THE IMPACT OF PHYSICAL FITNESS ON ACUTE MOUNTAIN SICKNESS INCIDENCE: A STUDY AT MOUNT BUTHAK BATU MALANG

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Abstract

Background: *Nowadays, hiking has become a highly favored trend among all groups. What is very much needed before hiking is to ensure that the body is in a healthy condition by maintaining physical fitness. This is because during hiking, the body requires energy to prevent injuries and altitude sickness, also known as Acute Mountain Sickness.* ***Objective:*** *To determine the Relationship between Physical Fitness and Acute Mountain Sickness (AMS) on Mount Buthak, Batu Malang Regency.* ***Method:*** *This study is a non-experimental research using a correlational analytic design with a cross-sectional time approach. The population in this study is 150 climbers with a sample size of 109 climbers using simple random sampling technique. The independent variable in this study is physical fitness while the dependent variable is Acute Mountain Sickness. The instruments used are a physical fitness questionnaire and an Acute Mountain Sickness questionnaire. Data analysis in this study uses Spearman's rho Test with the assistance of SPSS software for Windows version 25.* ***Results:*** *The statistical test results of the relationship between physical fitness and Acute Mountain Sickness obtained a significance value of $p < 0.05$ which means that H1 is accepted.* ***Conclusion:*** *The statistical test results of the relationship between physical fitness and Acute Mountain Sickness obtained a significance value of $p < 0.05$ which means that H1 is accepted, thus it can be concluded that there is a relationship between Physical Fitness and Acute Mountain Sickness (AMS) on Mount Buthak, Batu Malang Regency. Most respondents maintain good physical fitness, and half of the respondents experience Acute Mountain Sickness with a mild category.*

Keywords: Physical Fitness, Acute Mountain Sickness, Climbers

INTRODUCTION

Climbing at altitudes above 2,400 meters above sea level, the problem that often arises is Acute Mountain Sickness (AMS). AMS occurs because the body does not adapt well, characterized by headaches, digestive problems, difficulty sleeping, dizziness, and fatigue. Other symptoms include shortness of breath, especially when sleeping. If not addressed, AMS can lead to potentially fatal brain and lung edema (Nurajab, 2019).

In 2019, 11 people died on Everest, partly due to AMS. The

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number of climbers on Mount Rinjani, West Nusa Tenggara, increased, reaching 91,412 people in 2016, 30% of whom were from abroad. BASARNAS data shows 12 mountain accidents in 2019, 17 in 2016 and 2017, and 23 in 2018, with 6 deaths. In Pherice, Nepal, 43% of climbers experience AMS at an altitude of 4,343 meters. Studies in Colorado show a 22% incidence of AMS at altitudes of 1,850 meters to 2,750 meters, and 42% at 3,000 meters (Sari et al., 2023).

Interview studies with 5 climbers on Mount Buthak show that lack of physical preparation, especially physical fitness, can cause vomiting and dizziness during climbing. They experience discomfort and other health impacts. AMS, which occurs at altitudes above 2,400 meters above sea level, is the result of the body's inability to adapt, characterized by headaches and other symptoms in individuals who are not acclimatized during climbing.

Factors influencing AMS include altitude, climbing speed, alcohol consumption, fatigue, and lack of physical preparation. Symptoms of altitude sickness can occur at a minimum altitude of 2,500 meters, with serious symptoms occurring at 3,000 meters. Altitudes above 1,500 meters begin to affect humans, especially the respiratory system (Nurajab, 2019). AMS more commonly occurs in young men who climb quickly. The body adapts by increasing ventilation and the oxygen needs of muscles during rest. The adaptation process takes several days at high altitudes (Ariyanto et al., 2017).

AMS is a high-altitude illness that occurs in those who do not acclimatize before climbing. The acclimatization process is important to reduce fatigue and prevent acute climbing illnesses, even death. Therefore, it is important for climbers to undergo the acclimatization process to adjust the body to the altitude. Sport Development Index (SDI) is an index that reflects the success of sports development based on open space, human resources, community participation, and physical fitness. To be a good climber, technical skills, environmental understanding, and good physical fitness are needed. Good physical fitness can help minimize the occurrence of AMS (Sari et al., 2023). The purpose of this

research is to determine the Relationship between Physical Fitness and Acute Mountain Sickness (AMS) on Mount Buthak, Batu Malang Regency.

METHOD

This research uses a quantitative approach due to the empirical model and measurements based on existing theories, and the data obtained are then analyzed using statistics to answer or test research hypotheses. The time approach in this research is using a cross-sectional approach, which means this research emphasizes the timing of measuring or observing independent and dependent variable data only once at that time. In this type, independent and dependent variables are assessed simultaneously at a specific time, so there is no follow-up. The characteristics of this research are to search, explain a relationship, estimate, and test based on existing theories (Nursalam, 2020).

The population of this research is all climbers on Mount Buthak. The sampling technique in this research uses simple random sampling technique with 109 respondents. This study was conducted in November 2023 at Mount Buthak, Batu Malang. The data analysis used in this research is the Spearman's rho test with the assistance of SPSS software for Windows version 25.

RESULT

General data on the characteristics of respondents in Mount Buthak climbers in Batu Malang Regency described in the form of a table

Table 1 Distribution of Respondents Based on Characteristics of Climbers

No	Characteristics	*f*	*Percentage*
	Age		
1.	Teenagers 13 – 18 Years	13	12 %
2.	Old Adults 19 – 38 Years Old	96	88 %
	Gender		
1.	Male	75	68, 8 %
2.	Female	34	31,2 %
	Total	109	100 %

From table 1, it can be concluded that 109 (100%) respondents are mostly adults aged 19 - 38 years old, with 96 (88%) respondents falling into this age group. The majority of respondents are male, with 75 (68.8%) respondents being male.

This section explains specific data on Physical Fitness and Acute Mountain Sickness (AMS) among climbers in Mount Buthak, Batu Malang Regency, as well as the relationship between Physical Fitness and Acute Mountain Sickness (AMS) among climbers in Mount Buthak, Batu Malang Regency.

Table 2 Frequency Distribution of Respondents Based on Specific Data Among Climbers in Mount Buthak, Batu Malang Regency

No	Specific Data	*f*	*Percentage*
	Physical fitness		
1.	Poor	3	3 %
2.	Fair	14	13 %
3.	Moderate	20	18 %
4.	Good	58	53 %
5.	Excellent	14	13 %
	AMS		
1.	Mild	55	50 %
2.	Moderate	36	33 %
3.	Severe	18	17 %
	Total	109	100 %

From table 2, it can be seen that the majority of respondents who climbed Mount Buthak stated that they have good physical fitness, with 58 (53%) respondents falling into this category. Half of the respondents who climbed Mount Buthak experienced mild Acute Mountain Sickness, with 55 (50%) respondents falling into this category.

Table 3 Cross Distribution of the Relationship between Physical Fitness and Acute Mountain Sickness (AMS) in Mount Buthak, Batu Malang Regency.

Physical Fitness	*Acute Mountain Sickness*			
	Severe	Moderate	Mild	Total
Poor	3 (100%)	0 (0%)	0 (0%)	3 (100%)
Fair	14 (100%)	0 (0%)	0 (0%)	14 (100%)
Moderate	1 (5%)	19 (95%)	0 (0%)	20 (100%)
Good	0 (0%)	17 (29%)	41 (71%)	58 (100%)
Excellent	0 (0%)	0 (0%)	14 (100%)	14 (100%)

Based on table 3, it can be concluded that 14 (100%) respondents with poor physical fitness experienced severe AMS, and 19 (95%) respondents with fair physical fitness experienced moderate AMS. There are 41 (71%) respondents with good physical fitness who experienced mild AMS.

DISCUSSION

The research analysis in this study used Spearman's rho test with a significance level of $\alpha = 0.05$, and the calculations were performed using the SPSS for Windows software, resulting in a significance value of $p = 0.000$. This indicates that $p < \alpha$ ($0.000 < 0.05$), which means that H1 is accepted, indicating a relationship between Physical Fitness and Acute Mountain Sickness (AMS) in Mount Buthak, Batu Malang Regency. The test results also showed a positive correlation coefficient of 0.816, indicating a strong positive relationship between the two variables. This means that the higher the physical fitness, the lower the

occurrence of AMS in Mount Buthak, Batu Malang Regency.

This research is in line with the Chi-Square test results showing a significant relationship between the level of physical activity and Acute Mountain Sickness in Mountain Climbers (p = 0.034). Respondents in this study were dominated by the age group of 19-39 years with variations in the level of physical activity from moderate category (50%) to heavy (40.7%). All respondents experienced Acute Mountain Sickness incidents from mild category (73.7%) to moderate (23.7%). In the group of respondents with a high level of physical activity category, the majority (73.3%) of them only experienced mild Acute Mountain Sickness. Conversely, in the group of respondents with low physical activity, the majority (62.5%) of them experienced moderate Acute Mountain Sickness (Permatasari & Sidarta, 2021).

This value indicates that the higher the level of physical activity of climbers, the higher the prevalence of mild AMS compared to moderate and severe AMS. The majority of respondents experienced mild AMS with moderate physical activity, as they usually only walk or cycle every day. In addition, it is important for climbers to prepare well before climbing to reduce the risk of AMS-related illnesses. These findings can provide climbers with considerations to improve safety by understanding the importance of physical activity before climbing to avoid AMS incidents (Permatasari & Sidarta, 2021).

From a physiological perspective, mountain climbing is considered a physically demanding activity. Mountain climbers need to be in good physical condition to be able to climb without easily getting tired. In addition, the body undergoes adaptation to changes in air pressure due to changes in altitude from sea level. Therefore, a climber must have an adequate level of physical activity to be able to climb effectively. The results of this study are consistent with the explanation above, where the majority of climbers who were subjects of the study had moderate to high levels of physical activity (Husnul, 2023).

AMS is a disease caused by the body's inability to adapt to high

altitudes. This occurs due to rapid ascent without the body adapting to the different pressures on the mountain (Putra et al., 2020). Hypoxia is known as the main cause of AMS. The severity of this disease is closely related to the speed of ascent and the maximum altitude reached. Typically, individuals with other illnesses (such as diarrhea and upper respiratory tract infections) have a higher risk of experiencing AMS. Headache remains a typical symptom of AMS, characterized by throbbing, bilateral headaches, especially in the front of the head. These symptoms usually worsen in the morning, when lying flat, and also during strenuous exercise. To determine whether a climber is experiencing AMS or not, a physical examination and diagnostic tests can be performed to confirm the diagnosis. However, screening evaluations can also be conducted using validated questionnaires (Wahyuni & Rahmani, 2022).

From the research results, respondents with very good and good physical fitness categories experienced AMS with mild category, but there were also those who experienced moderate AMS because during the ascent, respondents felt that with good physical fitness, they could pass through the route on Mount Buthak without knowing the very long climbing route and steep terrain. Respondents pushed their bodies too hard, resulting in electrolyte imbalance causing moderate symptoms of headache, nausea, moderate weakness (lack of focus), moderate dizziness (confusion). Out of 72 respondents with very good and good physical fitness who experienced moderate AMS, 17 were male respondents and 14 were female respondents.

Respondents with sufficient physical fitness experienced moderate AMS, but there was 1 respondent with sufficient physical fitness who experienced severe AMS because the respondent believed that the climbing route on Mount Buthak was not long and the terrain was gentle or not too high, so the respondent pushed their body too hard, resulting in severe electrolyte imbalance, decreased consciousness marked by hypothermia, low body temperature which caused severe

headache, severe nausea, severe weakness, long-term fatigue effects, severe dizziness (blurred vision) and the respondent was female (Wahyuni & Rahmani, 2022).

Respondents with poor and very poor physical fitness experienced severe AMS because they believed that the climbing route on Mount Buthak was not long and the terrain was gentle or not too high, so they pushed their bodies too hard, resulting in severe electrolyte imbalance, decreased consciousness marked by hypothermia, low body temperature which caused severe headache, severe nausea, severe weakness, long-term fatigue effects, severe dizziness (blurred vision), with 10 male respondents and 8 female respondents.

The research results from climbers on Mount Buthak, Batu Malang Regency, show a relationship between physical fitness and Acute Mountain Sickness. This is because a person's physical condition will determine their success level in mountain climbing, as the common challenge faced by mountain climbers during the ascent is the drastic decrease in stamina when approaching the peak.

This condition occurs when oxygen becomes scarce with the climbing route of Mount Buthak being associated with dense forests that cause oxygen levels to drop, especially during night climbs, leading to a situation where climbers start to lose balance and control over their bodies, highlighting the importance of prime physical condition. The main cause of acute mountain sickness is often due to insufficient good physical fitness before climbing and underestimating the difficulty of the climbing route.

Many respondents complain that this issue significantly disrupts the climbing process, especially when lack of physical fitness preparation leads to symptoms of acute mountain sickness. If these symptoms are not promptly addressed, they can worsen and pose a serious threat to the climbers' lives. While this can be managed, in remote and high-altitude climbing locations, immediate assistance may not be readily available. Therefore, climbers are advised to minimize the occurrence of AMS by ensuring physical fitness and

warm-up exercises before embarking on the climbing journey.

The higher the level of physical activity prepared through physical preparation before climbing, the higher the prevalence of AMS. Through the appropriate level of physical activity, climbers are expected to achieve good fitness, especially in the efficient utilization of oxygen in the body (Elvira, 2015). When AMS strikes the body, air pressure and PaO2 tend to decrease with increasing altitude. Resting ventilation increases, and the oxygen demand of muscles also increases as altitude rises. Gas exchange and oxygen flow affect exchanges within the lungs. Decreased oxygen concentration in the body results in decreased PaO2 and blood oxygen saturation, causing the body to use more oxygen during climbing. Good fitness allows the body to use oxygen in the blood more efficiently. The level of physical activity is not the sole determinant of AMS symptoms. Other factors also influence AMS symptoms, such as migraines, acetazolamide use, and geographical location (Richalet et al., 2012).

CONCLUSION

From the research entitled "The Relationship between Physical Fitness and Acute Mountain Sickness (AMS) on Mount Buthak, Batu Malang Regency" involving 109 respondents, several conclusions can be drawn: 1) the majority of respondents who climbed Mount Buthak showed good physical fitness. 2) Half of the respondents who climbed Mount Buthak experienced Acute Mountain Sickness (AMS) in the mild category. 3) There is a relationship between physical fitness and Acute Mountain Sickness on Mount Buthak, Batu Malang Regency.

Recommendations that can be given: For the respondents, it is recommended to ensure a healthy body condition by engaging in physical fitness at least 2 weeks before the climb to facilitate the body's adaptation to the terrain. It is also important to bring energy food and check the logistics of food and drinks before the climb to minimize the risk of AMS. For the basecamp managers, it is hoped that they provide information and education on increasing energy intake and physical

fitness before climbing Mount Buthak, Batu Malang Regency to reduce the risk of AMS for climbers. It is also necessary to consider adding health posts to reduce emergencies, such as climber deaths. For future researchers, it is recommended to investigate the relationship between physical fitness and AMS more comprehensively to gain a deeper understanding of the impact of AMS on mountain climbing, considering the increasing interest of the public in this activity.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to all those who contributed to the completion of this research on "The Impact of Physical Fitness on Acute Mountain Sickness Incidence: A Study at Mount Buthak Batu Malang."

First and foremost, we extend our heartfelt appreciation to the participants of this study, whose cooperation and involvement were indispensable in gathering the necessary data and insights. Their willingness to share their experiences and engage in the research process greatly enriched our understanding of the topic.

We would also like to thank the management and staff of Mount Buthak Batu Malang for granting us permission to conduct our research within their premises. Their support and cooperation throughout the duration of the study were instrumental in ensuring its smooth execution.

Additionally, we are grateful to our academic advisors IIK NU Tuban and mentors for their guidance, support, and valuable feedback throughout the research process. Their expertise and insights have been invaluable in shaping the direction and methodology of this study.

Last but not least, we acknowledge the support of our friends and family members, whose encouragement and understanding sustained us during the challenges of the research journey.

This research would not have been possible without the collective efforts of all those mentioned above, and for that, we extend our heartfelt thanks.

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