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Research Article

PREDICTION OF MAXIMAL OXYGEN CONSUMPTION (VO2MAX) USING BICYCLE ERGOMETER AMONG MALES AND FEMALES IN GSL STUDENTS

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ABSTRACT
The maximal rate of oxygen uptake up take (VO2max)is an important determinant of cardio respiratory fitness and aerobic performance. A low cardiorespiratory fitness is an independent risk factor for mortality from all causes, but mainly for coro-nary heart disease. This study is aimed to find out the prediction of Maximal oxygen Consumption (Vo2max) Using Bicycle Ergometer in genders. The study was carried out for 60 people (30 males and 30 females) in the age group of 17 – 24years. The predicted Vo2 max is calculated using the Modified Astrands-Ryhming nomogram. The Vo_2 max is corrected for the age by using the formula suggested by the Sicinoff. In this study was found that Male individuals showed more VO2 max compared to females which was statistically significant.

Keywords: *Cardio Respiratory Fitness, Maximal Oxygen Consumption (Vo2max), Bicycle Ergometer*

INTRODUCTION
Cardiorespiratory fitness is commensurate with the ability of the body to take up and use oxygen and the internationally accepted reference standard for cardiorespiratory fitness (Baltimore *et al.,* 2010; Arts *et al.*, 1993). Aerobic power or maximum oxygen uptake (VO2)the maximum rate at which oxygen can be consumed, is a commonly used measure of cardiorespiratory (or aerobic) fitness. Direct measurement of V02 max is expensive both in terms of time and cost of precise gas analysis. Thus, various predictive tests have been devised to evaluate aerobic fitness. These include performance related measures, for example walking or running for a given time (Astrand *et al.*, 1954). VO2max can also be estimated using a variety of methods involving maximal or sub maximal exercise tests or non exercise questionnaires. Sub maximal tests have certain advantages over maximal tests in that specialized lab equipment is unnecessary, test administrators require less training, and the exercise intensity is realistic for most participants. Sub maximal testing is a popular and effective way of evaluating CRF and is valuable in developing individualized exercise programs.
In addition, periodic sub maximal testing provides a convenient way to monitor progress throughout an exercise program and educates participants about their potential risk for cardiovascular and other chronic diseases (Milani *et al.*,). Non exercise methods of predicting VO2max are also useful and convenient, requiring participants to simply answer a few questions and then compute a relatively accurate VO2max score using a multiple linear regression equation (Heli *et al.*, 1995). Sjostrand (1947) and Astrand and Ryhming (1954) were the first to develop sub maximal cycle ergometer protocols. Since then, researchers have continued to develop methods of predicting VO2max from sub maximal workloads using cycle ergometers (Sjostrand *et al.*, 1947). Cycle ergometry is an appealing mode of testing in that cycle ergometry allows for the selection of precise work rates which can be expressed with appropriate units of power (e.g., kgm·min-1); cycle ergometers require minimal space and are easy to transport; cycle ergometer exercise is a non weight-bearing activity that is usually well tolerated by individuals with orthopaedic or other physical limitations; and heart rate (HR), blood pressure, and electrocardiographic data are easily collected during the test protocol. In addition, sub maximal cycle ergometer tests provide relatively accurate estimates of CRF in a variety of populations (Fox, 1975). The present study was

designed to establish the prediction norms for VO2max from physical parameters among sedentary young healthy male and female college students.

MATERIALS AND METHODS

The present study was conducted in the department of physiology Ganni Subba Laxmi Medical College and General Hospital, Rajahmundry, Andhra Pradesh from 2011 to 2012 after approval of institutional ethical committee. About sixty (n=60) students age ranging from 19to 24 years were selected. All the subjects / students were informed about the study protocol and written consent was obtained from them to participate in the study prior to the procedure. Out of 60 students, boys=30 and girls=30, was selected for the study. A structured proforma was designed to evaluate and record the personal data of the selected subjects regarding their name, age, sex, height and weight, personal history like smoking, with duration and quantity, any history of lung disease, history of persistent cough etc. The student were included with no history of smoking; living with sedentary lifestyle and no history of any respiratory disease, no persistent cough/phlegm, hemoptysis, dyspnoea and wheezing at the time of the study.

Sub Maximal Cycle Ergometer Test

One day prior to the exercise-test, the subjects were explained about the procedure and instructed to come for the test without consuming alcohol, tea, coffee and without smoking. They were also instructed to come at least 2 -3 hours after a light breakfast, wearing a light clothing for exercise. The subjects were instructed to start cycling and the rate was adjusted to 60 rpm. His/her carotid pulse rate was counted every minute, during the last 30 seconds of each minute. The exercise continued for 5 minutes. If the pulse rate continued to rise each minute by more than 5 beats, the exercise was continued for the next minute (6^{th} minute). The average pulse rate of last 2 minute was taken as the steady state pulse rate at the given workload. If the steady pulse rate calculated as above with a given load is still less than the target heart rate of the subject, the work load is increased and the entire test was repeated as above after giving rest to the participant for 20 minutes. This was continued until the target pulse rate achieved and the particular workload was noted. From the target pulse rate and corresponding work load, the predicted Vo2 max is calculated using the Modified Astrands-Ryhming nomogram. The Vo_2 max is corrected for the age by using the formula suggested by the Sicinoff *et al.,* (1982).

$Y = 0.348 (X_1)-0.035 (X_2) + 3.011$

The data was statistically analyzed by using the SPSS software (version 12.0) and by applying Student's t-test.

RESULTS AND DISCUSSION

Results

Table 1: Shows Mean ±SD values of anthropometric parameters of both genders

s. no	Parameters	Boys (n=30) Mean ±SD	Girls (n=30) Mean ±SD
1.	Age (yrs)	22.0 ± 1.6	21.0 ± 1.45
2.	Height (cm)	165.36±7.2	155.0±4.3
3.	Weight(Kg)	61.7 ± 4.2	62.5 ± 6.1
4.	Pulse/min	74.6±5.0	69.6±7.6
5.	SBP (mmHg)	108.8 ±8.8	104.20±8.58
6.	DBP (mmHg)	70.1±5.81	62.46±8.11
7.	PP (mmHg)	38.7±7.96	41.85±7.12
8.	MAP (mmHg)	82.9±5.81	76.3±7.68

Table 2: Shows relation between VO2 max and Co2 max in the both genders

S. no	Group	Mean Vo2 max(L)	Mean Co2 max(L)	p-value
1.	Male (n=30)	3.1±0.26	3.3±0.14	<0.001
2.	Female (n=30)	2.7±0.20	3.2±0.18	<0.001

Table 3: Shows changes in parameters before and after exercise

Parameters	Boys (n=30) Mean ±SD	Girls(n=30) Mean ±SD
Before Exer cise		
Pulse /min	74.6±5.0	69.6±7.6
SBP(mmHg)	108.8 ±8.8	104.20±8.58
DBP(mmHg)	70.1±5.81	62.46±8.11
After Exercise		
Pulse /min	171±7.2	167 ± 10.9
SBP(mmHg)	156±4.7	147±7.2
DBP(mmHg)	55±6.4	53±4.9

Table 4: Shows the changes in the VO2max and its relation with age, body mass and sex

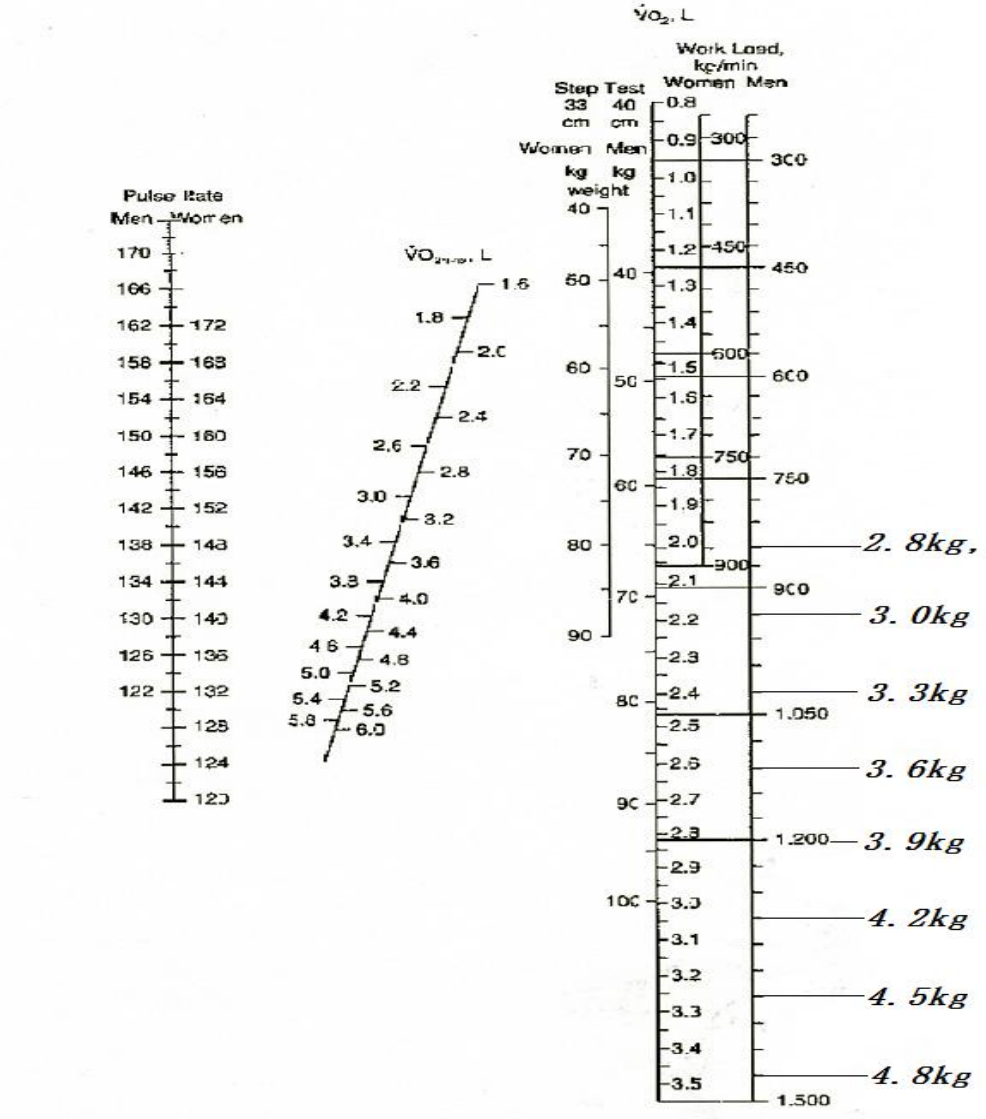
Group status	Mean VO2 max in L/ body weight ± SD	Mean VO2max in ml/kg/ min ± SD	Mean body mass in kg ± SD	Mean age in years, range (19-25) ± SD	Mean Target Heart Rate (THR) beats /min ± SD
Boys (n=30)	3.18 ± 0.26	51.76 ± 3.8	61.7 ± 4.2	22 ± 1.6	171 ± 7.2
Girls (n=30)	2.70 ± 0.20	44.07 ± 4.2	62.5 ± 6.1	21 ± 1.4	167 ± 10.9

Table no 1 shows that anthropometric parameters of boys and girlss. There was no significant difference in age on two groups, but there is significance difference in height, weight, Systolic blood pressure, Diastolic blood pressure, Pulse Pressure, Mean Arterial Pressure in males was high compared to females. The difference being statically insignificant. Table no 2 shows that relation between VO2 max and Co2 max in the both genders. Significance difference could be established in Vo2 max(L) and Mean Co2 max(L) in males was significantly higher compare to females. Table no 3 shows changes in parameters before and after exercise in boys and girls. Significance difference in pulse, SBP,DBP in males was significantly higher compare to females. Table 4 shows the changes in the VO2max and its relation with age, body mass and sex, there was no significant different in age and Mean body mass (Kg),mean Vo2 max(L)and Mean Co2 max(L) in males was significantly higher compare to females.

Discussion

In the present cross sectional study was predicted the VO2 max in males (n=30) and females (n=30) belonging to same age group (19-24) years using sub maximal bicycle ergometer protocol. We also tried

to compare and correlate the measured parameters and predicted parameter. The predicted VO2max obtained in the study matches the measured VO2 max using direct procedures in the same age groups.



Modified astrand–ryhming nomo gram

Comparison of our norms for prediction of VO2max from body mass with other previously available norms depicted wide range of variation in MEAN and SD (Niels *et al.,* 2004) hypothesized that VO2max can be predicted from the ratio between resting and maximum heart rate among trained individuals and body mass acted as a proportionality factor in-between the sexes probably due to proportionately higher fat percentage among females. Malek *et al.,* (2005) recommended one multiple linear prediction equation for prediction of VO2max from age, body mass, height, training hours per week, intensity of training and natural logarithm of years of training among aerobically trained females of USA. Despite considering six independent variables, the SEE (259 ml/min) was considerably large enough. Verma *et al.,* in their studies proposed that physical characteristics are good predictors of maximal oxygen uptake in Indian males and more importantly they obtained highest value of correlation coefficient when body mass was considered as an independent parameter. This fact corroborates with the findings among males of present investigation (Verma *et al.,* 1990). Absolute values of VO2max are typically 40-60% higher in men than

in women. Obviously, this difference is due to the variance in bodyweight and lean body mass between men and women. A more accurate comparison of maximal oxygen uptake between men and women would use the relative measure.

Research has shown that the average young untrained male will have a VO2 max of approximately 3.5 litres/minute (absolute) and 45 ml/kg/min (relative).

The average young untrained female will score a VO2 max of approximately 2.0 litres/minute and 38 ml/kg/min.

Conclusion

The above discussion it is concluded that on prediction of maximaloxygen consumption (vo2max) using bicycle ergometer among males and females, was found that Male individuals showed more VO2 max compared to females which was statistically significant ($p < 0.05$).

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