

# Effect of Strength, Flexibility, Balance and Confidence of Successful Wall Climbing Athletes in South Sumatra

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**Abstract**—This study aims to find out about the influence of four independent variables and dependent variable as well as the extent of the contribution of the athletes of South Sumatra. The method used in this study were (1) the path analysis (path analysis) (2) simple correlation (3) The coefficient of determination. The population of this study are all athletes from Southern Sumatra totaling 29 people (total sampling). The results of this study concluded that: (1). X1 on Y was 0,965 (2). X2 on Y was 0,859 (3). X3 on Y was 0,565, (4). X4 on Y was 0,678, (5). X1 on X4 was 0,416, (6). X2 on X4 was 0,556, (7). X2 on X4 was 0,669, (8). X1 on X2 was 0,518, (9). X2 on X3 was 0,796, (10). X3 on X1 was 0,982. There are direct significant influences, from 10 formulation problems shown in this research. The direct influence between the balances to the arm muscle power most greatly affects the success of free throw with value 0,931.

**Keywords**—*strength, flexibility, balance, confidence, climbing success.*

## I. INTRODUCTION

Sport is a physical activity that is conducted with certain rules and guidelines to improve physical condition and instill noble values as a result of participating in the sporting event. Sports offer positive benefits to the individual participants and the people who watch or are involved in the world of sports. This is acknowledged by the Government, which led to an umbrella law, i.e. the laws of the Republic of Indonesia number 3 in 2005 about the National Sports System. The Government then establishes a casual division of the end results of sports activities into three categories, namely sports achievement, sports education, and sports and recreation.

Sporting achievements, when examined carefully, demonstrate ability to benefit from excellence in the sport. Sports accomplishments can bolster pride and raise the level of self, society, and country. Efforts to excel in the various sports can yield many positive results. For instance, the sport of wall climbing offers the opportunity to earn many different types of medals. Contestants in the sport of wall climbing may compete in the categories of difficulty, bouldering, and speed. The third category is broken into several smaller categories such as number, ladies, *speed's son*, and even group climbing. It can be said that many climbers consider the category of difficulty competitions to

be their favorite, because the events in this category provide a tremendous challenge and the winners are highly honored. The category of difficulty indicates one of a group or class of contests in the wall climbing sport in which competitors are challenged to traverse a specific path that has a particular difficulty level (grade). The climber that can reach the highest point compared with other climbers is the winner. The technique of climbing in this category uses a system of ropes, secured from the bottom, and a mandatory security cord hooking the climber onto ring hooks. Each allows the climber to move along an otherwise impassable path. To lead in this category requires good physical condition. The primary physical attributes required to excel and win in the difficult category are arm strength, balance, and flexibility. Each of these three physical conditions play a vital role in the attainment of wall climbing achievements within the difficult category.

It was believed that athletes competing in wall climbing contests who have well-developed flexibility, the third of the three physical conditioning attributes, were obtaining resounding achievements. The reasoning is that the physical condition affected the ability of athletes to do their best. Arm strength in wall climbing supports the athletes as they grip the holds, lifting their body with just their hands to earn points. Flexibility is useful as it makes athletes competing in the difficult category of wall climbing able to move more easily on the wall, accruing more points-winning points. Meanwhile, balance is useful in efforts to maintain the center of gravity of the body when climbing.

Physical condition supports the techniques required in climbing. Thus, a climber in good physical condition will easily produce a high level of achievement. Achievements in wall climbing are earned by successful climbers mounting the wall beginning at the ground level and climbing up to the final holds or achieving the summit, thus scoring points. In other words, when identifying the great achievements of the top scoring athletes, chances are he or she successfully completed their climb all the way to the final point (top) and recorded the quickest time.

Achievements offered by the sport of wall climbing induce athletes across Indonesia to choose to compete in the sport and want to promote their individual achievements. South Sumatra Province is no exception, where athletes are

nurtured and trained in the sport of wall climbing with intentionality. Facilities and infrastructure have been built and furnished with requisite supplies all over the province of South Sumatra. Even an exercise program that's been created to involve the physical aspects is primarily designed for the difficult wall climbing category.

The effort is inversely proportional to the achievements gained; in wall climbing, South Sumatra reaped minimal achievements when *competing* in the National Championship. As in West Java XIX PON Championship 2016, South Sumatra wall climbing contingent was represented by two athletes, namely M. Inayah (specialist world speed record) and Wira Hutayanto (specialist speed classic). Achievements obtained by a contingent of South Sumatra wall climbing contestants are seen in the following data:

TABLE I. RESULTS ACHIEVEMENTS SPORT WALL CLIMBING CONTINGENT FROM SOUTH SUMATRA IN THE CHAMPIONSHIP PON XIX JABAR 2016

No	Name Athlete	Numbers	End Result
1	M. Inayah	<i>Speed Word Record</i>	Quarter
2	Wira Hutayanto	<i>Speed Clasic</i>	Elimination Round

Source: FPTI province of South Sumatra, 2016.

Based on the above explanation, the goals of the researchers, academics who care about the achievements in wall climbing, are to identify the problems and find solutions. Thus, they determined the need to direct research on the training process and the development of physical conditioning, especially regarding power, flexibility, balance and confidence. This resulted in an exercise program that involves the physical aspects influencing success in the difficult category of wall climbing competitions

## II. THEORETICAL STUDY

### A. *The success of Climbing*

The successful wall climber finishes one specific route up to the top within a certain amount of time. So the measurement of success of climbing can be said to be the result of the efforts of the athletes to climb the wall after climbing up to the top or to the final points before time runs out. The number of points in the category of difficulty is not specified or not defined, because it depends on the design of the line. The time allotted for athletes to complete climbing to the last point is 6 (six) minutes. So athletes climbing the wall should be able to complete the climb with a maximum time of 6 minutes.

According to Emi Zainah, a coach of the wall climbing Junior Jakarta, who is also the president of the jury at several wall climbing championships, said that the success of the climb is the result obtained by athletes climbing the wall, as the athletes completed climbing routes which have been determined from the ability levels of all athletes who would be climbing the wall. This statement highlights the success of the effort of climbing, encouraging an athlete to finish climbing by optimizing all the abilities they possess. A must-

have capability for athletes competing in climbing wall competitions is a combination of physical capability, mental preparation, and technique. In a similar statement, Hendrawan, an author from Jakarta, stated that success was a result of an athlete's exhibition climbing, on climbing routes which have been determined using all the abilities possessed by the athletes.

A successful climb is not easy, given that the specified path is not regular. Therefore the role of the physical and mental tactics and techniques of the athletes is very important to consider. The primary influence which appears in an attempt to measure success is the physical factor involved in climbing.

If the athlete does not possess a predominantly good physical condition, then the athlete's attempts to complete the event with the correct technique will have a reduced chance of success. Arm strength contributes to the ability of the athlete to retain their load while hanging. Flexibility is critical because the athletes must grab holds, accruing points, from uneven lines. Meanwhile the athletes also must have the ability to balance while maintaining their positions whether it is using a foothold, or hanging from one leg or one arm.

The primary physical factors will facilitate an athlete climbing a wall to be able to finish climbing all the way up to the final point. A successful climb will open opportunities to athletes to score achievements, because when athletes successfully completed exhibition climbs perfectly, then the possibility of successfully attaining the highest achievement in a competitive event increases.

### B. *Strength*

Strength is one element of the necessary physical conditioning athletes must possess when rock climbing and climbing walls. In every action involved in climbing a wall, athletes must execute their movements working against weight, withstanding the weight load from themselves or from outside the body. Every movement in wall climbing wall needs muscle power. There is great power in the muscles of the arms and legs, and even the stomach muscles.

This is in accordance with the statement by Rogram (2011:76) which is that muscle power alone can be described as the ability of a muscle or group of muscles to do a one-time maximum contraction against a restraint or a burden. In another opinion pointed out by Djoko (2011:599), power is the ability of a muscle or group of muscles to overcome a burden or a restraint which is present at the time of the activity or activities.

Based on the opinions stated above, that the strength is the ability of a muscle to do the contraction and the power must exceed the load, so if someone wants to lift a load weighing 100 kg, then they must have a power in excess of 100 kg, or at least the strength or muscle contraction should be the same as the load is lifted.

### C. *Flexibility*

Flexibility is an important factor in all aspects of human movement. The suppleness or flexibility is a necessary requirement automatically used for the continuation of motion in everyday life including while exercising. Of the

many components of physical fitness, flexibility for an athlete is absolutely necessary and very vital because it is the basis of almost every technique in motion. When they have good flexibility, the athletes can perform various tasks of motion efficiently and effectively. Flexibility can be defined as a series of movements in a joint. This relates to the movement and the limitations of the body or parts of the body that can be bent or extended with flexion and stretching muscles.

An opinion by Eka Hai (2014) states that a person's effectiveness is their flexibility in adjusting in all activities with the full body. According to Russell, Williams, and Siedentop in Fredericus Suharjana (2013:40), flexibility is the range of motion that can be created by certain joints and restricted by the arrangement of the joints. Uram states that flexibility is suppleness of the muscles and their ability to measure far enough so that the joints are allowed to react completely within the range of normal movement without causing injury. A statement that identifies that flexibility according to Uram is a form of gentle motion or the ability of a muscle to move/extend to the farthest extent.

Based on the statements of some of these experts it can be inferred that suppleness or flexibility is the ability to move joints involving organs located in the joints, muscle, bones, and ligaments.

#### *D. Balance*

Balance is one of the factors that are crucial and very important for all people, necessary for athletics as well as for everyday activities, either in a state of stillness or motion. Balance is not only necessary to perfect the techniques and tactics needed to complete a wall climbing course; it is also one of the elements of the necessary physical conditioning that must be increased in an attempt to attain greater achievements, because it is influenced by the situation and the conditions of the surrounding environment.

According to Rogram (2011:144), the ability to maintain balance means being able to hold the stance and body position exactly at the moment of standing (static balance) or at the time of movement (dynamic balance). Z. Iskandar Adisapoetra states that balance is the ability to maintain the attitude and position of the body properly at the time of standing (static balance) or at the time of the movement (dynamic balance). Winter (1995:194) adds that balance is a term that describes the dynamics of body posture to prevent falling. Posture itself is the orientation of each segment of the body against the relative gravity vector.

#### *E. Confidence*

According to James *tangkudung* (2012:41) is a personality trait that essential owned by someone that is reflected in his attitude or his deeds which are different than other individuals. A person's personality is formed through a process of interactions that occur within himself, with the influence of environment. Therefore a person's ability will be set by how and how they experience their environment. Factors that influence and shape one's personality include physical, physiological, mental, and emotional states, and motor skills. Therefore, in the process of coaching students in sports, every teacher of physical education/sports/coach

is responsible for instilling discipline, confidence, tenacity, perseverance, precision, determination, and a calm spirit.

Meanwhile, according to Apta Mulsidayu (2014:102), self confidence is a sense of trust in their own ability, that they are able to achieve certain accomplishments, and when these achievements are already high then that individual will have even more self-confidence. Self-confidence will give rise to a sense of security that can be seen from attitudes and behavior that seems calm; not easily shaken; not easily made nervous; and assertive. Athletes with aplomb (full confidence) usually set a target in accordance with their capability and then they take the appropriate actions to achieve the target. If failure occurs, it will be faced and accepted gracefully, not with frustration. RIA Lumintuarso (2013:119) states that confidence is the result of the match between goals and capabilities, and that athletes will have self confidence if they trust their ability to achieve their goals (you only achieve what you believe). Komarudin (2013:69) expressed that confidence is internal control of the feelings an individual has regarding belief in their own ability, and their awareness and responsibility against the opinions of others who try to put them down.

### III. RESEARCH METHOD

Based on the study of issues that will be examined and the goal will be achieved, then the method to be used in this research is a test of the right method, path analysis technique for the analysis of the data. This research involves five free variables, i.e. strength, balance, flexibility, motivation and achieving good results, focusing on the westbound, i.e. success of the athletes competing in wall climbing from South Sumatra. The link between non-variable variable bound. In accordance with the draft, there are five types of research that are to be collected: (1) data about the success of climbing; (2) data about strength; (3) data about flexibility; (4) data about balance; and (5) data about confidence. To obtain data for climbing success, strength, flexibility, balance, and confidence, use tests and measurements. Match the type of the given variables involved in this research, then obtain the data that is processed in this research. The instruments which are used consist of the following: (1) climbing test question forms; (2) tests of strength (hand grip dynamometer); (3) tests of flexibility (sit and reach); and (4) dynamic balance tests.

In this study the data analysis techniques used in hypothesis testing research are (1) the analysis path (path analysis) (2) (3) simple correlation coefficients of determination. Prior to testing the hypotheses in advance, completed testing of a normality test, i.e. requirements, by using the Lilliefors test, and tested its homogeneity by using the Kolmogorof-Smirnov test in terms of path analysis. In addition, an analysis of significance was conducted with  $\alpha = 0.05$  free variables influence against the variable bound either collectively or individually.

Target population in this study are all the athletes who climb the wall in South Sumatra, which amounted to 30 athletes climbing the wall. Because the population numbers only 30 athletes, then the entire population was made a

subject of research. Research samples taken from the populations with a total sampling, which is the entire cohort of athletes participating in wall climbing competitions in South Sumatra, which amounted to 30 athletes competing in wall climbing.

IV. RESEARCH RESULTS

Based on the results of processing the data using SPSS 23, then the hypothesis test results obtained in this study are as follows:

After meeting the testing requirement analysis as described in points B above, then the next stage is to do path analysis based on causal model established in theory. Is there any causal model theory as follows:

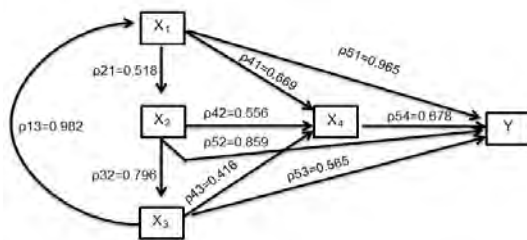


Fig. 1. X1 X2 X3 Structure relationships and Y Compared with X4

Based on causal models above there are 10 path coefficients i.e.,  $\rho_{51}$ ,  $\rho_{52}$ ,  $\rho_{53}$ ,  $\rho_{54}$ ,  $\rho_{41}$ ,  $\rho_{42}$ ,  $\rho_{43}$ ,  $\rho_{32}$ ,  $\rho_{13}$ ,  $\rho_{21}$ . Each coefficient of the line will be tested using the test with significance-t (t-test). If the value t calculate > value t Table for each coefficient line, then it can be inferred that the causal coefficient model lines were significant. The default value of the table t (0.05) = 1.70 and t table (0.01) = 2.47; if the value t calculate the coefficient table means  $t <$  path is not significant and the coefficients of the line can be deleted or omitted from the model causal model through trimming.

The results of the analysis of the previous section and the process of calculation performed on attachments 5 can be summarized as follows:

TABLE II. DIRECT RELATIONSHIP BETWEEN VARIABLES

No.	Direct Influence	Path coefficient	Dk	t calculate	t table 0,05	t table 0,01
1	X <sub>1</sub> against Y	0,965	27	19,091	1,70	2,47
2	X <sub>2</sub> against Y	0,859	27	8,719	1,70	2,47
3	X <sub>3</sub> against Y	0,565	27	3,560	1,70	2,47
4	X <sub>4</sub> against Y	0,678	27	4,797	1,70	2,47
5	X <sub>1</sub> against X <sub>4</sub>	0,416	27	2,698	1,70	2,47
6	X <sub>2</sub> against X <sub>4</sub>	0,556	27	3,475	1,70	2,47
7	X <sub>3</sub> against X <sub>4</sub>	0,669	27	4,671	1,70	2,47
8	X <sub>1</sub> against X <sub>2</sub>	0,518	27	3,145	1,70	2,47
9	X <sub>2</sub> against X <sub>3</sub>	0,769	27	6,241	1,70	2,47
10	X <sub>3</sub> against X <sub>1</sub>	0,982	27	12,150	1,70	2,47

V. DISCUSSION OF THE RESULTS OF RESEARCH

Based on the results obtained after analyzing the model used as the basis in answering the hypotheses and drawing conclusions on the research. Explanation of the hypothesis

answers compared with the results can be outlined as follows:

A. Direct Influence of Strength (X<sub>1</sub>) compared with the Success of Climbing (Y)

From calculation path analysis, direct influence of strength (X<sub>1</sub>) compared with the success of climbing (Y), the value of the path coefficient 0.965 where the t-count coefficient of t-table in value while 19.091 dk = 27 for  $\alpha = 0.05$  of 1.70, therefore the value of the coefficient t-count is greater than the value of the table, then H<sub>0</sub> is rejected; and accepted that strength thus H<sub>1</sub> (X<sub>1</sub>) directly towards the positive effect on the success of climbing (Y) can be accepted.

The results of the analysis provide findings that relates strength directly with the success of climbing. Based on these findings, it can be concluded that the success of climbing is influenced directly by force.

B. Direct Influence of Flexibility (X<sub>2</sub>) Compared with the Success Of Climbing (Y)

From the results of calculation of path analysis, direct influence of flexibility (X<sub>2</sub>) on the success of climbing (Y), the value of the path coefficient 0.859 where the t-count coefficient of t-table in value while 8.719 dk = 27 for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then H<sub>0</sub> is rejected, and flexibility H<sub>1</sub> (X<sub>2</sub>) directly and positively affects the success of climbing (Y) can be accepted.

The results of the analysis provide findings that flexibility directly affects confidence. Based on these findings, it can be concluded that the success of climbing is influenced directly by the flexibility.

C. Direct Influence of Balance (X<sub>3</sub>) on the Success of Climbing (Y)

From calculation path analysis, direct influence of balance (X<sub>3</sub>) on the success of climbing (Y) value of path coefficient coefficient t-count where 0.565 of 3.560 whereas t-table values on dk = 27 for  $\alpha = 0.05$  of 1.70; therefore the value of the coefficient t-count is greater than the value of the t-table, then H<sub>0</sub> is rejected, thus balance H<sub>1</sub> (X<sub>3</sub>) directly and positively influences the success of climbing (Y) can be accepted.

The results of the analysis provide findings that balance directly affects confidence. Based on these findings, it can be concluded that the success of climbing is influenced directly by balance.

D. Direct Influence of Self-confidence (X<sub>4</sub>) on the Success of Climbing (Y)

From calculation path analysis, direct influence of confidence (X<sub>4</sub>) on the success of climbing (Y), the value of

the coefficient of 0.678 line where the coefficients t-count of 4.797 while the value of t-table in  $dk = 27$  for  $\alpha = 0.05$  of 1.70; therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and the  $H_1$  is accepted. Thus confidence ( $X_4$ ) has a direct, positive influence on the success of climbing ( $Y$ ) can be accepted.

The results of the analysis provide findings that the self-confidence directly affects the success of climbing. Based on these findings, it can be concluded that the success of climbing is influenced by confidence.

#### *E. Direct Influence of Strength ( $X_1$ ) on Confidence ( $X_4$ )*

From hasi calculation path analysis, direct influence of strength ( $X_1$ ) on confidence ( $X_4$ ), the value of path coefficient 0.669 where the t-count coefficient of 4.671 while the t-table value in the  $dk = 27$  for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and accepted power thus  $H_1$  ( $X_1$ ) influential positive directly on the confident ( $X_4$ ) can be accepted.

The results of the analysis provide findings that are directly on the influential power of confidence. Based on these findings, it can be concluded that confidence is affected directly by force.

#### *F. Direct Influence Of Flexibility ( $X_2$ ) On The Confident ( $X_4$ )*

From hasi calculation path analysis, direct influence of flexibility ( $X_2$ ) on the confident ( $X_4$ ), the value of path coefficient 0.556 where the t-count coefficient of 3.475 while the value t-table on  $dk = 27$  for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and accepted flexibility thus  $H_1$  ( $X_2$ ) a positive effect directly on the confident ( $X_4$ ) can be accepted.

The results of the analysis provide findings that flexibility effect directly on the confident. Based on these findings, it can be concluded that confident is influenced directly by the flexibility.

#### *G. Direct Influence Of The Balance ( $X_3$ ) On The Confident ( $X_4$ )*

From hasi calculation path analysis, direct influence balance ( $X_3$ ) on the confident ( $X_4$ ), the value of path coefficient 0.461 where the t-count coefficient of 2.698 while the value t-table on  $dk = 27$  for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and accepted balance thus  $H_1$  ( $X_3$ ) a positive effect directly on the confident ( $X_4$ ) can be accepted.

The results of the analysis provide findings that balance effect directly on the confident. Based on these findings, it

can be concluded that the success of the climbing is influenced directly by the balance.

#### *H. Direct influence of strength ( $X_1$ ) on Flexibility ( $X_2$ )*

From the results of calculation of path analysis, direct influence strength ( $X_1$ ) on flexibility ( $X_2$ ), the value of path coefficient 0.518 where the t-count coefficient of 3.145 while the value t-table on  $dk = 27$  for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and accepted power thus  $H_1$  ( $X_1$ ) directly towards the positive effect of flexibility ( $X_2$ ) is acceptable.

The results of the analysis provide findings that strength directly affects flexibility. Based on these findings, it can be concluded that flexibility is influenced directly by strength.

#### *I. Direct Influence of Flexibility ( $X_2$ ) on Balance ( $X_3$ )*

From the results of calculation of path analysis, direct influence of flexibility ( $X_2$ ) on balance ( $X_3$ ), the value of path coefficient 0.769 where t-count coefficient of 6.241 while the value t-table on  $dk = 27$  for  $\alpha = 0.05$  of 1.70 therefore the value of the coefficient t-count is greater than the value of the t-table then  $H_0$  is rejected and accepted flexibility, thus  $H_1$  ( $X_2$ ) has a direct effect on balance ( $X_3$ ) is acceptable.

The results of the analysis provide findings that flexibility directly affects balance. Based on these findings, it can be concluded that balance is influenced directly by the flexibility.

#### *J. Direct Influence of Balance ( $X_3$ ) on Strength ( $X_1$ ),*

From calculation path analysis, direct influence of balance ( $X_3$ ) on strength ( $X_1$ ), the value of the path coefficient 0.982 where the t-count coefficient of 12.150 while the value t-table on  $dk = 27$  for  $\alpha = 0.05$  of 1.70; therefore the value of the coefficient t-count is greater than the value of the t-table, then  $H_0$  is rejected, and thus it is accepted that balance  $H_1$  ( $X_3$ ) take effect directly on the strength ( $X_1$ ), are acceptable.

The results of the analysis provide findings that balance is directly correlated with strength. Based on these findings, it can be concluded that balance is influenced directly by the strength.

## VI. CONCLUSION

### *A. Conclusion*

The withdrawal of the conclusions made on the basis of research findings with five variables, namely exogenous variables, one intervening variable, and one endogenous variable. Exogenous variables consist of strength ( $X_1$ ), flexibility ( $X_2$ ), balance ( $X_3$ ) and the intervening variable confidence ( $X_4$ ); whereas the endogenous variable is the success of wall climbing in the difficulty category ( $Y$ ). based

on the analysis of data and statistical calculations in the previous chapter, which can be summed up as follows:

1. There is a direct influence of strength on the success of the wall climbing exhibition
2. There is a direct influence of flexibility on the success of the exhibition
3. There is a direct influence of balance on the success of the exhibition
4. There is a direct influence of confidence on the success of the exhibition.
5. There is a direct influence of strength on confidence.
6. There is a direct influence of flexibility on confidence.
7. There was a direct influence of balance on confidence
8. There is a direct influence of strength on flexibility.
9. There are direct influences between flexibility and balance.
10. There was a direct influence on balance and strength

### B. Advice

Based on the conclusions of the study and implications as outlined above, there are suggestions as follows:

1. Since the overall test items have showed positive influence, then these can be placed into an exercise program in an attempt to increase the success of climbing. In addition, it is recommended that coaches athletes and researchers should also take advantage of the results of this research in order to improve the quality of climbing success.
2. In this study it was found that strength, flexibility, balance and confidence also have significant influences on the success to climbing, so with respect it is recommended that coaches may be able to pay attention to factors from the results of the research conducted, i.e. a combination of strength, flexibility, balance and confidence in raising achievement levels in the sport of wall climbing in the category of difficulty.
3. The purpose of the study is limited to researching the influences of strength, flexibility, balance and confidence compared with climbing success; therefore, as a follow-up another study can be carried out in the form of additional tests, observations and measurements of some kind, talented athletes who participate in the wall climbing contests of the difficult category.
4. The need for further research is demonstrated by adding variables and choosing variable categories or other attributes.

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