Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

Effects of short bouts of stair climbing on fitness fatness index among overweight individuals

Manoj Abraham[1], Saranya[1], Swarna Priya[2]

URL: https://ijptrs.com/view-issue/121/Fulltext

DOI:https://ijptrs.com/public/images/content/533swarnapriyav3i1.pdf

1,1,2 Principal, Vice principal and PG Student KG College of Physiotherapy, Coimbatore, Tamil Nadu, India.
Corresponding Author: Saranya Y, Vice Principal, KG College of Physiotherapy, Coimbatore, Tamil Nadu, India
E-mail: sarahphysio.y@gmail.com

Submission:16th November 2023
Revised: 26th November 2023
Publish: 1st January2024

Table of content

ABSTRACT

Background: Overweight is an important public concern. The future prevalence of overweight in India to 2040 among adults aged 20-69 years. Fitness Fatness Index (FFI) is a recently developed index that is used to predict cardiovascular disease (CVD) risk. This study focused on the Effects of Short bouts of stair climbing on Fitness Fatness Index among overweight individuals.
Materials & Methods: A total of 36 subjects were included and divided into two groups group A and Group B. Group A underwent a short bout of stair climbing training for 3 times per day, 3 days a week, a total of 54 training sessions over 8 weeks. Group B is a control group. Fitness Fatness Index was calculated by the ratio between cardiorespiratory fitness (submaximal test) and waist-to-height ratio.
Results: There was a significant difference between the Pre and Post-test scores between group A and Group B when evaluated with submaximal exercise test for cardiorespiratory fitness (VO_2max) and waist-to-height ratio. A statistically significant improvement was obtained in Group A (Mean-18.79 and 22.89) with $p < .05$ who underwent the training when compare with control group.
Conclusion: Based on the results short bout of exercise have improved the cardiorespiratory fitness among overweight individuals. The study concluded that there is a significant effect on Fitness Fatness Index stress among overweight individuals by short bout of stair climbing training. These results are obtained in comparison with the control group.
Keywords: Cardiorespiratory fitness, Fitness Fatness Index, Overweight, Short Bout of Stair Climbing.

Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

INTRODUCTION

Overweight is a public health issue. According to the World Health Organization (WHO), in 2020, the global overweight prevalence was 38%. Future prevalence of overweight among adults (20-69 years of age) in India by 2040. (Shammi Luhar, et al., 2020). Overall, the overweight prevalence among Indian adults between the ages of 20-69 is expected to rise by approximately 2-fold from 2010 to 2040. Patients who are overweight and obese may have a better outcome than their peers with normal body mass index (BMI) after developing clinical cardiovascular disease (CVD). The Fitness Fatness Index (FFI) is a recently developed index that is used to predict cardiovascular disease (CVD) risk. It is a measure of the ratio between an individual's cardiorespiratory fitness (CRF) and waist-to-height ratio (Daniel J. Leahy et al., 2022). Short bouts of Stair climbing increase Cardiorespiratory Fitness in young sedentary adults. Studies have shown that stair climbing is safe and beneficial. Minor alterations in physical activity levels (e.g., stair climbing) in sedentary populations (Valentino, Sydney E., et al) improve VO2max and improve weight loss in overweight adults (W. Daniel Schmidt, PhD, et al.,) (Ina Shaw et al.,2020).

Physical activity has long been recognized as an important part of maintaining good health and preventing illness (Shephard RJ). Despite this, a significant proportion of adults in most developed nations are not physically active enough to achieve any significant health and fitness outcomes (Blair SN). It has also been suggested that promoting physical activity among previously inactive individuals may be the most effective way to prevent cardiovascular disease on a population level (Caspersen CJ, Heath GW). According to current physical activity guidelines, every adult should do 30 minutes of moderate-intensity physical activity at most, if not all, five days a week. (Blair SN, et al). Accumulating exercise in short bursts throughout the day is one of the strategies recommended to achieve this activity goal. This approach has been tested experimentally with 10-minute bouts of activity (Murphy MH., et al.,). However, so far only one study on stair climbing has demonstrated that accumulation of very short bursts of exercise lasting approximately 2 minutes can also provide health benefits.

Approximately 39% of the global adult population was classified as overweight (Body Mass Index (BMI) 25.0–29.9 kg/m2) or obese (BMI > 29.9kg/m2) in 2014; a doubling since 1975. Whereas the prevalence of obesity was 6.4% among women and 3.2% among men in 1975, it had risen to 14.9% and 10.8%, respectively by 2014[13]. In developing countries like India, the increasing prevalence of overweight and obesity has coincided with the demographic and epidemiological transitions, in which mortality and fertility have declined, and lifestyle-related diseases have become more common (Dandona L. et al.). The prevalence of overweight and obesity in India is increasing faster than the world average. For instance, the prevalence of overweight increased from 8.4% to 15.5% among women between 1998 and 2015, and the prevalence of obesity increased from 2.2% to 5.1% over the same period (WHO). This fast-paced growth has been accompanied by notable increases in the burden of non-communicable diseases (NCDs). Whereas in 1990 the number of life years lost to disability (DALYs) attributable to communicable, maternal, neonatal, and nutritional disorders exceeded that attributable to NCDs in virtually all of India’s states, currently the opposite is true. Given the extent of the

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

increase in the prevalence of overweight and obesity, and its relationships with NCDs (Kelly T., et al.,), reliably predicting its future prevalence has become increasingly important.

A sedentary lifestyle which includes prolonged sitting time during waking hours and low energy expenditure, increases the risk of adverse health events, cardiovascular disease, and type 2 diabetes (T2DM) (Dempsey PC). This type of lifestyle leads to lower levels of cardiorespiratory fitness (CRF) and increased fatness, increasing cardiometabolic risk and mortality (Laukkanen JA). Improving CRF and lowering fatness with exercise promotes cardiovascular health and longevity. The Fitness-Fatness Index (FFI), developed in 2016, combines these two cardiometabolic risk factors and is better at identifying those at risk of adverse cardiovascular events than either measure alone. FFI is calculated by measuring maximal CRF in metabolic equivalents (METs) divided by the waist-to-height ratio (WtHR). A 1-unit increase in FFI is clinically significant and has been found to reduce all-cause mortality (9%) and cardiovascular disease (CVD) specific mortality by 13% (Sloan RA et.,).

Establishment of Fitness Fatness Index (FFI) To establish FFI and changes in FFI, anthropometric measurements of the waist (cm) and height (cm) and maximal CRF testing were required at baseline and 12 weeks post-intervention. The FFI was calculated as maximal CRF expressed as metabolic equivalents (METs) divided by the waist-to-height ratio (WtHR). [FFI = CRF (METs) / WtHR] CRF was determined by the maximal oxygen uptake (VO2max mL·kg-1·min-1) via a graded maximal exercise test (GXT), in further detail below, converted to METs by dividing by 3.5 mL·kg-1·min-1. WtHR was calculated by dividing the anthropometric measurements of the waist (cm) by height (cm). A higher number indicates a greater FFI.

Current physical activity guidelines recommend that every adult should engage in 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week (Blair SN, et al). One strategy advocated to meet this activity goal is to accumulate exercise in short bouts throughout the day. The efficacy of this approach has been shown experimentally using 10-minute bouts of activity (Murphy MH et al.,). However, to date, only one stair-climbing study has shown that accumulating very short bouts of exercise lasting about two minutes can also confer health benefits (Boreham C et al.,). In this study only one group underwent exercise, and the control group didn't receive any exercises, since to find out how much add-on effective is the short bout of stair climbing when compared to the normal lifestyle.

MATERIALS & METHODOLOGY:

Pre- and post-experimental study design. This study was conducted at KG College of Physiotherapy, KG pain relief center, Coimbatore, conducted over 6 months. 50 participants enrolled and only 36 were selected based on inclusion and exclusion criteria. The experimental flow chart outlining the study design is shown in Figure 1. Only males aged between 35 to 45 years. Males who are eligible as per BMI scores>25 and <30 were included. Males under any medications, musculoskeletal disorders, using drugs, alcohol and cigarettes, cardiovascular disease, hypertension, neurological deficit, any.

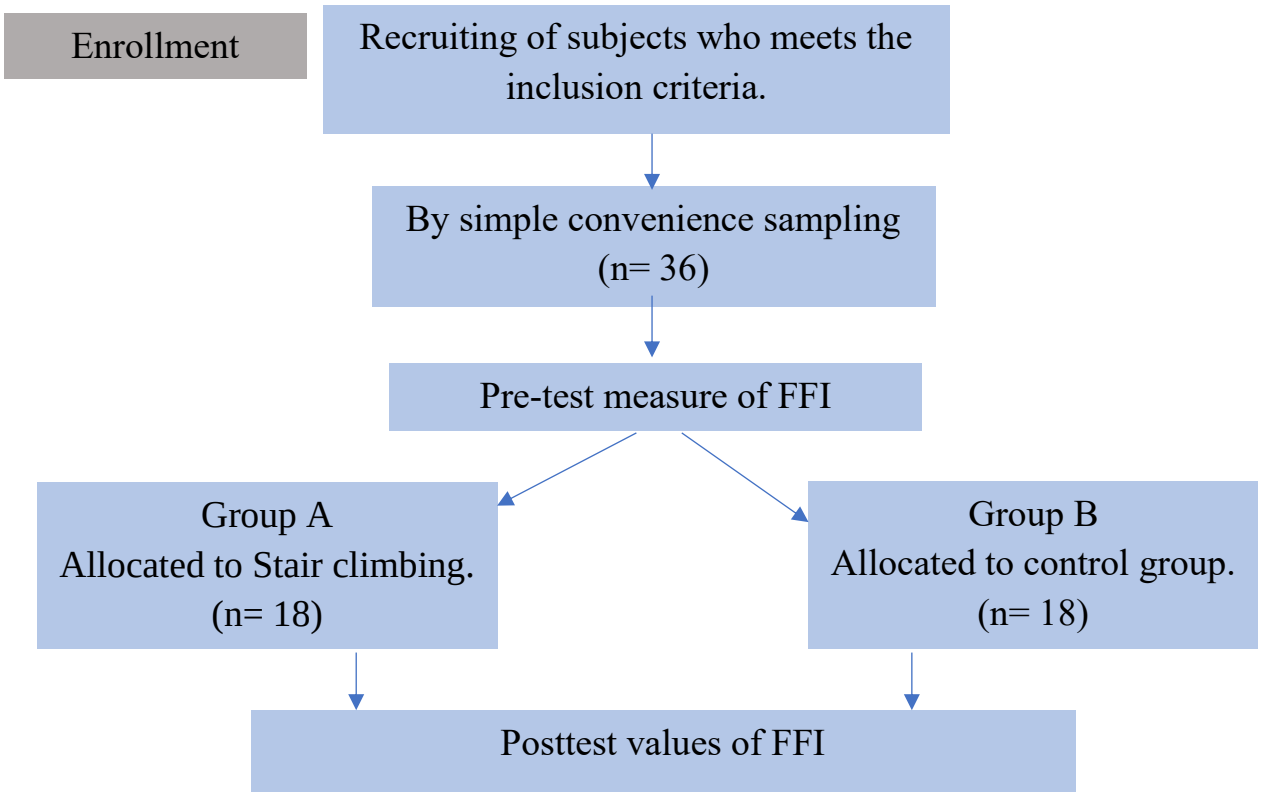
fractures, any recent surgeries, carcinoma were excluded. All the subjects have explained the purpose and test procedures.

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

and written informed consent and basic assessment were taken before their enrolment in the study. Participants were divided into two groups: Experimental Group A (n=18) and Group B Control Group (n=18). Group A underwent a short bout of stair climbing training 3 times per day, 3 days a week, a total of 54 training sessions over 8 weeks. A single bout of the 3-flight staircase. 3 X 20s sprints with 2 minutes recovery. 58±4 stairs were climbed/ bout of 180±11 stairs /session. Group B is a control group that did not Perform any kind of Exercise; Pre-Outcome Measures were taken on day 1 and Post-Outcome Measures were taken after the end of the 8th week of intervention. Both groups underwent baseline anthropometric testing and a submaximal test to determine the baseline FFI. Anthropometric measures included waist circumference and height to calculate waist-to-height ratio. Height was measured on a stadiometer to the nearest 0.5cm. Waist circumference was measured at the top of the right iliac crest with a nonelastic tape measure to the nearest 0.1cm. WHtR was calculated by dividing the waist in cm by height.

Fitness-Fatness Index: To determine the Fitness-fatness index (FFI), an estimated VO_2 max was used from the submaximal cardiorespiratory test, along with waist-to-height ratio. The estimated VO_2 max was calculated using the Queens College Step test. This metabolic equivalent (MET) was calculated (VO_2/3.5), while WHtR was determined by dividing the participant's recorded waist circumference in cm by their height. These two values were then divided to obtain FFI.

PROCEDURE:



Indian Journal of Physiotherapy and Rehabilitation Science

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

Sample size calculation:

Sample size, $n= 4pq/L^2$

Where, P= 90% = 0.09, q= 1-q = 0.10, L= 10%= L^2 = 0.01(marginal error), n= 36

A total of 36 subjects were divided into two groups through a simple random sampling method.

Ethical concern:

The study was approved by the ethical committee of K.G. Hospital, Coimbatore.

Characteristics	Group	N%
Age	35-45 years	40 ± 3.06
BMI	>25 - <30	27.02 ± 1.33
Educational	Educated	(22)60%
	Uneducated	(14)40%
Socio-economic level	Low	5 (13.3%)
	Moderate	22 (60%)
	High	9 (26.7%)

Table 1: Demographic data

The participant's demographic data were age, BMI, educational and socioeconomic level asshown in Table 1.

Groups	Mean values	N	Mean difference	SD	t value	P value
Group A (pre-test)	18.79	18	4.1	3.9209	8.2974	<0.0001
Group A (post-test)	22.89	18				
Group B (pre-test)	18.79	18	0.98	3.8214	4.4761	<0.0003
Group B (post-test)	19.77	18				

Table 2: Fitness-Fatness Index (pre and post-test mean scores)

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

The Mean values, mean difference, SD, t-value and P-value of the Fitness Fatness Index scoresof Group A and Group B are shown in Table 2.

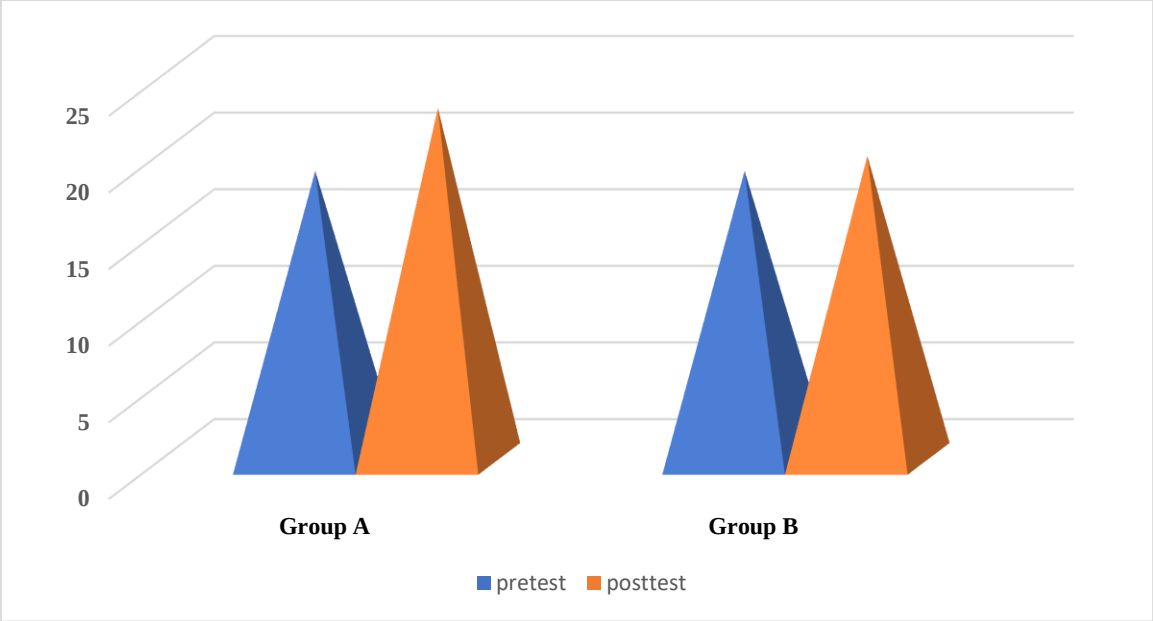


Figure 1. Pre-Test and Post-Test Mean Values for Fitness Fatness Index

RESULT

The purpose of the study was to find out the effects of short bouts of stair climbing exercise on the Fitness Fatness Index among overweight individuals. The Fitness Fatness Index was calculated by the ratio of Cardiorespiratory fitness with a waist-to-height ratio. Cardiorespiratory fitness is obtained by using the Queens College step test (submaximal step test) and converting it into METs. Our current study results indicated that there is a significant improvement in their cardiorespiratory fitness by short bouts of stair climbing exercise.

DISCUSSION

These findings show that an eight-week stair-climbing program characterized by multiple short bouts of vigorous activity can result in positive changes in important CVD risk factors. The substantial 17.1% improvement in VO2MAX reported in the present study provides evidence that just over 11 minutes a day of stair climbing is sufficient to elicit cardiovascular adaptations. Although genetic predisposition may account for about 40% of the variation in VO2MAX, 19 physical activity is the key determinant of the remaining 60%. Low levels of cardiorespiratory fitness are as strong a predictor of mortality as the conventional risk factors, such as cigarette smoking, and are a stronger predictor than hypercholesterolemia and hypertension.

It has also been observed that even small improvements in cardiorespiratory fitness can result in reduced risk of all-cause mortality. Improvement in cardiorespiratory fitness of the magnitude shown in this study should reduce the risk of mortality by about 20%, Stair climbing is a vigorous activity because it requires participants to raise all their body mass against gravity. Energy expenditure is proportional to mass raised and the speed of climbing is a relatively small contributor to metabolic cost.

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

Stair climbing is a vigorous physical activity, even at slow speeds, that can increase cardiorespiratory fitness with a lower time commitment than conventional physical activities. stair climbing interventions are one of the few physical activity initiatives that repeatedly change behavior. It has been estimated that the increased energy consumption from these interventions is six times more cost-effective than their nearest competitor. Repeated stair climbing at work, or in the home environment as reported here, would allow daily accumulation of stair climbing episodes. Unlike formal exercise sessions such as sports, stair climbing is a plausible behavior for most of the population. No skills are required, there is no competition, and there are few presentational concerns.

The exercising subjects in this investigation showed significant decreases in body weight, body mass index (kg/m2), the sum of skinfolds and the sum of circumference measures from baseline to post-treatment while the values for the non-exercising control subjects increased slightly over the same time frame. The fact that the control subjects in our study did not lose weight is perplexing and conflicts with other research that generally supports weight loss with caloric restriction. This could also explain the relatively small amount of weight lost by the exercising subjects as well, despite the significant calorie deficit they would have likely incurred with an increase in exercise-induced energy expenditure.

CONCLUSION

In conclusion, based on the results of this study it appears that two or three short bouts of exercise have the same effect as one continuous bout of exercise on aerobic fitness and weight loss in overweight individuals.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this manuscript.

ACKNOWLEDGEMENTS

The authors sincerely thank Dr. Manoj Abraham M, Professor / Principal, KG College of Physiotherapy, Coimbatore, India, for their support and logistical help in conducting this research.

REFERENCES

1. Blair SN. Physical activity, health, and ageing. In: Darcy P, ed. Exercise physiology. Philadelphia: Lippincott Williams & Wilkins, 2001:868–911.
2. Boreham C, Wallace W, Nevill A. Training effects of accumulated daily stairclimbing exercise in previously sedentary young women. Prev Med 2000; 30:277–81.
3. Caspersen CJ, Heath GW. The risk factor concept of coronary heart disease. In: Roitman JL, ed. ACSM's resource manual for guidelines for exercise testing and prescription. Philadelphia: Lea & Febinger, 1993:151–67.
4. Dandona L. et al. Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. Lancet 390, 2437–60 (2017). https://doi.org/ 10.1016/S0140-6736(17)32804-0 PMID: 29150201
5. *Daniel J. Leahy et al., 2022* changes in the fitness fatness index following reduced exertion high-intensity interval training versus moderate-intensity continuous training in physically inactive adults. *Frontiers in Sports and Active Living*
6. Di Cesare M. et al. Trends in adult body-mass index in 200 countries from 1975 to 2014: A pooled analysis of 1698 population-based measurement studies with 19.2 million participants. Lancet 387, 1377– 1396 (2016).

IJPTRS Vol 3(1) Jan-Feb-Mar 2024 pp1- 9 E-ISSN 2583-4304

https://doi.org/10.1016/S0140-6736(16)30054-X PMID: 27115820.

7. Dempsey PC, Owen N, Biddle SJ, Dunstan DW. Managing sedentary behavior to reduce the risk of diabetes and cardiovascular disease. Curr Diab Rep. 2014;14(9):522. Doi: 10.1007/s11892-014-0522-0. PMID: 25052856.
8. *Edwards, M.K., Addoh, O. and Loprinzi, P.D. (2017)* Predictive validity of a fitness fatness index in predicting cardiovascular disease and all-cause mortality. Mayo Clinic Proceedings 92, 851-852. https://doi.org/10.1016/j.mayocp.2017.02.013
9. International Institute for Population Sciences. National Family Health Survey (NFHS-3), India, 2005– 06. International Institute for Population Sciences (2009).
10. *Ina Shaw et al.,2020* Reductions in Cardiopulmonary Disease Risk Following Calisthenic Concurrent Aerobic and Resistance Training in Young Adults in a Low Resource Setting. *Asian J Sports Med. 2021; 12(1):e106562*
11. International Institute for Population Sciences. National Family Health Survey (NFHS-4) 2015–16 India. International Institute for Population Sciences (IIPS) and ICF (2017).
12. Kirton MJ, Burnley MT, Ramos JS, Weatherwax R, Dalleck LC. The Effects of Standardised versus Individualised Aerobic Exercise Prescription on Fitness-Fatness Index in Sedentary Adults: A Randomized Controlled Trial. J Sports Sci Med. 2022 Sep 1;21(3):347-355. Doi: 10.52082/jssm.2022.347. PMID: 36157386; PMCID: PMC9459763.
13. Kelly T., Yang W., Chen C.-S., Reynolds K. & He J. Global burden of obesity in 2005 and projections to 2030. Int. J. Obes. 32, 1431–1437 (2008).
14. Leahy DJ, Dalleck LC, Ramos JS. Changes in the Fitness Fatness Index following reduced exertion high-intensity interval training versus moderate-intensity continuous training in physically inactive adults. Front Sports Act Living. 2022 Aug 5; 4:961957. doi: 10.3389/fspor.2022.961957. PMID: 35992158; PMCID: PMC9388827.
15. Laukkanen JA, Kujala UM. Low Cardiorespiratory Fitness Is a Risk Factor for Death: Exercise Intervention May Lower Mortality? J Am Coll Cardiol. 2018 Nov 6;72(19):2293-2296. doi: 10.1016/j.jacc.2018.06.081. PMID: 30384884.
16. Murphy MH, Hardman AE. Training effects of short and long bouts of brisk walking in sedentary women. Med Sci Sports Exerc 1998; 30:152–7.
17. Murphy MH, Hardman AE. Training effects of short and long bouts of brisk walking in sedentary women. Med Sci Sports Exercise 1998; 30:152–7.
18. Pate RR, Pratt M, Blair SN, et al. Physical activity, and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995; 273:402–7.
19. Pate RR, Pratt M, Blair SN, et al. Physical activity, and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995; 273:402–7.
20. Prabhakaran D. et al. The changing patterns of cardiovascular diseases and their risk factors in the states of India: The Global Burden of Disease Study 1990–2016. Lancet Glob. Heal. 6, e1339–51 (2018).

21. *Shammi Luhar, et al., 2020* Forecasting the prevalence of overweight and obesity in India to 2040. *PLOS ONE | https://doi.org/10.1371/journal.pone.0229438*
22. Shephard RJ. How much physical activity is needed for good health? Int J Sports Med 1999; 20:23–7.
23. Sloan RA, Haaland BA, Sawada SS, Lee IM, Sui X, et al. (2016) A Fit-Fat Index for Predicting Incident Diabetes in Apparently Healthy Men: A Prospective Cohort Study. PLOS ONE 11(6)
24. Swain S. & Chowdhury S. Trends of nutritional status among rural adults in six states of India: findings from national survey data. Clin. Epidemiol. Glob. Heal. 6, 181–187 (2018)
25. Tandon N. et al. The increasing burden of diabetes and variations among the states of India: The Global Burden of Disease Study 1990–2016. Lancet Glob. Heal. 6, e1352–62 (2018).
26. *Valentino, Sydney E., et al.* "Cardiovascular responses to high-intensity stair climbing in individuals with coronary artery disease." *Physiological Reports* 10.10 (2022): e15308.
27. *W. Daniel Schmidt, PhD, et al.,* Effects of Long versus Short Bout Exercise on Fitness and Weight Loss in Overweight Females. *Journal of the American College of Nutrition, vol 20, No. 5, 494-501(2001).*
28. WHO. Obesity and Overweight: Fact sheet 311. WHO Media Centre (2016). http://www.who.int/mediacentre/factsheets/fs311/en/. (Accessed: 13th July 2017).