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Measurement of VO2 in sedentary healthy females: A normative study

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ABSTRACT

To measure normal values of VO2 in sedentary healthy females aged 18-25 years. To know normal values of VO2 in sedentary healthy females aged 18-25 years. 20 healthy females aged 18-25 years were selected as per the inclusion & the exclusion criteria. The study was conducted after taking consent from the subjects, personal details were obtained through performance, instructions about the procedure were given and required materials were used. Normal values of VO2 were measured using power lab machine with the treadmill. VO2 values of healthy females appear lower than those standards reported for females of comparable age, weight, and height in western countries. Current study presented normative data of VO2 in sedentary healthy females aged 18-25 years

Keywords— *VO2, Aerobic capacity*

1. INTRODUCTION

VO_2or O_2 consumption is a measure of the volume of oxygen that is used by the body to convert the energy stored in the foods into the energy molecules called 'ATP' which the body uses at the cellular level[(1)]. It is the difference between the volume of oxygen inspired and expired out [(2)]. This is an important concept in the context of exercise because ATP is the energy source that allows muscles to continue working and VO_2 is directly related to ATP generation [(1)].

There are three major energy systems that produce energy in the form of 'ATP'. These are:

- Phosphagen or Adenosine Triphosphate-Phosphocreatine (ATP –PC) System: In this system, phosphocreatine is the chemical fuel source. No oxygen is required. Maximum capacity is 0.7mol ATP. Maximum power is 3.7mol ATP/min. It provides energy during the first 30 seconds of intense exercise [(4)].
- The Anaerobic Glycolytic System: In this system glycogen is the fuel source. No oxygen is required. Maximum capacity is 1.2mol ATP. Maximum power is 1.6mol ATP/min. It provides a major source of energy from the 30^{th} to 90^{th} second of exercise [(4)].
- The Aerobic system: In this system glycogen, fats and proteins are the fuel sources. O_2 is the fuel source. Maximum capacity is 90mol ATP. Maximum power is 1 mol ATP/min. It starts after the 2 minutes of exercise [(4)].

As per the basic physiology of VO_2, breathing is the only first step in oxygen consumption and in fact not all the oxygen that we breathe in gets consumed. To actually consume the inhaled oxygen, the body needs to make use of it in the cellular respiration process that generates ATP. Delivery of oxygen to the cells require pulmonary ventilation to bring the oxygen to the body, diffusion of oxygen from the air to the capillaries that surround the lungs, contraction of heart to pump blood to the muscles and diffusion of oxygen from blood into the muscle cells. After this oxygen is used in the cellular respiration chemical reaction to produce ATP and the by-products of this are water and carbon dioxide [(1)]. Measurement of energy expenditure is done by two methods, direct calorimetry and indirect calorimetry method. Direct Calorimetry method involves measuring of energy expenditure or metabolic rate by measurement of heat production. While, indirect calorimetry method involves, measurement and analysis of the expired air to produce oxygen and carbon dioxide [(2)]. Our study is a normative study which tries to define how things should be, which means that it will be necessary to define the subjective point of view that shall be used. It includes specifying and planning improvements to the object of the study or the latter analogous objects [(5)]. In an attempt to measure VO_2 in healthy sedentary female subjects aged between 18 to 25 years we have used open circuit indirect spirometry method and manual set treadmill protocol.

2. BACKGROUND AND NEED FOR STUDY

- To know the normal values of VO_2in the healthy sedentary female subjects aged between 18 to 25 years, this would be very useful in interpreting the exercise data
- With this preliminary study, we aimed to set up a normative data for our lab which may also serve as a basis for future large population

3. AIM OF THE STUDY

To measure normal values of VO_2 in sedentary healthy females aged 18-25 years

4. MATERIAL AND METHODOLOGY

Study Design: Observational Cross-Section Study
Population: healthy females (18 to 25 years)
Sample Size: 20
Study Setup: VSPM'S College of Physiotherapy, hingna, Nagpur
Sampling technique: convenient sampling
Study duration: 3 months

4.1 Inclusion criteria

- Healthy females aged 18 to 25 years
- No strenuous exercise before testing

4.2 Exclusion criteria

- Any cardiorespiratory disorders
- Any musculoskeletal disorders
- Any neurological disorders
- Any medication
- Subjects who are not cooperative

5. PROCEDURE

The study was started with permission of the director of physiotherapy. Subjects were selected according to the inclusion criteria. The consent of each subject was taken and instructions about the procedure were given prior to testing. After instructing the subject 5 mins warm-up was given at the speed of 3 Km/hr. then the speed was increased to 5 Km/hr (constant)& grade was increased by 2% by every 2 minutes until volitional termination. Data was collected and 5 minutes of cool down was given.

6. DATA ANALYSIS

Data was collected & statistically analysed

Table 1: Distribution of subjects according to age

Age Group (years)	Number of subjects	%
18-19	2	10
20-21	3	15
22-23	11	55
24-25	4	20
Total	20	100

Table 2: Distribution of VO_2 (L/min) according to age

	Mean	SD
18-19	**1.39**	**0.04**
20-21	**1.06**	**0.22**
22-23	**0.84**	**0.38**
24-25	**0.7**	**0.51**

Table 3: Mean and standard deviation of age, height, weight, BMI, VO_2 and time

Variables	Mean	SD
Age (year)	22	2.7
Height (meters)	1.56	0.04
Weight (kg)	61.75	4.67
BMI (kg/m^2)	25.44	10.6
VO_2(L/min)	0.825	0.45
Time (mins)	13..35	2.69

7. DISCUSSION

The present study is the first one to report VO_2norm data for sedentary healthy females (18-25 yrs) in VSPM'S College of Physiotherapy. The results obtained from our study shows that the healthy female subjects between the age group of 18-25 years

have obtained a mean value of VO_2 around 0.825±0.45 L/min for a treadmill walking with the speed of 5 Km/hr and only the grades have been increased every 2 minutes by 2%. Our results concur with the studies done by, S. A. Al-Majed et al. who presented normal peak VO_2exercise values [7]. Hazzard. Al Hazza concluded that maximal oxygen uptake increases linearly from1.2±0.2 L.min-1 at age 7-9 years to 2.5±0.5 L.min-1 at age 13-15 years[10], Bandini et al. (1990) suggests that in obese children, excess body weight do not necessarily imply a reduced ability to consume oxygen, but excess fatness does have a detrimental effect on submaximal aerobic capacity[12]From our study, VO_2values of healthy females appear lower than those standards for females of comparable age, weight and height in western countries. In the study done by Henrik Loe, women had approximately 34% and 32% lower V_{Epeak} and V_{Tpeak}, respectively, and a 4% lower peak f_{Bpeak} than men. This is in agreement with other population-based studies on V_{Epeak} [39], [42]–[44], V_{Tpeak} and f_{Bpeak} [22], [45], and as expected as women have smaller lung size and dynamic lung function volumes than men, also after adjusting for differences in stature [46]. We observed 6–30% higher V_{Epeak} among men and women compared to that seen in Brazilian [42] (n=3992), American [43] (n=988) and French [44] (n=150) populations, as well as in small sample size studies [22], [45], [47], [48]. Yet, a Norwegian study [49] (n=759) displays V_{Epeaks} fairly consistent with ours. Hence, there might be population differences, which highlight the need of reference data in different populations.Lower V_{Epeak} with increasing age is consistent with findings in Brazilian [42] (n=3992), Israeli [23] (male =1424), Canadian [39] (n=100), [25] (male =816) and French [44](n=150) studies, and in line with an age attenuation in dynamic lung function largely attributed to decreased elastic recoil [50], [51].In this study the highest V_{Tpeak} was observed among the 30–49 year groups, in both men and women, with a decrease in subsequent age groups. These findings are unexpected, since the highest V_T should be in the youngest age group, with deterioration between subsequently older age groups [50], [51]. Our findings could be explained by the relative low sample size in the youngest age group. Contrary to us a Canadian [39](n=100) and Israeli [23] (n=1424) study presented their highest V_{Tpeak} in the youngest

8. CONCLUSION

Our study presented normative data for VO_2 in sedentary healthy females aged 18-25 years which ultimately indicates the functional capacity of cardio-respiratory function and acts as a measure of aerobic performance.

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