sukarniati (2021), which showed that fishermen's incomes were predominantly below 1,500,000 IDR (75,8%) in the Bantul and Gunungkidul regions (Yuniarti & Sukarniati, 2021). Low income levels among fishermen can be influenced by several factors, such as weather conditions or climate changes during fishing

trips, the technology used in fishing processes, the location of fishing activities, and non-physical factors, such as the experience and education level of the fishermen (Nainggolan et al., 2020).

During lean fishing seasons or when fish stocks are low, catch production may decrease without a corresponding increase in fish prices, because of stable or stagnant demand. This can be exacerbated by price increases in other essential goods that follow the rise in fish prices (Nainggolan et al., 2020). Based on interviews, all interviewed fishermen in Puger Wetan Village, Jember Regency (106 individuals) also reported unstable incomes due to lean fishing seasons, which prevented them from working during these periods.

The SOFI questionnaire results showed that energy deficiency at work was the most prominent indicator of work fatigue with an average score of 53,6. Work fatigue was measured using the SOFI questionnaire administered to 106 fishermen in Puger Wetan Village, Jember Regency. Most of the fishermen experienced moderate levels of fatigue (54,7%). This aligns with the findings of Tani et al. (2022), which showed that the highest level of work fatigue among fishermen in Manado was moderate (50,0%) (Tani et al., 2022). Similarly, Pratiwi et al. (2018) revealed that most fishermen in the Muara Dua area experienced moderate fatigue (50,0%) (Pratiwi et al., 2018). Another study by Hidayat & Febriyanto (2021) on traditional divers on Derawan Island, East Kalimantan, indicated that a significant portion of divers experienced moderate fatigue (45,7%) (Hidayat & Febriyanto, 2021).

In Puger Wetan Village, Jember Regency, fishermen, based on the SOFI questionnaire indicators, predominantly experienced energy deficiencies at work (53,6%) (Table 3). The symptoms associated with energy deficiency include feeling exhausted during activities (physical fatigue), energy drained during tasks, excessive workload, and feeling excessively tired to perform additional activities. This correlates with research by Lubis & Mu'minah (2022) on production workers in PT. Nugraha indicated that energy deficiency was the most common indicator of work fatigue (46,74%). Energy deficiency can result from physical exertion associated with high workloads and long hours, leading to fatigue and burnout (Lubis & Mu'minah, 2022).

Table 3. Distribution of work fatigue levels, hydration status, and energy adequacy level of fisherman

Variables	n	%
Work fatigue		
Mild	18	17,0
Moderate	58	54,7
Severe	30	28,3
Hydration Status		
Normal hydration	31	29,2
Mild dehydration	51	48,2
Severe dehydration	24	22,6
Energy Adequacy Level		
Severe deficit	14	13,2
Moderate deficit	44	41,5
Normal	43	40,6
Excessive	5	4,7

Work fatigue among fishermen in the Puger Wetan and Jember Regency can be attributed to their monotonous tasks at sea, irregular working hours, and heavy workloads. Their workload increases when the catch is manually transferred to suppliers' trucks or delivered to fish brokers for weighing. Work fatigue manifests as reduced alertness, coordination, cognitive abilities, memory lapses, and attention deviations (Chofsoh & Sahri, 2022; Krisdiana et al., 2020), which can impair performance and increase the likelihood of errors and workplace accidents. High error rates owing to fatigue pose significant risks and can lead to accidents (Aprilia et al., 2021). Mild fatigue accumulation has the potential to escalate into severe fatigue if not prevented, potentially resulting in serious incidents and fatalities (Setiawan et al., 2020). The adequacy of energy intake was measured using a 2×24-hour food recall questionnaire administered to 106 fishermen in Puger Wetan Village, Jember Regency. The data in Table 3 reveal that the majority of the fishermen experienced moderate energy deficiency (41,5%). The largest contributor to energy sources among fishermen in Puger Wetan Village, Jember Regency, came predominantly from carbohydrate consumption, averaging 330,6 grams while the average intake of protein and fat was 60 grams and 48,4 grams, respectively.

The research findings indicate that the majority of fishermen have a moderate energy deficiency (41,5%) in Puger Wetan Village, Jember Regency. This aligns with a study by Hariyati & Amareta (2020) on brick workers in Wringin Putih Village, which stated that a

significant portion experienced moderate energy consumption deficiency (57,1%) (Hariyati & Amareta, 2020). On average, the primary sources of energy among fishermen were carbohydrates at 330,6 grams, followed by protein at 60,0 grams, and fat at 48,4 grams. However, the daily requirements for carbohydrates, protein, and fat for adult males aged 30-49 are still insufficient according to the Recommended Dietary Allowances (RDA), with daily requirements of 415 g for carbohydrates, 65 g for protein, and 70 g for fat.

The deficit in energy adequacy among fishermen in Puger Wetan Village, Jember Regency, may be attributed to an insufficient food supply during work. Many fishermen, particularly laborers, do not utilize the meal allowances provided by their superiors to purchase adequate food to meet their energy intake while working. Energy intake is crucial for physical activities, especially in strenuous occupations, which necessitate substantial quantities (Agustinawati et al., 2019). Inadequate energy intake can effectively reduce the capacity of workers to perform tasks. Energy deficiency may disrupt the work capacity (Tasmi et al., 2015).

Hydration status was assessed using the PURI card method among 106 fishermen in Puger Wetan Village, Jember Regency. The data revealed that Most fishermen experienced mild

dehydration (48,1%) (Table 3). The research findings indicate that the majority of fishermen experienced mild dehydration (48,1%) in Puger Wetan Village, Jember Regency (Table 3). This is consistent with a study by Ratih et al. (2022) on fishermen in Kemojan Village, Jepara, which showed that most fishermen also experienced mild dehydration (61,9%) (Ratih et al., 2022). In Puger Wetan Village, Jember Regency, most fishermen began fishing during the day, starting at around 11:00 AM, totaling 51 individuals (48,11%). This contributes to the risk factors for dehydration among fishermen because a hot environment causes fluid loss through excessive sweating, compounded by inadequate fluid intake during fishing trips.

Mild dehydration results in a 1-2% deficit in body fluid and presents symptoms such as thirst, fatigue, weakness, slight restlessness, and reduced appetite. Mild dehydration during strenuous physical activity can lead to decreased performance and immunity. It can also affect mood and cognitive function, including alertness and concentration. Mild-to-moderate dehydration can also impair short-term memory in individuals (Andayani & Dieny, 2013). Several factors influence hydration status, including knowledge about body fluids and hydration, adequate fluid intake, and nutritional status (Kurniawati et al., 2021).

Table 4. Analysis of the relationship between energy adequacy levels and hydration status to work fatigue

Fatigue		Work Fatigue Level (n = 106)						p-value	r
Energy Adequacy Level and Hydration Status	Mild (n = 18)		Moderate (n = 58)		Severe (n = 30)				
	n	%	n	%	n	%			
Energy adequacy Level									
Heavy deficit	1	0,9	8	7,5	5	4,7	<0,0001*	-0,449 (0,26-0,5)	
Moderate deficit	3	2,8	19	17,9	22	20,8			
Normal	10	9,4	30	28,3	3	2,8			
Excessive	4	3,8	1	0,9	0	0,0			
Hydration Status									
Normal hydration	8	7,5	18	17,0	5	4,7	0,003*	0,289 (0,26-0,5)	
Mild dehydration	10	9,4	27	25,5	14	13,2			
Severe dehydration	0	0	13	12,3	11	10,4			

*Significant at p-value < 0,05

Based on the analysis conducted to examine the relationship between energy adequacy levels and work fatigue among fishermen in Puger Wetan Village, Jember

Regency, the findings are presented in Table 4. Most fishermen with normal energy adequacy levels experienced moderate work fatigue (28,3%). Based on the Spearman rank

correlation test between energy adequacy levels and work fatigue, a p -value $< 0,0001$ was obtained, indicating a relationship between energy adequacy levels and work fatigue ($p < 0,05$). The correlation coefficient (r) was $-0,449$, indicating a moderate negative correlation ($0,40$ - $0,59$) between energy adequacy levels and work fatigue. This means that, as energy adequacy levels decrease (indicating more deficiency), work fatigue levels tend to increase (Table 4).

This is in line with research conducted by Khoiroh et al. (2022), who stated that there is a relationship between the energy adequacy level and work fatigue ($p < 0,001$). Individuals with either excessive or insufficient energy adequacy levels may have an increased risk of work fatigue by 3,14 times (Khoiroh et al., 2022). Another study by Malik et al. (2021) indicated a relationship between energy intake and work fatigue ($p = 0,005$) (Malik et al., 2021).

Energy intake used during activities can come from glucose in the blood, glycogen stores in the liver and muscles, and fat stores in adipose tissue. When the body undergoes prolonged and intense skeletal muscle contractions, metabolism cannot adequately supply the required energy or eliminate metabolic waste, such as lactic acid. Accumulation of lactic acid can lead to muscle fatigue. Limited blood flow to muscles during contractions can cause compression of blood vessels, resulting in bodily fatigue (Buwana et al., 2016). On average, fishermen derive most of their energy from carbohydrates, totaling 330,6 grams, followed by 60,0 grams of protein and 48,4 grams of fat. The daily requirements for carbohydrates, protein, and fat for adult males aged 30-49 still do not meet the nutritional requirements according to the recommended nutrient intake (RNI), with daily needs of 415 g of carbohydrates, 65 g of protein, and 70 g of fat.

Moderate fatigue is most commonly experienced by fishermen in the Puger Wetan Village and Jember Regency. Fishermen in this area have irregular working hours, influenced by seasonal variations, resulting in uncertain incomes. The predominantly low-income fishermen in Puger Wetan also contributed to this situation. Income levels affect the ability to meet family food needs in terms of the quantity and quality of the food purchased (Ningsih & Masrikhiyah, 2021). Income significantly

influences food consumption in daily life (Astuti & Sulistyowati, 2010), which in turn affects the adequacy of energy obtained from consumed foods.

Based on an analysis conducted to determine the relationship between hydration status and work fatigue among fishermen in Puger Wetan Village, Kabupaten Jember, it was found that mild dehydration was more prevalent among fishermen experiencing moderate fatigue (25,5%). Based on the Spearman's rank correlation test results between hydration status and work fatigue, a p -value of 0,003 was obtained, indicating a significant relationship between hydration status and work fatigue (Table 4). The correlation coefficient (r) obtained was 0,289, indicating a weak positive relationship ($0,20$ - $0,39$) between hydration status and work fatigue, implying that as hydration status worsens, work fatigue also tends to worsen (Table 4). This is consistent with the findings of Pellicer-Caller et al. (2023), who stated that there is a relationship between hydration status and fatigue (Pellicer-Caller et al., 2023). Another study by Rahmawati (2018) also indicated a weak positive correlation between hydration status and work fatigue, indicating that a higher hydration status correlates with increased work fatigue (Rahmawati, 2018).

Workers in hot environments are more prone to dehydration (Ratih et al., 2022). Coastal areas, including coastal environments, are typically hot, with temperatures reaching up to $34,99^{\circ}\text{C}$ (Liwan & Latue, 2023). According to the National Institute for Occupational Safety and Health (NIOSH), individuals working in hot environments are recommended to drink 1 glass or 250 ml of water every 30 min. Water should not only be consumed when feeling thirsty, workers should be advised to drink even when not thirsty to prevent dehydration. This was aimed at maintaining the hydration level of the body. In hot working environments, fluid requirements are at least $\geq 2,8$ liters per day (Nofianti & Koesyanto, 2019).

Zulkarnain et al. (2020) reported that workers in hot environments (based on urine color observations, showed that 27 workers (52%) experienced severe dehydration. Excessive dehydration increases the level of fatigue in workers (Zulkarnain et al., 2020). In the case of fishermen in Puger Wetan Village,

Kabupaten Jember, most started fishing during the day, beginning at approximately 11:00 a.m., with 51 individuals (48,11%). The rest started in the early morning/night with 48 individuals (45,28%), and in the afternoon with seven individuals (6,60%). Combined with insufficient fluid intake during work, this can lead to dehydration in the fishermen. Hot working environments cause increased fluid loss through sweating or evaporation, thereby increasing the risk of dehydration (Ratih et al., 2022). Dehydration thickens the blood, making it harder for the heart to pump it, ultimately leading to fatigue (Camelia et al., 2020).

This study has several limitations, such as measuring the hydration status using subjective methods by observing urine color, which relies on the researcher's perception of urine color and categorizing it based on a self-created urine check card.

Conclusion

There was a significant relationship between energy sufficiency levels and work fatigue among fishermen. This indicates a moderately strong negative correlation, suggesting that, as the energy sufficiency level decreases, work fatigue increases. There was a significant relationship between hydration status and work fatigue among the fishermen. This indicates a weak positive correlation, suggesting that, as the hydration status worsens, work fatigue also increases. Future research should explore other factors related to occupational fatigue, such as workload, job stress, shift work, and sleep quality. Hydration status can be measured using more objective methods such as urine specific gravity.

In addition, the Health Office can provide guidance related to fishermen's Health Post or Pos Upaya Kesehatan Kerja (Pos UKK) facilitated by community health centers (Puskesmas) to enhance the understanding and awareness of workers' health. The Health Office can also advocate the local government for the procurement of medical equipment at Pos UKK and establish multisector collaboration.

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