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ANTHROPOMETRIC INDICES AND RESTING CARDIOVASCULAR PARAMETERS AS CORRELATES OF PHYSICAL FITNESS INDEX AMONG OVERWEIGHT UNDERGRADUATES OF A NIGERIAN UNIVERSITY

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ABSTRACT

Body anthropometry, resting cardiovascular parameters and physical fitness index are all inter-related to health, and their interrelationship has been documented but with little information among overweight individual especially undergraduates. The purpose of this study was to evaluate relationship among anthropometric indices, resting cardiovascular parameters and physical fitness index among undergraduates of university of Nigeria Enugu campus. The research involved a study of overweight students of University of Nigeria. Their body Anthropometry viz: weight, height, body mass index, fat mass, fat mass index, lean body mass, fat free mass index, waist circumference, hip circumference, waist hip ratio and conicty index were measured. Their cardiovascular parameter viz: heart rate, systolic and diastolic blood pressure, mean arterial pressure, pulse pressure and rate pressure product were also determined. Their physical fitness index was also determined using Harvard step test. The results showed a significant ($p < 0.05$) negative correlation between weight, percentage body fat, fat mass, fat mass index, hip circumference, heart rate and rate pressure product and physical fitness index, it also showed a significant ($p < 0.05$) positive correlation between

height, lean body mass, fat free mass index, waist hip ratio, and fat free mass index and physical fitness index. The result also showed non significant (p> 0.05) correlation between body mass index, waist circumference, conicity index, systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure and physical fitness index. The result of stepwise multiple regression showed that sex and rate pressure product (heart rate x systolic blood pressure)were significant predictor of physical fitness index. Sex had a coefficient of determinant (R^2) = 0.364 and when rate pressure product was added to the model, it increased to 0.414. It is concluded that, sex and rate pressure product are the two main factors determining physical fitness index.
Key words: Anthropometric Indices, Overweight, Cardiovascular Parameters, Physical Fitness

INTRODUCTION

Any bodily movement generated by Skeletal muscles the leads to energy expenditure is known as physical activity (PA) (Ying *et al.*, 2017). Physical activities in adults that are regular and adequate are essential for energy balance and weight control through energy expenditure (WHO, 2016). Importance of Physical activity for weight control has been reported by (Sarma et al., 2014). According to the 2010 WHO guidelines, 18 to 64years adults should perform a total physical activity level of at least 600 metabolic equivalent-minutes per week (MET-minutes/week) or 10MET -hours/week which is about 150min/week of moderate-intensity aerobic physical activity, or 75min/week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-and vigorous-intensity physical activity (WHO, 2010). 60min of moderate to vigorous intensity physical activity every day in a week is relatively needed to prevent and control unhealthy weight gain in adulthood (Haskell et al., 2007).

In the recent decade, a decline in physical activity among undergraduates has been observed (Sacheck, Kuder and Economos, 2010), thus an alarming decline in physical fitness among them. Also, based on self-reported height and weight, most of these undergraduates are either overweight or obese (Lowry, et al., 2008).Various factors like physical inactivity, alcohol intake, unhealthy dietary habits, socioeconomic conditions and genetic factors have been linked to cause overweight and obesity(Chan and Woo,2010), also changes in individual lifestyle behaviors, such as increased sedentary behavior associated with rapid urbanization, may lead to an increasing prevalence of overweight and obesity. Over weight and obesity result from an energy surplus over time that is stored in the body as fat. The correlation between overweight and obesity to genetic and environmental factors is not well understood (Ogunlade and Asafa, 2015). "Globesity", the global epidemic of overweight and obesity is the major public health problem in developed and developing world. Ogunlade and Asafain (2015) conducted a recent study among Nigerians who are young adults showed that more than one in every eight young adults were either overweight or obese.

Various non-communicable diseases such as cardiovascular disease type II diabetes mellitus, hypertension, dyslipidemia and certain types of cancer have been discovered from numerous studies to be related to overweight/obesity, which can further enhance the burden of diseases and the mortality rate (Brown et al.2009; Guhetal.,2009). The second risk factor for type 2 diabetes mellitus is overweight (Tuppad and

Jangam, 2014). In the last three decades, the number of overweight and obese people globally increased almost three folds (from 857million in 1980 to 2.1billion in 2013), with proportion of females out weighing males (Ng et al., 2014). In addition, World Health Organization (WHO) reported in 2014 that worldwide, adults aged 18 years and older who were overweight and obese were 39% and 13%, respectively. High-income countries were considered to be the only ones affected by overweight and obesity but developing countries predominantly urban dwellers have increased in the prevalence of overweight and obese people tremendously (WHO, 2016). This is due to reduced physical activity following rapid urbanization and modernization coupled with social, economic and nutritional transitions in these countries.

Height and body surface area (BSA) usually play a significant role in influencing cardiovascular variables especially left ventricular mass (LMV), as their anthropometric parameters were used for indexing LMV (Cuspidi et al., 2009) and waist-hip ratio (WHR) and waist-height ratio (WHtR) are closely related to cardiovascular risk factors. However, the most commonly assessed anthropometric parameters are weight, height, body mass index (BMI) or Quetelet index, body surface area (BSA), and waist/abdominal circumference. Haroonrashid et al., (2008), found no relationship between adiposity and the physical fitness index. Akinpelu, Oyewole and Oritogun (2008) showed that there was statistically non-significant negative correlation between cardiorespiratory fitness and blood pressure. There is no well-established relationship between the resting cardiorespiratory parameters and physical fitness. Therefore, the aim of this study is to determine the relationship among anthropometric indices, resting cardiovascular parameters and physical fitness index of over weight undergraduates. Over the years, several studies by Akinpelu, Oyewole, and Oritogun (2008), Blair, Cheng and Holder (2001), Laxmi (2008) and others have shown that individual with irregular physical activity tends to have low physical fitness and this may be attributed to their body anthropometry. Haroonrashid et al., (2008) found no relationship between adiposity and the physical fitness index. Nevertheless, there haven't been much literature on the relationship between cardiovascular parameters and physical fitness index of overweight individuals. Thus this study sought to determine the relationship among anthropometric indices, resting cardiovascular parameters and physical fitness index of overweight undergraduates of University of Nigeria, Enugu Campus.

MATERIALS AND METHOD

The study was carried out in University of Nigeria, Enugu campus. The participants were undergraduate students. Ethical approval from University of Nigeria Teaching Hospital (UNTH) was obtained before conducting the study. Informed consent was issued out to all the subjects before the study, which means that they had adequate information regarding the research and capable of comprehending the information, enabling them to voluntarily consent to participation in the research or decline participation.

Research Design: This study employed a correlational research study. It is a correlational study because it involves more than two variables from the same group of subjects, in which the researcher is trying to find out if there is a relationship between the variables.

Sample size: 67 participants comprising of 34 males and 33 females were selected using purposive sampling technique. Participants who were not fit upon assessment with International Physical Activity Readiness Questionnaire (IPA-R) were excluded from the study.

MATERIALS

The following instruments were employed in this study:

1. Weighing scale (Hamson 400KL): This was used to measure the weight of the subjects in kilograms..
2. Stadiometer (AYRON 226): This was used to measure the height of the subjects in centimeters.
3. Metronome: This was used to regulate the frequency at which the exercise was be carried out by each participant. It was set to beep every 2 second in order to correspond to the stepping of the subjects.
4. Body impedance analyzer: This was used be used to determine the percentage body fat of the subjects.
5. Tape (butterfly brand USA): This was used to measure waist and hip circumferences of the subjects.
6. Stop watch: This was used to measure the duration of exercise of the subjects and also the pulse rate
7. Step bench: This was used for the Harvard step climbing exercise which after the fitness index of the subjects were calculated. The subjects stepped up and down on the platform at the rate of 30 steps per minute (every two second) for 5 minutes or until exhaustion. Exhaustion is defined as when the subjects cannot maintain the stepping rate for 15 seconds. The subjects immediately sat down on the completion of the test and the total number of heart beats was counted between 1 to 1.5 minutes, between 2 to 2.5 minutes and between 3 to 3.5 minutes after finishing.

8. Stethoscope (Littman): This was used to measure the diastolic and systolic blood pressure of the subjects
9. Sphygmomanometer (WBIC 0197): This was used to measure the diastolic and systolic blood pressure of the subjects.

PROCEDURE FOR DATA COLLECTION

The study was introduced to prospective participants and informed consent sought and obtained. Socio-demographic details of interest were also obtained.

Measurement of height, weight, waist and hip circumferences and percentage body fat were used to estimate body composition. The researcher measured the heights of the subjects to the nearest centimeter using the stadiometer. To do this, the research ensured the subjects stood erect or barefoot, with their backs touching the stadiometer, their arms held laterally by their sides and with the two feet closely apposed. Also, the weight and percentage body fat of each participant was measured using a weighing scale and a body impedance analyzer respectively. The participant stood erect on the weighing scale while putting on light a clothing to avoid errors. The BMI was calculated from the weight (kg) and height (m) (weight/height^2). Fat mass index, lean body mass and fat free mass index was determined using the equation of Jackson and Pollock and Siri (ACSM, 2009).Waist and hip circumferences was measured using a tape measure. Waist circumference was determined by placing the tape immediately below the lowest rib, at the narrowest waist (ASM site). The hip circumference was determined by placing the tape at the widest part of the hip. This usually corresponds to groin level in female and 2 – 3 inches below the navel in male. Duplicate measurements will be taken at each site and will be obtained in a rotational order (ACSM, 2009). The waist-hip ratio was obtained by dividing the waist circumference by hip circumference. Conicity index which evaluates the waist circumference in relation to height and weight was determined.

Measurement of cardiovascular parameters

The researcher measured the systolic and diastolic pressure of the subjects using a stethoscope and a sphygmomanometer. With the participant sitting down relaxed, the sphygmomanometer cuff tied around the arm, then inflate the cuff to exert pressure at the brachial artery, then with the diaphragm of the stethoscope placed at the brachial artery near its bifurcation at the cubital fossa, the readings of systolic and diastolic blood pressure of the subject were recorded.

Heart rate was determined by measuring the pulse rate of the subject. The researcher places his index finger and middle finger over the radial artery at the wrist joint. The pulse rate was determined by counting the number of pulse gotten in a minute.

Harvard step test

Harvard step test is a test of aerobic fitness, developed by broucha et al. (1943) in the Harvard fatigue laboratory

Equipments: step or platform 20 inches / 50.8 cm high for men and 17 inches / 43.2 cm high, stop watch, metronome

Procedure: The subjects stepped up and down on the platform at the rate of 30 steps per minute (every two second) for 5 minutes or until exhaustion. Exhaustion is defined as when the subjects cannot maintain the stepping rate for 15 seconds. The subjects immediately sit down on the completion of the

test and the total number of heart beats was counted between 1 to 1.5 minutes, between 2 to 2.5 minutes and between 3 to 3.5 minutes after finishing.
Scoring: the fitness index score was be determined by the following equation
(100 x test duration) / (2 x sum of the heart beats in the recovery periods).
Physical fitness index category, see table 1

Data Analysis
Data were presented as means and standard deviation. Independent t-test was used to determine the difference in parameters between overweight males and females. Pearson correlation was used to know if there is relationship between the variables. Partial correlation was used to adjust for extraneous variables. Step wise multiple regression analysis was used to determine the influence of cardiorespiratory parameters, anthropometric indices on physical fitness index. Alpha level was set at 0.05

RESULTS

Table 1: Anthropometry Indices of the Subjects

Variables	Total N=67 Mean±SD	Sex		t- value	p-value
		Male n=34 Mean±SD	Females n=33 Mean±SD		
Age (years)	23.28±2.24	24.03±1.91	22.52±2.31	2.928	0.005*
Weight (Kg)	78.37±8.05	81.92±6.80	74.71±7.67	4.074	0.000*
Height (m)	1.71±0.79	1.75±0.07	1.66±0.07	5.535	0.000*
Body Mass Index (Kg/m^2)	26.88±1.68	26.75±1.53	27.02±1.85	-0.663	0.509
% Body Fat	28.26±9.19	20.89±4.78	35.87±5.76	-11.602	0.000*
Fat Mass (Kg)	21.88±6.74	17.04±3.55	26.83±5.52	-8.665	0.000*
Fat Mass Index (Kg/m^2)	7.65±2.68	5.62±1.38	9.71±2.02	-9.719	0.000*
Lean Body Mass (Kg)	56.16±10.74	64.20±7.22	47.87±6.67	6.018	0.000*
Fat Free Mass Index (Kg/m^2)	19.16±2.48	21.12±1.52	17.14±1.41	11.109	0.000*
Waist Circumference (cm)	86.28±5.32	87.59±4.79	84.94±5.58	2.087	0.041*
Hip Circumference (cm)	104.59±6.59	101.03±5.03	108.26±6.01	-8.349	0.000*
Waist-Hip Ratio	0.83±0.07	0.87±0.05	0.79±0.07	5.368	0.000*
Conicity Index ($m^{3/2}kg^{-1/2}$)	1.17±0.08	1.18±0.06	1.17±0.09	0.213	0.832

Key: * = Significance at $p < 0.05$, N = Number of subjects, SD = Standard Deviation, t = t-value

Table 1 shows the anthropometric indices of the subjects. Males had statistically significant ($p < 0.05$) higher mean value in age, weight, height, lean body mass, fat free mass index, waist circumference and waist-hip ratio than females, females had statistically significant ($p < 0.05$) higher mean value in percentage body fat, fat mass, fat mass index and hip circumference than males. Also, the females had a higher but statistically non significant (p > 0.05) mean value in body mass index than male, males had a higher but statistically non significant (p > 0.05) mean value in conicity index than female

Table 2: Resting Cardiovascular Parameters of the Subjects

Variables	Total N=67 X±SD	Sex		t-value	p-Value
		Male n=34 Mean±SD	Females n=33 Mean±SD		
Heart Rate (mmgH)	71.31±10.15	64.35±7.23	78.48±7.36	-7.926	0.000*
Systolic Blood Pressure (mmgH)	114.84±8.24	115.88±9.21	113.76±7.79	1.050	0.297
Diastolic Blood Pressure (mmgH)	70.90±9.38	70.15±10.65	71.67±7.98	-0.660	0.512
Mean Arterial Pressure (mmgH)	89.12±8.65	88.70±9.37	89.56±7.98	-0.403	0.688
Pulse Pressure (mmgH)	43.96±8.15	45.76±8.51	42.09±7.42	1.881	0.064
Rate Pressure Product (mmgH)	8192.40±1258.80	7474.35±1056.60	8932.21±1002.33	-5.91	0.000*

Key: * = Significance at p < 0.05, SD = Standard Deviation, N = Number of subjects, t = t-value

Table 2 shows resting cardiovascular parameters of the subjects. Females had a statistically significant ($p < 0.05$) higher mean value in heart rate, and rate pressure product than the females. Females also had a higher but statistically non significant ($p > 0.05$) mean value in diastolic blood pressure and mean arterial pressure than males. Males had a higher but statistically non significant ($p > 0.05$) mean value in systolic blood pressure and pulse pressure than female.

Table 3: Physical Fitness Index of the Subjects

Variables	Total N=67 X±SD	Sex		t-value	p-Value
		Male n=34 Mean±SD	Females n=33 Mean±SD		
Fitness Index	60.02±33.11	79.52±34.10	39.88±15.34	6.104	0.000*

Key: * = Significance at $p < 0.05$, N = Number of participant, SD = Standard Deviation

Table 3 shows the physical fitness index of the subjects. Males had statistically ($p < 0.05$) significant higher mean value in physical fitness index than female

Table 4: Category of the Fitness Index of the Subjects

Category	Total Subjects N (%)	Sex	
		Male n (%)	Female n (%)
Poor	36 (53.7)	6 (16.7)	30 (83.3)
Low Average	9 (13.4)	7 (20.6)	2 (6.1)
Average	8(11.9)	8 (23.5)	0 (0)
Good	7 (10.5)	7 (20.6)	0 (0)
Excellent	7 (10.5)	6 (17.6)	1 (3.6)

Key: N = No of subjects, % = Percentage of the subjects

Table 4 shows the category of the physical fitness index of the subjects. Generally, only 10.6% of the subjects had an excellent physical fitness index, l0.5% had good physical fitness index, 11.9% had average physical fitness index, 13.4% had physical fitness index within low average and 53.7% had poor physical fitness index. Females had more percentage with poor physical fitness index but lesser percentage of physical fitness index in other categories than males.

Table 5: Correlation Showing the Relationship between Anthropometric Indices and Physical Fitness Index of the Subjects

Variables		Fitness Index	
		Pearson Correlation	Partial Correlation ++
Age	r	.134	-.097
	P	.281	.441
Weight	r	-263	-.013
	P	.032*	.918
Height	r	.419	.127
	P	.000*	.308
BMI	r	-.195	-.183
	P	.114	.142
% Body Fat	r	-.596	-.220
	p	.000*	.075
Fat Mass	r	-.557	-.211
	P	.000*	.088
Fat Mass Index	r	-.576	-.218
	p	.000*	.070
Lean Body Mass	r	.507	.153
	P	.000*	.220
Fat Free Mass Index	r	.506	.038
	p	.000*	.764
Waist Circumference	r	.010	-.183
	p	.937	.141
Hip Circumferences	r	-.494	.242
	P	.000*	.050
Waist Hip Ratio	r	.324	-.016
	p	.007*	.900

Conicity Index	r	-.080	-.120
	P	.521	.337

Keys: *= significant at $p < 0.05$, p = value, ++ = partial correlation adjusted for sex

Table 5 shows the correlation between anthropometric indices and physical fitness index of the subjects. Pearson correlation showed that there is statistically significant positive correlation ($p < 0.05$, r = +ve) between physical fitness index and height, lean body mass, fat free mass index, and waist hip ratio. It also showed that there is statistically significant negative correlation ($p < 0.05$, r = +ve) between physical fitness index and weight, percentage body fat, hip circumference and fat mass. It also showed a statistically non-significant but positive correlation between physical fitness index and waist hip ratio and waist circumference. Partial correlation showed statistically non- significant correlation ($p < 0.05$) between physical fitness index and the variables.

Table 6: Correlation Showing the Relationship between Resting Cardiovascular Parameters and Physical Fitness Index of the Subjects.

Variables		Fitness Index	
		Pearson Correlation	Partial Correlation
Heart Rate	r	-.556	-.233
	P	.000*	.060
Systolic	r	-.062	-.177
Blood pressure	p	.620	.156
Diastolic	r	-.128	-.099
Blood Pressure	p	.301	.427
Mean	r	-.142	-.140
Arterial Pressure	p	.252	.261
Pulse	r	.085	-.067
Pressure	p	.492	.595
Rate	r	-.533	-.279
Pressure Product	p	.000*	.023*

*= significant at $p < 0.05$, p = p-value, ++ = partial correlation adjusted for sex

Table 6 shows the correlation between resting cardiovascular parameters and physical fitness index of the subjects.

Pearson correlation showed that there is statistically significant negative correlation ($p < 0.05$, r = +ve) between physical fitness index and heart rate and rate pressure product. Is also showed that there is statistically non significant negative correlation between physical fitness index and diastolic blood pressure, systolic blood pressure, mean arterial pressure and positive correlation between physical fitness index and pulse pressure. Partial correlation shows that there is statistically significant negative correlation between physical fitness index and rate pressure product. It also showed statistically non-significant correlation between physical fitness index and other variables.

Table 7: Pearson Correlation Showing the Relationship between Anthropometric Indices and Resting Cardiovascular Parameters of the Subjects

VARIABLE		AGE	WEIGHT	HEIGHT	BMI	% BF	FM	FMI	LBM	FFMI	W.C	H.C	W.H.R
H.R,	r	-.156	-.325	-.416	.082	.657	.606	.625	.606	-.670	.099	.342	-.295
	P	.209	.007*	.000*	.511	.000*	.000*	.000*	.000*	.000*	.426	.005*	.015*
S.B.P,	r	-.720	.260	.193	.113	-.059	.005	-.042	.160	.182	.001	.123	.096
	P	.563	.033*	.118	.361	.636	.968	.736	.197	.139	.993	.322	.438
D.B.P,	r	-.248	.106	.168	-.105	-.022	.002	-.035	.041	.025	.074	.116	-.122
	P	.043*	.393	.173	.396	.859	.989	.736	.740	.842	.554	.350	.324
M.A.P,	r	-.195	.155	.197	-.075	.050	.093	.029	.022	-.015	.029	.218	-.134
	P	.113	.212	.111	.548	.690	.456	.814	.883	.904	.814	.077	.218
P.P,	r	.211	.148	.006	.239	-.050	.006	-.003	.119	.160	.086	-.007	.041
	P	.086	.232	.959	.052	.771	.960	.978	.336	.196	.491	.958	.740
R.P.P,	r	-.186	-.188	-.293	.133	.567	.547	.544	-.481	-.525	-.110	.365	.326
	P	.133	.127	.016*	.365	.000*	.000*	.000*	.000*	.000*	.377	.002*	.007*

Key: *= Significant, $p < 0.05$, p = p-value, H.R = Heart rate, S.B.P = Systolic blood pressure, D.B.P = Diastolic blood pressure, M.A.P = Mean arterial pressure, P.P = Pulse pressure, R.P.P = Rate pressure product, BMI = body mass index, %BF = Percentage body fat, FM = Fat mass, FMI = Fat mass index, LBM = Lean body mass, FFMI = Fat free mass index, W.C = Waist Circumference, H.C = Hip circumference W.H.R = Waist hip ratio, C.I = Conicity index

Table 7 shows Pearson correlation between anthropometric indices and cardiovascular parameters of the subjects. Pearson correlation shows that there is statistically significant negative correlation between heart rate and weight, weight, height, fat free mass index and waist hip ratio. It also showed a statistically significant positive correlation (p-value ranges from 0.000 to 0.043) between heart rate and percentage body fat, fat mass, fat mass index, lean body mass and hip circumference.

Pearson correlation also shows that there is statistically significant positive correlation between systolic blood pressure and weight and a statistically significant negative correlation between diastolic blood pressure and age. It also showed a statistically significant negative correlation ($p < 0.05$) between rate pressure product and height, lean body mass, fat free mass, and a statistically significant positive correlation between rate pressure product and percentage body fat, fat mass, fat mass index, hip circumference and waist hip ratio.

Table 8: Partial Correlation Showing the Relationship between Anthropometric Indices and Resting Cardiovascular Parameters of the Subjects

VARIABLE		AGE	WEIGHT	HEIGHT	BMI	% BF	FM	FMI	LBM	FFMI	W.C	H.C	W.H.R
H.R,	r	-125	-.014	.048	.034	.199	.190	.187	-.151	.245	.111	-.077	.157
	P	.318	.910	.703	.786	.109	.126	.133	.226	.047*	.374	.538	.209
S.B.P,	r	-.124	.228	.147	.125	.083	-147	.091	.095	.154	-.053	.235	-.203
	p	.319	.065	.240	.315	.505	.237	.469	.466	.284	.795	.058	.101
D.B.P,	r	-.235	.160	.257	-.113	-.157	-.090	-.154	.162	.155	-.055	.085	-.093
	p	.058	.198	.037*	.367	.209	.470	.216	.194	.213	.661	.496	.457
M.A.P,	r	-.190	.199	.270	-.079	.015	.082	-.014	.094	.043	.043	.228	-.127
	p	.127	.110	.029	.528	.904	.510	.908	.451	.729	.750	.065	.308
P.P,	r	.146	.052	-.147	.265	.270	.260	.276	-.087	-.042	.030	.147	-.104
	p	.242	.677	.238	.031*	.028*	.035*	.025*	.451	.739	.809	.240	.404
R.P.P,	r	.018	.103	.044	.080	.190	.217	.182	-.066	-.111	.046	.063	-.004
	P	.888	.410	.725	.524	.126	.080	.143	.596	.373	.711	.617	.976

Key: *= Significant, $p < 0.05$, r = regression, p = p-value, H.R = Heart rate, S.B.P = Systolic blood pressure, D.B.P = Diastolic blood pressure, M.A.P = Mean arterial pressure, P.P = Pulse pressure, R.P.P = Rate pressure product, BMI = body mass index, %BF = Percentage body fat, FM = Fat mass, FMI = Fat mass index, LBM = Lean body mass, FFMI = Fat free mass index, W.C = Waist Circumference, H.C = Hip circumference W.H.R = Waist hip ratio, C.I = Conicity index.

Table 8 shows Partial correlation between anthropometric indices and cardiovascular parameters of the subjects. Partial correlation shows that there is statistically significant positive correlation between heart rate and fat free mass index, statistically significant positive correlation between diastolic blood pressure and height and a statistically significant positive correlation between pulse pressure and body mass index, percentage body fat, fat mass and fat mass index

Table 9 Stepwise Multiple Regression Showing the Strength of Sex and Resting Rate Pressure Product as a Predictors of Physical Fitness Index in overweight undergraduates.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.604 a	.364	.355	26.602
2	.643 b	.414	.396	25.741

a predictors: (constant), sex

b predictors: (constant), sex, resting rate pressure product

Table 9 shows that out of all the variable entered, sex and resting rate pressure product was shown to be the only significant predictor of physical fitness index and sex had a coefficient of determinant (R^2) = 0.364 and when rate pressure product was added to the model, it increased to 0.414.

DISCUSSION

The results obtained from the demographic characteristics of the subjects showed that the males had higher mean values in age, weight, height, lean body mass, fat free mass index, waist circumference, waist-hip ratio, conicity index, systolic blood pressure, pulse pressure and physical fitness index than females. Also, the girls had a higher mean value in percentage body fat, fat mass, fat mass index, body mass index and hip circumference heart rate, rate pressure product, mean arterial pressure and diastolic blood pressure than in males. These differences in mean values showed to be only significant in age, weight, height, lean body mass, fat free mass index, waist circumference, waist-hip ratio, percentage body fat, fat mass, fat mass index and hip circumference, heart rate, and rate pressure product and physical fitness index.

Findings by Moliner-Urdinales, et al., (2011) found that females had statistically significant higher value of percentage body fat than males which supported the result of this study. Also, Meeuwsen, Horgan and Elia (2009) showed that Females had a statistically significantly higher value in body fat than males. Shiniokata et al (1989) in their study showed that male had a statistically significant higher value in and waist-hip ratio than female. The result of their work also showed that females had a statistically significant higher value in hip circumference which is in support with results of this study. Their work also showed that male had a non significant value in waist circumference than female which is not in agreement with the result of this study. This is surprising and the difference may be attributed to overweight individual used in this study. Taylor, Bones, Willians and Goulding (2000) showed that males had a non statistically significant but higher value in conicity index than the female which is also in agreement with the results of this study.

Cardiovascular parameters of the subjects

The result from cardiovascular parameters showed that male had a higher value in systolic blood pressure and pulse pressure than female. Females had a higher value in heart rate, rate pressure product diastolic blood pressure and mean arterial pressure than males. This difference shows to be statistically significant in heart rate and rate pressure product.

Bagali et al, (2012) showed that females had statistically non significant but higher value in diastolic blood pressure and that males had statistically non significant but higher value in systolic blood pressure than females which is in support with the results of this study. Mbada et al, (2007) showed that male had statistically non significant but higher value diastolic blood pressure which does not agree with the result of this study. The difference may be linked to the age range that was use in their study (males: 39±10.82years, females: 38.96±11.82years) compared to the age used in this study (males: 24.03±1.91years, females: 22.52±2.31years). Also, Bagali et al, (2012), and Aithala et al (2014) in their respective studies showed that females had a statistically significant higher value in heart rate and rate pressure product than females. Ravisankar et al (2005) in their study also showed that males had statistically significant but higher value in pulse pressure, statistically non significant lower value in mean arterial pressure which was in support with the results of this study. These findings may be attributed to males being cardiovascular fitter than females.

Physical fitness index of the subjects

The result of physical fitness index of the subjects showed that males had statistically significant higher value physical fitness index than female. Pribis et al (2010) showed that the males had a statistically significant higher value in physical fitness index more than females. This is also in support with the results of this study. The agreement in the findings of both studies is not surprising as it has been established that males are more fit than females generally.

Influence of anthropometric indices on physical fitness index

The result of effect of anthropometric indices on physical fitness index from Pearson moment correlation showed that there is positive correlation between physical fitness index and height, fat free mass index, lean body mass, waist circumference and waist-hip ratio, and that there is negative correlation between physical fitness index and weight, BMI, percentage body fat, fat mass, fat mass index, hip circumference and conicity index. It also showed that this correlation is significant in weight, height, percentage body fat, fat mass, fat mass index, lean body mass, fat free mass index, hip circumference and waist hip ratio.

Haroonrashid et al, (2008) showed that there is statistically non significant positive correlation between BMI and physical fitness index which supported the result of this study. Amitabh, et al (2009) showed that there was statistically significant correlation between physical fitness index and percentage body fat and fat mass of those in the temperate region. The results of these studies supported the finding in this study. Hakkinen, et al (2009) showed the there is statistically significant positive correlation between physical fitness index and weight, height, fat mass and lean body mass which supported the findings in this study. Their work also showed a statistically significant negative correlation between physical fitness index and body mass index which is not in agreement to the result of this study. This difference may be linked to higher number of subjects used in their study (n = 727) compared to the number of subjects used in this study (n = 67). It may also be attributed to the fact that they only used males subject to carry out their study compared to both male and female subject used in this study. Also, the difference may be linked to BMI group of only overweighed individual used in this study.

Influence of resting cardiovascular parameters on physical fitness index

The result of the effect of resting cardiovascular parameters on physical fitness index from Pearson moment correlation showed that with the exception of pulse pressure, there is negative correlation between physical fitness index and cardiovascular parameters. Pearson also showed that this correlation is statistically significant in only heart rate and rate pressure product.

Amitabh et al (2009) showed that there was statistically non significant correlation between heart rate and physical fitness index. This was not in agreement with the result of this study which shows that it is statistically significant. The difference may be linked to only male subjects used in their study as compared to both male and female subjects used in this study. This was adjusted with partial correlation which showed a statistically non significant negative correlation which is the same with their study The difference may also be attributed to a smaller number of subjects used in their study (n = 30) as compared to higher number of subject used in this study. Fraser, Phillips and Harris (1983) in their study on physical fitness and blood pressure in school children showed that there is statistically significant negative correlation between physical fitness index and blood pressure (systolic and diastolic) which supports the results of this study. Also, Akinpelu, Oyewole and Oritogun (2008) showed that there was statistically non significant negative correlation between cardiorespiratory fitness and blood pressure. Their result is not in agreement with the finding of this study which shows that it is statistically non significant. This difference can be attributed to age range of the population used in their study (12years to 18years) as compared to age range of 18years to 29years used in this study. The difference can also be attributed to large number of subjects used in their study (n = 1638) compared to a smaller population used in this study. Holmberg, Winslow and Varnarkas (1971) showed that there is statistically significant negative correlation between rate pressure product and cardiorespiratory fitness which supported the result of this study.

Influence of anthropometric indices on resting cardiovascular parameters

The result of effect of anthropometric indices on resting cardiovascular parameters of the subjects from Pearson correlation shows that there is statistically significant negative correlation between heart rate and weight, weight, height, fat free mass index and waist hip ratio, statistically significant positive correlation between heart rate and percentage body fat, fat mass, fat mass index, lean body mass and hip circumference. It also shows that there is statistically significant positive correlation between systolic blood pressure and weight and a statistically significant negative correlation between diastolic blood pressure and age. It also showed that there is statistically significant negative correlation between rate pressure product and height, lean body mass, fat free mass, and a statistically significant positive correlation between rate pressure product and percentage body fat, fat mass, fat mass index, hip circumference and waist hip ratio.

Arazi, Hoseini (2001) showed that there is positive correlation between systolic blood pressure and BMI, weight and percentage body fat, and statistically significant with weight which is in agreement to the result of this study. There result also showed that there is positive correlation between diastolic blood pressure and weight, BMI and percentage body fat, which is statistically significant with exception of BMI. This does not agree with the result of this study in which diastolic blood pressure is found to negatively correlate with BMI and percentage body fat. The difference may be attributed to the fact that only females subject were involved in their study as compared to both male and female subjects used in this study. The difference can also be attributed to the fact that only overweighed individual was used in this study. Yar (2010) showed that there is statistically significant positive correlation between heart rate and BMI and waist circumference. This does not agree with the result of this study as the correlation appears to be insignificant. Her result also showed there is statistically non significant positive correlation between heart rate and waist-hip ratio. This also does not agree with the result of this study as the two variables appear to be statistically negatively correlated. This may be linked to the fact that they used obese subjects in their study as compared to overweight subjects used in this study. It can also be attributed to the fact that they used only male subjects in their study.

Influence of anthropometric indices and resting cardiovascular parameters on physical fitness index

From the results of the step wise multiple regression to determine the variables which predicts the values of physical fitness index. Out of all the 19 variables entered as predicators, sex and rate pressure product showed to be the only significant predictor of physical fitness index while the other variables were excluded. The summary of the Model fit showed that the coefficient of determination by sex was 0.364 (36.4%) and that of rate pressure product was 0.05 (5%). This explained that, 41.4% of the variance of physical fitness index was due to the sex and rate pressure product values. This further explains that, there are other variables which affect physical fitness index, but were not accounted by this study. Also the lower zero and partial correlation showed that much of the variance in physical fitness index explained by sex and rate pressure product is also explained by other variables. These unexplained variables could be psychological variables or lifestyle variables. Holmberg, Winslow and Varnarkas (1971) showed that rate pressure product is valid as predictive value of V02max during exercise especially in those with ischemic heart disease. Lasoki et al, (2010), showed that age, sex, body mass index and physical activity were the most important factors associated with fitness explaining 56% of the variance of cardiorespiratory fitness (R^2 = 0.56). They also showed that the addition of all other factors combined current smoking, systolic blood pressure, glucose, HDL and LDL cholesterol health status explained only a variance of 2% in cardiorespiratory fitness. Because the subjects in this study have the same BMI range, i.e. they are all overweight undergraduates, Rate pressure product was a better indicator. This showed that rate pressure product is a strong predictor of variance in cardio respiratory fitness and the researcher advocate that further studies should include other factors which may explain the remaining variance in cardiorespiratory fitness.

CLINICAL IMPLICATIONS OF THE STUDY

The result of this study showed that overweight individuals have a low physical fitness index. This can be attributed to their high value in rate pressure product as predicted form stepwise regression analysis. Rate pressure product is an indicator of oxygen requirement of the heart and is calculated as the product of heart rate and systolic blood pressure (the maximum pressure exerted by the blood on vessel walls). The heart is a living pump which needs a good supply of oxygen and nutrients in order to work. If these supply are inadequate, heart failure results. During aerobic exercise, heart rate and systolic blood pressure are the two main factors determining the workload on the heart. If these factors increase, the heart has to work harder, and will require more oxygen and nutrients to keep going. The response of the heart rate and blood pressure to a fixed level of exercise tends to decrease with regular, vigorous aerobic exercise, thus, a regular well-trained person is better able to satisfy the demands of the heart for oxygen and nutrients during exercise than an untrained person. In this regard, there is need to involve in constant physical activity that will help improve our cardiac function.

LIMITATION

The sample size may be a limitation to the external validity of the study.

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