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ASSESSMENT OF PHYSICAL ACTIVITY AND CARDIORESPIRATORY FITNESS IN MEDICAL STUDENTS

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ABSTRACT

Introduction: *Cardiorespiratory fitness is an indicator of cardiovascular health, usually expressed as VO2max. VO2max is the capacity of our body to transport and utilize oxygen during maximal exertion. The present study attempts to assess the level of physical activity and cardiorespiratory fitness in medical students and compare VO2max between physically active and insufficiently active students.*

Materials and Methods: *An observational cross sectional study was conducted in 246 medical students (123 males and females each) of age between 18 to 23 years in National Medical College, Birgunj. After obtaining ethical clearance, screening was done with American College of Sports Medicine participants screening questionnaire. Students were classified as physically active and insufficiently active by using Global Physical Activity Questionnaire. VO2max was calculated from recovery heart rate counted from fifth to twentieth second of recovery after step test. Finally, subjects were categorized into different level of cardiorespiratory fitness based on their VO_2max values.*

Result: *Present study found 33.6% of insufficiently physical active students. Females had higher prevalence of insufficient physical activity (40.6%) than males (26.8%). The VO2max of male and female was 46.79 ± 8.98 and 36.15 ± 4.66 ml/Kg/min respectively. Majority of female participants had 'average' VO2max whereas in male, distribution is almost equal in 'excellent', 'good' and 'fair' category.*

Conclusion: *Around one-third of medical students did not meet the level of physical activity recommended by WHO for health. Majority of them had 'average' level of VO2max and those physically active had better cardiorespiratory fitness.*

Keywords: *Cardiorespiratory fitness; Physical activity; Step test; VO_2max.*

INTRODUCTION

Cardiorespiratory fitness (CRF) is the ability of circulatory as well as respiratory system to provide adequate oxygen to muscles during sustained physical activities.[1] It is one of the components of physical fitness, expressed as VO_2max and has inverse relationship with cardiovascular diseases and mortality.[2,3] VO_2max is product of maximum Cardiac Output and maximum arterial-venous oxygen difference.[4] The VO_2max value in ml/kg/min should be considered when CRF level is estimated. Indirect method is equipment, cost and time effective whereas direct estimation is exhaustive and tedious.[5,6] Queen's College Step Test (QCT) is one of the valid indirect test.[7]

There is limited data regarding prevalence of insufficient physical activity and its relationship with cardiorespiratory fitness in Nepal. The present study attempts to assess the level of physical activity and cardiorespiratory fitness and compare VO_2max between physically

active and insufficiently active medical students, taking recommendations of World Health Organization (WHO) as cut-off level.

MATERIALS AND METHODS

It was a cross-sectional observational study conducted in 246 medical students of National Medical College, Birgunj, in the Clinical laboratory of Department of Physiology. Sample was collected from January 2022 to May 2022 after obtaining ethical clearance from NMC-IRC (Ref: F-NMC/522/077-078).

Sample size was calculated by using formula $n=Z^2p(1-P)/d$, Where, Z is a level of significance, P is expected proportion/prevalence and d is precision. According to a study by Hada et al, among Nepalese students, P = 0.8.[8] At 5% level of significance, Z = 1.96. Taking d = 0.05, sample size (n) = 246. All available students who met inclusive criteria (healthy and age between 18 - 24 years) were included in the study.

Students with cardiovascular diseases, respiratory diseases, electrolytes imbalance, functional impairments (fracture, muscle tear, muscular dystrophy) and acute non-cardiopulmonary disorder (infection, renal failure, thyrotoxicosis) that may affect exercise performance and pregnant were excluded from the study. Students with drug history (beta agonist, beta blocker, thyroxin, antithyroid drugs, antidepressant, digoxin) and uncooperative were also excluded from the study.

Participants were asked to fill the questionnaire on general health and risk factors based on widely used American Heart Association (AHA) - American College of Sports Medicine (ACSM) Participation Screening Questionnaire.[9] Subjects were classified as physically active or insufficiently active based on physical activity level from the global physical activity questionnaire using: Level of physical activity (MET min per week) = T1 X 8 + T2 X 4. Participants were categorized as physically active if they had physical activity more than 600 MET min per week and insufficiently active if physical activity less than 600 MET min per week. One MET is the rate of energy expenditure while sitting at rest which is equivalent to oxygen uptake of 3.5 ml per Kg body weight per minute.[10] Height and weight were measured in meter and kilogram respectively. Basal metabolic index (BMI) was calculated using formula weight (in Kg) / height (in m^2). QCT was performed on all the included participants who met the required preparations (no food and caffeine before 3 hours, no significant exertion/exercise on test day and comfortable clothes) using 16.25 inches high wooden box. Resting pulse rate was determined by palpating radial pulse after minimum 10 minutes rest. Participants were demonstrated how to step on the box at the rate of 24 steps per minute for males and 22 steps per minute for females keeping in pace with the metronome set at 96 beats per minute and 88 beats per minute respectively. Four beats in metronome completed one step. The sequence of foot movement was right foot up, left foot up, right foot down and left foot down. Participants practiced until they could do it correctly. They were instructed to begin stepping with start of stopwatch and stop exactly after 3 minutes. The recovery radial pulse was counted during fifth to twentieth second into recovery in standing position. VO_2max was then calculated using VO_2max = 111.33 - (0.42 X step-test recovery pulse rate, b/min) for male and VO_2max = 65.81 - (0.1847 X step-test recovery pulse rate, b/min) for female. Finally, the level of CRF was categorized according to their vo_2max level in ml/kg/min as excellent(male≥53; female≥49), good(male-44-52.9; female-39-48.9), average(male- 34-43.9; female-31-38.9),fair (male- 25-33.9;female-24-30.9) and poor(male≤24.9; female-≤23.9).[4]

The collected data was entered in Microsoft Office Excel 2016. SPSS software (IBM SPSS Statistics 20) was used for statistical analysis. For continuous variables, the data was expressed in means ± standard deviations (SD).

RESULTS

The present study was conducted in 246 medical students (123 males and females each). Their age ranged between 18 to 23 years. Their mean age, height and weight is shown in table 1. Mean pulse rate and recovery pulse rate in male was 74.53 ± 6.70 beats/min and 153.65 ± 21.38 beats/min respectively and VO_2max calculated was 46.79 ± 8.98 ml/kg/min. Similarly mean pulse rate, recovery pulse rate and calculated VO_2max in female was 76.34 ± 9.47 beats/min, 160.55 ± 25.26 beats/min and

36.15 ± 4.66 ml/kg/min respectively. The mean BMI in male was 23.09 ± 3.22kg/m^2 and 21.77 ± 3.98 kg/m^2 in female.

Table 1: Baseline characteristics and VO_2max of participants

Sex	Age (Years)	Weight (Kg)	Height (m)	Pulse (beats/min)	Recovery Pulse rate (beats/min)	VO_2max (ml/kg/min)	BMI (kg/m^2)
Male (n=123)	20.57 ± 1.04	65.22 ± 9.31	1.68 ± 0.05	74.53 ± 6.70	153.65 ± 21.38	46.79 ± 8.98	23.09 ± 3.22
Female (n=123)	19.77± 0.90	52.58± 10.21	1.55 ± 0.06	76.34± 9.47	160.55± 25.26	36.15 ± 4.66	21.77 ±3.98

Table 2 and 3 shows the comparison of study variables among physically active and insufficiently active male and female respectively. Ninety males (73.17%) were physically active which is higher in comparison to physically active females (59.34%). Weight and BMI in physically active male was found to be higher than insufficiently active male while the result was opposite in case of female. Resting pulse rate, recovery pulse rate and VO_2max was higher in both male and female physically active participants.

Table 2: Comparison of baseline characteristics and VO_2max in physically active and insufficiently active male

Physical Activity	Number (%)	Age (Years)	Height (m)	Weight (Kg)	BMI (Kg/m^2)	Resting Pulse rate (beats/min)	Recovery pulse rate (beats/min)	VO_2max (ml/Kg/min)
Active	90 (73.17%)	20.51±1.07	1.69±0.06	64.86±9.41	22.98±3.25	73.88±6.72	149.47±21.44	48.47±9.11
Insufficiently active	33 (26.82%)	20.76±0.97	1.68±0.05	66.26±9.16	23.64±3.19	76.37±6.44	165.09±16.81	41.88±7.09

Table 3: Comparison of baseline characteristics and VO_2max in physically active and insufficiently active female

Physical Activity	Number (%)	Age (years)	Height (m)	Weight (Kg)	BMI (Kg/m^2)	Resting Pulse rate (beats/min)	Recovery pulse rate (beats/min)	VO_2max (ml/Kg/min)
Active	73 (59.34%)	19.68 ± 0.87	1.56 ± 0.06	54.32 ± 8.16	22.35 ± 3.19	76.22 ± 9.38	159.24 ± 23.03	36.46 ± 4.26
Insufficiently active	50 (40.65%)	19.92 ± 0.95	1.55 ± 0.08	50.07 ± 12.29	20.84 ± 4.88	76.52 ± 9.73	162.48 ± 28.35	35.94 ± 5.19

As evident from fig. 1, majority of the female participants had 'average' level of VO_2max. Figure 2 shows one-third of the participants had 'average' level, other third had 'good' level and a good number had 'excellent' level of VO_2max. None of the female had 'excellent' and 'poor' level of VO_2max. Also, none of the male fell under 'poor' level of cardiorespiratory fitness.

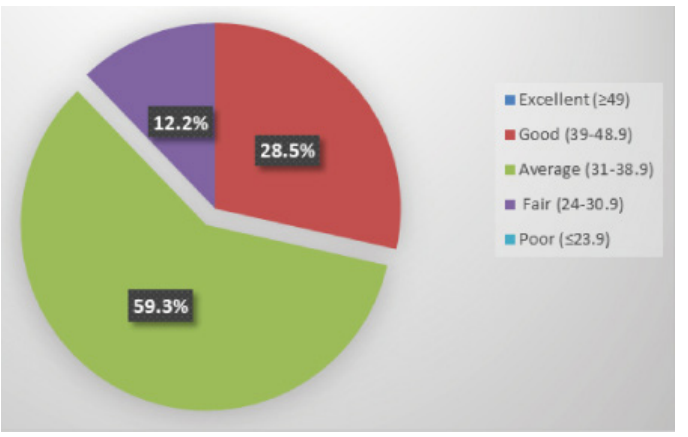

Fig 1: Categorization of cardiorespiratory fitness of female participants

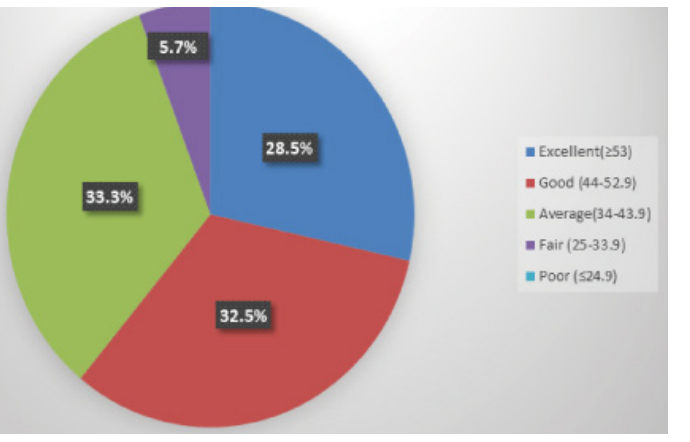

Fig 2: Categorization of cardiorespiratory fitness of male participants

DISCUSSION

Present study found the prevalence of insufficient physical inactivity to be 33.6% in both sexes. Females had higher prevalence of insufficient physical activity (40.6%) than

males (26.8%).Studies conducted by Giri et al on medical students and Hada et al on female medical students found the prevalence of insufficiently active population to be 79% and 80.3% respectively.[11,8] The disparity in physical activity between present and their studies are more likely due to differences in the questionnaires of the studies and increasing awareness of the health benefits of physical activity. The cut off level of physical activity for classification into active or inactive category has not been mentioned in those studies whereas the present study encompasses all domains of physical activity including work, transport and recreation.

Global Status Report on Non-communicable Diseases 2016 shows that 27.52% of adults aged above 18 years were insufficiently active (men 25.03% and women 32.22%) globally. The prevalence was 30.49 % in the South-East Asia. Women (46.84%) were less active in South-East Asia than men (21.57%).[12] According to the STEPS Survey 2019, 8.5% of Nepalese in Province 2(8.3% females and 8.8% males) did not meet the WHO recommended level of physical activity. The same study found 9.6 % (10.7% females and 8.5 % males) of respondents between 15-24 years had low level of physical activity.[13] Comparing the 2019 survey report with 2013, it is clear that the level of physical inactivity is increasing gradually in adult population; more marked in females.[14] Vaidya et al showed a high prevalence of insufficient physical activity (17.9% in males and 21.9 % in females) in the peri urban population.[15] Higher level of prevalence of physical inactivity in the medical students in this study as compared to the Nepalese population of 15-24 years seems to be due to lower involvement of the students in work, transport related and physical activities.

The QCT is the valid test to predict VO_2max in both male and female.[6,7,16,17] The VO_2max of present study in ml/Kg/min is 46.79 ± 8.98 for male and 36.15 ± 4.66 in female. These findings are consistent with findings of Hada et al.[8] Findings corroborating to present study were also recorded in ml/Kg/min by Vikawati et al (male-43.38±10.51, female- 34.31±5.27), Ali et al(female- 42.55±3.42), Koju et al(male-51.61±6.26, female- 36.02±3.71), Pandit et al(male- 47.5±6.57, female- 38.4±4.73) and Hingorjo et al(male- 55.41±9.45, female- 39.91±3.13).[18-22]

Majority of female participants in present study have 'average' VO_2max whereas in male, distribution is almost equal in 'excellent', 'good' and 'fair' group. Study done by Koju et al in medical students of Lumbini Medical College, Palpa also found the similar distribution of VO_2max in female participants but majority of male participants had 'good' VO_2max.[20] The differences in distribution of VO_2max in male can be explained mainly by the geographical differences of study site and more ambulatory nature of male as compared to female counterparts.

The questionnaire on the "level of physical activity" enquires about their physical activity level in a typical week. The participants were also found to be involving in household chores like washing clothes, dishes, mopping floor, walking to college and back home (< 10 minutes) that is not included in the questionnaire. These activities can be expected to put extra load on the heart, respiratory muscles and metabolic system of the used skeletal muscles and cause adaptive changes. An increase in maximum cardiac output is believed to be the most significant adaptation in cardiovascular function with regular aerobic activities.[4,23] Physically active and insufficiently active subgroups in this study are homogenous with regard to age and body composition (weight, height, body mass index). Hereditary factors could not be controlled. Subjective differences in self-reported level of physical activity might also have played role. An experimental design to evaluate VO_2 max before and after aerobic training might better reflect the role of physical activity to improve VO_2max.

CONCLUSION

About one-third of medical students (40.6% female and 26.8% male) did not meet the level of physical activity recommended by WHO for health. Physically active participants had better cardiorespiratory fitness than insufficiently active counterparts. Majority of female participants had 'average' level of VO_2max but male participants with 'average', 'good' and 'excellent' level of VO_2max were almost equal in number.

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