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VO2max Estimation from Up and Down Staircase Running test for College Level Students

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Abstract: Objective: The goal of the study was to create a submaximal exercise test that uses a three-minute up-and down staircase running exercise to estimate VO2 max. Methods:78 male college students, ages 18 to 22, were chosen to serve as test validation subjects. To find their VO2max, the participants finished a treadmill test at the human performance laboratory at LNIPE in Guwahati, India. After a three-minute up-and-down stairway running exercise, the subjects had a one-minute heart rate response. Age in years was noted, and BMI was evaluated. The multiple regression model used the directly measured VO2max data from the treadmill test as the dependent variable, and the number of turns in the 3-minute up-and-down staircase running performance, post-exercise heart rate 1-minute response, BMI, and age in years as the independent variables. Results: Male VO2max (ml/kg/min) was estimated using the multiple regression equation, which produced the following predicted equation: 58.133-.076 (total number of up and down staircase runs) -.031 (HR) -.024 (BMI) -.190 (Age). Adjusted R2 =.025, SEE = 1.21. The predicted VO2 max for the validation group was determined using the predicted equation. The direct method mean VO2 max and the validation group's predicted VO2 max were 43.97 ± 1.23 and 43.99 ±.310, respectively. The directly measured VO2 max and the predicted VO2 max had a.858 coefficient of correlation, which was significant at the 0.01 level. The cross-validation group (N=78) was used to test the predicted equation. The Queen College Step Test was used to measure VO2 max. Age, BMI, post-exercise heart rate, and three minutes of up-and-down staircase running were measured. The cross validation group's mean observed VO2 max was 44.07 ±.229, while their predicted VO2 max was 44.91 ±.250. A highly significant correlation (r = 0.627) between the observed and predicted VO2 max was found at the 0.01 level, confirming the validity and reliability of the predicted equation. Conclusion: In conclusion, a valid and reliable sub-maximum test for determining VO2max in college-level students aged 18 to 22 is a 3-minute up-and-down stair running test.

Keywords: VO2max, staircase, validation group, cross-validation group, direct method, indirect method

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INTRODUCTION

The highest rate of oxygen consumption recorded during incremental exercise is known as maximal oxygen uptake, or VO2max. The best measure of aerobic endurance and cardiovascular fitness is typically thought to be VO2max. The most accurate way to measure VO2max is definitely by using a maximal graded exercise test (GTX), which is typically measured in a laboratory setting. The GTX is performed to voluntary exhaustion on a motorized treadmill or cycle ergometer while gas analyzers continuously measure expired air. Nevertheless, the current techniques for directly estimating this index require costly measuring devices and skilled personnel to conduct the exercise test. Therefore, indirect VO2max estimation techniques are frequently employed, particularly in research involving large population samples. The linear relationship between heart rate and oxygen uptake, the relationship between power output and

oxygen uptake, the relationship between VO2max and the total amount of work done in a specific amount of time, or the relationship between VO2max and exercise intensity are all used in the indirect methods. Numerous indirect techniques, including the Cooper test (1968), the Astrand step test (1976), the Balk test (1963), the One Mile Track Walk Test (1987), the One Mile Jog Test (1963), the Queen College Step Test (1983), and others, can be used to predict VO2max. Relative VO2max is measured in litters/kg/min.

Climbing a flight of stairs is known as staircase running. Most homes, workplaces, schools, and even gyms have staircases. They are just waiting to be utilized and are free. Because stairs vary in width and length, if you enjoy running stairs, you can incorporate variation into your workouts by selecting different locations. Since it's a plyometric exercise, muscles use their maximal force in brief bursts. Running stairs also makes you defy gravity. Exercise like running up and down stairs helps you burn more calories and strengthen your legs and heart, among other things. A 60-minute session has the potential to burn 532 calories. It's one of the simplest ways to live a healthy life. According to the Harvard Alumni study, the mortality rate was 33 percent lower for those who climbed eight or more flights of stairs per day on average. For a healthy lifestyle, doctors now recommend walking upstairs once a day. Exercises involving staircase running improve coordination, strength, agility, and flexibility. The best exercise for increasing cardiovascular fitness is skipping running.

The current study's goal was to create a technique for indirectly determining a college-aged male's maximal oxygen uptake (VO2max) using staircase running, a submaximal test.

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. By signing the relevant documents, the subjects gave their informed consent to take part in this study. The subjects' BMI was measured. To ascertain their VO2max, the subjects finished a maximal GXT. Participants were instructed to avoid physically demanding activities for 24 hours before the test and to show up at 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 musk of treadmill was inserted in the mouth & nose of the subject when the start bottom 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_2max was measured of every subjects.

Next day subjects were performed up & down staircase running test on staircase. Staircase having not less than 10 steps with 6 inches high in each step and vertical height was 1.50 meters. With the starting signal stop watch started and from the ground/ zero level of staircase the subject started climbing upwards up to the 10 steps and come down to the zero level stepping all the stair during upwards and downwards running. In this way the subjects were asked to perform 10 times upwards stair climbing covering 10 steps and 10 times downwards running covering 10 steps per minute for the meals. With this work intensity the subjects

performed up and down staircase running as fast as possible for 3 minutes. After completion of 3 minutes was up & down staircase running the subjects was allowed to sit on a tool and after 5 second 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. The predicted VO2max equation was produced, with the predictor variables being age in years, BMI, post-exercise heart rate/min, and up-and-down staircase running performance for three minutes. Validity and reliability tests were conducted on the equation between the validation group.

The yielded predicted VO_2max 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_2maxwas 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_2max for male = 111.33-(0.42 x step test pulse rate, beats/ minute). Age, BMI, post-exercise heart rate, and the up-and-down staircase running test were given as they were for the validation group. The coefficient of correlation between the directly measured and predicted VO2max was determined using the Pearson product moment method of correlation.

RESULTS & DISCUSSION

Table- I: Statistical measure in directly measured VO_2max, up & down staircase running performance, heart rate, BMI and age for validation group male (N=55)

Measures	VO_2 max Direct method (ml/kg/min)	Up & down Staircase running Performance (nos.)	Heart rate (beats/min)	BMI (kg/m^2)	Age (years)	Predicted VO_2max from newly developed equation(ml/kg/min)
Mean	43.97	61.94	161.58	20.88	20.65	43.99
SD	1.23	1.96	1.96	1.69	1.43	.310

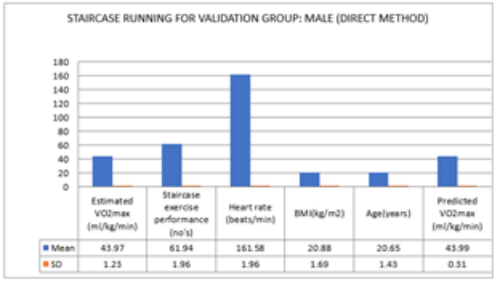

Figure-I: Graphical representation of statistical measures in directly VO_2max, up & down Staircase running performance, heart rate, BMI and age for Validation Group Male

Regression analysis yielded the following predicted equation to estimate VO_2max where directly measured VO_2max as dependent variable and staircase performance, heart rate, BMI, and age as predictor variables.

VO2max (ml/kg/min) = 58.133 -.076 (staircase running) -.031 (heart rate) -.024 (body mass index) -.190 (age).

Adjusted R2 =.025 and SEE = 1.21

The newly developed predicted equation was used to calculate the validation group's predicted VO2max, yielding a mean predicted VO2max of 43.99 ± 0.31 (Table I). At the 0.01 level, a highly significant correlation (r =.858) was found between the observed (direct) VO2max and the predicted VO2max. The outcome validated the newly created predicted equation's dependability.

To validate the newly developed prediction equation to estimate VO_2max, this equation was then applied to a cross validation group male (N=78). Age range was 18 to 22 years. VO_2max was measured using Queens College Step Test (QCST). Up & down staircase running, post exercise heart rate, Body Mass Index and age were assessed (Table – II).

Table – II: Statistical measures in VO_2max, up & down staircase running, heart rate, BMI and age for the cross validation group male (78)

Measures	Queens College Step Test VO_2max (ml/kg/min)	Up & down Staircase running Performance (nos.)	Heart rate (beats/min)	BMI (kg/m^2)	Age (years)	Predicted VO_2max from newly developed equation(ml/kg/min)
Mean	44.07	61.44	160.56	21.79	21.32	44.91
SD	.229	1.99	3.14	1.49	1.08	.250

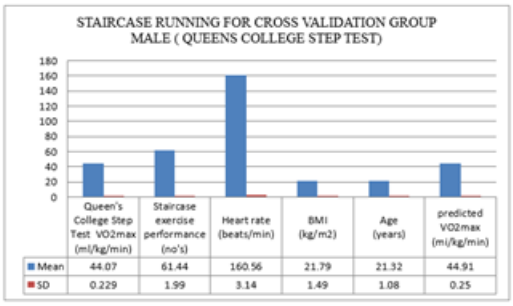

Figure –II: Graphical representation of statistical measures in directly VO_2max, up & down Staircase running performance, heart rate, BMI and age for Validation group Male.

Observed (QCST) mean VO_2max and predicted mean VO_2max were found 44.07 ± 0.229 and 44.91 ± 0.250 respectively. The coefficient of correlation between the observed VO_2max (Queens College Step Test) and predicted VO_2max was found r = 0.627 which was highly significant at 0.01 level.

CONCLUSION

The findings show that the following equation can be used to predict VO2max with a reasonable degree of

accuracy: For male college-level students aged 18 to 22, VO2max (ml/kg/min) = 58.133 -.076 (staircase running) -.031 (H.R) -.024 (BMI) -.190 (Age) and 3 minutes up & down staircase running provides a valid and reliable submaximal test.

References

1. Ashley, C. D., Smith, J. F., & Reneau, P.D. (1997). A modified step test based on a function of subjects' stature. Perceptual and motor skills, 85(3)987-993.
2. Beutner, F., Ubrich, R., Zachariae, S., Engel, C., Sandri, M., Teren, A., & Gielen, S. (2015). Validation of a brief step-test protocol for estimation of peak oxygen uptake. European journal of preventive cardiology,22(4), 503-512.
3. Brown, S.P., Anderson, E.R.., He, Q., Liu, S., Wu, Q.U.I.A.N., Li, H., & Whittle, R.(1992). Physiologic comparison and validation of stairobic stepping with bench stepping. The journal of sports medicine and physical fitness,32(3), 288-292.
4. Buckley, J.P., Sim, J., Eston, R . G., Hession, R., Fox, R.(2004). Reliability and validity of measures taken during the Chester step to aerobic power and to prescribe aerobic exercise. British journal of sports medicine, 38(2), 197-205.
5. Fish, A.F., Christman, S. K., Frid, D.J., Smith, B.A., & Bryant, C. X.(2009). Feasibility and acceptability of stepping exercise for cardiovascular fitness in women. Applied nursing research, 22(4), 274-279.
6. Hermiston, R. T., & Faulkner, J. A. (1971) Prediction of maximal oxygen uptake by a stepwise regression technique. Journal of applied physiology, 30(6), 833-837.
7. Shamsi, M.M., Alinejad, H. A., Ghaderi, M., & Badrabadi, K. T., (2011) Queen college step test predicted Vo2max: The effect of stature. Anal Bio Res, 2,371-377.
8. Tan, H.Y.F., Aziz, A. R., CHIA, Y.H.M., & Teh, K.C., (2005) Prediction of change in cardiorespiratory fitness by the stair-climb test after ten weeks of aerobic training. Adv Exerc Sport Physiol, 11(2), 61-70.
9. Town, G. P., Sol, N., & Sinning, W.E.(1980) A stair-climb test of cardiorespiratory fitness Singapore. Singapore medical journal, 41(12), 588-594.
10. Add Refrence here
11. Add Refrence here
12. Add Refrence here
13. Add Refrence here
14. Cooper, K. H., (1968) Ameans of assessing maximal oxygen intake: correlation between field and treadmill testing. Jama, 203(3), 201-204.
15. Turley, k.r.& Wilmore, J. H.,(1997) cardiovascular responses to treadmill and cycle ergometer exercise in children and adult. Journal of applied physiology, 83 (3), 948-957.