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Factors Affecting Nutritional Management of Type 2 Diabetes Mellitus in South Eastern Nigeria: A Systematic Review

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Abstract:

Introduction: *The global burden of type II diabetes mellitus is alarming. From the available statistics, the prevalence of diabetes globally is 6.4 % and type II diabetes accounts for 90 % (International Diabetes Federation 2011); in Nigeria the prevalence is 15 % and type II accounts for 10.5 % (Chukwunonye et al 2013) while in Ebonyi in South Eastern Nigeria, the prevalence of diabetes is 8.8 % and type II accounts for 7.9 % (Buowari 2013).*

Aim: *This is study aimed at exploring the socio-cultural and environmental factors affecting the nutritional management of type II diabetes in South Eastern Nigeria. The specific objectives include to explore the sociocultural and environmental variables influencing the nutritional management of type II diabetes, explore the experiences of the patients and identify gaps in Knowledge that require further action.*

Methodology: *The search strategies include the use of hand searches of published literature (primary and secondary sources) and searches of electronic databases. A systematic literature review was carried out using the following electronic databases: PSYCINFO, SCOPUS, Web of science, CINAHL and the Cochrane library.*

Findings: *Socio-cultural factors (social interactions, food preferences and family structure and family bound) affect nutritional management of type II diabetes mellitus South Eastern Nigeria. Environmental factors (social process, working place condition and pattern of work such as shift duty) affect compliance to nutritional management. Method of food preparation affects the glycaemic index of the food. There is evidence from research that mushrooms contain alpha glucosidase inhibitors which lowers blood glucose level.*

Keywords: *The key words are type 2 diabetes mellitus, psychosocial factors, socio-cultural factors, social process, environmental factors and nutritional management.*

Background of the study

Introduction: This section looks at the overview of nutritional management of type II diabetes, the brief history, types of diabetes and the epidemiology. The section ended by setting the scene for other sections in study.

Diabetes mellitus is a metabolic disorder of multiple aetiology characterised by chronic hyperglycaemia with disturbance of carbohydrate, protein and fat metabolism resulting from defect in insulin secretion, insulin action or both (Scottish Intercollegiate Guideline Network 2010, p.2). This definition seems to be similar to the definition of diabetes mellitus by World Health Organisation (1999, p.2). According to National Institute for Health and Clinical Excellence (NICE) (2011, P.3), "diabetes is a group of disorder with a number of common features characterised by raised blood glucose".

American Diabetes Association (2009, p.62) defines it as a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The defect in insulin secretion or action on target tissues or both is the reason for disorders of carbohydrate, fat, and protein metabolism in diabetes is deficient action of insulin on target tissues. International Diabetes Federation, South-East Asia (2012) defines diabetes mellitus as a chronic disease that arises when the pancreas does not produce enough insulin or where the body cannot effectively use the insulin it produces.

The five definitions recognise that in diabetes, there is defect in insulin secretion or action which affects carbohydrate, protein and fat metabolism with a resultant chronic hyperglycaemia. However, World Health Organisation (2006) and International Diabetes Federation (2012) state that for a diagnosis of diabetes mellitus to be made, the fasting venous plasma glucose concentration must be equal to or greater than 7mmol/l (126mg/dl) or greater than or equal to 11mmol/l (200mg/dl) two hours after a 75g glucose drink (oral glucose tolerance test (OGTT)). Moreover, a plasma random capillary blood glucose value of equal to or greater than 12.2 mmol/l(220g/dl) is considered diagnostic of diabetes mellitus. In United Kingdom and other developed countries, the diagnosis is also made by a glycated haemoglobin (HBA1c) level of 6.5 % (48mmol/mol) or above; however, it must be repeated for those being diagnosed for the first time for confirmation using World Health Organisation criteria (WHO 2012 and WHO 2011).

The history of diabetes mellitus has existed for a very long time; the first mention of diabetes symptoms was in 1552 B.C. by an Egyptian physician– Henry Ra, who documented frequent urination as a strange disease (McCoy 2013). He further states that investigations continued until 1675 A.D. when the first mention of the 'diabetes mellitus' was made by scientists - a term meaning ''honey siphon''. Nutritional management of diabetes mellitus began between 1700 and 1800; in 1870 during the Franco-Prussian war, a French physician (Apolonaire Bouchardat)discovered that the condition improved with war related starvation and this led to the use of fad diet (oat-cure, potato therapy) and starvation diet in 1900 in the management (McCoy 2013).The combination of diet and exercise in the management of diabetes was discovered by Elliot Joslin of Boston in 1916 while in 1922 a Canadian physician, Frederick Banting, initiated the use of insulin therapy after trying it on animals with his colleagues (McCoy 2013).

Aim and objectives of the study

The aim of this study is to explore the socio-cultural and environmental factors affecting the nutritional management of type 2 diabetes mellitus in South Eastern Nigeria amongst adults between the age range of 35 and 65 years. The specific objectives of the study are to:

- Explore the socio-cultural variables influencing the nutritional management of type 2 diabetes in south Eastern Nigeria.

- Explore environmental factors influencing the nutritional management of type 2 diabetes in south Eastern Nigeria.
- Identify gaps in knowledge in the nutritional management of type 2 diabetes that require further studies in south Eastern Nigeria.

1.2 Epidemiology of diabetes mellitus

Diabetes mellitus is a growing public health concern affecting people globally both in developing and developed countries and poses a major socioeconomic challenges. Out of the estimated world population of seven billion (7 billion), three hundred and sixty six million (366 million) people live with diabetes mellitus and it is estimated that by 2030, the figure will have risen to 552 million diabetics (International Diabetes Federation 2012 and United Nations 2007). According to a study carried out in 216 countries of the world by International Diabetes Federation (2011) and Wold Health Organisation (2011), 80 % of the cases of diabetes are type 2, 80 % of the total cases live in middle and low income countries, greater number of the cases are between 40 and 59 years and an average of £303 billion is spent on diabetes mellitus annually. The estimated global prevalence of diabetes mellitus is 6.4% out of which type 2 diabetes accounts for 90 % to 95 %. Below is the global statistics of diabetes mellitus by regions.

From a study carried out in Nigeria by Chukwunonye et al (2013) and Ekpenyong et al (2012) on prevalence of obesity and diabetes in Nigeria using a systematic review of 75 different studies, the prevalence of diabetes in Nigeria is 15 % out of which type 2 diabetes mellitus accounts for 10.5 %. The prevalence rate in Lagos and Kwara States in Western Nigeria are 22.2 % (type 2 = 19.2 %) and 9.8 % (type 2 = 8.8 %) respectively while that of Borno State in Northern Nigeria is 8.1 % and type 2 diabetes accounts for 7.3 % (Chukwunonye et al 2013). In Ebonyi and Enugu States in the South Eastern Nigeria, the prevalence of diabetes mellitus is the same figure thatis 8.8 % and type 2 diabetes accounts for 7.9 % in both States (Buowari 2013). In Edo State in the south, the prevalence rate is 9.8 % and type 2 accounts for 8.8 %.

From the statistics, the prevalence of type 2 diabetes mellitus seems to be higher in the west, followed by south and south east and least in the north. From the researcher's knowledge of the developmental trend and high carbohydrate food distribution in Nigeria, the prevalence tends to follow the developmental and high carbohydrate food distribution trend which is higher in the west and least in the north with south and east in the middle.

Selber (2012) states that the major risk factors fortype 2 diabetes mellitus are obesity, environmental factors and heredity; this may be linked to the thrifty gene hypothesis which may be an explanation for why it is more in Native Americans, Latin Americans, Asian Americans, African Americans and Pacific Islanders than other races of the world (Pyhtila 2007 and Graham 2012).

The nutritional management of diabetes mellitus has been generally controversial because of variations in the opinions of experts from different fields (Katsilambrose et al 2006). While Ekechi (2008) argue in favour of high fibre and low fat food because of their relatively low glycaemic index, Ebuka (2009) argues in favour of those food items that have a high glycaemic index to prevent the risk of hypoglycaemia which can be a complication resulting from over dependence on low glycaemic index food. South Eastern Nigeria is an interesting place for this study because their staple food items are very rich in high glycaemic carbohydrate foods such as yam, cassava and long grain rice and they depend mainly on their staple food for nutrition irrespective of any change in their health status. The people live together in communities and families and have strong family

tie; family members prepare their food together, eat together, solve their problem together and carry each other along including extended family relations. This strong family and community bond affect the nutritional habits of family and community members in good health and in ill-health.

RESEARCH METHODS

The search strategies include the use of hand searches of published literature (primary and secondary sources) and searches of electronic databases. A systematic literature review was carried out using the following electronic databases: psycinfo, SCOPUS, web of science, Cinahl and the Cochrane library. The years covered ranges from 2003 to 2013 because studies that are earlier than 2003 may not reflect current management of type II diabetes. The use of database was supplemented with internet searches using google search and different websites such as Pubmed, Willey Blackwell and ELSEVIER. Resources obtained from internet and hand searches however, were not limited by years; sources much earlier than 2003 that have basic facts or very relevant information were considered though not included in the list of major literatures reviewed.

The key words for the search were divided into target population, factors and dietary management approaches ; they include type 2 diabetes (population), psychosocial factors, socio-cultural factors, family structure, social process, environmental factors (factors), nutritional management, diet therapy, self monitoring, eating behaviour and food preferences (dietary management approaches). The search document types include reviews, journal articles, proceedings papers and reports. The inclusion criteria include the year range of 2003 to 2015, documents written in English Language, sources from developed and developing countries such as United Kingdom, United States of America, Australia, Canada, Nigeria, Kenya, Ghana, South Africa, China, India, Japan, Oman and South Korea among others.

The search areas were limited to medical sciences (Internal medicine, Nursing Sciences and Medical laboratory Sciences), endocrinology and metabolism, biochemistry and molecular biology, environmental and occupational health, Nutrition and Dietetics, sociology and psychology, health sciences, social sciences, biological sciences and environmental sciences.

Any resource material outside these areas was excluded because the areas mentioned are closely related to the study topic. The document types included are field research reports (experimental and non experimental), reviews, articles and proceeding papers because they undergo one form of research or the other before publication. These documents were limited only to those published in English Language since English is the only internationally recognised language that the researchers understand and communicate effectively with.

The documents were also limited to 2003 for the reason stated before. Countries other than United Kingdom, United States of America, Australia and all the developing countries including Nigeria, were excluded. The inclusion of key developed countries (United Kingdom, United States of America and Australia) was because of their relative high prevalence rate of type II diabetes mellitus and to make comparison with developing countries possible while other developing countries other than Nigeria were included for easy comparison between Nigeria and other developing countries.

The breakdown of the sources includes 246 from psycINFO, 245 from SCOPUS, 123 from CINAHL, 15 from Cochrane library and 367 from Web of sciences. Out of these figures, only 4, 1, 2, 0 and 1 are from Nigeria respectively. Greater numbers of the sources are from United States of America, India, Australia and United Kingdom. From these sources, the documents that most closely relate to the research topic were selected

and supplemented with other sources from specific websites as mentioned earlier. Relevant references (in-text and reference lists) from the reviewed literatures were also explored for more information.

The systematic review of relevant literature

The researchers reviewed the literature under the following sub-headings: aetiology of type II diabetes mellitus, the nutritional management of type 2 diabetes mellitus and exploration of controversies arising from differences in glycaemic indices of some food items in South Eastern Nigeria and other countries. Furthermore, the literature review addresses the issue of patients' compliance to the nutritional management, the socio-cultural and environmental challenges to the nutritional management and the experiences of type 2 diabetics in South Eastern Nigeria with respect to nutritional management and the influence of socio-cultural and environmental factors.

The aetiology of type II diabetes mellitus

Type II diabetes mellitus is the type found in individuals who have insulin resistance and usually have relative insulin deficiency. The insulin deficiency may be there initially and get exhausted with time although quite often, the relative deficiency may persist throughout their lifetime in which case, these individuals may not need insulin treatment for survival. Scottish Intercollegiate Guidelines Network (2010), National Institute for Health and Clinical Excellence (2011) and American Diabetes Association (2009) state that, diabetes mellitus globally was previously referred to as non-insulin-dependent diabetes or adult-onset diabetes. The label 'adult on-set' is no longer valid again as a number of diagnoses of type II have been made in children recently (Meeking 2011). Although the specific aetiologies are not known, autoimmune destruction of β-cells does not occur and patients do not have any of the other causes of diabetes mellitus such as pancreatic damage, liver cirrhosis, history of endocrine disorder, anti-viral or anti-psychotic drug therapy (NICE 2011).

Armenian Medical Network (2012) suggests that although heredity is a major risk factor for type II diabetes, the risk can be influenced by environment, diet and exercise. Favourable environment, good diet and exercise can help one with high hereditary risk of type II diabetes mellitus live his or her full life span without manifesting symptoms of diabetes mellitus. Selber (2012) further identified the following as other risk factors: obesity, impaired glucose tolerance, insulin resistance, age, sedentary life style, history of gestational diabetes and ethnic background. On ethnic background, Selber explained that type II diabetes mellitus is more in Native Americans, Latin Americans, Asian Americans, African Americans and Pacific Islanders than other races of the world. The aetiology however, will be discussed further under the thrifty gene hypothesis, metabolic syndrome and obesity since other risk factors tend to have one form of relationship or the other with the three.

The thrifty genes hypothesis: Thrifty genes are genes that help people to adapt and survive hunger in times of food scarcity and they were first described by an American geneticist, Dr James Neel in 1962 to explain why people gain weight and develop type 2 diabetes mellitus (Pyhtila 2007). Genes that are related to insulin signalling pathways, sensitivity, production, response and regulation show much variance between races and ancestral lineages (Graham 2012). A sequence that has been of interest recently is the insulin variable number of tandem repeats (INS - VNTR) which shows great variation between African and non African population; whereas non African heritage display only three variations f these sequence, the African heritage display over twenty – one variations (Graham 2012).

The second sequence that is claimed to possess the thrifty qualities is the gene encoding for ApoE, because of the great variations seen in the geographical distribution of its various forms;

ApoE2 is seen more in the Mediterranean population and ApoE4 common among the Aboriginals and Native Americans (Graham 2012). Neel believes that indigenous people have genes that help them survive periods of starvationby storing up glucose in time of plenty for use in scarcity; North Americans lived a hunter – gatherer not long ago, South Pacific Islanders starved for long while paddling long distance between islands and alternating between food scarcity and abundance also affected the Australian Aborigines, native Hawaiians and New Zealand Maoris among others (Pyhtila 2007). A study carried out in Gambia (because of her recent food shortage) by Prentice, Raycon-Solon and Moore (2005) to test the thrifty phenotype hypothesis revealed that more youths who experienced food shortage developed type 2 diabetes later in life than their mates who did not experience early life food shortage.

According to Pyhtila (2007), thrifty genes gave these people evolutionary advantage until the typical western life was adopted when situation improved. With less physical activity, high fat and energy dense diet, their bodies continued to store up calories in preparation for famine that never came because of development. The stored up calorie predisposes them to obesity which is a strong factor for type 2 diabetes. Although the thrifty gene hypothesis is facing a lot of criticisms, it is a good explanation for the aetiology of type II diabetes in Ebonyi state in Nigeria because the state is fast developing and more people a moving from period of food scarcity to relatively permanent abundance.

Metabolic syndrome: Metabolic syndrome which was first described by Gerald Reaven in 1988 is a combination of cardio-metabolic risk determinants which include central obesity, insulin resistance, glucose intolerance, dyslipidaemia and microalbuminaemia that puts an individual at a high risk of type II diabetes and cardiovascular diseases (Kimberley and Mark 2010). According to Kimberley and Mark (2010), Reaven first gave it the names "syndrome X" and later it was named after him "Reaven's syndrome" but with time, it was given the name "metabolic syndrome" because of the complex metabolic symptoms involved.

WHO (2010) states that the predisposing factors to metabolic syndrome include having an inherited tendency towards insulin resistance, obesity and physical inactivity. Kimberley and Mark (2010) however argue that although inheritance is associated with development of metabolic syndrome, the ratio is small when compared to the influence of developmental changes that occur between childhood and adulthood. According to Kimberley and Mark (2010), poor nutrition during childhood leads to development of obesity in adulthood when condition improves. Obesity on the other hand predisposes to type II diabetes, cardiovascular diseases and other components of metabolic syndrome as mentioned earlier.

Kimberley and Mark (2010) argument seems to agree with Pyhtila (2007) explanation of thrifty gene hypothesis as discussed earlier. WHO (1999) observed from studies on the ethnic spread that metabolic syndrome occurs commonly in a wide variety of ethnic groups such as Caucasians, Afro-Americans, Mexican-Americans, Asian-Indians, Chinese and Australian Aborigines. This observation is also similar to Graham (2012) explanation of the ethnic spread of obesity using the thrifty gene theory. The two theories (thrifty gene theory and developmental origin of metabolic syndrome) tend to establish a link between transition from starvation in childhood to abundance of food in adulthood and development of obesity which predisposes to type II diabetes mellitus.

Obesity: Obesity results from imbalance between energy in-take and energy expenditure; it is inheritable and the gene controlling eating behaviour and physical activity interact with the environment to increase susceptibility to weight gain in some individuals (Tataranni 2002). According to Tataranni (2002) weight gain causes insulinaemia and insulin resistance and in the

presence of insulin resistance, mild hyperglycaemia leads to increased insulin secretion in compensation which eventually leads to failure of the endocrine gland because of the detrimental effect of hyperglycaemia on the beta cells (glucotoxicity). Failure of the endocrine in the pancreas leads to insufficient or absence of insulin thus resulting I type II diabetes mellitus. This can be averted through exercise and nutritional adjustment that may result in weight loss.

Dietary Management of type II diabetes

Nutritional management is the first approach in the effective management and prevention of type II diabetes mellitus (Deakin et al 2012). According to Hart, Unachukwu and Chinenye (2007, p. 9) and Stephen (2009, p. 108), the objectives of dietary management of diabetes include achieving optimal blood glucose levels and blood lipid concentration, providing adequate energy for reasonable weight, growth and development and finally improving health through balanced nutrition. This has proved effective for years however, there is much debate over the dietary management of type II diabetes as the diet most often recommended include high soluble fibre diet and low fat diet especial saturated fat (Katsilambrose et al 2006).

Opara (2006) posits that the cause of the controversy is the incrimination of some food items on the ground of glycaemic index as the cause of increase in postprandial blood glucose level in the dietary management of type II diabetes mellitus. However, McDougall (2006) argues that the issue is not glycaemic index of food items but the total quantity of carbohydrate taken in a day in relation to the required daily dietary allowance of 50% to 75% of total daily energy requirement. He further states that restriction of carbohydrates on the ground of glycaemic index exposes the patient to a high risk of hypoglycaemia. This, as McDougal (2006) explains, is because depending on food with low glycaemic index alone may at a stage bring the patient's blood glucose level to a subnormal status which poses a threat of hypoglycaemia.

To maintain a balance, Stephen (2009) maintains that the current trend in dietary recommendation is a high carbohydrate, high fibre and low fat diet. He further maintains that the area of concentration should be on the glycaemic response of various carbohydrate foods instead of the conservative idea of simple and complex carbohydrates. Furthermore, he explains that same quantity of similar carbohydrate containing food by chemical analysis may cause different blood glucose response after eating. This as he explained, is because other factors such as carbohydrate type, type and quantity of fibre, protein, fat, food form, method of preparation and role of enzyme inhibitors all combine to affect the glycaemic index of each carbohydrate containing food item.

To enhance consensus in nutritional approach to the management of type II diabetes mellitus, different relevant organisations from across the globe have come up with dietary guidelines which emphasise high carbohydrate, high fibre, normal protein and low fat diet as summarised below. The items covered by the guidelines include calorie requirement, carbohydrate, protein, fat, minerals and vitamins, fibre, alcohol, sodium and sweeteners. Other considerations include diet in pregnancy, diet in children, vegetarians, exchange scheme, timing of meals, special diabetic products and diet (Diabetes UK Nutrition Working Group 2011, SIGN 2010, National Institute for Clinical Excellence (NICE) 2008, Stephen 2009, Deakin 2012, Katsilambros, Liatis and Makrilakis 2006, American Diabetic Association (ADA) 2008, ADA 2009 and World Health Organisation (WHO) 2012). The summary of the dietary management is as shown in table 2 in appendix 2.

Pregnancy: The dietary allowance should be based on the nutritional assessmentof the woman. Based on the assessment, the dietary plan is highly individualised to meet the nutritional requirement of the woman.

Vegan diet: It is recommended that diabetics who are vegetarians should continue with their diet as this is useful in the control of blood sugar (Katsilambros, Liatis and Makrilakis 2006). Furthermore, they added that it reduces the risk of obesity.

Timing of meals: All the relevant guidelines agree that diabetics should eat moderately at regular intervals, at least three times a day. This however should be guided by activity and combination of diet and insulin or oral hypoglycaemic agents. If that is the case, the main meals may be interspaced with low glycaemic snacks depending on the quantity of drug taken to avoid the risk of hypoglycaemia.

Special diabetes product: It is strongly advised that the use of products marketed specifically for diabetics should be discouraged on the ground of cost, uncertainty of content and cost effectiveness (Diabetes UK Nutrition Working group 2011). However, researchers have found that the use of cinnamon improves glucose uptake by stimulating the insulin receptors in the tissues and it is also relatively cheap when compared with other products (Young 2009 and Manzella 2010).

There is evidence from research carried out in China on the effect of mushroom in-take on blood glucose level using rats that maitake mushroom and other types of edible mushrooms contain alpha glucosidase inhibitors which lowers blood glucose level (Hong, Xun and Wutong 2007, Lo, Hsu and Chen 2008, Yang, Jung and Song 2007 and Liu,Fukuwatari and Okumura 2008). A similar study carried out in Uganda by Nabuya, M uyonga and Kabasa (2010) to investigate the nutrient composition and the hypocholesterolemic properties of edible mushrooms (temitomyces-microcarpus mushroom) using randomised control trial and experimental treatment on rats for 10 weeks revealed that mushrooms lowers blood cholesterol levels.

The two studies were carried out in rats and it seems that this is because of fear of harm and participants' safety. Whatever the case may be, the studies can be replicated in human beings in other parts of the world especially in Nigeria where the researcher is focussing since the mushrooms were said to be edible to human beings.

Whatever the dietary plan, it is worthy of note that all the relevant organisations and researchers agree that the diet should be individualised and that a registered dietician with good knowledge of diet in diabetes should always lead the implementation exercise. This sounds good to avoid misguiding the management team and the patients however, Diabetes UK Nutrition Working Group (2011) posits that other members of the management team with relevant knowledge can also lead the implementation if need be.

Guidelines for nutritional management of type II diabetes mellitus in Nigeria

In Nigeria, food measuring scales and standard measuring cups for quantifying foods are scarce in most homes and food exchange lists of local foods are almost non-existent (Fadupin 2009). This has resulted in the use of more complicated methods for assessing food intake during clinical studies, community surveys and in the estimation of standard local food measures and that was the motivation for the standardisation of Nigerian local foods to produce exchange lists (Fadupin 2009).

In carrying out the study, Fadupin (2009) listed commonly eaten food items in Nigeria according to their food groups. The number of grams of carbohydrate (x) in 100 g of each food item was obtained from the Food and Agricultural Organisation Food Composition Table for Use in Africa (1968 updated last in 2012). Each of the raw food samples weighing 100 g (except for fruits, biscuit, milk, and fat) was cooked in a pot which had been weighed. The weight of the cooked food was obtained by subtracting the weight of the empty pot from the weight of pot and food.

Thus the weight of cooked food from 100 g of raw food = y. The weight of cooked food (y) also contains x carbohydrates because the weight of carbohydrates in foods does not change with cooking. Thus the weight of cooked food in 10 g or 15 g carbohydrate

$$= \frac{(10 \text{ g or } 15 \text{ g})y}{x}$$

The conversion factor of 1 gm of raw food to cooked food was also calculated as the weight of cooked food divided by 100 $= \frac{y}{100}$

The weight of cooked food per selected calories was determined based on the American recommendation for daily energy distribution between the energy-yielding nutrients which requires that carbohydrate accounts for 50% of daily calorie requirements, fat accounts for 30% and protein accounts for 20% of the total daily energy requirement. This distribution is similar to the recommendations of SIGN (2010) and NICE (2008) with slight difference in carbohydrate which they recommend a range of 50% to 75%of the total daily calorie dietary allowance. In the case of fruits and biscuits, the quantities that contained 10 grammes or 15 grammes carbohydrate were calculated directly from the values of carbohydrate listed for 100 g edible portion for fruits and biscuits in the Food and Agricultural Organisation food composition.

Thus, the total daily energy required from car-bohydrate foods was based on 50% of the daily calorie required. The daily energy required from carbohydrate was distributed evenly between the three main meals (breakfast, lunch, and dinner) to obtain the weight of the different cooked food for each meal. The values for each meal could be modified to suit each individual's daily dietary requirements. The summary of the research as shown in the appendix is in use in Nigeria although the content was restricted to only the staple foods in the South Eastern part of Nigeria.

Socio-cultural and environmental factors affecting the nutritional management of type II diabetes mellitus in South Eastern Nigeria

Socio-cultural factors as used by the researchers refer to social interactions within the community, cultural practices (eating behaviour, food preferences, family structure and family bounds), economic status and level of education (NICE 2011). Environment refers to external environment (social processes within the living and working place, working condition and pattern of work such as shift duty which may involve night shift) and internal environment which includes changes in the biochemistry and physiology of the human body resulting directly or indirectly from changes in the external environment (Ershow 2009).

The effectiveness of nutritional management in the control of pre-prandial and postprandial glucose level in type 2 diabetes mellitus depends to a great extent on a number of factors. The factors that influence the nutritional management of type II diabetes as considered in this research include glycaemic index of various food items, quality of carbohydrate, culture, socio-economic status, environment, sleep pattern and patients' compliance.

Method of preparation and glycaemic index of different food items: Opara (2006) suggests that a lot of misunderstanding abound over the use of some food items by diabetics on the ground of their high glycaemic index (GI). British Diabetic Association (BDA) (2011) states that glycaemic index is a ranking of how quickly carbohydrate food make blood glucose level rise after eating them. Different types of carbohydrates have different GI because of their difference in the rate of digestion and this has effect on the blood glucose level; moreover, method of carbohydrate preparation affects the GI (BDA 2011).

In a study carried in Nigeria by Itam, Odey, Ejemot-Nwadiaro and Asenye (2012) on the effect of processing method on the GI of some carbohydrate food items (yam, potatoes and cassava)using 90 subjects, it was discovered that the GIof roasted form of the carbohydrate food was higher than that of the fried and boiled form

of the same food items. Similar study carried in Kenya by Mugendi, Njagi, Kuria, Mwasaru, Mureithi andApostolides (2010)using 100 subjects revealed changes in the quality of protein with processing method. This was exemplified by Fadupin (2009), whose analysis of Nigerian food samples processed in different forms revealed that the GI of boiled beans was higher than that of beans cake (akara).

Although the study population in the studies were not mentioned, samples of 90 and 100 subjects respectively seem small to make generalisation however, the studies were considered because of limited broader studies on the topic. Processing diabetic food therefore, should adapt methods that yield lowest GI.

Quality of food combination: Newby, et al (2007) opine that glycaemic index of carbohydrates containing food is not as important as the quality of the carbohydrates. In their view, what makes carbohydrate qualitative is the amount of non-digestible content (fibre) which plays a role in reducing blood glucose level, risk of obesity, cardiovascular problems, cancer and other health issues. In a systematic review conducted by Cooper et al (2012) on the effect of fruits and vegetable intake on type II diabetes mellitus using pooled data from five studies conducted in European countries, fibre contents of the vegetables and fruits were significantly associated with low risk of type 2 diabetes.

The major weak point of the studies reviewed is the self-reporting instrument used in colleting data from the participants as attempts by participants to impress the researchers may have introduced some biases to the study(Polit and Beck 2012). However, the use of standardised dietary questionnaire, 24-hours dietary recalls and large sample size with heterogeneous participants are strengths that make the findings acceptable. Care should therefore be taken in making the carbohydrate qualitative by increasing the fibre content of meal as poor quality carbohydrate will negatively influence its effectiveness in the management of type II diabetes.

The effect of culture and social interactions: Cultural belief system and social interaction determine the availability, appropriateness and acceptability of any nutritional intervention in type 2diabetes mellitus (NICE 2011). A review of health beliefs and lifestyle behaviour of women with previous gestational diabetes in Birmingham by Jones (2009) using eight articles and six studies showed that the cultural belief system of the women was positively correlated to their lifestyles with respect to eating habit. The limitations of the studies however, are the single 24 – hour reporting which may not reflect the true dietary in-take and the possibility of participants under reporting their dietary in take. Triangulation would have been necessary to make the findings more reliable.

Another systematic review of 38 studies carried in United States of America on family and environmental correlates of health behaviour in high risk youths by Lawman and Wilson (2012) revealed a significant positive correlation between parental and physical environmental factor and health behaviour of youths with respect to diet and choice of food. Although the studies reviewed were carried out among youths, the social and environmental contexts are the same as those of adults aged 35 years and above and this informed the researcher's decision for including it. Ogbera and Adeyemi (2011) similarly found out that social interactions and the type of information received directly affected the glycaemic control and self care habits of 150 type II diabetics from Nigerian subjects. In Nigeria for instance, family members live together and eat together; introducing nutritional intervention that is not acceptable to the family members will mean that the diabetic will eat alone which may not work as the patient will suffer social isolation. The major shortcoming of the study is that the researcher did not evaluate the distress arising from the diabetes complications which may have affected the subjects' glycaemic control and self care habits.

That notwithstanding, the patients' cultural background should be taken into account in planning his or her meals in order to enhance compliance with and effectiveness of intervention.

The influence of environmental factors and altered sleep pattern: Environmental factors can have much influence on nutritional intervention in type II diabetes mellitus. Ershow (2009) states that our environment determines our sleep pattern, nutritional information and lifestyles. A primary school teacher from the researcher's community in Nigeria developed type II diabetes in 2010 and was informed by his friends who were alcoholics and smokers that taking a reasonable quantity of alcohol would help him eat little and reduce his blood sugar. Following the advice, he changed his lifestyle into alcoholism and smoking which actually affected his appetite and five months later, he died of ketoacidosis as confirmed in the hospital probably because of starvation. Nature of work and noisy environment can alter the patient's sleep pattern (Ershow 2009); the impact of altered sleep pattern on metabolism is discussed in the next paragraph.

As explained by Ershow (2009), Sharma and Kavuru (2010) and Amos, McCarty and Zimmet (2010) in their articles titled "circadian rhythms and sleep", "sleep and metabolism" and "the global rising burden of diabetes mellitus"respectively, growth hormone and cortisol regulate glucose metabolism; these hormones increase during sleep and in sleep deprivation, there is dysregulation of glucose metabolism thereby increasing the risk of type II diabetes despite the intervention. Leptin (found in the adipose tissues) and ghrelin (found in the stomach) are peripheral hormones that regulate the appetite centre located in the nucleus arcuate region of hypothalamus.

Schmid, Hallschmid, Jauch-Chara, Born and Schultes (2008) in their article on "sleep deprivation" further explained that whereas leptin suppresses appetite, ghrelin increases it; leptin release increases during deep sleep while ghrelin level decreases thereby reducing appetite. In sleep deprivation, the reverse is the case which results in increased appetite and the individual tends to show more appetite for carbohydrates and sweet foods. This response destabilises the dietary plan for the diabetic patient (Schmid et al 2008).

The four articles tend to concentrate more on the impact of short sleep duration (sleep deprivation) without discussing that of long sleep duration (sleep elongation). Moreover, it would have been more interesting if the authors had highlighted the gender differences on the impacts however, the nutrition intervention team should always consider advising the patients on the need for adequate sleep as part of the nutritional intervention in type II diabetes mellitus.

The issues of patients 'compliance with nutritional advice: Compliance has to do with practices that are in line with the nutritional advice given to patients. The effectiveness of the advice depends so much on the patients' level of compliance. Idemyor (2010) states that the major challenges to compliance to dietary advice by diabetics in developing countries are level of education, economic status and inadequate or lack of interaction between the patients and health workers. A cross sectional survey carried out in six African countries (Nigeria, Senegal, Kenya, Ghana, Tanzania and Cameroun) by Sobngwiet al(2011) to evaluate compliance to glycaemic index control using 2,352 subjects drawn from specialists clinics in these six countries.

The findings revealed that 33.3 % (786) benefitted from standard care and 50 % (1176) had good glycaemic control probably because of access to health care. The major concern in this study is that participants were drawn from only specialist hospitals which makes generalisation to those managed by General Practitioners in non specialist hospitals difficult. Drawing participants from both specialists and non specialist health care facilities would have made generalisation more authentic.

Similarly, a cross sectional assessment of dietary practices among diabetics in the United Arab

Emirates (UAE) by Al-kabi et al (2008) using 409 subject made up 50 % illiterates and 50 % educated subject, the findings showed that 24 % read labels on food, 76 % were unableto distinguish between low and high glycaemic index food, 46 % had never seen a physician and more than 50 % had uncontrolled glycaemic index, hypertension and high lipid profile.

The key weak points of this study include the use of self reporting tool which may not be dependable as patients may want to impress the researcher (Gerrish and Lacey 2010) and the fact that the participants were drawn from the city only; generalising the findings to the whole of UAE is not authentic as the participants were not true representation of the whole country in terms of socio-economic and environmental status. Drawing participants from both rural and urban settings and combining self reporting with participant observation tool will make the findings more generalisable and dependable. This finding however, may apply to the practices of type II diabetics in South Eastern Nigeria because of similar ratio of educated to uneducated patients, developmental level, socio-cultural and environmental contexts.

DISCUSSION OF ISSUES ARISING FROM THE SYSTEMATIC REVIEW

The major issues arising from the proposal include the effect of socio-cultural factors, environmental factors and method of food preparation on the nutritional management of type II diabetes. Others include the issue of compliance and the effect of mushroom in the nutritional management of type II diabetes.

The issue of socio-cultural factors: From literatures from Nigeria, United Kingdom and United States of America, it was discovered that social interactions, family structures, food availability and economic status affect the nutritional management of type II diabetes mellitus (NICE 2011, Dawn and Wilson 2012 and Ogbera and Adeyemi 2011). The negative impacts seem to be more in Nigeria because of the unique family bonds and communal living (Ogbera and Adeyemi 2011). In United Kingdom and United States of America, the issue is more of cultural appropriateness of the nutritional intervention with respect to the communities (NICE 2011).

Planning nutritional intervention in type II diabetes should therefore take into consideration the family members and community of the patient. The acceptability, accessibility and affordability of the intervention should also be considered in the context of the individual patient and the community. The family members and the community should be carried along through out the course of intervention through effective communication.

The issue of environmental factors: The social process in the environment, work place condition and pattern of work such as shift duty and night duty may affect eating habits, sleep pattern and the biochemical processes in the body with respect to food digestion and glucose metabolism (Ershow 2009). Noise and stress resulting from social process in the environment can also affect glucose metabolism thereby making assessment of intervention difficult (Ershow). Type II diabetics on nutritional intervention should be properly advised with respect to work condition and pattern and possible change of occupation if it is not compatible with the new health status of the patient.

The issue of food processing method: Evidence from studies carried out in Nigeria and Kenya revealed that method of food processing affect the glycaemic index of the food. In Nigeria, research revealed that the GI of boiled yam was higher than that of same quantity of fried and roasted yam (Itametal 2012). Similarly, the Gi of boiled beans in Kenya was higher than that of beans cake (Mugendi et al 2010). The differences as explained by BDA (2011) were as a result of the difference in the rate of digestion.

Nutritionists and dieticians should organise nutritional advice to all industries and individuals involved in the processing of diabetic diets. Moreover, they should in collaboration with health care workers organise nutritional advice to diabetics with respect to choice of food and method of preparation. This should be included in the nutritional management guidelines for diabetes and other people who have need for weight or blood sugar control.

The issue of compliance: Available studies revealed that level of education, economic status and level of interaction between the patients and the health care workers affect their compliance to nutritional management; the higher the level, the more the compliance (Idemyor 2010, Sobngwi 2011 and A-kabi 2008). This is however, true in developing countries where the gap between the rich and the poor is much.

There is therefore need for more interaction between the health workers and the patients especially in developing countries like Nigeria, Kenya and United Arab Emirates. There is also need for health policy makers to develop favourable policies that will improve the health workers - patients' interaction in developing countries in order to improve compliance to the nutritional intervention.

The alpha glucosidase content in mushrooms: Researches conducted in China and India showed that mushrooms contain alpha glucosidase inhibitors which lower blood glucose level (Hong et al 2007, Yang etal 2007, Lo et al 2008 and Okumura 2008). This seems interesting as different types of mushrooms abound in Nigeria especially in the South East and some other countries like Ghana and Kenya although not in commercial quantity however; the limitation of this study is that it was carried out in rats. Although the research was carried out in rats, it should be replicated in human beings in South Eastern Nigeria and other countries with high prevalence of type II diabetes; if it works, then commercial production of mushrooms should be given special attention as an intervention strategy in the nutritional management of type II diabetes.

Summary of major findings from the systematic review

The major points from the literature reviewed are as summarised below:

- Diabetes mellitus is a growing public health concern affecting both developed and developing countries.
- According to International Diabetes Federation (2011), about 366 million out of 7 billion people live with diabetes globally; out of this number, 80 % are type II diabetes mellitus. The estimated global prevalence rate is 6.4 % and type II accounts for 90 %.
- The aetiology of type II diabetes mellitus can be traced to thrifty gene hypothesis, metabolic syndrome and other risk factors such as obesity, age and sedentary life style (Graham 2012 and Selber 2012).
- Nutrition management is the first approach in the management and prevention of type II diabetes mellitus (Deakin 2012, Stephen 2009 and Unachukwu and Chinenye 2007).
- Socio-cultural factors (social interactions, food preferences and family structure and family bound) affect nutritional management of type II diabetes mellitus South Eastern Nigeria and other developing and developed countries (NICE 2011, Dawn and Wilson 2012 and Ogbera and Adeyemi 2011).
- Environmental factors (social process, working place condition and pattern of work such as shift duty) affect compliance to nutritional management (Ershow 2009).
- Method of food preparation affects the glycaemic index of the food (British diabetic Association 2011, Itam et al 2012 and Mugendi et al 2010).
- Level of education, economic status and level of interaction between the patients

and health care team affect compliance to nutritional management guidelines (Idemyor 2010, Sobngwi 2011 and Al-kabi et al 2008).

- There is evidence from research that mushrooms contain alpha glucosidase inhibitors which lowers blood glucose level (Hong et al 2007, Yang et al 2007, Lo et al 2008 and Okumura 2008).
- . From the literature search, it obvious that there is limited study on the subject matter in South Eastern Nigeria and Nigeria at large.

Conclusion

This study looked at the factors affecting the nutritional management of type II diabetes in South Eastern Nigeria. The search strategy included the use of hand searches of printed sources and texts and use of electronic data base. A lot of resources from both developed and developing countries on the research topic were explored using those strategies.

The key issues arising from the study include the influence of socio-cultural and environmental factors on nutritional management of type II diabetes; the implication for researchers, health workers and health policy makers. The issues of food processing methods and glycaemic index, patients' compliance and the role of alpha glucosidase content of mushrooms in the control of blood glucose and cholesterol levels. The researchers suggested further studies on the findings using ethnographic and control randomised trial approaches to boost the data resource base on the area in Nigeria.

Suggestions for further studies

Further studies should be carried out on the same topic using ethnographic approach to explore the sociocultural and environmental factors for both type I and type II diabetes mellitus to add to resource database on the area in South Eastern Nigeria and Nigeria at large. Randomised control trial studies should be carried out on the effect of edible mushroom on blood sugar level using human beings.

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