

# Health-Related Physical Fitness Levels Among the Young Male Workers Performing Moderate and Heavy Physical Activity

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## ABSTRACT

**Introduction:** Health and fitness have a direct impact on work and leisure as it enables one to meet their day-to-day physical demands and decrease the probabilities of illness. Many employment situations require workers to be physically 'fit' and 'strong' to perform various occupational activities. Physical fitness is fully developed during the young adulthood and starts dipping from middle adulthood. Thus the Five components of Health-related fitness (HRF) can help understand the Physical fitness levels among the workers performing physical work of different intensity.

**Methods:** To assess the HRF levels, 69 healthy male workers, age 18–30 years were selected and classified into Moderate or Heavy PA (Physical Activity) group. Physical measurements on five components of HRF (Caspersen et.al., 1985) were measured using 13 test.

**Results:** Overall results revealed that Moderate PA group (n=32) scored significantly higher for Muscle Mass, Bone Mass, Hand Strength, Tip and Palmar Pinch Strength. Heavy PA workers (n=37) had significantly lower BMI, Fat %, Metabolic Age, Hip and Waist Circumference, which is a good indicator for better fitness. Likewise, Aerobic Fitness, Low Back Flexibility and Trunk lift scores were significantly superior than Moderate PA group. No significant difference was found in WHR, Key Pinch, Back Strength, Explosive strength of Leg, Push-up and Sit-up.

**Conclusion:** Moderate type of physical work may have contributed for better Bone Mass, Muscle Mass, Hand Strength, Tip and Palmar Pinch Strength; while heavy type of physical work may have attributed to lower Fat% and BMI; with enhanced Flexibility and Aerobic Capacity among the Heavy PA workers.

**Keywords:** Health-Related Fitness (HRF), Physical activity, Moderate and Heavy workload.

## INTRODUCTION

Physical fitness is as the ability of a person to perform daily activities with vigour, and capacities that are associated with a low risk for the development of chronic diseases and premature death. <sup>[1]</sup> It has been broadly classified into Health-related and Skill-related. Health-related Fitness (HRF) means the ability to perform daily activities with energy characteristics and capacities that are associated with a lower risk for developing chronic disease and premature death. <sup>[2]</sup> HRF directly

depends on the level of physical activity of the individual. <sup>[3]</sup> Physical fitness is all the more important now in view of the technological advancements which have reduced physical activities being performed by individuals to a bare minimum.

Many employment situations require workers to be physically 'strong' and 'fit' as they are capable of performing more physically demanding work without getting much tired. If you require employees to do physically demanding work, physical abilities testing determines if they are

physically able to perform the job. [4] Physical fitness requirements are critical to the employment process and cannot be compromised. [5] Tests on Five components of Health-related Fitness [6] can help understand the general fitness levels of the workers performing physical work of different intensity. Agriculture, manufacturing and construction sectors forms around 75% of the total employment in India [7] and most activities fall between Metabolic Equivalent values (METs) of 3 and above, thus indicating them as moderate to heavy type of physical activities (Compendium of Physical Activities [8]). Hence to perform various moderate to heavy occupational activities, workers need to achieve and maintain certain fitness levels. In India, hardly any research has been carried out to evaluate the HRF levels of workers and reference data on HRF is also limited. Therefore the current study is carried out with the objective to assess Health-related Fitness levels of worker performing moderate and heavy work, with an aim to find out how the heavy and moderate type of work influence the workers fitness level.

## METHODS

To measure the Physical Activity level (PAL) and HRF, 69 healthy male workers, age 18–30 years from Maharashtra and Gujarat were selected and classified into Moderate or Heavy PA (Physical Activity) group based on their daily physical activity involvement using Compendium of Physical Activities [8-9] and IPAQ Short Form. [10] A sample of 32 participants in Moderate PA group and 37 subjects into Heavy PA group were studied using Interview schedule.

### Physical Activity assessment

24-Hour Time Diary was used to examine the key activities in which the worker participated in all activities over 24-hour period on one working day were recorded. IPAQ (Short form) included 7 questions about three specific activities i.e., walking, moderate-intensity activities and vigorous-intensity. Summation of the duration (in

minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activities was done. Based on this results the workers were classified in Moderate PA and Heavy PA group.

### Tests for assessing 5 Components of Health Related Fitness

Physical measurement on Five components of Health Related Fitness [6] of the participants were measured using 13 tests adopted from Fitness batteries like FITNESSGRAM® by The Cooper Institute, [11] ALPHA test battery [12] and Total Physical Fitness Program, Kerala. [13]

### Body composition.

BMI was computed [Weight (kg)/Height squared (m<sup>2</sup>)] to classify participants into different categories (i.e.; <18.5- Underweight, 18.5 to 24.9- Normal weight, 25 to 29.9- Overweight and > 30- Obese). Body Fat %, Muscle mass, Bone mass & Metabolic Age was measured using Tanita BIA scale. Waist and Hip circumference were measured. Waist Hip Ratio (WHR) was calculated [waist/hip] and workers were classified as <0.85 –Excellent, 0.85-0.89 Good, 0.90-0.95 Average, > 0.95 At risk. [14]

### Muscular strength.

Pinch grip strength test (tip, palmar & key pinch) and hand grip test (right and left) were measured using Jamar dynamometer and maximum score (kg/force) was recorded. Back Muscle Strength was measured using Back leg dynamometer and maximum score (kg/force) was recorded. Explosive strength of Legs was measured by standing high Jump test (inch) where Initial reach was subtracted by maximum reach.

### Muscular endurance.

Abdominal endurance was measured with Sit-up/min (hands crossed on chest). Upper body endurance was measured with Push-up/min. Trunk lift test (inch) was used to measure trunk extension endurance.

### Flexibility.

Low Back Flexibility was recorded by Sit-&-Reach (SAR) with 1' high box and 15'' marked at feet level and scores (inch)

were recorded. [15] For Shoulder flexibility test, participants had to touch the fingers behind the back. If fingers overlapped they were graded as ‘Very good’, fingertips just touching as ‘Good’ and fingertips not touching as ‘Poor’.

### Aerobic Fitness.

It was measured with Queens College step Test (stool height of 41.3cm and metronome at 96 beats/min). VO<sub>2</sub> max (ml/kg/min) was calculated. [16]

## RESULTS

Workers considered in Moderate PA category (n = 32) were majorly from manufacturing sector like pickers in pharma industry, machine operators, mechanical inspection engineers and multipurpose workers. Heavy PA category (n = 37) included workers majorly from construction sectors like masons, false ceiling/AC installation/electrician, carpenter, welder and painter. The Moderate PA group were more educated (Range: 5th grade to Master level) compared to Heavy PA group (no education – 12th grade) (p < 0.05)(Table 1).

**Table 1. General Information about the Workers**

General Information	Moderate PA Group (n = 32)				Heavy PA Group (n = 37)				T score	p value
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Age	23.8	3.1	18	30	22.1	3.7	18	30	2.07	0.043
Education level	12.1	3.3	5	17	6.9	3.7	0	12	6.11	0.000
Work experience	4.1	3.3	0.1	11	5.5	4.4	0.1	15	-1.46	0.149

Note: All values are in years.

Mean height, weight and the BMI scores of the Moderate PA group was more than the Heavy PA group (p < 0.05). When workers were classified with respect to BMI, it was found that 18.8% and 29.73% were underweight in Moderate PA and Heavy PA category, respectively. Around 12.5% from Moderate PA group and only 2.7% from Heavy PA category were falling into overweight category. Further, it is important to note that none of the workers from both group belonged to Obese Category (BMI > 30) (Table 2).

**Table 2. Body Composition Scores of the Workers**

HRF Variable	Moderate PA Group (n = 32)				Heavy PA Group (n = 37)				T score	p value
	Mean	SD	Min	Max	Mean	SD	Min	Max		
<b>1. Body Mass Index</b>										
Height (cm)	165.9	6.8	151.1	178.2	159.7	5.5	148.5	171.2	4.22	<b>0.000</b>
Weight (kg)	59.4	10.8	40.0	86.2	50.2	6.2	38.6	73.5	4.28	<b>0.000</b>
BMI Score	21.43	2.72	17.40	27.50	19.72	2.12	15.50	26.70	2.87	<b>0.006</b>
<b>2. Detailed Body Composition – Bioelectrical Impedance Analysis (BIA)</b>										
Body Fat %	16.2	5.0	7.3	29.2	11.4	5.5	5.0	25.8	3.76	<b>0.000</b>
Muscle Mass (kg)	46.7	6.5	34.2	60.5	41.8	3.8	34.7	51.7	3.73	<b>0.001</b>
Bone mass (kg)	2.6	0.4	1.9	3.3	2.3	0.2	1.9	2.8	3.92	<b>0.000</b>
Metabolic age(yr)	21.7	6.8	15.0	46.0	18.0	6.0	14.0	41.0	2.37	<b>0.020</b>
Body Water (%)	55.2	4.8	43.3	68.1	58.1	5.0	46.4	71.2	-2.49	<b>0.015</b>
<b>3. Waist Hip ratio (WHR) – measuring Hip and waist circumference</b>										
Hip (cm)	91.4	7.8	79.0	112.0	83.1	6.8	65.0	99.0	4.74	<b>0.000</b>
Waist (cm)	76.0	8.0	64.0	93.0	69.9	8.0	51.0	92.0	3.19	<b>0.002</b>
WHR	0.83	0.04	0.75	0.93	0.84	0.06	0.72	0.94	-0.65	0.517

Body Fat % of Heavy PA group (11.42%) was found to be significantly less than the Moderate PA group (16.22%). But the mean scores of Muscle Mass (kg) and Bone mass (kg) was also less due to lesser weight and height. Body water percentage was found to be significantly more (p = 0.015) among the heavy PA Workers. Thus all the above factors have contributed to significantly less Metabolic age (Yrs)

among the Heavy PA Workers (p < 0.05) (Table 2).

The hip circumference and waist circumference of the Moderate PA workers was significantly higher (p<0.05) than the Heavy PA worker (Table 2) indicating more of fat deposited at abdominal and hip region. But for the WHR it was seen that none of the workers were falling into the risk category (WHR> 0.95).

**Table 3. Strength, Endurance, Flexibility and Aerobic Fitness Scores of the workers**

HRF Variable	Moderate PA Group (n = 32)				Heavy PA Group (n = 37)				T score	p value
	Mean	SD	Min	Max	Mean	SD	Min	Max		
<b>Muscular Strength</b>										
<b>4. Pinch Strength (kg)</b>										
Tip	5.06	1.18	2.8	7.3	4.09	1.07	2.3	6.5	3.56	<b>0.001</b>
Palmar	6.56	1.38	4.0	10.0	5.78	1.20	3.5	8.9	2.51	<b>0.015</b>
Key	8.37	1.48	6.4	12.0	7.95	1.42	5.5	11.8	1.20	0.236
<b>5. Hand Grip Strength (kg)</b>										
Hand Grip	34.13	6.80	21.0	50.0	30.39	6.10	17.5	46.0	2.40	<b>0.019</b>
<b>6. Back Strength (kg)</b>										
Back Strength	101.63	19.85	57.0	136.5	102.85	20.44	43.5	143.5	-0.25	0.802
<b>7. Explosive Strength of Leg (inch)</b>										
Vertical Jump	15.27	2.13	11.0	20.5	15.04	1.93	11.8	19.3	0.48	0.633
<b>Muscular Endurance</b>										
<b>8. Sit-up</b> (Nos/min)	22.19	8.05	6.0	36.0	18.57	7.25	3.0	29.0	1.96	0.054
<b>9. Push-up</b> (Nos/min)	22.47	11.02	1.0	50.0	19.76	7.02	3.0	35.0	1.20	0.236
<b>10. Trunk Lift</b> (inch)	10.50	1.46	7.5	12.0	11.23	1.03	8.0	12.0	-2.36	<b>0.022</b>
<b>Flexibility of Low Back and Hamstring - Sit &amp; Reach test (SAR) (inch)</b>										
<b>11. SAR</b>	16.08	4.48	6.3	21.7	18.70	2.76	12.6	24.8	-2.86	<b>0.006</b>
<b>Aerobic Fitness - Queens College Step Test (ml/kg/min)</b>										
<b>12. VO<sub>2</sub>Max</b>	51.32	8.66	32.4	65.97	58.80	6.59	44.1	71.0	-3.98	<b>0.000</b>

\*Note - Pinch Strength and Hand Grip Strength are the average scores of Right and Left hand.

Average Hand grip (34.1 kg), tip pinch (5.06 kg) and palmar Pinch strength (6.56 kg) of Moderate PA group was found to be significantly more ( $p < 0.05$ ) than Heavy PA group (Table 3). Whereas scores on Key pinch (around 8 kg), back strength (around 102 kg) and explosive strength (15 inch) was not significantly different in both the groups ( $p > 0.05$ ). For Muscular Endurance category it can be observed that mean scores of Moderate PA group on Sit-up (22 count/min) and Push-up (22 count/min) was more than Heavy PA group (Sit-up-19 count/min & Push-up 20 count/min), but were not significantly different. Trunk lift (11.23 inch), SAR (18.7 inch), VO<sub>2</sub> Max (58.8 ml/kg/min) of Heavy PA group were significantly better ( $p < 0.05$ ), thus representing a substantially enhanced trunk extension, low back flexibility and aerobic fitness than the Moderate PA Group (Table 3). Shoulder Flexibility with Right Hand up & Left down was found to be more in both groups with 87.6% of Moderate and 78.3% of Heavy PA group falling in Good to Very Good category; as compared to Left Hand up & Right down where the score was only 62.5% and 70.2% respectively.

## DISCUSSIONS

It is apparent from the results that Heavy type of Physical work is selected mostly as an occupation by those people

who could not pursue higher education above 12th grade. Heavy PA group (Underweight - 29.7%) had BMI scores significantly less than Moderate PA group (Underweight-18.8%). Likewise, Hip and waist circumference of the Heavy PA workers was also significantly lesser indicating less fat deposited at abdominal and hip region. Thus from present study it evident that Heavy PA work tends to significantly lessen BMI, Fat%, Metabolic Age and fat deposition at Hip and Waist region, which is an indicator of better fitness. Likewise one study mentioned that Heavy worker should possess primarily muscle and very little body fat. [5]

Besides it is crucial to note that both Moderate and Heavy PA work does not allows the BMI and WHR of the workers to fall in Obese Category (BMI>30) and risk category (WHR>0.95) respectively, thus preventing the workers from health hazards related to obesity. Moreover, involving in Heavy type of construction activity at work leads to decrease in overall fat % and reduced deposition of fat at waist and hip region. One study suggested a slight protection against overweight for men by any current non-sedentary work and moderately reduced mortality in both genders by heavy OPA compared with sedentary work. [17]

A Study found that the subjects with a higher Work Index performed worse than the subjects with a lower Work Index on functional and motor abilities. [3] Similarly in current research Muscle Mass (kg) and Bone mass (kg) of Heavy PA workers was found to be significantly less due to lesser weight and height. Thus, it may be an important contributing factor for reduced scores in some of the strength and endurance test among heavy workers as compared to Moderate PA group. One of the benchmark paper also stated that medium subjects in each age group were fitter than fat subjects; however thin subjects were not fitter than medium subjects. [18] Recent research similarly found that men doing heavy physical work scored better in cardiorespiratory fitness, handgrip strength, and trunk muscle endurance than men doing lighter work. [19] Thus a positive association was found between heavy physical work and a high level of fitness in young workers.

Moderate group workers were involved in household chores (34.4%), gym/exercise (18.8%) and Leisure/ sports activity (18.8%); whereas Heavy workers were primarily involved in household chores (54%) with hardly any involved in gym/exercise and Leisure time/ sports activity. Hence moderate occupational work, household chores, gym/exercise and Leisure/ sports activity may have contributed for better Tip, Palmar and Hand Strength among moderate group workers, however Heavy occupational activity and household chores both may have contributed for better Trunk extension, Low Back Flexibility and Aerobic Fitness among Heavy workers. Fitness Parameters which were not affected by moderate or heavy PA work were Key Pinch, Back Strength, Sit-up, Push-up and Explosive Strength of Leg. Previous study indicated that aerobic capacity mostly reflects the level of habitual physical activity, intensity and amount of dynamic, moderate-to-vigorous, sustained (aerobic) physical activity in which one participate. [20] Similarly in present study it was observed that apart from occupational

activities. Previous review gave some suggestions for cardiorespiratory fitness but stated that there is virtually no basis for evaluation for other components of health-related fitness. [21]

## CONCLUSION

Health and fitness has a direct impact on work and day to day activities. Measuring changes in population health and fitness is therefore very important, in order to evaluate interventions and to predict the need for health and social care. Continuous periodic testing of fitness needs to be recorded and maintained for future assessment and analysis. Health related fitness testing will be beneficial both to the employee and the employer by developing baseline physical fitness data of the workers.

Overall results on Five Health Related Physical Fitness component showed that Moderate PA group workers scored significantly higher for muscle mass, bone mass, hand strength, Tip and Palmar Pinch strength. Whereas Heavy PA workers had significantly lower BMI, Fat%, hip and waist circumference; and significantly better Aerobic fitness, low back flexibility and trunk lift scores. No significant difference was found in WHR, key pinch, back strength, Sit-up, Push-up and explosive strength of leg. Further, there is a need for a longitudinal study for comparing the health related fitness among workers performing activity of varying intensity to see the impact of occupational physical activity on health-related fitness.

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