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VO_2 Max Estimation from Skipping Test for College Age Individuals

Surojit Ghosh[1]* Prof. Brajanath Kundu[2]

[1] Research Scholar, Department of Physical Education, Visva-Bharati, Santiniketan, West Bengal

[2] Professor, Department of Physical Education, Visva-Bharati, Santiniketan, West Bengal

Abstract –

Objective: The purpose of the study was to develop a sub maximal exercise test for estimating VO_2 max utilizing 3 minutes both leg jump skipping exercise.

Methods: 35 college level males between the ages 18 to 22 years were recruited as the subjects for test validation. The subjects completed a treadmill test in the LNIPE, Guwahati, India, human performance laboratory to determine the VO_2 max. Subjects were performed 3 minutes both leg jump skipping exercise followed by heart rate / min response. BMI was assessed and age in years was recorded. The directly measured VO_2 max data obtained from treadmill test as the dependent variable and no. of turn in 3 min both leg jump skipping performance, post exercise heart rate / min response, BMI, and age in years were the independent variables and were utilized of the multiple regression model.

Results: The multiple regression equation yielded a predicted equation for estimating VO_2 max for male (ml/kg/min) = 39.130 (Total no of turn in both leg jump skipping) + .058(H.R) - .029(BMI) - .170(Age). SEE = 1.21, Adjusted R2= .025. On the basis of the predicted equation the predicted VO_2 max of the validation group was obtained. Mean VO_2 max (direct method) and predicted VO_2 max of the validation group were 43.97 ± 1.23 and 44.02 ± 0.312 respectively. The coefficient of correlation between the directly measured VO_2 max and predicted VO_2 max was found 0.895 which was significant at the 0.01 level. The predicted equation was tested on a cross validation group (N=55). VO_2 max was assessed using Queens College Step test. 3 min both leg jump skipping; post exercise heart rate, BMI, and age were assessed. Mean observed VO_2 max and predicted VO_2 max of the cross validation group were 44.07 ± 0.229 and 43.87 ± 0.254 respectively. The coefficient of correlation between the observed VO_2 max and predicted VO_2 max was found 0.858 which was significant at the 0.01 level that confirmed the reliability and validity of the predicted equation.

Conclusion: 3 minutes both leg jump skipping provides a valid and reliable sub maximal test for estimating VO_2 max in 18 to 22 years old college level male.

Key Words: Skipping, VO_2 Max, Indirect Method, Validation Group, Cross Validation Group.

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INTRODUCTION

Maximal oxygen uptake (VO_2 max) is considered as the best indicator of cardiopulmonary fitness of the organism. In the laboratory setting, the most accurate way to assess VO_2 max is undoubtedly via applying a maximal graded exercise test (GXT) performed to volitional exhaustion on a motorized treadmill or cycle ergometer while expired air is analyzed continuously by gas analyzers. However, the existing methods of direct estimation of this index employ expensive measuring equipments and qualified staff necessary to carry out the exercise test. Hence, indirect methods of estimating VO_2 max are often used, especially in studies of large population samples. In the indirect methods, the linear relation between heart rate and oxygen uptake as well as the relations between power output and oxygen uptake are utilized as are the relations between VO_2 max and the total work output in a given time or between VO_2 max and intensity of the exercise. There are number of indirect methods to predict VO_2 max such as Balke Test(1963), Cooper Test(1968), Queen's College Step Test(1972), Astrand Step Test (1976), One Mile Track Walk Test(1987), 1 Mile Jog Test(1993)

etc. VO_2 max is expressed as liters/min as an absolute value or in milliliters /kg/min as relative VO_2 max.

Skipping is a traditional aerobic type of exercise that may be effective to predict VO_2 max. The act of jumping over a rope that held and swung either the person jumping as a game or exercise is called skipping. In other words, to jump lightly over a rope that is held in both hands or by two other people and turned repeatedly under legs and overhead. Now skipping is an old popular sub maximal exercise and traditional activity. It is one of the simple and cheapest exercises in the world.

There are different forms of skipping exercises: Both leg jump, Alternate leg jump, Criss-cross, Heel to toe, Running in one spot, Side rope swing, High knee, Double jump, One + combo etc. One hour of rope skipping will burn up to 1300 calories. Lots of muscles are used at the same time. Skipping provide benefits of a full body workout in less than 15 minutes. Most important thing is that we need not to go outdoors, it can be done at any place and bad weather can't hamper fitness routine. Skipping exercise grows balance, co-ordination and agility. It is the best exercise to improve cardiovascular fitness.

The aim of the present study was to develop a method of the indirect determination of maximal oxygen uptake (VO_2 max) based on skipping, a sub maximal test, in college level male.

METHODOLOGY:

18 to 22 years in age ranged (Mean 20.65 ± 1.43) fifty five (55) College and University level male students were recruited as subjects in this study. The subjects expressed their informed consent to participate in this investigation by signing the appropriate forms. BMI of the subjects were assessed. Subjects completed a maximal GXT to determine VO_2 max. Participants were asked to refrain from strenuous exercises for 24 hours prior to testing and to arrive in the LNIPE, Guwahati, Human Performance laboratory after 3 hours after eating a meal. Subjects were performed on auto motor device treadmill machine joined with VO_2 max Qubit system ink machine. The Heart rate sensor was fixed on the left chest where heart is located. The musk of tread mill was inserted in the mouth & nose of the subject when the start bottom was pressed the tread mill started running. The subject started running for 15 minutes on the tread mill. According to Borg scale every three minute after the speed was increased as the subject's fitness level. After completing 15 minutes treadmill running VO_2 max was measured of every subject.

Next day subjects were performed both leg jump skipping test on an open smooth grassy field. Before performing the skipping the subjects were allowed to adjust the length of the rope as per their height. Holding the handles of the skipping rope, with a starting signal stop watch started, and the subjects performed both leg jump skipping as fast possible with bare footed so that the performance would not less than 90 turns /minute. The skipping test was continued for 3 minutes duration. After 3 minutes of skipping exercise the subjects were asked to sit on a tool. Just after 5 seconds rest post exercise heart rate was recorded from carotid artery for 15 seconds. 15 sec heart rate was then converted into heart rate per minute. Predicted VO_2 max equation was yielded where both leg jumps skipping performance for 3 min, post exercise heart rate / min, BMI, and age in years were the predictor variables. The equation was tested between the directly estimated and predicted VO_2 max on the validation group for its reliability and validity.

The yielded predicted VO_2 max equation was then applied on a cross validation group (N= 55). Age (Mean 21.32 ± 1.80), BMI (Mean 21.79 ± 1.49), both leg jump skipping performance (Mean 295.35 ± 7.21), and post exercise heart rate (Mean 160.21 ± 3.75) of the cross validation group were assessed. VO_2 max was assessed using Queens College Step Test following requisite procedures. For measuring Queen College step test subject was asked to stand in front of the tool. After a demonstration of the test, with a starting signal, stop watch started and the subject started step up-up- down-down on the tool and performed 24 steps/ minute. The subject continued the test for 3 minutes. After completion of 3 minutes step test the subject was asked to sit on the tool and after 5 seconds of recovery the pulse rate of the subject was measured from the carotid artery for 15 seconds. The 15 seconds pulse rate was then converted into heart rate per minute. As per Queens College step test estimation of VO_2 max for male = 111.33-(0.42 x step test pulse rate, beats / minute). The both leg foot jump skipping test, post exercise heart rate, BMI and age were administered as was conducted for validation group. Pearson Product moment method of correlation was used to find out the coefficient of correlation between the directly measured VO_2 max and predicted VO_2 max.

RESULTS & DISCUSSION:

Table-I

Statistical measure in directly measured VO_2 max, both leg skipping performance, heart rate, BMI, and age for validation group male (N=35)

Measures	VO_2max Direct method (ml/kg/min)	Both leg skipping performance (no's)	Heart rate (beats/min)	BMI (kg/m^2)	Age (years)	Predicted VO_2max (ml/kg/m)
Mean	43.97	281.77	160.08	20.88	20.65	44.02
SD	1.23	7.72	2.88	1.69	1.43	.312

Regression analysis yielded the following predicted equation to estimate VO_2 max where directly

measured VO_2 max as dependent variable and skipping performance, heart rate, BMI, and age as predictor variables.

VO_2 max (ml/kg/min) for male = 39.130(Total no of turn in both leg jump skipping) + .058(H.R) - .029(BMI) - .170(Age).

SEE = 1.21, Adjusted R2= .025.

The predicted VO_2 max of the validation group was calculated using the newly developed predicted equation and the mean predicted VO_2 max (44.02 ± 0.312) was obtained (Table-I). The coefficient of correlation between the observed (direct) VO_2 max and predicted VO_2 max was found r = .878 which was highly significant at 0.01 level. The result confirmed the reliability of the newly developed predicted equation.

To validate the newly developed prediction equation to estimate VO_2 max, this equation was then applied to a cross validation group male (N=55). Age range was 18 to 22 years. VO_2 max was measured using Queens College step test (QCST). Both leg jump skipping, post exercise heart rate, BMI, and age were assessed (Table-II).

Table – II

Statistical measures in VO_2 max, both leg jump skipping, heart rate, BMI and age for the cross validation group male (N = 55)

Measures	VO_2max Queen college step test method (ml/kg/min)	Both leg skipping performance (no's)	Heart rate (beats/min)	BMI (kg/m^2)	Age (years)	Predicted VO_2max (ml/kg/m)
Mean	44.07	295.35	160.21	21.79	21.32	43.87
SD	.229	7.21	3.75	1.49	1.80	.254

Observed (QCST) mean VO_2 max and predicted mean VO_2 max were found 44.07 ± .229 and 43.87 ± .254 respectively. The coefficient of correlation between the observed VO_2 max (Queens College step test) and predicted VO_2 max was found r = .806 which was highly significant at 0.01 level.

CONCLUSION:

The result indicate that it is possible to relatively precisely predict VO_2 max from the equation: VO_2 max (ml/kg/min) for male = 39.130(Total no of turn in both leg jump skipping) + .058(H.R) - .029(BMI) - .170(Age) and 3 minutes both leg jump skipping provides a valid and reliable sub maximal test for estimating VO_2 max in 18 to 22 years old college level male.

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Corresponding Author

Surojit Ghosh*

Research Scholar, Department of Physical Education, Visva-Bharati, Santiniketan, West Bengal

surojitghosh.vb@gmail.com