



A Study of Physical Fitness Index in Physiotherapy Students by Using Modified Harvard Step Test

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background and Objective: Physical fitness implies performing an inactive task efficiently besides sense of physical, mental and social well-being and the ability to deal with crisis demanding unusual physical endeavor. In this study, the physiotherapy students of age group 17 to 22 years of Visakha Academy of Paramedical Sciences College of Physiotherapy were taken to assess their physical fitness.

Methods: An observational study was done in 50 young male and female physiotherapy students by using Modified Harvard Step test to measure Physical Fitness Index.

Data Analysis: Statistical analysis was done using Chi Square test.

Results: Statistical analysis shows that physical fitness in physiotherapy students is not satisfactory. The Chi Square values show association between body mass index and physical fitness levels in physiotherapy students.

Conclusion: Physical fitness of physiotherapy students in Visakha Academy of Paramedical Sciences College of Physiotherapy, is not satisfactory. Subjects with higher BMI had lower physical fitness.

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1. INTRODUCTION

Physical fitness implies performing an inactive task efficiently along with sense of physical, mental and social well-being and the ability to deal with crisis demanding unusual physical endeavor. Low levels of physical fitness leads to obesity in individuals. In the past three decades the adult obesity rates have almost quadrupled [1-6]. Physiotherapy students during their curriculum are dealt with different kinds of burdens and stress and due to a more sedentary lifestyle, there's a decrease in physical fitness levels [7-12]. There is a necessity to know the Physical Fitness levels of our future Physiotherapists, therefore they can acquire a healthy lifestyle right from the beginning, so that they stay motivated to be healthy throughout their walk of life [13-22].

The two major challenges around the world for disease prevention and health are the epidemic of obesity and overweight [23-25]. Many countries have witnessed the rise of obesity in their citizens double and even quadruple due to increasingly sedentary lifestyle, urbanization, industrialization and consumption of processed foods and high calorie diets over the past three decades [26-28]. The healthy lifestyle of physiotherapy students facilitates the formation of physically fit professionals [29-36]. Therefore, there is compelling evidence that the health of Physiotherapists matters, and their physical activity levels practices influence their clinical attitudes towards physical fitness. The available information provided by Dharmesh Parmar, Nikita Modh (July 2015) in their study concluded that the Physical fitness of physiotherapy students in Ahmedabad Physiotherapy College is not satisfactory and Females are having better physical fitness. Further research is recommended to determine the available information, as it included only healthy and overweight BMI students excluding the Obese BMI students [37-40].

In this study, the physiotherapy students of age group 17 to 22 years of Visakha Academy of Paramedical Sciences College Of Physiotherapy were taken to assess their physical fitness. The study setup was prepared in VAPMS College of Physiotherapy. The well-equipped Physiotherapy department with good infrastructure, adequate ventilation, basic resources like Harvard Step Bench, Stadiometer, and a weighing scale was

provided, which efficiently helped in recording the physical anthropometry for pre and post-test evaluation [41-46]. In this study, Physical Fitness Index of fifty physiotherapy students was assessed using a Modified Harvard step test.

2. MATERIALS AND METHODS

Study Design: Observational Study

Study Setting: Visakha Academy of Paramedical Sciences College of Physiotherapy, Madhurawada, Visakhapatnam.

Study Period: 2 months

Study Subjects: Physiotherapy Students

Sample size: 50 Students

Statistical Test: Chi Square Test

2.1 Inclusion Criteria

- a. Healthy young male and female Physiotherapy students.
- b. Aged between 17 to 24 years.
- c. BMI 18-40 kg/m²

2.2 Exclusion Criteria

- a. History of cardiovascular disorders.
- b. History of respiratory disorders
- c. History of diabetes mellitus, hypertension, bronchial asthma
- d. History of any vital surgery in the recent past.
- e. History of drug intake.
- f. History of alcohol and smoking.
- g. Students with locomotor and musculoskeletal disability.

2.3 Materials

- 1: Modified Harvard Step bench: It is used for Harvard Step exercise testing
- 2: Stopwatch: It is used to record the timing in seconds during the procedure
- 3: Metronome App: It is used to adjust the frequency of steps.
- 4: Weighing Machine: It is used to measure the weight.
- 5: Stadiometer: It is used to measure the height.

2.4 Modified Harvard Step Test Method

The subjects were asked to relax during the procedure.

Recording of Physical Fitness Index by using Modified Harvard Step Test. The subjects were asked to be lightly clothed. They were asked to sit quietly for 5 min. Then resting pulse rate was recorded by palpating the radial artery manually. Thereafter, they were asked to perform the stepping exercise.

The person who is taking the test steps up and down on a platform in a cycle of 2 seconds. The step is at a height of 33cms a wooden box. The rate of 30 steps per minute must be sustained for five minutes or until the point of exhaustion, which means the point at which the subject cannot maintain the stepping rate for 15 seconds.

Stepping up and down a 33 cms high step box at a rate of 30 times/min for 5 min. The total duration of the stepping exercise and post-exercise pulse rate at 1-1.5 minutes will be recorded.

Those with heart rates above 200 beats per minute, had heavy breathing, or unable to sustain, were stopped immediately. Once the

participants have accomplished the step test or were ceased due to the aforementioned reasons, were quickly made to sit down on the box and rest.

The fitness test was conducted under close supervision. The detailed procedure of the exercise test was explained to the subjects & an actual demonstration was given before starting the test.

The Physical Fitness Index is calculated by using the following formulae.

$$\text{Physical Fitness Index} = \frac{(100 \times \text{test duration in seconds})}{(5.5 \times \text{pulse count between 1 and 1.5 minutes})}$$

According to the Modified Harvard Step test the following scores are used for classifying the physical fitness of study subjects.

3. DATA ANALYSIS

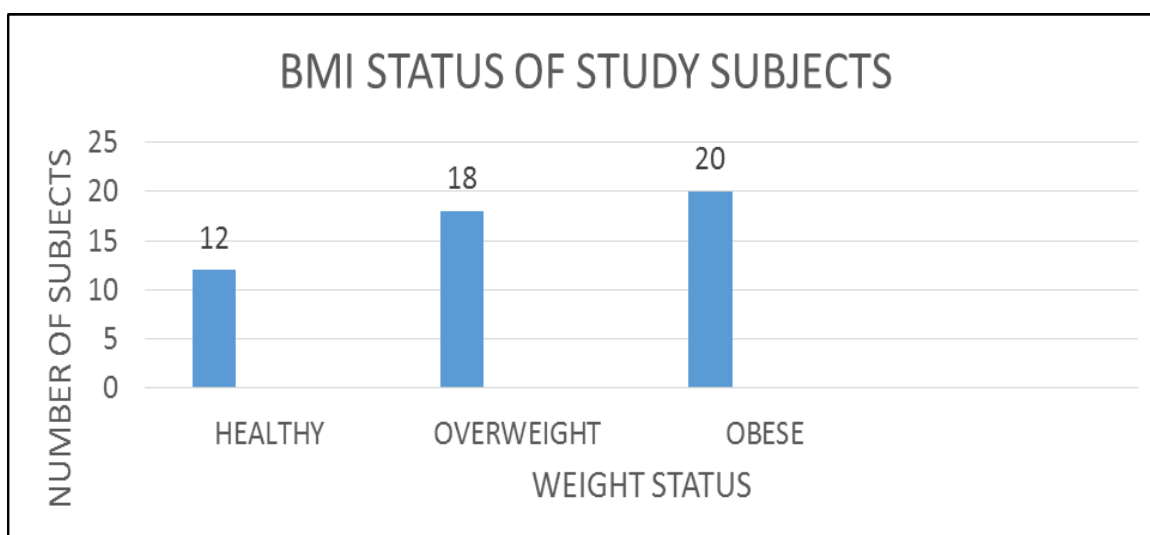
Statistical analysis was done using Chi square test.

Chart 1. Physical fitness index rating% (Edward L. Fox. et al., 1973)

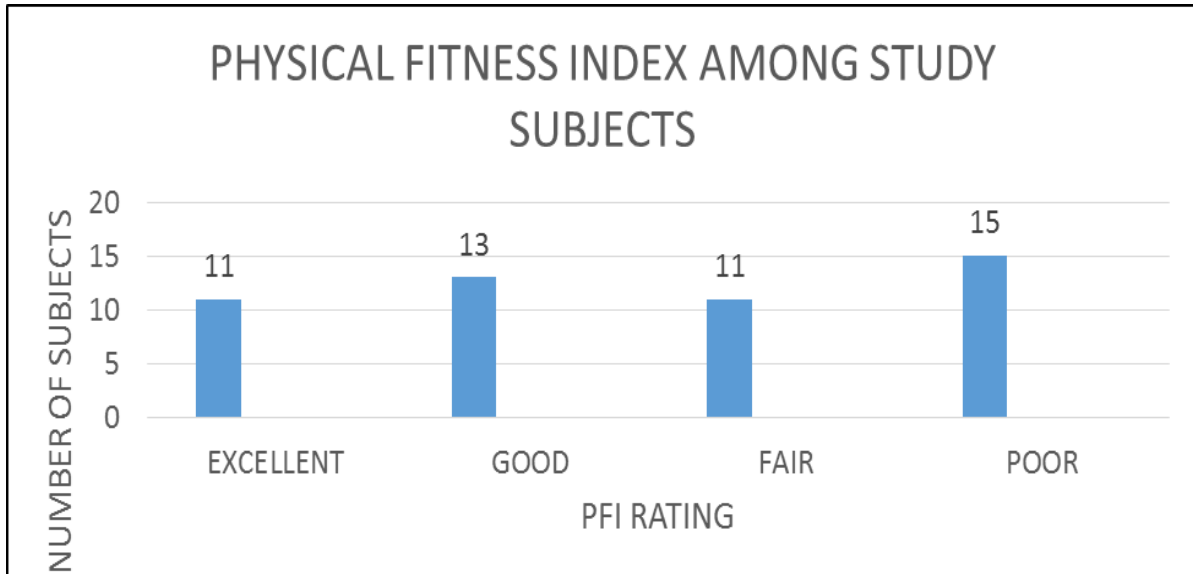
PFI Rating		PFI Score	
		Male	Female
o	Excellent	>115	>91
o	Good	103-115	84-91
o	Fair	91-102	77-83
o	Poor	<91	<77

4. OBSERVATION AND RESULTS

Graph 1: The X- axis represents the weight status (Healthy BMI, Overweight BMI, Obese BMI) of the study subjects and the Y-axis represents the number of study subjects in the BMI category of Healthy, Overweight, and Obese.



Graph 2: The X- axis represents the PFI Rating (Excellent, Good, Fair, Poor) and the Y axis represents the number of study subjects in the BMI category of Healthy, Overweight and Obese



Graph 3: The graph represents the data of Overall Performance of study subjects. The X-axis represents the PFI Rating and Y-Axis represents Performance Percentage 22% are excellent, 26% are good, 22% are fair, 30% are poor.

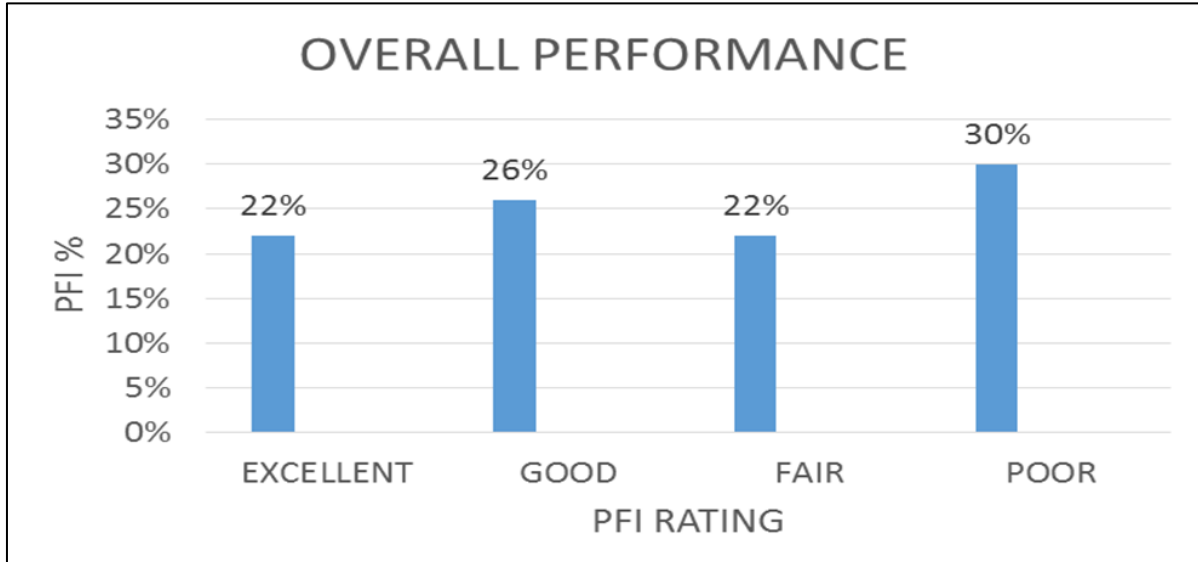


Table 1. Overall Performance of study subjects

	Overall performance		
	Healthy%	Overweight%	OBESE%
Excellent	4%	10%	8%
Good	16%	6%	4%
Fair	2%	10%	10%
Poor	2%	10%	18%

Graph 4: The graph represents the overall health status of study subjects. The X axis represents the PFI Rating and the Y axis represents the BMI Percentage.

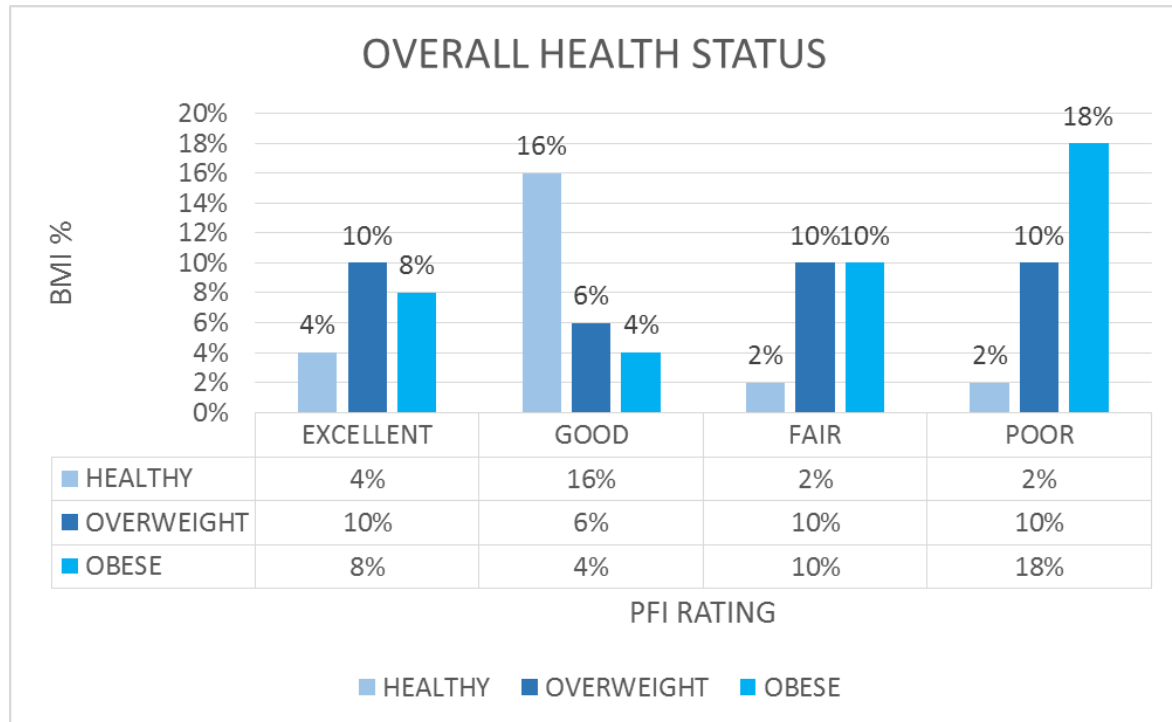


Table 2. Overall health status of study subjects

Excellent			
Total healthy	OW	OBESE	Total
2	5	4	11
4%	10%	8%	
Good			
Total healthy	OW	OBESE	Total
8	3	2	13
16%	6%	4%	
Fair			
Total healthy	OW	OBESE	Total
1	5	5	11
2%	10%	10%	
Poor			
Total healthy	OW	OBESE	Total
1	5	9	15
2%	10%	18%	

Table 3. Chi square test

	Excellent	Good	Fair	Poor	ROW totals
Healthy	2 (2.64) [0.16]	8(3.12) [7.63]	1(2.64) [1.02]	1 (3.60) [1.88]	12
Overweight	5 (3.96) [0.27]	3 (4.68) [0.60]	5(3.96) [0.27]	5 (5.40) [0.03]	18
OBESE	4 (4.40) [0.04]	2 (5.20) [1.97]	5(4.40) [0.08]	9 (6.00) [1.50]	20
Column totals	11	13	11	15	

Chi square: 15.4509, p: 0.017025

The chi square values show association between body mass index and physical fitness levels in physiotherapy students.

5. DISCUSSION

The present study evaluated the physical fitness of fifty physiotherapy students using Modified Harvard Step Method. It has four grades of physical fitness based on the scoring obtained after the exercise. This is determined to be a satisfactory method for assessing physical fitness of Indians. Many authors have demonstrated the utility of this method in Indian subjects. This method was adopted by Sunil KR Das, Samita Mahapatra, Goutam Bhattacharya, Debatri Mukherjee in the year 1993 at Laboratory of Human Performance Assessment, Department of Physiology, University Colleges of Science and Technology, Calcutta.

In the present study Fifty physiotherapy students with a mean age of 21 years and mean BMI of 27.944 were evaluated for physical fitness in this study. It is important for future physiotherapists to know their level of physical fitness and try to improve on it. Ganeriwal SK, Sen SL, Khandare "in the year 1968 performed the HST in Indian Students, 51 female medical college students in the age group of 17 to 25 years using a stepping height of 18 inches" Banerjee PK and Chatterjee S "in the year 1983 studied the effectiveness of the Harvard step test in assessing the physical fitness in 54 Indian adolescent boys".

The present study showed that physiotherapy students with some regular physical activity and participation in sports activities are having excellent physical fitness when compared to the students who don't regularly exercise. Twenty two percent of subjects had excellent physical fitness. Twenty six percent of the subjects had fair physical fitness. Twenty two percent of the subjects had fair physical fitness and thirty percent of the subjects had poor physical fitness. It was found that Forty eight percent of subjects participated in the study had grade 2' physical activity (like sports, athletics, gym, etc.) This study has clearly established that physical activity is an important factor and clairvoyant of physical fitness. Among subjects who had excellent physical fitness, pulse rate variability (pre and post exercise) was minimum and among subjects who had poor physical fitness index it was maximum. The present study is consistent with study by Hammond (1987) which

says that "endurance athletes have lower resting and exercise heart rates which may be in part relate to down regulation of cardiac B- adrenergic receptors secondary to repeated and prolonged episodes of sympathetic stimulation during exercise".

"Physical fitness was inversely related with BMI, physical activity, and cardiovascular variables. Physical fitness had a statistically significant inverse relation with BMI. The students who regularly exercise were under the category of excellent physical fitness. In the present study subjects of VAPMS College of Physiotherapy, who had regular physical activity had better physical fitness and two variables were inversely related" [47].

The above results states that this study rejects Null Hypothesis thereby accepting Alternate Hypothesis that there is significant association between BMI and PFI in a study of physical fitness index in Physiotherapy students by using Modified Harvard Step Test.

There were few challenges faced during the period of research period due to COVID-19 pandemic. The required sample size and the willingness of the students participation was a challenge.

Some students have been identified as more likely to be excluded from research as a result of the coronavirus pandemic. Some students who have been recovered from the coronavirus have participated in the study and the result of their physical fitness was poor. There was difficulty in collecting the anthropometric parameters in students in such situation and to avoid diurnal variation all the exercise data were collected during morning hours between 9 am to 12 pm.

All the precautionary measures were taken throughout. Further research is recommended for this study as it has being observational, physical fitness is limited and was assessed only once for every subject. Early exhaustion during the exercise test usually makes it difficult to assess fitness.

The 33 cm height of the step bench makes it difficult for the short stature subjects to step up and down while comparatively, it becomes easier for the taller subjects.

Using this test to assess in large groups will be time consuming.

The results of this study are limited to the Physiotherapy students of VAPMS College only. The recommendations for Physiotherapy students should be that they get encouraged to adopt a physically active lifestyle to maintain optimum fitness and health. The participation of students in sports activities at college should be made mandatory [48-52].

Being physically fit also ensures students being mentally fit, stress-free, energetic, and enthusiastic. It also helps in improving their professional growth [53-61].

6. CONCLUSION AND SUMMARY

Physical Fitness of Physiotherapy students at Visakha Academy of Paramedical Sciences College Of Physiotherapy, Madhurawada, Visakhapatnam is not satisfactory. This may be due to the sedentary lifestyle and lack of sporting activities and also over-emphasis on academic pursuits.

Regular physical activity is an important determinant of physical fitness. Overweight and Obesity decrease the physical fitness of individuals. Pulse rate variability is less among physically fit individuals during physical exercise [62-68].

An observational study was carried out in Visakha Academy of Paramedical Sciences, Madhurawada, Visakhapatnam to know the Physical Fitness Levels in Physiotherapy Students. All the students satisfying inclusion criteria and willing were included in the study. Fifty students participated in this study. Modified Harvard Step Test was used to assess the Physical Fitness Index. This is a validated method for Indian subjects and classifies the subjects into four groups of physical fitness based on the scores obtained. Heart rate recovery after the exercise using the Modified Harvard Step is used to calculate the scores.

Results were analyzed using Chi Square statistics. 22% of students had excellent physical fitness, 26% of students had good physical fitness, 22% of students had fair physical fitness and 30% of students had poor physical fitness.

Subjects with higher BMI had lower physical fitness. Not all the Obese students in the study were poor in their physical fitness. 8% of the obese students were in excellent category.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images'.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

- Masterchart

NAME	STATUS (BMI)	HEIGHT(cm)	WEIGHT(m2)	BMI	PULSE RATE(1 to 1.5 sec)	PFI SCORE	PFI RATING
1	H	161	62.85	24.2	57	95.69	EXCELLENT
2	H	155	58.7	24.4	60	90.9	GOOD
3	H	144	48.4	23.3	61	89.41	GOOD
4	H	165	56	20.6	69	79.05	FAIR
5	H	159	58.9	23.3	61	89.41	GOOD
6	H	155	44.85	18.7	73	74.71	POOR
7	H	160	58.9	23	62	87.97	GOOD
8	H	175	74.55	24.3	63	86.58	GOOD
9	H	156	44.85	18.4	61	89.41	GOOD
10	H	182	73.6	22.2	60	90.9	GOOD
11	H	158	59	23.5	59	92.44	GOOD
12	H	174	64.1	21.2	56	97.4	EXCELLENT
13	OW	154	60.3	25.4	59	92.44	EXCELLENT
14	OW	157	62.5	25.2	64	85.22	GOOD
15	OW	160	66.5	26	54	101.01	EXCELLENT
16	OW	160	69	27	62	87.97	GOOD
17	OW	158	80.5	32.2	59	92.44	EXCELLENT
18	OW	155	62.55	25.9	68	80.21	FAIR
19	OW	157	70.5	28.4	61	89.41	GOOD
20	OW	161	68	26.2	71	76	POOR
21	OW	154	71	29.9	72	75.75	POOR
22	OW	152	63	27.3	66	82.64	FAIR
23	OW	147	55	25.5	65	83	FAIR
24	OW	148	57	26	58	94.04	EXCELLENT
25	OW	160	68	26.6	74	73.71	POOR
26	OW	177	87	27.8	66	82.64	FAIR
27	OW	172	78	26.4	67	81.4	FAIR
28	OW	168	76	26.9	75	72.72	POOR
29	OW	178	88	27.8	57	95.69	EXCELLENT
30	OW	170	78	27	77	70.83	POOR
31	O	145	65.9	31.3	63	86.58	GOOD
32	O	165	87.25	32	56	97.4	EXCELLENT
33	O	150	62.05	24.2	62	87.97	GOOD
34	O	147	74.55	34.5	68	80.21	FAIR
35	O	174	92	30.4	78	69.93	POOR
36	O	157	77	31.2	69	79.05	FAIR
37	O	157	76	30.8	80	66.51	POOR
38	O	142	80	39.7	58	94.04	EXCELLENT
39	O	160	90	35.2	83	65.71	POOR
40	O	148	67	30.6	69	79.05	FAIR
41	O	176	101	32.5	82	66.51	POOR
42	O	180	107	33	84	64.9	POOR
43	O	183	104	31.3	86	63.42	POOR
44	O	186	110	31.8	59	92.44	EXCELLENT
45	O	178	105	33.1	67	81.4	FAIR
46	O	164	100	37.2	87	62.69	POOR
47	O	175	96	31.3	66	82.64	FAIR
48	O	178	99	31.2	59	92.44	EXCELLENT
49	O	175	93	30.4	89	61.2	POOR
50	O	186	107	30.9	90	60.6	POOR

- Pictures

1) Modified Harvard step test procedure performance by the female subject



2) Modified Harvard step test procedure performance by the male subject



3) Measurement of pulse rate in the female subject



4) Measurement of pulse rate in male subject



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