

2

Predictive Validity of the Influence of Protein, Lipids and Carbohydrates on Pupils' Intellectual Abilities in Primary Schools in Cross River State Nigeria

By

DR. OBI ABANG BICHENE

*Department of Education Foundations,
College of Education,
Akamkpa,
Cross-River State.*

REV. DR. CLEMENT IFEANYI ENUNWAH

*Department of Education Foundations,
College of Education,
Akamkpa,
Cross-River State.*

And

MAGDALENE OBI-ABANG

*Department of Biochemistry,
Cross River State University of Technology,
Calabar.*

Abstract

The purpose of this study was to determine the predictive validity of the influence of protein, lipids and carbohydrate on intellectual ability of primary six (6) pupils in southern Cross River State –Nigeria. The ex post facto research design was used in carrying out the study. The sample size consisted of five hundred and six (506) primary six (6) pupils drawn from forty (42) out of two hundred and seventy nine (279) public primary schools in southern Cross River State using stratified random sampling technique. The instrument used for this study was an intelligence test consisting of 29 items divided into

Journal of Resourcefulness and Distinction, Volume 8 No. 1, August, 2014

four sections A – D. Regression analysis was used in analyzing the data. The result revealed that protein significantly influence pupils’ intellectual abilities, the influence due to lipids is not significant, while the influence on intellectual ability due to carbohydrate is inversely, significant. It is therefore recommended that primary school proprietors, administrators, even parents and government should put machinery in place to provide quality food to maintain good nutritional status of their pupils to enhance good intellectual abilities.

The concept of *intelligence* may not be fully captured in a single definition. This is because intelligence is a psychological construct. Nobody has seen or touched intelligence. It is a scientific invention to help explain and predict aspects of human behaviour. Intelligence is an abstract phenomenon that can only be inferred from behaviour (Ukpong, 1999). According to Colman (2003), the word intelligence is derived from the Latin word *intelligere*’- meaning to understand. It is the faculty (natural ability) of reasoning and understanding as distinct from feeling and wishing.

The word ‘*ability*’ seems to be intimately related to such commonly used words as *able* and *can*. English and English (1998:4) defined ability as “actual power to perform an act, physical or mental whether or not, attained by training and education’. They further posited that general ability is concerned with all sorts of tasks but especially those of cognitive or intellectual sort. Denga (2002), defined ability as developed capacity as contrasted with potential capacity. Colman (2003) defined ability as developed skill existing capacity to perform some function, whether physical, mental or both without further education or training.

By using the phrase *intellectual ability*, Carroll (1993), limited the range of intellectual tasks to those that centrally involve mental functions not only in understanding of the intended end results, but also in the performance of the task most particularly, in the processing of mental information.

Nutrition is defined by Umoh (2008), as the combination of processes by which the living organism receives and utilizes the materials (food) necessary for the maintenance of its functions such as growth and the renewal of its components. Foods on the other hand, comprise all the solid and liquid materials taken into the digestive tract that are utilized to maintain and build body tissues, regulate body processes, and supply heat thereby, sustaining life. On their part, Ebong, Uboh and Atangwho (2005), defined nutrition as the science that deals with foods required by living organism, how the living organism utilizes the foods and how it deals with the waste products of its activities. In other words, nutrition is the study of the food an organism eats and the

Predictive Validity of the Influence of Protein, Lipids and Carbohydrates on Pupils' Intellectual Abilities in Primary Schools in Cross River State Nigeria

uses of this food in the body. The purpose of nutrition is to maintain good health and prevent illness (Ebong, et al, 2005).

Foods may provide the organism with one or more of the six (6) nutrients required by the body (Umoh, 2008). Nutrients are the active principles or the ultimate nourishing chemical substances in food. Nutrients constitute the functional units/entities in food (Ebong, et al, 2005). Food is eating not nutrients. These nutrients include; carbohydrates, protein, fats (Lipids), mineral elements and water.

Proteins are made up of the elements carbon, hydrogen, oxygen and nitrogen (Umoh, William and Eyong, 2010). Most proteins also contain sulphur, traces of phosphorous, iron and other elements. Proteins can be obtained from animals, plants and micro organisms. Animal sources include, meat, fish, milk, egg white etc. plant sources include; wheat, pea, soya beans, leaf proteins etc. Microbial sources include yeast (Umoh et al 2010). The functions of protein include; growth, body building, maintenance of body tissues and regulation of body processes. Proteins are the main structural materials in the body. Proteins constitute a major part of bone and muscle. Proteins are also important components in blood, cell membranes and immune factors (Umoh et al, 2010). Proteins are needed by the body in the manufacture of antibodies enzymes and hormones. As antibodies, proteins help to fight against disease agents. Iron is one of the mineral elements in proteins. Iron deficiency anaemia (IDA) is one of the most rife nutrition problems in the world today (WHO, 1990). According to World Health Organization WHO (1990), over all rates for iron deficiency anaemia in developing countries are 46% for school age children and 51% for children below four years of age. In Nigeria, surveys indicated that the prevalence of iron deficiency anaemia (IDA) range from 70% - 15% in pre school children (National planning commission, 1995).

The consequence of iron deficiency anaemia includes among others; impairment of cognitive (intellectual) performance of infants, preschool, school children, adolescent and adults (Webb & Oski, 1993). Anaemic school children in Thailand showed poorer performance in Thai languages and Mathematics tests (Pollitt Kotchabhakdi & Missel, 1999). Thus, while iron deficiency anaemia can impair cognitive (intellectual) performance at all stages of life, its effects in infancy and early childhood are not likely to be reversed by subsequent improvement in iron status (Scrimshaw, 1997).

Iron is a necessary part of brain tissue. Nerve impulses move slower when iron deficiency is present. Iron deficiency during infancy may cause permanent damage in the child's brain. However, too much of iron can also cause problems. Enough, not too much is the key to appropriate iron intake (Walter, 1993).

It is evident that sub-clinical protein energy malnutrition (PEM) affects learning and behavior. For instance, experiment by Craviota, Delicaare & Birch, (1986, 1988) in Mexico and Guatemala showed that pre-school children in the lowest quartile of weight for age had significantly poorer performances on various tests of intersensory perception than those of highest quartile.

Sigman, Neumann, Jansen and Biribo (1999), in a study carried out in Kenya observed that malnourished children who were administered a good protein supplement from birth to three years of age averaged 2.6cm taller and 642gm heavier than the control group and had higher test scores than the control group.

Lipids include oils, fats and waxes etc. Lipids are generally insoluble in water but soluble in organic solvents like ether and chloroform. Lipids are smooth, greasy substances containing Carbon, hydrogen and Oxygen (Umoh et al, 2010). Lipids generally contain fewer oxygen atoms than carbohydrate. This difference in composition of atoms accounts for why lipids yield more energy per gram than carbohydrate -9Kcal/g on the average (Umoh et al, 2010). While fats are lipids that are solid at room temperature, oils are lipids that are liquid at room temperature. Based on the chemical structure of their dominant fatty acids, lipids can be separated into two basic types – saturated and unsaturated. This property determines whether such a lipid is solid or liquid at room temperature. The main sources of lipids include palm oil, egg yolk, groundnuts, soya beans, seed oils, animal fats etc.

Plant oils tend to contain many unsaturated fatty acid which make them liquid. Animal fats are often rich in saturated fatty acids, which make them solid. Almost all foods contain a variety of saturated and unsaturated fatty acids (Umoh, et al, 2010).

Lipids serve as sources of energy, contribute colour, flavor and texture, give satiety to foods and also serve as lubricants for each swallowing. Essentially, fatty acids provide raw materials from which hormones are made. They also form part of the structure of all cell membranes. Fatty acids aid in mental acuity and prevention of age associated dementia (Carol, 2003). He also noted that foods rich in fatty acids such as nuts, seeds, peanut, butter, fish oil and avocados help ensure that the brain is operating at optimal levels.

Carbohydrates are composed mainly of the elements carbon, hydrogen and oxygen. Foods rich in carbohydrates are primary sources of energy, 4Kcal per gram (Kcal/g) on the average (Umoh et al 2010). Major sources of carbohydrates include – sugar, starches, celluloses etc. Simple carbohydrates are called sugars. On the basis of weight, proteins provide roughly the same amount of energy as carbohydrates, while lipids provide twice as much. Carbohydrates are also the most readily available to the

body because it is the most easily digested and absorbed. Carbohydrates are also the most preferable sources of energy for most body cells. Normally, nutrition demands that diets should be mixed. Excess intake of carbohydrates or sugar – rich foods may lead to obesity and to under consumption of other foods containing essential nutrients. The body can make best use of protein if it is eaten simultaneously with carbohydrate. Sugars are useful as sweetening agents in foods, snacks etc. Carbohydrates supplementation enhances cognitive (intellectual) performance in soldiers engaged in sustained intense physical activities that expend high levels of energy. United States Army Research Institute of Environmental Medicine (USARIEM), (2001). Chavez and Martinez (1995), in their study of Mexicans found that those who (young and adults), had been carbohydrates supplemented as young children continued to perform better in all respects when Intelligent Quotient (IQ) scores of the supplemented group were matched at all ages up to eighteen (18) years with unsupplemented control group.

The human body requires these nutrients in correct proportions each day for proper functioning. If any situation arises that these nutrient requirements are not met, it results in bad or faulty nutrition or malnutrition (Umoh, 2008).

According to Umoh, Williams and Eyong (2010), nutrients can be assigned to three (3) functional categories viz:

- i. those that primarily provide energy e.g. carbohydrates proteins and lipids (fats and Oils)
- ii. those that promote growth, development and maintenance e.g. proteins lipids, vitamins, mineral and water.
- iii. those that keep body functions running smoothly (regulate body processes) e.g. proteins, lipids, vitamins, minerals and water. Some overlaps exist among these groups.

It is an indisputable fact that children exhibit variation in intellectual ability. Even within a given population, some children perform better than others intellectually. Also, even identical twins vary in their level of intellectual abilities even when exposed to environmental conditions and experiences that are similar.

What perhaps, are matters for dispute are the reasons put forward for these variations in intellectual ability. The reasons no matter how many and varied, may be broadly categorized into either biological or environmental (nature or nurture). Indeed, environmental factors determine the extent to which an individual attains his/her fullest innate intellectual ability (Gure, 1993). Rai (2001) and Denga (2002), attributed differences in intellectual abilities to inequalities in many factors, which include the nutritional status of children (quality of feeding).

Onyejiaku (1991), remarked that a number of studies have revealed that malnutrition during the first year of life has adverse effects on the later development of mental power (abilities). The brain reaches 70% of its adult weight by the end of the first year of life and completes its growth by the second year of life (Onyejiaku, 1991). Stock and Smythe (1993), noted that throughout the period of study, members of the undernourished group had smaller heads, lower weights and lower intelligence quotient (IQ) than the well fed children from the same socio-economic group.

Poorly nourished children have more problem fighting infections. They may be sick more often, miss more classes and fail to keep up with classmates (Troccoli, 1993). Under- nutrition results in decreased activity levels, decreased curiosity and decreased cognitive function (Meyers and Cahwla, 2000). Many cross – sectional and longitudinal studies have demonstrated an association between early childhood malnutrition and later cognitive development (Grantham-McGregor, 2006).

Hamadani, Hilaly, Khatun, Sultana and Huda (2004), conducted a study on effects of malnutrition on mental development in Bangladesh. They randomly selected 20 accessible community nutrition centers. They randomly assigned 10 nutrition centers to the intervention group and 10 to the control group. They enrolled all malnourished children between 6 and 24 months of age until they achieved a sample size of 100 children in each group. The children were studied for the purpose of comparing their developmental outcomes. At the beginning and end, the child's development was assessed using the revised version of Bayley scales of infant development that comprises mental and psychomotor development indices (Bayley, 1993).

On enrollment, the adequately nourished group had a higher mental development index ($P = 0.06$) than the malnourished children. At the end of the study, there was a decline in mental development of the children in all the groups. (Goldstein, Rashash, Plewis, Driaper, Browne & Yang 1998). These studies reviewed reported only global influence due to all the nutrition classes on intellectual ability of pupils. If the influence due to each nutrition class is report this would be of tremendous importance for intervention measures than the global nutrition status. Therefore, the question this study seeks to answer is what is the level of influence of protein, Lipid and carbohydrate on intellectual ability of pupils' in Cross River state primary schools?

Hypotheses

The following hypotheses which guided the study were tested at 0.01% two tailed levels of significance

1. There is no significant influence of protein on pupils' intellectual abilities?
2. There is no significant influence of lipids on pupils' intellectual abilities?

3. There is no significant influence of carbohydrate on pupils' intellectual abilities?

Research Methods

The ex post facto research design was chosen for this study because the demographic or independent variable in this study had already occurred or existed in the life of primary six school pupils in Cross River State. The population of the study consisted of all the primary six (6) pupils in public primary schools in Southern educational zone of Cross River State. The total number of 16491 pupils (8228 males and 8263 females) in 279 public primary schools across the seven (7) local government areas that make up the zone (State Universal Basic Education Board SUBEB, 2012).

A sample of 506 pupils was used. The sampling procedure was done in stages involving disproportionate stratified random sampling techniques. The population of the study had definite subsets which thus lent itself to stratified random sampling technique. The first stage involved the grouping of the schools into the seven (7) local government areas that make up the area of study. The second stage involved random selection of six (6) schools from each of the seven (7) local government areas making a total of 42 schools representing 15% of the number of schools in the area of study. The third stage involved random sampling of 12 pupils from each of the 42 sampled schools making a total of 504 pupils. Two (2) additional pupils were from Odukpani because of its large population; thus giving a total of 510 pupils. All the schools sampled were mixed to ensure sex representation in the sample. Six (6) boys and six (6) girls were sampled from each of the schools sampled for the study.

Instrumentation

The data for this research was obtained from one research instrument called an intelligence test made up of 14 items on the different food types that give the classes of nutrient required for balanced diet. The questionnaire has levels of consumption ranging from zero to greater than nine.

The intelligence test was divided into four sections from A – D with a total of twenty nine (29) items. Section A is made up of fourteen (14) items on the different food items that give the classes of nutrient required for balanced diet. This section has levels of pupil's consumption rate per week ranging from zero to greater than nine. This section was designed by experts on human nutrition in the departments of Biochemistry from University of Calabar and Cross River State University of Technology Calabar. This section was designed to elicit information on the nutritional status of the pupils. Each item in this section is measured on a scale of 0 -9. Section B – D is made up of 15 objective test items adapted from standardized intelligence tests by Binet and Simon (1916) in Anastasi and Urbina (2006). Section B was designed to test the perceptual intellectual ability of the respondents. That is, how the respondents can

reason easily with symbols and shapes. This section is made up of 5 objective items. Section C was designed to test the logical ability of the respondents. Logical reasoning is meant to test the validity of the conclusion reached from premises by respondents based on the application of the rules of inference. This section is equally made up of 5 objective items. Section D was designed to test the acuity intellectual ability of the respondents. Acuity intellectual is the ability to think, see quickly and clearly. This section is equally made up of 5 objective items.

The respondents were assured of confidentiality. The respondents were requested to tick the right choice in each of the items on the instrument. For sections B – D, the questionnaire items are objective in nature with 4 options lettered (A – D). The right option only was to be ticked on the question paper. The duration of the exercise was 30 minutes. The researchers' justification for using the instrument is because it is a standardized intelligence test. In addition, one of the instruments for measuring cognitive domain is intelligence test. This is a test of general mental or intellectual ability. It measures an individual's capacity to think abstractly, to integrate new experiences and to adapt to new situations (Joshua, 2005).

Though the instrument was adapted from standardized intelligence tests, the content validity was ascertained by experts in measurement and evaluation from University of Calabar and Cross River State University of technology, Calabar.

To determine the reliability of the instrument, a pilot test was conducted using 60 primary six pupils randomly drawn from 2 primary schools in the area of study. A test-retest was administered on the 60 pupils sampled within an interval of two weeks. The reliability estimates ranged from 0.61 to 0.77. These values were considered sufficiently high to justify the use of the instrument for the study. The researchers personally visited the 42 schools sampled for the study. The instrument was administered by the researchers assisted by the class teachers. All the 506 copies of the instrument were retrieved representing 100% return rate. The data was analyzed using Pearson Product correlation coefficient statistic.

Results

The summary of the result from the analysis is presented in table 1.

Predictive Validity of the Influence of Protein, Lipids and Carbohydrates on Pupils' Intellectual Abilities in Primary Schools in Cross River State Nigeria

Table 1: Summary of Regression Coefficients Analysis

Model	Unstd. Coefficients		Std. coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	61.843	1.693		36.524	0.000
Protein	0.267	0.127	0.131	2.101	0.036
Lipids	0.105	0.058	0.086	1.829	0.068
Carbohydrate	-0.296	0.086	-0.211	-3.437	0.001

Hypothesis One: There is no Significant Influence of Protein on Pupils' Intellectual Abilities

Data in table 1 showed that the influence due to protein on pupils' intellectual abilities is 0.267. This is about 27 percent of the influence due to nutrition status on pupils' intellectual abilities. The student t value and probability of the level of influence is 2.101 and 0.036 respectively. The level of significance is less than 0.05 stipulated, therefore we reject the hypothesis, and conclude that protein significantly influence pupils' intellectual abilities. This finding confirms the studies of Webb and Oski, (1993), Pollith, Katchabhkdi and Missel (1999), who in separate but similar studies, found that protein intakes had significant influence on children intellectual abilities.

Hypothesis Two: There is no Significant Influence of Lipids on Pupil's Intellectual Abilities

The degree of influence of lipids on pupils' intellectual abilities is 0.105. (Table 1). This relationship is positive and indicated about 10.5 percent of the total influence due to nutrition status. The t value for such influence is 1.829 with a probability of 0.068. Because the probability of observing such degree of influence is greater than 0.05 stipulated for the study, this hypothesis is not rejected, so we conclude that the influence due to lipid on pupils' intellectual abilities is not significant. The result contradicts that of Kelly (2003), who reported in his study that lipids aid in mental acuity.

Hypothesis Three: There is no Significant Influence of Carbohydrates on Pupils' Intellectual Abilities

The contribution of carbohydrates to the over-all influence on pupils' intellectual abilities is -0.296. (table 1). This is about 29.6 percent of the total influence of nutrition status on pupils' intellectual abilities. The degree of influence of carbohydrates on pupils' intellectual abilities is inverse in direction. That is the more carbohydrates in-take, the less pupils' intellectual abilities. The t value associated with

this degree of influence is-3.437 with probability 0.001. The hypothesis is rejected because chosen level of significance (0.05) for the study is greater than the probability of observing this level of influence. Therefore, it is concluded that carbohydrates had significant influence of pupils' intellectual abilities. The finding confirms the studies of USARIEM (2001), and Chavez and Martinez (1995), who in separate but similar studies found that carbohydrate intakes enhance intellectual performance.

Recommendations

The following recommendations were made based on the results of the study

1. The existing diets should be improved upon by increasing the proportions of fish, periwinkle, snails and crayfish.
2. Cheap sources of nutrition like bush meat, insects, snakes, crabs and some unconventional, but available items could be consumed to supplement nutrient intake.
3. More edible fruits be consumed as snacks to make up for the loss of vitamins incurred in the handling, processing and preparation of meals.
4. Nutrition education should be introduced at all levels of education to improve upon the existing levels of nutrition intake.

References

- Anastasi, A. & Urbina, S. (2006). *Psychological Testing* (7th ed). New Delhi: Pearson.
- Bayley, M. B. (1993). *Scales of Infant Development* (3rd ed). San Antonio: The Psychological Corporation
- Carroll, J. B (1993). *Human Cognitive Abilities: A survey of factor analytic studies*. New York: Cambridge University Press.
- Colman, D. (2003). *Oxford dictionary of psychology*. Oxford:
- Chavez, A. & Martinez, C. (1995). *Growing up in a developing community*. Mexico City: National Nutrition Institute.
- Cravioto, J., Delicadie, E. R. & birch, H. G. (1986). Nutrition, growth and neutron-integrative development: an experimental and ecologic study. *Paediatrics*, 38(2), 319 – 372.
- Cravioto, J., Delicadie, E. R. & birch, H. G. (1986). Intersensory development of school aged children. In Scrimshaw N. S. and Gordon, J. E (eds), *Malnutrition Learning and Behaviour*, MIT press. 252 – 269.

Predictive Validity of the Influence of Protein, Lipids and Carbohydrates on Pupils' Intellectual Abilities in Primary Schools in Cross River State Nigeria

- Denga, D. I. (2002). *Educational and social psychology for schools and other social organizations*. Calabar: Clear lines.
- Ebong, P. E., Uboh, F. E., & Atangoho, I. J. (2005). *Nutrition health and diseases*. Calabar: Nku-Ubia Ventures.
- English, H. B. & English, A. C. (1998). *A comprehensive dictionary of Psychological and psychoanalytical terms: a guide to usage*. New York: McKay.
- Goldstein, H. B; Rasbash, J.; Pleivis, I; Draper, D.; Browne, W; & Yang, M. (1998). *A user's Guide*. London: Institute of Education.
- Gure, J. O. (1993). *Socio-economic status and academic achievement in primary school pupils*. Unpublished B.Sc project. Faculty of social science. University of Calabar – Nigeria.
- Hamadani, J. D., Hilaly, A., Khaatun, F. Sultana, P. & Huda, S. N. (2004). *Mothers' perception of children's development: Findings from focus group discussions*. Paper presented at regional on childhood disabilities: Dhaka.
- Joshua, M. T. (2005). *Fundamentals of tests and measurement in education*. Calabar: University of Calabar Press.
- Meryers, A. & Cahivla, N. (2000). Nutrition and the social emotional and cognitive development of infants and young children: *zero to three*: 21 (1) 6 – 12
- National planning commission (1995). National food and nutrition policy.
- Pollitt, E., Kotchabhakdi, N. J. & missel, L. (1999). Iron deficiency and educational achievement in Thailand. *Amer. J. Clin. Nutrition*. (50), 687 – 697.
- Onyejiaku, F. O. (1991). *Psychology of adolescence*. Calabar: Rapid Publishers.
- Rai, A. (2001). *Intelligence tests*. New Delhi: Sterling Publisher.
- Scrimshaw, N. S. (1997). Nutrition and health from womb to tomb. *Food and nutrition Bulletin* (18), 1 -19.
- Sigman, M., Neumann, C., Janse, A. A., & Bwibo, N. (1999). Cognitive abilities of Kenyan children in relation to nutrition family characteristics and education. *Child. Dis.* (60), 1463 – 1774.

- Troccoli, K. B. (1993). *Eat to learn, learn to eat: The link between nutrition and learning in children*. Washington D. C: National Health/ Education Consortium.
- Ukpong, E. M. (1999). The concept of intelligence, In A. F. Uduigwomen & K. Umoh, I. B. (2008). *Nutrition from womb to tomb*. Calabar: Kolmac Publishers
- Umoh, I. B., Williams, I. O. & Eyong E. U. (2010). *Principles and elements of human nutrition*. Calabar: Kalmac Publishers.
- United States Army Research Institute of Environmental Medicine, USARIEM (2001). Natick, MA. 01760 – 5007, USA
- Walter, T. (1993). Impact of iron deficiency on cognition in infancy and childhood. *European journal of clinical Nutrition*, (47), 307 – 316.
- Webb, T. & Oski, F. (1993). Iron deficiency anaemia and scholastic achievement in young adolescents.
- World Health organization,(WHO) (1990). Diet, Nutrition and prevention of chronic disease. *Technical Report Series 797, Geneva*