Consequences of prenatal geophagy on maternal prenatal health, risk of childhood geophagy and child psychomotor development

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Abstract

Objective: To investigate the relationship between prenatal geophagy, maternal prenatal haematological indices, malaria, helminth infections and cognitive and motor development among offspring.

Methods: At least a year after delivery, 552 out of 863 HIV-negative mothers with singleton births who completed a clinical trial comparing the efficacy of sulfadoxine-pyrimethamine and mefloquine during pregnancy in Allada, Benin, responded to a nutrition questionnaire including their geophageous habits during pregnancy. During the clinical trial, helminth infection, malaria, haemoglobin and ferritin concentrations were assessed at first and second antenatal care visits (ANV), and at delivery. After the first ANV, women were administered daily iron and folic acid supplements until three post-delivery. Singleton children were assessed for cognitive function at age one year using the Mullen Scales of Early Learning.

Results: The prevalence of geophagy during pregnancy was 31.9%. Pregnant women reporting geophagy were more likely to be anaemic (adjusted odds ratio, AOR= 1.9, 95% Confidence interval, CI [1.1, 3.4]) at their first ANV if they reported geophagy at the first trimester. Overall, prenatal geophagy was not associated with maternal haematological indices, malaria or helminth infections, but geophagy during the third trimester and throughout pregnancy was associated with poor motor function (AOR= -3.8, 95% CI [-6.9, -0.6]) and increased odds of geophageous behaviour in early childhood, respectively.

Conclusions: Prenatal geophagy is not associated with haematological indices in the presence of micronutrient supplementation. However, it may be associated with poor child motor function and infant geophagy. Geophagy should be screened early in pregnancy.

Keywords: geophagy; pica; anaemia; pregnancy; iron deficiency; child development.

Introduction

Maternal, neonatal and child health has taken centre stage in the policies of several health systems around the world especially in developing countries where maternal and infant mortalities are highest [1]. In Africa, the drive towards improving maternal and child health has been steered by the millennium development goals (MDGs) 4 and 5: to reduce by two thirds, between 1990 and 2015, the under-five mortality rate and within this same period, to reduce by three quarters the maternal mortality ratio, respectively [2]. This agenda is currently being furthered by the Strategic Development Goals to reduce global maternal deaths to 70 per 100,000 live births [3]. Notwithstanding the several interventions aimed at reducing maternal and child morbidity and eventual mortality, and the strides made by these interventions, very little attention has been paid to nutritional habits of pregnant women, particularly, pica practices, that could expose them and their offspring to adverse consequences.

Pica is the persistent craving and consumption of substances deemed non-nutritive by the consumer [4]. Common forms of pica include pagophagy (compulsive consumption of ice or freezer frosts), amylophagy (compulsive consumption of purified starch) and geophagy (compulsive consumption of earth, dirt or clay) [5]. The practice which has existed since the days of Hippocrates (460-370 BC) still persists in many parts of the world [6]. Geophagy in pregnancy has been reported even in some developed countries, mostly among minority groups in the United States [7]. The global prevalence of geophagy remains unknown but a recent meta-analysis estimated the global prevalence of prenatal maternal and postpartum pica to be 27.8% [8]. The Africa region was reported to have the highest prevalence of over 40% [8]. These regional and global estimates however only reflect the very limited studies on the subject and are likely to be an underestimation of the true prevalence.

Considering that geophagy and other forms of pica are common among pregnant women who are among the most vulnerable to environmental exposures, it is essential to understand the health and developmental consequences associated with the practice. The mystery surrounding geophagy in pregnancy is that even after millenniums of persistent practice, very little is understood on the causes and potential consequences on maternal health, immediate birth outcomes and later child health and development. Results from the few published studies on the subject report ambivalent findings with some reporting potential consequences due to mercury poisoning [9], exposure to metals such as cadmium, copper, manganese, arsenic [10, 11], soil-transmitted helminth (STH) infections (*A. lumbricoides*) [12] and reduced haemoglobin and ferritin concentrations [13].

As a secondary data analysis to the *Tovi* study which sought to investigate the impact of prenatal maternal anaemia on early child cognitive development, this paper assesses the relationship between geophagy in pregnancy and maternal anaemia, iron deficiency (ID), malaria and helminth infections, birth outcomes and, in the child, geophagy practices and cognitive and motor development.

Methods

Approximately one year after their children were born, mothers in the *Tovi* study who had [14] singleton births in Allada, Benin, were asked to respond to a Supplementary Nutrition Questionnaire (SNQ) on their eating habits during pregnancy. The SNQ was initially designed to investigate the sources of high blood lead levels observed in some of the children and mothers and the details are explained elsewhere [15]. As part of the SNQ, mothers responded to questions on geophagy practices during pregnancy as well as the nutrition and geophageous behaviour of their children. Mothers were asked about consuming processed clay (*kalaba* or kaolin, both of which are kaolinite soils) or earth during pregnancy, which are three common soil-types consumed by pregnant women in the region. In addition mothers indicated, to the best of their knowledge, which trimester in pregnancy, they practiced geophagy. Women were said to be geophageous if the consumed any of these three soil types during pregnancy. Women were considered to practice *polygeophagy* if they consumed two or more of these soil types during pregnancy.

Mothers enrolled in this retrospective nutritional survey were HIV negative and had participated in a clinical trial during pregnancy, called *Malaria in Pregnancy Preventive Alternative Drugs* (MiPPAD) (NCT00811421), which compared the efficacy of two intermittent preventive treatments for malaria in pregnancy (IPTp). The pregnant women were recruited into the clinical trial if they were at most 28 weeks pregnant, HIV negative and attending antenatal care visit (ANV) for the first time. Inclusion criteria into the trial included no prior intake of iron, folic acid or vitamin B12 supplements during pregnancy. Detailed inclusion and exclusion criteria for the MiPPAD clinical trial have been published elsewhere [16].

At first ANV, sociodemographic and anthropometric data, and gravidity of pregnant women were recorded. Pre-pregnancy body mass index (BMI) in kg/m^2 was calculated from BMI and gestational age at 1st ANV using the technique presented in an earlier publication [17]. At each of the three visits, blood and stool samples were taken for clinical assessments. Venous blood samples were taken for assessment of haemoglobin (Hb) concentration, serum ferritin concentration and plasmodium parasitemia. Stool samples were taken to determine the presence of helminth eggs using the Kato-Katz technique [18]. C-reactive protein (CRP) concentrations were measured to correct for high ferritin concentrations in participants with inflammations.

During the MiPPAD clinical trial, at the first ANV all women were administered anthelmintic if they were in the second trimester of pregnancy following the guidelines of the Beninese Ministry of Health. In addition, throughout pregnancy women were administered daily iron (200 mg oral ferrous sulphate) and folic acid (5 mg daily) supplements until three months after delivery. Women were treated when sick. Iron, folate and medicines for treating illness were provided to pregnant women free of charge. The direct intake of supplements was not monitored.

Anaemia was defined as Hb less than 110 g/l [19]. Helminth infection was defined as the presence of at least one egg of any intestinal helminth per gram of stool. Iron deficiency was defined as serum ferritin concentration less than 12µg/l or serum ferritin between 12µg/l and 70 µg/l when CRP concentration was greater than 5mg/L [20].

Gender, weight and gestational age (using fundal height) of the new-born were determined at birth. Low birth weight (LBW) and preterm birth were defined as less than 2500 g and less than 37 weeks of gestation, respectively. At age one year, cognitive and motor functions of the children were assessed by a trained nurse using the Mullen Scales of Early Learning (MSEL)[21] was adapted for this setting [22]. The MSEL consists of five scales: Gross Motor (GM) scale, Fine Motor (FM) scale, Receptive Language (RL) scale, Expressive Language (EL) scale and Visual Perception (VP) scale. Crude score for each MSEL scale was transformed into normalised scores called the *T*-scores by using a standardised table with the child's chronological age at assessment. The age-standardised *T*-scores of the FM, EL, RL and VP were combined to form the ELC score.

Within three days after the MSEL assessments, a different nurse conducted home visits during which mothers responded to questionnaires on family possessions, the home environment using the Home Observatory Measurement of the Environment (HOME) inventory [23], postnatal depression using Edinburgh Postnatal Depression Scale [24] and maternal postnatal intelligent quotient (IQ) using Raven's Progressive Matrices test [25]. The second nurse was blind to the MSEL results of the child.

Ethical consideration

Informed consent was sought from all women in the presence of a witness at recruitment into the clinical trial. Women provided thumbprints to confirm their agreement to participate in the study if they who could not read and write, after it has been explained to them in a local language. The *Tovi* study was approved by the institutional review boards of the University of Abomey-Calavi in Benin and New York University in USA and the Research Institute for Development's (IRD) Consultative Ethics Committee in France.

Statistical analyses

First we compared and described maternal baseline characteristics during pregnancy and child characteristics at birth between mothers who responded to the SNQ and those who did not respond. We also described the prevalence of geophagy among pregnant women and their offspring. Then we assessed the relationship between mother-child sociodemographic characteristics and geophagy during pregnancy.

Using unconditional logistic regression, we compared the odds of the major maternal outcome variables of interest i.e. anaemia, ID, malaria and helminth infection, at baseline between women who practiced geophagy during the first trimester and those who were not geophageous at the first trimester. Next, since the major maternal outcome variables of interest were assessed repeatedly at different ANVs over the course of pregnancy, mixed effect models were used to explain the effect of geophagy on the proposed outcomes. Specifically, random intercept was applied at the individual level in all models. Then we compared the model with the random slope at gestational age and random intercept at the individual level to the model with the model with only the random intercept using the likelihood ratio (LR) test. Where the LR test showed significant difference between the models, the model with the random slope was used. Individual level predictors included in the model were level of education, pre-pregnancy BMI, maternal gestational age, gravidity, age at first ANV, family possession and maternal IQ.

In assessing the consequences of prenatal maternal geophagy on adverse birth outcomes and child development, unconditional logistic regression models were used. For continuous outcomes, multiple linear regressions were used. Stepwise removal of covariates was used to deselect covariates whose P-values were more than 0.05 in the adjusted model with the exception of ID at the period of follow-up.

All statistical analyses were conducted using Stata IC/14.1 (StataCorp Lp, College station, TX).

Results

Of the 828 eligible mothers-child pairs, 552 (66.7%) responded to the SNQ of the *Tovi* study (Figure 1). Mothers who responded to SNQ had at baseline entry into the clinical trial, lower BMI, lower prevalence of ID, high prevalence of malaria and were more likely to be housewives compared to non-respondents. Child characteristics at birth were similar among respondent and non-respondent mothers (Table 1).

The prevalence of geophagy in pregnancy (i.e. geophagy during at least one trimester) was 31.9%. The majority of geophageous pregnant women preferred processed clay (*kalaba* or kaolin) to earth (Supplementary Table 1). The prevalence of geophagy was highest during second trimester (21.4%). Forty-five (54.2%) of the geophageous pregnant women at first trimester remained geophageous during second trimester. *Polygeophagy* was rare among pregnant women and no pregnant woman consumed all three soil-types. About half of one-year-old children were reported to be geophageous by their mothers, of whom 37.6% were geophageous during pregnancy.

Among pregnant women who practiced geophagy during the second trimester, the proportions of housewives were significantly higher compared to those who were employed (Supplementary Table 2). Pregnant women who practice geophagy during the first trimester were more likely to be anaemic, adjusted odds ratio (AOR) =1.9, 95% confidence interval, CI [1.1, 3.4], and less likely to have malaria, AOR = 0.4, 95% CI [0.2, 0.9] at their first ANV compared to those who did not practice geophagy during the first trimester (Table 2). Geophagy in pregnancy was not associated with maternal haematological indices, malaria or helminth infections during pregnancy in the multilevel analysis (Table 3).

As shown in Table 4, children were more likely to be geophageous at age one year if their mothers had practiced geophagy at any trimester during pregnancy (*P*-value<0.05). Children of mothers who practiced geophagy during the third trimester had 3.8 [95% CI: 0.6, 6.9] lower GM function at age one year compared to those whose mothers did not practice geophagy during the third trimester in the adjusted model (adjusted for gravidity, maternal education, HOME score, prenatal maternal ID at delivery).

Discussion

The findings of this study show that pregnant women who practiced geophagy during the first trimester were more likely to be anaemic at their first ANV compared to those who did not practice geophagy. Our study however does not show any later increased risk of anaemia, or risk of ID, malaria and helminth infection over the course of pregnancy between pregnant women who practiced geophagy and those who did not practice geophagy. The study further reveals that geophagy in pregnancy is associated with increased risk of geophagy in children, and poor child gross motor function (for geophagy in the third trimester).

The prevalence of geophagy during pregnancy in this study population is similar to that reported by Mensah et al [26] among pregnant women in Ghana (31.9%). Although geophagy is thought to be a practice common among people of low socioeconomic status, geophagy was not associated with socioeconomic factors of pregnant women in both the study in Ghana and in our study. Many other studies also found no association between the prevalence of geophagy and sociodemographic factors [12, 27].

The observed association between prenatal maternal geophagy and increased odds of anaemia and was associated with an increased risk of anaemia at the first ANV as shown by some cross-sectional studies [28, 29]. Although higher odds of ID at first ANV was observed among geophageous pregnant women, the association was not statistically significant. On the contrary, geophagy during the first trimester was associated with reduced odds of malaria at first ANV. A study among the same population in Benin showed that a high iron concentration in pregnancy is associated with an increased risk for malaria and plasmodium parasitaemia.[30] This may explain the reduced likelihood of malaria at first ANV among pregnant women who practiced geophagy during the first trimester although adjusting for ID did not change the strength of the association. We did not find an increased risk of anaemia and iron deficiency in any trimester among geophageous pregnant women, similar to what has been reported in a study with similar longitudinal data [12]. The administration of IFA supplements, IPTp and anthelmintic following the first ANV may have reduced the impact that geophagy in itself had on maternal health outcomes. Daily iron supplementation beginning at first ANV did not attenuate the prevalence of geophagy among pregnant women during the second and third trimesters similar to what was found in randomized control trial in children in Zambia [31]. On the contrary, the prevalence of geophagy was highest during the second trimester with 18% of pregnant women who did not practice geophagy during the first trimester, becoming geophageous by the second trimester. In our study population, hookworms were the most prevalent species of soil-transmitted helminths [32]. The most common mode of transmission of hookworms in our population maybe likely to be by cutaneous penetration relative to ingestion and this might explain the lack of association observed between geophagy and helminth infection during pregnancy. In addition, pregnant women in Allada, Benin preferred processed and dried clay (*kalaba* or kaolin) to earth. The processed clay is usually cooked and dried to get rid of moisture hence it is less likely to contain helminth eggs compared to earth.

In terms of birth outcomes and child development, results from our study showed that geophagy, regardless of the trimester, was not associated with preterm birth similar to the findings of a study conducted in Texas [33]. Geophagy at specific trimesters were consistently not associated with increased risk of LBW similar to the results found by some studies that assessed geophagy or pica at only one time during pregnancy [33, 34]. Geophagy at all trimesters of pregnancy was associated with increased risk of geophagy in children. Although the biological mechanism for such an association is unknown, mothers who reported that they practiced geophagy may have been forthcoming reporting about geophagy practice by their children compared to those who concealed the practice. Also, children whose mothers practiced geophagy in the third trimester of pregnancy performed poorer on GM scales compared to those whose mothers did not practice geophagy in this trimester. The biological explanation for this observed relationship is unknown. Even though we have shown in previous research that low prenatal Hb levels is associated with poor GM function of children [14], in the current study, prenatal geophagy was not associated with increased risk of anaemia or ID during pregnancy. The observed mean difference in GM scores is approximately 80% of that observed between at-risk autistic and low-risk 14-month-old children [35]. However, this represents 0.38 of the standard deviation of the population mean GM score and thus unlikely to be clinically significant.

The biological significance of geophagy remains controversial even though the practice of geophagy and other forms of pica during pregnancy appears to be common in sub-Saharan Africa. A recent comprehensive review on pica in pregnancy[36] acknowledges the controversy in the findings from existing published studies. This aforementioned review attributes the controversy to a number of problems including underreporting, inadequate study design (mainly, cross-sectional), and chanced discovery of geophagy by researchers. These problems inhibit the determination of temporality between geophagy and its risk factors or consequences.

To our knowledge, this study is the first to assess the consequences of prenatal maternal geophagy not only on maternal health and birth outcomes but also on child development and geophagy habits using a longitudinal data. Also, the use of multilevel analysis in assessing the association between geophagy and factors of maternal health allowed us to account for the intra-person variability due to the repeated measurements obtained over the course of pregnancy.

Our study is however limited in the retrospective assessment of geophagy in pregnancy which could have led to recall bias in the assessment of exposure among respondents. This also did not allow us to assess the quantity and frequency of soil consumption during the period of assessment as well as the physicochemical properties of the type of soil they consumed. Certain types of geophageous clay soils have been shown to have therapeutic effect particularly on the skin and the gastrointestinal tract due to their adsorptive properties and their ability to regulate the viscosity and flow of mucus in the intestinal tract [37, 38]. Considering the therapeutic properties of some geophageous soils, the ability to geochemically differentiate between *kalaba* or kaolin or earth could have added more information to this study. Also, the absence of data on the frequency of consumption did not permit the investigation of potential dose-response relationship between prenatal geophagy and the maternal and child health outcomes considered in this study. Further, maternal baseline characteristics were similar between mothers who responded to the SNQ and those who did not except for BMI, occupation, malaria and iron deficiency hence we cannot rule out the possibility of non-response bias in this study although it is unlikely that mothers refused participate in the study because of their BMI during their first

ANV. Housewives were however easier to find during follow-up data collection in the field compared to the employed mothers.

Conclusion

The findings of our study suggest that women who practice geophagy in pregnancy during the first trimester of pregnancy are more likely to be anaemic at their first ANV. However, geophagy in pregnancy is not associated with increased risk of malaria, helminth, ID or anaemia over the course of pregnancy. Further, geophagy in pregnancy increases the risk of geophagy in children and may lead to poor motor function of infants. Pregnant women should be informed about the potential consequences of geophagy in pregnancy. Also, health care providers should elucidate maternal geophagy early in pregnancy to prevent potential consequences.

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Table 1. Comparison of first ANV maternal baseline characteristics and infant birth outcomes among respondent and non-respondent mothers

Characteristics	Respondents (n=552)	Non-respondents (n=311)	*P*
Mothers			
Age at 1st ANV (years)[a]	25.8 ± 0.3	25.9 ± 0.2	0.857
Gestational age at 1st ANV (weeks)[a]	22.0 ± 0.2	22.4 ± 0.2	0.145
Prepregnancy BMI (kg/m²)[a]	21.0 ± 3.2	22.0 ± 4.1	<0.001
Gravidity			
Primigravida	100 (18.1)	55 (17.7)	0.874
Multigravida	452 (81.9)	256 (82.3)	
Education			
Primary or more	177 (32.1)	112 (36.0)	0.238
Never schooled	375 (67.9)	199 (64.0)	
Occupation			
Housewives	291 (52.7)	129 (41.5)	0.002
Employed	261 (47.3)	182 (58.5)	
Malaria at 1st ANV			
Negative	456 (82.6)	275 (88.4)	0.023
Positive	96 (17.4)	36 (11.6)	
Anemia at 1st ANV (Hb<110 g/l)			
No anemia	176 (31.9)	102 (32.8)	0.783
Anemia	376 (68.1)	209 (67.2)	
Iron deficiency at 1st ANV			
No iron deficiency	386 (69.9)	190 (61.1)	0.008
Iron deficiency	166 (30.1)	121 (38.9)	
Helminth infection at 1st ANV			
Negative	473 (87.0)	280 (91.2)	0.062
Positive	71 (13.0)	27 (8.8)	
Infants			
Birthweight			
Low (< 2500 g)	51 (10.0)	33 (11.4)	0.542
Normal (≥ 2500 g)	457 (90.0)	256 (88.6)	
Gestational age at birth			
Preterm (<37 weeks)	34 (6.3)	26 (9.0)	0.149
Normal (≥37 weeks)	506 (93.7)	262 (91.0)	
Sex			
Boy	271 (49.1)	143 (46.0)	0.379
Girl	281 (50.9)	168 (54.0)	

Unless otherwise stated, values are presented as number (percentage)

[a] Presented as Mean ± SD

ANV- antenatal care visit; BMI-body mass index

Table 2. Unconditional logistic regression on the relationship between geophagy at first trimester and maternal health outcomes at baseline

	Maternal health outcomes			
	Iron deficiency	Anemia	Malaria	Helminth
	AOR [95% CI]	AOR [95% CI]	AOR [95% CI]	AOR [95% CI]
Geophagy at 1st trimester				
Yes	1.3 [0.8; 2.1]	1.9 [1.1; 3.4]*	0.4 [0.2; 0.9]*	1.0 [0.5; 2.0]
No [Reference)	1	1	1	1

AOR- Adjusted odds ratio; ANV-Antenatal care visit
All models were adjusted for gravidity, pre-pregnancy BMI, maternal IQ, gestational age at ANV1, maternal age, family possession, and maternal education
*$P<0.05$

Table 3. Multilevel models on the consequences of geophagy in pregnancy on maternal health

	Iron deficiency [ID)	Malaria	Anemia	Helminth
	AOR [95% CI][a]	AOR [95% CI][a]	AOR [95% CI][b]	AOR [95% CI][a]
Geophagy in pregnancy				
Yes	1.1 [0.8, 1.6]	0.6 [0.4, 1.0]	1.2 [0.7, 1.8]	0.9 [0.5, 1.6]
No [Reference)	1	1	1	1

AOR- Adjusted odds ratio; CI- Confidence interval

[a] Random intercept at the individual level

[b] Random intercept at the individual level and random slope for gestational age.

All models adjusted for maternal gestational age, level of education, pre-pregnancy body mass index, gravidity, family possession score, age at first ANV, and maternal intelligent quotient.

Table 4. Consequences of geophagy in pregnancy on birth outcomes and infant development

Geophagy in pregnancy	Birth outcomes		Age one year		
	Preterm AOR [95% CI][b]	LBW AOR [95% CI][a]	Geophagy AOR [95% CI][d]	ELC score AMD [95% CI][h]	GM score AMD [95% CI][i]
Geophagy during 1st trimester	1.4 [0.6, 3.6]	1.7 [0.8, 3.7]	0.6 [0.4, 1.0][e]*	-0.1 [-3.3, 3.2]	0.4 [-2.8, 3.7]
Geophagy during 2nd trimester	1.0 [0.4, 2.5]	1.2 [0.6, 2.4][c]	2.8 [1.8, 4.3][f]≠	-0.2 [-3.1, 2.6]	-1.5 [-4.3, 1.4]
Geophagy during 3rd trimester	0.8 [0.3, 2.4]	1.0 [0.4, 2.3]	3.0 [1.8, 5.0][e]≠	-2.0 [-5.2, 1.2]	-3.8 [-6.9, -0.6]*
Geophagy during at least one trimester	0.9 [0.4, 2.1]	1.6 [0.9, 3.1]	1.5 [1.0, 2.2][g]*	-1.1 [-3.6, 1.5]	-1.4 [-3.4, 0.4][j]

AOR- Adjusted odds ratio; CI- Confidence interval; AMD- Adjusted mean difference; LBW- Low birth weight; ELC- Early learning composite; GM- Gross motor; ID – Iron deficiency; BMI - Body mass index

*$P<0.05$; ≠$P<0.001$

Adjusted for [a] gravidity + prenatal ID at time of follow-up, [b] a + family possession score, [c] b + ID at 2nd ANV, [d] pre-pregnancy BMI + maternal IQ + prenatal ID at time of follow-up, [e] d + maternal education, [f] a+d+ malaria at 2nd ANV, [g] a+d+ malaria at 1st ANV, [h] pre-pregnancy BMI + maternal education + maternal occupation + HOME score+ prenatal ID at time of follow-up, [i] gravidity + maternal education + HOME score+ prenatal ID at time of follow-up, [j] i + pre-pregnancy BMI + family possession score

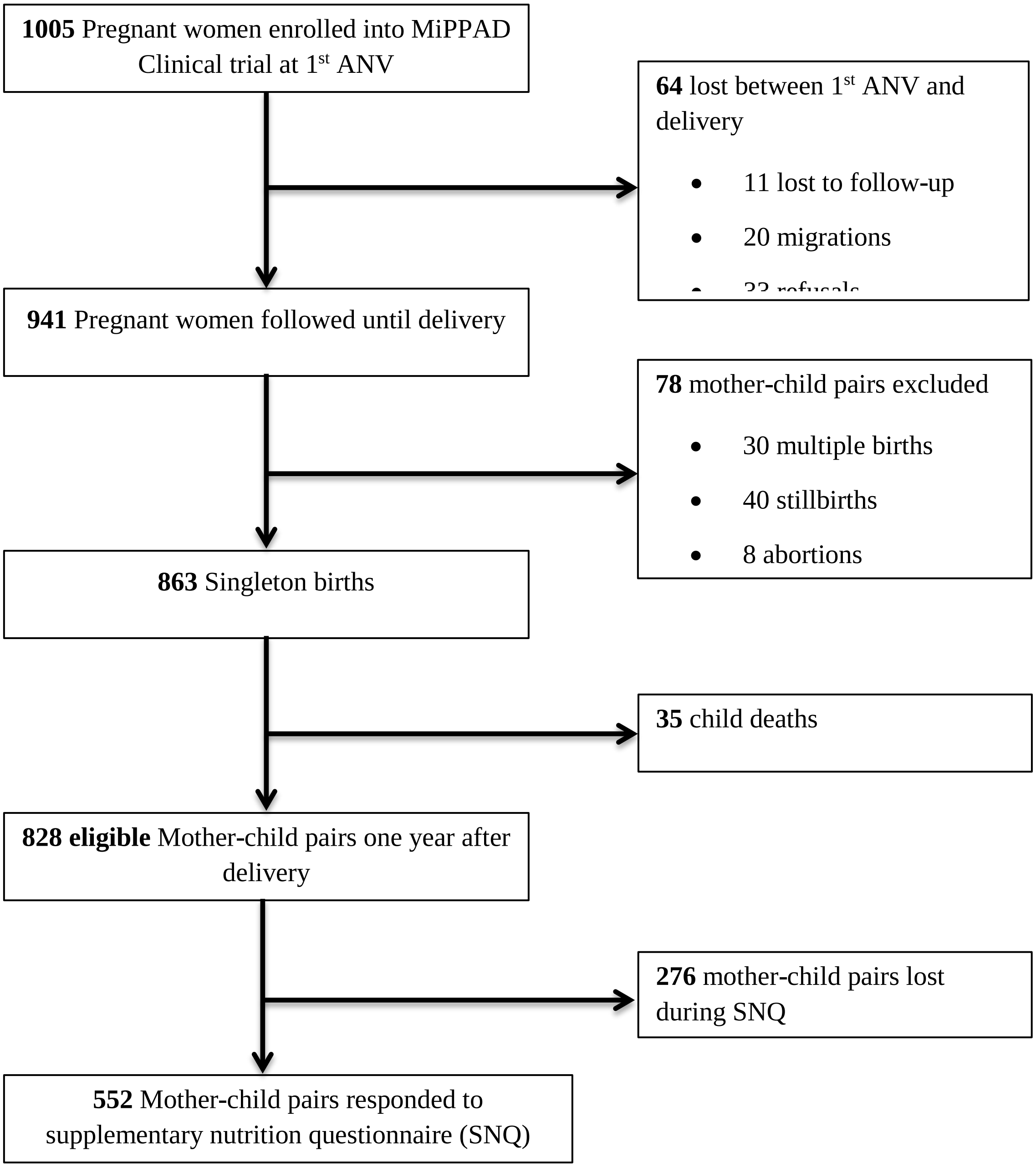

Figure 1. Flowchart of the follow-up of pregnant women and children

Supplementary Table 1. Prevalence of geophagy and soil preference among pregnant women and infants

	N=552 number (%)
Mothers	
Geophagy (either kalaba or kaolin or earth)	
1st trimester	83 (15.0)
2nd trimester	118 (21.4)
3rd trimester	92 (16.7)
Frequency of geophagy	
At least once during pregnancy	176 (31.9)
Never during pregnancy	376 (68.1)
Soil preference during pregnancy	
Kalaba	122 (22.1)
Kaolin	55 (10.0)
Earth	18 (3.3)
Polygeophagy	
Kalaba + kaolin	18 (3.3)
Kalaba + earth	1 (0.2)
Kaolin + earth	0 (0.0)
Kalaba + kaolin + earth	0 (0.0)
Infants	
Geophagous	271 (49.1)
Non-geophagous	281 (50.9)

Supplementary Table 2. Relationship between geophagy in pregnancy and maternal and infant sociodemographic characteristics

	Geophagy at 1st trimester			Geophagy at 2nd trimester			Geophagy at 3rd trimester		
	Yes	No	*P*	Yes	No	*P*	Yes	No	*P*
Age at 1st ANV (years)	26.1 ± 5.3	25.8 ± 5.6	0.636	25.6 ± 5.6	25.9 ± 5.6	0.629	25.6 ± 5.5	25.9 ± 5.6	0.632
Gestational age at 1st ANV (weeks)	21.7 ± 3.9	22.0 ± 3.9	0.389	21.8 ± 4.0	22.0 ± 3.8	0.492	21.7 ± 4.0	22.1 ± 3.8	0.362
Prepregnancy BMI (kg/m²)	21.2 ± 2.9	21.0 ± 3.2	0.649	21.2 ± 3.1	21.0 ± 3.2	0.395	21.1 ± 2.8	21.0 ± 3.3	0.726
Family possession score	5.8 ± 2.9	5.5 ± 2.7	0.415	5.8 ± 2.8	5.5 ± 2.8	0.402	5.7 ± 2.8	5.5 ± 2.8	0.537
RAVEN Score	15.0 ± 3.1	15.3 ± 4.9	0.991	14.4 ± 3.1	15.5 ± 5.0	0.094	14.4 ± 3.3	15.5 ± 4.9	0.075
EPDS Score	7.4 ± 4.0	8.1 ± 4.1	0.200	8.4 ± 4.0	7.9 ± 4.1	0.199	8.6 ± 4.1	7.9 ± 4.0	0.063
HOME Score	26.9 ± 2.1	26.9 ± 2.3	0.558	27.0 ± 2.1	26.8 ± 2.4	0.654	27.1 ± 2.1	26.8 ± 2.3	0.303
Gravidity, n (%)									
Primigravida	12 (12.0)	88 (88.0)	0.348	23 (23.0)	77 (77.0)	0.662	18 (18.0)	82 (82.0)	0.693
Multigravida	71 (15.7)	381 (84.3)		95 (21.0)	357 (79.0)		74 (16.4)	378 (83.6)	
Education, n (%)									
Primary or more	25 (14.1)	152 (85.9)	0.680	50 (28.3)	127 (71.8)	0.007	37 (20.9)	140 (79.1)	0.066
Never schooled	58 (15.5)	317 (84.5)		68 (18.1)	307 (81.9)		55 (14.7)	320 (85.3)	
Occupation, n (%)									
Housewives	35 (13.4)	226 (86.6)	0.311	67 (25.7)	194 (74.3)	0.020	46 (17.6)	215 (82.4)	0.567
Employed	48 (16.5)	243 (83.5)		51 (17.5)	240 (82.5)		46 (15.8)	245 (84.2)	

Unless otherwise stated, values are presented as Mean ± SD

[a] Presented as number (percentage)

ANV- antenatal care visit; BMI-body mass index; HOME- home observation measurement of the environment; EPDS- Edinburgh postnatal depression scale