EC NUTRITION
Thesis

Nutritional Status in the Periconception Period and Lifestyle Factors Associated with Preterm Birth Among Mothers Giving Birth in Kawempe and Naguru Hospitals in Kampala, Uganda

Peter Vivian Acire*, Arthur Bagonza, Saul Kamukama and Agnes Nyabigambo

Public Health Department, Makerere University, Kampala, Uganda

***Corresponding Author:** Peter Vivian Acire, The institution is Department of Community Health and Behavioral Sciences, School of Public Health, Makerere University, Kampala, Uganda.

Received: November 02, 2020; **Published:** December 30, 2020

Abstract

Background: Nutritional status in the periconception period and lifestyle factors constitute series of modifiable and non-modifiable exposures that influence adverse pregnancy outcomes such as preterm delivery. Unfortunately, due to limited research, knowledge regarding such factors are lacking in many Low- and Middle-Income Countries and thus failing programmes that are geared towards improving maternal and newborn health.

Objective: The purpose of the study was to determine the nutritional status in the periconception period and lifestyle factors associated with preterm birth among mothers giving birth in Kawempe and Naguru hospitals in Kampala, Uganda. Additional inquiry sought to explore perceptions of mothers towards nutritional and lifestyle factors associated with PTB.

Method: Un-matched hospital-based case control study was conducted in Kawempe and Naguru hospitals between June and August 2019. Data on nutritional status and lifestyle exposure factors for PTB including mothers' perceptions towards nutritional and lifestyle factors for PTB was collected using face to face interview of 310 cases and controls.

Results: Majority of the respondents (65.2%) were between 20 to 29 years old, 42.6% had given birth at least once, 76.8% lived in urban, only 5.2% had attained university education while significant percentage (41.3) had secondary school qualification. Their main occupations were trade and domestic work (equal percentage of 27.1) and 56.4% had married. After adjusting for age, marital status and other potential confounders, the odds of having had anemia were 2.37 times higher among mothers of PTB than mothers without PTB (AOR; 2.37, 95%CI:1.25 - 4.49, P = 0.008). Among lifestyle factors, the odds of exposure to tobacco product through passive smoking at home among mothers who had PTB were 4.44 times greater than that among mothers who never had preterm babies (AOR; 4.44; 95%CI:2.24 - 8.78, P = 0.000). The odds of caffeine consumption over 200 mg per day were 0.27 times lower among cases than controls (AOR; 0.27, 95%CI: 0.10 - 0.69, P = 0.006). The odds of exercise among those who had PTB are 0.22 times lower than that among mothers with full term babies (AOR; 0.22, 95%CI: 0.11 - 0.42, P = 0.000). For sleep quality, the odds of exposure among cases were 1.64 times higher than that among controls (OR: 1.64; 95%CI: 1.02 - 2.63; P = 0.040). Qualitatively, 8 out of 10 mothers indicated varied views towards BMI, general nutrition, alcohol, caffeine and tobacco consumption. Majority expressed divergent sentiments towards their babies. After giving birth, many felt the baby belonged to them. However, few weeks later, these feelings disappeared and many began to feel so worried, anxious, broken down and empty.

Conclusion: Results from our study lay open the independent and joint roles of periconception anemia, lack of fruit consumption, passive smoking and poor sleep quality as key determinants of PTB among the nutritional and lifestyle factors assessed. On the other hand, living in rural, BMI, vegetable consumption, exercise and caffeine intake were protective against PTB. Generally, maternal perceptions towards nutritional and lifestyle factors during periconception in relation to PTB were poor.

Recommendations: Governments, donors and other relevant authorities to put in place and or strengthen programmes that address lifestyle modification in the periconception period to reduce the risk of preterm birth among women of child bearing age.

Keywords: *Nutritional Status; Periconception Period; Preterm Birth, Lifestyle Factors*

Introduction

Preterm Birth is defined as infants born alive before 37 completed weeks of gestation. According to the World Health Organization (WHO), preterm birth is defined as any birth before 37 completed weeks of gestation, or fewer than 259 days since the first day of the woman's last menstrual period (LMP). Three sub-categories of preterm birth exist, predicated on gestational age; that is, extremely preterm (born less than 28 weeks), very preterm (born between 28 to 32 weeks) and moderate to late preterm (those born between 32 to 37 weeks of gestation). About 15 million babies are born prematurely - more than 1 in 10 of all babies born around the world [1]. Preterm birth is a global problem with prevalence ranging between 5 and 18% across 184 countries [2]. Sub-Saharan Africa and Asia, accounts for the highest rates of preterm birth (i.e. more than 60% of the world's preterm babies) and over 80% of the world's 1.1 million neonatal deaths annually are due to complications related to preterm birth [3]. Low- and Middle-Income Countries lack reliable data to track the trend of preterm birth. However, countries with reliable data shows an increase in preterm birth rates in the last 20 years [4]. In Uganda, each year, 226,000 babies are born too soon [5]. This gives Uganda a 13th position out of 184 countries with the highest number of preterm born babies. In terms of number of death due to premature birth complications, the country is ranked 11th with 38% of the 39,000 deaths occurring in the baby's first 28th days [6].

Prematurity is the world's single biggest cause of newborn death and the second leading cause of all child deaths following pneumonia. Many of the preterm babies who survive face a lifetime of disability such as cerebral palsy, intellectual impairment, chronic lung disease, and vision and hearing loss [1]. Infants born preterm are at increased risk of a range of poor outcomes including respiratory distress syndrome, necrotizing enterocolitis and neonatal sepsis [7, 8]. In the long-term, they are more likely to experience motor and sensory impairment, delay in cognitive development and behavioral problems than babies born at term [8].

In recent years there has been an increasing focus on optimizing women's nutrition and lifestyle in the periconception period as this is a key time for fetal development and also an important period in human life during which subfertility, miscarriage, congenital malformations, PTB, fetal growth restriction and placental-related disorders originate [9]. Most of these adverse health outcomes in pregnancy are as a result of regular misuse of one or more of harmful substances such as alcohol, smoking, caffeine and other similar lifestyle factors by women during periconception. Among women of child bearing age, concern for these exposures even carry greater weight due to their potential of inflicting harms to up to two generations [10]. Exposure to these substances during this period and their effects on maternal, fetal, and child health depend on the timing and duration of exposures and their potential long-term or latent effects. The relationship of exposures to outcomes can therefore be considered in terms of critical periods, sensitive periods, and cumulative effects [11]. From the maturation of gametes through to early embryonic development, parental nutrition and other lifestyle (such as exposure to alcohol, tobacco, and other drugs) can adversely influence long term risks of offspring's cardiovascular, metabolic, immune, and neurological morbidities, often termed as developmental programming [11, 12]. Evidences have emerged that the disturbance of 1-C metabolism due to subtle variations in 1-C metabolism genes and deficiencies in 1-C substrates/cofactors together with poor lifestyle, such as smoking and alcohol consumption can contribute significantly to the subfertility and early miscarriage and compromise offspring's health [9].

Biologically, the preconception phase may be considered to commence in women from around 26 weeks prior to conception when primordial follicles leave their resting state. However, because the most active phase of ovarian follicular development commences around 14 weeks before conception, so then, is the preconception period defined [9]. Periconception period is followed by the post-conception phase lasting through to 10 weeks after conception, coinciding with the closure of the secondary palate of the embryo [9]. Periconception period involves the following stages: - gametogenesis, fertilization/conception, implantation, placentation and embryo- or organogenesis [13].

Several studies show that micronutrient supplementation starting in pregnancy can correct important maternal nutrient deficiencies, but are not sufficient to fundamentally improve child health. For example, the consequences of materno-fetal iron deficiency does not rectify structural impairments to developing brain structures after an undetermined time point of repletion [14]. Other interventions to improve diet during pregnancy have had little effect on maternal and newborn health outcomes [11]. Indistinguishably, weight-control interventions, including drug treatment, in pregnant women who are obese or overweight have not had sufficient impact on pregnancy and birth outcomes, which suggests that the focus for intervention around preconception or post-partum periods could allow the time necessary for behavioral interventions to take effect [15]. Promoting good health during periconception therefore, particularly regarding diet, nutrition and lifestyle is a key determinant of pregnancy success and next generation's health [11].

Since majority of pregnancies in our setting is not planned and exposure to poor nutrition and lifestyle factors is at peak, this study aimed to understand the association between these factors and preterm birth as the main adverse birth outcome in Uganda in order to generate evidences necessary for improving preconception interventions.

Background/Rationale

A host of individual, social, medical, and environmental conditions can influence pregnancy outcomes, including genetic disorders, pre-existing physical and mental health conditions, teratogens, and domestic abuse to name a few. Their relevance is important to recognize, but assessment of these conditions were outside the scope of this study. This study was limited to assessing maternal nutritional status and modifiable lifestyle risk factors during periconception period and their association with PTB in Kawempe and Naguru hospitals in Kampala, Uganda.

In Uganda, the prevalence of nutrition and lifestyle risk factors among the general population rather than at targeted group or critical period of periconception is high. A recent study revealed that an estimated 11.1 million people (30 per cent) eat food described as "unacceptable" for human development, 3 million (8 percent) eat the poorest food and more than 8.4 million (22 percent) are on the borderline between good and bad food [16].

Ugandan alcohol consumption is way above WHO recommendation of one standard drink per day for women, and 1 - 2 standard drinks per day for men, with overall prevalence of current alcohol use of 26.8%, and an annual per capita alcohol consumption of 23.7 liters. Up to 94 percent consume the locally home-made liquor with alcohol concentration of about 42%, beer 4 percent and wine 2 percent [17].

Estimated average micronutrients intake, particularly of iron, folate, Vitamin A and Zinc are below the Estimated Average Recommendation (EAR) as it's the case in other Low-Income and Middle-Income Countries. For example, only 60 percent of pregnant women in Uganda are able to take iron supplements for 60 days or less and less than 1 percent follows the recommended dose of 90+ IFA supplementation [18].

Anemia, a condition marked by low levels of hemoglobin in the blood (Hb < 12.0 g/dl if not pregnant, < 11.0 g/dl if pregnant), remain endemic, affecting 1 in 3 (32 percent) of women of child bearing age [19]. Since Iron is a key component of hemoglobin, and iron deficiency is estimated to be responsible for half of all anemia globally, it's very likely that one of the main causes of anemia in Uganda could be due to iron deficiency.

Despite the abundance of fruits and vegetables across Uganda, average household consumption of green leafy vegetables is only three times a week, and less than twice a week for fruits. There are therefore indications that the benefits derived from eating fruits and vegetables in Uganda are limited in comparison to WHO recommendation of 4 - 5 servings per day.

Although consumption of coffee among Ugandans is as low as 3 percent [20], indiscriminate consumption of energy drinks which normally contain high concentration of caffeine, sugars, taurine, ginseng and various vitamins among others, is on the increase. Similarly, tobacco use among adults is rampant with 1 in every 10 Ugandans using tobacco products daily [21].

The proportion of population with poor BMI is on the rise. At least, 2.3% and 10.4 - 19% of young adults (aged between 18 - 30 years) in Uganda are obese and overweight respectively. 8 - 12% are underweight (BMI < 18.5 kg/m^2). Compared to males, females are more likely to be obese (2.9% vs. 1.8%) or overweight (17.4% vs. 3.3%) [22,23].

Interestingly, Physical Activity (PA) levels among adults are high, achieved mostly through travel and work-related activities of moderate intensity, with up to 94.3% being able to meet the WHO PA recommendations with the daily median sedentary time of 120 minutes (IQR = 60 to 240) [24]. On the contrary, the prevalence of sedentary behavior among women is 18.8% and physical inactivity is 37.6% [25]. Disturbed sleep due to intense daily activities is common in the general population, and pregnant women are a population at greater risk [26].

Bearing in mind the level of risk exposure shown above, there is therefore a likely indications that the consequences of such exposures on poor perinatal outcomes [11,13,27-32] could be the leading cause of high incidence of preterm birth in Uganda. The need to study these factors and their association with preterm birth is therefore important. Already, many studies from high-income countries have linked poor nutrition and unhealthy lifestyles to PTB. Regrettably, in Low and Middle Incomes Countries, particularly, Sub-Saharan Africa, knowledge about these risk factors and their association with pregnancy outcomes among targeted population is scarce. The likely exposure variations and influences on outcomes resulting from differences in socio-economic, demographic, cultural, dietary, lifestyle, environmental, regulatory and health systems characteristics, make broader generalizability of findings from such studies determinate. Data on risk exposures of women during periconception and their influence on PTB in low income settings are thus needed. It's envisaged that this information would be used by public health practitioners, governments and general public to strengthen and support preconception and early pregnancy initiatives for a desirable birth outcomes and overall maternal and child health.

Objectives

- To determine periconception nutritional status and factors associated with PTB among mothers giving birth in Naguru and Kawempe Hospital.
- To find out periconception lifestyle factors associated with PTB among mothers giving birth in Naguru and Kawempe hospital
- To explore the perceptions of mothers giving births in Naguru and Kawempe Hospital towards nutritional status and lifestyle risk factors during periconception.

Methods

Study design

Hospital-based, unmatched case control study.

Setting

The study was conducted in Kawempe referral hospital and Naguru general hospital which are all located in Uganda's capital city, Kampala. Kawempe hospital is located in Kawempe Division, approximately 6.0 kilometers by road, north of the city's Central Business District, along the Kampala-Gulu Highway. This health facility, together with Kiruddu were established in order to decongest Mulago National Referral Hospital. It's a 170 bed facility, offering obstetrics and gynecologic services, general pediatric care and surgery, dental services and HIV care [33]. Hospital birth record shows that between May 2018 and April 2019, a total of 25,874 babies were born, with daily average of 71. Out of these babies, 2,799 were born preterm (giving annual percent of 11).

On the other hand, Naguru general hospital also known as China-Uganda Friendship Hospital Naguru, was established between 2009 and 2012 with support from Chinese government. The hospital has a capacity of 100 beds and is located in the east of Central Business District of Kampala in Nakawa Division. Information extracted from hospital birth record reveals that 10,220 babies were born between June 2018 and May 2019. In the same period, out of this total birth, 1,095 babies were born preterm. These statistics therefore give a clear signal that there is high birth rate and incidence of preterm birth in the two health facilities.

Whereas these health facilities were meant to serve people from within and peri-urban Kampala, they serve a much wider community. Although some referral cases come from areas outside Kampala, majority of the clients served in these facilities are mainly citizens from both low and high socio-economic group within the city. Kawempe and Naguru hospitals were chosen because; first and foremost, both hospitals provide specialized obstetric and gynecologic services which were key precursors for the study. Secondly, both hospitals serve mainly an urban population whose exposure to poor nutrition and harmful lifestyles is greater than that in rural areas. Lastly, given the short duration of the study, the investigators chose the two hospitals because they would get the required numbers of research participants in the desired time.

Study participants

Study population comprised of both cases (mothers with preterm births) and controls (mothers who gave birth to full term and normal babies). Cases included mothers with recent singleton PTB outcomes in the selected hospitals. Spontaneous PTB included infants born less than 37 completed weeks of gestation. Confirmation of PTB was done upon delivery. Control group were mothers who gave birth to infants at full term (≥ 37 weeks). Periconception period was assessed by reviewing women's LNMP from the medical record.

Inclusion criteria for cases were

Giving birth to live singleton births at less than 37 completed weeks of gestation without congenital abnormalities or neurological impairments; having BMI and anemia data in the mother's medical form; having no history of medical complications and being in the age bracket of 15 - 45 years. For control group, inclusion criteria were: - giving normal live singleton birth at greater or equal to 37 weeks of gestation; having BMI and anemia data in the mother's medical form and being in the age bracket of 15 - 45 years. In all groups (cases and control), participants were selected within 48 hours of delivery in the same hospital (had the same time of hospitalization).

Exclusion criteria for both groups were

Giving births to twins; having chronic illness; having missing BMI and anemia data in medical record; having previous history of PTB; giving birth to abnormal babies and having postpartum complications manifesting beyond 48 hours. All mothers who met the inclusion criteria were invited to participate in the study after a referral was made by obstetric or midwifes. Upon obtaining informed consent, data on selected exposure factors for PTB was collected through face-to face interview at the time of enrolment in the study each day.

Sample selection

Case definitions of outcome variable - PTB, was based on WHO guidelines. That is, PTB included babies born alive less than 37 completed weeks of gestation as calculated from the date of last normal menstrual period or ultrasound scan. This was to ensure that all cases included in the study meet the same diagnostic criteria. Selection of cases involved purposive sampling.

Hospital controls which included all eligible mothers who gave birth in the same hospitals from which cases were selected, were randomly selected for participation into the study within 48 hours' period. A 1 to two (1:2) ratio of case to control was used. That is for every 1 case there were 2 controls. Enrolment in participating hospitals was based on average number of daily delivery (facility with higher number of births took higher number of participants).

Variables

The 17-risk exposure (independent) variables were grouped into 3 categories: - 1. Socio-demographic risk factors included women age, marital status, ethnicity, occupation, education (None, Primary, Secondary, Tertiary), and parity. 2. Lifestyle category explored data on alcohol (No. of standard drinks/day), tobacco use (current user of no user), exposure to second hand smoke (hours of exposure/day/week), physical activity (No. of hours on moderate PA/day/week) and sleep quality (duration, disorders, quality) and caffeine intake (ml or grams consumed/day). 3. Nutrition category included data on vegetable and fruits consumption (No. of serving/day), anemia (severe, moderate and mild) periconception use of folic acid supplementation (time of commencement of FA intake, the doses, duration of intake, the reason for use and who prescribed the use). Anthropometric domain which fall under nutrition, comprised of height and weight. Height and weight data at first antenatal care visit were used for calculating early pregnancy body mass index (BMI) to give a proxy preconception BMI (for mother who visited ANC within three months of their pregnancy). World Health Organization's classification or cut-offs were used to categorize, BMI, Anemia, Caffeine intake, alcohol consumption, smoking, FA intake and level of physical activity.

Data sources/measurement

Pre-corded, standardized structured questionnaires based on the Behavioral Risk Factor Surveillance System (BRFSS) survey tool guided the collection of data on nutritional and lifestyle factors for both cases and control. Data on periconception (nutritional and lifestyle factors including socio-demographic factors for both groups was based on recalls, except for medication use, BMI and Anemia status which were verified from prescriptions present with the women in the medical record. Being mindful of the post-delivery conditions of research participants, 10 In-depth Interviews (IDIs) using standardized guiding questions, appended at the end of 10 quantitative data collection tools, were used to collect qualitative data (i.e. perceptions of well-informed participants/cases about periconception nutritional status and lifestyle factors). All IDIs were audio-taped and the interview guide covered participants' views of life about nutritional status and lifestyle risk factors during periconception.

Upon arrival at the facility, IRB and administrative clearance were presented to the head of gynecology department. Staff in maternity unit and neonatal intensive care unit were contacted. Access to birth register, admission and discharge record were requested for review by research assistants. Active identification of cases and controls was made on each day of visit. All postpartum mothers admitted in maternity ward and neonatal intensive care unit within 48 hours were then approached and scrutinized for eligibility criteria by reviewing information in the medical forms available with them. Eligible participants were immediately interviewed upon seeking their consent.

Socio-demographic data

Age in complete years was recorded as a continuous variable. In the event that a respondent was unable to recall their age appropriately, significant past political or social local events were used as a proxy to estimate their age. Marital status was classified into 5 groups namely; never married, married, widowed, separated, divorced and cohabiting/married. Religion was classified as catholic, protestant, other Christian, Muslim, traditionalist and non-believer. Residence was categorized into two as rural and urban. Education classified as never attended school, primary, ordinary level, advanced level, college 1 year to 3 and university. Occupation included trade, domestic work, employed for wage, salaried employment, and farming.

BMI Measurements

Body conformation measurements only took care of the mothers' height as pregravid weight or weight at first ANC visit (taken as proxy) was assessed from the medical record. A height board was used for height measurement. Participants wearing light clothing were made to stand upright with their arms freely hanging on the side while barefooted, with heels together with their feet slightly diverging.

With hind head, buttocks and heels touching the vertical board, the head was moved slightly until the Frankfort plane was horizontal. The height board's movable head was moved down to the top most of the head while simultaneously applying adequate pressure to compress the hair and counter pressure by the chin. The height readings were then be taken to the nearest 0.1 cm. NB: Height measurement was only done for participants with missing height data in their medical record. Weight at first ANC visit and height measurements for each participant were then used to calculate Body Mass Index (BMI) as weight in kilograms divided by the square of height in meters, kg/m^2. BMI data or anthropometric measurements for mothers taken after three months of their 1st ANC visit were not considered. Categorization of BMI was based on WHO cutoffs i.e. < 18.5 kg/m^2 underweight; ≥ 18.5 but ≤ 24.9 kg/m^2 Normal; > 25 kg/m^2 but ≤ 29.9 kg/m^2 Overweight; and > 30 kg/m^2 obese.

Anemia assessment

Anemia test is routine in all ANC first visit. Data on Hb for assessment of anemia theretofore, was collected from the laboratory reports reflected on the medical records of participants. WHO Cut-offs for anemia in pregnancy (measured in g/dl) were used as ≥ 11 g/dL No anemia/normal; 10 g/l – 9 g/dL Mild; 7 g/l – 9 g/dL Moderate; and < 7 g/dL for Severe anemia. All eligible participants' medical records were reviewed and Hb data recorded.

Alcohol use assessment

For alcohol use, participants were asked whether they had ever consumed any alcoholic beverage or not during periconception. Those reporting that they had ever consumed alcohol were further asked to provide details of alcohol consumption such as type of alcohol consumed, the frequency of consumption, and the average quantity consumed per sitting. The amount alcohol consumed was quantified in terms of the numbers of standard drinks. WHO cutoffs were applied i.e. 0 SU as Never user, < 1SU Low user, 1SU medium, and > 1SU as heavy users. WHO defines one standard alcoholic drink as any alcohol drink that contains 10 g of pure alcohol (1SU is equivalent to 285 mls of beer, 120 mls of wine, 30mls of spirit/gin) [34].

Assessment of caffeine intake

To assess caffeine intake, participants were asked how often on average during the periconception period they had consumed coffee, tea and carbonated drinks. Consumption of decaffeinated coffee and different types of caffeinated soft drinks was assessed. Caffeine content per cup of coffee was estimated as 100 mg; one cup of tea 47 mg (300 mls standard cup for coffee and tea); One standard bottle or can of cola beverage (300 mls) at 46 mg; one standard can of energy drinks (300 mls) at 100 mg, and one serving of chocolate candy (50 g) estimated at 7 mg of caffeine [35]. The total daily intake of caffeine was assessed by summing the caffeine content for a specific amount of each food (cup for coffee or tea, bottle (s) or can (s) for carbonated beverages) multiplied by quantity proportional to the frequency of its use. Caffeine consumption per day in pregnancy was rated as (< 100 mg/day low; ≥ 100 mg but < 200 mg/day moderate; and > 200 mg/day high).

Physical activity assessment

Physical activity assessment involved asking participants questions on the number of times (frequency) and duration of time in hours and minutes spent in activities of different intensities for each of the PA domains listed. For each PA domain, the time in minutes per day or week in different intensities was multiplied by the number of times the PA was executed and comparison made with WHO PA cutoff for adults (i.e. less 30 minutes/day as sedentary; light, 30 mins/day of moderate exercise or 15 minutes/day of vigorous exercise as moderate; less than 30 minutes/day of moderate exercise or 30 minutes/day of vigorous exercise as hyperactive. Range of physical activities such as walking, house work/care giving, digging, rope skipping, bicycling, machine exercise, running and running were assessed.

Sleep quality assessment

women were asked whether during periconception they had poor or good quality sleep (sleep duration < 6 hours as short, 7 to 8 hours adequate or normal > 9 hours long; disorders such as insomnia, apnea, movement disorder). Sleep Disorder Classifications were made according to International Classification of Diseases, 9th Revision-Clinical Modification Codes and Diagnosis.

Smoking status determination

Tobacco users were categorized into 4 (never user, ever user, current user, passive smokers). Never users included those who never use or exposed to tobacco products. Ever and current users of tobacco products consisted of those involved in combustion and inhalation of tobacco smoke including chewing through the mouth while passive users were those who used tobacco product through second hand smokers. The use of tobacco product such as cigarettes, cigars, shisha or pipes were self-reported. Participants were asked how many products they smoke daily and how many times a day they used smokeless tobacco products.

Fruit and vegetable consumption

Participants were asked how many times per day, week or month during periconception when they took pure fruit juice, ate fresh fruits, and any vegetable products. Fruits and vegetables such as oranges, mangoes, pineapples, watermelons, avocados, pawpaw, bananas, apples, fresh green leafy and legume vegetables that are commonly sold or grown in Uganda were assessed. The number of serving per day was then ascertained and multiplied by quantity/serving (No. of serving x 80 g). Consumption was categorized into three groups (i.e. ≤ 240 g/day or 3 serving/day as low consumption; ≥ 240 g but ≤ 400 g or 5 serving, moderate and ≥ 400 g high consumption). One serving of fruit and vegetable = 80 g = 250ml of raw leafy vegetable = 125 mls of cooked or chopped vegetable.

Bias

Late presentation of pregnant women at ANC (delayed booking) and limited monitoring of weight among women before conception and during early pregnancy, resulted into exclusion of many mothers from the study as they lacked weight data for BMI calculation. This in a way, retarded data collection process as very few mothers were able to qualify for each day of recruitment.

The study was prone to many biases as mothers were asked about their risk exposures during periconception. Recall biases were very common. About 5 percent of the mothers interviewed were not able to recall precisely their dietary pattern and exposure to tobacco in the past 7, 8 months. To minimize this, the researcher carried out in-depth probing during interviews, citing examples and situations that happened during the periconception period.

Study size

Open Epi epidemiologic statistics software for Public Health, version 3 was used to calculate the desired sample size. The module for un-matched case-control study was used and the output is as shown in the table 1 below:

Based on the above taking Kelsey calculation, total study sample size was 310 for both groups. A ratio of 1:2 i.e. case to control was used.

Kelsey *et a*l., method is as described below in the given formulae:

$$n_1 = \frac{(Z_{\alpha/2} + Z_{1-\beta})^2 \, pq \, (r+1)}{r \, (P_{1} - P_{2})}$$

And $n_2 = rn_1$

Where: -

$n_{1} =$ number of cases

$n_{2} =$ number of controls

$Z_{\alpha/2} =$ standard normal deviate for two-tailed test based on alpha level (relates to the confidence interval level)

$Z_{1-\beta}$ = standard normal deviate for one-tailed test based on beta level (relates to the power level)

r = ratio of controls to cases

P_1 = proportion of cases with exposure and $q_1 = 1-p_1$

P_2 = proportion of controls with exposure and $q_2 = 1-p_2$

$p = \frac{p_1 + rp_2}{r + 1}$ and $q = 1 - p$

Substituting the formula: $$\frac{(1.96+0.8)^2 \text{ x } 0.37 \text{ x } 0.62 \text{ x } 3}{2\ (0.48 - 0.32)^2}$$

$$n_1 = 104$$

$$n_2 = rn_1 = 104 \text{ x } 2 = 208$$

Overall sample size = 313

For:				
	Two-sided confidence level(1-alpha)			95
	Power (% chance of detecting)			80
	Ratio of Cases to Controls			12
	Hypothetical proportion of controls with exposure			32
	Hypothetical proportion of cases with exposure:			48.48
	Least extreme Odds Ratio to be detected:			2.00
		Kelsey	**Fleiss**	**Fleiss with CC**
Sample Size – Cases		100	101	110
Sample Size – Controls		210	211	230
Total sample size:		310	312	340
References				
Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15				
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 and 3.19				

***Table 1:** Sample Size for Unmatched Case-Control Study.*

Patients and public involvement

At the design stage, oral interviews were conducted with patients/mothers and hospitals' administrators to register their views on the proposed study. These consultative meetings together with reviews of the participating hospital's records on birth outcomes shaped the choice of the outcome measure. Mother's experience before conception, during pregnancy and after delivery specifically, regarding their diet and lifestyle were ascertained. The information obtained steered the decision for selecting predictor variables and overall design of the research questions.

During tool development, experience and opinions of the midwives and patients/mothers were sought on the time frame mothers could be effectively engaged given their postpartum conditions and the nature of questions that might sound sensitive to them basing on their diverse cultural background. The information attained guided the length and conduct of the research tool administered. Mother's postpartum condition was given prime priority during tool development and administration. For example, Research Assistants were able to stop at any point they were asked by the mothers during the interview.

Patients/mothers were actively involved in the recruitment process, particularly at the time of assessing their eligibility. From the daily birth record, all potential mothers were directly asked especially about key information missing in their record for eligibility establishment. Recruitment status was thus determined by the information given by the patients/mothers together with those available in her record book.

Reporting and communications protocols of this study involved plans for interpreting and communicating results with multiple audiences. The results of this study was thus disseminated in a number of forum. The first dissemination was conducted in a scientific conference which comprised of members from academic institutions, legislators, donors, scientists and media representatives, including medical councils. The second sharing of results targeted research participants, community members and participating hospital authorities where presentations were made in a dissemination workshop and report shared in hard copies.

Statistical methods

Upon collection, data was cleaned and frequency of each of the measured variables in each of the two groups were calculated at univariate level. To obtain the CORs and AORs, inferential statistics were obtained using logistic regression. This was done in two stages; 1) Bivariate analysis was run to determine the potential variables associated with PTB. Crude Odds ratios (CORs) at 95% confidence interval were obtained to measure the potential associations. 2) Multivariate analysis was then performed to determine the actual factors associated with PTB. All variables that were statistically significant at bivariable analysis, including socio demographics, were included in the model. Variables were tested for collinearity before inclusion into the model. The model was built step wise while testing it using L-fit until the best model was obtained. Variables that remained statistically significant (i.e. P valu*e* less than 0.05) at 95% confidence interval were considered as factors associated with PTB. Adjusted Odds Ratios (AORs) were obtained as measures of association and were used to interpret final results. All variable that were significant (P value < 0.05) at bivariate analysis and P > 0.05 on L-fit test were selected for inclusion into multivariable model. Qualitative data analysis involved independent transcription of recorded interviews, presentation of findings for each topic using quotes and discussion verbatim. Interviews were used to provide rigorous understanding of quantitative findings.

Results

Study participants

During the study period, there were a total of 2970 potential eligible participants (i.e. all deliveries/mothers who gave birth from the two hospitals were expected to meet eligibility criteria). Overall, 56.0% (1663/2970) of total hospital delivery (from both Naguru and

Kawempe hospital) were examined for eligibility. Altogether, 40.7 (677/1663) cases and 59.3% (986/1663) controls were confirmed eligible. After simple random sampling, 27.1% (108/398) of the confirmed cases and 15.9% (202/1265) of controls, were included into the study and analyzed.

Socio-demographic characteristics

The average age of respondents was 25.2 years with a standard deviation of 5.2 years, majority 202/310 (65.2%) falling between 20 - 29 years. The average number of children was 2 with standard deviation of 1.35. Majority 238/310 (76.8%) of the participants resided in Urban, 128/310 (41.3%) had ordinary level of education, 84/310 (27.1%) of the respondents were domestic and trade workers. More than half 175/310 (56.4%) of the respondents were married, 105/310 (33.8%) were Catholics and many 146/310 (47.1%) were Baganda. Almost all 304 (98.1%) were Ugandans (Table 2).

Variable	Frequency (N=310)	Percentage (%)
Age		
15-19	35	11.3
20-29	202	65.2
30+	73	23.6
Parity		
1	132	42.6
2	83	26.8
3 and more	95	30.6
Residence		
Urban	238	76.8
Rural	72	23.2
Education		
Never attended school	8	2.6
Primary	94	30.3
Ordinary level	128	41.3
Advanced level	34	11.0
College 1 year to 3 years	30	9.7
University	16	5.2
Occupation		
Trade	84	27.1
Domestic work	84	27.1
Employed for wages	60	19.4
Salaried Employment	27	8.7
Retired	26	8.4
Don't know	14	4.5
Subsistence agriculture	10	3.2
Commercial agriculture	5	1.6
Religion		

Catholic	105	33.8
Moslem	75	24.2
Protestant	70	22.6
Others (Christian, Traditionalists	60	19.4
Marital status		
Married	175	56.4
Informally married	60	19.4
Never married	45	14.5
Separated/divorced/widowed	30	9.7
Ethinicity		
Baganda	146	47.1
Banyakole	50	16.1
Basoga	43	13.9
Luo	26	8.4
Ateso	13	4.2
Mixed blood	2	0.7

Table 2: *Socio-demographic Characteristics of the respondents.*

Nutritional status

Majority 107/202 (68.6%) of cases and 124/202 (61.4%) of controls had normal BMI three months preconception and early in pregnancy respectively. A greater number 71/108 (65.7%) of the cases had Anemia while only 60/202 (29.7%) of the controls had anemia (Table 3).

Variable	**Overall 310(%)**	**Pre Term Birth**	
		Cases (n=108) Controls (n=202)	
Pre conception BMI			
Normal	138(52.3)	31(39.7)	107(68.6)
Underweight	39(14.8)	27(34.6)	12(7.7)
Overweight and obese	57(21.6)	20(25.6)	37(23.7)
Early pregnancy BMI			
Normal	166(53.5)	42(38.9)	124(61.4)
Underweight	40(12.9)	28(25.9)	12(5.9)
Overweight obese	104(33.5)	38(35.2)	66(32.7)
Anemia			
Yes	131(42.3)	71(65.7)	60(29.7)
No	179(57.7)	37(34.3)	142(70.3)

Table 3: *Nutritional status.*

Nutritional related factors

Greater percentage (94.2) of both cases and controls did not take any form of vitamins supplement during preconception as compared with early pregnancy intake (overall percentage of 69.7). 33/108 (30.6%) of cases and 57/202 (28.2%) of controls took Folic Acid. Intake of fresh fruits was 221/310 (71.3%) among groups compared with fruit juice 31/310 (10.0%). 89 (82.4%) of cases and 163 (80.7%) of controls consumed some form of vegetables (Table 4).

Variable	Overall 310 (%)	Pre Term Birth	
		Cases (n=108)	Controls (n=202)
Vitamins supplement at preconception			
Yes	18 (5.8)	7 (6.5)	11 (5.5)
No	292 (94.2)	101 (93.5)	191 (94.5)
Vitamins supplements at early pregnancy			
Yes	94 (30.3)	36 (33.3)	58 (28.7)
No	216 (69.7)	72 (66.7)	144 (71.3)
Mult Vitamins			
Yes	84 (27.1)	35 (32.4)	49 (24.3)
No	226 (72.9)	73 (67.6)	153 (75.7)
Folic Acid			
Yes	90 (29.0)	33 (30.6)	57 (28.2)
No	220 (71.0)	75 (69.4)	145 (71.8)
Drank fruit juice			
Yes	31 (10.0)	9 (8.3)	22 (10.9)
Never	279 (90.0)	99 (91.7)	180 (89.1)
Ate a fruit			
Yes	221 (71.3)	58 (53.7)	163 (80.7)
Never	89 (28.7)	50 (46.3)	39 (19.3)
Beans			
Yes	278 (89.7)	185 (91.6)	93 (86.1)
No	32 (10.3)	17 (8.4)	15 (13.9)
Green vegetables			
Yes	262 (84.5)	182 (90.1)	80 (74.1)
No	48 (15.5)	20 (9.9)	28 (25.9)
Orange vegetables			
Yes	209 (67.4)	56 (51.9)	153 (75.7)
No	101 (32.6)	52 (48.2)	49 (24.3)
Vegetables			
Yes	252 (81.3)	89 (82.4)	163 (80.7)
No	58 (18.7)	19 (17.6)	39 (19.3)

Table 4: *Nutritional Related Factors.*

Lifestyle factors for PTB

Only 39/202 (19.3%) and 17/108 (15.7%) of the controls and cases respectively had ever taken alcohol. Altogether, only 3 (1.0%) of mothers had smoked. Taken all, 121/310 (39.0%), 194/310 (62.6%), 68/310 (21.9%) of both groups, inhaled tobacco smoke at home, at work and in a vehicle respectively. Majority 158/202 (78.2%) of the controls had ever exercised 3 months before getting pregnant and only 38/108 (35.2%) of the cases had exercised. Almost all 291/310 (93.9%) of the mothers had ever consumed caffeine and nearly half of both cases 63/108 (58.3%) and controls 93/202 (46.0%) ever had enough sleep (Table 5).

Variable	Overall 310 (%)	Pre Term Birth	
		Cases (n=108)	Controls (n=202)
Alcohol			
Yes	66 (21.3)	17 (15.7)	39 (19.3)
No	235 (75.8)	91 (84.3)	163 (80.7)
Smoke			
Some days	3 (1.0)	1 (0.9)	2 (1.0)
Not at all	307 (99.0)	107 (99.1)	200 (99.1)
Inhaled smoke at home			
Yes	121 (39.0)	75 (69.4)	46 (22.8)
No	189 (61.0	33 (30.6)	156 (77.2)
Inhaled smoke at work			
Yes	194 (62.6)	80 (74.1)	114 (56.4)
No	116 (37.4)	28 (25.9)	88 (43.6)
Inhaled smoke in a vehicle			
Yes	68 (21.9)	44 (40.7)	24 (11.9)
No	242 (78.1)	64 (59.3)	178 (88.1)
Consume caffeine			
Yes	291 (93.9)	104 (96.3)	187 (92.6)
No	19 (6.1)	4 (3.7)	15 (7.4)
Quantity of caffeine consumed			
<100 mg/day	123 (39.7)	32 (29.6)	91 (45.1)
≥100mg but < 200mg/day	117 (37.7)	34 (31.5)	83 (41.1)
≥200mg/day	70 (22.6)	42 (38.9)	28 (13.9)
Exercise			
Yes	196 (63.2)	38 (35.2)	158 (78.2)
No	114 (36.8)	70 (64.8)	44 (21.8)
Enough rest or sleep			
Yes	156 (50.3)	63 (58.3)	93 (46.0)
No	154 (49.7)	45 (41.7)	109 (54.1)

Table 5: *Lifestyle Factors for PTB.*

Factors associated with preterm birth

Bi variable analysis

Socio-demographic factors

At Bivariable analysis, only residence was statistically significant for PTB. The odds of living in rural areas were 0.47 times lower among cases than controls (OR; 0.47; 95% CI: 0.27 - 0.80, P = 0.006) (Table 6).

Variable	Pre term birth		OR (95%CI)	P-Value
	Cases (n=108)	Control (n=202)		
Age				
15-19	10 (9.2)	25 (12.4)	1.0	
20-29	76 (70.4)	126 (62.4)	0.66 (030-1.46)	0.306
30+	22 (20.4)	51 (25.2)	0.93 (0.38-2.25)	0.868
Parity				
1	43 (39.8)	89 (44.1)	1.0	
2	30 (27.8)	53 (26.2)	0.85 (0.48-1.52)	0.591
3 and more	35 (32.4)	60 (29.7)	0.82 (0.48-1.44)	0.505
Married				
Yes	79 (73.2)	156 (77.20	1.0	
No	29 (26.8)	46 (22.8)	0.80 (0.47-1.38)	0.425
Residence				
Urban	73 (67.6)	165 (81.7)	1.0	
Rural	35 (32.4)	37 (18.3)	0.47 (0.27-0.80)	**0.006**
Religion				
Catholic	34 (31.5)	71 (35.2)	1.0	
Protestant	23 (21.3)	47 (23.3)	0.98 (0.51-1.86)	0.947
Moslem	31 (28.7)	44 (21.8)	0.68 (0.37-1.26)	0.219
Others	20 (18.5)	40 (19.8)	0.96 (0.48-1.88)	0.900
Education				
Primary and Below	33 (30.5)	69 (34.2)	1.0	
Secondary	61 (65.5)	101 (50.0)	0.79 (0.46-1.33)	0.381
Tertiary	14 (13.0)	32 (15.8)	1.09 (0.51-2.32)	0.817
Employment				
Waged/salaried Employment	27 (25.0)	60 (29.7)	1.0	
Trade	27 (25.0)	57 (28.2)	0.95 (0.50-1.81)	0.876
Domestic Worker	34 (31.5)	50 (24.8)	0.67 (0.35-1.24)	0.199
Others	20 (18.5)	35 (17.3)	0.79 (0.39-1.61)	0.511

Table 6: *Bivariable analysis of socio-demographic factors associated with PTB.*
Keys: OR Odds Ratio; CI Confidence Interval.

Nutritional status and factors

Bivariable analysis revealed that preconception and early pregnancy BMI, anemia, eating fruits and vegetables were statistically significant for PTB. The odds of underweight both at pre conception and early pregnancy among mothers who had PTB were 0.13 and 0.15 times lower than that among mothers without PTB (OR: 0.13; 95% CI: 0.06 - 0.28, P = 0.000) and OR: 0.15, 95% CI: 0.07 - 0.31, P = 0.000) respectively. The odds of having had anemia were 4.54 times higher among PTB mothers than mothers who did not have PTB. (OR: 4.54; 95% CI: 78 - 7.48; P = 0.000). The odds of eating fresh fruits were 3.60 times higher among cases (mothers with PTB) than controls (mothers without PTB). The odds of having consumed green vegetables were 0.31 times lower among mothers who gave birth to preterm than those who gave birth to full term babies (OR, 0.31; 95% CI: 0.17 - 0.59; P = 0.0001) (Table 7).

Variable	**Pre Term Birth**		**OR (95%CI)**	**P-Value**
	Cases (n=108) controls (n=202)			
Pre conception BMI				
Normal	31(39.7)	107(68.6)	1.0	
Underweight	27(34.6)	12(7.7)	0.13(0.06-0.28)	**0.000**
Overweight and obese	20(25.6)	37(23.7)	0.53(0.27-1.05)	0.070
Early pregnancy BMI				
Normal	42(38.9)	124(61.4)	1.0	
Underweight	28(25.9)	12(5.9)	0.15(0.07-0.31)	**0.000**
Overweight obese	38(35.2)	66(32.7)	0.59(0.35-1.00)	0.05
Anemia				
Yes	71(65.7)	60(29.7)	1.0	
No	37(34.3)	142(70.3)	4.54(2.78-7.48)	**0.000**
Vitamins supplement at preconception				
Yes	7(6.5)	11(5.5)	1.0	
No	101(93.5)	191(94.5)	1.20(0.45-3.20)	0.711
Vitamins supplements at early pregnancy				
Yes	36(33.3)	58(28.7)	1.0	
No	72(66.7)	144(71.3)	1.24(0.75-2.05)	0.399
Mult Vitamins				
Yes	35(32.4)	49(24.3)	1.0	
No	73(67.6)	153(75.7)	1.50(0.89-2.51)	0.125
Folic Acid				
Yes	33(30.6)	57(28.2)	1.0	
No	75(69.4)	145(71.8)	1.12(0.67-1.86)	0.666
Drank fruit juice				
Yes	9(8.3)	22(10.9)	1.0	
Never	99(91.7)	180(89.1)	0.74(0.33-1.67)	0.476
Ate a fruit				
Yes	58(53.7)	163(80.7)	1.0	

Never	50(46.3)	39(19.3)	3.60(2.15-6.03)	**0.000**
Beans				
Yes	185(91.6)	93(86.1)	1.0	
No	17(8.4)	15(13.9)	0.57(0.27-1.19)	0.135
Green vegetables				
Yes	182(90.1)	80(74.1)	1.0	
No	20(9.9)	28(25.9)	0.31(0.17-0.59)	**0.000**
Orange vegetables				
Yes	56(51.9)	153(75.7)	1.0	
No	52(48.2)	49(24.3)	0.34(0.21-0.57)	**0.000**
Vegetables				
Yes	89(82.4)	163(80.7)	1.0	
No	19(17.6)	39(19.3)	1.12(0.611-2.05)	0.712

Table 7: *Bivariable analysis of nutritional status and factors associated with PTB.*
Keys: OR Odds Ratio; CI Confidence Interval.

Lifestyle factors

Passive smoking at home, workplace, vehicle, consumption of caffeine, exercise and sleep quality were statistically significant for preterm births. The odds of having inhaled tobacco smoke at home, work and vehicle were 7.71, 2.21 and 5.10 times higher among mothers who had PTB than mother without preterm birth (OR: 7.71; 95% CI: 4.56 - 13.03; P = 0.000), (OR: 2.21; 95% CI: 1.32 - 3.68; P = 0.000), and (OR: 5.10, 95% CI : 2.87 - 9.05, P = 0.0001) respectively. Consumption of over 200 mg of caffeine a day among mothers who had PTB were 0.23 times lower than that among those without PTB (OR: 0.23; 95% CI: 0.12 - 0.44; P = 0.000). The odds of physical activity were 0.15 times lower among cases than controls (OR: 0.15; 95% CI: 0.09 - 0.25; P = 0.000). On the other hand, the odds of having had enough rest or quality sleep were at 1.64 times higher among mothers with PTB than mothers without preterm babies (OR: 1.64; 95%CI: 1.02 - 2.63; P = 0.040) (Table 8).

Variable	**Pre Term Birth**		**OR (95%CI)**	**P-Value**
	Cases (n=108) Control (n=208			
Alcohol				
Yes	17 (15.7)	39 (19.3)	1.0	
No	91 (84.3)	163 (80.7)	0.78 (0.42-1.46)	0.438
Smoke				
Some days	1 (0.9)	2 (1.0)	1.0	
Not at all	107 (99.1)	200 (99.1)	Undefined	
Inhaled smoke at home				
Yes	75 (69.4)	46 (22.8)	1.0	
No	33 (30.6)	156 (77.2)	7.71 (4.56-13.03)	0.000
Inhaled smoke at work				
Yes	80 (74.1)	114 (56.4)	1.0	
No	28 (25.9)	88 (43.6)	2.21 (1.32-3.68)	0.002

Inhaled smoke in a vehicle				
Yes	44 (40.7)	24 (11.9)	1.0	
No	64 (59.3)	178 (88.1)	5.10 (2.87-9.05)	0.000
Caffeine consumed				
<100 mg/day	32 (29.6)	91 (45.1)	1.0	
≥100mg but < 200mg/day	34 (31.5)	83 (41.1)	0.86 (0.49-1.51)	0.598
≥200mg/day	42 (38.9)	28 (13.9)	0.23 (0.12-0.44)	0.000
Exercise				
Yes	38 (35.2)	158 (78.2)	1.0	
No	70 (64.8)	44 (21.8)	0.15 (0.09-0.25)	0.000
Enough rest or sleep				
Yes	63 (58.3)	93 (46.0)	1.0	
No	45 (41.7)	109 (54.1)	1.64 (1.02-2.63)	0.040

Table 8: *Bivariable analysis of Lifestyle factors associated with PTB.*
Keys: OR Odds Ratio; CI Confidence Interval.

Multivariable analysis of nutritional and lifestyle factors associated with PTB

After adjusting for age, marital status and other potential confounders, there was no factors under sociodemographic that remained statistically significant for PTB.

Among the nutritional factors, only anemia, was statistically significant for PTB. The odds of having had anemia were were 2.37 times higher among preterm mothers than mothers without preterm babies (AOR; 2.37, 95% CI: 1.25 - 4.49, P = 0.008).

Among the lifestyle factors associated with PTB after adjusting for potential confounders, inhaled tobacco smoke, quantity of caffeine consumed and physical exercise were statistically significant for PTB. The odds of exposure to inhaled tobacco smoke at home were 4.44 times higher among mothers with PTB than mothers who never had preterm babies (AOR; 4.44; 95% CI: 2.24 - 8.78, P = 0.000). The odds of having consumed over 200mg of caffeine per day were 0.27 times lower among cases than controls (AOR; 0.27, 95% CI: 0.10 - 0.69, P = 0.006). The odds of exercise among mothers who had PTB were 0.22 times lower than that among without PTB (AOR; 0.22, 95% CI: 0.11 - 0.42, P = 0.000) (Table 9).

Variable	Pre term birth		OR (95%CI)	AOR (95%CI)	P value
	Cases (n=108) Controls (n=208)				
Age					
15-19	10(9.2)	25(12.4)	1.0		
20-29	76(70.4)	126(62.4)	0.66(030-1.46)	0.53(0.17-1.61)	0.260
30+	22(20.4)	51(25.2)	0.93(0.38-2.25)	0.66(0.18-2.34)	0.516
Married					
Yes	79(73.2)	156(77.20	1.0		
No	29(26.8)	46(22.8)	0.80(0.47-1.38)	0.85(0.38-1.91)	0.702
Residence					
Urban	73(67.6)	165(81.7)	1.0		
Rural	35(32.4)	37(18.3)	0.47(0.27-0.80)	0.55(0.26-1.13)	0.105
Nutritional factors					
Early pregnancy BMI					
Normal	42(38.9)	124(61.4)	1.0		
Underweight	28(25.9)	12(5.9)	0.13(0.06-0.28)	0.42(0.15-1.15)	0.092
Overweight	38(35.2)	66(32.7)	0.53(0.27-1.05)	0.67(0.33-1.35)	0.266

Anemia					
Yes	71(65.7)	60(29.7)	1.0		
No	37(34.3)	142(70.3)	4.54(2.78-7.48)	2.37(1.25-4.49)	**0.008***
Ate a fruit					
Yes	58(53.7)	163(80.7)	1.0		
Never	50(46.3)	39(19.3)	3.60(2.15-6.03)	0.69(0.31-1.54)	0.336
Orange vegetables					
Yes	56(51.9)	153(75.7)	1.0		
No	52(48.2)	49(24.3)	0.34(0.21-0.57)	1.23(0.59-2.57)	0.567
Lifestyle factors					
Inhaled smoke at home					
Yes	75(69.4)	46(22.8)	1.0		
No	33(30.6)	156(77.2)	7.71(4.56-13.03)	4.44(2.24-8.78)	0.000
Inhaled smoke at work					
Yes	80(74.1)	114(56.4)	1.0		
No	28(25.9)	88(43.6)	2.21(1.32-3.68)	1.74(0.82-3.65)	0.146
Quantity of caffeine					
<100 mg/day	32(29.6)	91(45.1)	1.0		
≥100mg but < 200mg/day	34(31.5)	83(41.1)	0.86(0.49-1.51)	0.75(0.36-1.57)	0.445
≥200mg/day	42(38.9)	28(13.9)	0.23(0.12-0.44)	0.27(0.10-0.69)	0.006
Exercise					
Yes	38(35.2)	158(78.2)	1.0		
No	70(64.8)	44(21.8)	0.15 (0.09-0.25)	0.22(0.11-0.42)	0.000*
Enough rest or sleep					
Yes	63(58.3)	93(46.0)	1.0		
No	45(41.7)	109(54.1)	1.64(1.02-2.63)	1.08(0.56-2.09)	0.821

Table 9: *Multi Variable analysis of nutritional and lifestyle factors associated with PTB.*
*Keys: * significant factors at p-value < 0.05; OR Odds Ratio; AOR Adjusted Odds Ratio; CI Confidence Interval*
lfit: 0.2242.

Perceptions of mothers towards nutritional and lifestyle factors in relation to PTB

We interviewed 10 mothers who were initially selected as cases using in depth interviews about their perception towards preterm babies. All the 10 mothers interviewed were admitted in Neonatal Intensive Care Unit with their preterm babies in the two Hospitals. 8 of 10 mothers interacted with felt that the baby belonged to them immediately and after giving birth, and were positive about the outcome of their pregnancies. 'I felt happy and accepted that he was my child; you have to accept that the child is yours. God has given me a spirit to accept his will and this is what he had decided for me. I accept him as my child,' IDI, mother of a preterm baby.

Though the feeling of acceptance was strong in the beginning, as time went on, many began to develop anxieties and worries about the condition of their babies. Their worries were mainly out of long hospital stay and difficulties in caring for the baby. 'Whenever I look at my child my heart breaks, I feel so bad, It hurts me because am always anxious and don't know what will happen next or if he will survive. First of all I didn't even think I was capable of giving birth to a preterm, and when I look at my small child I pray that God help him survive. When children next to me die, I start wondering if mine would be next. Occasionally I even wake up suddenly in the night thinking my child is dead,' IDI, mother of a preterm baby. All the 10 mothers admitted having had difficulties in caring for a preterm baby compared to a full term. The difficulties indicated were in two folds; for the baby, care in terms of baby's hygiene management, sicknesses, maintaining warmth, carrying and feeding of the baby were a big problem. For mothers, stress due to long hospital stay, sleeplessness, financial difficulties, anxieties and isolation were common facets. Amidst these toils, majority of the mothers were however positive about their babies in terms of survival. This positivity appeared to be associated with moral support they received from visiting relatives and friends while in the hospitals.

In an attempt to find out whether mothers had any specific preference to what they ate during early pregnancy, diverse views were expressed. Majority of them (6/10) indicated going without food due to poor appetite and took only fruit snack. Close to half said they were not specific to diet as they ate nearly all varieties ranging from meat, leafy vegetables, beans, matooke, and rice to groundnut sauce. 'When I first got pregnant, I didn't actually know I had a baby growing inside me until two months later when I noticed my period had not come and my appetite was going down for almost all kind of foods. I had never gotten pregnant. I then asked my boyfriend (we weren't staying together yet) to walk me up to a clinic for pregnancy checkup. I was confirmed 9 week's pregnant and I first felt so bad about it, though I later had to accept it. From the hospital, the midwife gave me some red tablets (combined ferrous sulphate) to take all through my pregnancy. When I started taking those tabs, my appetite reduced further, I would vomit every day, I would eat very little and largely depended on fluid (pure juice without sugar) intake for two full weeks. I did not like to smell or see the look of any food,' IDI, mother of a preterm baby.

When exploring whether mothers mind about their weight before and during pregnancy, majority attested having had the desire to maintain average weight though it was something very hard to achieve. Many of them affirmed that maintenance of reasonable weight looked like some sort of luxury to women because of the kind of food they eat, the kind of work they do and the nature of environment they live in which most times compromise their ability or deny them opportunity to exercise. 'I wanted to remain 'portable' so that my husband would not leave me for another girl. Disappointedly, from the time I gave birth to my first born, I failed to reduced weight, many of my clothes did not fit me anymore. My friends began telling me that I was growing old so fast. I became worried, yet there was nothing I could do,' IDI, mother of a preterm baby.

In trying to understand the respondent's general views about alcohol consumption, smoking, caffeine intake, quality sleep and exercise at any time during a woman's lifetime, nearly half approved alcohol consumption. More than half pointed out that smoking and exercise were meant for men because they have more free time compared to women. They further added that coffee was everywhere around them and sleep was most preferred. 'When I was two months old with this baby, my friends advised me to drink a lot of alcohol if I wanted to give birth to a light skin baby, so I felt okay to drink. Each time they (my friends) would go out, I would join them. later on I became addicted and drunk every day, alcohol is sweet and has nothing to do with pregnancy, she emphasized,' IDI, mother of a preterm baby. In another interview one added, 'I would drink coffee about 8 times a day since I didn't have appetite for food. When my husband would go shopping, I would ask him to carry at least a bottle of rock boom (an energy drink). I think taking tea or any other cold drinks isn't bad for a women whether pregnant or not since they are not alcoholic,' IDI, mother of a preterm baby.

When asked about what they think causes preterm birth, mothers had mixed views, some said bleeding, absence of the child's father, under feeding, heavy workload, high blood pressure and witchcraft. 'There is one person in the village who is a witch. She practices witchcraft and evil spirits always ask for children from her. This I noticed when I was pregnant. Shortly after I became pregnant, a friend to my husband impregnated the witchdoctors' daughter and they had a child. One day when he came home, my husband shared the news of my pregnancy with him. The man then told his mother in law the news who later asked him to present to her my clothes. All over a sudden I noticed that my clothes were missing and a day later I got a sharp pain and something spoke to me that it was witchcraft. I became possessed and couldn't understand what was going on around me. The witchdoctor told me that my child would be killed and sacrificed and that's how I simply prematurely lost my baby,' IDI, mother of a preterm baby. None of the mothers knew about solutions to preventing preterm birth.

Discussions

Socio-demographic characteristics associated with preterm birth

Our study found no significant association between maternal socio-demographic characteristics and risk of preterm birth. This finding is thus contrary to what previous study in Beijing, China found [36] in which rural residence were 6.56 times at risk of giving birth to preterm baby (OR = 6.56, 95% CI: 2.68 - 16.10). In recent years, many efforts have been made by government of Uganda to improve maternal health care in rural areas. The huge gap in terms of medical and health care that used to exist between urban and rural areas, appear to be closing. This situation further seems to be influenced by improved income status of many rural and peri-urban occupants with resultant effects on increased access to essential services. Improved living conditions is known to directly decrease the risk of preterm birth through neuroendocrine and immune pathways that reduces susceptibility to infection and hypertension [37,38].

Nutritional status in the periconception period associated with PTB

Having anemia at periconception was found to have statistical significant for PTB. The odds of having had anemia were 2.37 times greater among cases than among controls. This implies that having anemia at periconception increase risk of having preterm birth by 2.37 times (AOR; 2.37, 95% CI: 1.25 - 4.49, P = 0.008). This finding agrees with discoveries from previous studies in Asia and Africa [39]. The increased risk could be due to the lower hemoglobin concentration which has negative footprint on oxygen-carrying capacity, erythrocytes repair, fetoplacental unit, and buffer mechanism against blood loss that usually occur during delivery [40,41].

Our study also found very strong statistical association between fruit, vegetable consumption and preterm birth (COR = 3.60, 95% CI: 2.15 - 6.03; P = 0.000). While the odds of fruit consumption among mothers who had PTB were greater and thus showing increased risk of exposure to outcome, consumption of vegetable was protective (COR = 0.31, 95% CI: 0.17 - 0.59, P = 0.000) i.e. risk of preterm birth deceased with consumption. This benefit was the same for both groups irrespective of the types of vegetable eaten and number of serving though those who consume more than one serving were at a decreased risk than those who consume ≤ 1 serving. This finding is compatible with what previous studies in Europe and Australia found, in which adherence to dietary pattern consisting of vegetables, fruits, whole grain and cereals, during periconception significantly reduced the risk of preterm delivery [42,43]. Justification for both findings could be due to profound supply of essential nutrients that fruits and vegetables offer in early pregnancy which subsequently determine placental function early in life and sustain growing fetus in late pregnancy [44].

In regard to maternal BMI, our study found inverse relationship between preconception and early pregnancy BMI, which is an indication of protective effect. Being underweight was associated with decreased risk of preterm birth compared to having normal weight (COR = 0.13, 95% CI: 0.06 - 0.28; P = 0.000) and (OR = 0.15, 95% CI: 0.07 - 0.31; P = 0.000) during pre and early pregnancy respectively. After adjusting for confounding factors, periconception BMI did not show statistical significance. This finding is consistent with findings from a study done in Malawi in which BMI was found to have protective effect on PTB [45]. However, contrary to this, previous studies in Asia, Europe and Africa found positively weaker association between underweight and PTB (OR = 1.09, OR = 1.10, and OR = 1.17 for underweight, overweight, obese respectively). These variations could be due to differences in the timing of the BMI measurements or study design. Therefore, to protect mothers from PTB risk, basing on suggestion that undernutrition during periconception influence the hypothalamic-pituitary-adrenal axis with subsequent impact on birth outcomes, there is need to improve overall maternal nutrition during a critical period of developmental programming.

Periconception lifestyle factors associated with preterm birth

As pertains tobacco use, only 1% of both controls and cases actively smoked. Exposure to tobacco smoke was however greater with passive/second hand smoking both at home and work place (39.0% and 62.6%) respectively. After adjusting for confounding factors, our finding shows significant association between second hand smoking and preterm delivery. Mothers who had exposure to second hand smoking during periconception were at increased risk of preterm delivery 4.44 times (AOR = 4.44, 95% CI: 2.24 - 8.78, P = 0.000). Our finding is consonant with [46,47] previous studies in Asia. Although the Uganda tobacco control act 2015 bans smoking in all public places such as workplaces, public transport and others, implementation and enforcement remain a big challenge as exposure to passive smoking continue to be serious hold-up. If Uganda is to reduce the risk of preterm birth at substantial level, exposure to passive smoking should be given careful attention.

On alcohol consumption, our study shows weak association between periconception alcohol use and preterm delivery at bivariate analysis (COR = 0.78, 95% CI: 0.42 - 1.46, P = 0.438). After adjusting for confounding factors at multivariate analysis, alcohol use did not show statistical significance. There was no difference in the risk of preterm delivery among abstainers, low, medium or heavy alcohol users. Although previous studies from developing countries on alcohol use during early pregnancy found strong association for intakes > 2 units/week with preterm birth, our study finding was however contradictory. Nevertheless, our finding seems to agree with what was found from a previous study in Western Europe, where alcohol consumption during early pregnancy showed decreased risk of preterm birth and in fact light to moderate alcohol consumption of 1.5 drinks/day showed no effect at all [48,49]. These results should however be interpreted with care, since no information on drinking patterns was taken in to account and underestimation could have occurred due to retrospective nature of the information collected and self-reporting on alcohol consumption. Consumption of small amount of alcohol concentrated within a few days may be harmful due to enhanced prostaglandin level in alcohol drinkers as prostaglandins can cause preterm birth [50]. Alcohol or its metabolites have also been hypothesized to affect fetal development causing fetal hypoxia, impairing cell proliferation, or affecting placental development [51].

Caffeine intake during periconception seems to play a critical in influencing pregnancy outcomes as evident in our findings. We discovered strong association between caffeine consumption and preterm delivery. After adjusting for confounding, the odds of exposure to caffeine ≥ 100 mg but < 200 mg/day were 0.75 times lower among PTB mothers than mothers without PTB, signifying protective effects of caffeine on PTB risk (AOR = 0.75, 95% CI: 0.36 - 1.57, P = 0.445). The risk of preterm delivery seems to reduce with increased intake of ≥ 200 mg/day (AOR = 0.27, 95% CI: 0.10 - 0.69, P = 0.006), suggesting dosage response relationship between the exposure and outcome. A study among Japanese women found maternal total caffeine intake to increase the risk of PTB [52] and our finding appear to be in disagreement with this. However, a similar studies conducted in Latin America and China agree with our finding. In those two studies, no association was found between periconception caffeine intake and risk of preterm birth [53]. This disparity could be due to variance in the level of caffeine measurement and dietary pattern. The physiological effects of caffeine are due to antagonism of adenosine action through competitive inhibition at the receptor level [54]. Caffeine is also known for its ability to cross placental wall to reach the fetus and is able to maintain its half-life longer (12 - 24 hours) in there than in adult (2 - 4 hours) due to the absence of CYP1A2 enzyme placenta and fetus [55]. Owing to our findings and in view of other scholars' revelations regarding caffeine consumption, women should be advised to limit their caffeine intake to less than 200 mg/day particularly during periconception period.

Regarding exercise, our study found strong association between physical activity and the risk of preterm birth. The odds of physical activities during periconception were 0.22 lower among mothers with PTB than mother who never had preterm birth (AOR = 0.22 95% CI: 01.11-0.42, P = 0.00), thus uncovering the protective effect of exercise on prematurity in terms of reducing the risk of PTB. Our finding is in support of what [56] found where physical activity were positively associated with preterm birth outcome. From a biological point of view, physical activity seems to influence the functions of blood flow which later positively affects vascular health of the mother and vascular performance and development of the placenta and fetus [57]. Considering the benefits associated with physical activity during early pregnancy, moderate maternal physical activity should be considered as a front-line therapy for reducing the risk of pregnancy complications and enhancing maternal physical and mental health.

Sleep quality appear to influence the risk of preterm birth. Our finding shows that the odds of exposure to poor sleep (i.e. slept < 6 hours/day) during periconception, was greater among mothers of PTB than mothers without, thus revealing the increased risk of PTB with poor sleep quality (COR = 1.64, 95% CI: 1.02 - 2.63, P = 0.040). However, this risk tends to vary with sleep duration. Our study did not find an association of long sleep duration with PTD as the number of women sleeping more than 9 hours per night was too small to fully evaluate in this study. On account of this finding therefore, mothers should be encouraged to effectively balance their work or physical activity schedules in order to have adequate rest during pregnancy.

Perceptions of mothers towards periconception nutritional and lifestyle in relation to PTB

Understanding the perceptions of mothers and caregivers towards periconception nutritional and lifestyle factors in relation to preterm birth is the first step to promoting and improving appropriate maternal and new born care in health facilities and community level. Knowledge of their feelings and understanding is also likely to inform and influence program design such as lifestyle modification aimed at preventing premature birth.

Regarding perceptions towards periconception nutritional status and factors, our findings show that even though women may have the will to eat varieties of food available, pregnancy complications particularly nausea make them lose appetite for most foods and thus reducing food intake with subsequent weight loss. If the mother had not been feeding well during preconception, this progressive weight loss could likely lead to adverse pregnancy outcomes. On the other hand, weight control efforts and desires appear to diminish with the woman's inability to exercise or make food choices as indicated by one of the mothers interviewed. These findings are in agreement with what [58] found in their study where many women cited physical, psychological and external (for example work, family, time and environmental) as barriers to physical activity during pregnancy thus making them to start exercising only when it's approaching delivery time. Findings from our quantitative study unveiled the contribution of underweight, overweight and obesity to PTB. Therefore, appropriate programmes that focuses on maternal nutrition during the time of periconception should be strengthened to support women struggling to cut down weight and or put back weight after losing.

From our findings, exposure to lifestyle factors such as alcohol, smoking, caffeine, and exercise during pregnancy seems to be driven by social factors other than individuals. The idea that alcohol consumption during pregnancy causes skin lightening in new born appears to be wide spread and it turns out to be one of the major reasons why pregnant women in urban setting consume alcohol. This finding is in line with what (Hammer and Inglin, 2014) found where women perceived that moderate drinking of alcohol during pregnancy was acceptable and viewed as responsible behavior under certain circumstances. Furthermore, the mindset that sweet drinks are better than alcohol and therefore must be enjoyed by women, looks like what's majority of women have towards high consumption of caffeine. These findings support results from our quantitative study where high proportion (21.3% and 93.9) of women were found to use alcohol and caffeine respectively. This revelation point to the needs for aggressive awareness creation in order to address the huge knowledge gap regarding modifiable risk for PTB that exist among women with subsequent long term gain in reducing the incidence of PTB.

Our finding further express that the perceptions of mothers towards their preterm babies varied with time, conditions of the baby and welfare of the mother herself. In the first few weeks of giving birth, mothers tend to have positive feelings towards their babies and this appear to be out of instinct. This acceptance however, begin to wane with increased new born care demand. The growing needs for high level of hygiene, feeding of the baby, and providing warmth are overwhelming and often comes with the mother's feeling of anxieties, worries, fatigue, and uncertainties and sometimes neglect. This finding is in agreement with what previous study in England on families whose babies had been admitted to neonatal units following premature delivery found [59]. In their finding, having a small, immature and often sick infant appeared to affect mothers' attitudes and perceptions of their ability to parent such an infant in terms of care both in the short or long term. Comparable to this, [60], indicated that many parents perceive PTB as a disruptive and stressful life event that affects parental quality of life via multiple pathways due to prolonged hospitalization, and intensive care of the preterm born infant. These comparability in findings point to the needs for psychosocial support to parents of preterm babies during hospitalization and in community.

Regarding their knowledge of causes of PTB, our findings disclosed assorted views. The understanding of causes of PTB seem to have connection with cultural background, social network, and access to health care services. The expression of witchcraft, bleeding, heavy workload, high blood pressure and undernutrition as possible causes of prematurity signifies a huge knowledge gap surrounding PTB among mothers. Our findings compound to what a study on perceptions of preterm birth among women who had experienced preterm delivery in Southern Malawi found. In the Malawian study, the perceived causes of preterm birth consisted of what was both termed as 'modern' and 'traditional' including illnesses, violence, witchcraft, ideas relating to impurity, heavy work, inadequate food and inappropriate use of medicine [61]. Our finding shows strong association between anemia, fruit/vegetable consumption, physical activity, caffeine intake, passive smoking, sleep quality and PTB. Advocating for good nutrition and lifestyle modification through aggressive awareness creation program at community contact points, is likely to strengthen community knowledge about causes of PTB for improved perinatal outcomes.

Conclusions

Results from our study lay open the independent and joint roles of periconception anemia, lack of fruit consumption, passive smoking and poor sleep quality as key determinants of PTD among the nutritional and lifestyle factors assessed. On the other hand, living in rural, BMI, vegetable consumption, exercise and caffeine intake were protective against PTB. Generally, maternal perceptions towards nutritional and lifestyle factors during periconception in relation to PTB are poor and untenable.

Recommendations

Findings from our study underpin the contributions of major lifestyle and nutritional factors around periconception to correlate with PTB. Since most of these factors are modifiable, designing, planning and implementation of interventions that target all women of reproductive age are likely to yield desirable outcomes. Programs such as nutrition and health education, screening test, and psychosocial support during adolescence, before conception, during and between pregnancies will improve opportunity for planned pregnancies and increase chances of healthy perinatal outcomes in Uganda. Government should make deliberate efforts to make such programs mandatory for every woman of child bearing age. Our finding particularly on micronutrient supplementation during periconception shows that very few women take micronutrient supplement before getting pregnant. Since micronutrient supplementation started late in pregnancy is not likely to repair fetal deficiency, all girls and women planning to enter into child bearing should be encouraged to seek care early in time to prevent adverse effects of micronutrient deficiencies on their future pregnancies.

Healthcare providers through a coherent system, need to strengthen public awareness on the importance of periconception health and behavioral change that influences pregnancy or birth outcomes, particularly among couples contemplating pregnancy. Government ministries in charge of healthcare should commit to supporting this process through redirecting resources and increasing health sector funding.

Government commitment to enforce tobacco control act 2015, together with increased public vigilance on use of tobacco products in public, will help reduce high level of exposure incurred from passive smoking. Our finding Provide coherent proof to government on the need to target interventions at a critical period of life development programming in order to improve and childbirth safety thus, directly contributing to the Sustainable Millennium Development Goals (SMDGs) for reducing maternal and child mortality.

Postnatal care services should stretch beyond caring for the infant alone, but also seek to offer psychosocial support to mothers and caregivers of preterm babies during hospitalization and while in the community in order to optimize care for preterm infants and maternal health.

Consumption of fruits and vegetables should be encouraged in all public institutions especially schools. Government should support systems that strengthen nutrition sensitive programs such as commercial vegetable and fruit production at household and community levels in order to provide affordable and quality sources of food to Ugandan growing population.

Rural healthcare system strengthening together with rural development initiatives must be supported by the national government. Delivering of effective reproductive health services, combined with implementation of tested economic programmes, will sustainably improve maternal health and yield significant gain in overall standards of living among rural population.

Further research on weight loss among pregnant women should be explored in order to devise practical solutions and recommendations to women struggling with the burdens of weight gain.

Limitations

Late presentation of pregnant women at ANC (delayed booking) and limited monitoring of weight among women before conception and during early pregnancy, resulted into exclusion of many mothers from the study as they lacked weight data for BMI calculation. Evidently, over 59.3% (986/1663) and 40.7% (677/1663) of examined cases and controls accordingly, were excluded from the study (ineligible). This in a way, retarded data collection process as very few mothers were able to qualify for each day of recruitment.

The study was prone to many biases as mothers were asked about their risk exposures during periconception. Recall biases were very common. About 7 percent of the mothers interviewed were not able to recall precisely their dietary pattern and exposure to tobacco in the past 7, 8 months. To minimize this, the researcher carried out in depth probing during interviews, citing examples and situations that happened during the periconception period.

Funding Note

This study was privately funded. Thus, there is no any competing interests or any commercial, financial or non-financial associations relevant to this article.

Acknowledgement

Many thanks are extended to staff in the department of Gynecology and Obstetrics of Kawempe referral hospital and Naguru general hospital for their indispensable supports. To mention a few, Dr. John Wanyama, Sr. Pal, Medias, Spinscious Amanya and Denese. You played a big role by advising and linking the patients/mothers with the research team. My deepest gratitude goes out to each one of you there mentioned. Above all, to administrators of the two hospitals, their warm reception can't go unrecognized. Indeed, they offered a conducive environment in which I was able to mix freely and collect my data without any hindrance. Thank you so much!.

Bibliography

1. March of Dimes TPfM. "Newborn and Child Health, Save the Children, World Health Organization". Born Too Soon, The Global Action Report on Preterm Birth (2012).

2. Blencowe H., *et al*. "National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications". *Lancet* 379.9832 (2012): 2162-2172.

3. Alkema L., *et al*. "Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group". *Lancet* 387.10017 (2016): 462-474.

4. Vogel JP., *et al*. "Global, regional and national levels and trends of preterm birth rates for 1990 to 2014: protocol for development of World Health Organization estimates". *Reproductive Health* 13.1 (2016): 76.

5. GAPPS. Uganda: Profile of preterm and low birth weight prevention and care (2017).

6. MOH, Health Sector report 'The burden of preterm birth (2018).

7. McCormick MC., *et al*. "Prematurity: an overview and public health implications". *The Annual Review of Public Health* 32 (2011): 367-379.

8. Lasiuk GC., *et al*. "Unexpected: an interpretive description of parental traumas' associated with preterm birth". *BMC Pregnancy Childbirth* 13.1 (2013): S13.

9. Steegers-Theunissen RP., *et al*. "The periconceptional period, reproduction and long-term health of offspring: the importance of one-carbon metabolism". *Human Reproduction* 19.6 (2013): 640-655.

10. Lassi Z., *et al*. "Preconception care: Caffeine, smoking, alcohol, drugs and other environmental chemical/radiation exposure 11.3 (2014): S6.

11. Stephenson J., *et al*. "Before the beginning: nutrition and lifestyle in the preconception period and its importance for future health". *The Lancet* 391.10132 (2018): 1830-1841.

12. Padhee M., *et al*. "The Periconceptional Environment and Cardiovascular Disease: Does In Vitro Embryo Culture and Transfer Influence Cardiovascular Development and Health?" *Nutrients* 7.3 (2015): 1378.

13. Cetin I., *et al*. "Role of micronutrients in the periconceptional period". *Human Reproduction* 16.1 (2010): 80-95.

14. Yang W., *et al*. "The Effects of Periconceptional Risk Factor Exposure and Micronutrient Supplementation on Birth Defects in Shaanxi Province in Western China". *PLoS ONE* 7.12 (2012): e53429.

15. Hanson M., *et al*. "Interventions to prevent maternal obesity before conception, during pregnancy, and post partum". *The Lancet Diabetes and Endocrinology* 5.1 (2017): 65-76.

16. UBOS, 11 million Ugandans eat unacceptable food: Uganda Bureau of Statistics report. Kampala (2017): 34.

17. Kabwama SN., *et al*. "Alcohol use among adults in Uganda: findings from the countrywide non-communicable diseases risk factor cross-sectional survey". *Global Health Action* 9 (2016): 10.

18. Uganda MOH. "Guidelines on Maternal Nutrition in Uganda, Health, Editor. Kampala, Uganda (2010).

19. UDHS, Prevalence of Anemia in children and women (2016).

20. USDA Foriegn Agricultural Services, G.A.N.G., Assessments Of Commodity And Trade Issues, Uganda Coffee Report (2017).

21. Kabwama SN., *et al*. "Tobacco use and associated factors among Adults in Uganda: Findings from a nationwide survey". *Tobacco Induced Diseases* 14 (2016): 27.

22. Baalwa J., *et al*. "Prevalence of overweight and obesity in young adults in Uganda". *African Health Sciences* 10.4 (2010): 367-373.

23. Turi KN., *et al*. "Spatial Distribution of Underweight, Overweight and Obesity among Women and Children: Results from the 2011 Uganda Demographic and Health Survey". *International Journal of Environmental Research and Public Health* 10.10 (2013): 4967-4981.

24. Guwatudde D., *et al*. "Physical Activity Levels Among Adults in Uganda: Findings From a Countrywide Cross-Sectional Survey". *Journal of Physical Activity and Health* 13.9 (2016): 938-945.

25. Kirunda B. "Body weight and phyiscal activity of adults in rural Uganda". *Bergen* (2017).

26. Gelaye B., *et al*. "Poor sleep quality, antepartum depression and suicidal ideation among pregnant women". *Journal of Affective Disorders* 209 (2017): 195-200.

27. Lawn JE., *et al*. "Born too soon: accelerating actions for prevention and care of 15 million newborns born too soon". *Reproductive Health* 10.1 (2013): S6.

28. Lang AY., *et al*. "Optimizing preconception health in women of reproductive age". *Minerva Ginecologica* 70.1 (2018): 99-119.

29. P Fleming T., *et al*. "Origins of lifetime health around the time of conception: causes and consequences 391 (2018).

30. Physicians, A.A.o.F. Preconception Care (2015).

31. V Dean S., *et al*. "Preconception care: Closing the gap in the continuum of care to accelerate improvements in maternal". *Newborn and Child Health* 11.3 (2014): S1.

32. Lin L., *et al*. "Prevalence, risk factors and associated adverse pregnancy outcomes of anaemia in Chinese pregnant women: a multicentre retrospective study". *BMC Pregnancy Childbirth* 18.1 (2018): 111.

33. Report PHC. "States of the government health facilitites in Kampala and Eeastern Uganda Parliament of Uganda (2017).

34. NHMRC, Australian guidlines to reduce health risks from drinking alcohol, Attorney-General, Editor. Australia (2009): 32.

35. Rai KP., *et al*. "Determination of caffeine and taurine contents in energy drinks by HPLC-UV". *Journal of Food Science and Technology Nepal* 9 (2016): 66-73.

36. Ayebare E., *et al*. "Maternal, reproductive and obstetric factors associated with preterm births in Mulago Hospital, Kampala, Uganda: a case control study". *Pan African Medical Journal* 30.1 (2018): 272.

37. Culhane JF., *et al*. "Exposure to chronic stress and ethnic differences in rates of bacterial vaginosis among pregnant women". *American Journal of Obstetrics and Gynecology* 187.5 (2002): 1272-1276.

38. Goldenberg RL., *et al*. "Epidemiology and causes of preterm birth". *The Lancet* 371.9606 (2008): 75-84.

39. Masukume G., *et al*. "Risk factors and birth outcomes of anaemia in early pregnancy in a nulliparous cohort". *PLoS One* 10.4 (2015): e0122729.

40. Hallberg L. "Advantages and disadvantages of an iron-rich diet". *European Journal of Clinical Nutrition* 56.S1 (2002): S12.

41. Hallberg L. "Iron balance in pregnancy. Vitamins and minerals in pregnancy and lactation 16 (1988): 115-127.

42. Englund-Ogge L., *et al*. "Maternal dietary patterns and preterm delivery: results from large prospective cohort study". *British Medical Journal* 348 (2014): g1446.

43. Grieger JA., *et al*. "Preconception dietary patterns in human pregnancies are associated with preterm delivery". *Journal of Nutrition* 144.7 (2014): 1075-1080.

44. Cetin I., *et al*. "Role of micronutrients in the periconceptional period". *Human Reproduction* 16.1 (2010): 80-95.

45. Van den Broek NR., *et al*. "Factors associated with preterm, early preterm and late preterm birth in Malawi". *PLoS One* 9.3 (2014): e90128.

46. Ko TJ., *et al*. "Parental smoking during pregnancy and its association with low birth weight, small for gestational age, and preterm birth offspring: a birth cohort study". *Pediatrics and Neonatology* 55.1 (2014): 20-27.

47. Qiu J., *et al*. "Passive smoking and preterm birth in urban China". *American Journal of Epidemiology* 180.1 (2014): 94-102.

48. Patra J., *et al*. "Dose-response relationship between alcohol consumption before and during pregnancy and the risks of low birth-weight, preterm birth and small for gestational age (SGA)-a systematic review and meta-analyses". *BJOG: An International Journal of Obstetrics and Gynaecology* 118.12 (2011): 1411-1421.

49. Pfinder M., *et al*. "Preterm birth and small for gestational age in relation to alcohol consumption during pregnancy: stronger associations among vulnerable women? Results from two large Western-European studies". *BMC Pregnancy and Childbirth* 13 (2013): 49-49.

50. Parazzini F., *et al*. "Moderate alcohol drinking and risk of preterm birth". *European Journal of Clinical Nutrition* 57.10 (2003): 1345.

51. Abel EL. "Consumption of alcohol during pregnancy: a review of effects on growth and development of offspring". *Human Biology* (1982): 421-453.

52. Okubo H., *et al*. "Maternal total caffeine intake, mainly from Japanese and Chinese tea, during pregnancy was associated with risk of preterm birth: the Osaka Maternal and Child Health Study". *Nutrition Research* 35.4 (2015): 309-316.

53. Vitti FP., *et al*. "Association between Caffeine Consumption in Pregnancy and Low Birth Weight and Preterm Birth in the birth Cohort of Ribeirao Preto". *Revista Brasileira de Ginecologia e Obstetrícia* 40.12 (2018): 749-756.

54. Fredholm BB., *et al*. "Actions of caffeine in the brain with special reference to factors that contribute to its widespread use". *Pharmacological Reviews* 51.1 (1999): 83-133.

55. Browne ML. "Maternal exposure to caffeine and risk of congenital anomalies: a systematic review". *Epidemiology* (2006): 324-331.

56. Takito MY., *et al*. "Physical activity by pregnant women and outcomes for newborns: a systematic review". *Revista de Saúde Pública* 43.6 (2009): 1059-1069.

57. Yates M., *et al*. "EULAR/ERA-EDTA recommendations for the management of ANCA-associated vasculitis". *Annals of the Rheumatic Diseases* 75.9 (2016): 1583-1594.

58. Weir Z., *et al*. "Physical activity in pregnancy: a qualitative study of the beliefs of overweight and obese pregnant women". *BMC Pregnancy and Childbirth* 10.1 (2010): 18.

59. Redshaw M. "Mothers of babies requiring special care: Attitudes and experiences AU - Redshaw, M. E". *Journal of Reproductive and Infant Psychology* 15.2 (1997): 109-120.

60. Henderson J., *et al*. "Impact of preterm birth on maternal well-being and women's perceptions of their baby: a population-based survey". *BMJ Open* 6.10 (2016): e012676.

61. Tolhurst R., *et al*. "I don't want all my babies to go to the grave': perceptions of preterm birth in Southern Malawi". *Midwifery* 24.1 (2008): 83-98.

Volume 16 Issue 1 January 2021
©All rights reserved by Peter Vivian Acire., *et al.*