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Original Research Article

Physical and Cardiorespiratory fitness of undergraduate male medical students

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Abstract

Objectives: 1) Assessment of physical fitness, Cardio-respiratory fitness 2) To assess the chances of developing obesity in medical students 3) If their fitness is already affected, suggest interventions to improve it & to prevent further harm.
Methods: Present study was carried out in young apparently healthy 100 medical students (aged 18-22). We studied body mass index (BMI) and depending on it students were divided into 5 groups (Underweight, Normal, overweight, preobese and obese). Maximum aerobic power (VO_2 max- measured from Queen's College Step test), maximum anaerobic power (PAP- measured from vertical jump test), waist/hip ratio (W/H), trunk flexibility and mobility (assessed by modified sit & reach test), resting heart rate and blood pressure, skin fold thickness measured by varnier caliper and Peak expiratory flow rate (PEFR) were measured. Results were computed as mean and standard deviation. By applying one way ANOVA results were compared.
Results: Compared to normal group underweight group had significant low values of waist circumference, hip girth, skin fold thickness and PAP. Overweight, Preobese and obese group had higher values of skin fold thickness, W/H ratio, resting heart rate, blood pressure and PAP. Whereas VO_2 max was not significantly reduced probably due to smaller sample size of these groups compared to normal (50 % of total).
Conclusions: Medical students have sedentary lifestyle and incidence of obesity is increasing (present study 38/100). Modification of sedentary life style and increasing physical activity will improve cardiorespiratory fitness of the medical students. Students were advised to do the required changes in their day to day activities.
Keywords: Body mass index, Cardiorespiratory fitness, Trunk flexibility.

1. Introduction

Cardiovascular disease is coming forward as a major cause of morbidity and mortality worldwide. Poor cardiorespiratory fitness in young adults has been emerging as a major cause of developing cardiovascular morbidity later in life. Obesity is an additional factor for development of cardiovascular disease. A strong association between low cardiorespitory fitness and mortality has been shown by various clinical studies [1-3]. Fast developing technology and easy availability of modern day commodities has thrown major young population into a sedentary lifestyle. Urbanization has increased frequent consumption of fast food- high calorie foods (high fat with low fiber) along with sweetened beverages at fast food centers, nowadays located even at small towns. These eating habits have been brought forward as a symbol of prosperity and sophisticated lifestyle. This culture is growing very fast in developing countries as well. This is an additional factor for development of obesity in children and young adults [4,5]. Childhood obesity is seen more in low socio-economic strata than their counterparts in developed countries. The opposite situation is observed in developing countries, childhood obesity is found more in upper socio-economic strata than that in poor [6,7]. Students in private medical colleges are coming from a well to do families. They have access to all modern commodities like motor vehicles, smart phones. This has forced them to sedentary lifestyle. Along with this consumption of junk food is likely to affect their cardiorespiratory fitness and may have to face comorbidities of obesity in their later life. Along with the specializations further come the responsibilities. And above all MBBS students have to cope for high levels of stress due to load of studies and vigorous lecture and clinic series. This all requires a lot of mental as well as physical input from the doctor. So we wanted to study the fitness of the MBBS students for this regard. Simple tests like measurements of waist circumference (WC), hip girth and calculation of waist/hip ratio (W/H ratio) gives fair idea about abdominal obesity. Abdominal obesity has been found a good predictor of cardiovascular disease [8]. Measurement of

maximal oxygen uptake which is the highest rate of oxygen consumption attained during maximal exercise. Evaluation of cardiorespiratory fitness from VO2 max is accepted internationally [9].

2. Material and Methods

2.1: Selection of participants

One hundred male MBBS students (age group 18 – 22 years) apparently healthy, who ever will be volunteering to participate in this study, were selected to serve as subjects for this study. Exclusion criteria were students having history of cardiac disease, lung disease, smoking, not undergoing any physical conditioning programme. Written informed consent was taken from each of them. Approval from Institutional Ethics Committee (IEC) was taken before hand. All the selected subjects were from Krishna Institute of Medical Sciences, Karad (Maharashtra). They were explained about the experimental protocol to reduce anxiety and elicit active cooperation from them. All of them were called in the Department of Physiology, KIMS, Karad, where the facilities for conducting all the required tests were available. Initially data related to their Name, age, sex was noted. Their height and weight was measured using standard measuring devices and parameters.

2.2: Calculation of BMI

For assessing their physical fitness Body mass index (BMI) was calculated by formula [BMI] = Body weight in Kg/ (Height in meter)^2 [10]. Standing Height was measured in cms, to the nearest 0.1 cm and body weight to the nearest 0.1kg. Based on the studies of BMI the students were divided into five groups: Group I-Normal weight (BMI: 18.5-24.99), Group II- Underweight (MBI < 18.5), Group III-Overweight (BMI:25-29.99), Group IV-Preobese (BMI:30-34.99) and Obese (BMI ≥ 35). Waist to hip ratio (W/H ratio) was taken into consideration by measuring waist girth at naval and hip girth over the buttocks, where girth is largest [11].

2.3: Measurement of skin folds thickness

For assessing the obesity, along with the Body mass index (BMI) assessment Skin Fold thickness test (site – abdominal fat) was done using the Varnier caliper. A mark was made 5cm to right of umbilicus. The vertical pinch was made at the marked site, and the calipers were placed just below the pinch and measurement was taken.

2.4: Measurement of flexibility & mobility

For testing the flexibility and mobility modified sit and reach test [12] was done. In this test subject was sitting on the floor with the back and head against a wall, legs fully extended with the bottoms of the feet against the sit and reach box, hands on top of each other, stretching arms forward. The distance from the finger tips to the box edge (measured with yard stick) represented the starting point. Then subject slowly bent and reached forward as far as possible (moving head and back away from the wall, sliding the fingers along the yard stick holding this final position for 2 secs). Total distance reached to the nearest 0.1cm represented the final score. Peak anaerobic power output (PAP) was measured by Vertical jump test [12]. It was calculated by following equation.

PAP (wt) = 60.7 (VJ cm) + 45.3(BM kg) - 2055 [11]

2.5: Measurement of maximal aerobic capacity

For Cardio Respiratory fitness analysis, resting Heart rate and Blood pressure (after 15 minutes of rest) was measured. Queen's College Step test was used as an indirect method to assess the individual's maximal aerobic capacity (VO_2 max). Subjects were asked to perform 25 complete step-ups per minute, regulated by metronome at 100 beats/min. Each stepping cycle consisted of a four step cadence, "Up-Up-Down-Down". After the completion of stepping student remained standing, while pulse rate was measured for 15 secs, 5- 20 secs into recovery. Recovery heart rate was converted to beats/min (measured Heart rate for 15secs X 4). VO_2 max was calculated by formula.

VO2 max = 65.81 – [0.1847 x step test pulse rate (beats/min)] [11]

2.6: Measurement of PEFR

Peak expiratory flow rate (PEFR) was measured by computerized Spirometry (RMS, Chandigarh). Three readings were taken for each subject and best of them was selected as final one.

2.7 Statistical Methods

All the values of anthropometric, physical and cardio respiratory fitness were expressed as mean and standard deviation. Based on the division of the groups mentioned the analysis of variance followed by multiple comparison tests was performed to find out the significant difference in selected groups of anthropometric, physical and cardio respiratory fitness. A p value of <0.05 was considered statistically significant.

3. Results

Anthropometric measurements results of various groups are shown in table 1.

Table 1: Anthropometric measurements of various groups

Test	Group I Normal (n=50) Mean ± SD	Group II UW (n=12) Mean ± SD	Group III OW (n=10) Mean ± SD	Group IV PO (n=21) Mean ± SD	Group V Obese GI (n=7) Mean ± SD	P Value	F Value
Age(yrs)	20.16 ± 1.057	19.83 ± 0.71	20.6 ± 0.51	20.38 ± 0.32	20.14 ± 099	0.35^{ns}	1.121
Body wt.(kg)	66.18 ± 7.27	54.08 ± 5.12	74.6 ± 7.19	82.90 ± 7.27	95.71 ± 6.70	***<0.0001	60.77
Height (cms)	173.92 ± 6.29	177.5 ± 4.60	173.2 ± 8.09	174.80 ± 5.48	174.0 ± 4.69	0.41^{ns}	0.987

ns- no statistically significant difference, ***-p < 0.001

It is observed that there was no significant difference in age and height of subjects in various groups ($p > 0.05$). There was highly significant difference in body weight of various groups ($p < 0.0001$). Table 2 presents the descriptive statistics of different tests of physical and cardiorespiratory fitness for various groups.

Table 2: Values of various tests in different groups

Test	Group I Normal (n=50)	Group II UW (n=12)	Group III OW (n=10)	Group IV PO (n=21)	Group V Obese GI (n=7)	P Value	F Value
BMI	21.64 ± 1.54	17.15 ± 1.05	24.89 ± 0.27	27.09 ± 1.14	31.78±1.54	***<0.0001	197.61
Waist circumference (inches)	32.22 ±2.69	29.25±3.62	35.4±2.67	37.26±3.37	42.71±1.38	***<0.0001	35.537
Hip girth (inches)	36.82 ±3.23	32.41±2.99	39.7±2.94	41.14±2.81	45.28±1.11	<0.001**	29.214
W/H ratio	0.87 ± 0.04	0.88 ± 0.07	0.89 ± 0.07	0.90 ± 0.05	0.94 ± 0.32	0.0106*	3.484
Skin fold thickness Sit & reach test	19.6 ± 5.34	11.99 ± 4.20	25.11 ± 4.91	28.30 ± 7.51	31.98±7.22	***<0.0001	22.75
Sit & reach test	27.44 ± 7.53	24.41 ± 9.20	27.2 ± 9.10	27.66 ± 5.79	20.42±9.64	0.17 ns	1.614
PAP(wt)	3221.35±592.42	2782.5±501.47	3333.55±778.92	3517.74±637.21	4301.1±559.57	***<0.0001	7.721
Resting heart rate	73.72 ± 5.92	76.33 ± 7.12	75.2 ± 4.02	75.90 ± 4.44	80.57± 6.29	0.04*	2.615
Systolic B.P.	120.72 ± 7.15	119.33 ± 4.53	122.4 ± 4.19	125.23 ± 11.54	131 ± 11.64	0.01*	3.504
Diastolic B.P.	80.8 ± 5.98	77.83 ± 4.38	86.2 ± 8.29	84.57 ± 10.49	89.71 ± 9.69	0.002**	4.424
VO2 max	49.47 ± 2.06	50.41 ± 3.02	48.42 ± 1.66	49.17± 1.30	48.04 ± 1.98	0.07 ns	2.159
PEFR (L/s)	7.05 ± 1.71	6.46± 1.94	6.73 ± 1.78	8.30 ± 1.49	7.19 ± 1.50	0.02*	3.070

ns- no statistically significant difference, *- $p < 0.05$,**- $p < 0.01$,***-$p < 0.001$

There was highly significant difference in skin fold thickness ($p < 0.0001$) among Groups which is measure of adiposity and had linear correlation with BMI. There was no significant difference in results of sit & reach test and VO2 max in groups. There was highly significant difference in waist circumference and hip girth among groups ($p < 0.0001$).The W/H ratio also showed significant difference among groups ($p < 0.05$). There was highly significant difference in PAP value among groups ($p < 0.0001$).

Post- Hoc test also showed significant difference in values of various parameters compared to normal weight group. Group II (Underweight) had highly significant lower values of Hip girth compared to Group I ($p < 0.001$) and significant lower waist circumference and skin fold thickness ($p < 0.05$). PAP value was significantly low in Group II compared to normal ($p < 0.05$). Skin fold thickness was in lean category in 4 of this group and rest had values in ideal range. However values of remaining tests were low than normal group but the difference was not statistically significant ($p > 0.05$).

There was statistically significant difference in waist circumference of Group III (Overweight) compared to normal group ($p < 0.05$). All the students in this group had skin fold thickness in overweight range. The values of remaining tests were higher than normal group, but the difference was not statistically significant ($p > 0.05$). PAP value was more in this group compared to normal but not to statistically significant level.

Group IV (Preobese) showed highly significant difference in values of waist circumference, hip girth and skin fold thickness compared to normal group ($p < 0.001$). PEFR was also significantly reduced in this group ($p < 0.05$).W/H ratio, Systolic B.P. and Diastolic B.P. was higher but not statistically significant. All the students in this group had skin fold thickness in overweight range. PAP value was more in this group compared to normal but not to statistically significant level. Flexibility and mobility measured by sit & reach test was also low compared to normal but not to statistically significant level.

Group V(Obese grade I) had highly significant higher values of waist circumference, hip girth and skin fold thickness compared to normal group ($p < 0.001$).The values of W/H ratio, resting heart rate, systolic B.P. and diastolic B.P. were higher this group and the difference was statistically significant ($p < 0.05$). PAP was significantly more in this group compared to normal ($p < 0.0001$). Flexibility and mobility test values were low but not to statistically significant level.

4. Discussion

In this study cardiorespiratory fitness along with flexibility and mobility of trunk of medical students was tested by applying various tests like measurement of BMI, W/H ratio, VO2 max, Peak anaerobic power, Resting heart rate, Blood pressure and PEFR. Out of total 100 students 50 (Half) were having BMI within normal range. Out of remaining half 12 were underweight, 10 overweight, 21 preobese and 7 obese.VO2 max measurement is one of the indices of one's cardiorespiratory fitness. Higher is the value of this parameter there is proportionate reduction in risk factors related to cardiovascular disease [11]. Direct measurement of VO2 max requires well equipped laboratory and is time consuming. Indirect method like Queens College step test can fairly measure maximal aerobic power of an individual so VO2 max was indirectly calculated by this method. In our study we did not find significant difference in this parameter in groups compared to normal. Obese

individuals had lower values compared to normal, but the difference was not statistically significant. The reason might me small group samples compared to normal (50 % of total).Earlier studies have recorded reduced value of VO2 max in obese individuals [13,14]. As there was deviation from normal towards obesity (measured by BMI) the values of waist circumference, hip girth, W/H ratio and skin fold thickness were found to be increasing. Underweight group had lower values of all these parameters compared to normal as expected. Obese students had reduced flexibility and mobility than normal measured by modified sit and reach test. Anaerobic power output calculated from vertical jump test had negative correlation with BMI. The reason for increase in anaerobic work output of the obese group might be due to more excess fat [15]. PEFR which depends on muscle strength had more value in obese compared to normal but not to significant level. Preobese had significant low value compared to normal. There is increased sympathetic nerve discharge than normal in overweight individuals. This might be the reason of higher values of resting heart rate and blood pressure that were recorded in our study. Obesity results in a situation of chronic volume overload. There is increased pre-load and stroke volume. This results in hypertension and greater likelihood of cardiac failure. Similar findings were observed in earlier studies [13]. There is increased burden of excess body fat on cardiac function particularly during heavy exercise. Weight reduction programmes in obese can increase their VO2 max. This is due to removal of fat induced inhibitory action on oxygen utilization by body muscles [13]. So obesity has adverse action on cardiorespiratory fitness. So by modification of sedentary life style and increasing physical activity can reduce the morbidity and mortality related with obesity. Students were advised accordingly. A study involving large sample may throw more light on this topic.

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