



Cardiopulmonary Fitness In Young Adults With Inactive, Minimally Active And HEPA Active Lifestyle

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ABSTRACT:

With a rapid shift towards a sedentary lifestyle among young adults in the recent pandemic times, inactivity has become a rising issue. The awareness regarding the benefits of physical activity in improving cardio respiratory fitness is important specially among those individuals who lead an inactive and sedentary lifestyle. This study aimed to compare the cardiopulmonary fitness in young adults, among highly active, minimally active and among those with a sedentary lifestyle. YMCA 3MST was performed on 45 adults who were categorized into 3 groups based on their physical activity levels. Inter group comparison was done using one way ANOVA followed by pair wise comparison using post hoc test. It was concluded that individuals engaging in health enhancing physical activity (mean heart rate recorded in this group was 96.00 with SD of 9.943) recorded better CRF levels as compared to other groups (mean heart rate recorded was 124.87 \pm 8.132 and 118.27 \pm 8.198).

Key-words: cardiopulmonary fitness, young adults, sedentary lifestyle, highly active, YMCA 3MST

INTRODUCTION:

According to World Health Organization (WHO), physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. In March 2020, when the government announced a nationwide lockdown to contain the spread of Covid-19, work from home became the norm. This meant that people no longer had to commute daily to work and instead had to meet the demands of their work from home. This however has promoted physical inactivity, as individuals spend a lot of time sitting. This shift towards a sedentary lifestyle is worrisome as indirectly it predisposes such individuals to a wide range of Non-Communicable Diseases (NCDs). As for school and college going students, conventional classroom teaching was replaced by online classes. This has been one of the major reasons of inactivity in the recent times.

Evidence regarding health benefits of physical activity is overwhelming and plays a critical role in both the primary and secondary prevention of coronary artery disease (CAD).^[1] Many Non-Communicable Diseases (NCDs) prevalent in India, such as CAD, hypertension, Diabetes Mellitus (DM), can be prevented and treated by regular physical activity.^[2] A sedentary lifestyle is considered to be the most important modifiable risk factor for cardiovascular morbidity and mortality.^[1] Cardiovascular health is independently associated with physical activity, with physical

inactivity linked with the greatest risk of developing CVD^[2]. With the given pandemic at hand, there is lower participation in active transport or purposeful physical activity as there is a shift in employment condition, where individuals now work from home. There is thus an increase in sedentary time among such individuals. Potential benefits of physical activity and exercise training includes reduced blood pressure, improved heart rate variability, improved insulin sensitivity, reduced visceral adiposity, improved mood and psychological stress and improved sleep.^[2] However, public health recommendations of closing gymnasiums, parks, and fitness centres have resulted in a reduced scope for physical activity.^[3]

Cardio respiratory Fitness (CRF) refers to the capacity of the circulatory and respiratory systems to supply oxygen to skeletal muscle mitochondria for energy production needed during physical activity.^[4] Low or unhealthy CRF is a strong, independent predictor of cardiovascular disease (CVD) and all-cause mortality in adults.^[4] CRF helps in estimating the functional capacity of an individual. It is dependent on a number of systemic processes such as pulmonary ventilation and diffusion, systolic and diastolic ventricular function, the interaction between the left ventricle and the arterial system.

CRF is directly related to the integrated function of numerous systems, and it is thus considered a reflection of total body health.^[5] CRF can be measured or estimated with a variety of tests and protocols. The tests used to measure CRF that require maximal effort are referred to as Maximal Exercise Tests.^[4] Maximal exercise tests like Bruce protocol, Modified Bruce protocol, Balke treadmill test measures cardio metabolic parameters. Tests that do not require maximal effort are referred to as Sub maximal Exercise Tests.^[4] Sub maximal exercise tests often estimate CRF with the use of equations or nomograms that have been validated against CRF measurements obtained directly during a maximal exercise test. Sub maximal tests can be used when a maximal test cannot be performed for safety, setting, or cost reasons. Sub maximal tests are easier to perform and may be useful for identifying and following up those with low/unhealthy CRF.^[4]

There are various sub maximal tests used to measure CRF, examples of which includes 6- minute walk test (6MWT), 20m shuttle run test (20mSRT), Step tests like YMCA 3MST, Tecumseh step test etc and questionnaires to assess fitness level etc.

This study aims at measuring the cardio respiratory fitness using the Young Men's Christian Association 3-minute step test (YMCA 3MST). YMCA 3MST is easy to administer and does not require expensive equipment's. This test is based on how quickly an individual's heart rate recovers following a short bout of exercise. The YMCA 3MST equation is a valid sub-maximal test for the prediction of maximum aerobic capacity. With its useful features (convenience, low cost, safety, and ease of use), the YMCA 3MST equation is suitable to be used in clinical or community settings.^[6] It gives us an idea about an individual's CRF levels and can thus be helpful in the early detection of poor CRF.

In this given time of the pandemic, owing to the shift of conventional classes to online platforms and Work from Home scenario for working individuals, physical activity levels have reduced. Reduced physical activity can be linked to lower CRF levels. Exercise therapy is a cost-effective intervention to both prevent and mitigate the impact of the metabolic syndrome but it remains underutilized.^[7] Moreover, a growing number of studies has reported that higher cardio respiratory fitness is

inversely related to the development of the metabolic syndrome.^[7] Thus, it is necessary that people are made aware of the ill effects of sedentary behavior. This in turn would help them work towards engaging themselves in physical activity, thereby improving their CRF levels by adopting a healthy lifestyle. So, the purpose of this study was to compare the Cardiopulmonary Fitness in young adults; among Highly Active, Minimally Active and among those with a Sedentary lifestyle using IPAQ-SF and YMCA 3MST.

METHODS:

Study Design- Cross sectional study

Tools and Materials Used-

- a) IPAQ- short form for assessing the participants physical activity level.
- b) YMCA 3MST Metronome.
- c) 12-inch-high Step.
- d) Watch or Clock that counts seconds.

Study Subjects- General young adult population between the ages of 18 to 35

Study Setting/place- a) Rawfit Gym, Vakola, Mumbai
b) Amardeep Co-op Housing Society, Santacruz, Mumbai

Sample size- 45

Group A- 15 young adults with inactive lifestyle

Group B- 15 young adults with minimally active lifestyle

Group C- 15 young adults with Health enhancing physical activity (HEPA Active) lifestyle

Inclusion Criteria-

1. Healthy young adults between 18 and 35 years of age at the time of screening.
2. Subjects who fully understood the test and decided to participate of their own free will and agreed with the written consent form.

Exclusion Criteria-

1. Subjects with cardiovascular and pulmonary disease, hypertension, orthopaedic disabilities, pregnancy.

2. Subjects who did not abstain from caffeine or alcohol for 24 hours, food for 2 hours, and strenuous exercise for the last 10 hours prior to the test.
3. subjects who required antipsychotic medication within 2 months before the screening test.
4. Subjects who are on beta blocker or beta agonist asthma medications.

Study Procedure-

1. Each participant was provided with a consent form.
2. A self-reporting questionnaire, International Physical Activity Questionnaire – Short Form (IPAQ-SF) was filled by the participants which helped in estimating their total physical activity which in turn helped us divide them into three groups. (Inactive, minimally active and HEPA active lifestyle).
3. Lastly, the YMCA 3MST was performed.
For the test, the metronome was set at 96 beats per minute. The participant was asked to stand facing the step. When ready to begin, the examiner starts the stopwatch or timer and asks the participant to step on and off the step to the metronome beat following a cadence of up, up, down, down. This is continued for 3 minutes. As soon as 3 minutes are up, the participant is asked to stop immediately and sit down on the step. Their pulse rate is then measured manually for an entire of 60 seconds. After this, the examiner locates the score on the YMCA rating scale which is based on age adjusted standards and is different for men and women.
4. On completion of the test, the participant is asked to stop immediately and sit down as their pulse rate will be manually measured for 60 seconds.



Fig 1. 12 Inch Stepper



Fig 2. Subject performing YMCA 3MST

RESULTS:

Statistical procedures

- Data obtained was compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States).
- Data was subjected to statistical analysis using Statistical package for social sciences (SPSS v 26.0, IBM).
- Descriptive statistics like frequencies and percentage for categorical data, Mean & SD for numerical data has been depicted.
- ✓ Inter group comparison (>2 groups) was done using one way ANOVA followed by pair wise comparison using post hoc test.
- ✓ Comparison of frequencies of categories of variables with groups was done using chi square test.

For all the statistical tests, $p < 0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

* = statistically significant difference ($p < 0.05$)

** = statistically highly significant difference ($p < 0.01$)

= non-significant difference ($p > 0.05$) ... **for all tables**

- This study involved participants aged between 18 to 35 years of age with the mean age being 25.58 ± 5.092 years.

		N	Mean	SD	Error	Lower Bound	Upper Bound	Minimum	Maximum		
DAYSINAWEEK SPENTDOINGVI GOROUSPHYSI CALACTIVITY	1	15	.00	.000	.000	m.00	.00	0	0		
	2	15	.00	.000	.000	.00	.00	0	0	85.51	8.000**
	3	15	5.20	2.178	.562	3.99	6.41	0	7		
TIME SPENTDOING VIGOROUSPH YSICALACTIVI TY (min)	1	15	.00	.000	.000	.00	.00	0	0		
	2	15	.00	.000	.000	.00	.00	0	0	63.84	5.000**
	3	15	92.00	44.593	11.514	67.30	116.70	0	150		
DAYSINAWEEK SPENTDOING MODERATEPH YSICALACTIVIT Y TIME	1	15	.00	.000	.000	.00	.00	0	0		
	2	15	.33	1.291	.333	-.38	1.05	0	5	16.28	8.000**
	3	15	2.87	2.264	.584	1.61	4.12	0	7		
TIME SPENTDOING MODERATEP HYSICALACTIV ITY (min)	1	15	.00	.000	.000	.00	.00	0	0		
	2	15	3.00	11.619	3.000	-3.43	9.43	0	45	11.44	6.000**
	3	15	68.33	75.679	19.540	26.42	110.24	0	240		
DAYSINAWEEK SPENTWALKIN G TIME	1	15	1.67	1.915	.494	.61	2.73	0	5		
	2	15	6.60	.737	.190	6.19	7.01	5	7	41.90	6.000**
	3	15	6.00	1.890	.488	4.95	7.05	0	7		
TIME SPENTWALKI NG	1	15	17.33	20.430	5.275	6.02	28.65	0	60		
	2	15	55.67	19.988	5.161	44.60	66.74	10	90	10.64	7.000**

(min)	3	15	40.67	27.572	7.119	25.40	55.94	0	120		
TIME SPENT	1	15	10.600	2.5579	.6604	9.183	12.017	8.0	16.0		
SITTING ON A WEEKDAY IN THE LAST 7 DAYS hrs	2	15	7.700	2.1531	.5559	6.508	8.892	3.0	12.0	14.269	.000**
	3	15	6.200	2.1448	.5538	5.012	7.388	3.0	10.0		
HEART RATE	1	15	124.87	8.132	2.100	120.36	129.37	112	142	44.338	.000**
	2	15	118.27	8.198	2.117	113.73	122.81	107	141		
	3	15	96.00	9.943	2.567	90.49	101.51	75	113		
TOTAL PHYSICAL ACTIVITY MET-min/week	1	15	174.900	196.798	50.813	65.917	283.88	.0	495.0		
	2	15	1205.100	277.665	71.692	1051.34	1358.66	495.0	1386.0	93.779	.000**
	3	15	5878.733	2077.94	536.52	4728.07	7029.459	3066.0	10212.0		

INFERENCE - There was a statistically highly significant difference seen for the values between the groups ($p < 0.01$) for-

- Higher values were seen in Group 3 for **days in a week spent doing vigorous and moderate level of physical activity** as well as for **time spent (in minutes) doing vigorous and moderate level of physical activity**. Group 3 also recorded higher values for **total physical activity MET-min/week**.
- Higher values were seen in Group 2 for **days in a week spent walking**, as well as for **time spent walking (in minutes)**.
- Higher values were seen in Group 1 for **time spent sitting on a weekday in the last 7 days (in hours)**. In addition to this, higher values were seen in Group 1 for **Heart Rate**.

TABLE 2- Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
DAYS IN A WEEK SPENT DOING VIGOROUS PHYSICAL ACTIVITY	12.337	2	42	.000
TIME SPENT DOING VIGOROUS PHYSICAL ACTIVITY (min)	22.646	2	42	.000
DAYS IN A WEEK SPENT DOING MODERATE PHYSICAL ACTIVITY	11.726	2	42	.000
TIME SPENT DOING MODERATE PHYSICAL ACTIVITY (min)	23.993	2	42	.000
DAYS IN A WEEK SPENT WALKING	4.271	2	42	.020
TIME SPENT WALKING (min)	.615	2	42	.546
TIME SPENT SITTING ON A WEEKDAY IN THE LAST 7 DAYS hrs	.523	2	42	.597
HEART RATE	.422	2	42	.659
TOTAL PHYSICAL ACTIVITY MET-min/week	21.332	2	42	.000

INFERENCE- Levene's Test of Homogeneity of Variances tested the null hypothesis that there is no difference in the variances are equal. As a rule of thumb, we reject the null hypothesis if $p < 0.05$

Table 3- Pair wise comparison using Games-Howell Post Hoc Tests							
Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	p value	95% Confidence Interval	
						Lower Bound	Upper Bound
DAYS IN A WEEK SPENT DOING VIGOROUS PHYSICAL ACTIVITY	1	2	.000	.000	.	.00	.00
		3	-5.200*	.562	.000**	-6.67	-3.73
	2	3	-5.200*	.562	.000**	-6.67	-3.73
TIME SPENT DOING VIGOROUS PHYSICAL ACTIVITY (min)	1	2	.000	.000	.	.00	.00
		3	-92.000*	11.514	.000**	-122.14	-61.86
	2	3	-92.000*	11.514	.000**	-122.14	-61.86
DAYS IN A WEEK SPENT DOING MODERATE PHYSICAL ACTIVITY	1	2	-.333	.333	.589#	-1.21	.54
		3	-2.867*	.584	.001**	-4.40	-1.34
	2	3	-2.533*	.673	.003**	-4.22	-.84
TIME SPENT DOING MODERATE PHYSICAL	1	2	-3.000	3.000	.589#	-10.85	4.85
		3	-68.333*	19.540	.009**	-119.48	-17.19

ACTIVITY (min)	2	3	-65.333*	19.769	.013*	-116.81	-13.86
DAYS IN A WEEK SPENT WALKING	1	2	-4.933*	.530	.000**	-6.28	-3.58
		3	-4.333*	.695	.000**	-6.05	-2.61
	2	3	.600	.524	.499#	-.74	1.94
TIME SPENT WALKING (min)	1	2	-38.333*	7.380	.000**	-56.59	-20.07
		3	-23.333*	8.860	.036*	-45.36	-1.31
	2	3	15.000	8.793	.222#	-6.87	36.87
TIME SPENT SITTING ON A WEEKDAY IN THE LAST 7 DAYS hrs	1	2	2.9000*	.8633	.006**	.761	5.039
		3	4.4000*	.8619	.000**	2.264	6.536
	2	3	1.5000	.7847	.154#	-.442	3.442

HEART RATE	1	2	6.600	2.981	.086#	-.78	13.98
		3	28.867*	3.316	.000**	20.64	37.09
	2	3	22.267*	3.327	.000**	14.02	30.52
TOTAL PHYSICAL ACTIVITY MET-min/week	1	2	- 1030.2000 *	87.874 0	.000**	- 1248.9 55	- 811.445
		3	- 5703.8333 *	538.92 32	.000**	- 7111.5 12	- 4296.15 5
	2	3	- 4673.6333 *	541.29 12	.000**	- 6084.7 84	- 3262.48 3

INFERENCE-

- HEART RATE

Statistically highly significant p value ($p < 0.01$) seen when comparing group 1 with group 3 and group 2 with group 3.

Group 3 recorded a lower heart rate by the end of the test when compared to group 1 and group 2. This indicates that group 3 had better CRF when compared to group 1 and group 2.

- TOTAL PHYSICAL ACTIVITY

Highly significant p value ($p < 0.01$) obtained when comparing group 1 with group 2, group 1 with group 3 and group 2 with group 3.

Group 2 spent doing more physical activity (more MET min/week) when compared to group 1.

Group 3 spent doing more physical activity (more MET min/week) when compared to group 2.

Out of the 3 groups being compared, group 3 spent doing the most physical activity.

DISCUSSION:

After subjecting the data to statistical analysis, intergroup comparison of outcome variables based on IPAQ-SF questionnaire was obtained.

The three groups were compared on the basis of the number of days in a week that they spent doing vigorous physical activity as well as the time they spent (in minutes) doing vigorous physical activity. Statistically highly significant difference was seen for the values between the groups ($p < 0.01$). Group 3 spent a mean of 5.20 days with SD 2.178 engaging themselves in vigorous physical activity. They also spent a mean of 92.00 minutes with SD 44.593 doing vigorous physical activity. Group 1 and group 2 spent 0 days engaging in vigorous physical activity.

The three groups were compared on the basis of the number of days in a week that they spent doing moderate physical activity as well as the time they spent (in minutes) doing moderate physical activity. Group 2 spent a mean of .33 days with SD 1.291; whereas Group 3 spent a mean of 2.87 days with SD 2.264 engaging themselves in moderate physical activity. Group 2 spent a mean of

3.00 minutes with SD 11.619 doing moderate physical activity and Group 3 spent a mean of 68.33 minutes with SD 75.679 doing moderate physical activity. Here we see that only group 2 and group 3 engaged themselves in moderate physical activity. And among the two, group 3 showed higher values (more days and more time) as compared to group 2.

The three groups were compared on the basis of the number of days in a week that they spent walking and the time they spent walking (in minutes). Group 1 spent a mean of 1.67 days with SD 1.915 walking. Group 2 spent a mean of 6.60 days with SD .737 walking. Group 3 spent a mean of 6.00 days with SD 1.890 walking. Group 1 spent a mean of 17.33 minutes with SD 20.430 walking. Group 2 spent a mean of 55.67 minutes with SD 19.988 walking. Group 3 spent a mean of 40.67 minutes with SD of 27.572 walking. All the three groups participated in walking. Group 2 spent more days and time walking than group 3. The least values were recorded in group 1.

When the three groups were compared on the basis of hours spent sitting on a weekday in the last 7 days, group 1 spent a mean of 10.600 hours with SD 2.5579 sitting. Group 2 spent a mean of 7.700 hours with SD 2.1531 sitting. Group 3 spent a mean of 6.200 hours with SD 2.1448 sitting. Here we infer that group 1 spent the most hours sitting. Group 1 comprised of individuals with a sedentary lifestyle. It included individuals with a desk job, working from home and students attending online lectures. Thus, due to the nature of their work/medium of learning during this pandemic time, they spend more hours sitting with less physical activity. The least hours spent sitting were observed in individuals from Group 3. This Group included individuals leading a very active lifestyle. They engaged in working out at gymnasiums and most of them also spent time walking outdoors on a daily basis thus maintaining high levels of physical activity.

When the three groups were compared on the basis of the heart rate recorded after completion of the YMCA 3MST, group 1 recorded the highest values (mean of 124.87 beats per minute with SD 8.132). Individuals of Group 1 were inactive. In people who are sedentary, the heart has to beat more frequently to meet the body's oxygen demands. This could possibly explain the higher

heartrate values recorded in this group. The lowest value was seen among individuals of group 3 (mean of 96.00 beats per minute with SD 9.943). People who get a lot of physical activity or are very athletic generally have lower heart rates because their heart is in better condition and does not need to work as hard. Group 2 recorded a mean of 118.27 beats per minute with SD 8.198. Lastly, comparing the groups on the basis of total physical activity (measured in MET-min/week), Group 3 spent a mean of 5878.733 MET-min/week with SD 2077.9423 engaging in physical activity. Group 2 spent a mean of 1205.100 MET-min/week with SD 277.6655 engaging in physical activity. Group 1 spent a mean of 174.900 MET-min/week with SD 196.7981 engaging in physical activity. The highest values were seen in group 3 followed by group 2 with the least values recorded in group 1. Group 3 engaged in vigorous physical activity; spent more days and time doing vigorous and moderate levels of physical activity. Group 2 spent more days and time walking which categorised them as being minimally active. Group 1 comprised of individuals with a sedentary lifestyle who spent more hours in a day sitting.

Furthermore, pair wise comparison was done using Games-Howell Post Hoc Test. There was a statistically significant / highly significant difference seen for the values between the groups ($p < 0.01, 0.05$).

Statistically significant p value ($p < 0.05$) obtained when comparing group 1 and group 2 on the basis of time spent sitting on a weekday in the last 7 days (in hours). Likewise, statistically highly significant p value ($p < 0.01$) was obtained when comparing group 1 and group 3. Group 1 spent the most time sitting when compared to group 2 and group 3.

Statistically highly significant p value ($p < 0.01$) seen when comparing group 1 with group 3 and group 2 with group 3 on the basis of heart rate recorded. Group 3 recorded a lower heart rate by the end of the test when compared to group 1 and group 2. This indicates that group 3 had better CRF when compared to group 1 and group 2. Being more physically active corresponds to better CRF. The circulatory and respiratory systems in such individuals are better able to supply oxygen during sustained physical activity. The more sedentary or inactive the lifestyle, the poorer would be the CRF levels.

Highly significant p value ($p < 0.01$) obtained when comparing group 1 with group 2, group 1 with group 3 and group 2 with group 3 on the basis of total physical activity.

In conclusion,

- Group 1 comprised of individuals leading a sedentary lifestyle. Their CRF levels ranged from below average to poor to very poor. (The mean heart rate recorded in this group was 124.87 with SD of 8.132).
- Group 2 comprised of individuals who were minimally active. Their CRF levels ranged from below average to poor. (The mean heart rate recorded in this group was 118.27 with SD of 8.198).
- Group 3 comprised of individuals engaging in health enhancing physical activity. Their CRF levels ranged from below average to average to good. (The mean heart rate recorded in this group was 96.00 with SD of 9.943).

- Group 3 recorded better CRF levels as compared to Group 2 and Group 1.

CONFLICT OF INTEREST:

The authors declare that there is no conflict of interest with regards to this research.

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AUTHOR CONTRIBUTION:

All the authors contributed to the conception and design of study and approval for the submission to publication. Prabhu S.S contributed to the manuscript drafting.

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