PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (10): 1645-1648, 2009
ISSN 1680-5194

The Use of Associations Between Anthropometric and Food Variables in the Assessment of Nutritional Status of Queens College Students of Lagos State, Nigeria

O. Akinyemi
Department of Statistics, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa

Abstract: Traditionally, malnutrition is identified using anthropometric indices based on NCHS/WHO reference standards, in this paper, we explore the associations that exist between anthropometric and nutrition variables for assessing the nutritional status of Queens College Students of Lagos State, Nigeria. Results show that the nature of associations are causally related to nutritional status; the participants are not adequately fed on protein which might be a contributing factor to students' poor performance in the boarding secondary school. Tests on correlation and regression show that food intakes are not associated with physical characteristics but with food intakes. The implications of the findings are discussed and suggestions on ways to alleviate the problems.

Key words: Associations, food variables, anthropometric variables, malnutrition

INTRODUCTION

Nutritional status continues to be a major player in classroom education worldwide; a malnourished child is more susceptible to educational deficiencies than a well fed child. A malnourished individual clearly signifies an impoverished individual i.e. malnutrition is a reflection of abject poverty. Child health and nutrition are strongly associated with educational achievement (Behrman, 1996) little or none can be achieved in children educational pursuit without adequate nutrition. In developing countries, malnutrition continues to be a major health burden as the immune system of individuals becomes sensitively disfunctional without adequate nutrition; preschool and school age children are more prone to nutritional related problems as they need food for physical and brain development than adults. Children who suffer malnutrition are more likely to have slowed growth, delayed development, difficulty in school and high rates of illness and they may remain malnourished to adulthood (Scrimshaw, 1998; Abidoye and Eze, 2000). The incidence of malnutrition during early childhood has irreversible negative effects on the intelligence, educability, disease resistance and productivity thus hindering the socio economic and human development of a nation with damaging implications for people and communities (Akinyemi and Ibraheem, 2009). Apart from its significant negative effects on intelligence, educability and socioeconomic development, Pelletier *et al*. (1995) see malnutrition as a major waste of human energy, causing more than half of all children's death worldwide. Adequate nutrition is a prerequisite to good health and one important determinant of growth and development. Pollitt (1990) sees highly prevalent nutrition and health conditions among school-age children as important determinants of educational outcomes and correlates nutritional deficiencies and poor health in primary school children with poor school enrolment, absenteeism, early drop-out and poor classroom performance positing that educational policy-makers and planners often overlook nutrition and health as determinants of school entry, wastage and attainment. Poor education is more damaging to girls, for example UNICEF (1988) reports that close to or more than 50% of the school age girls are not enrolled in primary schools in some Asian countries. Malnutrition is more worrisome in adolescents (secondary school students) as this in many instances force them to get involved in out of school activities like menial jobs, teenage prostitution and other vices thereby leading to teen pregnancy, failure and drop out. Akinyemi and Ibraheem (2009) see nutritional status to contribute significantly to the attendance, concentration and academic achievements of students in schools, with poor nutrition leading to truancy, gangsterism and other social norms making the school environment uncomfortable.

Nutritional assessment determines the state of health of individuals or groups as influenced by the intake and utilization of food nutrients. Globally, nutritional assessment is particularly important with a view to formulating and implementing appropriate nutritional intervention programmes to improve the level of nutritional health of the population. In nutrition evaluation, anthropometric and dietary information are more often used because they reveal nutrient and energy requirements and also because of easy and quick access. Given the composition of food, the average intakes of food based on age and physiological characteristics can be used to make estimates of nutritional requirements; energy and nutrient

requirements depend on energy expenditure which is primarily determined by physical activity and growth, body size and composition, age and sex. Anthropometric assessments only use physical characteristics resulting from heredity and environment valuable in the assessment of growth failure (Jelliffe, 1966) which may not identify unhealthy eating in particular. Rather than using anthropometric and dietary information separately for nutrition assessment, the relationships that exist among them (together with energy intake and expenditure) tend to give a better concept of evaluation of nutrition and energy requirement.

Several studies have used such relationships to give better insight into nutritional assessment; in their paper, Ravussin *et al.* (1988) and Tataranni *et al.* (2003) examine relationship between low relative Resting Energy Expenditure (REE) and weight in adult Pima Indians; in a comparative study between African-Americans and rural Nigerians, Luke *et al.* (2000) use association between REE and body size and composition to determine the prevalence of obesity and Luke *et al.* (2006) also use REE and body size and composition to determine weight gain in a lean adult Nigerian population. Mikolajczyk *et al.* (2009) show consistent associations between unhealthy food consumption and depressive symptoms and perceived stress among female students from three European countries. In this paper, we explore the association that exist between anthropometric and nutrition variables for assessing the nutritional status.

MATERIALS AND METHODS

Subjects: A sample of forty students was selected across all classes using simple random sampling and the anthropometric characteristics and dietary intake were recorded. The measurements include body weight, body height, age, foods intake and energy intake. Probability sampling is necessary for any nutrition survey so that the research findings will at best be certain, unbiased and correct. Witts (1964) points out that with correct sampling, investigation of only a portion of the population can provide accurate, unbiased and representative results with a consequent savings of time, money and staff and less disruption of the entire population. The relatively small sample is justified because of the homogeneous characteristics of the units as in Luke *et al.* (1999) who use a pilot sample of n = 30 to study blood pressure and relative weight in rural Nigeria and Konig *et al.* (2009) who study the effect of a Multimineral Supplement (MMS) on acid-base balance in humans with a sample of 25.

Measurement: Data was analyzed using the SPSS software package version 17. Regression and correlation analyses were used to assess the relationships between the anthropometric and nutritional characteristics. Data was considered significant for $p<0.01$, 0.05 at 95% confidence limit.

RESULTS

A total of 40 boarding students aged between 11 and 17 years are included in the analysis. Participants' characteristics are presented in Table 1. The mean (±SD) of Body mass index (BMI in kg/m^2) and Body weight (BWT in kg) were 21.3 (±2.9) and 58.9 (±10.3). Food consumption averages show that carbohydrate (CHO) was most fed followed by fat (FAT) and protein (PRO) and vitamin c (VIT C), an indication that the students were mostly fed on CHO.

Table 1: Participants' Characteristics

	Mean	S.D.
Energy intake (EITJ in Joules)	6471.83	2283.56
Carbohydrate (CHO in g)	158.36	69.30
Protein (PRO in g)	56.04	21.13
Fat (FAT in g)	76.56	25.74
Age (AGE in years)	14.25	1.61
Bodyweight (BWT in kg)	58.93	10.25
Vitamin c (VITC in mg)	30.28	24.90
Body height (BHT in m)	1.65	0.071
Body mass index (BMI in kg/m^2)	21.34	2.94
Basal metabolic rate (BMRJ in Joules)	6039.95	882.63

The correlation matrix in Table 2 shows significant association between energy intake (in joules) (EITJ) and the food groups CHO, FAT and PRO at $p<0.01$ and VITC at $p<0.05$ while the insignificant weak correlations between EITJ and BHT, BWT and AGE show that they do not influence EITJ. AGE was significantly correlated with BMI and VITC at $p<0.05$; BWT had significant association with BMI, BHT and BMRJ at $p<0.01$ and with VITC at $p<0.05$ while BMRJ significantly correlates with BWT and BMI at $p<0.01$ and PRO and VITC at $p<0.05$. The higher correlation between PRO and VIT C shows their importance; only VITC was significant with AGE, thus the need for VITC to be given based on age of the students. The following insignificant negative correlations are worth noting: EITJ and BHT; BHT and CHO, an indication that EITJ does not depend on BHT and that CHO doesn't contribute to growth like other food groups.

The linear regression model in Table 3a used to assess the relation between EITJ and other characteristics showed that CHO, FAT and PRO are significantly associated with EITJ while AGE, BWT, VITC and BHT are not. The corresponding t values of the fitted regression undoubtedly showed that the students are mostly fed on CHO and least fed on PRO with VITC highly insignificant. The ANOVA for the fitted regression in Table 3b is highly significant.

DISCUSSION

Traditionally, malnourished children are identified using anthropometric indices based on NCHS/WHO reference standards; this study was designed to examine the

Table 2: Correlations of participants' characteristics

	EITJ	Age	BWT	BHT	BMI	CHO	PRO	FAT	VITC	BMRJ
EITJ	1.00	0.11	0.04	-0.09	0.09	0.93**	0.88**	0.93**	0.33*	0.28
Age	0.11	1.00	0.26	0.17	0.34*	0.07	0.29	0.07	0.33*	0.39
BWT	0.04	0.26	1.00	0.63**	0.83**	0.01	0.10	0.04	0.36*	0.56**
BHT	-0.09	0.17	0.63**	1.00	0.17	-0.19	0.03	0.01	0.23	0.30
BMI	0.09	0.34*	0.83**	0.17	1.00	0.10	0.12	0.06	0.37*	0.52**
CHO	0.93**	0.07	0.01	-0.19	0.10	1.00	0.71**	0.73**	0.21	0.23
PRO	0.88**	0.29	0.10	0.03	0.12	0.71**	1.00	0.86**	0.45**	0.33*
FAT	0.93**	0.07	0.04	0.01	0.06	0.73**	0.86**	1.00	0.37*	0.26
VITC	0.33*	0.33*	0.36*	0.23	0.37*	0.21	0.45**	0.37*	1.00	0.36*
BMRJ	0.28	0.39	0.56**	0.30	0.52**	0.23	0.33*	0.26	0.36*	1.00

*Significant at 5%, **Significant at 1%

Table 3a: Parameter estimates from the linear regression model to test the association between EITJ and BMRJ, CHO, VITC, Age, BHT, BWT, FAT, PRO

					95% Confidence Interval for B	
Model	Estimate (B)	Std. Error	t	Sig.	Lower Bound	Upper Bound
(Constant)	-10.45	11.96	-0.87	0.39	-34.85	13.94
Age	0.27	0.30	0.90	0.37	-0.34	0.88
BWT	-0.06	0.06	-1.04	0.31	-0.19	0.06
BHT	5.83	7.87	0.74	0.46	-10.21	21.88
CHO	16.74	0.01	1765.22	0.00	16.72	16.76
PRO	16.69	0.04	384.382	0.00	16.61	16.78
FAT	37.66	0.03	1102.44	0.00	37.59	37.73
VITC	0.01	0.02	0.69	0.50	-0.03	0.05
BMRJ	0.00	0.00	0.67	0.51	0.00	0.00

a. Dependent Variable: EITJ

Table 3b: Analysis of variance (ANOVA) for the fitted regression

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2.034E8	8	2.542E7	4067158.87	0.000[a]
Residual	193.76	31	6.250	-	-
Total	2.034E8	39	-	-	-

Predictors: (Constant), BMRJ, CHO, VITC, Age, BHT, BWT, FAT, PRO, Dependent Variable: EITJ

adequacy of energy and nutrient intake using associations between anthropometric and nutritional characteristics of the sampled female boarding school. Food groups predominantly fed to the students were identified. Assessment of nutrition status using reference standards on intake of nutrients and energy (FAO/WHO, 1974; 1985) and using BMI (UN, 1992) when compared with Table 1 does not actually identify the nutritional inadequacy (imbalance diet) in the school while the nature of associations in Table 2 and 3 are causally related to nutritional status. The significant associations between EITJ and the food groups indicated that the students were inadequately fed on PRO but on FAT and CHO and the insignificant association between EITJ and BHT, BWT and AGE show that they do not actually influence EITJ; thus the feeding of the students must not be based on age or their physical characteristics but on their energy needs. While CHO consumption has been considered as part of the causal link for developing obesity (Arnow *et al*., 1992; Liberman *et al*., 1986) which is correlated with stress in children (Koch *et al*., 2008; Gundersen *et al*., 2008) and FAT also a source of weight gain (Adams and Rini, 2007), it is suggested that increasing the PRO intake may be the adequate way of adding values to the diets of the students. The direction of association of BMI interestingly revealed that wasting or obesity was significantly associated with AGE, BWT and BMRJ and not on food intake per se. Results from the present study show that the participants are not adequately fed on protein which agree with other findings (Akinyemi and Ibraheem, 2009; Okwu *et al*., 2007) which might be a contributing factor to poor performance (Mikolajczyk *et al*., 2009; King and Burgess, 1993).

Conclusion: In conclusion, nutritional deficiencies contribute to all the vices that happen in boarding secondary schools today. Nigeria public boarding secondary schools that were once centre of excellence and attraction to intending students are now being characterized by high prevalence of dropouts and failure of public examinations; education policy-makers, planners and all parties involved can no longer claim ignorance and undermine the effects of nutrition on students' education, there is need for urgent intervention on the improvement of the quality of foods served to

students in Nigeria boarding schools as this will yield beneficial effects on the students and society at large. It is proposed that appropriate and effective nutritional intervention will yield significant results in educational efficiency in Nigeria.

REFERENCES

Abidoye, R.O. and D.I. Eze, 2000. Comparative School Performance Through Better Health and Nutrition in Nsukka, Enugu, Nigeria. Nutr. Res., 20: 609-620.

Adams, T. and A. Rini, 2007. Predicting 1-Year Change in Body Mass Index Among College Students. J. Am. College Health, 55: 361-365.

Akinyemi, O. and A.G. Ibraheem, 2009. Assessment of Nutritional Status of Queens College Students of Lagos State, Nigeria. Pak. J. Nutr., 8: 937-939.

Arnow, B., J. Kenardy and W.S. Agras, 1992. Binge Eating among the Obese: A Descriptive Study. J. Behavioral Medicine, 15: 155-170.

Behrman, J.R., 1996. The Impact of Health and Nutrition on Education. The World Bank Research Observer, pp: 23-37.

FAO/WHO, 1974. Recommended intakes of nutrients in Handbook on Human Nutritional Requirements, WHO, Geneva.

FAO/WHO, 1985. Energy and protein requirements. Technical Report series No 230, Geneva.

Gundersen, C., B.J. Lohman, J.C. Eisenmann, S. Garasky and S.D. Stewart, 2008. Child-Specific Food Insecurity and Overweight are not Associated in a Sample of 10-15 Year Old Low-Income Youth. J. Nutr., 138: 371-378.

Jelliffe, D.B., 1966. The Assessment of the Nutritional Status of the Community, WHO, Geneva.

King, F.S. and A. Burgess, 1993. Nutrition for developing countries. Oxford, UK, Oxford University Press. 2nd Edn.

Koch, F.S., A. Sepa and J. Ludvigsson, 2008. Psychological Stress and Obesity. J. Pediatrics, 153: 839-844.

König, D., K. Muser, H. Dickhuth, A. Berg and P. Deibert, 2009. (In press). Effect of a Supplement Rich in Alkaline Minerals on Acid-base Balance in Humans. Nutr. J., 8: 23.

Liberman, H.R., J.J. Wurtman and B. Chew, 1986. Changes in the Mood After Carbohydrate Consumption among Obese Individuals. Am. J. Clin. Nutr., 44: 772-778.

Luke, A., C.N. Rotimi, A.A. Adeyemo, R.A. Durazo-Arvizu, T.E. Prewitt, L. Moragne-Kayser, R. Harders and R.S. Cooper, 2000. Comparability of Resting Energy in Nigerians and U.S. blacks. Obesity Res., 8: 351-359.

Luke, A., C.N. Rotimi, A. Adeyemo and R.S. Cooper, 1999. Resting Metabolic Rate and Weight Change in Black Women: Potential Modifying Effect of Current Environment. Obesity Res., 7: 71S (abstr).

Luke, A., R. Durazo-Arvizu, G. Cao, A. Adeyemo, B. Tayo and R. Cooper, 2006. Positive Association Between Resting Energy Expenditure and Weight Gain in a Lean Adult Population. Am. J. Clin. Nutr., 83: 1076-1081.

Mikolajczyk, R.T., W. El Ansari and A.E. Maxwell, 2009. (In press). Food Consumption frequency and perceived stress and depressive symptoms among students in three European Countries. Nutr. J., 8: 31.

Okwu, G.N., A.I. Ukoha, N. Nwachukwu and N.C. Agha, 2007. Studies on the Predisposing Factors of Protein Energy Malnutrition Among Pregnant Women in a Nigerian Community. Online J. Health and Allied Sci., 6: 1-9.

Pelletier, D.L., E.A. Frongillo, D.G. Schroeder and J.P. Habicht, 1995. The effects of malnutrition on child mortality in developing countries. Bulletin of the World Health Organization, 73: 443-448.

Pollitt, E., 1990. Malnutrition and Infection in the Classroom. UNESCO.

Ravussin, E., S. Lillioja, W.C. Knowler, L. Christin, D. Freymond, W.G. Abbott, V. Boyce, B.V. Howard and C. Bogardus, 1988. Reduced Rate of Energy Expenditure as a Risk Factor for Body-Weight Gain. New England J. Medicine, 318: 467-472.

Scrimshaw, N.S., 1998. Malnutrition, Brain Development, Learning and Behaviour. Nutr. Res., 18: 351-379.

Tataranni, P.A., I.T. Harper, S. Snitker, A. Del Parigi, B. Vozarova, J. Bunt, C. Bogardus and E. Ravussin, 2003. Body Weight Gain in Free Living Pima Indians: Effect of Energy Intake vs Expenditure. Int. J. Obesity and Related Metabolic Disorders, 27: 1578-1583.

United Nations Administrative Committee on Coordination/Subcommittee on Nutrition, 1992. Second Report on the World Nutrition Situation, vol. 1, Geneva.

United Nations Children's Fund (UNICEF, 1988. Asian and Pacific Atlas of Children in National Development. Bangkok, East Asia and Pakistan Regional Office.

Witts, L.J., 1964. Medical Surveys and Clinical Trials: Some Methods and Applications of Group of Research in Medicine. Oxford University Press. 2nd Edn.