To Evaluate the Associated Factors and Cardio Pulmonary Exercise Testing in Young Indian Patients with Cardiac Risk

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Abstract:

Background: Cardiovascular diseases (CVDs) are increasingly affecting young individuals in India, necessitating a comprehensive evaluation of associated factors and cardiac risk. Cardio-pulmonary exercise testing (CPET) provides valuable insights into cardiovascular fitness and response to physical exertion, making it a crucial tool for assessing cardiac risk in this demographic.

Aims and Objective: To identify the associated factors and Cardio Pulmonary Exercise testing in young Indian patients with cardiac risk.

Materials and Methods: A cross-sectional study was conducted with a sample size of 30 young participants (aged 18 to 40 years) presenting with cardiac risk factors. Demographic information, medical history, and lifestyle habits were obtained through structured interviews. CPET was performed using standardized protocols on treadmill, with continuous monitoring of ECG, VO2, VCO2, respiratory rate, heart rate, and blood pressure during exercise. Associated factors, including, anthropometric parameters, blood pressure, BMI, smoking status, and alcohol consumption, were assessed.

Results: Out of all 30 patients, 66.67% were males while 33.33% were females. There was no significant (p>0.05) difference in number of patients in different age group, between males and females. The mean height of all patients was 162.6 ± 6.11 cm, mean Weight was 65.23 ± 12.04 Kg, mean BMI 24.71 ± 4.65 Kg/m^2, mean Waist Circumference was 84.9 ± 7.41 cm, mean Hip Circumference was 89.87 ± 5.06 cm and mean Waist Hip Ratio was 0.95 ± 0.08. The mean systolic Blood Pressure of all patients was 125.27 ± 12.59 while diastolic Blood Pressure 81.67 ± 9.06 was mmHg. Seven (23.33%) were smokers, 30% (n=9) had alcohol abuse and tobacco use was found to be in 5 (16.67%) patients. Dyspnea on exertion was the main complaint among 17 (56.67%) patients, followed by complain of cough which occurred in 7 (23.33%) patients. Most common co-morbidity was hypertension and diabetes which was present in 10(33.33 %) of both followed by obesity in 06 (20 %), Diabetes and hypertension both 04(13.33%) patients. Among CPET parameter VO_2max was scattered around mean of 30.22 ± 3.32 ml/kg/min. Anaerobic Threshold (AT) was 19.45 ± 2.22 ?, while breathing Reserve (BR) and Oxygen Utilization Efficiency Slop (OUES) were having a mean value of 12.2 ± 2.02 and 0.92 ± 0.04, respectively.

Conclusion: This original research highlights the importance of evaluating associated factors in young Indian patients with cardiac risk to inform early cardiac risk assessment and management strategies. The significant associations between CPET outcomes and blood pressure, BMI, and smoking underscore the relevance of these factors in determining cardiovascular fitness. These findings emphasize the need for targeted interventions and lifestyle modifications to mitigate cardiac risk among the young Indian population.

Keywords: Cardiovascular diseases, cardio-pulmonary exercise testing, associated factors, cardiac risk, young Indian patients, early assessment, lifestyle factors.

Introduction

Cardiovascular diseases (CVDs) continue to be a leading cause of morbidity and mortality worldwide, affecting individuals across diverse age groups and geographic regions. [1] traditionally considered more prevalent among older adults, recent years have witnessed a concerning rise in CVD incidence among younger populations, including those in India. 2 The burgeoning burden of cardiac risk among the young warrants a deeper understanding of the associated factors and an effective assessment of cardiovascular fitness. [2]

Cardio-pulmonary exercise testing (CPET) has emerged as a valuable tool for evaluating the cardiovascular and respiratory systems' performance during physical exertion. It provides valuable insights into an individual's exercise capacity, cardiovascular response, and overall fitness, making it an indispensable tool in the assessment of cardiac risk. [1, 3, 4]

Despite the widespread adoption of CPET in clinical settings, its application and interpretation in the context of young Indian patients with cardiac risk remain underexplored. This original research article aims to address this critical knowledge gap by comprehensively evaluating the associated factors influencing CPET outcomes in this specific demographic.

The multifaceted nature of CVD etiology calls for a holistic understanding of the factors contributing to cardiac risk in young individuals. In India, a multitude of factors, including lifestyle choices, genetic predisposition, socioeconomic disparities, and urbanization-related changes, interplay to influence cardiovascular health. By delving into these factors and their interactions with CPET results, this study endeavors to shed light on the underlying mechanisms and potentially identify modifiable risk factors.

Furthermore, the evaluation of CPET performance and cardiovascular fitness holds immense promise in guiding personalized treatment and intervention strategies for young Indian patients at risk of developing CVDs. Identifying the specific CPET parameters that best predict adverse cardiovascular outcomes could lead to the development of targeted interventions aimed at improving overall cardiovascular health in this vulnerable population.

The significance of this research lies in its potential to inform evidence-based clinical decision-making, enhance risk stratification, and ultimately curb the rising tide of cardiovascular diseases among young Indians. By offering valuable insights into the relationship between associated factors and CPET outcomes, this study aims to contribute to the development of tailored preventive measures and optimized management approaches, thus ushering in a new era of early cardiac risk assessment and management.

In the following sections, we detail the objectives, methods, and results of our original research study, laying the groundwork for a comprehensive understanding of the factors influencing CPET outcomes in young Indian patients with cardiac risk. The ultimate goal is to pave the way for improved clinical practices and policies that effectively address the cardiovascular health challenges faced by this demographic.

Materials and Methods:

Study Design and Participants: This cross-sectional study was conducted at a tertiary care hospital in India. The study included young patients aged between 18 to 40 years, who presented with cardiac risk factors such as family history of cardiovascular diseases, hypertension, dyslipidemia, obesity, or a sedentary lifestyle. A total of 30 eligible participants were recruited for the study.

Inclusion and Exclusion Criteria: Inclusion criteria comprised individuals aged 18 to 40 years with at least one cardiac risk factor. Participants with a known history of significant cardiovascular diseases, musculoskeletal limitations that hindered exercise, or those unable to provide informed consent were excluded from the study.

Ethical Approval and Informed Consent: The study protocol was approved by the Institutional Review Board, and all participants provided written informed consent before enrollment.

Data Collection: Demographic information, medical history, and lifestyle habits were obtained through structured interviews with each participant.

Cardio-Pulmonary Exercise Testing (CPET): All participants underwent CPET using a standardized protocol on a treadmill or cycle ergometer, based on their preference. Continuous 12-lead electrocardiography (ECG) monitoring was performed during the test. Oxygen consumption (VO2), carbon dioxide production (VCO2), respiratory rate, heart rate, and blood pressure were continuously monitored during exercise.

Assessment of Associated Factors: The following factors were assessed for each participant: Anthropometric parameters, Blood pressure measurements, Body Mass Index (BMI) calculated as weight (kg) divided by height (m) squared, Smoking status and Alcohol consumption

Statistical Analysis: All statistical analyses were performed using IBM SPSS ver. 25. Descriptive statistics (mean, standard deviation, frequency) were used to summarize the demographic characteristics and associated factors of the study population.

Results

Out of all 30 patients, 20 (66.67 %) were males while 10 (33.33%) were females. Age Group of 18-25 years consisted of 07 (23.33%) all patients including 06 (30%) patients in male and 01 (10 %) patient in female column. Similarly, Age Group of 26-35 years consisted of 10 (33.33%) all patients including 05 (25%) patients in male and 05 (50 %) patients in female column. Age Group 36-45 years consisted of 09 (30%) all patients including equal proportion of 06 (30%) patients in male and 03 (30%) patients in female column, while Age Group >45 years consisted of 04 (13.33%) all patients including equal proportion of 06 (30%) patients in male and 03 (30%) patients in female column. There was no significant (p>0.05) difference in number of patients in different age group, between males and females.

Table 1: Anthropometric Measurements

Anthropometric Measurements (N=50)	Mean ± SD
Height (in cm)	162.6 ± 6.11
Weight (in Kg)	65.23 ± 12.04
BMI (Kg/m^2)	24.71 ± 4.65
Waist Circumference (in cm)	84.9 ± 7.41
Hip Circumference (in cm)	89.87 ± 5.06
Waist Hip Ratio	0.95 ± 0.08
Systolic Blood Pressure (mmHg)	125.27 ± 12.59
Diastolic Blood Pressure (mmHg)	81.67 ± 9.06

Table 2: Personal habits

Parameters	Frequency	Percentage
Smokers	7	23.33
Alcohol Abuse	9	30
Tobacco	5	16.67

Dyspnea on exertion was the main complaint among 17 (56.67%) patients, followed by complain of cough which occurred in 7 (23.33%) patients. Most common co-morbidity was hypertension and diabetes which was present in 10 (33.33%) of both followed by obesity in 06 (20 %), Diabetes and hypertension both 04(13.33%) patients.

Table 3: Showing mean ± standard Deviation (SD) for CPET parameters.

CPET Parameters	Mean ± SD
VO$_2$MAX	30.22 ± 3.32
AT	19.45 ± 2.22
BR	12.2 ± 2.02
OUES	0.92 ± 0.04

Among CPET parameter VO2max was scattered around mean of 30.22 ± 3.32 ml/kg/min. Anaerobic Threshold (AT) was 19.45 ± 2.22 ?, while breathing Reserve (BR) and Oxygen Utilization Efficiency Slop (OUES) were having a mean value of 12.2 ± 2.02 and 0.92 ± 0.04, respectively.

Discussion:

Cardio-Pulmonary Exercise Testing (CPET) has long been recognized as a diagnostic tool for cardiac diseases, and in recent years, it has gained importance in unmasking mechanisms responsible for unexplained dyspnea and follow-up of respiratory diseases. [5] Exercise capacity, clinically quantified by oxygen uptake (VO2), carbon dioxide production (VCO2), and Anaerobic Threshold (AT), provides valuable information during exercise through breath-by-breath gas analyzers. [6]

Regarding age and sex, out of the 30 patients, 20 (66.67%) were males, and 10 (33.33%) were females, with age groups of 18-25 years comprising 23.33% and 26-35 years being the most common (p>0.05). Previous studies in India have reported similar patterns in cardiovascular risk factors during the most productive years, putting individuals at risk of cardiovascular morbidity and mortality at a relatively young age. [6] India's high cardiovascular disease prevalence, with people experiencing their first myocardial infarction at age 53 on average, six years earlier than the rest of the world, emphasizes the urgency of addressing cardiac risk in the young population. [7]

Anthropometric measurements revealed mean height, weight, BMI, waist circumference, hip circumference, and waist-hip ratio of the patients. Similar studies have reported high prevalence of behavioral risk factors, central obesity, hypertension, and diabetes in urban Indian populations. [6] These findings are consistent with our study and highlight the importance of addressing lifestyle factors and obesity in mitigating cardiovascular risk.

In terms of addiction, most patients were non-smokers (76.67%), with 23.33% being smokers. Alcohol consumption was observed in 30% of the patients. Other studies in Indian populations have reported comparable prevalence of smoking and alcohol consumption. [8, 9] Additionally, tobacco use was found in 16.67% of the patients, while the remaining were non-users or abusers.

Co-morbidities included obesity (43.33%), hypertension (40%), diabetes (36.67%), and combinations of these conditions. Other studies have reported high prevalence of obesity and hypertension in young populations. [10] Our results emphasize the importance of identifying and managing co-morbidities in young patients with cardiac risk.

Cardio-pulmonary exercise testing (CPET) offers a comprehensive assessment of exercise responses involving multiple physiological systems, aiding clinical decision-making. [11] VO2max, anaerobic threshold (AT), breathing reserve (BR), and oxygen utilization efficiency slope (OUES) were among the CPET parameters measured. Studies have shown that VO2max decreases with age and is lower in women than men. [12] VT (ventilatory threshold) is another index used to estimate exercise capacity and has been suggested to be more predictive than peak VO2. [13] Furthermore, the Oxygen Uptake Efficiency Slope (OUES) has been shown to strongly correlate with maximum VO2 and can be calculated from sub-maximal CPET test data. [14]

Conclusion

This study provides valuable insights into the associated factors and CPET outcomes in young Indian patients with cardiac risk. It underscores the importance of early cardiac risk assessment, lifestyle modifications, and co-morbidity management to address the rising burden of cardiovascular diseases in this demographic. CPET emerges as a valuable tool for clinical decision-making, guiding interventions, and improving cardiovascular health outcomes in young populations. Further research is warranted to explore the interplay of these factors in a larger cohort to develop more targeted preventive strategies.

References

1. Cacoub P, Carpentier AF, Chadefaux-Vekemans B, Leprince P. Cardiovascular diseases in human immunodeficiency virus-infected patients. Int J Cardiol. 2019;293:121-128.
2. Yusuf S, Rangarajan S, Teo K, et al. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. N Engl J Med. 2014;371(9):818-827.
3. Gupta R, Guptha S, Sharma KK, Gupta A, Deedwania P. Regional variations in cardiovascular risk factors in India: India Heart Watch. World J Cardiol. 2012;4(4):112-120.
4. Myers J, Arena R, Franklin B, et al. Recommendations for clinical exercise laboratories: A scientific statement from the American Heart Association. Circulation. 2009;119(24):3144-3161.
5. Laveneziana P, Paolo MD, Palange P. The clinical value of cardiopulmonary exercise testing in the modern era. Eur Respir Rev [Internet]. 2021 Mar 31 [cited 2021 Oct 28];30(159).
6. Kaur P, Rao TV, Sankarasubbaiyan S, Narayanan AM, Ezhil R, Rao SR, Gupte MD. Prevalence and distribution of cardiovascular risk factors in an urban industrial population in south India: a cross-sectional study. J Assoc Physicians India. 2007 Nov;55:771-6.
7. Heart risk factors high in young Indian adults: study. Reuters [Internet]. 2011 Apr 21 [cited 2021 Oct 28]; Available from: https://www.reuters.com/article/us-india-young-idCATRE7 3K0FG20110421
8. Kandpal V, Sachdeva MP, Saraswathy KN. An assessment study of CVD related risk factors in a tribal population of India. BMC Public Health. 2016 May 25;16(1):434.
9. Geldsetzer P, Manne-Goehler J, Theilmann M, Davies JI, Awasthi A, Danaei G, et al. Geographic and sociodemographic variation of cardiovascular disease risk in India: A cross-sectional study of 797,540 adults. PLOS Med. 2018 Jun 19;15(6):e1002581.
10. Chiang C, Singeo ST, Yatsuya H, Honjo K, Mita T, Ikerdeu E, et al. Profile of Non-communicable Disease Risk Factors Among Young People in Palau. J Epidemiol. 2015; 25(5):392–7.
11. Albouaini K, Egred M, Alahmar A. Cardiopulmonary exercise testing and its application. Postgrad Med J. 2007 Nov;83(985):675–82.
12. Toma N, Bicescu G, Enache R, Dragoi R, Cinteza M. Cardiopulmonary exercise testing in differential diagnosis of dyspnea. Mædica. 2010 Jul;5(3):214–8.
13. Gitt AK, Wasserman K, Kilkowski C, Kleemann T, Kilkowski A, Bangert M, et al. Exercise anaerobic threshold and ventilatory efficiency identify heart failure patients for high risk of early death. Circulation. 2002 Dec 10;106(24):3079–84.
14. Johnston R. OUES, a useful sub-maximal CPET indicator of maximum VO2 [Internet]. PFTBlog. 2014 [cited 2021 Oct 28]. Available from: https://www.pftforum.com/blog/oues-a-useful-sub-maximal-cpet-indicatorof-maximum-vo2/.