The Effect of Body weight, Percentage Body fat and Body Mass Index on Adolescent Academic Performance.

Oyebamiji Oyedele Oketayo[1 *], Joshua Olufemi Ojo[2], Ephriam Peter Inyang[1], Raphael Adewale Adenodi[1], Francis Omowonuola Akinluyi[1] and Rufus Temidayo Akinnubi[1]

1. Department of Physics, Adeyemi College of Education, Ondo, 35100, Nigeria.
2. Department of Physics, Obafemi Awolowo University, Ile-Ife, 220002, Nigeria.
oketayodele06@yahoo.com

Abstract: Studies have been made to evaluate the nutritional status of 110 Nigerian higher institution Physics students and compare it with their performances over a period of one year. Students' weight, Percentage Body Fat (% BF) and Body Mass Index (BMI) were measured using Bioimpedance technique while their performances were determined by finding the Cumulative Grade Point average (CGPA) for all the courses offered. The data were analyzed using Pearson correlation at both 0.01 and 0.05 level of significance for all the subjects (generally) and on the basis of Body Mass Index. While a significant positive correlation was found between the body fat and weight with academic performance (r = 0.921, r = 0.885) for overweight subjects, a negative significant relationship was obtained between the adolescent academic performance and body fat (r = - 0.920) as well as body weight (r = - 0.954) for the obese . The results show that the academic performance of the obese adolescents can strongly be influenced by their body fat and weight after controlling for unobserved heterogeneity. The finding indicates that adolescent obesity may have adverse academic consequences. Thus targeting obesity reduction policies may not only improve health outcomes but also have a positive impact on improving their academic performance and human capital accumulation. [Nature and Science 2010;8(6):36-42]. (ISSN: 1545-0740).

Keywords: percentage body fat ; body mass index ; adolescent academic performance

Introduction

There is growing clinical interest in body composition most especially the percentage body fat. This is because of the evidence that links body composition with health risks and the development of certain diseases (Tanita Corporation of America, 2003). New research also indicates that fat loss, not weight loss can extend human longevity (John Dae, 2003). The important aspect of the contemporary study of nutritional diseases is establishing the phenotypic characteristics of human subjects (Pietrobelli, 2003). Body composition is really the ratio of lean body mass to fat body mass. According to John Dae (2003), too much fat can lead to health problems such as heart diseases, diabetics, high cholesterol and other serious conditions. He asserted that too little body fat can be just detrimental as too much. If people can keep their body fat at a reasonable level, they can be healthier, happier, and of course, look their best (Kenneth, 2004).This infact makes monitoring percentage body fat a key component of any weight loss or fitness programme. Obesity is a known indicator of many serious medical conditions including heart disease, diabetes and even certain form of cancer. Body mass index is a simple calculation that determines height to weight ratio. The index correlates a person's physical stature with mortality ratios based on actuarial studies. According to the National Institute of health and World Health Organization, overweight is defined as Body mass index between 25 and 29.9 kg/m^2 and obesity as a BMI equal to or greater than 30. A BMI of 18 or lower indicates that a person is underweight. Due to increasing prevalence of obesity among Nigerian men and women, this paper examines the sensitivity of the association between adolescent body weight, body mass index, body fat (nutritional status) and academic performance (to potential biases caused by unmeasured heterogeneity) of students with less discipline inferrals (i.e. with few or no disciplinary incidents), with high level of cardiovascular fitness measured as by walking / running test, good class attendance and little or low psychological stress. Studies have shown that the performance of adolescents in their various academic endeavours depends on a lot of factors. Kenneth H. Cooper in an attempt to study Texas students' fitness in relation to their academic performance, discovered that better performance are associated with high levels of fitness, healthy levels of cardiovascular fitness, fewer disciplinary incidents and better school attendance (Kenneth, 2004). The research also conducted with a view to having the National longitudinal study of adolescent health, the relationship between several measures of adolescent body weight and grade point average (GPA) using Pearson correlation coefficient produced consistent evidence of a negative relationship between body weight and academic performance for white females aged 16-24 while for white males and non-white females, little

evidence of significant relationship between body weight and academic performance after controlling for unobserved heterogeneity (Hoffmann *et al*, 2006).These findings indicate that adolescent obesity may have adverse academic consequences for males and females thus, targeting obesity reduction policies which may not only improve health outcomes but also have a positive impact on improving their academic performance and human capital accumulation. Furthermore, those who were screened positive for weight preoccupation according to OBGYN news magazine were dissatisfied with their body size and reported that their weights and eating habits affected their worth and also interfered with their academic performance or social relationship (Sullivan and Michelle, 2005). Martha Holden (2008) in the study to see if there is correlation between BMI and academic achievement in mathematics of 450 students in Ohio achievement test, a statistically significant negative relationship was found and most importantly, a direct relation was obtained between students at risk for obesity and lower test performance (Mattha, 2009). This research was a correlational study aiming at investigating the relationship between adolescents' body fat, body weight, body mass index and academic performance taking the subjects as a group and on the basis of sex and their BMI or nutritional status.

Materials and Methods

Written and verbal consent were obtained from 105 subjects (male = 63, female = 42) aged 18-28yrs in year 1 of a College of Education located in a medium-sized city before commencing the research and after obtaining ethical clearance from the College Medical Centre. Only non-pregnant female students were allowed to participate in the exercise without any age limit. For each subject, the height was measured to the nearest 0.1cm by having the subject stand erect, looking straight ahead, against a calibrated wall. Body weight (with minimal clothing and without foot wears) was obtained to the nearest 0.1kg (on semester basis) using Tanita Body Composition Analyzer (BF 350) which at the same time determines the percentage body fat to the nearest 0.1% based on bioimpedance technique. In this system, two footpad electrodes (pressure contact) are incorporated to the platform of a precision electronic scale. The subject's measurements are taken while in standing position with the electrodes in contact with base feet. The body fat monitor /analyzer automatically measure weight and then impedance. The computer software embedded in the product uses the impedance, subject's gender, height, fitness level, age and weight to determine the percentage body fat based on equation or formular. The student's performance was determined by finding the cumulative grade point average (CGPA) for a session. Adolescents were asked questions on their education, health, family, romantic relationships, pear group, neighborhoods and sexual relationship to cater for potential biases caused by unmeasured heterogeneity.

Results and discussion

This study utilized data of the weight, body fat, and body mass index from bioimpedance technique to examine the relationship between adolescent nutritional status and their academic performance. Out of the 105 subjects studied, 71.4% of the adolescents had their BMI within the normal range, 18.1% were underweight, 4.7% were overweight and 5.7% were obese. Tables 1 and 2 depict the statistical distribution of the subjects on the basis of sex and World Health Organization (WHO) body mass index classifications respectively while figures 1 and 2 show the frequency distribution of the no of subjects and the Mean performance (CGPA) according to their Body Mass Index (BMI) groups.

Table 1: The Range, Mean and Standard Deviation of Students' Nutritional status and their CGPA on the Basis of Sex

Parameters	Male (n = 63)		Female (n = 42)	
	Range	Mean ± SD	Range	Mean ± SD
Age (yrs)	18.00 -28.00	21.96 ± 2.66	19.00 - 26.00	21.54 ± 2.14
Height (m)	1.52 - 1.83	1.69 ± 0.06	1.50 - 1.79	1.65 ± 0.07
Weight (Kg)	46.20 - 78.20	59.70 ± 7.10	44.2 - 87.30	55.81 ± 8.53
BodyFat (%)	3.60 - 43.00	12.10 ± 7.50	3.50 - 42.30	16.29 ± 8.97
BMI (Kg/m^2)	17.25 - 27.84	20.68 ± 2.25	16.50 - 33.67	20.50 ± 3.18
CGPA	0.88 - 4.82	2.72 ± 1.06	0.65 - 4.53	2.32 ± 0.89

Table 2: Statistical table showing Students' Nutritional status and their CGPA on the basis of their BMI (WHO)

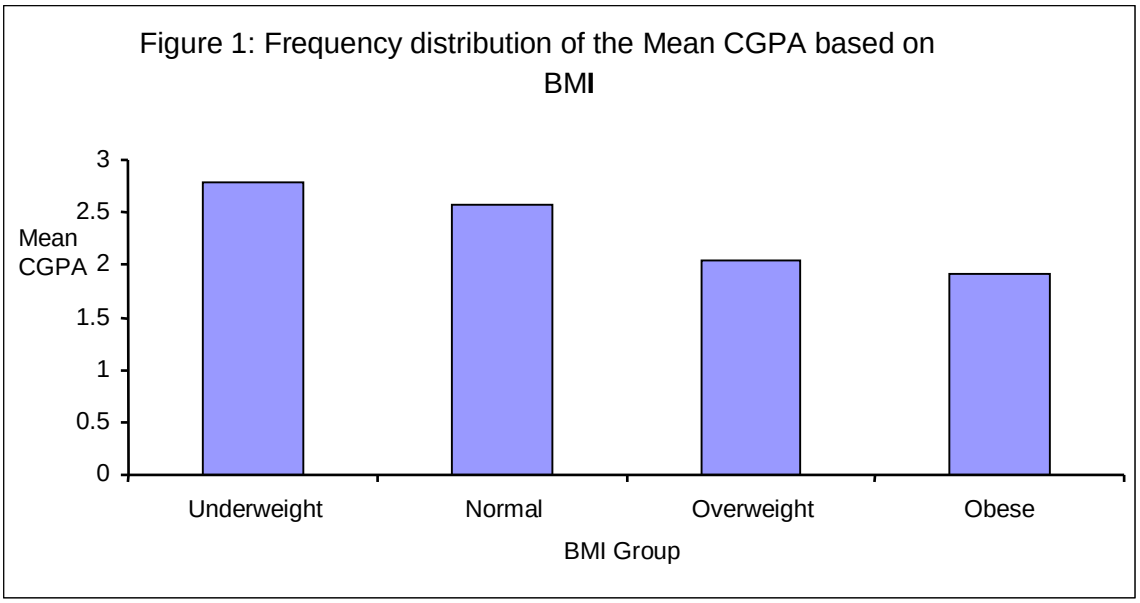
BMI Group	Body fat (%)	BMI (Kg/m^2)	CGPA			
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Underweight (n = 19)	3.50-17.30	13.31 ± 9.14	16.50-18.47	17.74 ± 0.58	2.78 – 4.04	2.78 ± 1.04
Normal (n=75)	5.60-32.10	13.42 ± 6.71	18.70-24.70	20.81 ± 1.63	0.65 – 4.82	2.58 ± 1.00
Overweight (n=5)	13.00-38.4	24.04 ± 9.77	25.03-27.84	25.95 ± 27.84	1.24 – 3.65	2.04 ± 0.97
Obese (n=6)	37.6 - 2.30	40.01 ± 2.01	30.09-33.60	32.77 ± 1.38	0.71 - 3.45	1.91 ± 0.99
BMI Group	Age (yrs)	Height (m)	Weight (Kg)			
Underweight (n = 19)	18.00-26.00	21.73 ± 2.72	1.58-1.80	1.68 ± 0.06	44.30 - 58.50	50.17 ± 4.04
Normal (n=75)	18.00-28.00	21.68 ± 2.34	1.50-1.83	1.68 ± 0.07	44.20 - 71.40	59.10 ± 61.90
Overweight (n=5)	20.00-28.00	23.20 ± 3.11	1.52-1.73	1.64 ± 0.08	59.30 - 78.20	70.48 ± 7.81
Obese (n=6)	24.00 - 26.00	24.83 ± 0.75	1.60-1.65	1.61 ± 0.02	86.00 - 87.30	86.95 ± 0.74

Table 3: Correlation coefficient table (on sex basis)

	Sex	Height	Weight	BMI	Age	Academic performance
Body fat	Male	-0.272*	0.272*	0.509**	0.029	0.086
	Female	-0.513**	0.461**	0.763**	0.089	-0.330*
BMI	Male	-0.207	0.752**	1.000	0.140	0.035
	Female	-0.211	0.853**	1.000	0.221	-0.376*

* = *significant at 0.05 level* ** = *significant at 0.01 level* *Non-asterisked figures= Not significant*

On sex basis, for male (n = 63), no significant relationship exists between adolescent academic performance and body fat or weight where as a weak negative significant correlation was obtained for female adolescents (Table 3). This indicates that these two parameters may in one way or the other have a negative influence on female academic performance. The average performance of the overweight and the obese is lower than the underweight and those whose BMI fall within the normal range - Figure 1. For both underweight and normal subjects, no significant correlation exists among body fat, body mass index and academic performance but a positive significant association exists between the academic performance and body fat (r = 0.920) as well as BMI (r = 0.920) for overweight and a negative significant correlation was obtained between academic performance and body fat (r = -0.920) so also with body weight (r = - 0.754) as shown in figures 3 - 6 respectively. Several reasons could account for such a negative relationship between these two parameters for the obese. According to Cowley (2004), it may be that poor academic performance causes higher body weight .This may be the case, if, for example, adolescent choose to eat excessively to psychologically compensate for performing poorly in school (Cowley, 2004; Kenneth, 2004). The mean academic performance (CGPA) increased for adolescents with low body mass index for the obese group (Table 2). Moreover, Poor academic stress may also cause psychological stress, which reduces once appetite and resultant body weight (Hoffmann *et al* , 2006). In the 1st three BMI groups, the weights of these students were also found to be positively correlated with their heights (r between 0.692 and 0.922) but the reverse is the case in obese group where a weak negative correlation coefficient (r = -0.265) is obtained. For both male and female adolescents, there is also a positive significant correlation between body weight and height or body fat. This positive significant relationship obtained for female adolescents in case of weight and height or body fat in this study agrees closely with the work of Ojo *et al* (2008) for Nigerian women in child-bearing age (18-52 yrs).



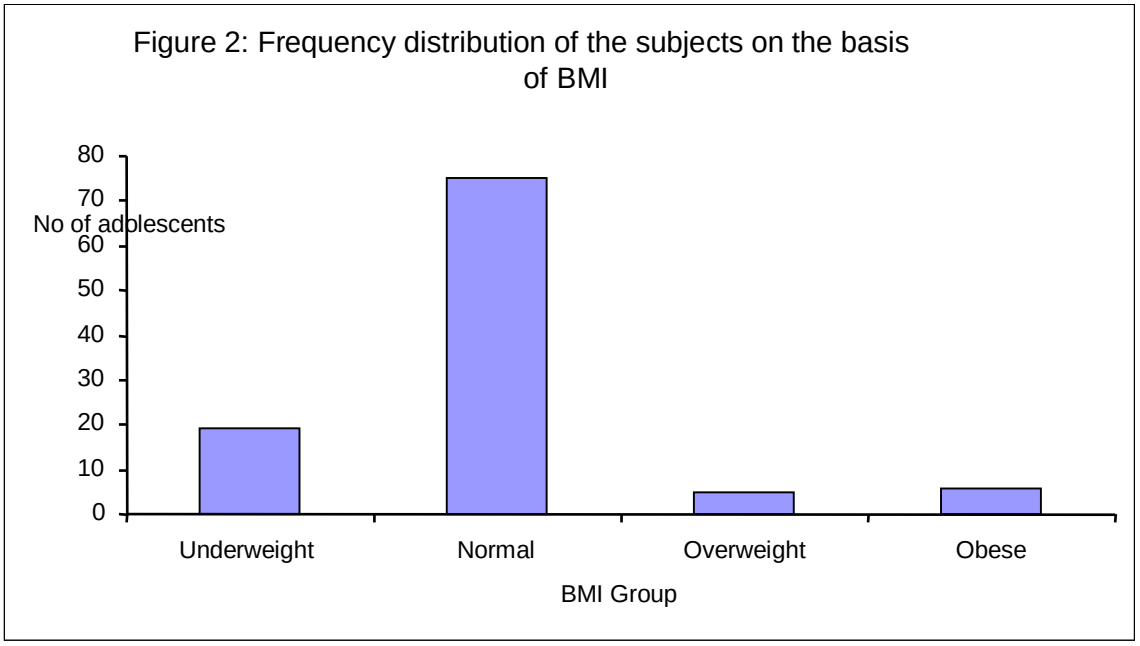


Figure 3: The relationship between adolescent academic performance and the Percentage Body Fat for adolescents in overweight group

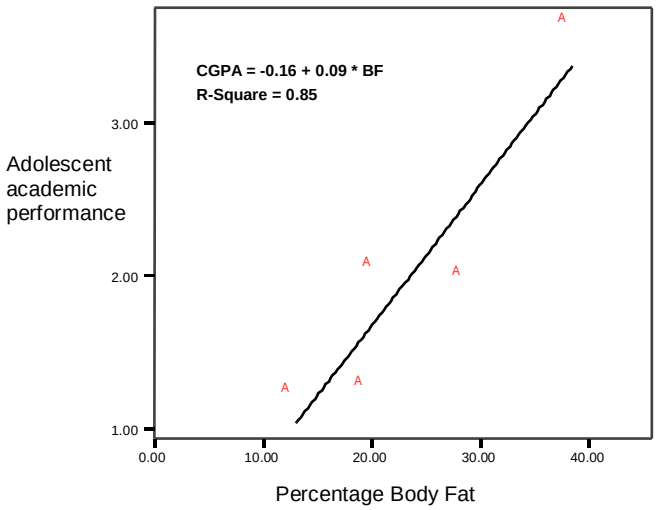


Figure 4: The academic Performance (CGPA) against Body Mass Index for Overweight group

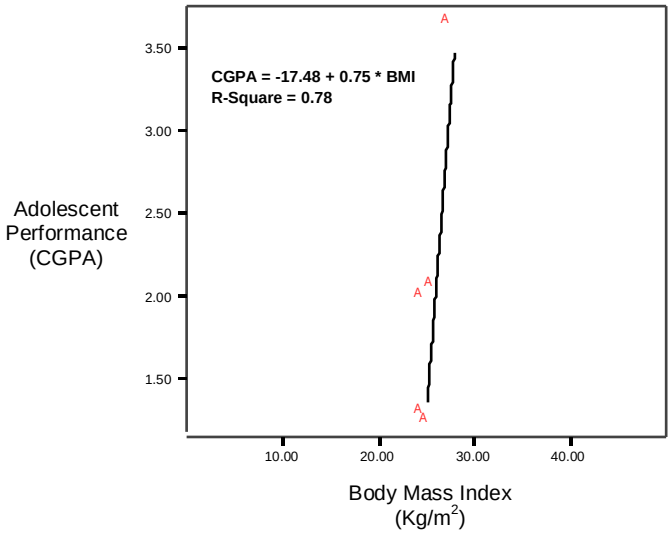


Figure 5: Adolescent academic performance against Body fat for the obese

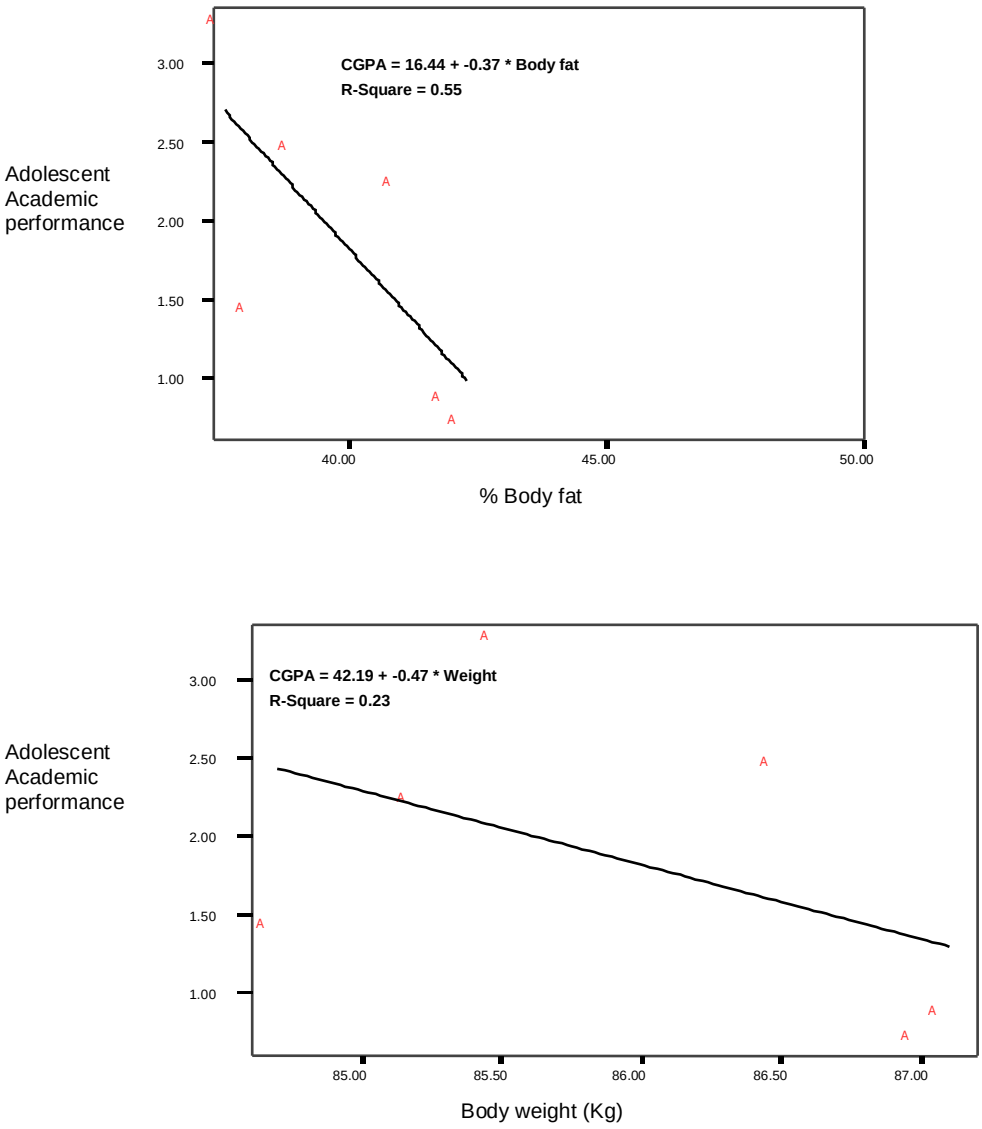


Figure 6: The adolescent academic performance against Body weight for obese

Conclusion

As a pioneering work within this metropolis, this paper examines critically the relationship between adolescent body weight, body mass index, percentage body fat and their academic performance. The results suggest a robust evidence of a positive relationship between body weight and academic achievement among the overweight adolescents after controlling the various form of unmeasured heterogeneity. A lot of studies have shown that high levels of fitness at school are significantly associated with high levels of cardiovascular fitness, better school attendance, fewer disciplinary incidents and high passing rates or better academic performance (Kenneth, 2004). There was also a strong negative correlation between body fat / body mass index and academic performance in the obese group. Thus, targeting obesity reduction policies may not only improve health outcomes but also have a positive impact on improving their academic performance and human capital accumulation. Physical fitness assessment (in terms of body composition, aerobic capacity, muscular strength, endurance and flexibility etc) is therefore recommended for adolescents most especially the obese to avoid health risks posed by obesity and for an improved academic performance. Such adolescents who are at potential risks for obesity are advised to monitor their dietary intakes as well.

Acknowledgement

The authors are very grateful to the Coordinator of Biological Trace Elements Research

(BTER) Laboratory, Department of Physics, Obafemi Awolowo University for giving us the chance to use the equipment.

Correspondence to :
Oketayo Oyebamiji Oyedele
Department of Physics,
Adeyemi College of Education,
Ondo*35100* .Nigeria.
Cellular Phone: +234-8068565178, +234-8033596566
Email: oketayodele06@ yahoo.com

References

[1] Tanita Corporation of America. Understanding Body Fat Analysis excerpt from the pamphlet 1999: 1-3.
[2] John Doe. Bodyometryfutrex, http://www.futrex.com/6100htm/. 2003:1-3
[3] Pietrobelli. Multi-Component Body Composition Models: Recent advances and future directions European Journals of Clinical Nutrition, 55. 2001: 69-70.
[4] Kenneth H. Cooper. The impact of Exercise on Growing Brain Cooper Aerobics Center -News Magazine, 2004: 324.

3/11/2010.

[5] Hoffmann, Daniel. J., Policastro, Peggy Quick, Virginia Lee and Soo-Kynng. Change in body weight and fat mass of men and women in the first year of University Education, Journal of American College Health. 2006; (2): 5-8.
[6] Sullivan, Michele. G. Weight training Programme may improve self-image (Clinical rounds) OBGYN News Magazine, 2005: 5-10.
[7] Mattha Holden J. Correlation between body Mass Index and Academic achievement. A Study by Lakewood schools and Lakewood hospital, Mattha Holden Jennings Foundation, westshore Magazine. 2009; 266-771-2833:10-15.
[8] Cowley W. The Effect of Body Weight in Adolescent Academic Performance, Southern Economic Journal Articles. 2004; (1): 210-220.
[9] J. O. Ojo, O. O. Oketayo, A. O. Aboderin, A A. Salawu and S.R A. Adewusi. Evaluation of Nutritional Status using Body fat, Physiological and Biochemical Parameters in some Nigerian Women. A paper presented by A A. Salawu at Sourcechem-international Conference of Osun State Chapter of Chemical Society of Nigeria, Obafemi Awolowo University, Ile-Ife, 2008:27-29.