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Occupation, Physical Fitness and Adiposity Markers among Security Guards and Students of Delhi University

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Abstract

Physical fitness and health are reciprocal to each other and examining adiposity is an important parameter to assess physical fitness. The present study examines the relationship between different adiposity markers and physical fitness based on occupation. A cross sectional sample of 82 security guards (mean age: 36.86 ± 8.72) and 43 students (mean age: 23.4 ± 3.86) of Delhi University were studied. Anthropometric measurements (height, body weight, waist and hip circumference) and socio-demographic characteristics were ascertained. Body composition parameters (body fat percentage, fat mass, fat free mass, muscle mass, total body water, bone mass and visceral fat) were assessed by bioelectric-impedance method using Tanita Body Composition Analyzer (BCA). Harvard step test was performed to test the physical fitness using Rapid Fitness Index. Student's t test was used to compare the physical fitness and adiposity markers between the security guards and the students. ANOVA was used to categorize the level of physical fitness with adiposity markers amongst the two groups. As RFI scores decreased, mean value of body weight, waist circumference, hip circumference, MUAC, fat mass, visceral fat and BMI increased among the security guards showing a trend which indicates that with an increase in adiposity, the tendency to perform physical work decreases. However, no consistent trend as such was observed amongst the students between the RFI categories. Nevertheless, Delhi University students were found to be more physically fit than the security guards that may be attributable to the differences in their leisure time physical activity preferences and occupational workloads besides the underlying genetic, metabolic or dietary influences. Workplace interventions to reduce occupational sitting among the university security guards may boost cardiorespiratory fitness in the long run.

Keywords

Adiposity Markers, RFI, Physical Fitness, Security Guards, Occupation

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1. Introduction

Physical fitness affects many dimensions of health and it can be defined as the ability of an individual to carry out routine tasks with strength and vigilance, without any fatigue and with sufficient energy to enjoy leisure time pursuits, also to meet unpredicted emergencies [1]. In contemporary society, the intensity and the pattern of physical activity are changing. In developed societies, the requirement for hard physical work has been waned. While for developing societies the changes are not very clear [2]. In ancient time, people were mainly dependent on their physical fitness which includes speed, strength and endurance for their survival [3]. There has been a distinguishable increase over the last four decades in the prevalence of obesity and decline in physical fitness in adults across all ages, genders and ethnic group [4].

Degraded physical fitness is causing negative effects on the individual as well as on the society. It can cause many risk factors including hypertension, coronary heart disease, stroke, respiratory problems to health and is associated with increased mortality causes [5]. On the other hand, regular physical activity limits or prevents weight gain and maintains Body Mass Index (BMI) [6]. It not only shows that people tend to become more active with increasing fitness and that the fittest individuals tend to be the most active, but it also specifies that fitness is related to health in a reciprocal manner. That is, fitness influences health, and health status also influences both habitual physical activity level and fitness level. Other factors are also associated with individual differences in health status. Likewise, the level of fitness is not determined entirely by an individual's level of habitual physical activity. Others like lifestyle behaviors, physical and social environmental conditions, personal attributes, and genetic characteristics also affect the major components of the basic model and determine their interrelationships [7].

Obesity is recognized as a major health problem. The WHO refers obesity as a global epidemic because of rapid increase in the number of overweight and obese individuals in the last 20 years [8]. Maintenance of an acceptable body weight is therefore an important aspect of a healthy lifestyle. The rise in obesity may be attributed to many factors, out of which physical activity is one. Increase in fat mass is associated with the decreased exercise performance in overweight children and adolescents [9]. Every individual has a different level for physical fitness, which may vary with age, gender, situation, time and place of work. Examining adiposity is one of the important parameters to assess the physical fitness of an individual. Changes in lifestyle, physical activity, diet and epigenetic mechanisms have indirect associations with prolonged positive energy imbalance. These are also associated with decrease in total energy expenditure due to decline in spontaneous but not voluntary physical activity and psycho-social stress. Consequently all these have led to significant upward trends of obesity [10]. The negative impact of obesity on physical fitness has been documented; however this issue has not been explored occupationally. The purpose of this study was to examine the relationship between different adiposity markers and physical fitness based on occupation.

2. Material and Methods

One hundred twenty five subjects from University of Delhi were selected for the present study. Out of 125, 82 were security guards working in the University of Delhi and 43 were students studying in the same university. All the subjects were from diverse ethnic milieu staying in Delhi. The security guards were from low to middle income families and most of them were educated up to intermediate. Their waking and sleeping hours couldn't be ascertained as some had their duty in the morning while some at night for eight hours each. However, their sleeping hours ranged between 6 - 7 hours. They had three meals a day and were mostly non-vegetarian. Most of them remain seated for a longer period of time, *i.e.*, 7 - 8 hours as compared to standing during working hours. They commuted to their workplace mostly by metro while some by bus, bicycle and two-wheeler. They spent around an hour/day watching television. Few of them were irregularly or regularly engaged in leisure-time physical activity like walking and yoga. On the other hand, the students were from middle to high income families and most of them were in post-graduation. They usually woke up around 7 - 8 am, slept around 11:30 pm-12:30 am and had sleeping hours ranging between 7 hrs 30 mins to 8 hrs 30 mins. They also had three meals a day and were mostly non-vegetarians. Since most of them stayed in the vicinity of the university campus, they walked to their respective colleges/departments; few commuted by metro, auto rickshaw and bus. They usually sat for 40 - 45 mins. in a lecture/class followed by frequent breaks in between different lectures. They mostly spent their time watching movies and playing games in their laptops rather than watching TV. Most of them were regularly engaged in leisure-time physical activity like walking, running and gyming.

All the tests were conducted in the Physiological Anthropology Laboratory, University of Delhi after explaining the procedure involved to each subject after explaining the purpose of the study, written consent was taken from each subject. Socio demographic information was collected from all the participants using structured self-administered proforma. Anthropometric measurements including height, weight, waist and hip circumference were obtained using standardized procedures and various indices of obesity were calculated. All measurements taken were conducted by trained personnel and all the instruments used were calibrated regularly. The protocol of the study was reviewed and approved by the ethical committee of the Department of Anthropology, University of Delhi, Delhi, India. Body composition parameters were assessed by bioelectric-impedance method through Tanita Body Composition Analyzer (BCA). Body fat percentage, fat mass, fat free mass, muscle mass, total body water, bone mass and visceral fat were measured. Bioelectric-impedance method in BCA along with a display unit with analog circuit provides signal to microprocessor. This microprocessor calculates the body impedance as a function of the ratio of body network voltage and reference network voltage signals, which provide tremendously accurate results [11] [12].

To test the cardiovascular fitness, step test was used. Brouha and his colleagues introduced the Harvard step test in 1943 for the first time [13]. This test is used to measure the physical fitness for the muscular work and to check the ability for cardiovascular recovery based on the notion that increase in heart rate will be lesser if an individual's cardiovascular fitness is high and the heart rate will return to normal post exercise faster as compared to an individual who have a low cardiovascular fitness. This is called pulse recovery rate [14].

In this test, subject was asked to step up onto a 20 inch bench in case of men and on a 16 inch bench in case of women and back down from the step at a rate of 30 steps per minute (one second up, one second down) for 5 minutes or until exhaustion. Exhaustion in this case is defined as when the subject cannot maintain the stepping rate for 15 continuous seconds. The subject was immediately made to sit down on completion of the test, and the total number of his pulse rate was taken 1 to 1 min 30 secs post exercise. Rapid fitness index was calculated by using the following formula:

RFI = (Duration of exercise [sec] × 100)/(5.5 × Pulse rate for 30 seconds [1 to 1 min 30 secs]).

The fitness of the subjects were rated using the following chart (**Chart 1**).

Chart 1. Fitness of the subjects.

Rating	Rapid fitness index
Excellent	>96
Good	83 - 96
Average	68 - 82
Below average or poor	<68

Fox *et al*., 1973.

Statistical Analysis: The results are expressed as mean ± Standard Deviation (SD). A p value of <0.05 was considered statistically significant. The Statistical Package for the Social Sciences (SPSS version 17.0) was used to analyze the data. Student's t test was used to compare the physical fitness and adiposity markers between the security guards and the students. ANOVA was used to categorize the level of physical fitness with adiposity measures based on occupation.

3. Result

The height (cm) and body weight (kg) of the security guards were 165.0 ± 9.35 and 67.8 ± 14.66 (mean ± SD), and those of the students were 161.8 ± 7.75 and 60.2 ± 12.56 (mean ± SD), respectively. Mean age of the security guards was 36.86 ± 8.72 and that of the students was 23.4 ± 3.86. All results are represented in **Tables 1-3**.

Table 1 shows the comparison of physical fitness, body composition and anthropometric variables among security guards and students using t-test. Security guards had higher mean values than the students in all the variables studied except body fat percentage and RFI. Significant differences were found in weight, waist circumference, fat free mass, muscle mass, total body water, bone mass, visceral fat and BMI between the two groups. Mean body mass index of security guards and students came under overweight and normal category respectively. However, mean RFI scores of both the security guards and students revealed good physical fitness level.

Table 1. Comparison of physical fitness, anthropometric and body composition variables between security guards and students.

Variables	Mean ± SD		t-test
	Security guards	Students	
Age (years)	36.86 ± 8.72	23.4 ± 3.86	9.625***
Stature (cm)	165.0 ± 9.35	161.8 ± 7.75	1.907
Weight (kg)	67.8 ± 14.66	60.2 ± 12.56	2.864**
Waist circumference (cm)	83.5 ± 11.42	74.4 ± 9.37	4.499***
Hip circumference (cm)	95.5 ± 8.46	94.8 ± 7.53	0.430
MUAC (cm)	26.6 ± 4.02	25.6 ± 4.04	1.284
Fat mass (kg)	18.3 ± 9.19	16.6 ± 7.16	1.015
Fat %	25.8 ± 9.77	26.8 ± 7.62	0.577
FFM (kg)	50.3 ± 10.00	44.4 ± 8.87	3.162**
Muscle mass (kg)	47.7 ± 9.48	42.0 ± 8.46	3.210**
TBW	34.9 ± 7.66	30.4 ± 6.04	3.247**
Bone mass	2.6 ± 0.65	2.4 ± 0.44	2.477*
Visceral fat	9.1 ± 4.54	5.8 ± 3.38	4.023***
BMI (kg/m^2)	25.1 ± 4.94	23.3 ± 3.88	2.050*
RFI	82.9 ± 33.08	89.4 ± 26.9	1.069

MUAC = Mid-Upper Arm Circumference; FFM = Fat Free Mass; TBW = Total Body Water; BMI = Body Mass Index; RFI = Physical Fitness Index. *p < 0.05, **p < 0.01, ***p < 0.001.

Table 2. Distribution of subjects according to RFI score categories.

RFI category	Security guards		Students		Total
	No.	%	No.	%	
Excellent	26	31.7	13	30.2	39 (31.2%)
Good	10	12.2	10	23.2	20 (16.0%)
Average	13	15.8	11	25.6	24 (19.2%)
Poor	19	23.2	6	14.0	25 (20.0%)
Not performed	14	17.1	03	7.0	17 (13.6%)

Table 2 presents the percentage of security guards and students under different RFI score categories. 31.7% security guards and 30.2% students showed excellent rapid fitness index. Only 12.2% and 15.8% of security guards showed good and average RFI scores respectively whereas 23.2% and 25.6% of students showed good and average RFI scores. Higher percentage of security guards (23.2%) showed poor RFI scores when compared with students (14%). 17% security guards and 7% students did not perform the step test.

Table 3 presents the anthropometric and body composition variables of security guards and students according to RFI categories using ANOVA test. Among the security guards, mean value of all the variables increase from excellent to poor RFI scores except FFM, muscle mass, TBW and bone mass. Hip circumference ($p < 0.05$), fat mass ($p < 0.01$), fat % ($p < 0.01$) and BMI ($p < 0.05$) showed significant differences. On the other hand, among students, no consistent trend was observed in the mean value of all the variables between RFI categories. But mean value of all the variables except FFM, muscle mass, total body water and bone mass in excellent category of RFI was less as compared to the poor RFI category. Fat % ($p < 0.05$) showed significant difference.

Table 3. Anthropometric and body composition variables of security guards and students according to RFI score categories.

Variables	Security Guards					Students				
	RFI				F value	RFI				F value
	Excellent	Good	Average	Poor		Excellent	Good	Average	Poor	
Weight (kg)	63.7 ± 9.31	65.8 ± 10.01	70.6 ± 13.84	72.1 ± 20.87	1.496	61.8 ± 11.76	56.9 ± 11.78	58.9 ± 12.36	62.8 ± 15.06	0.427
Waist circumference (cm)	81.6 ± 9.12	82.6 ± 8.5	83.1 ± 10.07	85.9 ± 15.2	0.543	74.2 ± 9.23	72.8 ± 8.34	74.2 ± 10.07	77.4 ± 9.54	0.299
Hip circumference (cm)	92.2 ± 7.2	92.3 ± 5.54	94.9 ± 7.88	99.9 ± 9.38	4.076*	95.6 ± 6.39	93.0 ± 5.44	93.9 ± 9.41	97.4 ± 7.47	0.560
MUAC (cm)	25.7 ± 3.97	26.1 ± 2.88	27.1 ± 3.77	27.9 ± 4.45	0.993	26.3 ± 3.28	23.9 ± 5.49	26.0 ± 2.67	27.7 ± 4.85	0.983
Fat mass (kg)	14.5 ± 6.97	16.6 ± 7.16	16.4 ± 7.81	24.5 ± 10.93	5.255**	17.1 ± 3.89	12.5 ± 4.27	15.9 ± 8.73	20.9 ± 6.90	2.471
Fat %	21.6 ± 8.33	24.5 ± 8.33	22.7 ± 8.81	32.4 ± 9.56	5.864**	27.4 ± 5.19	21.5 ± 6.27	26.8 ± 8.56	31.6 ± 6.83	3.078*
FFM (kg)	49.8 ± 6.13	49.5 ± 6.63	54.2 ± 10.30	48.9 ± 13.63	0.893	45.9 ± 10.47	45.8 ± 8.48	41.6 ± 6.74	44.6 ± 10.72	0.491
Muscle mass (kg)	47.6 ± 5.76	46.8 ± 6.34	51.4 ± 9.81	46.3 ± 12.99	0.906	43.3 ± 10.04	43.4 ± 8.08	39.4 ± 6.39	42.2 ± 10.25	0.482
TBW	33.2 ± 5.73	34.1 ± 4.30	37.4 ± 7.25	36.01 ± 10.42	1.123	31.3 ± 7.11	30.6 ± 5.36	28.6 ± 4.86	31.3 ± 7.66	0.410
Bone mass	2.6 ± 0.29	2.6 ± 0.33	2.8 ± 0.49	2.7 ± 1.17	0.835	2.4 ± 0.51	2.4 ± 0.41	2.2 ± 0.38	2.4 ± 0.49	0.472
Visceral fat	8.4 ± 3.87	8.5 ± 3.10	9.2 ± 4.67	10.6 ± 5.88	0.880	6.4 ± 3.50	5.0 ± 3.59	5.2 ± 2.97	6.6 ± 3.38	0.531
BMI (kg/m^2)	23.2 ± 3.59	24.4 ± 3.21	25.5 ± 4.30	27.7 ± 6.42	3.413*	23.5 ± 281	21.4 ± 2.29	22.9 ± 4.71	25.8 ± 3.97	2.064

MUAC = Mid-upper arm circumference; FFM = Fat free mass; TBW = total body water; BMI = Body mass index; RFI = Physical Fitness Index. *$p < 0.05$, **$p < 0.01$.

4. Discussion

Physical fitness is an important marker of health status in youth, thereby pointing towards the need of a meaningful physical fitness assessment in young people [15]. It is divided into three main categories: static (absence of disease), dynamic (ability to perform strenuous work) and motor skills fitness. Step test measures the dynamic fitness [16]. In the present study, step test was used to assess the physical fitness of the subjects which has been proven to be a suitable method for assessing the physical fitness of Indians [17]-[19]. Body composition, *i.e.*, lean body mass to fat ratio, is one of the best morphological characteristics to measure physical fitness of an individual due to its close proximity to functional indicators.

Since university security guards were significantly older than the student age wise, they had higher mean values in almost all the anthropometric and adiposity variables. Anthropometric measures reflect the nutritional status which may affect the fitness pattern, however no significant difference was observed between the two groups. Energy store and protein mass of the body between the security guards and the students were similar as there was no significant difference in the mean Mid-Upper Arm Circumference (MUAC) between the two groups [20]. Mean BMI of the security guards came under overweight category while that of the students were under normal weight category. However, both the groups had good mean physical fitness index. Similarly, [21] have found that overweight and non-overweight subjects had similar physical fitness but the capability to perform exhausting work was less in overweight subjects. Comparatively the students were found to be more physically fit than the security guards according to the prevalence of higher proportion of the former group in good RFI category than the latter.

As RFI scores decreased, body weight, waist circumference, hip circumference, MUAC, fat mass, visceral fat and BMI increased among the security guards showing a trend. This trend clearly indicates that with an increase in adiposity, the tendency to perform physical work decreases. This is because of the fact that overweight adult's energy demand increased as compared to their non overweight counterparts to move their excess body weight. For any given level of BMI between 18 and 35 kg/m^2, adults who have higher level of cardiorespiratory fitness have a lower waist circumference and lower levels of visceral fat than those having lower level of cardiorespiratory fitness [22]. A significant difference in hip circumference, fat mass, fat % and BMI amongst the four RFI

categories of security guards was seen which could be a prognosticator of stronger impact of these adiposity variables in effecting the RFI scores of the security guards in particular. Peter *et al*. [23] found that there is a significant negative correlation between physical fitness levels and % body fat for males which is congruent with our findings.

Physical fitness decreased progressively as BMI increased. Security guards having normal mean values of BMI had excellent and good RFI scores while those who were overweight had average and poor RFI scores. In case of students, normal BMI individuals had excellent, good and average RFI scores while overweight individuals had poor RFI scores as can be seen in studies done by Welsh *et al*. [24], Ozcelick *et al*. [25], Anabel *et al*. [26] and Sameer [27]. This trend revealed that physical fitness is relatively poor among the university security guards and students who were overweight. Greater the BMI, greater the functional impairment thus the excessive amount of fat on cardiorespiratory functions increases the oxygen uptake by the working muscles [28]. Since overweight and obesity are the precursors of metabolic syndrome or chronic diseases like hypertension, type II diabetes, coronary heart disease, etc., health related fitness programs should be made aware. Most individuals can prevent falling into the low physical fitness category by engaging in regular physical activity, such as brisk walking for 30 min ≥5 days per week [29]. Low physical fitness may be the potential indicator of low muscle mass as can be seen among the University security guards and students having poor RFI scores [30]. Greater physical fitness also lead to increased body muscle mass [31]. All the anthropometric and body composition parameters fluctuated amongst the four RFI categories of the university students but significant difference could be seen only in fat%. This observation may be attributable to difference in physical activity preferences or relatively small sample size of the university students, which made generalization of the results difficult. Further investigation incorporating larger cohort is required.

5. Conclusion

Delhi University students were found to be more physically fit than the security guards. It may be attributable to the differences in their leisure time physical activity preferences and occupational workloads besides the underlying genetic, metabolic or dietary influences, as security guards were found to be more sedentary with lower levels of leisure time physical activity than the students who had higher levels of leisure time physical activity. The study also revealed that excess fat impairs the physical fitness of an individual. BMI and physical fitness were found to be inversely associated with each other. Workplace interventions to reduce occupational sitting among the university security guards appear to be the prime mandate with respect to cardiorespiratory fitness and its related health consequences.

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References

[1] Caspersen, C.J., Powell, K.E. and Christenson, G.M. (1985) Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for Health-Related Research. *Public Health Reports,* **100**, 126.

[2] World Health Report (1968) Exercise Test in Relation to Cardiovascular Function. World Health Organization, Geneva.

[3] Gill, M., Deol, N.S. and Kaur, R. (2010) Comparative Study of Physical Fitness Components of Rural and Urban Female Students of Punjabi University, Patiala. *Anthropologist*, **12**, 17-21.

[4] Ichinohe, M., Mita, R. and Saito, K. (2004) Physical Activity, Fitness and Health: Obesity and Lifestyle in Jamaica. *International Collaboration in Community Health*, **1267**, 39-50.

[5] Cataldo, C. (1999) Nutrition and Diet Therapy: Principles and Practice. West Publishing Company, St. Paul, 232-238.

[6] Kyle, U.G., Gremion, G., Genton, L., Slosman, D.O., Golay, A. and Pichard, C. (2001) Physical Activity and Fat Free and Fat Mass as Measured by Bioelectrical Impedence in 3853 Adults. *Medicine & Science in Sports & Exercise*, **33**, 576-584. http://dx.doi.org/10.1097/00005768-200104000-00011

[7] Bouchard, C., Blair, S.N. and Haskell, W. (2006) Physical Activity and Health. Human Kinetics.

[8] Shah, C., Diwan, J., Rao, P., Bhabhor, M., Gokhle, P. and Mehta, H. (2008) Assessment of Obesity in School Children.

Calicat Medical Journal, **6**, e2.

[9] Drinkard, B., McDuffie, J., McCann, S., Uwaifo, G.I., Nicholson, J. and Yanovski, J.A. (2001) Relationships between Walk/Run Performance and Cardiorespiratory Fitness in Adolescents Who Are Overweight. *Physical Therapy*, **81**, 1889-1896.

[10] Kapoor, S., *et al*. (2013) Development of Obesity over Four Decades among North Indian Females. *Eurasian Journal of Anthropology*, **4**, 16-22.

[11] Gallup, D.A., Mercola, J.M. and Shaw, W.E. (1994) Body Composition Analyzer. U.S. Patent No. 5,372,141.

[12] Kelly, K.A. (1990) Body Composition Analyzer. U.S. Patent No. 4,947,862.

[13] Brouha, L. (1943) The Step Test: A Simple Method for Measuring Physical Fitness for Muscular Work in Young Men. *Research Quarterly*, **14**, 31-36.

[14] Srivastava, S., Dhar, U. and Malhotra, V. (2013) Correlation between Physical Fitness and Body Mass Index. *IJCRR*, **5**, 44-48.

[15] Ruiz, J.R., Castro-Piñero, J., Artero, E.G., *et al*. (2009) Predictive Validity of Health-Related Fitness in Youth: A Systematic Review. *British Journal of Sports Medicine*, **43**, 909-923. http://dx.doi.org/10.1136/bjsm.2008.056499

[16] Sengupta, P. (2013) The Laboratory Rat: Relating Its Age with Humans. *International Journal of Preventive Medicine*, **4**, 624-630.

[17] Ganeriwal, S.K., Sen, S.C. and Khandare, S.S. (1968) Test of Physical Fitness (Harvard Step Test) in Indian Female. *Indian Journal of Medical Research*, **56**, 845-849.

[18] Chatterjee, S. and Banerajee, P.K. (1983) Harvard Step Test as a Measure of Physical Fitness in Adolescent Boys. *Indian Journal of Medical Research*, **79**, 413-417.

[19] Das, S.K. and Mahapatra, S. (1993) Determination of Physical Fitness Index (PFI) with Modified Harvard Step Test in Young Men and Women. *Indian Journal of Physiology and Allied Sciences*, **47**, 73-75.

[20] Chandra, A.K., Goswami, H. and Sengupta, P. (2012) Dietary Calcium Induced Cytological and Biochemical Changes in Thyroid. *Environmental Toxicology and Pharmacology*, **34**, 454-465. http://dx.doi.org/10.1016/j.etap.2012.06.003

[21] Patkar, K.U. and Joshi, A.S. (2011) Comparison of VO2max in Obese and Non-Obese Young Indian Population. *Indian Journal of Physiology and Pharmacology*, **55**, 188-192.

[22] Janssen, I., Katzmarzyk, P.T., Ross, R., Leon, A.S., Skinner, J.S., Rao, D.C., Wilmore, J.H., Rankinen, T. and Bouchard, C. (2004) Fitness Alters the Associations of BMI and Waist Circumference with Total and Abdominal Fat. *Obesity Research*, **12**, 525-537. http://dx.doi.org/10.1038/oby.2004.60

[23] Pribis, P., Carol, A., Burtnack, S., McKenzie, O. and Thayer, J. (2010) Trends in Body Fat, Body Mass Index and Physical Fitness among Male and Female College Students. *Nutrients*, **2**, 1075-1085. http://dx.doi.org/10.3390/nu2101075

[24] Welsh, B.E., Rieneau, R.P., Crisp, C.E. and Isenstein, R.S. (1958) Relationship of Maximal Oxygen Consumption to Various Components of Body Composition. *Journal of Applied Physiology*, **12**, 395-398.

[25] Ozcelick, O., Aslan, M., Ayar, A. and Kelestimur, H. (2004) Effects of Body Mass Index on Maximal Work Production Capacity and Aerobic Fitness during Incremental Exercise. *Physiological Research*, **53**, 165-170.

[26] Anabel, N.R., Anselmo, J.P., Luciana, C. and Nazare, S.B. (2007) The Association between Cardio-Respiratory Fitness and Cardiovascular Risk in Adolescent. *Jornal de Pediatria*, **83**, 1-12.

[27] Sameer, S. (2013) Correlation between Physical Fitness and Body Mass Index. *International Journal of Current Research and Review*, **5**, 44-48.

[28] Setty, P., Padmanabha, B. and Doddamani, B. (2013) Correlation between Obesity and Cardio Respiratory Fitness. *International Journal of Medical Science and Public Health*, **2**, 300-304. http://dx.doi.org/10.5455/ijmsph.2013.2.298-302

[29] Haskell, W.L., Lee, I.M., Pate, R.R., Powell, K.E., Blair, S.N., Franklin, B.A., Macera, C.A., Heath, G.W., Thompson, P.D. and Bauman, A. (2007) Physical Activity and Public Health, Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise*, **39**, 1423-1434. http://dx.doi.org/10.1249/mss.0b013e3180616b27

[30] Kim, T.N., Park, M.S., Kim, Y.J., Lee, E.J., Kim, M.K., Kim, J.M., Ko, K.S., Rhee, B.D. and Won, J.C. (2014) Association of Low Muscle Mass and Combined Low Muscle Mass and Visceral Obesity with Low Cardiorespiratory Fitness. *PLoS ONE*, **9**, e100118. http://dx.doi.org/10.1371/journal.pone.0100118

[31] Jaafari, L. (2012) Health-Related Anthropometric Measures in Connection with Physical Fitness Factors. *International Proceedings of Economics Development and Research*, **31**, 21.

Abbreviations

BMI = Body Mass Index;
RFI = Rapid Fitness Index;
FM = Fat Mass;
FFM = Fat Free Mass;
MUAC = Mid Upper Arm Circumference;
TBW = Total Body Water.