

A Cross-Sectional Study Evaluating Cardiorespiratory Fitness of College Youth Using Ruffier Dickson Test

Krupal Modi¹, Shruti Jain²

¹PhD Scholar & Assistant Professor, Shree Swaminarayan Physiotherapy College, Kadodara, Surat, Gujarat.

²UG Student, Shree Swaminarayan Physiotherapy College, Kadodara, Surat, Gujarat.

Corresponding Author: Krupal Modi

DOI: <https://doi.org/10.52403/ijhsr.20240315>

ABSTRACT

BACKGROUND: Cardiovascular Diseases (CVD) strike Indians a decade earlier than the Western population and college youth are not exempted. Despite having an extensive understanding of physical exercise and its benefits, Physiotherapy students are less active than they were before attending graduate school. CVD shows an inverse relationship with Cardiorespiratory fitness (CRF). The Submaximal Ruffier Dickson Test (RDT) is used here to evaluate CRF of apparently healthy college youth.

AIM: To evaluate the Cardiorespiratory fitness of college youth using the Ruffier-Dickson test.

METHODOLOGY: This cross-sectional study was done on 70 participants between the age group of 18-23 years. The RDT was performed by all participants and the Ruffier Dickson Index of cardiorespiratory endurance was calculated.

RESULT: Out of 70 participants, 55 were able to complete the test. The result shows that 43.6% of participants (n=24) were having Average Endurance (RI 6 to 9), 34.5% (n=19) were having Reasonably Good Endurance (RI 3 to 6), 9% (n=5) were having Very Good Endurance (RI 0 to 3), 7.2% (n=4) were having Moderate Endurance (RI 9 to 12), 5.5% (n=3) were having Poor Endurance (RI 12 to 15), and 0% were having RI value less than 0 and >15 which indicates Excellent Endurance and Very Poor Endurance respectively.

CONCLUSION: Nearly half of the participants fall into the 'Average Endurance' category of the Ruffier Dickson Index. So, the central focus here is to raise awareness about the need to assess CRF in Youth and predict current and future health in otherwise healthy youth.

KEYWORDS: Cardiorespiratory Fitness, College Students, Ruffier Dickson Test, Ruffier Index.

INTRODUCTION

Cardiovascular Diseases (CVD) strike Indians a decade earlier than the Western population. For us Indians, particular causes of concern in CVD are early age of onset, rapid progression, and high mortality rate. The Global Burden of Disease study states that the age-standardized cardiovascular disease death rate is 272 per 1,00,000 population in India which is much higher than that of the global average of 235.¹ CVD shows an inverse relationship with Fitness status. Among all the parameters of fitness

Cardiorespiratory Fitness (CRF) is of utmost importance.²

Cardiorespiratory fitness refers to 'the ability of the cardiovascular and respiratory system to deliver oxygen and nutrients to the muscles during physical activity'. It is influenced by factors such as heart function, lung capacity, and overall physical conditioning. Low or unhealthy CRF is a strong, independent predictor of CVD and all-cause mortality.³ Therefore, cardiorespiratory fitness is considered as a direct measure of the physiologic status of the individual.

The overall physical activity and fitness level of the population is steadily declining with more than one-third of the population being unfit.⁴ Previous studies in this area show that not only adults and older but the college youth are not exempted from this. Although CRF is assessed at times in certain youth such as those with congenital heart disease, asthma, and cystic fibrosis, assessment of CRF has a broader range of applications. In youth, CRF is a predictor of several health indicators, including cardiometabolic health, premature CVD, academic achievement, and mental health.³

College life is a period during which individuals have to struggle with educational overburden, lack of free time often picking up habits like smoking, and lack of balanced diet posing a barrier to the adoption of healthy practices.⁵ A study done by Jalene S (2021) revealed that depression is a serious but treatable health issue that affects college students at an alarming rate. Improved cardiorespiratory fitness decreases depression risk and severity but this relationship has not been fully evaluated in the college student population. Another study conducted by Geetha, and Raghuvver (2020) concluded that healthy CRF is positively associated with cardiovascular health, academic achievement, and mental well-being in youth.

The Ruffier Dickson Test (developed in the 1950s by James-Edward Ruffier and modified by J. Dickson) is a reliable, practical & simplest submaximal cardiovascular fitness test used to evaluate cardiovascular fitness and classify Cardiorespiratory endurance.⁶

As health care professionals, physiotherapy students will influence their patient's attitudes toward maintaining optimal physical fitness and advocating good health physical exercise. For better productivity, students should be healthy and have good physical fitness. Therefore, the need for study is to evaluate cardiorespiratory fitness among college-going youngsters using RDT to early identify cardiorespiratory disease

risk and to increase awareness about cardiorespiratory fitness.

MATERIAL AND METHODOLOGY

It was a Cross-sectional observational study done at one Physiotherapy College. The study population was 18- to 23-year-old college-going females. The total sample size was 70 subjects selected with a convenient sampling method. Inclusion criteria were participants aged between 18 to 23 years, only female subjects, and willing to participate in the study. Exclusion criteria were participants with a recent history of any surgery, known cardiac-respiratory disease, diabetes mellitus, hypertension, etc., subjects with neurological defects or any other medical problems, known case of any recent knee or other lower limb injury/trauma.

The study was started after getting Ethical clearance from the institute. All subjects received an identical clear explanation of the test procedure, including termination criteria. A written informed consent was taken prior to the test. A sample of 70 college-going females was taken according to inclusion and exclusion criteria. Baseline data was collected including Age, Gender, Height (cm), and Weight (kg). Then the participants were asked to perform the RDT test.

Technique to perform Ruffier Dickson Squat test:

First, ask the participant to sit on a chair. The investigator will measure heart rate for 15 seconds (Resting HR-1). Then, the participant is asked to perform 30 squats in 45 seconds (in a wide standing position, bending the knees to a 90-degree angle, keeping the back straight and the arms extended straight forward). On completion of the 45 seconds, get the participants to immediately sit down, and the post-exercise heart rate is taken over the first 15 seconds (Immediate HR-2), then again one minute after the test (post-exercise HR-3) from 1 minute to 1-minute 15-second post-exercise. Scoring: After collecting data of all 3 heart rates, values were put into the formula of the Ruffier Dickson index (RDI) which is written

below. Value is compared with index (Table-1). Lower scores indicate better exercise tolerance. Termination Criteria: Increase in repetition and inability to complete the test within the given time.

Formula: $RDI = [(HR2-70) + 2(HR3-HR1)] / 10$

RI VALUE	ENDURANCE RATING
Less than 0	Excellent endurance
From 0 to 3	Very good endurance
From 3 to 6	Reasonably good endurance
From 6 to 9	Average endurance
From 9 to 12	Moderate endurance
From 12 to 15	Poor endurance
From 15 and up	Very poor endurance

TABLE:1 RUFFIER DICKSON INDEX

STATISTICAL ANALYSIS

For this cross-sectional study, statistical analysis was processed using the Statistics in Microsoft Office Excel (2019). Means and standard deviations (SD) were calculated using the AVERAGE and STDEV in Microsoft Office Excel (2019). For the Objective of the study, the participants were divided into one of the seven categories according to their RDI value ranging from excellent endurance category to very poor endurance category.

RESULTS

The Mean ± SD of the participant's Age, BMI, HR-1(Resting HR), HR-2 (Immediate HR), HR-3 (Post-exercise HR), and Ruffier Dickson Index are mentioned below in Table-2 and Graph-1.

RUFFIER-DICKSON INDEX (RDI)	ENDURANCE RATING	NO. OF PARTICIPANT IN EACH CATEGORY	PERCENTAGE (%)
Less than 0	Excellent Endurance	0	0
From 0 to 3	Very Good Endurance	5	9 %
From 3 to 6	Reasonably Good Endurance	19	34.5 %
From 6 to 9	Average Endurance	24	43.6 %
From 9 to 12	Moderate Endurance	4	7.2 %
From 12 to 15	Poor Endurance	3	5.5 %
From 15 and up	Very Poor Endurance	0	0

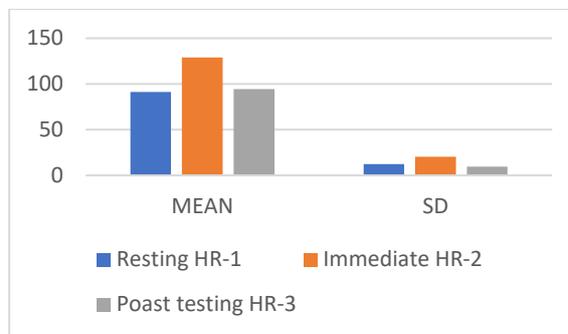
TABLE:3 NO. OF PARTICIPANTS IN EACH CATEGORY ACCORDING TO RDI

DISCUSSION

Indians are known to have the highest coronary artery disease rates, and the conventional risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and sedentary lifestyle fail to explain this

PARTICIPANT	MEAN	SD
AGE (YEARS)	20.2	1.29
BMI	22.23	4.17
RESTING HR-1	91.4	12.4
IMMEDIATE HR-2	129	20.3
POST EXERCISE HR-3	94.3	9.7
RDI	6.4	2.6

TABLE: 2 MEAN & SD OF AGE, BMI, HR-1, HR-2, HR-3 & RDI



GRAPH:1 MEAN & SD OF HR-1, HR-2 & HR-3

The result shows that 43.6% of participants (n=24) were having RI value from 6 to 9 which indicates Average Endurance, 34.5% (n=19) were having RI value from 3 to 6 which indicates Reasonably Good Endurance, 9% (n=5) were having RI value from 0 to 3 which indicates Very Good Endurance and , 7.2% (n=4) were having RI value from 9 to 12 which indicates Moderate Endurance, 5.5% (n=3) were having RI value from 12 to 15 which indicates Poor Endurance and 0% were having RI value less than 0 and >15 which indicates Excellent Endurance and Very Poor Endurance respectively.

increased risk. Other causes may include rapid lifestyle changes due to urbanization and nutritional transitions that accompany such economic developments.

Cardiorespiratory Fitness is an objective measure of health that can be tracked over time and compared across populations.

Whereas self-reported physical activity levels can be unreliable and provide only a snapshot of behavior, assessments of CRF provide a more robust measure of cardiovascular health. The American Heart Association (AHA) also emphasized the importance of CRF, and it is considered an essential marker that should be evaluated and intervened. This cross-sectional study aimed to evaluate the cardiorespiratory fitness level of 18-23 years old college-going female students and to prevent the risk of cardiorespiratory disease in the future. The result of the current study states that nearly half of the participants (43.6%) fall into the Average Endurance category and very few participants (9%) fall into the good endurance category.

A similar study was conducted by S Koley et al. (2006) in Amritsar, Punjab to see the difference between the Cardiorespiratory and other parameters in the collegiate population & The result concluded that the populations that belong to the male gender and involved in the physical activity do have higher cardiorespiratory fitness and hence less chances of Cardio-vascular disease.⁷ Peter et al. (2010) examined the trends in body fat, body mass index, and physical fitness among male and female college students. Studies revealed that a high physical fitness level in childhood and adolescence is associated with more favorable health-related outcomes, concerning present and future risks of obesity, cardiovascular disease, skeletal health, and mental health, which highlights the need to include physical fitness testing in health and/or educational monitoring systems.⁸

In medical colleges, students are at higher risk of getting obese due to physical inactivity and a sedentary lifestyle. Obesity is responsible for the decrease in lung compliance and stiffening of the respiratory muscles which may lead to increased risk of cardiovascular disease mortality.⁹ This was supported by a study done by Alahmari KA, and Rengaramanujam K (2020) which demonstrated that the VO₂max estimated by the Ruffier Dickson Test was inversely

correlated with body weight and BMI.¹⁰ A recent study done by Halmová N, Kanášová J and Šiška L (2019) among 11-15-year old population suggested that body fat mass and BMI value could help achieve optimum physical fitness.¹¹ In addition, poor performance during RDT evaluation predicts that overweight adolescents showed significantly decreased VO₂ max due to increased oxygen demand to move excess body weight.¹² Excess adiposity may result in a state of cardiopulmonary deconditioning associated with greater cardiac load and functional impairment, which was also reported earlier.¹³

The Ruffier-Dickson Index was used in the study and holds significant importance in assessing cardiovascular health. It provides valuable insights into an individual's cardiovascular fitness level and can help identify potential risks and areas for improvement. The significance of the Ruffier-Dickson Index in assessing cardiovascular health includes:

1) Evaluation of Cardiovascular Fitness, 2) Identification of Health Risks, 3) Monitoring Changes Over Time, 4) Personalized Exercise Prescription, 5) Health Promotion and Disease Prevention, 6) Screening Tool for Non-Athletic Populations.

CONCLUSION

This observational study concludes that nearly half of the participants fall into the 'Average Endurance' category of the Ruffier Dickson Index. So, the central focus here is to raise awareness about the need to assess CRF in Youth and predict current and future health in otherwise healthy youth. By incorporating the Ruffier-Dickson Index into clinical practice and personal health management, individuals can strive for optimal cardiovascular fitness and overall well-being.

Limitation of the Study

- Limited sample size i.e., 70 subjects.
- Only female subjects were included.

- Limited age group i.e., 18-23 years was taken.
- Only one physiotherapy institute was taken into consideration.

Future Recommendations

- Further study can be done including both genders.
- This could be done among younger school-going students.
- The effect of BMI on CRF can be assessed.
- The study can be done using an instrument called a Holter monitor.
- The fitness index can also be calculated with different exercises, such as 20 push-ups performed for 30 seconds.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Prabhakaran D, Jeemon P, Roy A. Cardiovascular diseases in India. *Circulation*. 2016; 133:1605e1620.
2. Neide Simões-Capela, Jan Cornelis, Giuseppina Schiavone and Chris Van Hoof, KU Leuven, Kasteelpark Arenberg, Heverlee, Kapeldreef, Heverlee, Eindhoven, A 2-minute Fitness Test for Lifestyle Applications: The PhysioFit Task and Its Analysis based on Heart Rate. 10.5220/0010234503770385. HEALTHINF 2021.
3. Raghuvver, Geetha, et al. "Cardiorespiratory Fitness in Youth: An Important Marker of Health: A Scientific Statement from the American Heart Association." *Circulation* vol. 142,7 (2020): e101-e118. doi:10.1161/CIR.0000000000000866
4. Belton S, O'Brien W, Meegan S, et al. Youth-physical activity towards health: Evidence and background to the development of the Y-PATH physical activity intervention for adolescents. *BMC Public Health*. 2014 Dec; 14(1): 1–2.

5. Almutairi KM, Alonazi WB, Vinluan JM, et al. The health-promoting lifestyle of university students in Saudi Arabia: a cross-sectional assessment. *BMC Public Health*. 2018; 18(1): 1093.
6. Dickson, "Utilisation de l'indice cardiaque de Ruffier dans le controle medico-sportif," *Medicine Education Physical et Sport*, vol. 2, p. 65, 1950.
7. S Koley et al. Association of Cardio Respiratory Fitness, Body Composition and Blood Pressure in Collegiate Population of Amritsar, Punjab, India. *The Internet Journal of Biological Anthropology*. 2006; 1:1.
8. Peter et al. Relationship between habitual physical activity and aerobic fitness in adolescents. *Pediatr Exerc Sci*. 2010; 6:315-329.
9. Zerf M. Obesity degrees and their relationships with weakness of musculoskeletal system among the obese housewife. *Saudi J Sports Med* 2017; 17: 7-13
10. Alahmari KA, Rengaramanujam K, Reddy RS, Samuel PS, Kakaraparthi VN, Ahmad I, et al. Cardiorespiratory Fitness as a Correlate of Cardiovascular, Anthropometric, and Physical Risk Factors: Using the Ruffier Test as a Template. *Can Respir J* 2020; 2020: 3407345
11. Halmová N, Kanášová J, Šiška L. Physical fitness and level of body components in the 11-15-year-old population in west Slovakia. 2019.
12. Idris MM, Mohammed Z. Relationship between heartbeats and body composition among some fat algerians housewives. *Am J Innovative Res Appl Sci* 2016; 2: 128-34
13. Rehman SSU, Karimi H, Gillani SA, Ahmad S. Effects of a supervised structured aerobic exercise training program on the level of Exertion, dyspnea, VO₂ max, and Body Mass Index in patients with type 2 diabetes mellitus. *J Pak Med Assoc* 2017; 67: 1670-3.

How to cite this article: Krupal Modi, Shruti Jain. A cross-sectional study evaluating cardiorespiratory fitness of college youth using Ruffier Dickson Test. *Int J Health Sci Res*. 2024; 14(3):87-91. DOI: [10.52403/ijhsr.20240315](https://doi.org/10.52403/ijhsr.20240315)
