ORIGINAL ARTICLE

Pica and associated factors among pregnant women attending antenatal clinic at Chelstone Level One Hospital and Mtendere clinic, Lusaka District, Zambia

Thelma Ngoma,[1] Pamela A. Marinda,[2] Irene Ogada,[3] Rosaline Sinkala,[1] Jimmy Hangoma[4]

[1]*Department of Nutrition and Dietetics, School of Health Sciences, Levy Mwanawasa Medical University.*
[2]*Department of Food Science and Nutrition, School of Agricultural Sciences, University of Zambia.*
[3]*Department of Applied Human Nutrition, Mount Saint Vincent University, Canada.*
[4]*Department of Pharmacy, School of Health Sciences, Levy Mwanawasa Medical University*

ABSTRACT

Background: Pica, the consumption of non-food substances during pregnancy, remains a poorly addressed maternal health concern in Zambia. This study aimed to determine the prevalence of pica and identify associated factors among pregnant women attending antenatal care at Chelstone Level One Hospital and Mtendere Clinic in Lusaka District.

Methods: A descriptive cross-sectional study was conducted among 372 pregnant women using interviewer-administered structured questionnaires. Participants were selected using stratified and simple random sampling. Data were analysed using SPSS version 23. Descriptive statistics summarized demographic and obstetric characteristics. Chi-square tests and logistic regression were used to determine associations between pica and socio-demographic, obstetric, and nutritional variables. A p-value of <0.05 was considered statistically significant.

Results: The prevalence of pica was 38.2%, with soil (84.5%) being the most consumed non-food item. Common reasons for practicing pica included cravings (62%) and sensory appeal (16.9%). Significant associations were found between pica and education level, religious affiliation, cultural beliefs, history of pica, and pica practice among family or friends ($p < 0.05$). There was no significant association between pica and mid-upper arm circumference or haemoglobin levels. Logistic regression identified history of pica as a significant predictor of current pica practice (OR = 0.169; 95% CI: 0.100–0.286).

Conclusion: Pica remains prevalent among pregnant women in Lusaka District, driven by behavioural and cultural factors. Routine screening for pica and targeted education during antenatal care are recommended to mitigate potential health risks for both mother and child.

INTRODUCTION

Food choice in pregnancy is important as it affects both the pregnant woman and the outcome of

Corresponding author:
Thelma Ngoma,
Department of Nutrition and Dietetics, School of Health Sciences, Levy Mwanawasa Medical University, P.O Box 33991, Chainama Area, Lusaka, Zambia. Email: thelmangoma@yahoo.com

Keywords: Chronic Pain, Dentist, Ergonomics, Musculoskeletal disorders, Occupational Health

This article is available online at: http://www.mjz.co.zm, http://ajol.info/index.php/mjz, doi: https://doi.org/10.55320/mjz.51.4.738

The Medical Journal of Zambia, ISSN 0047-651X, is published by the Zambia Medical Association

© This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

pregnancy. Food choices during pregnancy are influenced by smell, enhanced perception of aromas, nausea, and other gastric disturbances.[1] Several hypotheses proposing functional as well as evolutionary links between pregnancy-related changes and visceral appetite changes have been suggested.[2] These appetite changes lead to cravings resulting in the ingestion of non-food materials such as clay, chalk, ice, starch, and other materials. The consumption of non-food materials among expectant women is an old practice and is called pica.[3]

Many factors proposed in the aetiology of pica include cultural expectations, hunger, age, gender, religion, dyspepsia, gastrointestinal distress, micronutrient deficiencies, and protection against toxins and pathogens.[4] For most of the factors implicated in the aetiology of pica practice, no direct causality has been established.[4] However, several population-based studies have found that low micronutrient levels such as calcium and iron are factors implicated in the aetiology of pica.[4,5]

Pica is a worldwide problem that has been studied by many scholars.[6, 7] Despite this, its prevalence in most communities has been difficult to establish due to reluctance of patients to admit abnormal ingestion and/or craving and also due to reluctance on the part of health workers.[4] Several studies have detailed the prevalence of pica among pregnant women, though estimates have been varied across studies and populations. The practice of pica is most prevalent in Africa (44.8%) compared with elsewhere in the world.[5]

Pica is associated with both positive and negative health consequences, such as micronutrient deficiencies especially among pregnant women.[8, 9, 10] Available evidence indicates that pica was significantly associated with low Hb levels and this association was more among those practicing Geophagia.[6] Other possible risks of pica include haematological and gastrointestinal disorders and interference with nutrient ingestion and absorption.[11, 12]

In Zambia, the story is no different from other African countries. Despite antenatal care (ANC) guidelines on pica, it is still practiced among pregnant women. According to Shinondo and Mwikuma[13] 31.8% of pregnant women in Lusaka practiced pica. Several studies conducted in African countries have shown that the practice of pica is rife among pregnant women.[14, 15] Therefore this study therefore sought to establish the prevalence of pica and associated factors among pregnant women attending antenatal care at Chelstone Level one Hospital and Mtendere Clinic, in Lusaka District.

METHODS

Study Design and Setting

This was a cross-sectional study conducted in Lusaka the capital city of Zambia at Chelstone Level one hospital and Mtendere Clinic. The two facilities are the largest health facilities in Chelstone sub-district and admits pregnant women from diverse areas across the sub-district. Both health facilities offer antenatal services to over 50% of the sub-district population.[16] The study population included all pregnant women who attended routine Antenatal care (ANC) at the two study sites as pica is practiced across all trimesters during pregnancy. Data was collected by the researcher (a registered nutritionist) and four research assistants (Qualified Nutrition Technologists). Research assistants were trained on procedures and methods of data collection prior to commencement of data collection by the researcher.

Study population, sample size and sampling procedure

The sample size was obtained using the statistical Fisher's formula[5] and adjusted for attrition at 10%. Stratified and simple random sampling techniques were used to recruit the pregnant women into the study until the sample size of 372 was gotten. Eligible participants included all pregnant women within the reproductive age group who were healthy and had no chronic medical condition or any complication related to the pregnancy. Participants

who declined to participate were not included in the study. A structured questionnaire was administered in Nyanja by trained research assistants. The questionnaire used in the study was developed for this study. To ensure the validity and reliability of the data collection tools, the study instruments were pre-tested on pregnant women attending antenatal clinic at Kalingalinga Clinic within the sub-district. After the pre-test, the data collection tools were reviewed and modified accordingly. Data collected included demographic, socio-economic characteristics and obstetric history of participants. Potential confounders (e.g., nutritional education exposure) were controlled for at the study design stage, through randomization.

Statistical analysis

Data analysis was performed using SPSS version 23. Descriptive statistics such as frequencies, means, and percentages were used to describe the study population in terms of demographic, socio-economic, and obstetric characteristics. Inferential statistics included were Test of significance (using Pearson's Chi-Square and Fisher's Exact Test) and Association (using Logistic Regression Model) to examine associations between pica practice (dependent variable) and:

- Socio-demographic characteristics (age, education level, marital status, employment Status, household income level, religious affiliation and place of residence)
- Obstetric history and pica practice (parity, current trimester of pregnancy, history of pica practice, culture and pica practice among family and friends.
- Nutrition status (MUAC)
- Haemoglobin level

Statistical significance was set as p-value < 0.05 at 95% confidence interval.

RESULTS

A total of 372 pregnant women participated in this study. The age range of the participants was between 15-48 years with a mean age of 26.5 (± 4.8). Most of the participants were married (81.2%), multi gravida (70.2%), unemployed (67.7%), religiously affiliated (97%) and with secondary level education (53%). Majority of the participants (65.3%) were in the income bracket of K1001-K3000 per month, residing in high density areas (Table 1).

Table 1. Demographic and Socio-economic characteristics of respondents

Variable	Frequency	Percentage (%)
Age Group (years)		
Mean Age = 26.5 (± 4.8) years		
15-25	124	33.3
26-35	181	48.7
Above 35	67	18.0
Education Status		
No education	26	7
Primary	116	31.2
Secondary	197	53
Tertiary	33	8.9
Marital Status		
Single	59	15.9
Married	302	81.2
Widow	8	2.2
Divorced	3	0.8
Employment Status		
Employed	120	32.3
Unemployed	252	67.7
Household income level		
< K1000	53	14.2
Between K1001-K3000	243	65.3
Between K3001-K5000	45	12.1
> K5001	31	8.3
Religious Affiliation		
Affiliated	361	97
Not affiliated	11	3
Place of residence		
low density	9	2.4
medium density	61	16.4
High density	302	81.2

Table 2 shows that of the 372 participants interviewed, 142 indicated that they practiced pica, representing 38.2% of the study population. The most ingested non-food substances by these pregnant women were soil (84.5%) and ice (12%). When asked to estimate the amount of pica substances that they consumed, 66.2% (n=94) pregnant women revealed that they consumed unknown quantities per day as highlighted in table 2. Reasons ascribed for the practice of pica by study participants included cravings (62%,), sensory reasons (smell, taste, smell) of the non-food item (16.9%), to reduce nausea and vomiting (15.5%) and others (5.6%). Nearly half (45.1%) of the women ate soil three or more times a day. Noteworthy, 47.2% of the pregnant women practicing pica reported that they felt depressed when they did not consume the non-food item.

Table 2. Practices of pica among pregnant women

Variable	N=372 Frequency	Percentage (%)
Practicing pica		
Yes	142	38.2
No	230	61.8
Pica substances consumed		
Soil	120	84.5
Charcoal	5	3.5
Ice	17	12
Frequency of consuming pica		
Once daily	64	45.1
2 -3 times daily	50	35.2
More than 3 times	18	12.7
More than 4 times	10	7
Quantity consumed per day		
One teaspoon	20	14.1
One tablespoon	12	8.5
> a tablespoon	16	11.2
Unknown quantity	94	66.2
Reasons for Practicing Pica		
Cravings	88	62
Cravings		
Sensory reasons (texture, taste, smell)	24	16.9
Reduce Nausea and vomiting	22	15.5
Copy other women	3	2.1
No reason	2	1.4
Cultural norm	1	0.7
Loneliness and lack of attention	1	0.7
Hunger	1	0.7
Perceived effects of not eating pica		
Feels depressed	67	47.2
Feels sick	40	28.2
Nothing happens	31	21.8
Feels Hungry	2	1.4
Other	2	1.4

Table 3 shows that 29.8% (n=111) of the participants were primigravida, (in their first pregnancy), while 70.2% (n=261) of the participants where multiparous women. The results also indicated that majority of the participants were in their 2nd trimester (57.3%; n=213) and was closely followed by participants in their 3rd trimester (n=130; 34.9%). About 68.3% (n=254) of participants had no history of pica practice. Out of the 118 participants that had a history of pica, 62.7% (n=74) of the participants practiced pica during their previous pregnancy, while 33.9% (n=40) and 3.4% (n=4) of the participants practiced pica during adolescence and childhood respectively. Results revealed that out of those that practiced pica, 55.6% (n=79) of the participants, started practicing pica in the first trimester, while 30.3% (n=43) of the participants started practicing pica in their second trimester and 14.1% (n=20) of the participants started practicing pica in their third trimester.

Table 3. Obstetric History of pregnant women

Variable	Frequency	Percentage
Parity		
Primigravida	111	29.8
Multigravida	261	70.2
Current trimester of pregnancy		
First trimester	29	7.8
Second trimester	213	57.3
Third trimester	130	34.9
History of pica practice		
Yes	118	31.7
No	254	68.3
Period of previous pica practice (n=118)		
Childhood	4	3.4
Adolescence	40	33.9
Previous Pregnancy	74	62.7
Onset of pica during current pregnancy (n=142)		
First trimester	79	
Second trimester	43	
Third trimester	20	
Pica practice among family and friends		
Yes	234	62.9
No	138	37.1

Table 4 shows that the factors associated with the practice of pica include education, culture, history of pica, religious affiliation and pica practice among family or friends (P = <0.05).

Table 4. Factors associated with Pica among pregnant women

Characteristic	Yes (n=142) n (%)	No (n=230) n (%)	Degrees of Freedom	Chi-square	P value
Education			1	0.034	0.105
No education	15 (4)	11 (3)			
With education	142 (34.1)	219 (58.9)			
Affiliation to any religious group			1	0.017	0.018
Affiliated	134 (36)	227 (61)			
Not Affiliated	8 (2.2)	3 (0.8)			
History of pica practice			1	<0.001	0.000
Yes	74 (20.3)	36 (9.9)			
No	68 (18.7)	186 (51.1)			
Culture			1	0.027	0.002
Yes	5 (1.4)	1 (0.3)			
No	136 (38.1)	215 (60.2)			
Pica practice among family or friends			1	0.039	0.005
Yes	103 (72.5)	148 (64.3)			
No	39 (27.5)	82 (35.7)			
MUAC			1	0.613	0.736
At risk of malnutrition (<23cm)	13 (3.5)	16 (4.3)			
Normal (23cm - 32cm)	124 (33.3)	16 (55.1)			
Obese (>33cm)	5 (1.3)	9 (2.4)			
Haemoglobin level			1	0.613	0.736
Severely anaemic (<7.0g/dl)	0 (0)	1 (0.3)			
Moderately anaemic (7.0 - 9.9g/dl)	23 (6.2)	42 (11.3)			
Mildly anaemic (10.0-10.9g/dl)	84 (22.6)	115 (30.9)			
Normal (>11g/dl)	35 (9.4)	72 (19.4)			

Table 5 shows the mean MUAC measurement was 26.8 cm. Majority of the participants [88.4% (n=329)] had MUAC measurement between ≥23.0 - 32.0cm signifying normal nutritional status. However, 7.8% (n=29) of the study women had MUAC measurement of <23.0 cm (at risk of malnutrition), and 3.8% (n=14) had MUAC measurement above 33cm. Table 5 further shows the mean Hb levels for the pregnant women who participated in the study was 11.5 g/dl. Minimum Hb level was 7.8g/dl while maximum Hb level was 15.9g/dl. The results indicate that 17.5% (n=65) were moderately anaemic (7.0-9.9 g/dl), 53.5% (n=199) had Hb level (10.0-10.9 g/dl) categorized as mildly anaemic Hb level during pregnancy (WHO, 2006), and 28.8% (n=107) had Hb levels >11.0g/dl categorized as normal Hb levels.

Table 5. Nutrition status (MUAC and Haemoglobin Levels)

MUAC	**Frequency (n)**	**Percentage (%)**
<23.0 cm (at risk of malnutrition)	29	7.4
=23.0 -32.0cm (normal nutritional status)	329	88.4
above 33cm (at risk of obesity)	14	3.8
Haemoglobin Level	**Frequency (n)**	**Percentage (%)**
<7.0 g/dl severely anaemic	1	0.3
7.0-9.9 g/dl moderately anaemic	65	17.5
10.0-10.9 g/dl mildly anaemic	199	53.5
>11 normal	107	28.8

Table 6 shows the results of binary logistic regression analysis of the data. The full logistic regression model containing all the five predictors was statistically significant, X2 = 63.039, df =5, N= 372, p<.000 indicating that the independent variables fit very well in the predictor model making it a good predictor model for predicting pica practice. The model classified correctly 55% of the respondents who were practicing pica and 84.7% of those who were not practicing pica, for an overall classification success rate of 72.8%. Confounders where properly measured and included as independent variables (predictors) in the model. History of pica was statistically significant (p<0.001). The odds of practicing pica were significantly lower for those who had history of pica compared to those without a history of pica practice (OR=.0.169; CI; 0.100 – 0.286). Therefore, the logistic regression model showed that history of pica was a predictor of pica practice among pregnant women.

Table 6. Predictors of pica

Variable	**df**	**p-value**	**OR**	**95% CI**	
				Lower	Upper
Education	1	0.341	1.602	0.607	4.230
Religious affiliation	1	0.133	3.107	0.708	13.642
History of pica	1	0.000	0.169	0.100	0.286
Culture	1	0.308	0.296	0.029	3.074
Pica practice among family and friends	1	0.690	0.901	0.540	1.504

DISCUSSION

Demographic and Socio-economic Characteristics

Pica during pregnancy can impact the health of a mother and her baby with a potential to cause serious harm.[11] Adverse effects of pica are associated with metabolic, endocrine, psychological and nutritional changes that result in negative effects for the woman and her foetus, including high prevalence of abortions, low birth weight, obstetric complications and postpartum depression.[17, 18] Despite this, pica practice remains a common practice among expectant mothers.[19] The age range of 15 – 48 years shows that the habit is considered acceptable for most pregnant women and cuts across various age groups. More than half of the participants had attained secondary education, and education was associated with the practice of pica. This is

indicative that education level was associated with the practice of pica (Table 1). It is likely that women with education were literate and understood some of the health dangers associated with the practice of pica. Studies have shown an association between health practices and education level.[7, 12, 14, 20] Further, Pica was also more common among multiparous women with history of pica as observed in the study (Table 3), showing the past pica practice is associated with pica practice in subsequent pregnancies.

Prevalence of Pica Practice and Pica Items Consumed

The study reported that pica practice is common among pregnant women. The prevalence of pica among pregnant women is like earlier studies carried out in Lusaka, Zambia.[13] Shinondo and Mwikuma reported pica prevalence to be 31.8% among pregnant women in Lusaka; these findings are similar (38.2%) to this study (Table 2). The prevalence of pica in this study is relatively comparable to other studies conducted in African countries such as Ghana at 47.5%, South Africa at 54.0% and Nigeria at 38.9%.[6, 17, 21] This variation may be attributed to methodological considerations in the various studies as well as regional variations. The results of the present study revealed that soil (84.6%) was the most consumed and favoured non-food substance that is consumed by pregnant women. This agrees with findings from other studies that soil is the most consumed non-food substance during pregnancy.[6, 17]

In a similar study Boadu[6] reported that the ingestion of soil and ice were high among the pregnant women, with soil (58.44%) being the common pica item among the pregnant women followed by ice (20.45%). These study findings on types of substances consumed, likely shows that most women consume non-food substances that are readily available and the ones they can easily access. According to Al Nasser and Alsaad,[14] the eating of earth materials such as clay, soil, small stones, and gravel results in complications most commonly affecting intestines and the bowel. These include constipation, obstruction due to indigestible mass formed, cramping & pain, hypokalaemia, and nutritional deficiencies. Geophagia material can also cause perforation from sharp objects like gravel and can be a source of infectious agents such as helminths and lead poisoning.[14] Pagophagia which is the ingestion of ice has negative effects which include decreased absorption of nutrients in the gut, and during early pregnancy, this type of pica is also suggested to cause iron deficiency, tooth decay & tooth sensitivity.[14, 22]

Several complications resulting from pica practice affecting both mother and child have been reported in many research findings.[19, 22] Case reports of intrauterine toxicity and lead poisoning resulting in long term neurological disabilities in infants due to maternal pica have been reported. Geophagia has been associated with some consequences which include interference in the absorption of some mineral nutrients like zinc & iron, maternal & foetal anaemia, childhood motor function delay, digestive problems, helminthic infestations, preeclampsia and increased infant deaths.[22, 23] Another study carried out by Agarwal[24] on pica, suggested that pica is often a cause of malnutrition in most parts of the world where it is practiced as micronutrient deficiencies were common in pica cases.

Reasons for Pica Practice

Cravings was the most common reason for consumption of non-food items. This is consistent with other studies in both developed and developing countries.[18, 25] Some participants reported consuming non-food items due to sensory reasons such as taste, smell and texture. The reason for this may be the heightened sensitivity to smell and texture during pregnancy, when women may have a greater inclination towards pica during this period and commonly feel the need to satisfy the craving or sensory needs. Though majority of the women had no cultural reasons for the practice, influences from the participants' friends, direct family members or community members posed as contributing factors in the manifestation of this practice (OR=0.296; 0.029 - 3.074).

Pica and Associated Factors

Also observed in this study is the significant association between history of pica (OR=.0.169; CI; 0.100 – 0.286) and pica practice (Table 4). This was also the findings of Aminu where pica was more common among women that had personal or family history in pica exposed communities in Nigeria. This is even more compounded by cultural and community acceptance of pica which is considered as a sign of pregnancy and not consuming soil during pregnancy is regarded as an unusual behaviour.[26] This finding further supports the observation made by Simpson[18] that a family history of pica and its presence during childhood is a risk factor for pica in pregnancy.

The findings of this study showed no association between pica practice and nutritional status, this could probably be attributed to the fact that MUAC measurement does not specify the exact micronutrient deficiencies of a pregnant woman which might be linked with the pica practice.[27] Additionally, pica was not significantly associated with Hb levels which is in agreement with Nakiyemba *et al*[28] who observed that there was no association between Hb and pica. However, other studies reported contrasting findings including the meta-analysis by Miao *et al*[29] which independently reported that pregnant individuals practicing pica were 1.92 times more likely to have significantly lower haemoglobin levels compared with individuals who did not practice Pica. Fawcett *et al*[30] in a meta-analysis further found that Pica was "a marker for micronutrient deficiencies across several populations (e.g., children, adults and individuals who were pregnant)". However, they noted that the direction of the relationship between pica and haemoglobin level remains unclear.[30]

Implications of Findings on ANC and Maternal Health Policy

The identification of high pica prevalence in pregnant women underscores the critical need to integrate pica assessment into routine antenatal care. This requires a coordinated response from both healthcare providers and policymakers, including screening protocols, provider training, public education, and continued research. Addressing pica comprehensively can reduce maternal and foetal health risks, improve nutritional outcomes, and enhance the overall quality of prenatal care.

Limitations of the study

The study was conducted in health facilities where study participants received health and nutrition education thus could have been exposed to information on risks of pica. In addition, data collection relied on a self-report by study participants on their practice of pica. These two factors could have resulted in participants not reporting their actual practice.

CONCLUSION

Pregnant women are a vulnerable group with higher nutritional demands for their health and well-being as well as that of their concept. Physiological and psychological changes during pregnancy alter a lot of things resulting in many pregnant women indulging in the consumption of non-food substances. The practice of pica among pregnant women is compounded by sociocultural influences that tend to encourage the consumption of these substances. This has been observed not just in Zambia but in other countries where people are unaware of the health implications of pica practice. The prevalence of pica practice among this population accentuates the need to raise questions about the presence of pica practice routinely in antenatal care clinics. Understanding that pica practice is an important part of comprehensive care and noting it in medical records may give health care providers an opportunity to assess and intervene. We recommend the inclusion of pica assessment and education during antenatal care and within communities among women of reproductive age.

The findings from this study point to several critical implications for future research. There is a need for future research on pica among pregnant women to move beyond prevalence, to examine causality, progression, health impacts, and intervention effectiveness. Longitudinal and interventional studies are especially critical to understand the

temporal dynamics of pica and to design strategies that improve maternal and foetal health outcomes. Interdisciplinary approaches, combining medical, nutritional, behavioural, and cultural perspectives, will be essential to generate actionable insights.

DECLARATIONS

Ethical approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Levy Mwanawasa Medical University Research Ethics committee (LMMUREC 0006/20) at Levy Mwanawasa Medical University. Written permission from the District Director of Health and the Senior Medical Superintendent of Chelstone Level one Hospital and Mtendere Clinic was also sought. We used the STROBE-nut checklist when writing our report. Verbal as well as written voluntary informed consent from each participant was obtained. For minors and illiterate participants, written consent was obtained from parents or legal guardians.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding:

The current research is academic research and all expenses are self-financing.

Author Contribution

Thelma Ngoma conceptualized and designed the study, prepared the initial draft of the manuscript. Pamela A. Marinda assisted with data analysis. Irene Ogada, Rosaline Sinkala and Jimmy Hangoma reviewed and participated in the writing of the manuscript. The final version has been read and approved by all authors.

Acknowledgement:

We acknowledge the contributions of Ministry of Higher Education, Science and Technology. Cooperation of the staff in selected of health facilities is highly recognized. We would like to thank the laboratory experts and other colleagues at Chelstone level one Hospital and Mtendere Clinic who have contributed to this research. We are sincerely grateful to all the participants who made this study possible.

REFERENCES

1. Mahan LK, Raymond JL. Krause's food and the nutritional care process. 14th ed. St. Louis (MO): Elsevier; 2017.
2. McKerracher L, Collard M, Henrich J. Food aversions and cravings during pregnancy on Yasawa Island, Fiji. *Hum Nat*. 2016 Sep;27(3):296–315.
3. Young SL. Pica in pregnancy: new ideas about an old condition. *Annu Rev Nutr.* 2010 Jul;30(1):403–22.
4. Young SL. Craving earth: understanding pica: the urge to eat clay, starch, ice, and chalk. New York: Columbia University Press; 2012. 246 p.
5. Jung SH. Stratified Fisher's exact test and its sample size calculation. *Biom J.* 2014 Jan 7; 56:129–40.
6. Boadu I, Mensah FO, Dadson JK. Prevalence of pica behaviour among pregnant women in the Bibiani-Anhwiaso Bekwai district in the Western Region of Ghana. 2015;2(5):5.
7. Konlan KD, Abdulai JA, Konlan KD, Amoah RM, Doat A. Practices of pica among pregnant women in a tertiary healthcare facility in Ghana. *Nurs Open*. 2020 Jan 28;7(3):783–92.
8. Sackey J, Zhang FF, Rogers B, Aryeetey R, Wanke C. Implementation of the nutrition assessment, counselling and support program is not associated with body mass index among people living with HIV in Accra, Ghana. *AIDS Care*. 2018 May;30(5):586–90.
9. Sadeghzadeh M, Khoshnevisasl P, Sadeghzadeh S. The relation between pica and iron deficiency in children in Zanjan, Islamic

Republic of Iran: a case-control study. *East Mediterr Health J*. 2017 Jun 1;23(6):404–7.
10. Kariuki L. Pica practices, food cravings and aversions among pregnant women in Kenya. 2016;10.
11. Galali Y. Study the prevalence, characteristics of mothers, and associated risk factors of pica eating among pregnant women: a cross-sectional study. *Cihan Univ-Erbil Sci J*. 2021 May 22;4:19–24.
12. Anthonia PA. Pica practice and associated factors among pregnant women receiving antenatal care in Obio Cottage Hospital, Port Harcourt, Rivers State. 2019;12.
13. Shinondo CJ, Mwikuma G. Geophagy as a risk factor for helminth infections in pregnant women in Lusaka, Zambia [Internet]. 2009 [cited 2020 Jan 8]. Available from: https://www.researchgate.net/publication/272470947
14. Al Nasser Y, Alsaad AJ. Pica [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 [cited 2020 May 7]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK532242/
15. Agomuo EN, Amadi PU, Adumekwe C. Gestational geophagia affects nephrocardiac integrity, ATP-driven proton pumps, the renin–angiotensin–aldosterone system, and F2-isoprostane status. *Med Sci*. 2019 Feb;7(2):13.
16. LDHO. District & sub district monthly data analysis November 2018.pptx. 2019.
17. Aminu MB, Mohammed A, Muhammed BA, Abdulrazak T, Chinedu A. Prevalence of pica among pregnant women attending antenatal clinic in a tertiary facility in Nigeria. *Ann Afr Med Res* [Internet]. 2019 [cited 2020 May 7];2(2). Available from: https://aamronline.org/index.php/aamr/article/view/89
18. Simpson E, Mull JD, Longley E, East J. Pica during pregnancy in low-income women born in Mexico. *West J Med*. 2000 Jul;173(1):20–4.
19. Rose EA, Porcerelli JH, Neale AV. Pica: common but commonly missed. 2000;7.
20. Ogallo OI. Prevalence of pica practices among pregnant women attending antenatal care clinic at PCEA, Kikuyu Hospital [research report]. Nairobi: University of Nairobi; 2008.
21. Macheka LR, Olowoyo JO, Matsela L, Khine AA. Prevalence of geophagia and its contributing factors among pregnant women at Dr. George Mukhari Academic Hospital, Pretoria. *Afr Health Sci*. 2017 Mar 7;16(4):972.
22. Tisdale JD. Pregnancy and lactation. In: Heimburger DC, Ard JD, editors. Handbook of clinical nutrition. 4th ed. Mosby; 2006 [cited 2022 Feb 14]. p. 138–52. Available from: https://www.sciencedirect.com/science/article/pii/B9780323039529500106
23. Epler KE, Pierce A, Rappaport VJ. Pica in pregnancy: an unusual presentation. *Obstet Gynecol*. 2017 Dec;130(6):1377–9.
24. Agarwal A. Pica: an enigma of malnutrition. *J Nutr Disord Ther*. 2017;7(2):1–2.
25. Chung EO, Mattah B, Hickey MD, Salmen CR, Milner EM, Bukusi EA, et al. Characteristics of pica behaviour among mothers around Lake Victoria, Kenya: a cross-sectional study. *Int J Environ Res Public Health*. 2019 Jul 14;16(14):2510.
26. Njiru H, Elchalal U, Paltiel O. Geophagy during pregnancy in Africa: a literature review. *Obstet Gynecol Surv*. 2011;66(7):452–9.
27. Ververs MT, Antierens A, Sackl A, Staderini N, Captier V. Which anthropometric indicators identify a pregnant woman as acutely malnourished and predict adverse birth outcomes in the humanitarian context? *PLoS Curr* [Internet]. 2013 Jun 7 [cited 2019 Oct 18];5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3682760/
28. Nakiyemba O, Obore S, Musaba M, Wandabwa J, Kiondo P. Covariates of pica among pregnant women attending antenatal care at Kawempe Hospital, Kampala, Uganda: a cross-sectional study. *Am J Trop Med Hyg*. 2021 Oct 6;105(4):909–14.

29. Miao D, Young SL, Golden CD. A meta-analysis of pica and micronutrient status. *Am J Hum Biol*. 2015 Feb;27(1):84–93.
30. Fawcett EJ, Fawcett JM, Mazmanian D. A meta-analysis of the worldwide prevalence of pica during pregnancy and the postpartum period. *Int J Gynecol Obstet*. 2016 Jun;133(3):277–83.
31. Lachat C, Hawwash D, Ocké MC, Berg C, Forsum E, Hörnell A, et al. Strengthening the reporting of observational studies in epidemiology-nutritional epidemiology (STROBE-nut) [Internet]. [cited 2023 Sep 4]. Available from: https://www.goodreports.org/reporting-checklists/strobe-nut/