

VO₂MAX ESTIMATION FROM ALTERNATIVE LEG JUMP SKIPPING TEST FOR COLLEGE AND UNIVERSITY LEVEL MALE STUDENTS

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ABSTRACT:

Objective: The purpose of the study was to develop a sub maximal exercise test for estimating VO₂max utilizing 3 minutes Alternative Leg Jump Skipping exercise.

Methods: Seventy Eight (78) college and University level males between the ages 18 to 22 years were recruited as the subjects for test validation. The subjects completed a treadmill test in LNIPE, Guwahati, India, human performance laboratory to determine the VO₂max. Subjects were performed 3 minutes Alternative leg jump skipping exercise followed by heart rate 1 minute response. BMI was assessed and age in years was recorded. The directly measured VO₂max data obtained from treadmill test as the dependent variable and number of turn in 3 minute Alternative leg jump skipping performance, post exercise heart rate 1 minute 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 VO₂max for male (ml/kg/min) = 46.809 +.012(Total no of Alternative leg jump skipping) - .008(H.R) - .026(BMI) - .182(Age). SEE = 1.22, Adjusted R² = .012. On the basis of the predicted equation the predicted VO₂ max of the validation group was obtained. Mean VO₂ max (Direct method) and predicted VO₂ max of the validation group were 43.97 ± 1.23 and 43.87 ± 0.28. respectively. The coefficient of correlation between the directly measured VO₂max and predicted VO₂ max was found 0.895 which was significant at the 0.01 level. The predicted equation was tested on a cross validation group (N=78). VO₂ max was assessed using Queen College Step Test. 3 min Alternative leg jump skipping ; post exercise heart rate; BMI and age were assessed. Mean observed VO₂ max and predicted VO₂ max of the cross validation group were 44.07 ± .229 and 44.39 ± .247 respectively. The coefficient of correlation between the observed VO₂ max and predicted VO₂max was found .788 which was highly significant at the 0.01 level that confirmed the reliability and validity of the predicted equation.

Conclusion: Three (3) minutes Alternative leg jump skipping provides a valid and reliable sub – maximal test for estimating VO₂max in 18 to 22 years old college and University level students.

Key Words: Alternative leg jump skipping, VO₂max, regression equation, Direct Method, Indirect Method, Validation group, Cross Validation Group, Queen College Step Test.

INTRODUCTION:

Maximal oxygen uptake ($VO_2\text{max}$) is the maximum rate of oxygen consumption measured during incremental exercise. $VO_2\text{max}$ is generally considered the best indicator of cardiovascular fitness and aerobic endurance. Direct method usually measured in the laboratory setting, the most accurate way to assess $VO_2\text{max}$ 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 equipment's and qualified staff necessary to carry out the exercise test. Hence, indirect methods of estimation $VO_2\text{max}$ 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 $VO_2\text{max}$ and the total work output in a given time or between $VO_2\text{max}$ and intensity of the exercise. There are number of indirect methods to predict $VO_2\text{max}$ such as Cooper test (1968), Astrand step test(1976), Balk test(1963), One mile track walk test(1987), One Mile jog test(1963), Queen college step test(1983) etc. $VO_2\text{max}$ is expressed as liters/kg/min as relative $VO_2\text{max}$.

Skipping is a traditional aerobic type of exercise that may be effective to predict $VO_2\text{max}$. 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.

Alternative leg jump skipping is a form of aerobic exercise in which a person jumps using a skipping rope while alternating legs, similar to a running motion. Instead of jumping with both feet together, one foot lands at a time in a rhythmic pattern. This exercise is commonly used to improve cardiovascular fitness, coordination, balance, and agility. It also helps in increasing endurance and burning calories. The movement requires proper timing between the hands and feet, making it beneficial for developing motor skills.

To perform Alternative leg jump skipping, stand upright holding the rope handles firmly. Swing the rope over your head and jump lightly as it passes under your feet, landing on one foot and then the other alternately. Maintain a steady rhythm and keep your jumps low to reduce fatigue. This exercise is suitable for people of different fitness levels and can be included in warm-ups, training sessions, or fitness tests. Regular practice can contribute to better heart health and overall physical fitness. 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 ($VO_2\text{max}$) based on Alternative leg jump skipping, a sub maximal test, in college and University level male.

METHODOLOGY:

18 to 22 years in age (Mean 20.65 ± 1.43) seventy eight (78) 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 hour prior to testing and to arrive in the LNIPE, Guwahati, Human Performance laboratory after 3 hours after eating a meal. Subject 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 mask of treadmill was inserted in the mouth & nose of the subject when the start button was pressed the treadmill 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 subjects.

Next day subjects were performed Alternative leg jump skipping test on skipping. Alternative leg jump skipping test was administered on an open smooth grassy field. Before performing the skipping the subjects were allowed to adjust the length of the skipping rope as per their height. Holding the handles of the skipping rope with a starting signal stop watch started and the subjects performed alternate leg jump skipping as fast possible with bare footed so that the performance would not less than 70 nos. of turns /min for the males, and continued for 3 minutes. With this work intensity the subjects performed up and down staircase running as fast as possible for 3 minutes.

Just after completion of 3 minutes exercise the subject was allowed to sit on a tool and after 5 sec. rest 15 seconds post exercise pulse count was recorded from the carotid artery. 15 seconds heart rate was the converted into heart rate per minute. Predicted $VO_2\max$ equation was yielded where up & down staircase running performance for 3 minutes, post exercise heart rate/min, BMI, and age in years were the predictor variables. The equation was tested between the validation group for its reliability and validity.

The yielded predicted $VO_2\max$ equation was then applied on a cross validation (N=78). Age (Mean 21.32 ± 1.08), BMI (Mean 21.79 ± 1.49), up & down staircase running performance (Mean 61.44 ± 1.99) and post exercise heart rate (Mean 160.56 ± 3.14) of the cross validation group were assessed. $VO_2\max$ was assessed using Queens College Step Test following requisite procedures. For measuring Queens 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 second. 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 = $111.33 - (0.42 \times \text{step test pulse rate, beats/ minute})$. The Alternative leg 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

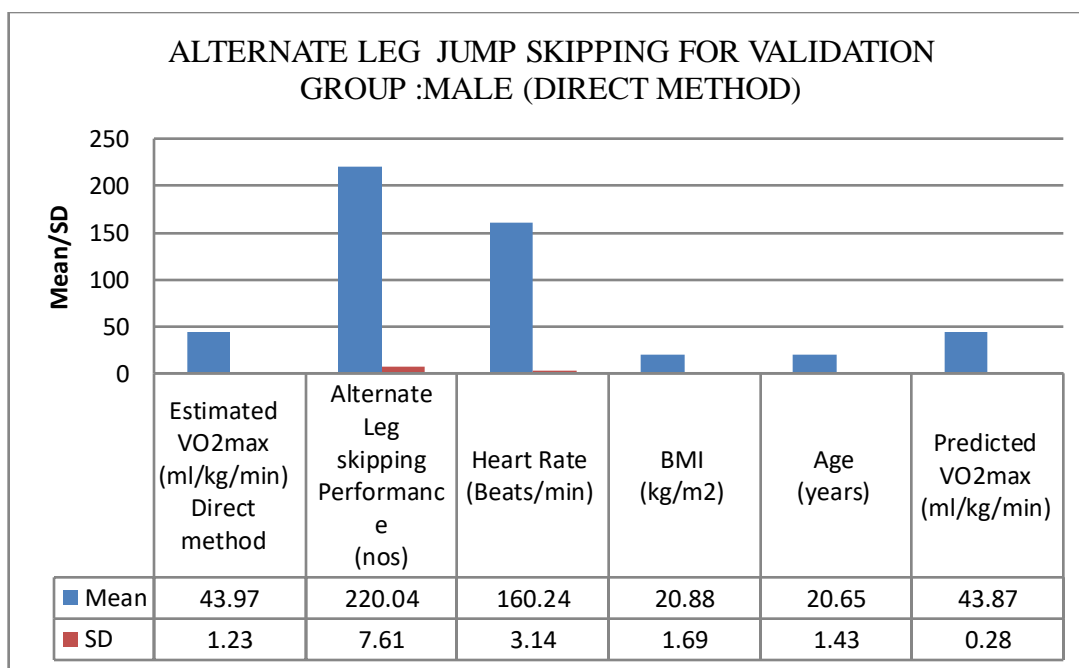
Statistical measure in directly measured $VO_2\max$, Alternative leg jump skipping performance,, heart rate, BMI and age for validation group male (N=78)

Statistical measures in Alternate leg jump skipping for Validation Group: Male (N=78)

Measures	Estimated VO ₂ max (ml/kg/min) Direct method	Alternate leg jump skipping Performance (nos.)	Heart Rate (Beats/min)	BMI (kg/m ²)	Age (years)	Predicted VO ₂ max from newly developed equation (ml/kg/min)
Mean	43.97	220.04	160.24	20.88	20.65	43.87
SD	1.23	7.61	3.14	1.69	1.43	.280

FIGURE-I

Graphical representation of statistical measures in directly VO₂max, Alternative leg jump skipping performance, heart rate, BMI and age for Validation group Male



Regression analysis yielded the following predicted equation to estimate VO₂max where directly measured VO₂max as dependent variable and Alternative leg jump skipping performance, heart rate, BMI, and age as predictor variables.

$$\text{VO}_2\text{max (ml/kg/min) for Male} = 46.809 + .012(\text{Alternate leg jump skipping}) - .008(\text{H.R}) - .026(\text{BMI}) - .182(\text{Age}).$$

Adjusted R²= .012 and SEE=1.22,

The predicted VO₂max of the validation group was calculated using the newly developed predicted equation and the mean predicted VO₂max (43.87 ± 0.28) was obtained (Table-I). The coefficient of correlation between the observed (direct) VO₂max and predicted VO₂max was found r = 0.895 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 VO₂max, this equation was then applied to a cross validation group male (N=78). Age range was 18 to 22 years. VO₂max was measured using Queens College Step Test (QCST). Alternative leg jump skipping test, post exercise heart rate, BMI and age were assessed.

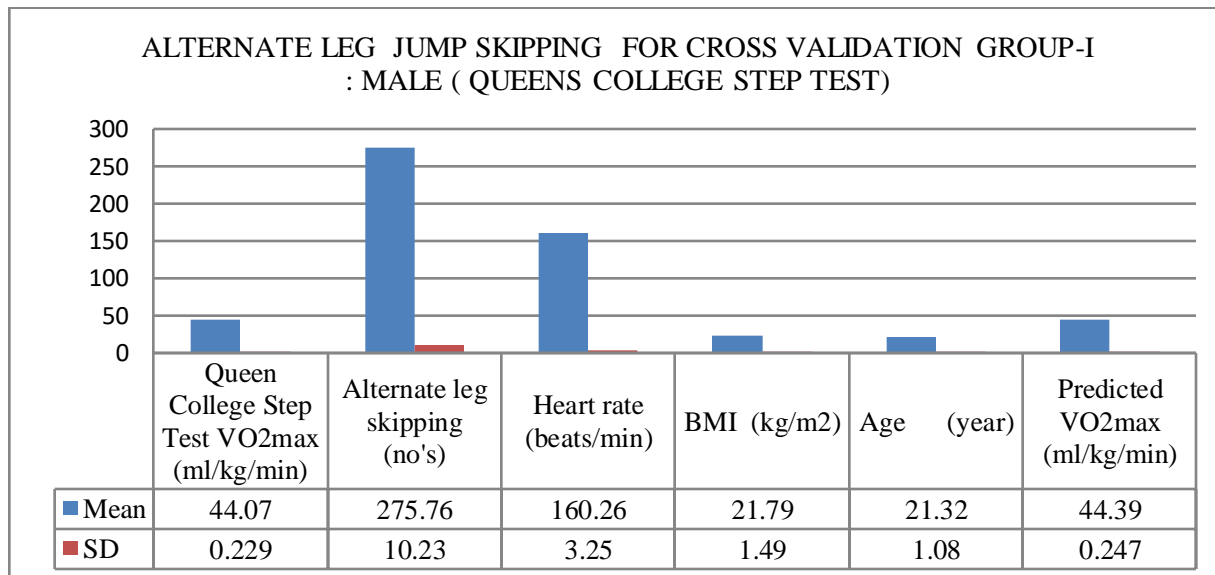
TABLE- II.

Statistical measures in VO_2 max, Alternative leg jump skipping, heart rate, BMI, and age for Cross Validation Group male (N=78)

Measures	VO_2 max QCST Method (ml/kg/min)	Alternate leg jump skipping Performance (nos.)	Heart rate (beats/min)	BMI (kg/m ²)	Age (years)	Predicted VO_2 max from newly developed equation (ml/kg/min)
Mean	44.07	275.76	160.26	21.79	21.32	44.39
SD	.229	10.23	3.25	1.49	1.08	.247

Figure - II

Graphical representation of statistical measures in QCST VO_2 max, Alternate leg jump skipping performance, heart rate, BMI, and age for Cross Validation group Male.



Observed (QCST) mean VO_2 max and predicted mean VO_2 max were found 44.07 ± 0.229 and 44.39 ± 0.247 respectively. The coefficient of correlation between the observed VO_2 max (Queens College Step Test) and predicted VO_2 max was found $r = 0.788$ which was highly significant at 0.01 level.

CONCLUSION:

The results indicate that it is possible to relatively precisely predict $VO_2\max$ from equation: $VO_2\max$ (ml/kg/min) for male = $VO_2\max$ (ml/kg/min) for Male = $46.809 + .012(\text{Alternate leg jump skipping}) - .008(\text{H.R}) - .026(\text{BMI}) - .182(\text{Age})$ and 3 minutes Alternative leg jump skipping provides a valid and reliable sub- maximal test for estimating $VO_2\max$ in 18 to 22 years old college and university level male students

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