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Comparison Level of Handgrip Strength for the Three Categories among Male Athlete's Artificial Wall Climbing and Factors WILL Affect

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Abstract

The aim of this study is to compare the level of handgrip strength (HGS) in male's athletes between three different categories of climbing (boulder, lead, and speed) during competition. Grip strength refers to the ability of the fingers and hand to generate muscle power and force. In sport climbing, performance on climbing athletes are not only depending on handgrip strength but also other factors that should be consider such as anthropometry, finger strength, arm span, experiences in climbing and percentages of body fat. The research design is ex-post facto. The participants were 123 male athletes as subjects (boulders; 41, lead; 41, speed; 41) whose average age is 22.46±4 years. All of them are students of a university in Malaysia. The handgrip strength was measured statically using a hand dynamometer (handgrip). Descriptive statistics were used to explore the differences of handgrip strength in three categories. Descriptive data for boulder (M=102.646; SD=14.71), lead (M=92.42; SD=15.88), and speed (M=88.13; SD=16.43) were determined. The findings showed significant differences handgrip strength score in three categories of climbing [F (2,120) =9.26, p=0.000)]. Data analysis by using post hoc turkey test showed significance difference between boulder and lead (p=0.011), and boulder and speed (p=0.000). Significant difference showed in covariance variable of experience [F (1,115) = 21.41; P = 0.00, eta squared = 0.16], BMI [F (1,115) = 10.50; P = 0.002, eta squared = 0.084], finger strength power [F (1,115) = 60.39; P = 0.00, eta squared = 0.34], and percentage of body fat [F (1,115) = 5.73; P = 0.018, eta squared = 0.047]. Conclusion from this study indicate the level of handgrip strength. Based on the research, boulder climbing found to be stronger compare to lead climbers in handgrip strength. In sport climbing, another factors that should be focus on effected to handgrip strength also on climbing performance.

Keywords: Handgrip Strength, Boulder, Lead, Speed, Artificial Wall Climbing

Introduction

The handgrip strength refers to the hand gesture ability for hands and fingers to generate muscle power (Chang, Chou, Lin, Lin, & Wang, 2010). The handgrip strength is an important component for athletes in artificial wall and rock wall climbing sportss. It is one of the factors that can determine the performance of climbers during competition (Bourne, Halali, Vanwanseele & Clarke, 2011). Wall wall climbing sports requires high mental and physical strength where more on gymnastics movements while in climbing vertically upwards on an overhanging route in vertical wall and this sports activities where climbing with controlled and safe environment. (Fleming & Horst, 2010). Route is a critical path of climber that can be distinguished by the movement of techniques and strengths used by climbers (Jeremie, Ludovic, Romain, & Jean, 2015). The fact that climbing is undertaken both indoors and outdoors increases the attractiveness of this sport (Janot, Steffen, Porcari, & Maher, 2000; Nick, Dickson, Fryer, & Ellis, 2011; Fanchini, Violette, Impellizzeri, & Maffiuletti, 2013). There is also has a climbing gym where the climbers can improve and learn climbing techniques in safe conditions and in preparation for climbing a harder route. Artificial wall is the walls that have different structures according to the difficulty of the route. It made up from many type of materials such as multiplex off wood. The wall has a rock to grip known as a hold where use for foot and hand during climbing. Hold is a artificial stone that use to replace a real stone on artificial wall. The development of wall wall climbing sportss has been on international competitions at senior and junior levels. The increasing number of participation in this artificial wall climbing competition was recorded in 1997 by the "International Council for Climbing Competition" (ICC) and reinforced by the International Federation of Sport Climbing (IFSC). The main plan of the IFSC is to facilitate the development required during Olympic games. In 2007, a temporary recognition was awarded by the "International Olympic Committee" (IOC) to the IFSC for its involvement in this sport. The status of this artificial wall wall climbing sports has been upgraded and better known in 2010 as one of the events in Olympic Games (Gurer, & Yildiz, 2015; Sheel, 2004).

Sport climbing is one of the extreme sports and the danger can be reduced by pre-placing protection points on rocks or artificial wall walls (Sheel, 2004). Handgrip strength is one of the main factors which determine the climber's performance with the strength of isometric muscle contraction making it one of the variables that can predict early performance in a contest (Bourne, Halali, Vanwanseele, & Clarke, 2011). The strength of the handgrip is important in this sport because it uses a lot of movement on the wrist and digit flexors muscles. This wall climbing sports requires muscle strength or muscle group that can accommodate and resist resistance during climbing. Performing muscle strength can be done by increasing muscle training and the best way is to put extra weight during training. Due to this, Watts et al., (1993) stated that the strength and agility of the climbers involves the strength of the forearm and handgrip strength where is factor that cannot be underestimated in this wall climbing sports (Michailov, Mladenov, & Schöffl, 2009). Sport climbing includes three different categories which is bouldering, speed, and lead (Nick, et al., 2011). Bouldering refers to categories that do not require use of ropes during climbing. It involves over a short distance known as 'problem' that generally involves more intense and sustained anaerobic power moves. Scoring is counted through the number of attempts to solve the given route problem within a specified time (Fanchini, et al., 2013). Lead climbing is a category that is performed on a wall higher than 12 meters and climbing times is longer than the bouldering category. Lead competition starts at the bottom of the route and must be climbed according

to the route provided during the time set up by the organizer which is around 6-8 minutes. This category is different from bouldering because the climber needs a safety strap clip on the runner in various distances along the route provided (Nick, et al., 2011). Before the competition starts, participants can see the route (4-6 minutes) before being segregated to wait for the competition. The mark is calculated according to the last hold held and the fastest but must hold the hold steady. Speed is one of the facts seen in the speed category (Ryepko, 2013). This category is usually done either individually or in a group with the fastest time will be announce as winner. This category uses safety straps from above the climber at the anchor at the end of the route. The fastest time recorded and the fastest participant is considered the winner for this event.

Many findings of the previous study on the handgrips strength were performed overseas. Domestic studies also showed that the artificial strength of the artificial wall climbers in all three categories at a time has not yet been done. Based on knowledge, this is the only study of difference handgrip strength between three categories of climbing and the findings of this study can be used as reference data. Each category in this sport involves complex training and different training methods. The difference in the training shows that there are differences in strengths in each climber in different categories. According to a study by Fanchini et al., (2013), the three categories in this sport use different handgrip strength during the competition. But the findings on the differences of the three categories against the level of hand grip strength are not told. Measurement of hand grip strength levels should be undertaken among the athlete so that the systematic training and program can be formed in training the artificial wall climbers. There are other factors that contribute to the handgrip strength of artificial wall climbers such as anthropometry (weight, height, arm span and others). Therefore, this study needs to be done to determine the level of strength of handgrip amongst male's athletes in different artificial wall climbing categories.The main objective of this study is to determine the level of handgrip strength for male's athlete on boulder, lead, and speed categories in wall climbing sport. The specific objectives of the study are as follows:

i. To determine the level of male's athlete handgrip strength in the boulder, lead, and speed categories.
ii. To identify the difference in the power for male's athlete handgrip strength in the category of boulder, lead, and speed.
iii. To identify the factors that affect the handgrip strength for male's athlete

Methodology

The design of this study is using the ex-post facto design. This design is chosen because the features tested on the subject occur naturally and researchers do not manipulate these features. The population of the study were male athletes from several local universities from all over Malaysia who were involved in the Vasity Artifical Wall Climbing Championship (VAWC) 2017. 123 subjects involved representing three categories in artificial wall climbing (boulder 41; lead 41; speed; 41).

The data were taken before the competition begins. Subjects must fill out the score form containing personal information and fill out the form as a sign of consent to be a subject of this study. The test is done in the same direction on each subject involved. The assistants in this study were volunteers who were given training and also has the experience in conducting test procedures. Anthropometric measurements are performed based on the Lafayette

anthropometric measurement method, where the reading is used by a measuring gauge to obtain all dimensional dimensions (Watts, Joubert, Lish, Mast, & Wilkins, 2003). Four measurements were performed to obtain anthropometric data related to height, weight, body mass index or body mass index (BMI), percentage body fat (% BF), experience in climbing (in years), and arm span. Measurement using the Tanita (TBF-300) reading tool is taken to the nearest centimeter. This instrument uses a bioelectric analysis of impedance (Bioelectrical Impedance Analysis; BIA) electrode presses 'footprints to footprints'. For measurement purposes, subject information (gender, body type, age and height) is included in the BIA system using standard mode based on Tanita's manual. Weight and body mass index are calculated automatically using the programming equations program. BIA is a non-invasive measurement method and is a commonly used to estimate the percentage of body fat. The reliability of BIA for estimating the body fat measured using the correlation coefficient is high (male, r = 0.948; female r = 0.945) (Miller, 2006). Samples in vertical, non-stitched and vertical body positions stand to stadiometer tools. Weight loss is valued using the tanita electronic scale to the nearest 0.1kg reading value. The body mass index (BMI) is calculated (weight in kilograms of high parts in square meters) (Liang, et al., 2014). Measurement of hand span is also based on the method suggested by (Kasunka, Raj, & Arulsingh, 2015) using measuring tape.

The handgrip strength is measured using a handgrip dynamomter (Takei 5401 Digital Handgrip Dynamometer) (Gerodimos, 2012). This tool can measure the power of hand gestures between 0 and 100 kg. Handgrip strength dynamometer tool is adjusted according to the size of the hand. The subject is in a standing position, straight forward in front, dynamometer device is held on the body side with a fully straight hand. Grasping as strong as they can be without changing the position of the hand (Heyward, 2010). Each subject was required to hold for three times and the best scores was recorded. One minute break is given between each hand. Validity and reliability are high on the Takei 5401 Digital Handgrip Dynomometer (Gerodimos & Karatrantou, 2013; Balaghi, Sarshin, & Bahari, 2014) tool with of intrasession were analyzed using the Intraclass Correlation Coefficient (ICC) and the ICC value between 0.992 and 0.993. The same value or greater than 0.80 is considered as good. The measurements for finger grip strength tests are performed using a 2.5cm wide wood. The subject should hang on the fingers on the wood of a straightened hand. Tests for finger strength with four fingers in the open grip and the legs do not touch the floor (Balas et al., 2011; Watt, 2004). The thumb can be used to hold it from under the wood. This test is recorded as long as the subject can hang on with the finger. Results are measured with 0.1s accuracy.

Data Analysis

Descriptive analysis was carried out to give an overview of the background respondents from the aspect of handgrip strength to the athlete. The value of mean and standard deviation were carried out the data of handgrip strength on the three categories artificial wall climbing athletes. Reliability testing is also used to test the reliability being studied. ANOVA analysis is used to identify the differences in the handgrip strength three categories. While the ANCOVA analysis test was used to identify other factors that affecting the handgrip strength to the male's athlete.

Normality test requirements when the subject size in each variable in categories is not small than 15 and when the subject size reaches 30, the study data is considered to be normal

(Chua, 2006). The linearity between the three variables is roughly through the bivariate scatterplot checks that are in the form of a straight line. If the three variables are normally distributed and there is a linearity relationship, then the line must be split from left to right or right to left then it satisfies the linearity assumption. The findings of the study on dependent variable showed the oval-shaped scatterplot and it fulfills the linearity assumption. The correlation analysis between the dependent variables of this study shows a linear relationship. Levene statistical test was conducted to satisfy homogeneity assumptions. The normal value of the Levene test must be greater than the significant level of 0.5. All Levene values are found to satisfy homogeneity assumptions. All categories indicate the normal distribution of dependent variables. Analysis shows that data ($p = 0.609$) is not significant ($p > 0.5$), this indicates that the data do not violate homogeneity variance assumptions.

Finding

What is the level of male's athlete handgrip strength in three categories of artificial wall climbers?

Descriptive methods showed value of mean and standard deviations based on handgrip strength scores, body mass index (BMI), arm span, finger grip strength, body fat percentage and experience. Referring to table 1, subjects are categorized into three different categories of boulder, lead, and speed. The subjects are students representing their respective universities in sports climbing artificial wall at the Vasity Artifical Wall Climbing Championship (VAWC). They are between 18 and 29 years old ($M = 22.46$, $SD = 2.73$).The main focus of this study is to determine the level of male's athlete handgrip strength. The table below shows the average mean value and standard deviation for each category in artificial wall climbing sports. The differences in all tests between categories are clear. Overall, the mean value for the overall of the athlete's handgrip strength at a good level of min is 94.40 with a standard deviation of 16.72.

Table 1:
Min and Standard Deviation Distribution for Male's Athlete in Handgrip Strength

Items	N	Mean	SD
Boulder	41	102.65	14.71
Lead	41	92.42	15.88
Speed	41	88.13	16.43
Total HGS	123	94.40	16.72

Referring to descriptive analysis results, the minimum value and maximum handgrip strength range is from 79.0 to 134.07 ($M = 102.65$, $SD = 14.7$), lead category between 65.63 and 130.0 ($M = 92.42$, $SD = 15.88$), and speed 60.90 to 129.53 ($M = 88.13$, $SD = 16.43$). Based on the min score for the dependent variables in three category it is found that the boulder category obtains the highest mean value followed by the lead category and thus the speed category. All the assessed scores were at a good level and the respondents acceptance during the tests. Conclusions from the findings showed that male's athletes in the boulder category had the highest strength of hand grip compared to other categories.

Overall analysis of the level handgrip strength for male's athlete described in table 2. The findings showed based on the criteria level of athlete handgrip strength excellent 17 (13.8%)

is the highest, 21 (17.1%) at a good level, moderate with 12 people (9.8%), low with 43 (35.0%) and 30 (24.4%) at very low level. This finding shows that the handgrip strength of the male's athlete is still at satisfactory level overall.

Table 2:
Level Distribution, Frequency and Percentage of Handgrip Strength in Male's Athletes Artificial Wall Climbing

Level	f	%
Excellent	17	13.8
Good	21	17.1
Moderate	12	9.8
Low	43	35.0
Very Low	30	24.4
Total	123	100.0

Based on table 3, findings showed that the boulder category has the highest number for excellent level with 9 athletes (20.0%), followed by leads with 5 (12.2%) athletes and 3 (7.3%) athletes. At very low level the lead category was the highest among 14 (34.1%) athletes compared to speed 13 (31%) athletes and boulder 3 (7.3%). The findings also show that the speed category 18 (43.9%) has the most number of athletes who are at a low level of handgrip strength. This shows athletes in boulder category among the most powerful in terms of handgrip strength over other categories.

The findings of the descriptive analysis are shown in table 4. It showed the highest handgrip strength in boulder category (M = 102.65, SP = 14.71), lead (M = 92.42, SP = 15.88) and speed (M = 88.13, SP = 16.43). Min BMI did not show significant differences in the three categories with boulder (M = 20.46, SP = 2.10), lead (M = 20.16, SP = 2.41), and speed (M = 21.18, SP = 2.01). The arm span for boulder category (M = 173.31, SP = 9.99) showed the highest value, speed category (M = 170.73, SP = 10.84), and lead (M = 169.88, SP = 8.36) is the lowest. For male athlete experience in climbing artificial wall sports do not show any significant difference too, the highest is the boulder (M = 3.56, SP = 1.05) and the lowest is the speed (M = 2.76, SP = 0.99). Min for the finger grip strength on boulder athlete (M = 61.15, SP = 20.48) shows the highest value compared to lead (M = 37.58, SP = 19.30) and speed (M = 38.02, SP = 12.71). The for body fat percentage scores for boulder (M = 4.81, SP = 1.75) were the lowest and lead (M = 5.02, SP = 1.89) were the highest.

Table 3:
Level Distribution, Frequency and Percentage Handgrip Strength of Male's Athletes in Three Categories Artificial Wall Climbing

Category	Level	f	%
Boulder	Excellent	9	22.0
	Good	9	22.0
	Moderate	8	19.5
	Low	12	29.3
	Very Low	3	7.3
	Total	41	100.0

Lead	Excellent	5	12.2
	Good	8	19.5
	Moderate	1	2.4
	Low	13	31.7
	Very Low	14	34.1
	Total	41	100.0
Speed	Excellent	3	7.3
	Good	4	9.8
	Moderate	2	7.3
	Low	18	43.9
	Very Low	13	31.7
	Total	41	100.0

Table 4:
Statistics Descriptive for Handgrip Strength and Factors Affected Handgrip Strength in Artificial Wall Climbing

Category	Variable	N	Mean	SD
Boulder		41		
	HGS		102.65	14.71
	BMI		20.46	2.10
	Arm Span		173.31	9.99
	Experiences		3.56	1.05
	Finger Strength		61.15	20.48
	%BF		4.81	1.75
Lead		41		
	HGS		92.42	15.88
	BMI		20.16	2.41
	Arm Span		169.88	8.36
	Experiences		3.05	1.38
	Finger Strength		37.58	19.30
	%BF		5.02	1.89
Speed		41		
	HGS		88.13	16.43
	BMI		21.18	2.01
	Arm Span		170.73	10.84
	Experiences		2.76	0.99
	Finger Strength		38.02	12.71
	%BF		5.52	1.87

Note: BMI=body mass index, SD=standard deviation, HGS=handgrip strength, %BF=percentage of body fat

The difference in athlete's handgrip strength between the three categories of artificial wall climbers

This analysis is to identify the differences in the strength of male's athlete hands on the boulder, lead, and speed categories. Analysis of Variance (ANOVA) method was conducted on

this research to determine whether there is a significant difference ($p < 0.05$) in handgrip strength test on all three categories are involved. The findings of the study as in table 5 showed that there is a significant difference [$F(2,120) = 9.26$, $p = 0.000$] on the score of the handgrip strength between the three categories in sports climbing the artificial wall of the male's athlete.

Table 5:
Analysis of ANOVA for Handgrip Strength on Three Categories Artificial Wall Climbing

Variable	Sum of Squares	df	M(Square)	F	P Value
Between Group	4557.855	2	2278.927	9.26	0.000
Within Group	29540.280	120	246.169		
Total	34098.138				

*P < 0.000

Based on Cohen's table, the value of the findings above shows that the data analysis can be considered as a medium effect size with the value of η2 is 0.134 or 13.4%. This shows that the variance of this variance is influenced by the dependent variable that the handgrip strength on all three categories in sports climbing. The Post Hoc analysis in table 6 shows the significant difference between the three categories in climbing. Significant differences were shown between boulder and lead (mean = 10.22) with $p = 0.011$ and between boulder and speed (mean = 14.51) with $p = 0.000$, while between lead and speed there was no significant difference = 4.29) with the value of $p = 0.433$.

Table 6:
Post Hoc Analysis for Handgrip Strength between the Three Categories in Artificial Wall Climbing

Category		Mean Diff.	P Value
Boulder	*Lead*	10.22	0.011
	Speed	14.51	0.000
Lead	*Speed*	4.29	0.433

p<0.05

Other factors affecting male's athletes on handgrip strength in all three categories of artificial wall climbers

Analysis of Covariance (ANCOVA) results in table 7 showed there was significant difference in covariance of experience [$F(1,115) = 21.41$; $P = 0.00$, eta squared = 0.16], BMI [$F(1,115) = 10.50$; $P = 0.002$, eta squared = 0.084], finger strength power [$F(1,115) = 60.39$; $P = 0.00$, eta squared = 0.34], and percentage of body fat [$F(1,115) = 5.73$; $P = 0.018$, eta squared = 0.047]. This showed that four covariate variables also have significant impact on the strength of the hands of male athlete climbers. While the arm span ($p = 0.439$) there is no significant difference in these three categories in sports climbing the artificial wall. From the significant values for the categories ($p = 0.486$), there was no significant difference. It shows that the value $p = 0.486$ is greater than the significant value ($p < 0.05$). Because there was no significant difference, the Post-Hoc ANOVA test was not necessary.

Table 7:
Analysis of ANCOVA on Handgrip Strength in Three Different Climbing Categories with Covariant Variables

Source	*Type III Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Experience	1752.23	1	1752.225	21.41	.000
BMI	859.23	1	859.23	10.499	.002
%BF	469.25	1	469.25	5.734	.018
Arm Span	49.39	1	49.39	.604	.439
Finger Hang	4942.73	1	4942.73	60.393	.000
Category	118.99	2	59.50	.727	.486
Error	9411.855	115	81.842		

a. R Squared = .727 (Adjusted R Squared = .708)
Note. %BF = percentage body fat, BMI = body mass index

Discussion of the Handgrip Strength on the Male's Athletes in Artificial Wall Climbing
This study is aimed to determine the level handgrip strength of male's athlete in artificial wall climbing sports. There are three categories in this wall climbing sports which are boulder, lead, and speed as dependent variables. The analysis showed that the score of the handgrip strength on the athlete of the boulder category is higher than the lead and speed. The use of hand dynamometer tools as a tool for hand-held grip strength tests is supported by many researchers (Gurer, & Yildiz, 2015; Watts 2004).

A study by Watts (2004) stated that the wrong muscle concentration during warming up can affect the results of the handgrip test strength test results. The findings of the study by Balas, et al., (2011) also proved that the level of performance of this wall climbing sports athlete increases with an increase in the score of handgrip strength score. Sports climbing the artificial wall also increases strength and agility in both hands and it is assumed that the handgrip strength one of the factor that cannot be underestimated in this sport (Watts, 2004). The level of handgrip strength is also influenced by activity during the training session (Fanchini et al., 2013). In different category, athletes influence the different of specific tools in exercises such as campus boards or other training exercises to train the existing energy capacity. This allows the potential for increasing in energy level or the rate of force development (RFD) on the flexible fingers.

The handgrip strength also shows a very high level of performance in climbing sport and it is one of the significant factors in predicting the athletes ability (Watts, 2004). The findings of the study show that the number of athletes with high level of handgrip strength is too small in each category. As a result of the recent study findings by Fanchini, et al., (2013), the strength of the handgrip strength on the athlete category of boulder is higher than the lead category. This shows that the findings are in line with past findings. Based on knowledge, this is the only study that examines the level of difference between the three categories at a time. This shows the research between boulder and speed categories, and lead and speed has not been studied and this could be the findings of this study as the main data. As a whole result the handgrip strength on athlete artificial wall climbing in Malaysia on the male athlete is still poorly graded.

The Relationship between Factors Affecting the Handgrip Strength of Male's Athlete

Assessment of the relationship between factors affecting the handgrip strength is assessed through ANCOVA analysis. Significant differences are strong in climbing experience relationships, body fat percentages and finger grip strength show strong relationships in anticipation of initial climbers performance (Gurer, & Yildiz, 2015). According to BMI analysis data, body fat percentages, finger hang strength and experience indicate a significant difference in which these factors are also a prediction of early performance of climbers. This assures that other factors are very important in sports climbing artificial walls.

The finger grip strength is the factor that contributes to the handgrip strength. Research by Watts (2004), continuous or repeated exercises over a short period of time does not give a reading of different or stronger handgrip strengths. In this wall climbing sports, other factors such as artificial hold or real stone are more of the use on finger positions to hold. Artificial wall climbers often use pincer and crimping in every movement where tendon strength is more important (Grant, Hynes, Whittaker, & Aitchison, 2007).

Overall in each sport proves the experience in sports shows the level of performance of an athlete. The findings from the recent study by Fanchini, et al. (2013) shows increased handgrip strength and energy levels in all categories in artificial walls or rock climbing. It is stated that the adjustment does not respond to muscles caused by long training. Longer experience in exposure to the sport increases the performance of athletes in training, testing, or competition.

Significant differences are show in the percentage of body fat over the three categories of artificial wall climbers. According to the findings of the previous study, generally artificial wall climbers or real rocks have smaller bodies and lower body fat percentages (Michailov et al, 2009). Low body fat percentage also shows where it is one of the factors that determines the performance of athletes climbing the artificial wall, this is because excessive fat can increase the use of muscle capacity. The findings show that athletes for the boulder category (M = 4.81, SP = 1.75) are the highest proportion of body fat compared to lead category (M = 5.02, SP = 1.89) and speed (M = 5.52, SP = 1.87). This shows a significant difference between the percentage of body fat to the handgrip strength on achievements found in the study.

Conclusion

The researcher found that this study has achieved all three established objectives and is able to identify the level and the differences of handgrip strength as well as other factors affecting the of the handgrip strength. All the information, especially the handgrip strength obtained from the results of the study, it should be guided to sharp or improve the performance of athletes especially in wall climbing sports. The weaknesses revealed through the results of the study are not so great, they still need improvement from time to time to improve the quality of training of the athlete. The strength of handgrip on the aspects of testing or exercise should be different in each category and should not be said that the three categories are the same. This wall climbing sports is not centered on the handgrip, but the fingers also have a role because hold or artificial stone is made of various shapes. This can help in organizing activities as well as training according to athlete’s needs and expanding knowledge about the factors that contribute to the strength of the handgrip.

This study showed that the handgrip strength is also influenced by other factors such as BMI, body fat percentage, finger grip strength and experience. These factors also show the contribution of the male athlete's grip strength. This suggests that wall climbing sportss are not only focused on the handgrip strength alone but there are other factors that affect the handgrip strength and thus affect the performance of the athlete itself. This study also proves the intermediate experience factor that contributes to the impact of handgrip strength. This is because earlier exposure to this sport helps to improve the performance of athletes. The findings show that athletes still need technical training and improve themselves in this wall climbing sports. The results of this study suggest that the strength of the handgrip on the male athlete can be benchmark the performance of other athletes in achieving the objectives of the importance and the relationship of handgrip strength to the artificial wall climber in the future. Other factors also have a large role and affect the handgrip strength of athletes artificial wall climbing. This can be summarized that the performance of athletes is enhanced with an improved systematic and planned training program. The results of this study can illustrate the level or athlete's standards and thus improve the existing shortcomings. This study can help operators and coaches in training athletes to modify and use other training approaches to improve the performance of climbers especially on wall climbing sportss athletes. This is because every category in this wall climbing sports requires different strengths and exercises.

Recommendation

The suggestion in developing this study in depth on the handgrip strength and other factors in influencing the performance of athletes in artificial wall climbing sports is to make the effect of consistent training on the athlete for a long time depending on the training program set up. This means that in future studies we can see how the impact of the training program gained during the training program can be adopted and whether it will make the performance of an athlete better in the short term. The program's duration is necessary to provide more in-depth learning and athletes can follow the training program provided and achieve significant in the performance of sports climbing athletes. The next study also needs to be deeper in looking at whether there is a relationship between other factors such as gender, bent-arm hang, flexibility, and physiology in influencing the performance of the athlete. In future studies it is hoped to see how far the difference and other factors can affect the wall wall climbing sports. In addition, the planning and development of training programs in this study should be modified according to age, physical and athlete gender differences as it plays a role in the performance of the athlete.

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