Relationship between Leg Muscle Strength and Arm Muscle Strength with The Results of The Landing Accuracy of Paragliding Athletes

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Abstract. Paragliding is an extreme sport that is experiencing increasing interest in Indonesia. One of the championship numbers in paragliding is the accuracy of landing. The purpose of this study was to ascertain how paragliding athletes' arm and leg muscle strength correlated with landing precision. 39 paragliding athletes were studied cross-sectionally using a total sampling technique. The following tools were utilized in this study: a hand and back dynamometer for measuring arm muscle strength, a dynamometer for measuring leg muscle strength, and a dynamometer for measuring landing accuracy at the first foot on the ground. The findings indicated that landing precision was substantially correlated with leg muscular strength ($p = 0.00$). In contrast, arm muscle strength was not related to landing accuracy results ($p => 0.05$). This study concludes that leg muscle strength is a significant factor in obtaining good landing accuracy results.

Keywords: Leg muscle strength, arm muscle strength, landing accuracy, paragliding.

1 Introduction

Sports fly free with a parachute by launching from a mountain or slope and using the wind. Using the wind as a source of lift, the parachute soars far into the air. The two types of wind that make up the flying mechanism are the dynamic lift—a rising wind that hits and follows the contour of the slope—and the thermal lift (thermal lift) [1]. By utilizing these two sources, the pilot can stay in the air and fly high and reach great distances. Interestingly, all that is done is machine-free, solely taking advantage of the wind[2]. FASI is the governing body for paragliding in Indonesia (Federation of Aero Sport Indonesia) [3].

Some people engage in paragliding for recreation or achievement. Some of the numbers competed in the paragliding sport include accuracy in landing, limited-distance trails, and open-distance crossings [4]. The precision of tandem landing, which involves taking off with passengers and landing at a specific location, was one of the additional races that took place in Indonesia. The number of pilots in Indonesia has dramatically expanded in recent years. The rise in the number of competitors in the paragliding competitions, which are held throughout Indonesia, may be seen as a result of the landing accuracy number.

Several factors can influence the landing accuracy number, which is a result. Among these are the wind factor, the level of exertion, the capacity to focus, the adequacy of the parachute for

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the user's weight, and physical fitness. The athlete adjusts the height, low, and parachute speed during in flight using the wind's direction and speed. The athlete's capacity to raise or lower the flying position will be impacted by the wind's intensity or size in addition to its direction and speed. However, there is a major risk of getting dragged away if the athlete lands in strong winds because they will be closer to the location [5].

Accidents frequently happen during the championship (landing accuracy number), namely when the athlete makes a landing, and this is because of a variety of circumstances, including: the athlete forces too much to lower the height (this is worsened when lowering the height, the athlete's arm muscle strength is not balanced between togel (steering) right and left that are pulled unbalanced / not as expected), landing is not in the direction of the wind (crosswind / tailwind), this causes the athlete to force the parachute to land on the target by extending its legs as long as possible so that it can touch the target point, athlete's concentration (this can be caused by the athlete's intake (inadequate food or drink), physical fitness (one of the leg muscle strength must be strong,because the weakness of the leg muscles can cause ankle injuries during landing), the parachute's suitability for body weight (underweight or overweight that does not match the parachute's capacity will make the parachute challenging to control)[4].

This study seeks to ascertain whether there is a connection between dietary state, leg muscle strength, and arm muscular strength using the findings of paragliding athletes' landing precision.

1.1 Objective

This study aimed to determine the relationship between leg muscle strength and arm muscle strength with landing accuracy for paragliding athletes.

2 Literature review

2.1 Paragliding

Paragliding is branch sport aero/ aerial recreation where available one pilot operating parachute without use machine and can maintain position wind for can fly, stay be in position certain above or even cross an area. Sport paragliding different with hang-gliding aero sport nor skydiving. As for the difference lies in the type and shape the parachute used, where in paragliding parachute used shaped long and thin material[4]. FAI (Federation Aeronautique Internationale) has set a number of competed in the branch sport paragliding. That is including: Accuracy land, cross natural distance limited and cross natural open[4]. A number of race. The additions that are competed in the State of Indonesia are: accuracy tandem landing, i.e. flying with bring passengers and must landed at the point that has been determined.

2.2 Connection between Nutritional Status, Leg Length, Strength Muscle Limbs and Strength Muscle Arm with Accuracy Results Land

A number of studies related to nutritional status with concentration already once done, that is connection level adequacy energy, protein and nutritional status with concentration study students of SMP Purnama 1 Semarang City. With results there is significant relationship between nutritional status with concentration.

Leg length is another factor that support achievement of sport. On some branch of exercise, the length of limbs is factor determinant result match. At the championship paragliding, long limbs very help when attach to do landing at the target point. Research that has been conducted by Amin (2012) about donation long limbs to start swimmin. The more of limbs length of someone, then the more long / too far reach.

in line with long limbs, strength muscle limbs also become factor main that can support performance athlete. The more of limbs length of someone, structure muscle limbs will the more long too. At the championship paragliding, power muscle limbs used as focus at the moment landed. Happens often an accident (ankle) caused by a less athletes good at the moment landed. Which research support at the moment exercising is connection long limbs, strength muscle limbs and flexibility ankle against kick distance far away. Which shows results there is relationship Among strength muscle limbs with kick. This thing because the stronger muscle limbs someone, eat the more his kick is also strong [5]. Likewise when athlete To do landing, someone 's ankle Becomes strong and not easy injury.

3 Methods

36 paragliding athletes participated in this correlational descriptive study, which used a total sampling methodology. The main parachute, a backup parachute, a harness, a helmet, radio communication, and shoes are all used by athletes to complete the flight. A safety officer in charge of the operations oversees all flights. The launch marshal controls takeoff and is responsible for adjusting the fly distance, advising on acceptable wind direction (for senior athletes, wind should be toward the crosswind hill) and wind speed (0–15 knots) [6],[7]. A judge will measure the accuracy of the landing and determine whether or not athletes fall (in which case they receive a maximum value of 500cm).

4 Data collection

4.1 Measurement of Leg Muscle Strength

The tools used are the back and leg dynamometer. The measurement of leg muscle strength is done by trying to straighten the leg as hard as possible with a device already attached to the respondent's hip. Respondents were allowed to do three experiments. The resulting figures will be used in data analysis.

4.2 Measurement of Arm Muscle Strength

The tool used is the hand dynamometer. Measuring the strength of the arm muscles is done by squeezing the tool with all strength and alternating between the right and left arms.
Respondents were allowed to do three experiments. The resulting figures will be used in data analysis.

4.3 Determination of Landing Accuracy Results

A certified jury performs the measurements using a dead center disc with a digital system whose results are presented on a screen (measuring radius 0-22 cm) and meter (measuring radius 22cm-499 cm). When an athlete lands, measurements are taken, and the first step of the foot that contacts the ground is what is counted. The athlete will receive a maximum score of 500cm if they land in the landing area (fall in the landing area or contact the ground [3].

In order to characterize the key information, ascertain the frequency of all variables, and enable future analysis, secondary data as well as data received from the measurement of leg muscle strength, arm muscle strength, and landing accuracy results were analyzed univariately. Then, using the Spearman's correlation test, a bivariate analysis was carried out to ascertain the link between the variables. The analysis results are said to be related if the test results show a significance value of $p < 0.05$ and are said to be unrelated if the test results show a significance value of $p > 0.05$[8].

5. Results and discussion

5.1 Characteristics of Study Subject

The paragliding athletes that participated in this study ranged in age from 16 to 45, with a mean age of 29. Because there is no upper age limit for paragliding, the age range is significantly off. The capacity of competitors to pass exams to obtain a pilot license, unlike some sports generally, is a requirement to compete in the paragliding championship—the average response in the PL-1 licensed study (Pilot License 1).

Respondents in this study were paragliding athletes with 22 male athletes and 14 female athletes. At the time of the championship, match numbers are differentiated between men and women. In paragliding, the license category is qualified with the PL-1, PL-2, PL-3, and commercial pilots (master tandem), namely T-1, T2, and T-3. However, at the time of the championship, the participant category was distinguished between juniors (PL-1) who were considered new to be able to master basic paragliding techniques and seniors (PL-2 and PL-3) who had mastered advanced techniques (medium and high techniques). An overview of the characteristics of research subjects can be seen in table 1.

The nutritional status of respondents was almost evenly distributed, only at the lowest underweight nutritional status, namely only two people. In paragliding, athletes have long limbs capable of contributing to a long leg to step on the desired landing point. Based on the correlation test analysis results, it was found that the nutritional status was not related to the results of the landing accuracy of the paragliding athletes. This result is because, in paragliding, athletes use parachutes according to their body weight. Even if they have underweight, overweight, or obese nutritional status, athletes can use a suitable parachute for their body weight. So this does not affect the parachute's performance in going or lowering the altitude for landing.

Table 1. Overview of The Characteristics of Study Subjects.

Characteristics	Landing Accuracy Results (N = 36) (476.97 ± 121.49)						Amount		P
	0-22		23-499		500				
	n	%	n	%	n	%	n	%	
Gender									
Male	16	44.4	6	16.6	0	0	22	61.1	0.43
Female	7	19.4	7	19.4	0	0	14	38.9	
License									
PL-1	1	2.7	7	19.4	0	0	8	22.2	
PL-2	10	27.7	6	16.6	0	0	16	44.4	0.47
PL-3	12	33.3	0	0	0	0	12	33.3	
Nutritional Status									
Underweight	1	2.7	1	2.7	0	0	2	5.5	
Normal	5	13.8	9	25	0	0	14	38.9	
Overweight	9	25	1	2.7	0	0	10	27.7	0.40
Obes-1	8	22.2	2	5.5	0	0	10	27.7	

Correlation test using the Spearman's Test

5.2 The Relationship between Leg Muscle Strength and Accuracy of Landing Results

In table 2, it can be seen that there is a significant relationship between leg muscle strength and landing accuracy results (p = 0.00). This result is because the leg muscles can significantly contribute when the athlete makes a landing by stepping on the desired point.

Table 2. The Relationship between Leg Muscle Strength and Accuracy of Landing Results

Characteristics	Landing Accuracy Results (N = 36) (476.97 ± 121.49)						Amount		P-Value
	0-22		23-499		500				
	n	%	n	%	n	%	n	%	
Limb Muscle Strength (2.75 ± 1.40)									
Very less	2	5.5	7	19.4	0	0	9	25	
Less	4	11.1	4	11.1	0	0	8	22.2	0.00 *
Enough	5	13.8	2	5.5	0	0	7	19.4	
Good	7	19.4	0	0	0	0	7	19.4	
Very well	5	13.8	0	0	0	0	5	13.8	

Correlation test using the Spearman's Test

However, the better the leg muscle strength of the respondent, the better the results of the resulting landing accuracy. Strength is the driving force for every physical activity, plays a role in protecting athletes from injury, and can enable athletes to run, jump and support

appropriately. During the championship, accidents often occur when athletes make landings. Namely, one of them when the athlete forces to land at the desired point [9],[10].

5.3 The Relationship between Arm Muscle Strength and Landing Accuracy Results

Table 3 shows no significant relationship between arm muscle strength and landing accuracy results (p => 0.05). This result can mean that respondents with good arm muscle strength do not necessarily have good landing accuracy results, or respondents with poor strength do not necessarily get the results of poor landing accuracy either. The ability of athletes to regulate wind direction and parachute height, namely by having arm muscle strength, is not a significant factor in getting good landing accuracy results.

Table 3. The Relationship between Arm Muscle Strength and Accuracy of Landing Results

Characteristics	Landing Accuracy Results (N = 36) (476.97 ± 121.49)						Amount		P-Value
	0-22		23-499		500				
	n	%	n	%	n	%	n	%	
Right Arm Muscle Strength (2.11 ± 1.00)									0.23
Very less	7	19.4	7	19.4	0	0	14	38.9	
Less	2	5.5	4	11.1	0	0	6	16.6	
Enough	12	33.3	2	5.5	0	0	14	38.9	
Good	2	5.5	0	0	0	0	2	5.5	
Very well	0	0	0	0	0	0	0	0	
Left Arm Muscle Strength (2.11 ± 1.00)									0.29
Very less	7	19.4	7	19.4	0	0	14	38.9	
Less	2	5.5	4	11.1	0	0	6	16.6	
Enough	12	33.3	2	5.5	0	0	14	38.9	
Good	2	5.5	0	0	0	0	2	5.5	
Very well	0	0	0	0	0	0	0	0	

Correlation test using the Spearman's Test

6. Conclusion

It can be concluded that leg muscle strength can significantly contribute to the result of landing accuracy. Meanwhile, gender, license, nutritional status, and arm muscle strength were not the main factors in obtaining good landing accuracy results.

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