KNOWLEDGE AND PRACTICES OF PREGNANT WOMEN RELATING TO PREVENTION OF FOETAL ORIGIN OF ADULT DISEASES IN OLORUNDA LOCAL GOVERNMENT AREA, OSUN STATE

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DEDICATION

This work is dedicated to my best friend, Jesus Christ whom without which this work would have come to a successful completion. It is also dedicated to my adorable daughter, Adesewa, and people with chronic illnesses of foetal origin.

ABSTRACT

Foetal Origin of Adult Diseases (FOAD) are chronic diseases which occur later in future due to deficiencies of micronutrients like folate, ferrous, zinc and vitamin B_{12} during the first trimester of pregnancy. There is increasing incidence of chronic diseases not linked to hereditary or other environmental factors, but traceable to deficiency of nutrients in utero. Previous studies have shown that many pregnant women had little or no knowledge of the concept of FOAD in relation to essential nutritions in the first trimester. Hence, this study was designed to determine pregnant women's knowledge and practice on the prevention of FOAD in Olorunda Local Government Area, Osogbo.

A descriptive, cross-sectional design was adopted using a two-stage random sampling technique to select Wards, Primary Health Centres, and 422 consenting respondents. A semi-structured interviewer-administered questionnaire was used to elicit information on socio-demographic characteristics,knowledge and prevention of FOAD. Knowledge of FOAD was measured on a 29-point scale; scores of <10, ≥10-20, and >25 were categorised as poor, fair, and good, respectively. Practice was measured on a 14-point scale: scores of <7 and ≥7 were categorised as poor and good, respectively. Three Focus Group Discussion sessions (FGDs) comprising of 10 respondents each were conducted. Quantitative data were analysed using descriptive statistics, Chi-square test and logistic regression models at p=0.05 while qualitative data were analysed thematically.

Age of respondents was 30.9±6.8 years and 32.0% had no formal education. Respondents' knowledge score was 11.4 ±3.4. Those with poor, fair and good knowledge were 48.3%,44.1% and 7.6%, respectively. About fifty six percent wrongly reported that third trimester is the most sensitive of all trimesters. Seventy one percent reported that deficiency of folate could only cause jaundice, malaria and ricket in children while 69.7 %, 71.6 % and 74.6 % reported that intake of folate containing diets in the first trimester cannot prevent hypertension, diabetes and obesity, respectively. Seventy percent said the deficiency of ferrous could rather lead to jaundice, malaria and ricket while only about 25.0% percentage rightly reported that its deficiency could cause chronic diseases. Practice score on the prevention of FOAD was 6.2±1.8 with 77.0% having poor practice. Antenatal clinic attendance was related with the knowledge of FOAD. Respondents who attended all antenatal

visits were more likely to have good knowledge of FOAD (81.0%) than those who did not attend (17.8%) (OR=3.7: CI=3.4-7.5). Knowledge was significantly related with practice on the prevention of FOAD. A higher proportion of respondents with poor practice (48.3%) were less likely to have good knowledge (OR=0.4: CI=0.3-0.6). Majority of the focus group discussion participants also opined that the chronic diseases are never of foetal origin but rather hereditary. However, excerpts from the discussions showed that the participants had poor knowledge and practice in relation to the prevention of FOAD.

Majority of the respondents had poor knowledge and practice of prevention of FOAD Therefore, strategies like health education and use of information education and communication media (radio, posters) should be promoted to improve the knowledge and practice.

Keywords: Micronutrients deficiency, Pregnant women, Foetal Origin of Adult diseases, Primary health Centres.

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Ojo Oyeronke Olanrewaju

CERTIFICATION

I certify that this project was carried out by Ojo Oyeronke Olanrewaju of the Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan, under my supervision.

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LIST OF ABBREVIATIONS

FOAD:	Foetal Origin of Adult Diseases
ACOG:	American Congress of Obstetricians and Gynecologists
WHO:	World Health Organisation
Zn:	Zinc
Fe:	Iron
Fo:	Folic acid
Vit B12:	Vitamin B12
PHC:	Primary Health Care
LGA:	Local Government Areas
CVD:	Cardiovascular diseases
CHD:	Coronary Heart diseases
LBW:	Low birth weight
RDA:	Recommended daily allowance

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

As a Chinese ancient philosopher's saying goes, "it is formidably difficult, if not impossible, to recover any birth deficits in postnatal life" (Hales and Barker,1991). It appears that humans have recognized the importance of intrauterine life environments for health in later life since antiquity. Yet it is only until the last two decades that the causal relationships between early life experience and later risk of disease have come into light. Too small birth size (due to poor foetal growth and/or preterm delivery) has been consistently associated with substantially elevated risks of certain chronic disorders such as the metabolic syndrome (dislipidemia, insulin resistance, hypertension),type 2 diabetes and cardiovascular disease. (Hales, Barker, Clark,Cox, Fall 1991; Singhal, Cole, Fewtrell and Lucas, 2004).

Similar to other factors like lifestyle, genetics, etc, nutrition during pregnancy also plays a key role in the well-being of the mother and the newborn infant and further influences health during childhood and adulthood. Thus in the course of pregnancy, the quantity and quality of nourishment is of particular importance. Evidence suggests that inadequate nutrition during pregnancy, leads to spontaneous abortion, impaired foetal growth, learning impairment and behavioral problems of the offspring as well as poor weight gain in pregnancy (Harding, 2001).

The foetal origins hypothesis, developed by David Barker and colleagues, proposes that when nutritional intake of a foetus is limited, the body's physiology and metabolism are changed fundamentally, and some of the consequences of these changes would become visible much later in life. The hypothesis of in utero "programming" posits that under-nutrition in utero leads to adaptive changes in growth and development that may be beneficial in the short-run, but produces susceptibility to coronary heart disease and the related disorders hypertension, stroke, and diabetes later in life.

Proffesor David Barker described in his work the "thrifty phenotype" as a term used to explain d the hypothesis that insulin resistance and type 2 diabetes originate from under-nutrition in the womb. The hypothesis proposes that an undernourished baby becomes thrifty.

It maintains high levels of sugar in the bloodstream that benefits the brain, but less sugar is stored in muscles. Muscle growth may be "traded off" to protect the brain. Once adopted, this thrifty behaviour becomes permanent and, combined with adiposity in later life, leads to type 2 diabetes.

During the first 2 months of pregnancy, the embryo and placenta undergo processes of rapid cell differentiation and division and are particularly sensitive to excesses and differences in micro nutrients (Godfrey and Barker, 2000). They observed that inadequate levels of maternal nutrients during this crucial period may lead to reprogramming within the foetal tissues that exposes the infants to chronic illness or malformation in adulthood. Therefore an appropriate eating pattern is essential throughout pregnancy to ensure a healthy pregnancy and baby (Pickel, Pinheiro and Seabra, 2005).

Higgins (2003), identified dietary factors, overall diet quality and food habits as independent variables in determining pregnancy outcome and maternal weight gain. Assessment of dietary intake during pregnancy is important because it is well established that both nutrient deficiencies and excesses can have adverse effects on pregnancy outcome. (Worthington-Roberts et al. 1996).The type of food taken by women during pregnancy influences the health of pregnant women and foetal development. It has impacts on the development of the placental and maternal state of health or wellbeing (Carmichael and Abrams 1997; Siega-Riz, Adair and Hobel 1996; Smith, 2004).

Physical disorders have not only been linked with poor nutrition before and during pregnancy, but neurological disorders and handicaps are a risk that is run by mothers, who are malnourished, a condition which can also lead to the child becoming more susceptible to later degenerative disease. Lack of dietary knowledge and the knowledge about consequences of malnutrition among future mothers may result in a lot of dietary indiscretions (Lingen, 2006). Accordingly, maternal dietary habits, poor dietary pattern and poor nutritional status of women before and during pregnancy are one of the major causes of malnutrition which is usually also responsible for chronic illnesses in adulthood (Anderson, 2008).

Periconceptual folate status is important since neural tube closure occurs early in gestation, and severe deficiency is associated with neural tube defects. Sustained folate intake is needed in order for cell replication to be normal, since there is no long-term store of folate. Janies (1997) postulated that seasonal cycles of folate intakes may be relevant to cyclical changes in

birth weight as observed in tropical countries. and that lower folate intakes in lower socioeconomic groups may be related to lower birth weight (James, 1997). Low folate is associated with low birth weight, (LBW); it is also associated with high serum homocysteinemia, which is associated with CVD risk (Vollset et al., 2000).

The incidence of dietary inadequacies as a result of dietary habits and patterns in pregnancy is higher during pregnancy than at any other stage of the life cycle (Rao et al., 2001). In light of this, a satisfactory nutritional status as a result of optimal food intake, before and during pregnancy is important for a successful pregnancy.

1.2 Statement of the problem

In 1965, a World Health Organization (WHO) Expert committee on nutrition in pregnancy and Lactation observed that next to young children, pregnant and lactating women are nutritionally the most vulnerable group especially in the developing regions of the world. Regrettably the situation deeply affects developing nation like Nigeria, majority of women are in constant state of nutritional stress (WHO, 1965). This in fact has been accountable for premature death, chronic protein-energy malnutrition, iron deficiency anaemia and a host of other deficiencies. Household or pregnant women's nutritional status depends on socioeconomic and socio-cultural factors such as income, literacy or traditional beliefs (WHO,1965).

The incidence of dietary inadequacies as a result of dietary habits and patterns in pregnancy is higher during pregnancy than at any other stage of the life cycle (Rao et al., 2001).

The burden of chronic diseases is rapidly increasing worldwide. It has been calculated that, in 2001, chronic diseases contributed approximately 46% of the global burden of disease (WHO Report, 2002). About half of these deaths are attributable to cardiovascular diseases; obesity and diabetes are also showing worrying trends, not only because they already affect a large proportion of the population, but also because they have started to appear earlier in life. Based on current estimates, the proportion of the burden of chronic diseases is expected to increase to 57% by the year 2020, at enormous healthcare and other costs for societies and governments (Murray, Lopez,1996, Epping et al 2001)). Already, 79% of deaths attributable to chronic, non communicable, diseases are occurring in developing countries, predominantly in middle-aged men (WHO 2002).

According to the Foetal Origin of Adult Diseases (FOAD) hypothesis, increasing child and adult obesity in combination with persistently poor foetal growth creates a high risk for adult CVD and diabetes more so because of undergoing rapid economic development and modernization (Reddy, 2002). Also, according to Dunger, Ong, Huxtable, *et al.* (1998), death rates in babies in the 1900s showed that the usual cause of certified death was low birth weight usually as a result of maternal under nutrition, and both men and women who were small at birth were at increased risk of coronary artery disease and stroke.

King (1990), has predicted that the prevalence of type 2 diabetes will rise by 30% worldwide, from 4.0% to 5.4% by 2025, and that the proportional rise will be greatest in developing countries. Accordingly, maternal dietary habits, poor dietary pattern and poor nutritional status of women before and during pregnancy is one of the major causes of malnutrition viz low birth weight which is usually responsible for chronic illnesses in adulthood (Anderson, 2008).

In a similar study in Nigeria, Ojofeitimi, Ogunjuyibo, Sanusi, Orji *et al.* (2008) reported that more than 60% of their sample did not meet the requirement for energy due to lack of nutritional knowledge. Mean energy intake for this study group was 2146.6Kcal compared to the RNI of 2400kcal.This finding is in line with Huybregs, Roberfriod, Kolsteren and Vancamp (2009) in Burkina Faso where mean energy and nutrient intakes were found to be insufficient compared with the recommended daily allowances, especially for pregnant women, and as a result of food aversion due to inadequate nutritional knowledge, the mean intake of folate was alarmingly low, similar to studies in Sweden by Andersen, Compbell and Shepherd (2008). The lower intake of folate in the study was probably due to low intake of vegetables.

Generally, low birth weight infants account for large public health expenditures —studies show that more than one third of the total dollar amount spent in the US on health care during the first year of life can be attributed to low birth weight. (Levitt et al, 1995).The linear and graded trends in CVD mortality with birth weight suggest that majority of the world's population experience sub-optimal foetal growth being highest in developing countries. A high proportion of infants and children in the developing country are still undernourished, but with economic progress, childhood and adult obesity is an emerging problem, especially in cities (Lucas, Fewtrell and Cole ,1999).

It is however becoming clear that, while the number of people dying from heart disease continues to fall each year in countries such as the UK, the number of people suffering from this disease is rising. in part this is due to the age structure of developed societies, but it also emphasizes that we are still far from understanding the causes of heart disease and until we do, prevention will be difficult. (www.heartstats.org retrieved June 6, 2013). Begley, (2002) found out there is a lack of consistent education on nutrition for pregnant women and there is a need to design and implement new more effective nutrition programmes.

1.3 Justification of the study

Biological determinism and fatalism easily springs to mind with the notion that adult disease originates in the foetal stage (Taylor, 2004). If increased risk for adult disease is a direct consequence of irreversible structural and functional changes occurring during gestation, it has implications for public health initiatives in which this study is set to be part of.

Begley (2002), found out there is a lack of consistent education on nutrition for pregnant women and there is a need to design and implement new and more effective nutrition programmes. However, with this study, the level of knowledge possessed by pregnant women on the prevention of foetal origin of adult diseases will be known. The study provides baseline data for further researches and thus create rooms for researchers to initiate intervention programmes towards correcting certain misconceptions/belief about some foods especially in the first trimester and also creating nutritional awareness for women of reproductive ages, because a woman knowing that her own diets and body composition before and during pregnancy play a major role in programming the future health of her children will encourage/motivate her to know what she can do to optimize the intrauterine environment she provides for her babies.

Nonetheless, this study buttressed all other previous report findings on foetal origin of adult diseases and thus reinforced the need for the inclusion of nutritional programmes in women preventive health.

Most physicians and their patients understand that proper nutrition and supplements during pregnancy is important, but many are not aware of specific recommendations and how to achieve these behaviours. In many cases, healthcare providers simply tell women to eat a healthy diet, take drugs and gain appropriate weight during pregnancy. However, to achieve this, healthcare providers need to be knowledgeable to give women the tools and direction to

do so properly (Vouse, Martz, Richard, & Gralich, 2006).Therefore, conducting this study at the Primary Health Care Centre provided an opportunity to know the kind of nutritional information /education received and also to know certain nutritional/supplements taboos, belief and restrictions at the grass root level.

1.4 Definition of terms.

This phase deals with definition of terms related to this study in an operational and a conceptual way;

- **Foetal Origin of Adult Diseases**: The "foetal origins of Adult diseases hypothesis", proposes that non-communicable diseases including coronary heart disease, type 2 diabetes and hypertension originate through the responses of a foetus to under nutrition, that permanently change the structure and function of the body (Barker, 1993).
- **Programming**

  This term has been used to describe the process whereby a stimulus or insult at a "sensitive" or "critical" period of development has lasting effects on the structure or function of the body (Barker , 1998).
- **Thrifty Phenotype**

  A term that was coined to describe the hypothesis that insulin resistance and type 2 diabetes originate from under-nutrition in the womb. The hypothesis proposes that an undernourished baby becomes thrifty. It maintains high levels of sugar in the bloodstream that benefits the brain, but less sugar is stored in muscles. Muscle growth may be "traded off" to protect the brain. Once adopted, this thrifty behaviour becomes permanent and, combined with adiposity in later life, leads to type 2 diabetes(Barker, 1995).
- **Micronutrients**: iron, folate, zine and vitamin B_{12} These are essential elements that are needed by the foetus especially in the first trimester for growth and development and to prevent chronic diseases like diabetes, obesity and cardiovascular diseases in the child in future.

1.5 Research questions

a) What is the knowledge of pregnant women on micronutrients essential in the first trimester to prevent foetal origin of adult diseases?

b) What are the factors that influence the nutritional knowledge of pregnant women towards the prevention of foetal origin of adult diseases?

c) What is the practice of pregnant women towards the consumption of the nutrients essential in the prevention of foetal origin of adult diseases?

1.6 Objective of the study

To investigate the knowledge and practice of pregnant women in relation to the nutrients essential in the first trimester in the prevention of foetal origin of adult disease.

1.7 Specific objectives

- To assess level of nutritional knowledge of pregnant women on the prevention of foetal origin of adult disease.
- To assess the preventive practice of pregnant women on micronutrients essential towards prevention of of foetal origin of adult diseases.
- To determine the factors that influence the nutritional knowledge of pregnant women on foetal origin of adult diseases.

1.8 Research hypotheses

The following Null Hypotheses was tested:

H_o1: There is no significant difference between the antenatal attendance of the pregnant women and their nutritional knowledge of the prevention of foetal origin of adult diseases.

H_o2: There is no significant difference between the pregnant women's level of education and their nutritional knowledge of the prevention of foetal origin of adult diseases.

Ho3: There is no significant difference between parity of the pregnant women and their nutritional knowledge of prevention of foetal origin of adult disease.

H_oA: There is no significant difference between the nutritional knowledge of the pregnant women and their practices relating to the prevention of foetal origin of adult disease.

CHAPTER TWO

2.0 LITERATURE REVIEW

It is now widely accepted that the risks of a number of chronic diseases in adulthood such as insulin dependent diabetes mellitus, hypertension and coronary heart disease may have their origins before birth. Professor David Barker and colleagues in Southampton have produced a large proportion of the data in this field over the last decade, although the relationship between early life events and adult diseases had been raised many years earlier (Barker 1998, Forsdahl 1977). He also proposed that poor nutrition during foetal (and early postnatal) life was a strong factor responsible for increased vulnerability to chronic disease. Measurements made on babies at birth, including birth-weight, length, body proportions and placental weight, are strongly related to either later disease incidence (coronary heart disease mortality, noninsulin- dependent diabetes) or risk factors for those diseases (hypertension, glucose intolerance, hyperlipidemia) (Barker 1998,Barker 1994).

2.1 Origin of foetal origin of adult diseases

Historical overview

The relationship between infant mortality and subsequent ischaemic heart disease in survivors from the same generation was first demonstrated in Norway (Forsdahl, 1977). Neonatal mortality was found to be more strongly associated with cardiovascular diseases than post-neonatal mortality, which pointed to the importance of prenatal life. The same type of ecological correlation was reported in 1986 by Barker & Osmond in England and Wales. It was observed that Coronary Heart Disease (CHD) was most common in the poorest parts of the UK (Martyn, 1994). Areas of the country that had high rates of infant mortality in the past, now have high rates of heart disease. In contrast, those with low infant mortality now have relatively lower rates of CHD. High infant mortality occurs in places with high rates of LBW, reduced infant growth, and poor nutrition and health of pregnant women. As LBW and reduced infant growth reflect adverse environmental influences during pregnancy or infancy, it was hypothesized that these influences initiated patho-physiological mechanisms that ultimately lead to CHD.

A major difficulty has been the availability of data on birth weight and other relevant obstetric and neonatal information in order to substantiate the hypothesis.

Barker however began by documenting CHD events in population groups where he could find well-kept records on births. This is how he studied the relationship of early events (birth weight and status at birth, weight gain, feeding in infancy, etc.) and disease patterns in large cohorts of adults born in the '20s and'30s in Hertfordshire, Preston and Sheffield. He developed his "early origins" hypothesis based on these retrospective studies showing an inverse association of birth weights and CHD mortality and morbidity rates. Epidemiological data from Britain and other parts of Europe, Australia, Asia, the Caribbean and Latin America, the USA, and even Africa, have since corroborated and extended the initial observations of increased risk of CHD, type-2 diabetes, and other components of the insulin resistance (or metabolic) syndrome with decreasing birth weights.

Consensus was reached in an international nutrition coordinating body regarding the existence of associations between foetal growth as evidenced by anthropometric indicators and adult disease, in particular high blood pressure, ischaemic heart disease, and type-2 diabetes, although areas of uncertainty were underlined (Grivetti et al., 1998).

Many of the conditions which have been diversely linked to size or proportions at birth as a reflection of foetal growth often coexist as part of syndrome X or metabolic syndrome (Reaven 1988), that is, hypertension, dyslipoproteinemia, and other CVD risk markers such as obesity, in addition to insulin resistance or impaired glucose tolerance or type-2 diabetes. Barker et al (1993) even coined the name "small baby syndrome" for syndrome X. Yet, chronic disease risk markers associated with suboptimum foetal growth have been usually considered individually, particularly in earlier studies. This is the reason for separately reviewing epidemiological findings on CHD, high blood pressure, and insulin resistance/diabetes.

The foetal origin, hypothesis was developed by linking records of births in the early 20th century with health in later life from the Hertfordshire records (Barker , 1989). The proposal that events in childhood influenced adult disease was not new. However, the unique feature of the hypothesis proposed by Barker was the suggestion that intrauterine events influenced adult disease. The notion that chronic adult diseases, such as coronary artery disease, might be influenced by events occurring in the foetus,due to undernutrition was proposed by Barker and colleagues approximately 10 years ago. In early studies investigating the origins of heart disease, Barker and colleagues linked the standardized mortality ratios for cardiovascular disease for 16,000 individuals, born in Hertfordshire from 1911–1930, to birth data for these individuals (Barker , 2001).

The data suggested that low weight, small head circumference and low ponderal index (mass/height^3) at birth was associated with an increased risk for coronary heart disease in adulthood (Osmond, Barker, 2000). These findings were considered the first evidence that an adverse intrauterine environment, as measured by individual anthropometric measurements at birth, had longstanding effects on the development of adult disease. Elevated blood pressure, high serum cholesterol and diabetes mellitus are considered some of the major risk factors for coronary heart disease (Grundy, et al. 1999), and was therefore studied as possible mediators of the low birth weight–FOAD link. In 1989, the first report of an inverse relationship between birth weight and blood pressure was published (Barker et al. 1989).

In a secondary analysis of the link between birth weight and blood pressure, the authors concluded that the elevated blood pressure continued to increase throughout the lifetime (Lawet al.1993). Around the same time, an inverse relationship between birth weight and serum cholesterol was published (Barker et al.1993) Among men and women born during the Dutch famine of 1944-45, late gestation exposure to famine was associated with glucose intolerance, insulin resistance, and a (small) increase in type 2 diabetes. Early gestation exposure was associated with higher LDL/HDL cholesterol concentrations and (in women) higher BMI and waist circumference. Three recent studies suggested that the balance of maternal protein and carbohydrate intakes during pregnancy is related to blood pressure in the offspring (Barker et al. 1993).

The concept of a foetal origin of adult disease have been extended well beyond coronary heart disease and being a risk factor for coronary heart disease, and now includes investigations of the development of the central nervous system, early origins of adult mental health(Alati ,Lawlor , Mamun et al, 2007), and cognitive function.(Jefferis, Power, Hertzman ,2002).

2.2 The Concept of Foetal Origin of Adult Disease

Epidemiologic research is the key to identifying determinants of disease. Over the last century, epidemiologic research in western societies has steadily turned its focus from communicable to non-communicable disorders, such as coronary heart disease, non-insulin dependent diabetes, asthma and chronic obstructive pulmonary disease, and a strengthened interest in lifestyle and social factors as determinants for disease (Barker 2001). According to Krieger, 1994, the shift has also increased the focus on more distal factors, both socio-

culturally (i.e. socioeconomic region) and temporally (i.e. events during earlier stages of life e.g nutrition).

The classical observations on the associations between early growth and later risk of disease came from Drs. Barker and Hales group's retrospective cohort studies on foetal growth (birth weight as a surrogate) and infant growth (weight at 1 year) in relation to later risk of impaired glucose tolerance,the metabolic syndrome and cardiovascular risk in adulthoods (Hales et al 1991, Barker et al ,1993 :1995).

Low birth weight (< 2500 g.) was associated with substantially increased risks of impaired glucose tolerance, the metabolic syndrome, and coronary heart disease in later life. Subsequent epidemiological studies in various populations have largely confirmed this "foetal origins" phenomenon.

2.2.1 The "Thrifty Phenotype" Hypothesis

Drs Barker and Hales proposed the "thrifty phenotype" (Hales, Barker 1992, Hales, Barker 2001). The hypothesis suggests that foetal malnutrition may induce physiological and/or metabolic adaptations to ensure nutrient supply to the most vital organs (e.g., brain) at the expenses of other less vital organs (e.g., pancreas). Such adaptations during critical periods may permanently reset (e.g., reduced b-cell mass) or programme the metabolic system, which increases the foetus' chance of survival in poor nutritional environments. but results in difficulty in coping with nutritional abundance in later life ("mismatch") with deleterious long-term consequences. The hypothesis also speculates that malnutrition in infancy may contribute to reduced b-cell functional capacity impairment. The thrifty phenotype hypothesis emphasizes the aetiologic role of poor foetal nutrition.

Foetal malnutrition (e.g., protein restriction) manipulations in animal models have demonstrated some "programming" changes in pancreatic islets, liver and muscle, and adult onset of metabolic syndrome in offspring. The thrifty phenotype seems to be the most widely accepted hypothesis to explain developmental origins of disease. The hypothesis implicitly advocates promoting foetal and infant nutrition and growth (Betram, Hanson 2001) It has been suggested that a growing foetus faced with adverse conditions, responds with endocrine, metabolic and vascular or other structural adaptations (Barker,1990, Godfrey and Barker 2000, Frankel et al 1996).

The commonest adversity for the foetus may be 'malnutrition'. The first priority for a developing foetus is survival, and during the 'lean' periods this is achieved by reduced rate of growth (intrauterine growth retardation, IUGR). The time during intrauterine life when this occurs determines the systems affected. The 'foetal origins' hypothesis suggests that these adjustments are 'imprinted', affecting the response of the system in future life ('programming').

The increasing prevalence of the metabolic syndrome with the increasing birth weights in many developed countries raises further concern as to whether poor foetal nutrition itself is an important driver of adverse programming. Barker hypothesized that the associations between small size at birth or during infancy and later CVD reflect permanent effects of foetal under nutrition. The foetus is dependent on the nutrients from the mother and adapts to an inadequate nutrient supply in a number of ways: prioritization of brain growth at the expense of other tissues such as the abdominal viscera, reduced secretion of/sensitivity to the foetal growth hormones insulin and IGF-I, and up-regulation of the hypothalamo-pituitary adrenal (HPA) axis. The FOAD hypothesis proposes that although occurring in response to a transient phenomenon (foetal under-nutrition) these adaptations become permanent or 'programmed' because they occur during critical periods of early development (Barker,1995).The hypothesis is supported by examples in experimental animals of permanent structural and metabolic changes resulting from transient nutritional insults in utero. It is a well-established biological phenomenon and there are many well-known examples. In rats, maternal protein restriction in pregnancy leads to higher blood pressure, impaired glucose tolerance, insulin resistance and altered hepatic architecture and function in the adult offspring. The framework originally labeled 'the Barker hypothesis' (Barker,1995) has become among the more important frameworks on distal temporal determinants, suggesting that chronic illness is initiated by processes at prenatal stages (Barker, 2001). The main feature of the model is that intrauterine environmental exposures and events affect the foetus' development, and thereby increases the risk of specific diseases in adult life (Barker, 1997).

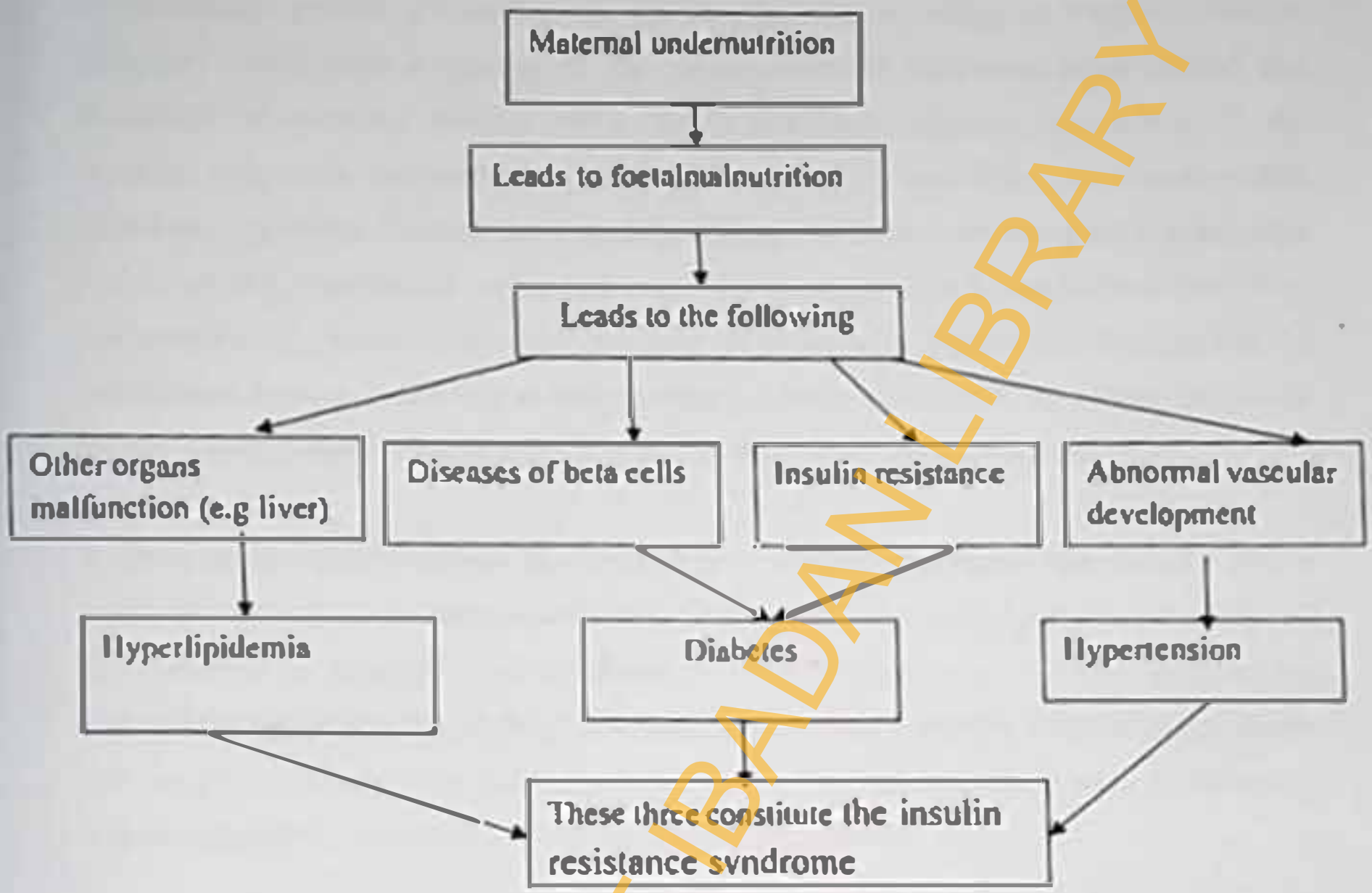


Fig 2.1 (Nair et al ,Indian pediatrics, volume 46 supplement, January,2009)

The core of the theory of foetal origins of disease is that nutritional deprivation of the foetus during critical periods of development forces the baby to resort to adaptive survival strategies, which entail a resetting of the normal course of metabolic, physiological, and anatomical development (Barker,1995). These adaptations become maladaptive if the organism encounters contrasting nutritional circumstances in later life. The "foetal origins hypothesis", proposes that non-communicable diseases including coronary heart disease, type 2 diabetes and hypertension originate through the responses of a foetus to under nutrition, that permanently change the structure and function of the body. Barker hypothesized that the associations between small size at birth or during infancy and later CVD reflect permanent effects of foetal under nutrition especially during the critical periods of development.

In the epidemiological literature, the foetal origins hypothesis associated with David J. Barker posits that chronic, degenerative conditions of adult health, including heart disease and type 2 diabetes, may be triggered by circumstance decades earlier, in utero nutrition in particular. Economists have expanded on this hypothesis, investigating a broader range of foetal shocks and circumstances and have found a wealth of later-life impacts on outcomes including test scores, educational attainment, and income, along with health.

Also according to David J. Barker, a British physician and epidemiologist, he argued that inadequate nutrition in utero programs" the foetus to have metabolic characteristics that can lead to future disease (Barker, 1992). For example, Barker argued that individuals starved in utero are more likely to become overweight as adults, and that they are more likely to suffer from diseases associated with obesity including cardiovascular problems and diabetes.

2.2.2 Programming and the "Foetal Origins" Hypothesis

The "foetal origins" hypothesis proposes that alterations in foetal nutrition and endocrine status result in developmental adaptations that permanently change structure, physiology, and metabolism, thereby predisposing individuals to cardiovascular, metabolic, and endocrine disease in adult life (Barker, 1995). The process whereby a stimulus or insult at a sensitive or critical period of development has long-term effects is termed programming. In evolutionary terms, the phenomenon is likely to reflect the benefits of plasticity during early development. Consistent with this, it is thought that coronary heart disease may be a consequence of foetal adaptations to under nutrition that are beneficial for short-term survival, even though they are detrimental to health in post reproductive life (Barker,1998).

Experimental studies in animals have documented many examples of foetal programming, with recent studies showing that alterations in maternal nutrition can have long-term effects on the offspring that are relevant to human cardiovascular disease. For example, feeding pregnant rats a low-protein diet results in lifelong elevation of blood pressure in the offspring (Langley, Jackson, 1994). Rats whose mothers had been fed a diet with a low ratio of protein to energy during pregnancy showed a permanently altered balance between hepatic glucose production and utilization; control rats fed the same diet during postnatal life had no alterations in hepatic glucose metabolism (Desai, Crowther, Ozanne, Lucas , Hales, 1995). Other notable long-term effects of alterations in maternal nutrition include changes in cholesterol metabolism, insulin secretion, and renal development (Barker, 1998).

2.2.3 Birth Parameters as Marker of Nutrition in Pregnancy

Empirical studies on birth parameters and adult diseases

Moore *et al* (1999) showed that low birth weight was negatively associated with the offspring's systolic blood pressure at age 20 in both men and women. As would be expected, this relationship was enhanced with increased weight and weight for height. Their findings led them to consider poor infant growth and low birth weight as risk factors for the triad of disease states that are known as the metabolic syndrome; type II diabetes, in and high blood pressure.

Death rates in babies in the 1900s showed that the usual cause of certified death was low birth weight, and both men and women who were small at birth were at increased risk of coronary artery disease and stroke (Dunger et al 1998).Measurements made on babies at birth, including birth-weight, length, body proportions and placental weight, are strongly related to either later disease incidence (coronary heart disease mortality, non-insulin-dependent diabetes) or risk factors for those diseases : hypertension, glucose intolerance, hyperlipidemia (Barker 1998; Forsdahl 1977; Barker 1994).

The epidemiological evidence that pointed to the importance of low birth weight in the aetiology of coronary heart disease was based on the long term follow up of men and women whose measurements at birth had been recorded routinely. Among 10,141 men born in Hertfordshire between 1911 and 1930, death rates from coronary artery disease were two times lower in those at the upper end of the distributions of birth weight and weight at 1 year of age than in those at the lower end (Barker, Winter, Osmond, 1989). As regards body Parameters, the foetal origin hypothesis is summarized below.

Four birth phenotypes associated with later disease have been identified; (a) babies who are thin at birth; (b) babies who are short at birth; (c) babies short and fat at birth, and (d) babies born with a large placenta(Barker,1998). Babies that are thin tend to be insulin resistant as children and adults, and are therefore liable to develop the insulin resistance syndrome (Phillips, Barker, Hales, Hirst, Osmond, 1994).

It could be that the thin baby has adapted to under-nutrition through endocrine and metabolic changes. Babies that are short in relation to their head circumference, and babies that have a reduced abdominal circumference, tend to have persisting abnormalities of liver function, including raised serum LDL cholesterol and plasma fibrinogen concentrations (Barker, Martyn, Osmond, Hales, Fall 1993, Martyn, Meade, Stirling, and Barker, 1995).

Studies in Preston showed that babies whose placentas are disproportionately large in relation to their own weight (which is usually as a result of malnutrition in pregnancy) tend to have raised blood pressure (Barker, Bull, Osmond, Simmonds, 1990).A study in Sheffield where detailed obstetric records are available showed that it was men who were small at birth because they were growth retarded, rather than premature, who were at increased risk (Barker, Godfrey, Osmond, 1992).In both populations, low birth weight was associated with an increased risk of stroke. (Martyn, Barker, Osmond, 1996). The association between low birth weight and coronary artery disease has subsequently been confirmed in studies of men in Uppsala, Sweden; Helsinki, Finland; and Caerphilly, South Wales; and among 80 000 women in the American nurses study, where there was a similar twofold decrease in relative risk for non-fatal coronary heart disease across the range of birth weights (Rich-Edwards, Stampfer, Manson, 1997).

Similarly in India, among South Indian men and women, the prevalence of coronary artery disease fell from 18% in those who weighed 2500 g at birth to 4% in those who weighed 3200 g at birth (Stein, Fall and Kumaran, 1996).Babies that have a small abdominal circumference in relation to their head circumference can result from "brain sparing" circulatory adaptations by which cardiac output is diverted to the brain at the expense of the trunk (Barker, Martyn, Osmond, Hales, Fall 1993).

These findings were similar to those seen in Pima Indians and also with observations in Sheffield that showed an association between abdominal circumference at birth and death from coronary heart disease (McCance, Pettitt, Hanson, Jacobsson, Knowler, Bennett, 1994). Studies in southern India have shown that babies who are short and fat tend to become insulin

deficient and have high rates of non-insulin dependent diabetes (Fall, Stein, Kumaran , Cox , Osmond, Barker, et al., 1998).

In 1995, studies in Britain showed for the first time that low birth weight was associated with increased risks of coronary heart disease and the disorders related to it: stroke, non-insulin dependent diabetes, raised blood pressure, and the metabolic syndrome

The Hertfordshire study and many of the other studies throughout the world only have data on the weight of the baby at birth. Clearly, birth weight is only a summary measure of growth and development of the foetus in utero. Where data are available on other anthropometric measurements at birth, including body length and head circumference, they show that suboptimal foetal growth, as indicated by thinness at birth (that is, a low ponderal index: birth weight/length3) or stunting, predict atherosclerotic vascular disease in later life (Forsen, Eriksson, Tuomilehto, *et al. 1997).*

The associations between birth size and cardiovascular disease are paralleled by associations between early growth and many risk factors for cardiovascular disease, in particular type 2 diabetes and hypertension. In Hertfordshire, the prevalence of type 2 diabetes or its precursor, glucose intolerance, fell from 40% among those who weighed <2.5kg at birth to 14% in those who weighed >4kg To date, 70 studies throughout the world have replicated the association between birth size parameters and hypertension, and 30 studies have shown an association between these parameters and glucose intolerance. Taken together, these studies have involved approximately 400 000 individuals (Law, 1999).

Type 2 diabetes and hypertension frequently occur together in the same patients and this combination, which is also associated with other disorders such as dyslipidaemia, central obesity, and insulin resistance, is known as the metabolic syndrome, which strongly predisposes to atherosclerotic vascular disease. Low birth weight is strongly associated with the metabolic syndrome, and the prevalence of this syndrome fell from 30% among men in Hertfordshire who were <2.5kg at birth, to 6% in those who weighed >4kg (Law, de Swiet, Osmond, et al, 1993).

Although obesity, and in particular central obesity, predispose to the development of the metabolic syndrome, it seems that the effects of low birth weight and adult obesity are

additive. The highest risk of developing the metabolic syndrome is nmong men and women who were small at birth but who become obese in adult life. Because the metabolic syndrome is characterized by insulin resistance, this suggested that low birth weiglit might be associated with insulin resistance. Insulin resistance was measured using a short insulin tolerance test in a sample of men and women in the Preston study. The results suggested that men and women who were thin at birth, as indicated by a low ponderal index, were insulin resistant in adult life (Barker, Martyn, Osmond, Hales, Fall, 1993). The association was independent of current body mass index. The relation between reduced foetal growth and insulin resistance has now been conlimed by a variety of techniques including the euglycaemic clamp and the intravenous glucose tolerance test with minimal modeling (De Boo, Harding, 2006, Perry, 1996: Hales, Barker 2001, Law, de Swiet, Osmond 1993). Taken together with the data on the relation between birth weight and the prevalence of the metabolic syndrome, these findings suggest that insulin resistance may originate through impaired development in foetal life, and might play an important part in mediating the link between low birth weight and cardiovascular disease (Alnti, Lawlor and Maman , 2007).

Poor maternal nutrition during crucial periods of foetal development might not only impair foetal growth but might permanently affect the structure and physiology of several organs and tissues. For example, a reduced nutrient supply to the foetal guinea pig induced by either unilateral uterine artery ligation or a low protein maternal diet during gestation in rats causes a lifelong increase in blood pressure in the offspring (Law and Shiell, 1996: Valdez, Athens, Thompson, Bradsshaw, Stem 1994). These results represent examples of programming where the stimulus applied during development has resulted in lifelong effects. The data from these experiments led to the hypothesis that an association between reduced foetnl growth and diabetes in adult life occurred because of foetal under nutrition. This hypothesis is supported by a follow up study of babies born in the "Dutch hunger winter" of 1944. This study of men and women, aged 50 years, who were born around the time of the Dutch famine shows that under nutrition particularly during the later stages of gestation was associated with reduced glucose tolerance in middle age and this effect. was independent of any influence of adult obesity (Mc Cance 1994).

Differential nutrition would also affect maternal body composition, which might in turn influence foetal development. For example, a plentiful food supply would potentially coproduce overweight mothers who would be more insulin resistant that lean mothers.

Maternal insulin resistance might then have an adverse influence on growth and development of the foetus during pregnancy. A wide variety of factors, apart from maternal malnutrition during pregnancy, can also cause undernourishment in the human foetus. These include poor maternal nutritional reserves, inadequate uterine blood flow, or defective placental transfer of nutrients. As a consequence of the operation of one or more of these factors, the nutrient demand of the foetus might exceed the nutrient supply, with detrimental consequences for foetal growth and development foetal exposure to maternal under nutrition might influence the growth and differentiation of tissues in the foetus. Recent experiments in a rat model of altered maternal nutrition show that a maternal low protein diet might permanently alter the function (and perhaps structure) of the developing foetal liver. The bulk of evidence suggests that the pathogenesis of atherosclerotic vascular disease and related disorders, such as the metabolic syndrome and/or type 2 diabetes, is influenced by factors occurring in utero. Animal evidence supports the notion that maternal nutrition might be able to programme adult metabolism, although whether altered maternal nutrition programmes diseases such as type 2 diabetes and atherosclerotic vascular disease is not known.

Low birth weight babies undergo compensatory post-natal growth, the rapidity of which may simply indicate the severity of the growth retardation. Alternatively rapid weight gain may be disadvantageous in itself, for example because of excess demand on tissues which are not capable of compensatory hyperplasia such as the pancreas, or through body composition (Fall, Yajnik, Rao, Coyaji, Shier, 1999).

Recent evidence from human and animal studies highlight the critical importance of early childhood for brain development and for setting in place the structures that will shape future cognitive, social, emotional, and health outcomes (Shonkoff and Phillips, 2000).

The seminal epidemiological observations of David Barker demonstrated that birth weight across the normal range is inversely proportional to the risk for hypertension, cardiovascular disease, and type 2 diabetes in adulthood (Barker, 1998). Increasing evidence suggests that either low birth weight or accelerated postnatal weight gain or a combination of the 2, may predispose the above diseases (Barker, 2005). As a consequence of these observations, David Barker developed a theory, the now eponymic "Barker hypothesis," proposing that adverse events in utero induce compensatory responses in the foetus that reflect "developmental plasticity" during this critical period (Bateson, et al 2004) and persist permanently, thus defining an altered phenotype not only at birth but also for a lifetime. In other words, altered

developmental programming limits the range of postnatal adapt-ability, creating disease vulnerability (Bateson, 2007).

Neonatal size is strongly related to maternal BMI, height, head circumference and even birth weight. This probably has both genetic and environmental components, but strongly suggests that the nutrition of a female throughout her life (during her own foetal life and childhood) as well as during pregnancy, influences the growth of her foetus.

2.2.4 The criticism and clarifications on foetal origin of adult disease

The FOAD-hypothesis has been praised as a paradigmatic shift from proximal factors to include distal factors as determinants of disease (Robinson, 1992). Some now argue that the empirical support for the link between an adverse intrauterine environment and later specific disease is so strong, that our focus should be to search for mechanisms (Poulter, 2001). Others criticize the hypothesis on a number of accounts, both methodologically and theoretically. Susser and colleague, Levin (1999) has argued that the original hypothesis is too vaguely and broadly defined. According to them, stating that n foetus' nutritional status during gestation will influence the disease risk in adulthood, allows researchers to test n near unlimited matrix of potential nutritional measures and any later disease. Such a setting is prone to produce 'Type-I' errors (Gillman, Rich-Edwards, 2000). Secondly, due to the general formulation of the original hypothesis it could not be readily falsified, which is crucial in scientific theory testing (Pedhazur, Schmelkin ,1991). Rather, as Paneth and Susser (1995) put it: *'example is piled on example, each somewhat consistent with hypothesis but none seriously testing it'*

These criticisms have been met to a certain degree by a further refinement of the basic hypothesis as well as an elaboration of the hypothesis in relation to specific diseases (such as the 'thrifty phenotype'). Additionally, there has been an increased focus on potential mechanisms underlying the proposed causal relationship, (Barker, 2001) including research based on animal models and intervention studies involving human subjects.(Barker, Bagby,2005; Lucas , Fewtrell, Cole,1999: Armitage . Khan . Taylor, Nathanielsz . Poston ,2004). Thus, through a more clear-cut formulation of the hypothesis (and disease-specific sub-hypotheses), development of a theoretical framework, identification of potential mechanisms and replication in animal models, some of the early criticism regarding the FOAD hypothesis have been addressed. (Gillman, Rich-Edwards, 2000).

The FOAD-hypothesis has also been criticized on account of how one should interpret the statistical association between anthropometric measures at birth, and outcomes in adulthood. As for any observed association, the relationship could be a result of chance, bias, confounders, or it may be a genuine causal effect (Stewart, 2003).

Many of the early criticisms of the observed association between anthropometric measures at birth and later disease concerned the lack of adjustment for important third variables (Susser and Levin, 1999).For example, socioeconomic status (SES) is associated with birth weight, coronary heart disease and life-style factors such as diet, cigarette smoking and physical exercise. This makes SES a plausible confounder, as it may influence birth weight and disease in adult life, but also lifestyle factors associated with adult disease such as smoking and physical exercise (James 1997).

Further, critics have argued that some of the established associations between early factors and adult outcomes partly emerge through statistical over-adjustment (Tu ,West, Ellison and Gilthorpe, 2005) This statistical phenomenon is called the 'reversal paradox', where a relationship between two variables becomes distorted when introducing a third variable, either through adjustments or stratification(Tu , Gunnell and Gilthorpe, 2008). As an example, it is seen as inappropriate to adjust associations between birth weight and blood pressure for adult body weight, since adult body weight in part is a function of birth weight, and not necessarily a confounder (Lucas, Cole and Fewtrell 2001)

Tu, West , Ellison, Gilthorpe, (2005) have through data simulation provided convincing evidence that adjusting for adult body size can alter conclusions, regardless of whether the datasets truly contain either no association, a modest inverse association or a modest positive association. As the impact of over-adjustment is difficult to assess retrospectively, the results of the simulation cannot invalidate the FOAD-hypothesis. It does, however, underline the importance of correct interpretations of statistical modeling and results. A suggested strategy is to specify four regression models when investigating the early origins hypothesis: (1) the first should investigate the bivariate association between early exposure and adult outcome, (2) the second should add information on intermediate exposures to the first model, (3) the third should investigate the potential interaction between early exposure and intermediate exposures, and (4) the fourth should investigate to which degree intermediate exposure is related to the adult outcome (Lucas, Cole, and Fewtrell, 2001).

In order to claim support for the FOAD-hypothesis, the first model should indicate a significant relationship between the early exposure and adult outcome before moving to test regression models (Lucas, Cole, Fewtrell, 2001). Alternatively, structural equation modeling, with its synthesis of confirmatory factor analysis and regression analysis, enables investigation and estimation of proposed causal relationships (Susser and Levin, 1999;Tu, Gunnell, and Gilthorpe, 2008). Attrition and selection bias has also been a major concern in relation to the FOAD-hypothesis, especially in the early reports, where birth records of cohorts 50 years ago or more were used (Susser and Levin,1999). Later, studies with high follow-up rates and information about social and economic status have emerged, reducing criticism concerning potential attrition, confounding and selection bias (Gillman,2002).

In 2003, a meta-analysis reported evidence of publication bias regarding the inverse relation between birth-weight and blood pressure (Schluchter, 2003). A re-analysis of the data, with control for the estimated bias, weakened the association but remained in support of the FOAD-hypothesis. Publication bias was also investigated in relation to 'the thrifty phenotype' association, but with no strong evidence. Although meta-analyses have taken publication bias into consideration, the issue is not altogether resolved. Despite major objections since the initial reports, evidence in support of the FOAD-hypothesis keeps accumulating, with better study designs and increased awareness of the possible caveats in analyzing and interpreting the findings (Gillman,2000).Much of the criticism has been resolved or at least attended to, and the hypothesis maintains credence in the scientific community.

2.3 Maternal influences on foetal nutrition

Size at birth reflects the product of the foetus's trajectory of growth, set at an early stage in development, and the materno-placental capacity to supply sufficient nutrients to maintain that trajectory. In Western communities, it has been thought that regulatory mechanisms in the maternal and placental systems act to ensure that human foetal growth and development is little influenced by normal variations in maternal nutrient intake and that there is a simple relation between a woman's body composition and the growth of her foetus. Recent experimental studies in animals and our own observations in humans challenge these concepts (Barker, 1998). These studies suggest that a mother's own foetal growth and her dietary intakes and body composition can exert major effects on the balance between the foetal demand for nutrients and the maternoplacental capacity to meet that demand. Failure of

the matermoplacental supply line to satisfy foetal nutrient requirements results in a range of fuetal adaptations and developmental changes; although these adaptations may be beneficial for short-term survival, they may lead to permanent alterations in the body's structure and metabolism and thereby to cardiovascular and metabolic disease in adult life (Barker, 1998). Limited parental resources (poverty and lack of health insurance) and its attendant stressors have the potential to shape the neurobiology of the developing child in powerful ways, which may lead directly to worse health later in life. Research suggests that many factors including dietary knowledge, discomfort, and doctor interaction influence dietary behavior during pregnancy

2.3.1 Maternal Dietary Balance and Body Composition

Neonatal size is strongly related to maternal BMI, height, head circumference and even birth weight. This probably has both genetic and environmental components, but also strongly suggests that the nutrition of a female throughout her life (during her own foetal life and childhood) as well as during pregnancy, influences the growth of her foetus. Nutritional effects on foetal growth are also shown by the drop in birth weight observed during famines (Barker et al ,1993). There is some evidence that improvement in the micronutrient quality of mothers' diets leads to an increase in foetal growth.

Indications that the balance of macronutrients in the mother's diet can have important short- and long-term effects on the offspring came from a series of experimental studies in pregnant rats. These studies found that maternal diets with a low ratio of protein to carbohydrate and fat alter foetal and placental growth and result in lifelong elevations of blood pressure in the offspring (Langley, Jackson,1994). A follow-up study of 40-year old men and women in Aberdeen, United Kingdom, suggested that alterations in the maternal micronutrient balance during pregnancy could have similar adverse effects on the offspring (Campbell, et al,1996).; the relations with maternal diet were, however, complex, and studies to replicate them are in progress. Among women who reported animal protein intakes <50 g/d, a high maternal carbohydrate intake was associated with higher adult blood pressure in the offspring; among those who reported animal protein intakes >50 g/d, a low maternal carbohydrate intake was associated with higher blood pressure. These increases in blood pressure were associated with reduced placental size (Campbell et al 1996).Also,Studies in India found that a low maternal weight in pregnancy is associated with an increased risk of coronary heart disease in the offspring in adult life (Stein,et al 1996).

2.3.2 Foetal Nutrition

The finding that normal variations in foetal size at birth have implications for health throughout life has prompted a reevaluation of the regulation of foetal growth and development. Although the foetal genome determines growth potential in utero, the weight of evidence suggests that it plays a subordinate role in determining the growth that is actually achieved (Curr-Hill, Campbell, Hall, Meredith, 1987). Rather, it seems that the dominant determinant of foetal growth is the nutritional and hormonal milieu in which the foetus develops, and in particular, the nutrient and oxygen supply (Ounsted, 1966).

Evidence supporting the importance of the intrauterine environment comes from animal cross-breeding experiments(Walton, Hammond, 1938), from studies of half-siblings related through either the mother or the father (Morton,1955), and from embryo transfer studies (Brooks, Johnson, Steer, Pawson, Abdalla, 1995). For example, among half-siblings, those with the same mother have similar birth weights, the correlation coefficient being 0.58; the birth weights of half-siblings with the same father are, however, dissimilar, the correlation coefficient being only 0.1.(Morton 1955). In embryo transfer studies, it is the recipient mother rather than the donor mother that more strongly influences the growth of the foetus; a foetus transferred to a larger uterus will achieve a larger birth size .(Brooks ,et al 1995).

2.3.3 Micronutrients essential in the critical period of development

Vitamin B12- It is essential for the production of red blood cell, the manufacturing of genetic materials and healthy functioning of the nervous system. The RDA is 24microgram per day in non pregnant compared to 2.6microgram in a pregnant state. Deficiency of Vitamin B12 at the early state of pregnancy may increase the risk of birth defect such as neural tube defect, preterm delivery and cardiovascular diseases in future (Molly et al.,2008).The only natural dietary sources are animal products including meats, daily products, egg, fish. It can also be found in commercial dried cereals.

Folate: It is a vitamin B derivative and particularly important in synthesis DNA in the cells.The RDA for folic acid in non pregnant state is 400microgram and 600microgram per day during pregnancy. Good sources include Banana, orange juice, dry cereals, green leafy vegetable, drybeans and peas. Monitoring has shown that fortification has been effective in reducing the incidence of neural tube defect. Folic acid has been effective in reducing cardiovascular disease in the U.S. During the same period, stroke and stroke death declined by 15% (Yang et al,2006).

Iron: It is a trace element for foetal growth and development because it plays a key role as a cofactor for enzyme in oxidation reduction reaction which occurs in all cells during metabolism. Iron is also necessary as the component that allows red blood cells to carry oxygen needed throughout the body, perhaps, most importantly, iron is essential for normal neurodevelopment during foetal and early childhood development. Worldwide inadequate dietary iron intake is the most common nutrient deficiency and women are at particular high risk because of a regular loss of iron during monthly menses. Sources include red meat, green leafy vegetables, organ meats, fortified cereals.

Zinc: RDA for zinc during pregnancy is 11 microgram per day. Adequate zinc is extremely important during the first trimester when organs are formed and may play a role in assisting in immune system development (Shak and Sachdev, 2006). Zinc deficiency is common worldwide and supplementation within the RDA is advised during pregnancy.

According to Jerome (2007), the conceptus requires zinc for normal growth and development and is therefore at heightened risk when the supply of zinc is suboptimal. Maternal zinc deficiency can disrupt the normal function of trophoblast, the embryonic-derived component of the placenta responsible for implantation, production and secretion of hormones, establishment of the maternal-fetal barrier and the mediation of metabolic exchanges across this barrier.. Fetuses in zinc-deficient mothers often show growth retardation, and a high frequency of skeletal abnormalities. Biochemical and functional abnormalities can be displayed in the lung and pancreatic systems. Evidence that zinc deficiency is a teratogenic risk in humans include (i) women with acrodermatitis enteropathica tend to have complicated pregnancies if they do not receive zinc supplements; (ii) low plasma zinc levels have been associated with increased risk of malformations and low birth weight; and (iii) several studies show that zinc supplementation is associated with increased birth weights and reduced pregnancy complications. Zinc deficiency in the mother can jeopardize a child's health in two ways. On the one hand, it increases the rate of pregnancy and the risks of delivery complications, low birth weight and other adverse birth outcomes. On the other hand, maternal zinc deficiency can lead to adverse post-natal development and latent effects which can persist throughout lifetime. Maternal zinc deficiency during early pregnancy can influence the development of epigenetic marks at the locus in the early embryo thereby influencing all tissue development and possibly the germ line. Subsequent incomplete erasure of the epigenetic alterations induced by zinc deficiency represents a plausible mechanism by which adaptive evolution may occur in animals. It is increasingly evident that epigenetic

alterations at metastable epiallelles may be the mechanistic link between early nutrition and zinc deficiency and chronic disease susceptibility in adults. Zinc deficiency can be considered an important contributory factor to the "Barker Effect" which posits that exposures in the womb and postnatal environment can predispose one to the heightened risk of certain autoimmune diseases such as asthma, diabetes, hypertension and coronary heart disease later in life. In this sense, the effects of maternal exposure to zinc deficiency on birth defects may be more profound than is generally realized.

2.4 Knowledge and Practice Towards the Prevention of Foetal Origin of Adult Diseases

INFLUENCING FACTORS:

Many chronic disorders that manifest later in life may be related to two seemingly opposing factors potentially present early in life; (i) poverty (i.e. malnourished mothers give birth to malnourished infants with low birth weight [LBW]), and (ii) prosperity (exposure of an infant with LBW phenotype to a high caloric diet).These factors contribute to the biological phenomenon of developmental plasticity, or the ability of a genotype to produce multiple forms and behaviors in response to environmental conditioning(Barker ,1998).

Limited parental resources (including poverty and lack of health insurance) and its attendant stressors have the potential to shape the neurobiology of the developing child in powerful ways, which may lead directly to worse health later in life. Research suggests that many factors including dietary knowledge, discomfort, and doctor interaction influence dietary behavior during pregnancy.

Begley (2002), suggested that women feel they are lacking general nutrition knowledge while Dundas and Yarbro (2000) reported that low and high levels of caloric consumption may be affected by discomfort. Pregnant women have reported eating small amounts of food more frequently to counteract the feeling of fullness during their third trimester, and because many believed that their baby would be healthier if they ate more frequently. Furthermore, physical sensations associated with food deprivation changed during pregnancy making them feel hunger more often in some cases and less in others (Fairburn & Welch, 1989).

Excess or inadequate weight gain may be influenced by lack of knowledge and understanding regarding the importance of a nutritious diet or the failure of health professionals to properly educate patients on this topic. Begley (2002), suggests there is a lack of consistent education on nutrition for pregnant women and there is a need to design and implement new more

effective nutrition programs. Most physicians and their patients understand that proper nutrition during pregnancy is important, but many are not aware of specific recommendations and how to achieve these behaviors. In many cases, healthcare providers simply tell women to eat a healthy diet and gain appropriate weight during pregnancy. However, to achieve this, healthcare providers need to give women the tools and direction to do so properly (Vause, Martz, Richard, & Gralich, 2006).

According to Bada, (2012) in his study, impact of level of education of pregnant women on nutritional adherence, the researchers observed that a lot of school children appear to have problem assimilating, memorizing and even have problem with reading. Most of the pupils interviewed from lower and higher classes, educated and illiterate homes, there appear to be discrepancies in their study habit, posture, behaviour and their social interaction. The researcher therefore looked at the background of the children, observed and interacted with the pregnant women to find out if the pregnancy state have impact on certain attributes possessed by the pupils. It also appears as if the level of education and their amenability to counseling impacts on the management of pregnancy through nutrition. Majority of the pregnant women are immature financially and agemaking them unable to manage the state of pregnancy. The effect of gender and poverty on nutritional status of pregnant women may be synergistic. Levinson, (1974) in an economic analysis of malnutrition among young children in Punjab found that while gender was the most statistically significant determinant of nutritional status, male-female differential in nutritional status were especially great among the lower socioeconomic group. Nutritional status among the higher and owning caste was better on the whole and the gender differentials was also smaller.

According to McNeill (1984), as females grow older, the combined result of socio-cultural, economic, biological processes, gender differences in adult nutritional status also appear to be exacerbated by poverty. The marital status, time of marriage and child bearing affect pregnant women nutritional status directly as well as indirectly through associated socio-cultural norms and practices. They also affect pregnant women's education and employment which exert considerable influence on household nutrition. Among the correlates of age at marriage, female literacy is paramount, while other factors such as general literacy, per capital income level of urbanization, non- agricultural employment and mass media are also important (Srivastav, 1986). Thus, where women are married early they are not only deprived of schooling, the benefits of this may affect their nutritional awareness, while they are also

exposed to the double energy demands of grueling agricultural work, early frequent and prolonged childbearing. Early, frequent and prolonged childbearing are associated with higher risks of malnourishment and mortality to both pregnant mothers and infants. Accessibility to health care also affects the nutritional status and roles of pregnant women. According to Adinci et al (2008), women, particularly in developing countries, are nutritionally at risk. Gender biases influence food consumption and distribution in families with women being the last recipient of food both in quality and quantity.

One of the major factors determining dietary practices in the first trimester is morning sickness. During this time, the body is bombarded with hormonal changes especially in early pregnancy. Studies in USA have shown that at least 70% of mothers to be experience nausea, vomiting, fatigue, stress and/or other discomforts in the first trimester limiting diet options and this affects their eating pattern (ACOG, 2004).

Tayic et al (2000) reported that nausea and vomiting (morning sickness) during pregnancy are associated with a decrease in maternal nutrition, weight gain and infant birth weight. Factors contributing to dietary changes during pregnancy which is more common are food craving, aversion and pica practice. Studies in developed countries have shown that between 76% and 90% of expectant mothers experience craving for at least one food during pregnancy and between 50% and 85% have at least one food aversion (Pickel et al., 2005). In a cross sectional study in an antenatal clinic at Killi District Hospital in Kenya, low iron status and anaemia were reported among 56% of pregnant women who practised pica (Frii and Lowe,1998). Socio-demographics such as age, education, social class and geographical location have also been found to correlate significantly with dietary habit and hence nutrient intake especially among pregnant women.

Perceptional food taboos often influence food avoidance during pregnancy. Kroskey, (1990) reported a significant positive correlation between food avoidance and lower intakes of nutrients especially micronutrients. Maneethorn et al. (2005) reported that pregnant women with higher family income and higher level of formal education tended to consume a nutritious diet with greater frequency than poorer groups. As a result of food aversion, The mean intake of folate was alarmingly low, similar to studies in Sweden by Andersen et al (2008). The lower intake of folate in the study is probably due to low intake of vegetables. In a similar study in Nigeria, Ojofeithni et al. (2008) reported that more than 60% of their sample did not meet the requirement for energy due to lack of nutritional knowledge. Mean

energy intake for this study group was 2146.6Kcal compared to the RNI of 2400Kcal. Dundas and Yarbro (2000) reported most women seem to either consume too few or too many calories with few women consuming appropriate caloric levels for optimal health during pregnancy. Shortness and fatness are thought to be the result of maternal hyperglycaemin, with consequent imbalance in the supply of glucose and other nutrients to the foetus. According to Ojofeitimi (2007), of all the hurdles to be crossed in maintaining optimal nutritional status among the pregnant women in the rural areas, food taboos stand to be the most important one. Food taboo is the prohibition of certain food items to a particular group of people at one time of their life span. The striking thing about food taboos is that it is more towards body building and protective food groups than energy giving food groups. Others are Food belief, food restriction, seasonal variation, family food distribution, food preference, type of food crops grown in an area, general occupation of the people, trend of food prices in the community, Current nutritional problems at the family or society level etc.

2.5 Nutritional Knowledge and Behaviour

Research supports the idea that knowledge influences behaviour. Increased nutritional knowledge has been shown to contribute to increase changes in healthy eating habits as well as healthier lifestyle (Fahlman, Dake, McCaughtry, and Martin, 2008).

Petrini, Hamner, Flores, and Mulinare (2006), reported that women who were least likely to consume adequate amounts of folic acid were those who had the least knowledge about folic acid and its benefits for pregnancy, and Shanker (2004) found that the second strongest indicator of female's food choices was nutritional knowledge. It is important for a person to have a basic threshold of knowledge in order to make rational behavioral altering choices (Sapp, 2002). In addition to education, O'Brien and Davis, (2007) reported that knowledge is more salient when transmitted in the context of specific behavior and suggested the integration of nutrition education into behavioral programmes targeting dietary behavior change.

2.5.1 Nutritional Recommendation

Dundas and Yarbro (2000), suggest physicians, dietitians, and other health care providers should discuss appropriate weight gain with pregnant women early in pregnancy so that women can make efforts during the first trimester to overcome poor eating habits and reach specific weight goals. Blount (2005), doubtlessly expressed that nutrition, well-balanced eating adherence is one of the greatest gifts a pregnant woman can give to her soon

to-be-born baby. Adopting a healthy nutrition adherence before pregnancy is ideal. According to him eating and supplying one's body with a tasty blend of nutritious food can improve fertility, and pave the way for an easier labour. This can also help to establish essential building blocks of growth and overall health for the expected child even in the future.

The food one eats on a daily basis affects how ones bodies work, how one heals and grows, how she maintains energy and strength for years. It determines the basic nutritional health that children are born with and provides model for their eating habits during childhood and beyond. Pregnancy is the one time in one's life when one's eating habits affect another person. The pregnant women's decision to incorporate delicious vegetables, whole grains and legumes, lean proteins and food choices into their eating adherence before and during pregnancy will give the baby a strong start in life.

In addition to exercise, the American Congress of Obstetricians and Gynaecologists provides guidelines for dietary behaviors throughout the pregnancy process. Foods consumed by women during pregnancy are the primary source of nutrients for a developing foetus. The ACOG recommends women carefully plan meals to ensure a balanced diet, consume additional iron and folic acid, and become aware of foods and substances to avoid.

According to Ojofeitimi (2007), primarily, nutrition education endeavours to promote and maintain overt healthful food habits among pregnant women. However, in an attempt to achieve health for all by the year 2015, people's unhealthful food habits must be modified or changed gradually and permanently. Nutrition education is the pivot to achieving this goal, and this can be achieved through the following means:

a) Nutrition information: Is the dissemination of nutritional knowledge on different type of foods, their food values, various methods of food preparation s and making informed choices as to prevent differences through nutrition.
b) Nutrition education: Nutrition education includes nutrition information and the ultimate positive change in nutritional behavior.
c) Nutritional counseling: This is the process which a client is actively and effectively helped by the nutritionist or a dietitian to appreciate the role which adequate nutrition plays in wellbeing or in sickness.

- The can be through
- Antenatal class
- Mass media
- Group discussion
- Peer nutrition education
- Food demonstration
- Group leaders nutrition education
- Church, mosque, market nutrition education
- Role playing
- Story telling.

2.5.2 The Goals of Nutrition Education For Pregnant Women

1) To create awareness as well as facilitate the need for healthful nutritional practices

2) To encourage the pregnant women to eat foodstuff that will promote, sustain and maintain her life as well as that of the unborn child

3) To motivate them to consider home gardening in order to reduce family food expenses

4) To allow the individual to make decision about the role food plays in the attainment of good health.

5) To encourage clients to understand the importance and usefulness of selecting healthy fc foodsfs.

2.6 Effect of education and income on Nutritional Knowledge among Pregnant Women

In a study by Tayie *et al* (2000), in Ghana on dietary, compares this study, pregnant women with higher education level consumed higher nmount of protein compared to women with low and middle level of education. This might be due to access to nutrition information and knowledge about quality sources of Food. Again increased family income increased the intake of protein and zinc. Pregnant women with higher family income had higher protein intake due to affordability. This finding is in line with studies by Manoethorn et al. (2005) in Thailand where pregnant women with higher family income and formal education tended to consume a nutritious diet with greater frequency than poorer group. In addition, studies by Rogers et al (1998) reported lower intake of protein, iron and zinc among pregnant women of

low socioeconomic status. By statistical evidence investing in education and increasing economic power would be of much importance.

The mechanisms where women's education results in lower child mortality have been the subject of some speculations. Children health and survival appears to be enhanced by better hygiene, improved nutrition and feeding practices of the child and the mother and timely medical intervention. Education may enable women to take independent decisions and act on them. Educated women appear to have greater roles in household decision making and be permitted by other household members to pursue appropriate strategies. The effect of women's education on their own nutritional status and on their children is exerted through their roles as providers of household health and nutrition care. (Rogers et al,1998).

Bairagi, (1980) studied the relationship between child nutrition and factors such as family income, maternal education and birth order. He found that income was not the only constraint on nutritional status, even in the lowest income group. Maternal education had a significant influence on nutritional status as did the child's sex and birth order .A literate mother used scarce resources better for her child's welfare than did an illiterate mother with higher income. Sen & Sengupta (1983) studied two villages in West Bengal, it was revealed that children with literate mothers fared better than those with illiterate mothers in terms of nourishment .It shows that literacy and prosperity went hand in hand.

The woman is the first health care provider within the household. A woman's knowledge of good health and nutrition practices is crucial. This knowledge may be gleaned from school, older family members or other informal networks. Pregnant mothers should have the preventive knowledge of health. This will enable them to carry out their preventive multiple roles as producers, mothers and child minders. Antenatal, intranatal and postnatal care affect the viability of infants and the survival of mothers nutritional case, protect growth and development and ensure better health for pregnant and lactating women.

According to the American Congress of Obstetricians and Gynecologists (ACOG), pregnant women should have a diet that consists of variety foods including proteins, carbohydrates, vitamins, minerals and fats. Nutritional effects on foetal growth are also shown by the drop in birth weight observed during famines (Barker, Osmond, Winter, Margetts, and Simmonds, 1989). There is some evidence that improvement in the micronutrient quality of mothers' diets leads to an increase in foetal growth. A balanced diet is the best way to receive nutrients, but vitamin supplements can also be beneficial. Pregnant women should only take

vitamin supplements on a health care provider's recommendation. Supplements do not replace a healthy diet but rather ensure that a woman is receiving enough daily nutrients. Vitamin supplements work best when taken as part of a healthy diet and not as a substitute for a healthy diet.

However, improving pregnant women nutritional knowledge on various food sources according to nutritional content especially at the critical period of development will be helpful.

2.7 Limitations of reviewed literatures

As important as the concept of Foetal Origin of Adult Disease is, and as cost effective its prevention could be, there is limited findings/research into the knowledge and practice of pregnant women towards the prevention of Foetal origin of adult diseases. Apart from the follow up conducted to determine the outcome of the children born during the famine period, there has been no other evidence of such follow ups whether through descriptive or experimental means. There is also no other research that probes into the knowledge of pregnant women in relation to Foetal Origin of Adult Disease (FOAD). Likewise, the study that probed into the pre-gravid nutritional status of pregnant women in relation to the prevention of Foetal origin of adult diseases was not also found, meanwhile, not only the nutritional status of pregnant women in the critical period contributes to FOAD, but also the pre-gravid nutritional status. Some of the studies reviewed only focused on the nutritional state of pregnant women during the famine period but not at any other usual period and conditions, meanwhile malnutrition could also be inherent and practiced at some other times other than the famine period, and also did not state majority of reasons responsible for malnutrion in relation to FOAD.

In most literatures reviewed, it was discovered that the deficiencies of the micro nutrients related to FOAD is only limited to these three chronic diseases viz Diabetes, hypertension and obesity, meanwhile, deficiency of some of these micronutrients like folate, zinc, vitamin B12, and iron can also lead to other diseases like mental retardation, immunodeficiency disease, dermatitis and so on. And also, most researchers only focused on the effect of deficiencies of micronutrients and many did not talk about the effect of micronutrient excesses in relation to the prevention of FOAD.

There was nowhere in the literature reviewed, where the knowledge of the health care providers was assessed in relation to FOAD, meanwhile, it is this people's knowledge and

understanding on this that can determine and further influence the knowledge and practice of pregnant women .However, the efforts and the contributions of the government towards the prevention of Foetal Origin of Adult Diseases via health education of the health care providers and the women in general was not found in any reviewed literature

2.8 Conceptual Framework of Precede Model

Conceptual frame work of "PRECEDE for Knowledge and practice of pregnant women on prevention of FOAD

The acronym "PRECEDE" stands for predisposing, reinforcing and enabling factors. The model was developed by Green, Kreuter, Partridge and others. It is an important conceptual framework in health education, planning aimed at diagnosing the health problems of a community, understanding the factors that influence the people's behaviour and developing intervention to promote healthy behavior or change such behavior to positive ones (Green and Kreuter, 1999). The model consists of three antecedent factors name which are; predisposing, reinforcing and enabling factors that influence human behavior positively or negatively. The conceptual frame work are designed and adopted for use as they allow viewers to instantly visualize and grabs relationship. The model will be applied to the knowledge of pregnant women on prevention of foetal origin of adult disease

2.8.1 Predisposing factors

The predisposing factors are behavioural antecedent factors that motivate or provide a reason for behaviour. These are factors which must be present before a decision can take place about behavior. They include Knowledge, readiness to change, Awareness, Attitude, perceptions and belief of pregnant women towards the prevention of foetal origin of adult disease. Knowledge as a factor will be used in assessing what pregnant women know about the prevention of foetal origin of adult diseases.

2.8.2 Enabling factors

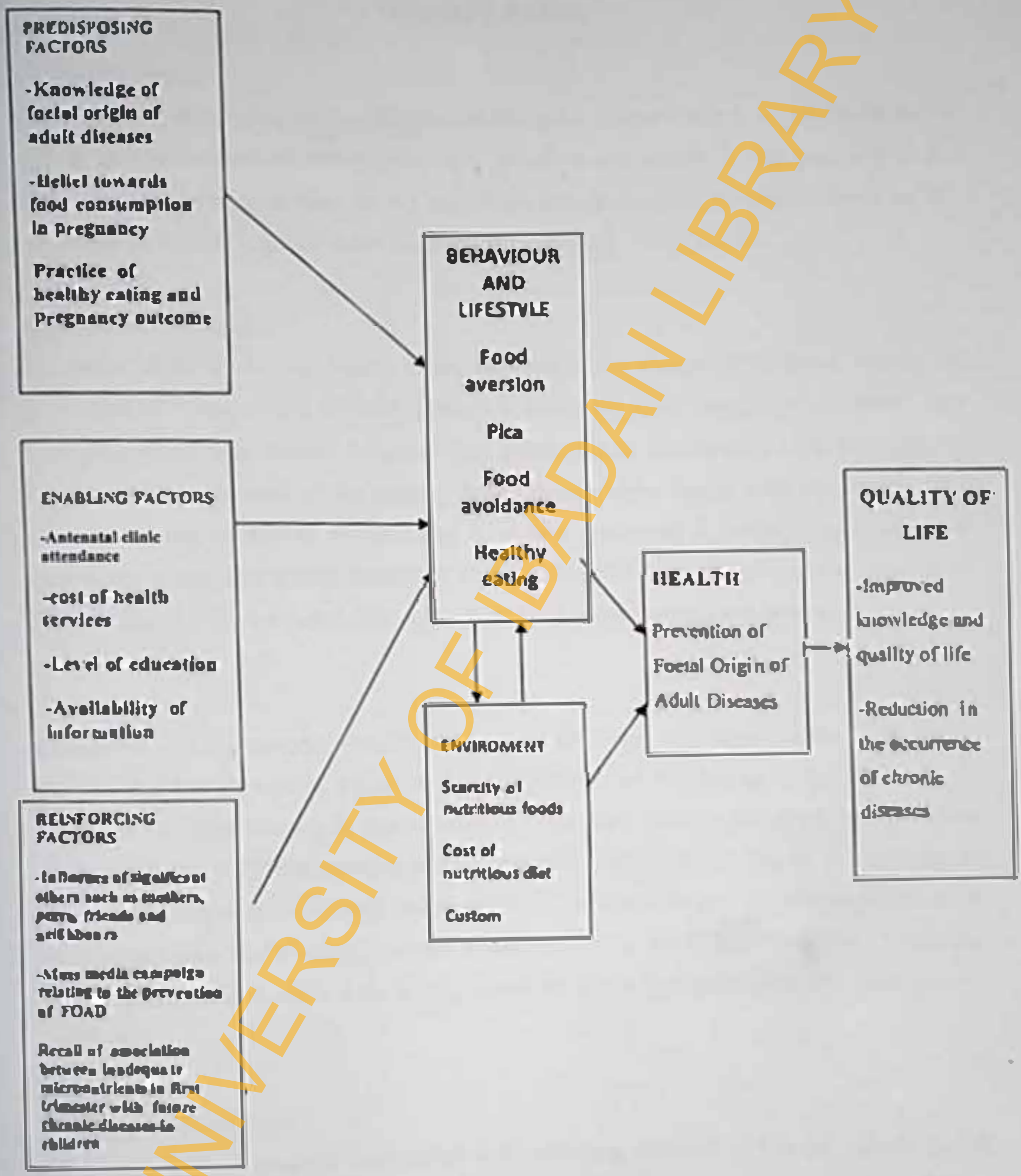
These are factors that make any health related behavior more or less likely to occur. These are factors which are presented before the behavioml decision takes place. These factors include cost of seeking health, flexibility, availability and accessibility of nutritional information to prevent Foetal Origin Of Adult Diseases.

2.8.3 Reinforcing factors

These are factors related to the influence of significant others such as influence of friends, Mass media (Newspaper and magazine), family members, peer group and superior in work place/boss.

These factors can influence the knowledge that pregnant women has towards the prevention of Foetal Origin of Adult Disease.

2.9 Application of PRECEDE Model to knowledge and practice of pregnant women towards the prevention of FOAD in Olorunda L.GA Osogbo



(Green and Kreuter,1999)

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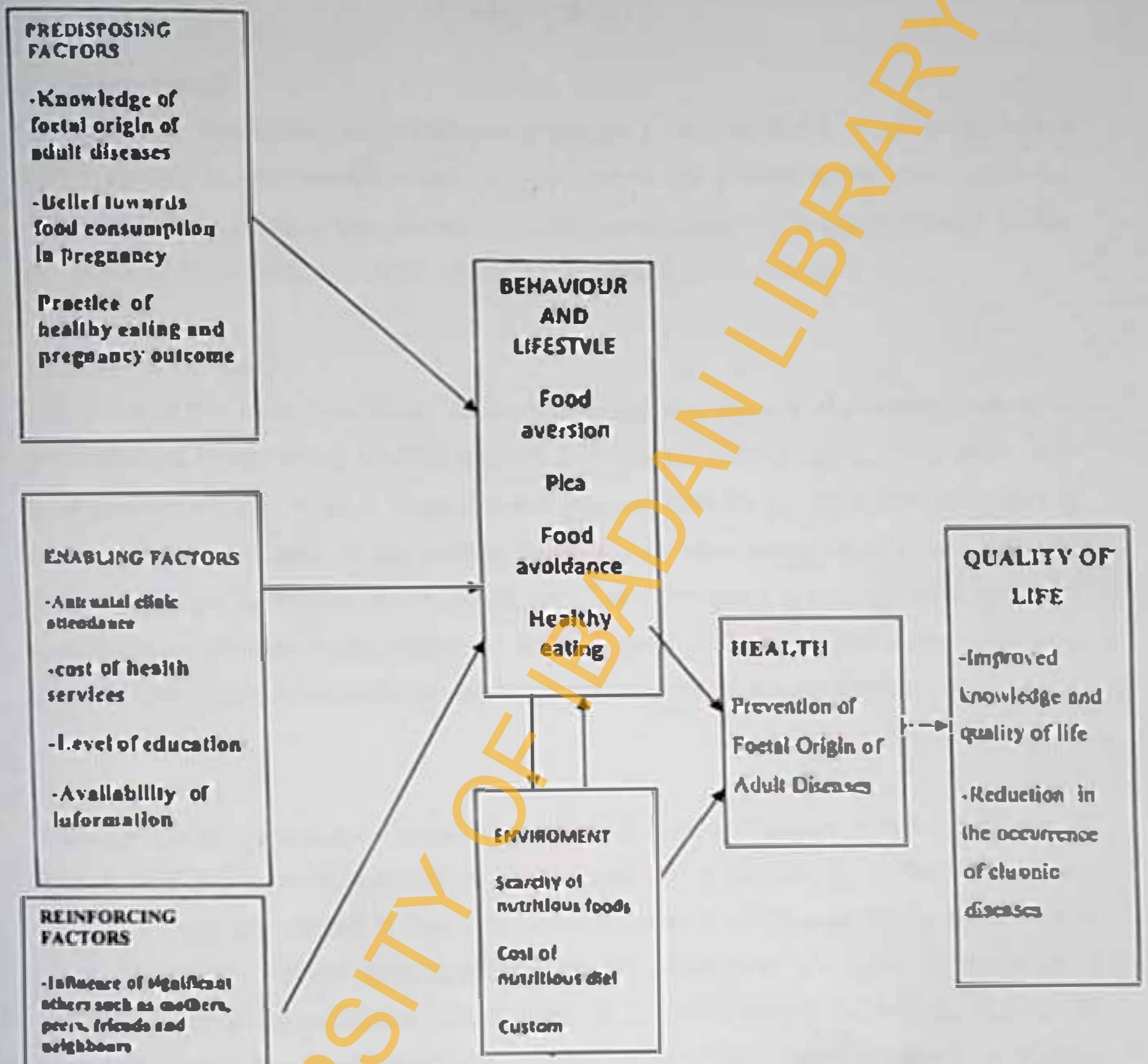

(Green and Kreuter,1999)

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This study was descriptive cross - sectional in design. It allowed data to be collected at one point in time on several variables such as age, education and income. It also gave a snapshot of the situation at a given time on the knowledge and practice of pregnant women on the prevention of Foetal Origin of Adult Diseases in Olorunda L.G.A. Osogbo.

3.2 Scope of the study

The scope of the study was limited to the knowledge and practice of pregnant women on prevention of Foetal origin of adult diseases in Olorunda LGA Osogbo, Osun State. This local government was selected because it was gathered from the record of birth that majority of the baby born in each of the primary health centers were low at birth (a precursor for chronic diseases in future), which could have been prevented if mothers have sufficient knowledge of nutrition during pregnancy, and the choice of this local government also arose from the fact that such research like this has never been conducted there before.

3.3 Study Area

Olorunda Local Government, Osogbo was used for the study, it is located at the north east of Osogbo and has an area of 97km^2. It has a population of 135,240 as at the 2006 census. Olorunda Local government is largely made up of people from the same ethnic group . They are predominantly Yoruba speaking people. However, due to the high degree of hospitality of the natives, people from different ethnic groups in Nigeria settle and live happily in the local government area.The local government is made up of 11 wards and there are 11 primary health centers in each ward in the local government with a high proportion of male to female residents.

3.4 Target Population

This encompassed pregnant women that were receiving antenatal care in the primary health care centers in Olorunda Local Government, Osogbo at the time of conduct of the research.

3.5 Determination of sample size

The sample size (n) was determined by using Leslie Kish's sample size determination formula:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where n = minimum sample size required

Z= The standard normal deviation set at 1.96 (which correspond to the 95% confidence interval).

P= the proportion of target population estimated to have a particular phenomenon of interest in the study. Since there was no literature which quantify the prevalence of knowledge of pregnant women on FOAD, a significant value for p was assumed to be 50% i.e 0.5.

d= the degree of accuracy set at 0.05

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384$$

Adjusting for anticipated 10% non response rate;

$$10\% \text{ of } 384 = \frac{384 \times 10}{100} = 38$$

This was added to sample size calculated to make 422 in order to address any possible case of non- response, incomplete questionnaire etc and increase the generalizability of the data collected.

3.6 Sampling technique

Two stage stamplingg method

Olorunda LGA was selected using purposive sampling method, and convenience sampling method was used to select eight wards out of the eleven wards in Olorunda Local Government Area.(See table 3. 1)

- Systematic random sampling method was used to select pregnant women that participated in this research, on calculation, with k=2
- Simple random sampling as used to select the respondent within therange of estimated" k" Upon selection of the first respondent, for example if respondent with tallying number 2 was selected, the next respondent k + 2 also was selected , that was the respondent. This procedure was repeated until 53 respondents from each unit of

PHC was selected and this was done for the 8 PHC's equally to attain the 422 number of respondents required for the study.

3.7 Inclusion Criteria

The respondents were

1) Pregnant women attending antenatal clinic at the time of conduct of the study.
2) Pregnant women who consented to participation in the study.

Exclusion Criteria:

1) Pregnant women who did not consent to participating in the study.

Methods for Data Collection

Development of Instruments and Methods for Data Collection

Both qualitative and quantitative methods were used in collecting the data.

Qualitative Method: The qualitative method used was the Focus group discussion (FGD). A Focus group Discussion guide was developed which explored issues relating to Foetal origin of adult diseases, nutrition wise. Three (3) Focus Group Discussion were conducted. Group one was made up of pregnant women in their first trimester (either primip or multips). Group two was made up of people in their second trimester, group three was made up of pregnant women in their third trimester. A group made up 9-12 members. The information obtained from the clients was collected with the use of a tape recorder which the clients consented to before the use and also with note taking, and it was used to redefine /modify the questionairre administered.

The Questionnaire and the Focus Group Discussion Guide were translated to Yoruba language and back translated .The FGD was also be transcribed into English language

Quantitative method: The data were collected using a validated semi-structured interviewer administered questionnaire. The questionnaire was developed based on the objectives, short review of the literature and also based on the findings/ excerpt modifications from the 3 focus group discussion sessions. Section A focused on the socio-demographic data of the respondents and contained eight questions. Section B focused on the Knowledge of pregnant women on Foetal Origin of Adult Diseases. Knowledge of FOAD was measured on a 29-point scale; scores of < 10, $\geq$ 10-20, and > 25 were categorized as poor, fair and good, respectively. Section C focused on the practices of pregnant women which was measured on a 14-point scale: scores of <7 and ≥ 7 were categorized as poor and good, respectively.

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3.8 Validity of instruments.

Validity is the ability of an instrument to measure what the investigator set to measure and was censured by the following steps:

- The two instruments viz 42 questionnaire and 2 focus group discussions were pre-tested at a Primary Healthcare Center in Osogbo Local Govemment.
- The two instruments were pre-tested in Osogbo LGA to ascertain suitability and appropriateness to field situations, determine whether the questions were clear and simple enough for participants comprehension and determine the trend in the response of participants and the amount of time it took to administer the questionnaire. Two Focus Group Discussions was conducted, comprising of 10 respondents each of different parity and trimesters, and 42 pregnant women representing 10% of the sample size for this study were interviewed with the questionnaire.
- Content validity of the questionnaire was further ensured through the incorporation of the preliminary pretested Focus Group Discussion result.
- The draft instrument went through an independent review from peers and experts in thefield of public health (Health promotion and Education and Environmental Health).

Reliability of Instrument

- Cronbach Alpha technique was used to determine the reliability co-efficient of the questionnaire .The reliability co-efficient of 0.7 or more (maximum of 1) was used to adjudge the questionnaire as being reliable.
- At the end of the exercise, items that were not easily understood were reframed; those that were found to be irrelevant were removed. The pretested questionnaire was analyzed using the SPSS package version 18.

3.8.1 Data Collection Procedure

The Instruments were modified and standardized after which three research assistants were trained for data collection, They were student nurses who were presently in training. They were fluent in English and Yoruba language. The research assistants were trained for two days. A time table was drawn for this period, it took them 3 hours 9a.m.12 noon daily. The research assistants were trained in the following areas; the objectives of the study, basic facts on sampling procedure as well as a review of the instruments item by item in order to ensure adequate understanding of the instruments, appropriate recording of responses and seeking clarification

in case of unclear responses and communication skills. In addition, ethical issues such as obtaining informed consent, respect for privacy and confidentiality of information were explained to the research assistants. A manual of field operation were prepared to explain how entries would be made, the number of questionnaires to be administered and how variables would be coded.

The research assistants with the researcher were involved in the collection of the data. Data collection took place mostly in the morning when it was easier to get the participants at the antenatal clinics. Short debriefing sessions was also held at the end of each day where the day's work was reviewed and the next plan of action disseminated to the research assistants.

3.82 Data Management and Analysis

- The questionnaires were checked for completeness, collated, sorted and edited.
- The questionnaires were hand coded with the use of a coding guide and a template was designed on the SPSS for entering of the coded data into the computer.
- The data collected were kept safe. The questionnaires were stored in a place that will be safe from destruction of water or fire or where an unauthorized person could not have access to.
- Quantitative data were analyzed using descriptive statistics, Chi-square and logistic regression tests at p=0.05 level of significance while qualitative focus group discussion (FGD) data which were used to fine tune or modify the questionnaire were analysed thematically.
- The tape – recorded responses from the FGDs was transcribed verbatim and used to update the write up of the recorder. The FGD report was analyzed manually by the researcher. Content and context analysis using a thematic approach involving the grouping together of similar themes in each transcript was done followed by identifying emerging trends and differences across transcripts.

In respect to data analysis from the questionnaire the following were done.

Quantitative data were entered into the computer and analysis was done using descriptive statistics of Mean Median, Standard Deviation and Chi-Square and Inferential statistics of t-test and logistic regression multivariate analysis was used for the analysis. Findings were summarized and presented in tables and charts.

3.9 Ethical Consideration

Research protocol was submitted to the Osun state ethics review committee for ethical approval .Informed consent form was given to the participants which were both in verbal or a written form. Participation in the study was voluntary. The nature of the study, benefits and objectives were explained to the participant and were also assured that the information given will be treated with utmost confidentiality.

However, participants were given equal opportunities to withdraw their consent freely during the study. Confidentiality of each participant was maximally maintained during and after the collection of his or her information. Information gathered from the respondent was stored in the computer for analysis by the researcher while the questionnaire filled by the respondent will be kept for maximum of ten years after the purpose of the study had been accomplished Finally, participants' right of confidentiality and the right of responsibilities of the respondents was maintained throughout the course of the study.

CHAPTER FOUR

RESULTS

The results are presented under the following sections. Section one depicts the demographic characteristics of the pregnant women. Section two sought to know the level of knowledge of the pregnant women on the essential micronutrients - containing diet that they consume during first trimester of pregnancy. Section three depicts practices of the pregnant women towards prevention of foetal origin of adult disease considering their nutrition in the first trimester and section four sought thefactors influencing nutritional knowledge and practice of pregnant in the first trimester in relation to the prevention of future diseases .

4.1 Socio-Demographic Characteristics of Respondents

A complete response rate of 100% (422 out of 422) was obtained with the questionnaire among pregnant women selected for the study, the ages of the pregnant women ranged from 16 to 49 years and the mean age of 30.9±6.8 respectively with few (28.2%) of the respondents within 25-30years age bracket. (Table 4.1) shows the distribution age of the pregnant women. Majority (94.3%) of the respondents were Married, and 5.7% were not married. Some (59.2%) of the respondents were self-employed, 25.4% were civil servants, and 11.8% were unemployed while 3.6% of the respondents were students. The distribution of respondents by religion showed that some (53.8%) were Muslims, 34.6% were Christians while 11.6% of the respondents were practicing African religions.

Few (26.2%) of the respondents said they had two children, 24.2% claimed they had no child, possible because they were carrying their first "viable" pregnancy while 19.7% had three children. 14.5% of the respondents had one child, 11.8% had four children while 3.3% had five children. Few (27.7%) of the respondents was carrying their fifth or more pregnancy. 23.9% were on their first pregnancy, 23.9% were on their third pregnancy, 12.6% were on their second pregnancy while 11.9% were on their fourth pregnancy.. The educational qualification showed that few (32.0%) had no formal education, 27.2% had Primary education, and 21.1% of the respondents had tertiary education while 19.7% had Secondary education (see table 4.1). Few (44.8%) of the respondents were in their third trimester, followed by 33.8% in second trimester and 16.4% in first trimester.

Table 4.1 SOCIODEMOGRAPHIC FACTORS

Factors	Response	Percentage(%)
Age	<25	18
	25-30	28
	31-35	27
	36-40	19
	41-45	6
	>45	2
Marital Status	Yes	398(94.3)
	No	24(5.7)
Occupation	Student	15(3.6)
	Civil servant	107(25.4)
	Self employed	250(59.2)
	Unemployed	50(11.8)
Highest level of education	Tertiary	146(34.6)
	Secondary	83(19.7)
	Primary	115(27.2)
	No formal education	135(32.8)
Religion	Christianity	146(34.6)
	Islam	22.7(53.8)
	Traditional	49(11.8)
Number of Children	0 (first viable pregnancy)	102(24.2)
	1	61(14.5)
	2	112(36.5)
	3	83(19.7)
	4	50(11.8)
	5 or more	14(3.3)
Current Trimester	First	69(16.4)
	Second	142(33.8)
	Third	211(49.8)
ANC attendance during previous pregnancy	Yes	342(81.0)
	No	80(19.0)

4.2 Respondents Knowledge of micronutrients essential in the first trimester

Respondents' mean knowledge score was 11.4±5.3. The respondents score ranged between 4 to 25. 0 to 10 represented poor knowledge, 11 to 20 represented average knowledge and 21 to 29 represented good knowledge. The knowledge grade of the respondents is shown in table 4.5 below. Only few (23.7%) of the respondents were able to define correctly the meaning of the growth of fetus during the first trimester as the critical period when most organs are formed and the period when essential micronutrients are required to prevent chronic diseases in future . When asked about when pregnant women should register at the antenatal clinic; some (39.6%) said it should be the first trimester. Forty-one per cent of the respondents claimed that it is important to start taking folate containing diets like orange and spinach during the first trimester 35.1% of the respondents claimed that it is important to start taking iron containing nutrients like liver, meat, bone marrow, organ meat and egg yolk during the nutrients like milk, fish and egg during the third trimester.

The respondents mentioned fish (26.2%) and liver (22.0%) respectively as the two major food sources of Iron. The respondents mentioned animal protein (26.2%) and groundnut (22.0%) respectively as the two major food sources of Zinc. The respondents mentioned muscle meat (25.9%) and milk (16.8%) respectively as the two major food sources of Vitamin B12.

Moreover, majority (64.2%) of the respondents claimed they didn't know that folate can be found in green leafy vegetables like spinach while almost seventy-one per cent of the respondents said they didn't know that folate can be found in oranges.

Also, majority 69.7%, 74.2% , and 71.6% of the respondents claimed they didn't know that intake of folate containing food like spinach and orange in the first three months by the mother can prevent hypertension,diabetes and obesity respectively in the baby in the future.

Some 72% , 68.5%, and 76.1% of the respondents claimed they didn't know that deficiency of Iron in the first trimester by the mother can lead hypertension, diabetes and obesity respectively. Majority (71.3%, 65.2%, 70.2% and 68.7%) of the respondents respectively wrongly claimed that Jaundice, Malaria and Rickets are the non-communicable diseases that can be traced to lack/deficiency of folate, vitamin B12, iron, and zinc during the first trimester.

Findings from focus Group Discussion were in support that most respondents did not hove knowledge of FOAD and its prevention . The following quotes reflected some of their comments:

When asked whether they have heard about the concept of FOETAL ORIGIN OF ADULT DISEASES (FOAD) and their positions about it as regards the chronic diseases caused by the deficiencies of some micronutrients in utero which manifests later in future

8 people out of 10 claimed that they have only heard before that deficiency of some micronutrients in utero can cause some diseases in the child like neural tube defect but not chronic diseases in future as it relates to FOAD, while 2 other people were not sure whether they have heard of it or not.

One of the 8 people said this: Me I don't believe that hypertension, Diabetes and Obesity can be caused by deficiency of some micronutrients when pregnant. It could rather be hereditary /genetically determined or due to some unpleasant lifestyles in pregnancy.

Another respondent out of the afore mentioned 8 said what I know about diabetes is that it is caused by consumption of excess sugar, hypertension is caused by excess salt while obesity is caused by the consumption of excess fatty foods.

When asked about the micronutrients that are essential for the good health of babies and mothers and their functions

4 only mentioned folate and stated that it only prevents spinal bifida and provides blood for mother and child 3 mentioned folate and ferrous and also stated that they prevents anaemia in mother and jaundice in the child later.

3 gave no response

While no body mentioned zinc or vitamin B12 as they claimed they were usually being told about folate and ferrous in anenatal clinic and nothing more

Accordingly, when asked whether the respondents belief or know that in addition to neurol tube defect, some chronic diseases may generate later in future due to inadequacies of folate, ferrous, vitamin B12 and zinc , about 7 respondents out of 10 said they don't know or believe, 2 reluctantly said yes and 1 respondent gave no response

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Table 4.2: Some samples of respondents' answer to knowledge questions on nutrients essential in the first trimester to prevent FOAD

Knowledge Statement	Freq. (%)
How many trimesters are in a term pregnancy?	
a) One (Correct)	12 (2.8)
b) Two	98 (23.3)
c) Three	312 (73.9)
What trimester is it important to start taking folate containing diets like orange, spinach?	
a) Before and during the first trimester(Correct)	173 (41.0)
b) Second trimester	152 (36.0)
c) Third trimester	97 (22.8)
When is it important to start taking iron containing nutrients like liver, meat bone, marrow, organ meat in pregnancy?	
a) Before and during the first trimester(Correct)	143 (33.9)
b) Second trimester	92 (21.8)
c) Third trimester	187 (44.3)
When is it important to start taking vitamin B12 containing nutrients like milk, fish, egg in pregnancy?	
a) Before and during the first trimester(Correct)	115 (27.2)
b) Second trimester	75 (17.8)
c) Third trimester	232 (55)
Can folate be found in green leafy vegetables like spinach?	
a) Yes (Correct)	151 (35.8)
b) No	271 (64.2)
Can intake of folate containing food like spinach , orange in the first three months by the mother prevent hypertension in the baby in adulthood?	
a) Yes(Correct)	128 (30.3)
b) No	294 (69.7)

Can the intake of folate containing diets like mushroom, orange spinach in the first trimester by the mother prevent obesity in the baby in future?	
a) Yes(Correct)	109 (25.8)
b) No	313 (74.2)
Do you know if deficiency of folate containing foods like spinach, orange in the first trimester can cause diabetes in the baby in adulthood?	
a) Yes(Correct)	120 (28.4)
b) No	302 (71.6)
Can deficiency of iron in the first trimester by the mother lead to hypertension in the baby in future ?	
a)Yes(correct)	118(28.0)
b)No	304(72.0)
Can deficiency of iron in the first trimester by the mother lead to diabetes in the baby in adulthood?	
a) Yes(Correct)	133 (31.5)
b) No	289 (68.5)

Table 4.3: Grading of Knowledge score of prevention of FOAD

Knowledge score	Freq. (%)
Poor Knowledge (0-10 points)	204 (48.3)
Average Knowledge (>10-20points)	186 (44.1)
Good Knowledge (>20 points)	32 (7.6)
Total	422 (100.0)

4.3: Respondents' Practice on micronutrients consumption in the first trimester

Respondents' mean practice score was 6.2±1.8. The respondents practice score ranged between 2 to 9. 0 to 7 representing poor practice, 8 to 14 representing good practice. The practice grade of the respondents is shown in table 4.6 below.Some (51.7%) of the respondents claimed they they do not usually go for antenatal care in the first three months of pregnancy while some (58.1%) said they usually take oranges (folate) regularly in the first three months of pregnancy. Majority (66.4%) said they do not take spinach regularly in the first three months of pregnancy. slighily half (53.6%) of the respondents claimed they do take egg (zinc) regularly in the first three months of pregnancy while fifty-four per cent of the respondents said they do take liver (iron) regularly in the first three months of pregnancy.

Excerpts from the Focus group discussion further revealed that most people do not go for antenatal in the first trimester and most do not believe that first trimester is the ideal time for consumption of micronutrients needed to prevent FOAD

When asked about the trimester important and sensitive to prevent future disease, these are some of their responses

Respondent 1: *As for me, all trimesters are important and sensitive. I can attend antenatal clinic anytime. If a person did not take the nutrients in the first trimester whether due to lack of knowledge of pregnancy or nauseous feelings, she may start taking it in the second or third trimester and there will be nothing wrong with the baby in future.*

Another respondent said this: *To me, I can say it is first trimester because I was told that antenatal drugs should be commenced as early as first trimester to prevent spinal bifida in children, even though I don't usually go during this period and I think in the like vein with the prevention of FOAD, the first trimester is important to consume this micronutrients rich diet, although I am just hearing about it now (The future diseases).*

3rd respondent. I don't know anything about FOAD, but I believe third trimester is the most important to attend ANC and consume the micronutrients you just mentioned to prevent any kind of disease whether in recent times or in future.

4th respondent: I also don't know about the concept of FOAD, but I think the 2nd trimester is the most important to attend ANC and consume the micronutrients you discussed about. Reason is that many pregnant women usually feel nauseated to take food in the first trimester, and like me many also feel too lazy in the third trimester to consume diets, even those that can benefit the mother and baby, therefore , I think the 2nd trimester is a kind of relief period when advantage can be taken to eat such nutritious diet.

Table 4.4: Respondents' practices of Prevention of foetal origin of adult diseases

Question on Practices	Freq. (%)
Do you register and go for ante-natal care in the first three months of pregnancy?	
a) Yes	204 (48.3)
b) No	218 (51.7)
Do you take oranges regularly in the first three months of pregnancy?	
a) Yes	245 (58.1)
b) No	177 (41.9)
Do you consider taking spinach regularly in the first three months of pregnancy?	
a) Yes	142 (33.6)
b) No	280 (66.4)
Do you include egg regularly in your diet in the first three months of pregnancy?	
a) Yes	226 (53.6)
b) No	196 (46.4)
Is liver regularly consumed in the first three months of pregnancy?	
a) Yes	229 (54.3)
b) No	193 (45.7)

Table 4.5: Respondents preventive practice grade of the prevention of FOAD in the wise of nutrition in the first trimester

Practice Score	Freq. (%)
Poor Practice (0-7 points)	325 (77.0)
Good Practice (>7points)	97 (23.0)
Total	422 (100.0)

4.4 Factors affecting respondents nutritional knowledge and preventive Practice in the first trimester.

Marity of the respondents both in the FGD sessions and from Interviewer administered questionairre claimed that either their low / nil level of their education might be a contributory factor from understanding and accepting that essential nutrients are required in the first trimester to prevent chronic diseases in adulthood.

Only those with nil or low educational background were gathered to be influenced by food taboos,restricting them from eating certain diets in the first trimester .most of which are essential to prevent future diseases in the child. The maintainance cost for buying most of these required diets regularly is also another factor affecting the preventive practice of pregnant women.and this may be inversely related to their knowledge,because a pregnant women with a sound nutritional knowledge will make use of scarce resources to find good health for herself and the unborn baby.

The Geographical location of some respondents also influence their nutritional knowledge and practice.In this wise, ANC attendance was not regular,limiting their information ability and also most of these nutrients e.g animal protein and some other ones are found in the town(a location far from them) at a relatively cheap rate because of its abundance. Other factors like unawareness of pregnancy at the early stage,morning sickness and occupation affect pregnant woman in nutritional practices during the first trimester.

The Table below shows the influencing factors and frequency of pregnant women affected.

Table 4.6 Factors affecting respondents nutritional knowledge and preventive practice in the first trimester

FACTORS	TOTAL NUMBER	PERCENTAGE
Food tabooos	180/422	43%
Finance	207/422	49%
Higher education	300/422	71%
Occupation	215/422	51%
Unavailability of the essential diets needed	267/422	63%
Morning sickness	297/422	70%
Unawareness of pregnancy	248/422	59%

4.5: Test of Hypotheses

Hypotheses One

There is no significant relationship between respondents'nutritional knowledge of Prevention of foetal origin of adult diseases and antenatal attendance

The first null hypothesis which stated that there is no significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and antenatal attendance was tested. Table 4.18 shows the cross tabulation of respondents' knowledge on Prevention of foetal origin of adult diseases with respondents' antenatal attendance using Chi Square statistic. There was a significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and their antenatal attendance at 95 per cent confidence interval ($p<0.05$). Respondents' antenatal attendance has a role to play in their knowledge on Prevention of foetal origin of adult diseases. The null hypothesis was therefore rejected.

Table 4.7: Relationship between respondents' previous antenatal attendance and knowledge

		Respondents' Knowledge of Prevention of foetal origin of adult diseases			
		Poor	Average	Good	Total
Antenatal Attendance	Yes	129 (30.6)	182 (43.1)	31 (7.3)	342 (81.0)
	No	75 (17.8)	4 (1.0)	1 (0.2)	80 (19.0)
Total		204 (48.3)	186 (44.1)	32 (7.6)	422 (100.0)

$\chi^2 = 81.524$

df = 2

p = 0.000

Hypotheses Two

There is no significant relationship between respondents' level of education and nutritional knowledge of Prevention of foetal origin of adult diseases

The second null hypothesis which stated that there is no significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and level of education was tested. Table 4.11 shows the cross tabulation of respondents' knowledge on Prevention of foetal origin of adult diseases with respondents' level of education using Chi Square statistic. There was a significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and their level of education at 95 per cent confidence interval ($p<0.05$). Respondents' level of education has a role to play in their knowledge on Prevention of foetal origin of adult diseases. The null hypothesis was therefore rejected.

Table 4.8: Relationship between respondents' level of education and knowledge

		Respondents' knowledge of Prevention of foetal origin of adult diseases			
		Poor	Average	Good	Total
		Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Level of Education	Tertiary	17 (4.0)	44 (10.4)	28 (6.6)	89 (21.1)
	Secondary School	36 (8.5)	47 (11.1)	0 (0.0)	83 (19.7)
	Primary School	65 (15.4)	47 (11.1)	3 (0.7)	115 (27.3)
	No formal Education	86 (20.4)	48 (11.4)	1 (0.2)	135 (32.0)
Total		204 (48.3)	186 (44.1)	32 (7.6)	422 (100.0)

$\chi^2 = 115.7$

df = 6, p=0.0000

Hypotheses Three

There is no significant relationship between respondents' number of children and nutritional knowledge of prevention of foetal origin of adult diseases.

The third null hypothesis which stated that there is no significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and number of children was tested. Table 4.20 shows the cross tabulation of respondents' knowledge on Prevention of foetal origin of adult diseases with respondents' number of children using Chi Square statistic. There was a significant relationship between respondents' knowledge eon Prevention of foetal origin of adult diseases and their number of children at 95 per cent confidence interval ($p<0.05$). Respondents' number of children has a role to play in their knowledge on Prevention of foetal origin of adult diseases. The null hypothesis was therefore rejected.

Table 4.9: Relationship between respondents' number of children and knowledge

	Respondents' Knowledge of Prevention of foetal origin of adult diseases				
		Poor Freq. (%)	Average Freq. (%)	Good Freq. (%)	Total Freq. (%)
No of Children	0	64 (15.2)	37 (8.8)	1 (0.2)	102 (24.2)
	1	19 (4.5)	27 (6.4)	15 (3.6)	61(14.5)
	2	48 (11.4)	50 (11.8)	14 (3.3)	112 (26.5)
	3	33 (7.8)	49 (11.6)	1(0.2)	83 (19.7)
	4	32 (7.6)	17 (4.0)	1 (0.2)	50 (11.8)
	5	8 (1.9)	6 (1.6)	0 (0.0)	14 (3.3)
Total		204 (48.3)	186 (44.1)	32 (7.6)	422 (100.0)

$\chi^2 = 59.89$

df = 10

p = 0.000

Hypotheses Four

There is no significant relationship between respondents' preventive practice and their nutritional knowledge of Prevention of foetal origin of adult diseases.

The fourth null hypothesis which stated that there is no significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and respondents' practice on Prevention of foetal origin of adult diseases was tested. Table 4.21 shows the cross tabulation of respondents' knowledge on Prevention of foetal origin of adult diseases with respondents' practice on Prevention of foetal origin of adult diseases using Chi Square statistic. There was a significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and their practice on Prevention of foetal origin of adult diseases at 95 per cent confidence interval ($p<0.05$). Respondents' practice on Prevention of foetal origin of adult diseases has a role to play in their knowledge on Prevention of foetal origin of adult diseases. The null hypothesis was therefore rejected.

Hypotheses Four

There is no significant relationship between respondents' preventive practice and their nutritional knowledge of Prevention of foetal origin of adult diseases.

The fourth null hypothesis which stated that there is no significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and respondents' practice on Prevention of foetal origin of adult diseases was tested. Table 4.21 shows the cross tabulation of respondents' knowledge on Prevention of foetal origin of adult diseases with respondents' practice on Prevention of foetal origin of adult diseases using Chi Square statistic. There was a significant relationship between respondents' knowledge on Prevention of foetal origin of adult diseases and their practice on Prevention of foetal origin of adult diseases at 95 per cent confidence interval ($p<0.05$). Respondents' practice on Prevention of foetal origin of adult diseases has a role to play in their knowledge on Prevention of foetal origin of adult diseases. The null hypothesis was therefore rejected.

Table 4.10: Relationship between respondents' practice and knowledge

		Respondents' Practice of Prevention of foetal origin of adult diseases		
		Poor	Good	Total
		Freq. (%)	Freq. (%)	Freq. (%)
Knowledge Score	Poor	165 (39.1)	39 (9.2)	204 (48.3)
	Average	155 (36.7)	31 (7.3)	186 (44.1)
	Good	5 (1.2)	27 (6.4)	32 (7.6)
Total		325 (77.0)	97 (23.0)	422 (100.0)

$\chi^2 = 74.044$

df = 2

p = 0.000

CHAPTER FIVE

DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Discussion of findings

5.1 Respondents Knowledge on Prevention of foetal origin of adult diseases

From this study, majority (69.7%, 71.6% and 74.2%) of the respondents wrongly claimed they didn't know that intake of folate containing food like spinach and orange in the first three months by the mother can prevent hypertension, diabetes and obesity respectively in the baby in the future.This is in line with the statement from Petrini, Hamner, Flores, and Mulinare (2006), who reported that women who were least likely to consume adequate amounts of folic acid were those who had the least knowledge about folic acid and its benefits for pregnancy, and Shanker (2004) found that the second strongest indicator of female's food choices was nutritional knowledge. It is important for a person to have a basic threshold of knowledge in order to make rational behavioral altering choices (Sapp, 2002). In addition to education, O'Brien and Davis,(2007) reported that knowledge is more salient when transmitted in the context of specific behavior and suggested the integration of nutrition education into behavioral programmes targeting dietary behavior change. This however correlates with the study carried out by Schmidt and his team in 2012. The study found that women who each day consumed the recommended amount of folic acid (600 micrograms, or .6 milligrams) during the first month of pregnancy had good knowledge on nutritional intake at this time and thus they experienced a reduced risk of having a child with autism spectrum disorder in addition to all the other (Schmidt et.al. 2012). Low folate is associated with LBW; it is also associated with high serum homocysteinemia, which is associated with CVD risk (Vollset et al., 2000).

Folic acid supplements consumed before and during pregnancy may reduce the risk of heart defects in infants if women had knowledge on the essential supplements and nutrients to consume to prevent or reduce this. (Bazzano, 2009) However, two separate studies also found that the risk of neural tube defects is significantly reduced when supplemental folic acid is consumed in addition to a healthy diet before conception and during the first three months after conception (Milunsky et.al, 1989 and Mulinare et.al, 1988). Supplementation with folic acid and folate diets has also been shown to reduce the risk of congenital heart

defects, cleft lips, (Wilcox et.al, 2007) limb defects, and urinary tract anomalies (Goh and Koren, 2008).

In this study 72.0%, 68.5% and 76.1% of the respondents claimed they didn't know that deficiency of Iron in the first trimester by the mother can lead to hypertension, diabetes and obesity respectively in the baby in the future. Evidence shows that deficiency of iron in pregnancy increases the risk of severe anaemia and increased maternal morbidity and mortality (Khan et al., 2006). Iron deficiency in pregnancy, is also associated with maternal and infant complications such as low binh weight (LBW), prematurity, perinatal mortality, increased risk of maternal infections and lowered tolerance to blood loss and infection (Murray Kolb and Beard 2009). In infants and young children, Iron deficiency is associated with delayed mental, motor, and emotional maturation (Beard 2008).

From this study, 65.2% of the respondents claimed that Jaundice, Malaria and Rickets are the non-communicable diseases that can be traced to lack/deficiency of Vitamin B12 during the first trimester. This is in contrast to Molly et al ,2008 study that deficiency of Vitamin B12 at the early state of pregnancy may increase the risk of birth defect such as neural tube defect, preterm delivery and cardiovascular diseases in future (Molly et al.,2008).Vitamins play important roles in cellular metabolism, maintenance and growth to such an extent that even before clinical symptoms are apparent, marginal deficiencies may be manifested as impaired fertility or reduced foetal and neonatal viability (Hurley and Doane, 1989). Lack of maternal vitamin B12 during pregnancy retards myelination of the foetal nervous system, posing health problems for the child in future (Lovblad, 1997).

From this study, 70.2% of the respondents claimed that Jaundice, Malaria and Rickets are the non-communicable diseases that can be traced to lack/deficiency of Iron/Ferrous during the first trimester rather than the chronic diseases of FOAD. This is in contrast to Barker's group finding where they have found that low iron status during pregnancy leads to an increased placenta foetal ratio, in turn a good predictor of cardiovascular disease later in life (Barker et.al, 1989). Anemia (defined as blood hemoglobin concentration less than 11.0 g/dl) is fairly common in women, especially in those from a poor socioeconomic background. It is commonly assumed that it is as a result of iron deficiency (Alnwick, 1998).

From this study, 68.7% of the respondents claimed that Jaundice, Malaria and Rickets are the non-communicable diseases that can be traced to lack/deficiency of Zinc during the first trimester instead of hypertension, diabetes and obesity as it relates to FOAD.

However this is in support of the fact that, Zinc deficiency can be considered an important contributory factor to the "Barker Effect" which posits that exposures in the womb and postnatal environment can predispose one to the heightened risk of certain autoimmune diseases such as asthma, diabetes, hypertension and coronary heart disease later in life. In this sense, the effects of maternal exposure to zinc deficiency on birth defects may be more profound than is generally realized.

Diabetes mellitus is one of the most common chronic diseases of FOAD,and according to WHO, estimate nearly 300 million individuals are affected by this disorder. Diabetes is one of the major causes of blindness, increased risk of cardiovascular disorder, end-stage renal disease, and non traumatic limb amputation (Chimienti , Rutter , Wheeler , Wijesekara , 2011).

Zinc is crucial for the pancreas and the regulation ofblood glucose. Insulin is stored in a crystalline form as a zinc insulin complex. Hence, the zinc concentration of the pancreatic b cells is among the highest in the body. Addition of zinc to insulin in vitro extended the duration of insulin action. In the 1930s, zinc ions were added in vitro to produce protamine zinc insulin to control the blood sugar in diabetic patients. In the presence of zinc ions, both insulin and proinsulin dimers aggregate into hexamers containing bound zinc (Chimienti , Rutter , Wheeler , Wijesekara ,2011) . ZnT8 mRNA and protein has been shown to be almost exclusively confined to pancreatic islets and to participate in the regulation of insulin secretion(Chimienti , Rutter , Wheeler , Wijesekara ,2011). ZnT8 is believed to be crucial for both zinc transport in the insulin granules and insulin crystallization, which could not occur unless zinc is present. Zinc is a potent physiological regulator of insulin signal transduction, mainly through the inhibitory effect on protein tyrosine phosphatase 1b, the key phosphatase that dephosphorylates the insulin receptor. An adequate supply of zinc is crucial for insulin biosynthesis and storage, especially when there is hyperglycemia. In zinc-deficient states, there isa clear decrease in islet cell insulin content (Chimienti , Rutter , Wheeler , Wijesekara ,2011 ; Sakurai H,2005) .

Recent studies by Jansen et al. (2012) showed that zinc supplementation may be a potential treatment adjunct in type 2 diabetes because zinc also promotes insulin signaling.

In a recent review, Caulfield and colleagues clearly showed that zinc supplementation of pregnant women has maternal and foetal benefits. Most of the unequivocal data come from animal experiments, but there are also human studies that show supplementation increasing

gestation length, decreasing risk of PROM and decreases in vaginal bleeding (Kynast and Saling, 1986).

Some (57.1%) claimed that a pregnant woman should visit the clinic for check-up up to 4 times for effective education sessions.This is also corroborated by Fagbamigbe *et.al.* (2013) study, where they reported in their study that majority (73.7%) of their respondents attended clinic upto four times for check-up based on earlier information they had on importance of ANC.

5.2 Respondents' Nutritional Practice on Prevention of foetal origin of adult diseases

Though, over half of the respondents either from the FGD or the interviewer ndministered questionnaire claimed that they consume most of these nutrients (Zn,Vit B12,Fe and Fo) containing diets e.g orange, spinach because the family members and health workers advised them to, but not in the proportion and manner at which it could prevent FOAD, this mighty be because they were only told these diet are good for development of baby and mostly stressed on the health of the mother and not because of the prevention of FOAD, in which if told would have increased their knowledge about it and consequently improve their practice in a manner that these essential diets would be consumes religiously to prevent FOAD most of them are not practicing it for the prevention of foetal origin of adult diseases. From the study, above half (58.1%) of the respondents claimed they do take oranges regularly in the first three months of pregnancy, 53.6% of the respondents claimed they do take egg regularly but 33.6% said they do take spinach but not for the prevention of Foetal Origin of Adult diseases.Overall, they have poor practice on prevention of foetal origin of adult diseases.

5.3: Factors influencing respondents nutritional knowledge and practice in the prevention of chronic diseases in adulthood.

Excerps from the Focus group discussion and the responses of some respondents showed that the nutritonal knowledge and the preventive practice of the pregnant women especially during the first trimester is influenced by factors such as Food taboos,occupation,inaccesibility to health centers,level of education, Economy/poverty, unawareness of pregnancy early enough.

Some respondents claimed that they would almost be entering into the third month of pregnancy before discovering they are pregnant.Some even said that morning sicknesses do not allow them to eat nutritious diet ,while some said may be their level of education had hindered them from having sufficient nutritional knowledge.Other factors such as food taboos

were also listed as some mentioned that they are usually forbiddden by their culture to eat certain diiet in the first trimester espceially animal products so as to prevent the child from stealing in future.Occupation was also a factor mentioned by some people as they claimed they are usually busy at work and lack the chance to prepare some of these diets which are listed to be essential in the first trimester of pregnancy for the prevention of Foetal Origin of Adult diseases.

5.4 Conclusion

The result of the current study on knowledge and practice on prevention of foetal origin of adult diseases revealed that, some of the socio-demographic factors (marital status and religion) of the respondents were not associated with knowledge (P values ranged from 0.065 to 0.198). However, there was significant association between knowledge (the outcome) and other factors. These were; age, occupation, parity, and number of children (P – values were < 0.05). Also, only one of the socio-demographic factors (religion) of the respondents was not associated with practice (P values ranged from 0.821). However, there was significant association between practice (the outcome) and other factors. These were; age, marital status, occupation, parity and number of children (P – values were < 0.05).

The level of knowledge of pregnant women on the prevention of foetal origin of adult disease in terms of micronutrients was assessed and it can be concluded that the pregnant women in the study area had low knowledge on the prevention of foetal origin of adult disease as many rather knew much about spinal bifida and jaundice which folate deficiency in the first trimester could cause. Only few of the respondents were able to define correctly the meaning of the growth of foetus during the first trimester as many claimed the foetus is just in bloody form at this time and little or no serious attention as regards the prevention of FOAD is considered . The practice of pregnant women on the prevention of foetal origin of adult disease was also determined and it can be concluded that the pregnant women in the study area were on the average practicing prevention of foetal origin of adult disease unknowingly as they claim they consume most of the diets rich in the micronutrients but for other purposes other than the prevention of FOAD. Also, almost half of the respondents claimed not to go for ante-natal care service for the first three month of their pregnancy, but they were taking the necessary food although not in a bid to prevent FOAD, but to prevent other common acute diseases like malaria, neural tube defect, jaundice, polio etc in the child .

Factors influencing nutritional knowledge and practice of the pregnant women were sought to include food taboos during pregnancy, economic factors, occupation,morning sickness,lack of awareness of pregnancy at the early stage, inaccessibility to health centers.

5.5 Implication of Findings for Health Promotion and Education

Health education is any combination of learning experiences designed to help individuals and communities improve their health by increasing their knowledge or influencing their attitude (WHO, 2015).

Findings from this work has a great impact on health promotion and education in that it determined the educational need of health care providers. With this study, the knowledge of the health care providers was indirectly known as pregnant women claimed that health care providers simply tell them to eat good food and do not most of the times specify what to take and in what proportion to take them. As found out in the study, many health care provider do not know that fruits and vegetables are replacement for most routine drugs. However, with this finding,a reference to base health education and promotion upon is established.

These findings have implications for nutrition education and designing programs aimed at changing pregnants women dietary' pattern positively, therefore targeted interventions such as encouraging women likely to have low birth weight babies have been suggested, although only for those at risk in affluence area to avoid increasing risk such as those outlined in the thrifty phenotype model. By extension, it has also been suggested to circumvent the focus on fetal development altogether and rather focus on universal intervention such as encouraging breastfeeding.

The findings of this work enabled one to know the nutrients that are good for fetal development but yet are forbidden by culture and also the nutrient that misconception has denied pregnant women access to. However, the finding of this study is relevant to health promotion and education because it will focus on these weaknessess to bring out a positive attitude towards dietary pattern in pregnant women.

Likewise, an individual knowing that he/she is at increased risk of developing adult diseases of foetal origin and taking strict measures to prevent it or reduce the risk is an implication for Health education and promotion.

5.6 Recommendation

Based on the findings from the study, the following recommendations are hereby made;

- Helping women deal with unpleasant side effects of pregnancy as well as more serious ones should be a focus of prenatal support. This can be done by encouraging healthful nutritious diet rather than bombarding and scaring mothers away with enormous nausea aggravating antenatal drugs.
- Because of the likely high global prevalence of zinc deficiency and the serious range of complications that can be induced by this condition, public health programs are urgently needed to prevent low zinc intake and poor absorption of zinc.
- It is recommended that pregnant women should be screened whenever they go for antenatal clinic for micronutrient deficiency. Knowing the high risk seasonal periods for maternal micronutrient deficiencies can aid in developing and targeting interventions for their control.
- Health care personnel involved in antenatal class coaching should be well trained and screened on their knowledge on the prevention of foetal origin of adult diseases.
- Birth weights of children should be taken at birth and closely monitored so as to reduce the incidence of chronic diseases because knowing the consequencies of low birth weight will enable an individual at risk to live a precautious lifestyle that would not further aggravate the occurrence of these chronic diseases in future.
- Husbands and other significant others should also be carried along in the ante natal education so as to give necessary assistance /push to their pregnant wives when needed.
- A collaborative process to develop and disseminate necessary guidelines outlining key reproductive and child health activities is recommended. This is useful especially in the area of nutrition requirement in pregnancy.
- Capacity building which includes development of educational materials, posters and handbills should be recommended. And most of it should be in local language that the pregnant women can understand.

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APPENDICES

APPENDIX I

DRAFT FOCUS GROUP DISCUSSION GUIDE ON KNOWLEDGE AND PRACTICE OF PREGNANT WOMEN ON THE PREVENTION OF FOETAL ORIGIN OF ADULT DISEASE IN OLORUNDA LOCAL GOVERNMENT AREA, OSOGBO,OSUN STATE

Dear respondent,

I am a post graduate student in the department of health promotion and education in the faculty of Public health, University of Ibadan. I am presently conducting a research titled "KNOWLEDGE AND PRACTICE OF PREGNANT WOMEN ON THE PREVENTION OF FOETAL ORIGIN OF ADULT DISEASE IN OLORUNDA LOCAL GOVERNMENT AREA,OSOGBO,OSUN STATE. I assure you that all the responses provided will be handled with utmost confidentiality. There are no wrong or right answers, honest and sincere answers would be appreciated. A tape recorder will be used for this exercise to enhance recall of our conversations.

Thank you for your cooperation

Investigators signature:

Date :

Mobile no: 08032416867

E.mail: ronkicojo@yahoo.co.uk

MAIN QUESTIONS	FOLLOW UP QUESTIONS
1) There are some diseases which occur in adulthood and are traceable to lack of essential nutrients in pregnancy. Are you aware of this?	Probe for "YES" as an answer
2) Name 3 diseases that are caused as a result of lack of essential nutrients like folate,calcium, Ferrous in pregnancy?	Probe: Hypertension, Diabetes, Obesity

3) What are the nutrients required to take during pregnancy to prevent these diseases?	Probe: Folate, Calcium, Ferrous sulfate
4) Name the diets where Folates can be found	Probe: Oranges, Green leafy Vegetables
5)Name the diets where calcium can be found	Probe: Bone, Milk
6)Name the diet where blood supplements (Ferrous) can be found	Organ meat, Ugu leaves
7) What are the factors that can prevent you from taking either or all of these e.g oranges, milk, vegetables, organ meats in pregnancy?	Probe: Poverty, Culture, food taboo, Inadequate information, Inadequate Knowledge
8)What are the sources of information that you have received on the prevention of foetal origin of adult diseases?	Probe :Antenatal class, Significant others, church, mosque, Radio, Television, postals

APPENDIX II

YORUBA FOCUS GROUP DISCUSSION GUIDE FOR PREGNANT WOMEN

INTRODUCTION

Mo je omo ile iwe giga unifasiti Ibadan. Mo n se iwadi lori awon aarun olojo pipe ti aironije ti o ni eraja ti o se koko je ninu oyun nfa fun awon omo ni ojo iwaju. Mo nilo ifosowopo yin, mo sin ro yin ki edahun awon ibeere ti a o ma bi yin gege bi o se wa lokan yin, a sin seleri wipe oun kohun ti e ba so koni tu sita ko si ni je akoba fun yin. A o ma lo ero agbohunsile lati ranwalowo gba oun yin sile,ki o le ranwa leti gbogbo oro ti a o ma so nihin. E seun pupo

Koko inu ibeere	Idahun amugbalegbe
1)Nje e mo nipa awon aarun olojo pipe ti aironje asaraloore je ninu oyun nfa lojo iwaju?	a)Beeni b)Beeko
2) E daruko koko aarun meta ti ai lo ogun eje, ogun amegunle,ogun ofefe/foliki nfa lojo iwaju fun omo	Aarun ejerinu, Arogbe, Isanraju
3)Ogun ti aloyun nlo gbodo ni eroja Ounje ti o nsaraloore ninu bii.....	Foliki,oguneje,Ogunamegunle
4) Inu ounje won i a ti le ri Ogun ofefe/foliki ti alaboyun nlo	Osan, ewebe
5) Inu Ounje woni a ti le ri ogun amegunle ti Alaboyunnlo	Eegunesan,Miliki
6)Inu ounje woni n ti le ri ogun eje ti alaboyun nlo	Nkan inu eran ,Ugu
7)Kini awon ounti o le dena yin lati ma je awon ounje wonyii?	Esin, Asa, ainiimo to ,aisowo
8)Niboni e ti gba idanileko rii lori aarun ojoiwaju ti aironje asaraloore je ninu oyun nfa?	Telitision, redio, Ile iwosan, Ebi/ara, iweilewo,ile ijosin

E se pupo fun ifarabale yin

APPENDIX III

QUESTIONNAIRE FOR SURVEY ON THE TOPIC KNWOLEDGE AND PRACTICE OF PREGNANT WOMEN IN RELATION TO THE PREVENTION OF FOETAL ORIGIN OF ADULT DISEASES IN OLORUNDA LOCAL GOVERNMENT, OSOGBO, OSUN STATE.

INTRODUCTION

Dear Sir/Ma,

I am a student of University of Ibadan, Department of Health Promotion and Education. I am carrying out a research on the Knowledge and Practice of pregnant women on the prevention of Foetal Origin of Adult Diseases.

The increasing number of cases of chronic disease /have now been traced and confirmed to have originated from foetal life during the critical period of development other than through genetic and environmental causes ,which could have been prevented if women had sound nutritional knowledge and practice.

I hereby crave your indulgence to provide answers to the questions filed below in order to provide baseline data for the propagation of future nutritional programmes to prevent such occurence.

You are entitled to your own opinions and I promise to treat all provided information with utmost confidentiality.

Are you willing to participate?

Name of PHC:.....

Ojo Oyeronke Olanrewaju. ronkieojo@yahoo.co.uk 08163471528

For official use only_____

Serial Number_____

Interviewer's Name:_____

Date_____

SECTION A

NO	QUESTIONS	OPTIONS	RESPONSE
1	How old are you now?		
2	Are you married?	1)Yes 2)No/I do not know	
	What is your Occupation?	1)Student 2)Civil servant 3)Artisan 4)Housewife 5)trading	
4	What is your religion?	1)Christianity 2) Islam 3) traditional 4) Others	
5	How many children do you have?		
7	Do you attend ante natal clinic previously whenever you are pregnant?	1)Yes 2)No	
8	Where do you previously attend the clinic?	1) Health centers 2) Mission houses 3) Tradomedical houses 4)Home	
9	What is your highest level of education?	1) Tertiary 2) secondary school 3) primary school 4)No formal education	
10	What trimester are you now?	1)First trimester 2)Second trimester 3)Third trimester	

SECTION B

KNOWLEGE OF PREGNANT WOMENON THE IMPORTANCE OF FIRST TRIMESTER AND NUTRITION IN RELATION TO FOAD

S/N	QUESTION	RESPONSE	CODE
11)	How many trimester is a term pregnancy? 1) 1 2) 2 3) 3		0 0 1
12)	Which trimester is the most critical one? 1) First trimester 2)Second trimester 3)Third trimester		1 0 0
13)	What do you understand about the growth in the foetus during the first trimester? a)Critical period when most organs are formed b)Anything other than A		1 0
14)	When should a pregnant woman register at the ante natal clinic? 1) First trimester 2)Second trimester 3)Third trimester		1 0 0
15)	At what trimester is it important to start taking folate containing diets like orange,spinach,? 1) First trimester 2) Second trimester 3) Third trimester		1 0 0
16)	Among these trimesters, when is it important to start taking iron containing nutrients like liver, meat bone marrow,organmeat,egg yolk? 1) First trimester 2) Second trimester 3) Third trimester		1 0 0
17)	Among these trimesters, when is it important to start taking Zinc containing nutrients like oysters, crab, soybeans? 1) First trimester 2) Second trimester 3) Third trimester		1 0 0
18)	Among these trimesters, when is it important to start taking Vitamin B12 containing nutrients like milk, fish, egg? 1) First trimester 2) Second trimester 3) Third trimester		1 0 0

19)	List two importance of folic acid in pregnancy Any of the following is correct 1)For normal red and white blood formation 2)Enhances cell division 3)For cell growth and reproduction 4)Prevents neural tube defect		Any 2 points is correct(1/2mark each)
20)	Can folate be found in green leafy vegetables like spinnach ? 1) Yes 2)No/I do not know		1 0
21)	Can folate be found in oranges ? 1) Yes 2)No/I do not know		1 0
22)	Can intake of folate containing food like spinach, orange in the first three months by the mother prevent hypertension in the baby in future? 1) Yes 2)No/I do not know		1 0
23)	Can deficiency of folate containing foods like spinach,orange in the first trimester cause diabetes in the baby in future? 1)Yes 2)No/I do not know		Any 2 points is correct(1/2 mark each) 0
24)	Can intake of folate containing diets like spinach,mushroom,orange in the first trimester by the mother prevent obesity in the baby in future? 1) Yes 2)No/I do not know		1 0
25)	List 2 importance of iron supplement in pregnancy a)Building of red blood cell b)As a part of enzymes responsible for breaking down fat carbohydrate and protein c)It helps in the conversion of hydrogen peroxide to oxygen and water		Any 2 points is correct(1/2mark each)
26)	Can deficiency of iron in first trimester by the mother lead to hypertention in the baby in future.? 1) Yes 2)No/I do not know		1

			0
27)	Can deficiency of iron in the first trimester by the mother lead to diabetes in baby in future? 1) Yes 2)No/I do not know		1 0
28)	Do you think not taking iron diets in first trimester by the mother can lead to obesity in the baby in future.? 1)Yes 2)No/I do not know		1 0
29	Mention 2 food sources of iron Any 2 of the following list(1 mark each) Liver, Oyster, Fish, Eggyolk, Kidney, Meat bonemarrow, dark green leafy vegetables, wholegrain, dried beans and dried fruits		
30	List two importance of zinc in pregnancy? Any 2 of the following point For rapid wound healing, It promotes growth, It improves appetite, It improves immune defense mechanism, It assists in sexual maturation, It assists in Carbohydrate protein digestion and metabolism, It enhances insulin and other enzymes activities		Any 2 points is correct(1/2mark each)
31	Mention 2 food sources of Zinc Oysters,Crabs,animalprotein,groundnut, wholegrain.drybeans,soya beans.		Any 2 points is correct(1/2 mark each)
32	List 2 importance of Vitamin B12 in pregnancy? a)It is important in the synthesis of genetic materials b)It aids in normal red blood formation c)For better concentration and memeory d)Helps in the utilisation of protein,Carbohydrate and fat e)It is a part of co enzymes that helps in the metabolism of body cells particularly bone marrow and GIT		Any 2 points is correct(1/2 mark each)
33	List two vitamin B12 food sources that you know Any 2 is correct(1 mark each) Cheese,Milk,musclemeat,liver,kidney,egg,fish		Any 2 points is correct(1/2mark each)
34	What are the non-communicable diseases that can be		

	traced to lack of folate during the first three months of pregnancy? 1) Hypertension, diabetes, obesity 2) Jaundice, malaria Ricket 3) Pellagra, measles, polio		1 0 0
35	What are the non-communicable diseases that can be traced to lack/deficiency of Ferrous,during the first trimester 1)Hypertension, diabetes, obesity 2) Jaundice, malaria Ricket 3) Pellagra, measles, polio		1 0 0
36	What are the non-communicable diseases that can be traced to lack /deficiency of Zinc during the first trimester 1)Hypertension, diabetes, obesity 2) Jaundice, malaria Ricket 3) Pellagra, measles, polio		1 0 0
37)	What are the non-communicable diseases that can be traced to lack of Vitamin B12 during the first trimester 1)Hypertension, diabetes, obesity 2) Jaundice, malaria Ricket 3) Pellagra, measles, polio		1 0 0
38)	How many times should a pregnant woman attend antenatal care during the course of pregnancy		
39)	Give 2 dangers associated with lack of complete antenatal care attendance.Any 2 is correct except for the last option a)Poor fetal development b)Poor knowledge on safe pregnancy tips c)Poor maternal health d)Foetal origin of adult diseases e)None		Any 2 points is correct(1/2 mark each)
40)	Total scores obtained:		
41)	Code:		

SECTION C

PRACTICE OF PREGNANT WOMEN ON NUTRITION IN THE FIRST TRIMESTER IN RELATION TO FOAD.

42)	Do you go for antenatal care in the first three months of pregnancy? 1)Yes 2)No		I 0
43)	Do you take oranges regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
44)	Do you take spinach regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
45)	Do you take egg regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
46)	Do you take liver regularly in the first 3 months of pregnancy? 1)Yes 2)No		1 0
47)	Please state the food you take regularly in the first trimester (Zinc)Oyster, crab, groundnut, egg, wholegrain, soynbeans, drybeans VitB12:Liver,Kidney,milk,fish, cheese, musclemeat Folate: Spinach, orange, mushroom, oat, Iron: fish, eggyolk, meat boncmarrow.organ meal More than 2 folate diet=0 More than 2 zinc containing diet=0 More than 2 Vit B12 diet=0 More than 2 iron containing diet=0		
48)	Total score obtained:		
49)	Code:		

SECTION C

PRACTICE OF PREGNANT WOMEN ON NUTRITION IN THE FIRST TRIMESTER IN RELATION TO FOAD.

42)	Do you go for antenatal care in the first three months of pregnancy? 1)Yes 2)No		1 0
43)	Do you take oranges regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
44)	Do you take spinach regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
45)	Do you take egg regularly in the first three months of pregnancy? 1)Yes 2)No		1 0
46)	Do you take liver regularly in the first 3 months of pregnancy? 1)Yes 2)No		1 0
47)	Please state the food you take regularly in the first trimester (Zinc)Oyster, crab, groundnut, egg, wholegrain, soyabeans, drybeans VitB12:Liver,Kidney,milk, fish, cheese, musclemeat Folate: Spinach, orange, mushroom, oat, Iron: fish, eggyolk, meat bonemarrow,organ meat More than 2 folate diet=0 More than 2 zinc containing diet=0 More than 2 Vit B12 diet=0 More than 2 iron containing diet=0		
48)	Total score obtained:		
49)	Code:		

SECTION D

FACTORS INFLUENCING THE NUTRITIONAL KNOWLEDGE AND PRACTICE OF PREGNANT WOMEN DURING F IRST TRIMESTER

Please tick where oppropriate

Morning sickness		
Poverty		
Occupation		
Lack of higher education		
Unaccessibility to health centers		
Unawareness of pregnancy early		
Food taboos		

YORUBA DRAFT OF QUESTIONAIRRE FOR PREGNANT WOMEN

Oro Isaaju

Mo je omo ile iwe unifasiti Ibadan, mo si n se iwadi lori imo ati isesi awon oloyun wa nipa aarun ojo iwaaju olojo pipe ti ai ri awon eroja ounje kan je ninu osu meta akoko ninu oyun nfa.

Eri ti o daju fihan pe opolopo awon aarun olojo pipe ni ibasepo pelu aije ounje asaraloore ninu oyun eleyi ti o se dena bi opolopo obirin ba ni imo ti o to nipa ounje ti o se koko ninu oyun papa julo ninu osu meta akoko, ti o si n je won.

Mo nilo iranlowo yin nipa fi fi idahun ti o ye si awon ibeere ti a fe bi yin yii. mo si fi n dayin loju wipe ohunkohun ti e ba ko tabi ami idanimo yin ko ni tu sita. Ese pupo

Nje o wu yin loti kopa?-----

APA KINI:

Nomba	Ibeere	Idahun	Aayo	koodu
1	Omo Odun melo ni yin bayii?			
2	Nje e wu nile oko bayii?	1) Beeni 2)Beeko		1 2
3	Ise wo ni e n se?	1)Omo ile iwe 2)Onise osu 3)Onise owo 4)Oluwase		1 2 3 4

SECTION D

FACTORS INFLUENCING THE NUTRITIONAL KNOWLEDGE AND PRACTICE OF PREGNANT WOMEN DURING FIRST TRIMESTER

Please tick where appropriate

Morning sickness		
Poverty		
Occupation		
Lack of higher education		
Unaccessibility to health centers		
Unawareness of pregnancy early		
Food taboos		

YORUBA DRAFT OF QUESTIONAIRRE FOR PREGNANT WOMEN

Oro Isaaju

Mo je omo ile iwe unifasiti Ibadan, mo si n se iwadi lori imo ati iscsi awon oloyun wa nipa aarun ojo iwaaju olojo pipe ti ai ri awon eroja ounje kan je ninu osu mefa akoko niau oyun nfa.

Eri ti o daju lihan pe opolopo awon aarun olojo pipe ni ibasepo pelu aije ounje asaraloore ninu oyun eleyi ti o se dena bi opolopo obirin ba ni imo ti o to nipa ounje ti o se koko ninu oyun papa julo ninu osu mefa akoko, ti o si nje won.

Mo nilo iranlowo yin nipa fi fi idahun ti o ye si awon ibeere ti a fe bi yin yii, mo si fi n dayin loju wipe ohunkohun ti e ba ko tabi ami idanimo yin ko ni tu sita. Ese pupo

Nje o wu yin lati kopa?———

APA KINI:

Nomba	Ibeere	Idahun	Aayo	koodu
1	Omo Odun melo ni yin bayii?			
2	Nje e wu nile oko bayii?	1) Beeni 2)Beeko		1 2
3	Ise wo ni e n se?	1)Omo ile iwe 2)Onise osu 3)Onise owo 4)Alawase		1 2 3 4

4	Elesin wo ni yin?	1)Onigbagbo 2)Musulumi 3)Awon omiran		1 2 3
5	O to omo melo ti e bi?			
6	Oyun elekelo ni eyi?			
7	Nje e maa nlo fun idanileko Kankan ni igbakugba ti e ba loyun?	1)Beeni 2)Beeko		1 2
8	Nibo ni e ti ma ngba idanileko nigbakugba ti e ba loyun?	1)Ile iwosan 2)Ile ijosin 3)Ile agbebi 4)Abe ile		1 2 3 4
9	Kini ipele eko yin ti o ga julo?	1)unifasiti 2)Ii eko girama 3)Ile eko alakobere 4)Nko kawe		1 2 3 4
10)	Kini ipele oyun ti e wa bayii?			

APA KEJI: IMO AWON OLOYUN NIPA PATAKI OUNJE ATI OYUN NI OSU META AKOKO.

11)	Ipele melo ni igba iloyun pin si? 1)Okan 2)Meji 3)Meta 4)Meta si oke		0 0 2 0
12)	Ninu awon ipele oyun yii,ewo ni o se elege julo ? 1)Alakoko 2)Elekeji 3)Eleketa 4)Eleketa si oke		2 0 0 0
13)	Kini o ye yin nipa bi omo inu se ndagba ninu osu meta akoko? 1) Igba yi se elege ti awon eya Pataki ara ntidi mule 2)Oro ti o yato si idahun akoko		2 0
14)	Ewo ninu awon ipele yii ni o se koko lati lo fonako sile fun ayewo ninu oyun? 1)Alakoko 2)Elekeji 3)Eleketa 4)Eleketa si oke		2 0 0 0

15)	Ewo ninu won ni o se koko lati bere sii ni je ounje ti o ni eroja ogun adena arun aluyin ninu bii osan,ugu,olu? a)Alakoko b)Elekeji c)Eleketa d)Eleketa si oke		2 0 0 0
16)	Ewo ninu awon ipele yii nii o se koko lati bere sii ni je ounje ti o ni eroja ogun eje ninu bii edo,bogo,inu eyin? a)Alakoko b)Elekeji c)Eleketa d)Eleketa si oke		2 0 0 0
17)	Ewo ninu won ni o se koko lati bere sii ni je ounje ti o ni eroja ogun idagbe omode ninu bii soya,alakan,wara? a)Alakoko b)Elekeji c)Eleketa d)Eleketa si oke		2 0 0 0
18)	Ewo ninu won ni o se koko lati bere sii ni je ounje ti o ni eroja litamin B12 ninu bii eyin,milliki,eja? a)Alakoko b)Elekeji c)Eleketa d)Eleketa si oke		2 0 0 0
19)	E daruko meji lara iwulo ogun ofefe ti e mo. 1)Fun sisun eje pupa ati eje adena aarun 2)fun idagbosoke opolopo eya ara 3)Fun ibisi ninu eya ara 4)Lati dena aarun aluyin		
20)	Nje a le ri eroja ogun adena arun aluyin ninu awon efo alawo ewe dudu biii ugu? 1)Beeni 2)Beeko		2 0
21)	Nje a le ri eroja ogun adena arun aluyin ninu osan? 1)Beeni 2)Beeko		2 0
22)	Nje jije ounje ti o ni ogun adena arun aluyin ninu bii osan,ugu ni osu meta akoko le dena aarun eje riru ninu omo nioJo iwaju? 1)Beeni 2)Beeko		2 0

23)	Nje aije ounje ti o ni ogun adena arun aluyin ninu bii osan,ugu ni osu meta akoko le fa ito suga ninu omo ni ojo iwaju 1)Beeni 2)Beeko		2 0
24)	Nje jije ounje ti o ni eroja ogun adena arun aluyin bii osan,ugu ninu osu meta akoko ninu ojun le dena aarun isanraju ninu omo? 1)Beeni 2)Beeko		2 0
25)	E doruko iwulo ogun alawopupa meji ti e mo Maaki kookan fun ayo kookan a)Fun ipese eje ninu ara b)oluranlowo nipa wiwo ounje afunilokun, amunidagba ati ora pele c)On sise ipese omi laago ara		
26)	Nje oije ounje ti o ni eroja ogun eje ninu bii edo,inu eyin,bogo obbl ni osu meta akoko le fa aarun eje tiru ninu omo ni ojo iwaju? 1)Beeni 2)Beeko		2 0
27)	Nje aije ounje ti o ni eroja ogun eje ninu oyun ni osu meta akoko le fa aarun ito suga ni ojo iwaju fun omo? 1)Beeni 2)Beeko		2 0
28)	Nje aije ounje ti o ni eroja ogun eje ninu oyun ni osu meta akoko le fa aarun isanraju ninu omo ni ojo iwaju? 1)Beeni 2)Beeko		2 0
29)	E daruko iru ounje meji ti a ti le ri eroja ogun alawopupa. Edo,eja,bogo,ugu,kidirin,		
30)	E daruko iwulo ogun idagbe omode meji ninu oyun (maaki kookan) Fun jijina egbo ni kiakia, fun idagbosoke, fun didena aarun, fun riran apaadun ati amuseya ago ara lowo ninu ise won, Fun sisi enu fun ounje, fun riran ounje afunilokun,adena arun,ora,ati amunidagbo lowo lati sise		
31)	E daruko orisi ounje meji ti a ti le ri ogun idagbe omode		

	Maaki kookan fun aayo kan Alakan,eran,epa,soya,ewa		
32)	E daruko iwulo vitamin B12 meji ti e mo Any 2 points is correct(1 mark each) a)fun eje sisun b)Fun opoloti o ji pepe ati iranti ti o ye koro c)fun amulo afaralookun,protein ati fat d)On ran eya ara lowo papajulo orisun eje ninu isc won		
33)	E daruko orisi ounje meji ti a ti le ri vitamin B12 ;Wara,miliki,eran,edo,kidirin,eyin,eja		
34)	Kini orisi aarun olojo pipe ti airi ounje electroja adena nrun aluyin je ninu osu meta akoko oyun le fa ninu omo ni ojo iwaju 1) Eje riru,itosuga, isanraju 2) Aarun ponju ponto,iba,romoleegun 3)Aarunigbona,romolapa,romolese,idagunle		2 0 0
35)	Kini orisi aarun olojo pipe ti airi ounje electroja ofefe je ninu osu meta akoko oyun le fa ninu omo ni ojo iwaju 1) Eje riru,itosuga, isanraju 2) Aarun ponju ponto,iba,romoleegun 3) Aarunigbona,romolapa,romolese,idagunle		2 0 0
36)	Kini orisi aarun olojo pipe ti airi ounje electroja ogun alawopupa je ninu osu meta akoko oyun le fa ninu omo ni ojo iwaju 1)Eje riru,itosuga, isanraju 2)Aarun ponju ponto,iba,romoleegun 3)Aarunigbona,romolapa,romolese,idagunle		2 0 0
37)	Kini orisi aarun olojo pipe ti airi ounje electroja ogun idagbe omode je ninu osu meta akoko oyun le fa fun omo ni ojo iwaju 1)Eje riru,itosuga, isanraju 2)Aarun ponjponto,iba,romoleegun 3)aarunigbona,romolapa,romolese,idagunle		2 0 0
38)	Igba melo ni o to fun alaboyun lati lo fun ayewo ninu oyun?		
39)	E daruko ewu meji ti o ro mo ailo fun ayewo ninu oyun Any 2 is correct except for the last option a)Aisedeede omo ninu oyun b)Ainimo ti oye koro lori oun jije ninu oyun papa julo osu meta akoko		

	c)Ailera iya ati oino e)kosi		
40)	Total Scores obtained:		
41)	Code:		

APA KETA: ISEESI AWON OLOYUN LORI OUNJE NI OSU META AKOKO NINU OYUN

42)	Nje e ma nlo fun ayewo ni osu meta akoko ti e ba loyun? 1)Beeni 2)Beeko		1 0
43)	Nje e ma nmu osan lorekoore ninu osu meta akoko ti e ba loyun? 1)Beeni 2)Beeko		1 0
44)	Nje e ma nje efo ugu deede ninu osu meta akoko ti e ba loyun? 1)Beeni 2)Beeko		1 0
45)	Nje e ma nje eyin deede ni osu meta akoko ti e ba loyun 1)Beeni 2)Beeko		1 0
46)	Nje e ma nje ounje ele roja ogun eje/alawopupa ninu osu meta akoko ti e ba loyun? 1)Beeni 2)Beeko		1 0
47)	E fala si idi ounje ti e ma n je deede ninu osu meta akoko ninu oyun (Zinc)alakan,epa, Eyin ,jero,baba,soya,ewa, VitB12:Edo,Kidirin,miliki,eja,wara,eran Folate:Ugu,osan,olu,oat , Iron:,inu eyin,edo,bogo,inu eran 2 folate diet=2 2 zinc containing diet=2 2 Vit B12 diet=2 2 iron containing diet=2		
48) Scores obtained			
49) Code	:		

APA KERIN

Awon koko ti o nfa idena lati ni imo ati iseesi ti o yc kooru nipa awon anrun ojo iwaju ti aije oun ti o peye ni osu meta akoko nfu fun awon omo ni ojo iwaju. Eni anfaani lati mu ju aayo kan lo.

Ecwo ounje		
Aisan owuro/olosu meta akoko		
Ise		
Aikawe pupo		
Ainimo oyun lakoko		
Owo		
Jijina ile iwosan si ibugbe.		

E SEUN PUPO

APPENDIX V

I am Ojo Oyeronke Olanrewaju, a post-graduate student of the Department of Health promotion and Education, college of medicine university of Ibadan. I am conducting a research study on knowledge and practice of pregnant women in relation to the prevention of foetal origin of adult diseases in some primary health care centers in Olorunda L.G,Osogbo,Osun state

Title of the research: knowledge and practice of pregnant women in relation to the prevention of foetal origin of adult diseases in some primary health care centers in Olorunda L.G,Osogbo,Osun state

Names and Affiliations of researcher: This study is been conducted by Ojo Oyeronke Olanrewaju of the department of health promotion and Education College of Medicine, Faculty of Public Health, University of Ibadan Oyo State, Nigeria

Purpose of Research: The purpose of this study is to investigate knowledge and practice of pregnant women in relation to the prevention of foetal origin of adult diseases in some primary health care centers in Olorunda L.G, Osogbo, Osun state

Procedure of the research: I will be recruiting 422 participants into the study and I invite you to take part in this research project. If you accept, you will be asked to participate in the filling of the questionnaire which will be given to you. No one else other than the researcher or research assistant will be present. The information that will be given is considered confidential and only Ojo Oyeronke O. and her colleagues will have access to the information during the research.

Expected duration of research and participant involvement: The duration of the data collection for this research, which you are being requested to participate in is two weeks and each respondent will spend about 15 minutes to 20 minutes in filling the questionnaire.

Risk and Discomforts: There are no physical risks associated with participation in this study. However, if you feel uncomfortable with some of the questions being asked, you may decide not to answer such questions.

Cost to the participation: Your participation in the research will not cost you anything.

Confidentiality

Privacy of participants was ensured by using a serial number on the information collected, rather than a name. Only the researcher knew the identification, and this information was kept secret. The data was not disclosed to anyone

Translation
The informed consent form, questionnaire and focus group discussion guide was translated to Yoruba language, this was achieved by colleague who specialise in speaking and writing Yoruba language.

Beneficence: The results of the research would be made available to the study participants and useful for programs like counselling, health talk that will help to improve the knowledge of pregnant women on pre-eclampsia and its preventive strategies.

Non-Maleficence
This research was relatively risk free.

Voluntariness
Participation in the study was completely voluntary, and based on informed consent obtained from the respondent. Participants were made to understand that they can withdraw from this study at any time.

Permission
Permission was obtained from each PHC Management Board, before the research was conducted. The findings of this will be made available to the Osun state Ministry of Health and other policy makers for planning purpose.

Ethical consideration
Approval for the study was obtained from Oyo state Ethics Review Committee at the state Ministry of Health. Should you have any question about your participation in this research, you may contact the principal investigator;
Ojo Oyeronke Olanrewaju

Address: Department of health promotion and Education, Faculty of Public health.University college Hospital, Ibadan.
Telephone: 08032416867.
E-mail:ronkiojo@yahoo.co.uk
Or the supervisor of this Research;
Dr O.E Oyewole
Address: Department of Health promotion and Education, Faculty of public Health, University College hospital, Ibadan.
Telephone: 08023259403

Translation
The informed consent form, questionnaire and focus group discussion guide was translated to Yoruba language, this was achieved by colleague who specialise in speaking and writing Yoruba language.

Beneficence: The results of the research would be made available to the study participants and useful for programs like counselling, health talk that will help to improve the knowledge of pregnant women on pre-eclampsia and its preventive strategies.

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Ojo Oyeronke Olanrewaju

Address: Department of health promotion and Education, Faculty of Public health.University college Hospital, Ibadan.
Telephone: 08032416867.
E-mail:ronkieojo@yahoo.co.uk
Or the supervisor of this Research;
Dr O.E Oyewole
Address: Department of Health promotion and Education, Faculty of public Health, University College hospital, Ibadan.
Telephone: 08023259403

APPENDIX VI

Statement of person Obtaining informed consent:

I have fully explained this research to _____and have given sufficient information, including about risks and benefits, to make an informed decision.

DATE: _____SIGNATURE:_____

NAME: _____

Statement of person given consent

Now that the study has been well explained to me and fully understand the consent of the study process, I hereby agree to be part of the study.

DATE: _____ SIGNATURE:_____

APPENDIX VII

List of wards in Olorunda L.G, Osun State

Namesof Wards	Names of PHC in each ward	Average numbers of pregnant women that visit on a monthly basis
• Akogun	Akogun Maternity centre	150
• Oke Onitea	Oke Onitea maternity centre	100
• Ota Efun	Ota Efun Maternity centre	100
• Ilie	Ilie primary health centre	80
• Oba ile	Oba Ile maternity centre in Oba Ile	100
• Oba Oke	Oba Oke maternity centre	70
• Atelewo	Atelewo maternity centre	130
• Sabo	Sabo dispensary	140
• Kolawole	Enikan o yun dispensary	100
• Oba ile	Oba dispensary	80
• Dagbolu	Dagbolu Dispensary	100
Total 11	Total 11	Total 1070

••• Eight wards and eight PHC centers were selected for the study