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Relationship of Dietary Intake of Food Group and Academic Performance of College Student (Study in Zimbabwe)

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Abstract: This study sought to establish the relationship of food group intake and academic performance of college students. The quantitative approach was used and data were analysed using Pearson's correlation co-efficient at 1% and 5% significance levels in the SPSS version 23.0. The population of the study was the student teachers in a college of teacher training in Matabeleland south in Zimbabwe. The sample comprised of 100 students purposively selected from different main subject areas offered in the college. The study concluded that adequate and sufficient healthy intake of food is essential for the appropriate functioning of the brain. Without adequate food, the brain lacks the necessary nutrients that enhance its ability to carry out the so much energy-consuming intellectual activities such as comprehension, evaluation and application which students must demonstrate when they are learning. The study recommends that food should not merely be directed at ensuring food security for all, but should also achieve the consumption of adequate quantities of safe and good quality foods from different food groups that together make up healthy diets which promote brain functioning.

Keywords: Dietary intake, Food group, Nutrients & Academic performance.

1. Introduction

The study and understanding of nutrition and brain function has not been given much attention in relation to human learning in the sub-Saharan Africa (Helwig, 2009). Information Processing Model is one of the theoretical lenses through which the researcher appraises issues in this study in order to understand the coordinated functioning of the transmission of neural impulses that take place in the brain cells during the processing of information. It is the researcher's contention that for the proper information to occur in a student while involved in learning, the brain cells must be well nourished. In conjunction with the

physiological explanation of motivated behaviour through satisfaction of food that Maslow offers the proper functioning of the neurological system has a bearing on one's physiological arousal such as the motivation to learn or lack of it. Thus, in a bid to satisfy the higher order level of human self-actualisation, the human organism must have an active neural system as a result of food intake from different food groups.

While much work has been done on the influence of factors such as college type, location, parental involvement, family structure and gender on academic performance of college students in Zimbabwe (Mpofu, 2009), the researcher could not lay hold on any study that considered the effects of food group intake on the learning process and outcomes among college students in Zimbabwe.

According to Barker (2002), cognition occurs through activity within the brain's structure and the brain is mainly made up of nerve cells known as neurons and glial cells that support the neurons. Brain development starts three weeks after conception, when neurons begin to form and to multiply, and develop rapidly from the second trimester of pregnancy through the first year of life so that by age one, a baby has about 100 billion neurons and will maintain roughly the same amount through adulthood (Kagan, 2009).

Though stable in number, these neurons continue to grow and change dramatically based on the unique activities they are stimulated to undertake (Crichton, Bryan, Murphy & Buckley, 2010)). In order for any human action to occur, neurons must communicate with each other. Neurotransmission, which is the communication between neurons, happens when one neuron's axon sends information out of its cell and another neuron's dendrite picks up the information. The number of synapses decreases as connections become more efficient and networks of connections become more permanently established where during cognition, each activated synapse fires about 200 times per second (Kagan, 2009) and this is clear that cognition is an energy-expensive activity since the brain consumes a huge amount of energy in comparison to the rest of the body. According to Crichton, Bryan, Murphy & Buckley (2010), the human brain accounts for only about 2% of a person's body weight, but consumes between 20-30% of the body's available energy and oxygen because active neurons burn fuel to function. Therefore, mechanisms involved in the transfer of energy from foods to neurons are fundamental to the control of the brain function which determines cognition. Simply choosing different foods that fuel the brain can have a significant effect on academic performance. Eating certain foods can improve ability to focus, retain information and remain mentally alert in order to get through the most gruelling of study sessions. The best are foods that not only fill the belly, but feed the brain as well, enabling better grades.

Murakami et al., (2008) assert that all cells in the human body, including neurons and glial cells, derive energy from food calories in the form of macronutrients: carbohydrates, proteins, and fats. Before cells can gain energy from food, it must be converted into simple sugars, especially in the form of glucose, a simple sugar that is the primary source of fuel for the brain, nervous system, and red blood cells, and a preferred energy source for all other bodily cells and tissues. Carbohydrates provide the most efficient source of energy for the body because they easily break down into simple sugars and are quickly converted to glucose in the liver.

The World Health Organization (WHO) recommends 55-75% of humans' calories come from carbohydrate, based on the Dietary Guidelines for Americans, of at 45-65% (WHO Expert Consultation, 2004). Likewise, U.S. dietary guidelines recommend a higher ratio of calories coming from fat (25-35%) and protein (10-30%) than those of the WHO (U.S. Department of Health and Human Services [USDHHS] and U.S. Department of Agriculture [USDA], (2005). Using either protein or fat for energy requires extra work during conversion to glucose, produces toxic by-products, and depletes the body of protein and fat needed for other bodily functions (Davis & Melina, 2010; Graham, 2006). Therefore, to minimise exertion of extra work on the already overloaded brain, it would seem more reasonable to adopt the WHO recommendations for carbohydrate as the major source of energy which is less expensive to convert into glucose.

Food also fortifies the body with micro-nutrients (vitamins and minerals) that are involved with a variety of processes that promote neural survival. In addition, micronutrients synthesise brain chemicals called neurotransmitters that are responsible for carrying information across synapses, and support efficient

transmission along these pathways. Deficiencies or excesses of certain vitamins or minerals can damage nerves in the brain, causing changes in memory, limiting problem-solving ability and impairing brain function (Mpofu et al., 2018).

As an energy-expensive organ, the brain, therefore, requires adequate energy in the form of glucose and sufficient nutrients to function properly (Helland, et al., 2003). The brain's energy needs are elevated throughout childhood, which suggests a more crucial need for suitable nutrition during development. The technologies that allow scientists to monitor energy metabolism in the brain provide detailed information about brain activity in various cognitive processes. In relation to academic achievement, some studies imply that students with an insufficient glucose supply or nutrient deficits will have compromised cognitive potential (Helland, et al., 2003).

Maximising brain function is a prime factor in seizing appropriate cognitive capability for example, ability to focus, comprehension, evaluation and application in learning (Kretchmer, Beard & Carlson, 1996). The literature thus illustrates the fact that there seems to exist a direct relationship between the intake of food as a basic, physiological need that Maslow emphasises and the functioning of the mind as a means of attaining the growth need of academic achievement. If the students are exposed to deficiency in protein, the malnourished brain cells may inhibit cognitive functioning.

In view of the above literature, the researcher is of the contention that although Maslow did not attempt to explain the neurological function of food in the human body, the important assumption is that it is through the provision of adequate food that students will function well in their cognition as they would get the energy to engage with academic tasks. It is through the provision of adequate and well-nourishing food that a student's neurological system may function well enough to facilitate effective information processing during their contact with learning materials. The researcher believes that the nutritional neuroscientific approach to explaining the link between the kind of food one takes and the way the electrochemical transmission of neurons in the brain cells happens, is relevant in regarding how physiological processes in the body may, ultimately, affect the way a student responds to learning stimuli.

1.2 Research question

- What is the relationship of food group intake and academic performance?

2. Methodology

The research design and methodology that was used in this case study is described in this section.

2.1 Research design

This case study used the mixed methods research approach, that is, both quantitative and qualitative approaches as a method of data triangulation. Mixed methods research offers the best of both worlds, helping answer questions that could not be answered by qualitative or quantitative approaches alone.

2.2 Population

The population of this study comprised college students from the Department of Teacher Education and the kitchen staff at a Teacher Training College in Matabeleland South, Zimbabwe. The population was identified so that the researcher could gather as much information as needed concerning food consumption patterns for college students from different groups that deal with students' food provisions.

2.3 Sample and sampling strategies

Sampling for this study was done in two phases. The first phase used purposive sampling to select 100 students. The sample was used to collect quantitative data. According to Lincoln and Guba (2006), purposive sampling aims at capturing and describing the principal outcomes that cut across a great deal of participant variation. The second phase used purposive sampling procedure to select a sample of 14 students and 2 kitchen staff members for qualitative data.

2.4 Instruments

Face to face interviews and observations were used to collect qualitative data while questionnaires, 24-hour dietary recall, food frequency questionnaire were to collect quantitative data.

2.5 Data collection

In this study the researcher collected data in two phases. Phase 1 collected using quantitative data while Phase 2 collected qualitative data.

2.6 Data analysis

Quantitative data analysis for this study was done using the IBM Statistical Package for Social Sciences (SPSS) version 23.0 while qualitative data employed thematic analysis.

2.7 Ethical considerations

Ethical clearance was sought from the University of Venda and from the Ministry of Higher and Tertiary Education, Science and Technology Development in Zimbabwe. The clearance was approved by both institutions. Two key ethical issues considered were consent and confidentiality.

3. Findings and Discussions

3.1 Food Frequency

Food frequency questionnaire was used to establish how often students consumed particular foods.

3.1.1 Consumption of fats, oils and sweets

Table 1 shows the particular fats, oils and sweets consumed by the students.

Table 1: Frequency of consumption of fats, oils and sweets (n=100)

Food variety	Never		Sometimes		Once per month		Once per week		Once per day	
		%		%		%		%		%
Oils	0	0%	0	0%	0	0%	0	0%	100	100%
Sugars	6	6%	13	13%	4	4%	2	2%	75	75%
Sweets	5	5%	10	10%	13	13%	12	12%	60	60%
Soft drinks	13	13%	43	43%	15	15%	9	9%	35	35%
Candies	60	60%	11	11%	4	4%	2	2%	30	30%
Margarine	16	16%	74	74%	3	3%	4	4%	1	1%
Cakes	99	99%	1	1%	0	0%	0	0%	0	0%
Butter	80	80%	19	19%	1	1%	0	0%	0	0%
Sweet desserts	65	65%	24	24%	11	11%	0	0%	0	0%

Results in Table 1 indicate that much of the fats and oils are consumed through the intake of fast foods which include fried foods. Fats provide essential fatty acids, which are not made by the body and must be obtained from food. The essential fatty acids are linoleic and linolenic acid, important for controlling inflammation, blood clotting, and brain development. While fats and oils are essential for the proper functioning of the body and brain development it is imperative that they are taken sparingly and not in large quantities as they cause weight gain resulting in obesity (Niemeier et al., 2006). Butter and oils are examples of fats. Healthy sources of fat can be found in fish, nuts, and certain fruits and vegetables, such as avocados (Wardlow & Smith, 2011). Eating fish leads to better grades; the facts lie in the high

concentrations of Omega-3 fatty acids found in most fish (Murakami et al., 2008). These fatty acids are essential to proper neural function.

The greater part of the brain is made up of fatty tissue, so it makes sense that eating fish and other foods high in fatty acids would help students focus more and to study more efficiently. According to Murakami et al., (2008) eating fish regularly can also reduce the risk of dementia as one gets older, another indication of its impact on brain health. Results shown in Table 2 reflect that only 3% ate fish once a week and the rest did not take fish at all while in college. Results of this study suggest that a greater percentage of students were taking unhealthy fats and oils in large quantities, and this may be the reason why 64% of the study participants are overweight. Overweight and obesity are risk factors for hypertension which is also a risk factor for the decline in cognitive abilities aggravated by a tendency of feeling weak and tired more often thereby losing concentration resulting in poor academic performance. These findings mean that students were taking too much fats and oils more than the recommended amounts as per “myplate” food guide.

3.1.2 Consumption of starchy foods (Cereals, breads and grains)

To establish how often students consumed starchy foods, the students were asked to indicate number of times they ate the foods indicated in Table 4.12. Starchy foods provide carbohydrates needed by the body for energy. Whole wheat, brown bread and cereals provide complex carbohydrates and are considered to be the good ones because they convert into energy and keep one going all day without fatigue. “Sadza” (pap) and white bread are regarded as simple carbohydrates which usually consist of some type of sugar hence they give instant bursts of energy and when these quickly dissipate, energy levels drastically drop (Westover & Marangel, 2002). However, white bread gives iron which is needed for academic performance.

Table 2 shows the students’ frequency of consumption of starchy foods (Cereals, breads and grains).

Table 2: Frequency (n=100) of consumption of starchy foods (Cereals, breads and grains)

Food variety	Never		Sometimes		Once per month		Once per week		Once per day	
		%		%		%		%		%
Sadza	0	0%	0	0%	0	0%	0	0%	100	100%
White bread	3	3%	0	0%	1	1%	3	3%	93	93%
Polished rice	6	6%	9	9%	3	3%	8	8%	74	74%
Brown bread	64	64%	22	22%	7	7%	0	0%	7	7%
Cornflakes	64	64%	30	30%	0	0%	0	0%	6	6%
Cerevita	87	87%	9	9%	0	0%	2	2%	2	2%
Whole wheat bread	81	81%	16	16%	2	2%	0	0%	1	1%
Oatmeal	99	99%	0	0%	0	0%	1	1%	0	0%
Mealie meal porridge	96	96%	3	3%	0	0%	3	3%	0	0%
Brown rice	84	84%	16	16%	0	0%	0	0%	0	0%

The next highest consumed nutrients were carbohydrates with “sadza” having the highest percentage of 100% followed by the consumption of white bread with 83%, polished rice with 74% respectively. Several research studies established that too much intake of unhealthy carbohydrates leads to obesity and cardiovascular diseases. A dense meal of carbohydrates can leave one feeling sluggish and tired as it increases the levels of tryptophan in the brain. According to Parker (1989), eating lots of refined carbohydrates like refined mealie-meal porridge, white bread and white pasta is not only bad for physical

health, but it also leads to sleepiness, lethargy and mental dullness. However, whole grains tend to have the opposite effect and can lead to enhanced memory function and even better grades. Whole grain breads, wheat bran and brown pasta provide a quick energy boost while studying. They release glucose slowly into the blood stream keeping one mentally alert throughout the day.

Results from the 24 hour dietary recall reflect that although the students took carbohydrates more than other nutrients, they did not meet the minimum dietary requirements for enough energy supply. Thus, the majority of the students have food consumption patterns packed with carbohydrate than other nutrients. These results suggest that students had unbalanced diet and were at risk of overweight.

3.1.3 Consumption of meat, fish, eggs and nuts

Meat, fish, eggs and nuts provide the body with proteins and are crucial for muscle growth. Adequate amounts of protein can be met by regularly eating any type of meat and can also be found in lentils and beans, as well as soy products. Table 4 shows the frequency at which students consumed protein giving foods.

Table 3 Frequency (n=100) of consumption of protein foods, Meat, fish, eggs and nuts

Food variety	Never		Sometimes		per Once month		per Once week		per Once day	
		%		%		%		%		%
Beef	2	2%	14	14%	3	3%	2	2%	77	77%
Chicken	1	1%	24	24%	0	0%	25	25%	50	50%
Eggs	41	41%	33	33%	11	11%	6	6%	9	9%
Beans	11	11%	35	35%	2	2%	50	50%	2	2%
Fish	31	31%	55	55%	11	11%	3	3%	0	0%
Nuts	0	0%	98	98%	0	0%	2	2%	0	0%
Pork	100	100%	0	0%	0	0%	0	0%	0	0%

Proteins were ranked third with the meat group having beef being the most consumed food item with 77% consuming red meat once per day. Red meat like grass-fed beef is a source of protein and also an excellent source of vitamin B12, which is vital for healthy brain function. Smith et al., (2011) in their study, report that people with high levels of markers for vitamin B12 deficiency are more likely to score lower on cognitive tests, as well as have a smaller total brain volume, which suggests a lack of the vitamin may lead to brain shrinkage. Protein should be taken in the right proportion since it is a vital part of brain growth during early development. Neurons, though mostly fat and fueled by glucose, they use proteins to communicate with one another and control what happens throughout the body. The enzymes, neurotransmitters and hormones that carry signals and help accomplish the tasks the brain dictates are made from protein. Protein however, has unique abilities to bend, twist and shape itself into the structures that allow enzymes to work and are vital to brain health (Barker, 2002). They aid digestion so that the brain gets the nutrients it needs, but they also work inside the brain too, breaking down plaque, creating neurotransmitters and much more. According to (Smith et al., 2011) too much animal protein can put some strain on the kidneys and deliver much more fat than one needs. However, plants are not devoid of protein. Nuts, seeds, legumes, lentils, beans and some whole grains are good sources of healthy proteins. Protein deficiencies slow down development and lower cognitive function. Lack of proteins depletes the chemicals in the brain that control mood, appetite and energy levels (Barker, 2002), thus compromising on academic performance.

Chicken was consumed by 50% of the students while only 9% consumed eggs once per day. According to Azhar, Zubaidah, Norjan, Zhuang and Tsang (2013) besides chicken and eggs being sources

of protein, they have been found to provide high levels of choline naturally in addition to many other nutrients. They went on to say that choline is a macronutrient that is important for liver function, normal brain development, nerve function, muscle movement, supporting energy levels and maintaining a healthy metabolism. Nutrition experts recommend getting higher levels of choline in order to boost brain function and to retain memory. Choline deficiency is associated with low energy levels, fatigue, memory loss, cognitive decline, learning disabilities, muscle aches, nerve damage and mood changes disorders. Thus, the results of this study suggest that half the students were having chicken at least once a day, which is an indicator for sound academic performance if coupled with other nutrients to balance the diet.

Only 2% had beans at least once per day which is a very insignificant number. Tiemeier et al., (2003) assert that legumes such as beans, chickpeas, kidney beans and lentils contain substantial amounts of protein which power the brain and make studying a breeze. Willet et al., (2010) reiterate that beans are under-recognised yet they are economical. Beans stabilise glucose (blood sugar) levels. Since the brain is dependent on glucose for fuel and cannot store the glucose, it relies on steady stream of energy, which beans can provide, hence the need for students to consume at least half cup of beans per day. In addition, legumes of all varieties contain high concentrations of folic acid which improves ability to recall information.

Nuts had 0% rate of intake per day though 9% indicated consumption of nuts once per week, it is still not sufficient, implying that none took nuts regularly yet like fish, many types of nuts such as almonds and walnuts contain high levels of essential fatty acids that help the brain to perform optimally (Meyers, Sampson & Weitzman,1991). As an added benefit, nuts contain a good amount of iron and also provide oxygen to the brain which increases mental alertness and ability to retain information. A minimum of 20grams of nuts per day is recommended for optimal brain health. Since nuts are high in unsaturated fat (good-fat) and calories, they make great sources of energy as well. The students' food consumption patterns were comprised of low protein. These results suggest that students' protein supply was not met which results in them not being able to concentrate in class since protein boosts brain function, the organ used in information processing in learning.

On the whole, 18% of the students consumed milk as relish with pap and in tea and none consumed yoghurt and cheese yet yoghurt, as well as cheese consumption, has been shown to aid cognitive function in both younger adults and the elderly. Emerging evidence suggests that milk products may play a beneficial role in improving cognitive function and thus aid in thought processing and mental ability (Prinz et al., 2013).

3.1.4 Consumption of milk and milk products

Yoghurt and cheese consumption has been shown to aid cognitive function in young adults and the elderly. Emerging evidence suggests that milk products play a beneficial role in improving cognitive function and thus aid in thought processing and mental ability (Elwood 2005).

Frequencies in Table 4 show how often students consumed milk and milk products such and yoghurt, cheese and milk in tea or as relish.

Table 4: Frequency (n=100) of consumption of milk and milk products

Food variety	Never		Sometimes		Once per month		Once per week		Once per day	
		%		%		%		%		%
Milk	16	16%	65	65%	65	65%	1	1%	18	18%
Yoghurt	94	94%	6	6%	6	6%	0	0%	0	0%
Cheese	99	99%	1	1%	1	1%	0	0%	0	0%

Previous studies have established that a high-dairy diet improves working memory performance while lower consumption of milk and milk products has been associated with poorer cognitive function and an increased risk for vascular dementia (Crichton, et al., 2012). Increased serotonin level from milk has beneficial effects on mood and cognitive function, including information processing. It can be deduced that milk products may be beneficial for the prevention of cognitive decline. Results of this study suggest that very few students consume milk and milk products on a daily basis which puts them at risk of cognitive function.

3.1.5 Consumption of vegetables

According to a study conducted by Anding et al., (2000), most vegetables had positive effect on memory retention, meaning they most likely help achieve better grades. Spinach does not top the list of popular vegetables, but it does make the cut when it comes to foods proven to boost brain power, and that could mean better grades. Spinach is full of folic acid and has even been shown to reverse memory loss (Astorg et al., 2004).

Table 5 shows the frequency at which students consumed different types of vegetables as indicated in the table.

Table 5 Frequency of consumption of vegetables

Food variety	Never		Sometimes		Once per month		Once per week		Once per day	
		%		%		%		%		%
Cooked leafy vegetables	16	16%	14	14%	6	6%	53	53%	11	11%
Spinach	98	98%	2	2%	0	0%	0	0%	0	0%
Vegetable salads	92	92%	5	5%	1	1%	1	1%	1	1%
Cabbages	83	83%	8	8%	4	4%	4	4%	1	1%
Butter nuts	86	86%	14	14%	0	0%	0	0%	0	0%
Carrots	97	97%	3	3%	0	0%	0	0%	0	0%
Pumpkins	88	88%	5	5%	0	0%	0	0%	0	0%

Only 11% consumed cooked leafy vegetables per day while 53% consumed them once per week which is very insufficient. Green leafy vegetables are one of the best food sources of magnesium and magnesium citrate benefits brain cell receptors to speed the transmission of messages, while also relaxing blood vessels, which allows more blood flow to the brain (Selkowitz, 2000). Getting adequate vegetables, especially cruciferous ones which include broccoli, cauliflower, cabbage and dark leafy greens, may help improve memory (Torres & Nowson, 2007).

Eating these vegetables raw is the best way to get the optimal nutritional benefit, since cooking them often cooks out the nutrients the body and the brain need most (Taras, 2005). The results of the study suggest that students were not taking the most nutritious vegetables which they can even eat without cooking. Therefore students' consumption patterns lacked the most needed vegetables in their diet. It is suggested that students include vegetables in their daily meals for proper functioning of their brains.

3.1.6 Consumption of fruits

Table 6 highlights the frequency of fruit intake by students.

Table 6 Frequency (n=100) of consumption of fruits

Food variety	Never		Sometime		Once per month		Once per week		Once per day	
		%		%		%		%		%
Apples	91	91%	2	2%	0	0%	0	0%	7	7%
Bananas	90	90%	5	5%	3	3%	1	1%	1	1%
Berries	90	90%	5	5%	3	3%	1	1%	1	1%
Oranges	89	89%	10	10%	1	1%	0	0%	0	0%
Pears	99	99%	1	1%	0	0%	0	0%	0	0%
Fruit juice	89	89%	11	11%	0	0%	0	0%	0	0%
Avocados	100	100%	0	0%	0	0%	0	0%	0	0%

Fruits were next in ranking, with 7% consuming apples and none consumed avocados. Pallesen et al., (2009) points out that the peel of the apple includes a powerful antioxidant called quercetin that enhances memory function. None of the students consumed avocados at all. The avocado is a fatty fruit, a mono-unsaturated fat, which contributes to cardiovascular health and healthy blood flow (Taras & Potts-Datema, 2005). Avocados lower blood pressure and a lower blood pressure promotes brain health (Dabas et al., 2013). The results of the study suggest that students’ food consumption patterns had insufficient fruit intake with just a few taking apples and none of the other fruits regardless of their importance to brain function. Based on the results of the questionnaire and interviews up to this point, it is clear that generally students had food consumption patterns that represented unbalanced diets. The cooks also reiterated that although the prescribed meals seemed adequate for the students, they were limited in terms of nutritive value and in terms of variety to cater for the supply of all necessary nutrients to balance the diet. In addition, the students’ penchant for beef and chicken and not vegetables for their relish as reported by the cooks, resident students contributed to food consumption patterns that neglected other important nutrients.

3.2 Relationship of food nutrients intake and academic performance

To establish the impact of students’ diet on academic performance, the relationships of individual nutrients and students’ marks from five (5) subjects were correlated using IBM SPSS version 23. The students’ marks per subject were correlated to intake of individual food groups in order to establish the relationship of intake of different foods and academic performance. The subjects that were considered were the five subjects that were taken by all the students in the college which comprised Theory of Education (TOE), Physical Education (PE), Music, Home Economics (HE) and Information Technology (IT).

Table 7: Relationship of dietary intake of starchy foods and academic performance

		TOE	PE	Music	HE	IT
Starchy foods	Pearson Correlation	-0.346**	.568**	.530**	.528**	.572**
	Sig. (2-tailed)	.000	.000	.000	.000	.000

*. Correlation is significant at the 0.05 level (2-tailed)

** . Correlation is significant at the 0.01 level (2-tailed)

Results in Table 7 indicate that when starch intake increases, performance in Theory of Education decreases significantly. ($r=-0.346$; $p=0.000$ at $\alpha=0.01$). However, data from 24-hour dietary recall record showed that students did not even take adequate starch, meaning if they did, the negative correlation could

have been higher.

TOE is an academic subject while the other subjects are practical subjects and thus the reason why the performance decreases in TOE when there is an increase in intake of starchy foods. The facts lie in the differences between energy expenditure in TOE and practical subjects. One needs to have more energy when doing practical subjects than when doing academic subjects. Carbohydrates found in starchy foods provide that energy. According to Tull, (1999) after eating, there is break down of carbohydrates into glucose sugar that fuels the cells of the body to function well. During digestion, glucose moves into the bloodstream which carries it to cells where it is used as a source of energy. When starchy food is increased in excess of the energy expended and activity remains low, the risk is excess starch is easily converted to fat, especially when accompanied with the high insulin levels that result from increasing blood sugar levels (Taras & Potts-Datema, 2005). The body becomes weak and feeling of dizziness is experienced thereby compromising on the concentration span and memory retention consequently affecting academic performance.

Excess fat in the body is a risk factor for obesity, a condition that causes shorter attention spans, decreased mental flexibility and lower estimated intellectual functioning, all of which may present challenges for students’ learning (Ebbeling, Pawlak, & Ludwig, 2002). Researchers have found that with an increase in obesity comes the development of other diseases, which may also affect academic achievement. For instance, studies have shown that the prevalence of obesity parallels a rise in Metabolic Syndrome, a disease that increases the risk of cardiovascular disease and diabetes which is also associated with cognitive impairments in adults and adolescents (Ebbeling & Ludwig, 2002).

On the other hand, the results also indicate that when starch increases, performance increases significantly in the other subjects with Physical Education ($r=0.568$; $p=0.000$ at $\alpha 0.01$); Music ($r=0.538$; $p=0.000$ at $\alpha =0.01$); Home Economics ($r=0.528$; $p=0.000$ at $\alpha =0.01$). Information Technology ($r=0.572$; $p=0.000$ at $\alpha =0.01$). Thus, after excess starch is converted to fat, it is then stored in the body fat stores for later use. Results of the study show that performance increases significantly in practical subjects when starchy foods increase as they sustain the body energy which because of their nature students expend more energy when doing practical work, hence the positive correlation. However, it is worth noting that although carbohydrates are important they should come from healthy sources such as fresh fruits, vegetables and whole foods and not from candy, soft drinks and processed foods as is the situation in this study. A dense meal of carbohydrates can leave one feeling sluggish and tired as it also increases the levels of tryptophan in the brain (Tull, 1999). The amino acid tryptophan encourages the production of serotonin, a calming neurotransmitter associated with appetite, blood pressure, sleep patterns and learning

Table 8: Relationship of dietary intake of meat and substitutes and academic performance

		TOE	PE	Music	HE	IT
Meat and substitutes	Pearson Correlation	-.201*	-.121	-.028	-.157	-.131
	Sig. (2-tailed)	.045	.230	.785	.119	.194

*. Correlation is significant at the 0.05 level (2-tailed)

**. Correlation is significant at the 0.01 level (2-tailed)

Results in Table 9 indicate that when meat and substitutes, which provide protein intake increases, performance in Theory of Education decreases significantly. ($r=-0.201$; $p=0.045$ at $\alpha =0.05$). Too much protein has a negative effect on the functioning of the brain, for instance proteins (meat) and foods are burnt in a different way and costs the body more energy to burn proteins together than apart from each other as much blood has to be sent to the digestive system and non is sent to the brain. According to Kretchmer (1996), neurons use proteins to communicate with each other and control what happens throughout the body. Thus, the enzymes, neuro-transmitters and hormones that carry signals and help accomplish the tasks the brain dictates are made from protein. Enzymes are made from protein and are vital to brain health as they aid digestion so the brain gets the nutrients it needs. Proteins assist one to stay

healthy and alert during workdays. However the brain still needs a mix of carbohydrates, protein, good fats, and plenty of vitamins, minerals and antioxidants to keep functioning at optimum. When optimum functioning is achieved academic performance improves.

The findings indicate no significant correlation of protein intake and practical subjects. The facts lie in the inadequate amounts of proteins taken by the students. The amounts were far below the recommended daily protein requirement for students hence the no significance being found.

Table 9: Relationship of dietary intake of fruits and vegetables and academic performance

		TOE	PE	Music	HE	IT
Fruits and vegetables	Pearson Correlation	.580**	.363**	.364**	.337**	.307**
	Sig. (2-tailed)	.000	.000	.001	.001	.002

*. Correlation is significant at the 0.05 level (2-tailed)

**.. Correlation is significant at the 0.01 level (2-tailed)

Results in Table 10 indicate that when fruits and vegetable intake increases, performance in all the subject areas increases significantly. TOE is ($r=0.580$; $p=0.00$ at $\alpha =0.01$); PE ($r=0.363$; $p=0.000$ at $\alpha =0.01$); Music ($r=0.364$; $p=0.001$ at $\alpha =0.01$); HE ($r=0.337$; $p=0.001$ at $\alpha =0.01$) and IT ($r=0.3307$; $p=0.002$ at $\alpha =0.01$). Fruits have a very positive effect on the brains which stimulates brain functions. One of the substances that fruit contains is natural sugars which stimulate the brain so that one can think faster and recall information more quickly. There are several other substances that fruit contains which scientists found to stimulate the brain Selkowitz, 2000. Fruits are considered as the ultimate brain fuel. Deficiencies or excesses of certain vitamins or minerals can damage nerves in the brain, causing changes in memory, limiting problem-solving ability and impairing brain function (Selkowitz, 2000).

Table 10: Relationship of dietary intake of dairy products and academic performance

		TOE	PE	Music	HE	IT
Dairy and products	Pearson Correlation	-.257**	-.231*	-.223*	-.150*	-.056*
	Sig. (2-tailed)	.010	.021	.026	.136	.581

*. Correlation is significant at the 0.05 level (2-tailed)

**.. Correlation is significant at the 0.01 level (2-tailed)

Results in Table 11 indicate that when dairy and dairy products intake increases, performance in all the subject areas decreases significantly. TOE is ($r=-0.257$; $p=0.10$ at $\alpha=0.01$); PE ($r=-0.231$; $p=0.021$ at $\alpha=0.05$); HE ($r=-0.223$; $p=0.026$ at $\alpha=0.05$). According to Crichton (2012) milk products have a beneficial impact on cognitive health through improvement in cardiovascular risk factors and metabolic syndrome components linked to detrimental brain damage (Kretchmer, 1996). In addition, calcium and whey protein may also be important through their associated roles in glucose regulation and weight management. Other dairy components such as bioactive peptides with anti-oxidative properties may also have a direct effect on brain function which may enhance cognitive ability by preventing oxidative stress in the nervous system (Selkowitz, 2000). Higher serotonin levels may also attenuate the effects of reduced neurogenesis due to stress and aging (Selkowitz, 2000). Vitamin B₁₂ in milk and milk products may also play a role in cognitive function and healthy brain aging. However, epidemiological studies have linked vitamin B₁₂ deficiency to an increased risk of Alzheimer’s disease.

Table 11: Relationship of dietary intake of fizzy drinks and academic performance

		TOE	PE	Music	HE	IT
Fizzy drinks	Pearson Correlation	.580**	.363**	.364**	.337**	.307**
	Sig. (2-tailed)	.000	.000	.001	.001	.002

*. Correlation is significant at the 0.05 level (2-tailed)

** . Correlation is significant at the 0.01 level (2-tailed)

Results in Table 12 indicate that when fizzy drinks intake increases, performance in all the subject areas increases significantly. TOE is ($r= 0.580$; $p=0.000$ at $\alpha=0.01$); PE ($r=0.363$; $p=0.000$ at $\alpha=0.01$); Music ($r=0.364$; $p=0.001$ at $\alpha=0.01$); HE ($r=0.337$; $p=0.001$ at $\alpha=0.01$); IT ($r=0.307$; $p=0.002$ at $\alpha=0.01$). Fizzy drinks contain little to no vitamins or other essential nutrients (Murakami et al., 2008). However, they contain caffeine, carbonation, simple sugar or worse sugar substitutes and often food additives such as artificial colouring, flavouring and preservatives. There has been a remarkable rise in the consumption of the soft drinks, yet too much of soft drinks can cause severe health problems from which one can hardly recover Trockel, 2000). A lot of research has found that consumption of soft drinks in high quantities is responsible for many health problems that include nutritional depletion, heart disease and mental distress. It is seen from the table above that intake of energy is significant. The Dietary pattern indicates a significantly higher energy intake. Habitual high sugar intake has been shown to impair cognitive function (Trockel, 2000). This study results contradict this literature as results have suggested that the more the intake of fizzy drinks, the higher the increase in academic performance. Since the sugar found in fizzy drinks provides energy to the body, it may have complemented the shortage of energy that was supposed to be achieved from carbohydrates, but this study showed that students were taking inadequate carbohydrate to meet the recommended daily intake of carbohydrate as source of energy.

Table 12: Relationship of dietary intake of fats, oils and sweets and academic performance

		TOE	PE	Music	HE	IT
Fats, oils	Pearson Correlation	-.283**	.460**	.019**	.597**	.314**
And sweets	Sig. (2-tailed)	.004	.000	.855	.000	.001

*. Correlation is significant at the 0.05 level (2-tailed)

** . Correlation is significant at the 0.01 level (2-tailed)

Results in Table 13 indicate that when fats, oils and sweets intake increases, performance in Theory of Education decreases significantly. TOE is ($r=- 0.283$; $p=0.004$ at $\alpha=0.01$). While fats and oils are essential for the proper functioning of the body and brain development it is imperative that they be taken sparingly and not in large quantities as they cause weight gain resulting in obesity (Niemeier et al., 2006). Overweight and obesity are risk factors for hypertension which is also a risk factor for the decline in cognitive abilities aggravated by a tendency of feeling weak and tired more often thereby losing concentration resulting in poor academic performance. Theory of Education is also an academic subject which does not need too much energy as this may cause drowsiness since not much energy is expended during the lectures.

However, when fats, oils and sweets intake increases, performance in PE, Music, HE and IT increases significantly. PE ($r=0.460$; $p=0.000$ at $\alpha=0.01$); HE ($r=0.597$; $p=0.000$ at $\alpha=0.01$); IT ($r=0.314$; $p=0.001$ at $\alpha=0.01$) because these are practical subjects and if fat is taken it can be burnt during the lectures without causing any effects. Fats provide essential fatty acids, which are not made by the body and must be obtained from food. Butter and oils are examples of fats. Healthy sources of fat can be found in fish, nuts, and certain fruits and vegetables, such as avocados (Wardlow & Smith, 2011). Eating high concentrations of Omega-3 fatty acids leads to better grades, the facts lie in the point that fatty acids are essential to proper neural function (Murakami et al., 2008). The greater part of the brain is made up of fatty tissue, so it makes sense that eating fish and other foods high in fatty acids would help students to focus and study more efficiently.

4. Conclusion

The study concluded that as students' intake of starch increased, their performance in Theory of Education decreased significantly. When starch is increased in excess of the energy expended and activity remains low, the risk is excess starch is easily converted to fat. TOE is an academic subject which does not require a lot of energy. The excess fat in the body is a risk factor for obesity a condition that causes shorter attention spans, decreased mental flexibility and lower estimated intellectual functioning, all of which may present challenges for students' learning. This is the reason why most students reported being weak and feeling dizzy compromising on the concentration span and memory retention, consequently affecting their academic performance. By implication, starchy foods should not be increased when one is leading a life of less physical activity as this may cause one to feel weak and dizzy because of the raised blood sugar levels. Feelings of weakness and dizziness are unfavourable conditions for academic attainment. It is therefore necessary to take starchy foods according to level of activity in order to realise the benefits of carbohydrates as a source of energy during learning activities.

The performance of students in PE increased significantly when their starch intake increased. Arguably, after excess starch is converted to fat, it is then stored in the body fat stores for later use, thus performance increases significantly in practical subjects when starchy foods increase as they sustain the body energy during practical subjects which because of their nature students expend more energy when doing practical work, hence the positive correlation.

The study also concluded that when the intake of meat and substitutes increased, performance in Theory of Education decreased significantly which shows that too much protein has a negative effect on the functioning of the brain, for instance, meat and meat products take long to digest and cost the body more energy to burn them; therefore, much blood has to be sent to the digestive system and very little goes to the brain. Protein raises levels of the amino acid tyrosine which promotes the creation of norepinephrine and dopamine that boost activity alertness and energy and these are favourable conditions for learning.

Fruits and vegetables have been found to have a very positive effect on the brain, which stimulates brain functions. One of the substances that fruit contains is natural sugars which stimulate the brain so that one can think faster and recall information more quickly. The two students who were on vegetarian diet were found to perform very well in all subject areas. Quite a large number did not consume fruits and vegetables and deficiencies excesses of certain vitamins or minerals can damage nerves in the brain, causing changes in memory, limiting problem-solving ability and impairing brain function. Hence, the low grades in most of the students who did not take fruits and vegetables.

When dairy intake decreases performance decreases in all the subjects. The scenario lies in the fact that students did not take enough of dairy foods hence the negative correlation. Milk products have a beneficial impact on cognitive health through improvements in cardiovascular risk factors and metabolic syndrome components, which are factors that have been linked to detrimental brain damage. In addition, calcium and whey protein is also important through their associated role in glucose regulation and weight management. Other dairy components such as bioactive peptides with anti-oxidative properties also have a direct effect on brain function and enhance cognitive ability by preventing oxidative stress in the nervous system. Milk as a good source of tryptophan (an amino acid precursor of serotonin), α -lactalbumin, has been shown to raise brain serotonin levels. It has been established that an increased serotonin level has beneficial effects on mood and cognitive function, including information processing.

This study also concluded that the more the intake of fizzy drinks the increase in academic performance. Since the sugar found in fizzy drinks provides energy to the body, it complemented the shortage of energy that was supposed to be achieved from carbohydrates, since this study showed that students were taking inadequate starchy foods to meet the recommended daily intake of carbohydrates. However, it should be borne in mind that there has been a remarkable rise in the consumption of soft drinks, yet too much of soft drinks can cause severe health problems from which one can hardly recover.

Students were taking too much fats and oils and there was significant decrease in performance in Theory of Education. Since TOE is an academic subject not much fat was burnt during lectures and the fat may have caused drowsiness during the lectures. While fats and oils are essential for the proper

functioning of the body and brain development it is imperative that they be taken sparingly and not in large quantities as they cause weight gain. Too much intake of fat results in obesity, a risk factor for hypertension which is also a risk factor for the decline in cognitive abilities aggravated by a tendency of feeling weak and tiring more often thereby losing concentration resulting in poor academic performance.

When fats and oils intake increased, performance in practical subjects also increased significantly since intake of high fatty acids leads to better grades. Fatty acids are essential to proper neural function. Fat is burnt and used as energy during lecture activities without causing any effects.

5. Recommendations

The study recommends that students like any other people should take food from all food groups in their right proportions if they are to exploit the benefits of all of them for maximum cognitive functioning.

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