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Development of Instrument Physical Abilities Mountaineers (Validity And Reliability Test Physical Fitness And Motor Fitness Mountaineers)

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ABSTRACT

Introduction; Outdoor sports activities require excellent skills in situations of high physical stress, so physical condition plays a vital role in supporting the success of mountaineering. **Objectives;** This study aims to test the validity and reliability of the physical fitness and motor fitness components as a reference for determining the optimal physical performance of mountain climbers. **Methods;** The method used is Research and Development, the participants this 7 mountaineers on 18 peaks for 12 days at an altitude of 3000 MDPL in Indonesia. The sampling technique used was total sampling. The analysis used is content validity and construct validity. Data analysis was carried out, namely the first to sixth steps, namely the stage of developing standard indicators for physical abilities components in terms of physical fitness and motor fitness. The seventh to tenth steps are the instrument development stage. The small-scale test was used as a product development trial to test the validity and reliability of the test instrument. A large-scale test to develop norms and standards for assessing mountaineer's physical abilities test instruments. **Result;** The components of developing the physical abilities test for mountaineers include physical fitness factors, including cardiorespiratory endurance fitness (Balke test), muscular strength and power (jump decathlon test), muscular endurance (wall squat test), flexibility (Static Flexibility Test – Hip and Trunk), body composition (BMI and % fat content). Motor fitness factors include speed (running 35 m speed test), agility (hexagonal

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obstacle test), coordination (Hand and eye coordination test), balance (standing stroke test), and reaction time (whole-body reaction). **Conclusion;** the physical abilities component of mountaineers has a substantial correlation value, and the test instrument can be used as an evaluation method to measure mountaineers' physical and motor fitness.

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1. Introduction

In this section the author should be able to provide background on topics or issues related to the research according to the development of the current situation and conditions. Explain why researchers take this topic and why researchers think of this as an important topic. Reveal about previous research related to research and gaps in these studies. Please see the sample of introduction below.

Mountains are one of the most popular tourist destinations among outdoor enthusiasts. Millions of hikers (trekkers) and mountain climbers (hikers) visit mountainous areas for different purposes. This shows that the mountains have become a mass tourist destination for connoisseurs of activities at high altitudes. Mountaineering is an adventure sport that outdoor activists have long practiced based on physical activity, challenges, and exercise media for risk-taking (Apollo, 2017). Because mountaineering has become mass tourism due to the increasing frequency of visits to mountainous areas, it will also impact significant ecological changes. These ecological changes have positive and negative impacts. However, it is very worrying that there will be many negative changes in the surrounding environment if they are not addressed early on (Apollo & Andreychouk, 2020). Ecological changes include outdoor activists, especially mountain climbers. The majority need to gain fundamental knowledge of mountain climbing activities due to the democratization process, facilitated by convenience, including climbing administration, still attaching importance to personal economic needs with many climbing service agents. Uncertified climate change around the hiking trails due to uncontrolled human activities on the hiking trails and the cleanliness of the mountain will be polluted with much garbage on the hiking trails (Beedie & Hudson, 2003).

Climbing a mountain means stepping into a space of ignorance filled with uncertainty (Gilchrist, 2008). This statement implies that climbing a mountain is the same as challenging the dangers that at any time turn into a disaster, even death. Such harsh natural challenges are the main attraction for adventurous people. This means that not all mountain climbers will experience the things they fear because, with common sense, people can control the dangers around them so that accidents do not happen to them (Rokowski et al., 2017).

The primary role of success in mountain climbing is not only viewed from one side, but all components contribute. One of these points, for example, regarding physical and mental conditions, is the most critical requirement. The basic concept of safety is that accidents are more likely to occur in physically, psychologically, and socially unfit people. Thus, people who are healthy or fit physically and mentally can reach the top of the mountain and complete the climb (Sukarmin, 2016). Furthermore, the components of mountain climbers' physical condition (physical ability) can be determined by the level of general fitness and motor or special fitness. The description of the general fitness level consists of 1) Endurance (cardiorespiratory fitness); 2) Muscular strength; 3) Muscular endurance; 4) Flexibility; 5) Body composition, and at a specific level of fitness (motor), including 1) Speed; 2) Agility; 3) Balances; 4) Coordination, and 5) Reaction Time (Cooke, Bunting, and Hara 2010). Physical ability training plays a critical role in mountaineering activities. Since success in sports often requires excellent skill in situations of high physical stress, it is clear that physical condition plays a significant role in supporting successful climbing (Blake et al., 2017; Chamim et al., 2022).

Furthermore, physical conditions become the main capital in a climb where, if a climber has an excellent dynamic health degree, the climber has to walk for hours in unpredictable weather conditions without any burden. The body has many benefits if the climber has

DOI: xxx
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physical fitness in the good category. Thus the factor of physical condition (Physical ability) becomes the principal capital in mountaineering activities and requires climbers to adapt to time quickly, weather, steep roads, and objective and subjective hazards (Rahman et al., 2018). Therefore, the physical exercise program (periodization training) must be well planned and systematically arranged to benefit functional abilities and improve physical fitness so that mountain climbing is most likely to be achieved successfully and safely (Sidik et al., 2019).

A scientific discipline requires evaluation to determine the extent to which the program has achieved particular success. All the goals and objectives can be known as success from what has been evaluated and measured. Evaluation, with tests as a measuring tool and measurement as a data collection process, is a job that must be done to determine the extent to which an effort has achieved the expected results. Based on this explanation, the researchers tested the physical abilities test evaluation tool for mountaineers of 18 peaks for 12 days at an altitude of 3000 MDPL in Indonesia.

2. Methods

The method in this research is Research and Development. The development of research instruments determines to what extent something is valuable, of quality, or value to the instrument. Development focuses on the product or effect produced under all the instructional objectives that should be achieved. The development of the instrument has several stages, such as determining the constructs, variables, characteristics of the type of measurement, types of measurement instruments, validity, and reliability in measuring instrument assessments. This research aims to develop a mountain climber's physical abilities test product.

2.1 Participant

We collected data from 7 mountaineers aged between 18 and 19 years (ages 18 = 4 and 19 = 3), and they were elite mountaineers with 20 mountaineering experiences/year.

2.2 Population & Sample

The population in this study is members of extracurricular PAMOR (Pencinta Alam Mahasiswa Olahraga) Universitas Pendidikan Indonesia participated in the selection to become a climbing team totaling 7 mountaineers. The sample is a subgroup of the target population determined by the researcher to be studied. It is from this sample that the researcher obtains the necessary information (Fraenkel et al., 2012). The sampling technique used in this study is total sampling. Total sampling is a technique where the number of samples equals the population, and the total population is less than 100 (Fraenkel et al., 2012). The number of samples is the total population of 7 mountaineers.

DOI: xxx
p-ISSN 2807-1611 e-ISSN 280701638

2.3 Instrument

The instrument used in this study was a systematic observation, using a battery test consisting of components in physical abilities (motor fitness and physical fitness). The instrument has not been tested for validation and reliability, so an in-depth study of the test aid is needed.

2.4 Procedure

The procedure for developing a physical abilities test consisting of motor fitness and physical fitness (Morrow, Mood, and Disc, 2015) is as follows:

1. The first step is to review the criteria for a physical abilities test consisting of motor fitness and physical fitness based on references that are considered appropriate to the needs of this study. This criteria for a review of several components of mountain climbers' physical abilities, including endurance, cardiorespiratory fitness, muscular strength and power, muscular endurance, flexibility, body composition, speed, agility, coordination, balance, and reaction time (Cooke, Bunting, and Hara 2010).
2. The second step is to analyze the physical skills of the sport that will be measured and used as experimental test items. The test items for each component of mountain climbers' physical abilities include the balke test, jump decathlon test, wall squat test, Test – Hip and Trunk, BMI & fat percentage, 35-meter speed test, hexagonal obstacle test, Hand and eye coordination test, standing stroke test, whole-body reaction (Winter et al. 2016; Mackenzie, 2005b; Jaiswal, 2018; Mackenzie, 2005a; Morrow, Mood, and Disc, 2015).
3. The third step is to conduct a literature review. Based on the literature review and discussions with experts, the indicators for physical abilities (motor fitness and physical fitness) are as follows:
4. *Physical fitness* of endurance cardiorespiratory fitness (balke test); muscular strength and power (jump decathlon test); muscular endurance (wall squat test); flexibility (Static Flexibility Test – Hip and Trunk); body composition (BMI and fat percentage)
5. *Motor fitness* of speed (running 35 meters speed test); agility (hexagonal obstacle test); coordination (Hand and eye coordination test); balance (standing stroke test); reaction time (whole-body reaction).
6. The fourth step is a pilot study or small-scale trial of the instrument that the experts have agreed upon to obtain an initial score as material for testing the validity and reliability of the instrument.
7. The fifth step is to get the value of validity and reliability on a small scale.
8. The sixth step is to determine test norms and standards using large-scale tests.
9. The seventh step is to construct the test for the final product.

DOI: xxx
p-ISSN 2807-1611 e-ISSN 280701638

2.5 Data Analysis

The data analysis technique in this study analyzed the validity of the content validity and construct validity tests. Furthermore, the reliability test in this study used the test-retest method, and the reliability coefficient was calculated using Cronbach's alpha. The next step is to determine the norm with a large-scale trial.

The data is measured using a battery test by changing the data in the form of a z score using the following formula:

$$ZScore = \frac{x - \underline{x}}{St.dev}$$

Furthermore, the processing results from the Z-score are converted into T-score data to equate the units, while the formula is as follows:

$$TScore = 50 \pm 10^{*}\left(\frac{x - \underline{x}}{St.Dev}\right)$$

The next step is testing the validity and reliability based on the overall score.

3. Results

The results of the data analysis are as follows:

3.1 Testing Validity and Reliability on a Small Scale

Validity and reliability of the test instrument using the test-retest test or the data obtained from two observations using the same instrument.

3.1.1 Mountaineers Physical Abilities Validity Test

The results of testing the validity of the mountain climber's physical abilities test instrument are as follows:

DOI: xxx
p-ISSN 2807-1611 e-ISSN 280701638

Table 1. Results of the Physical Abilities Instrument Validity Test for mountaineers

Component	Subcomponents	r count	r table	Information
Physical fitness	*Endurance cardiorespiratory fitness*	0.914	0.669	Valid
	muscular strength and power	0.759		Valid
	muscular endurance	0.893		Valid
	flexibility	0.896		Valid
	body composition	0.746		Valid
Motor fitness	*Speed*	0.792		Valid
	Agility	0.735		Valid
	Coordination	0.896		Valid
	Balance	0.907		Valid
	Reaction time	0.735		Valid

Table 1 shows that the research test results are compared with the value of r table N=7 with a 5% significance level of 0.669.

3.1.2 Mountaineers Physical Abilities Reliability Test

The results of the reliability test in this study are as follows:

Table 2. Physical Abilities Reliability Test Results in Mountaineers

Component	Subcomponents	Cronbach's Alpha Coefficient	Information
Physical fitness	*Endurance cardiorespiratory fitness*	0.947	Reliable
	muscular strength and power	0.936	Reliable
	muscular endurance	0.946	Reliable
	flexibility	0.938	Reliable
	body composition	0.944	Reliable
Motor fitness	*Speed*	0.946	Reliable
	Agility	0.937	Reliable
	Coordination	0.938	Reliable
	Balance	0.938	Reliable
	Reaction time	0.946	Reliable

The reliability testing results on all test instruments show a reliability coefficient value > 0.6. These results show that all mountain climbers' physical abilities test instruments are reliable and feasible for large-scale research data collection.

DOI: xxx
p-ISSN 2807-1611 e-ISSN 280701638

3.2 Norms and Standards for Assessment of Physical Abilities for Mountaineers

The data collection results in large-scale tests are used to make norms and standards for assessing mountain climbers' physical abilities. The preparation of norms and assessment standards is based on the Norm Reference Benchmark (PAN), which is based on the calculated mean and standard deviation. Formulation of the formula for calculating norms and standards using4 categories: very good, good, moderate, and low. The formula for determining the criteria, according to Sugiyono (2013), is as follows:

Table 3. The formula for the Calculation of Norms and Standards

(Sugiyono 2013)

Criteria	Formula
Very good	X≥ (M + 1,5SD)
Good	M ≤ X< (M + 1,5SD)
Enough	(M - 0,5SD) ≤ X< M
Low	(M - 1,5SD) ≥ X

The results of large-scale test data and the calculation of the norms and standards of test assessment *physical abilities of* Mountain climber is as follows:

Table 4. Descriptive Test of Physical Abilities Mountaineers

Component	Subcomponents	N	Minimum	Maximum	Mean	Std. Deviation
Motor Fitness	*Endurance cardiorespiratory fitness*	7	46.23	52.41	49.07	2.192
	Muscular strength and power		45	58	50.86	4.706
	Muscular endurance		65	88	76.43	8.923
	Flexibility		29.3	43.6	37.3	5.069
	Body composition		15.15	20.85	18.68	2.306
Motor Fitness	*Speed*		4.00	5.59	4.84	0.57
	Agility		12.46	13.44	13.13	0.422
	Coordination		12	18	15	2.081
	Balance		45	62	50	6.083
	Reaction time		5	8	6.29	0.951

Based on the table, each component's *physical abilities* of the Mountain climber are distributed in calculating norms and standards. The distribution results are as follows:

DOI: xxx
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Table 5. Norms and Standards of Assessment of Each Physical Abilities Component of Mountaineers

Endurance cardiorespiratory fitness

Score Interval			Criteria
	X ≥	52.36	Very good
49.07	≤ s.d <	52.36	Good
47.97	≤ s.d <	49.07	Enough
	X ≤	45.78	Low

Speed

Score Interval			Criteria
	X ≥	5.70	Low
4.84	≤ s.d <	5.70	Enough
4.56	≤ s.d <	4.84	Good
	X ≤	3.99	Very good

Muscular strength and power

Score Interval			Criteria
	X ≥	57.92	Very good
50.86	≤ s.d <	57.92	Good
48.51	≤ s.d <	50.86	Enough
	X ≤	43.80	Low

Agility

Score Interval			Criteria
	X ≥	13.76	Low
13.13	≤ s.d <	13.76	Enough
12.92	≤ s.d <	13.13	Good
	X ≤	12.50	Very good

Muscular endurance

Score Interval			Criteria
	X ≥	89.81	Very good
76.43	≤ s.d <	89.81	Good
71.97	≤ s.d <	76.43	Enough
	X ≤	63.05	Low

Coordination

Score Interval			Criteria
	X ≥	18.12	Very good
15	≤ s.d <	18.12	Good
13.96	≤ s.d <	15.00	Enough
	X ≤	11.88	Low

Flexibility

Score Interval			Criteria
	X ≥	44.90	Very good
37.3	≤ s.d <	44.90	Good
34.77	≤ s.d <	37.30	Enough
	X ≤	29.70	Low

Balance

Score Interval			Criteria
	X ≥	59.12	Very good
50	≤ s.d <	59.12	Good
46.96	≤ s.d <	50.00	Enough
	X ≤	40.88	Low

Body composition

Score Interval			Criteria
	X ≥	22.14	Very good
18.68	≤ s.d <	22.14	Good
17.53	≤ s.d <	18.68	Enough
	X ≤	15.22	Low

Reaction Time

Score Interval			Criteria
	X ≥	7.72	Very good
6.29	≤ s.d <	7.72	Good
5.81	≤ s.d <	6.29	Enough
	X ≤	4.86	Low

After calculating the norms and standards of physical skill tests for each component, then the overall physical abilities of mountain climbers are calculated. Because the data is measured using a battery test, the normal calculation results are as follows.

Table 6. Norms and Standards for Assessment of Physical Abilities for Mountaineers

Score Interval			Criteria
	X ≥	631.48	Very good
501.15	≤ s.d <	631.48	Good
457.71	≤ s.d <	501.15	Enough
	X ≤	370.83	Low

DOI: xxx
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4. Discussion

Physical conditions are the main capital in a climb where, if a climber has good dynamic health. Without any burden, the climber has to walk for hours in unpredictable weather conditions. The body has many benefits if the climber has physical fitness in the good category. Thus the factor of physical condition (Physical ability) becomes the main capital in mountaineering activities and requires climbers to quickly adapt to time, weather, steep roads, and objective and subjective hazards (Rahman et al., 2018). Therefore, the physical exercise program (periodization training) must be well planned and systematically arranged to benefit functional abilities and improve physical fitness so that mountain climbing is most likely to be achieved successfully and safely (Sidik et al., 2019). In addition, the risk is caused by a lack of physical preparation. The changes caused by altitude are metabolic changes marked by increased carbohydrate oxidation (CHO) on total energy expenditure (Brooks et al., 1991). To reduce the risk of climbing accidents caused by decreasing physical condition, they need to optimize the performance of aerobic metabolism (Mcclelland et al., 1998). So the importance of an accurate plan in forming physical conditions in mountaineering because activities carried out at high altitudes also affect aerobic and anaerobic performance (Gore et al., 1996), given the validity and reliability of an instrument.

5. Conclusion

The physical abilities component of mountain climbers has a strong correlation value. The test instrument can be used as an evaluation method to measure mountain climbers' physical and motor fitness.

6. Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

7. References

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