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Research Article

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Prevalence and Predictors of Geophagy among Adolescent Girls in Likuyani District of Kakamega County

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Abstract

Geophagy is the regular and deliberate eating of soil by humans. Geophagy is a widespread practice in western Kenya. Geophagy significantly increases the risk of infestation with *Ascaris*, impair the absorption of micronutrients and cause micronutrient deficiency, particularly iron. It is estimated that approximately half of adolescent girls living in sub-Saharan Africa are anemic. Adverse effects of anemia range from severe morbidity to decreased physical work capacity to deficits in cognitive development and potentially school performance. The relationship between geophagy with iron status and anaemia is still obscure, it has not been clearly elucidated whether it is geophagy that causes iron deficiency, or it is iron deficiency that causes geophagy. The objective of this study was to determine the prevalence and predictors of geophagy among adolescent girls.

The study was done in secondary boarding schools in Likuyani District of Kakamega County, Kenya. A cross sectional survey was done on 302 girls. Random sampling was used to come up with a representative sample.

The prevalence of geophagy was 45%. Predictors of geophagy were geophagic mothers/ guardians and family size. Anemia was not a significant predictor of geophagy. Geophagy is practiced for psychosomatic reasons rather than nutritional. In areas where proper hygiene is practiced, geophagy may not be a risk factor of helminthes infestation. Primary nutrition education is needed to ensure a greater awareness of geophagy and its implications.

Keywords: Adolescent girls; Prevalence; Geophagy; Anemia

Introduction

Geophagy (consumption of soil, clay or rock powder) is common among pregnant women and children in Sub-Saharan Africa. It is a cultural and widely accepted practice in African societies [1]. The prevalence of geophagy among children in Western Kenya was reported to be 73.1% [2] and 74.4% among Zambian girls [3]. A variety of soil types are consumed, including hardened clay soil (commonly found selling in shops and markets for the purpose) and soil from the walls of houses or termite mounds. Consumption of dust or sand has also been reported.

There are three major groups of hypotheses concerning the physiological causes of pica: hunger, micronutrient deficiency, and protection from toxins and pathogens [4]. The hunger hypothesis posits that people consume non-food substances because they do not have anything else to eat [5].

The micronutrient deficiency hypothesis posits that people with micronutrient deficiencies eat non-food substances in an attempt to increase micronutrient intake of iron [6] and Zinc [7]. Another version of this hypothesis is that a micronutrient deficiency causes disturbed taste sensitivities or malfunctioning of appetite-regulating brain enzymes that cause non-food substances to become appealing [8]. In this scenario, pica is a consequence of micronutrient deficiency, but not an attempt to remedy it.

The protection hypothesis states that pica is motivated by an attempt to mitigate the harmful effects of plant chemicals or microbes [9,10]. It is proposed that pica substances protect by either adsorbing pathogens or toxins within the gut lumen or by coating the surface of the intestinal endothelium, thereby rendering it less permeable to toxins and pathogens.

According to this hypothesis, overt gastrointestinal distress, which can be the result of exposure to either toxins or pathogens [11], also trigger pica. Additionally, this hypothesis implies that pica substances would be ingested during periods of rapid growth, i.e., the times of greatest need for protection from toxins and microbes. Under this hypothesis, childhood and pregnancy, especially early pregnancy (which is the critical period of organogenesis [12]), are the periods when pica most likely would occur [13].

A transitional period between childhood and adulthood, adolescence provides an opportunity to prepare for a healthy productive and reproductive life, and to prevent the onset of nutrition-related chronic diseases in adult life, while addressing adolescence-specific nutrition issues and possibly also correcting some nutritional problems originating in the past [14]. Heavy menstrual blood loss may be an important factor of iron deficiency anaemia, as observed in Nigerian girls. Geophagy is also speculated to be a risk factor for helminth infestation. Helminth infestation is reported to affect over 1 billion people in tropical developing countries and contributes to severe morbidity [14]. People who practice geophagy are at high risk of infestation with *Ascaris lumbricoides* and *Trichuris trichiura* by ingesting eggs from contaminated soil. *Ascaris lumbricoides* and other intestinal helminthes may cause anemia [15].

The objectives of this study were to determine the baseline characteristics of adolescent girls with geophagy with a view of establishing the significant predictors of geophagy among adolescent girls.

Methodology

Study design

A cross sectional study design was done. Cross sectional studies are suitable for determining prevalence or incidences at a point in time.

Study setting

The study was done in girls boarding schools in Likuyani District of Kakamega County. Kakamega county has six districts, these are; Butere, Ikolomani, Khwisero, Lugari, Likuyani and Lurambi. Likuyani district was randomly sampled from the six districts. Likuyani district has two girls boarding schools. The two schools are; Moi girls Nangili and St Anne's Nzoia.

Study population

All girls in the two secondary schools formed the population of the study. The total population of students in the two schools was 1470. Moi girls Nangili had a student population of 750 while St Anne's had a population of 620 students.

Sample size determination

The prevalence of geophagy among girls in Kenya was reported to be 74.4 % [2]. This prevalence was used to calculate the sample size. A formula of calculating sample size in epidemiological studies when random sampling is to be used in sampling was used to calculate the sample size [16]

$n= (1.96^2 \times 0.73 (1-0.73))/0.05^2$

n = 302

Where: n = required sample size

Pexp= expected prevalence

d = desired absolute precision = 0.05

Sampling procedure

A sample of 302 girls was proportionately drawn from the two schools. Fifty one percent (154 girls) of the sample was drawn from Moi girls Nangili while 49% (148 girls) came from St Anne's. Stratified random sampling was used to come up with a representative sample that included girls from all classes. The samples were also proportionately drawn from the classes. Before the process of recruitment commenced, the school principals and administrators were asked to include a short study advertisement in school newsletters, school notice boards and school counselors were provided with flyers to distribute.

The researcher after consultation with the administrators of the two schools then gave presentations to all the girls in the two schools in their schools. The sessions were done for each class. The researcher introduced the research issue to the students. The background, purpose of the study, voluntary participation, eligibility and randomization during the recruitment were highlighted during the sessions. The girls were allowed to ask questions and raise any concerns about the research. After the session, those willing to participate remained in the room as others left. The remaining girls were given numbers and the numbers recorded against their names. This was repeated for all the four classes. Then using the random number tables, a proportionate sample was drawn from each class based on the population of the class. A statistician carried out the randomization process.

Inclusion and Exclusion Criteria

All girls in the two schools had a chance of participating in the study. Those who were pregnant were not eligible for participation.

Data Collection

Socio-demographic data, nutritional characteristics, geophagy and nutrient status were collected.

A questionnaire was used to collect baseline data. Anthropometric measurements of height, weight and mid upper arm circumference of the participants were taken using standard procedures [17].

Data on dietary intake of iron was collected using the 7 days record method. The type of food eaten, and the volume of cooked food consumed by the enrolled girls was recorded using standard tools (utensils). The data obtained was used for calculating the amount of food consumed and subsequently nutrient intake of the girls. The intake of iron was obtained by using the food composition tables and nutrient calculator.

Blood samples of about 5ml were taken and stored in ice for transportation to the laboratory.

To examine the extent of iron deficiency, a trained laboratory technician carried out an Hb analysis of the blood samples to determine iron deficiency. A coulter counter was used, hemoglobin (Hb) was recorded. Girls were categorized as having iron deficiency anemia when found with Hb of <12g/dl.

The participants were given sterile labeled containers and plastic spoons to collect feacal samples and deliver them immediately after collection for proper storage. They were instructed to collect at least one spoon (5g) of the sample. Fecal flotation was used because common helminth eggs and protozoan cysts are less dense than the fecal analysis solution and will float to the top of the solution where they can be collected for microscopic examination. This was done by mixing the feces with the test solution and allowing it to sit on the laboratory bench. This was followed by microscopic examination.

Participants were asked to identify the termite mound in school where they collected the soil they ate. A soil sample was collected from the mound for analysis. Soil samples were also bought from Kitale and Nairobi markets since the participants had indicated that sometimes they bought the soil they ate. For analysis of helminthes in the soil, soils in 3mg samples were dissolved in water and the mixture sieved through gauze lined tea strainer. This was repeated several times to remove large particles of debris. Then Zinc sulphate and saturated sodium chloride floatation, as well as the sedimentation techniques for ova isolation were applied.

Data analysis

Statistical package of social scientists (SPSS) version 17 was used in data analysis. Data collected at baseline and after the intervention was analyzed. The data was coded after collection; it was then entered into SPSS program for analysis. Descriptive statistics was used to summarize data. Frequency tables were used to summarize data on the general characteristics and nutrition data of the respondents. Chi-square tests were done to test the differences between groups on categorical variables. A multivariate logistic regression was used to determine the significant predictors of geophagy.

Ethical considerations

The proposal was submitted to Ethical Research Committee of the University of Nairobi for approval. Consent was also sought from the school administration of the participating schools. Participants eighteen years and above read and signed the consent form attached on the questionnaire, those under eighteen had their consent forms signed by their parents but they signed assent forms. Participation in this study was voluntary and participants were free to withdraw from participation if they so wished.

Parents of participants under the age of 18 were contacted through phone calls and the research issue explained to them. Those who accepted to have their daughters participate were further invited in school through the school administration. They were then given the forms to read and allowed to ask for clarification of any issues they had before signing. The child also signed the assent form after the parent consenting. Participation was only after the consent had been approved. Questionnaires had numbers rather than the name of the participant to ensure confidentiality.

Results

Prevalence of geophagy

A total of 302 respondents formed the sample of the study. Out of the 302 respondents interviewed 135 (45%) were geophagic (Figure 1).

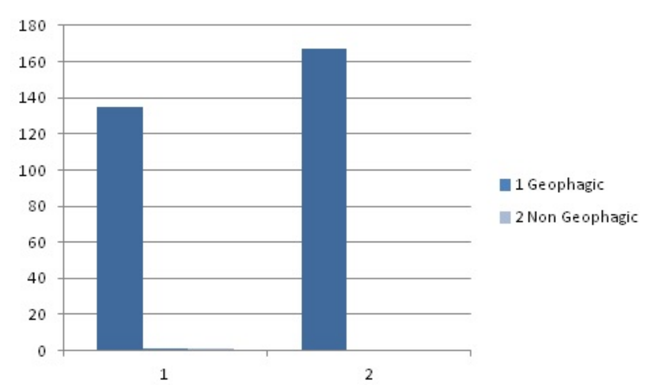

Figure 1: Prevalence of Geophagy among Adolescent girls

General characteristics of the respondents

The results were collected from a sample of 302 respondents who were randomly sampled from the population. It was observed that 67(50 %) of the geophageous girls came from St Anne's school while 68 (50 %) from Nangili school. There was no significant difference in the distribution of geophagy among the two schools (p= 0.469, χ^2 = 0.038) (Table 1).

Characteristics	**Geophageous n=135 N (%)**	**Non Geophageous n=167 N (%)**	**χ2**	**df**	**P**
School					
St Anne's	67(50)	81(49)	0.038	1	0.469
Nangili	68(50)	86(51)			
Class					
Form 1	23(17)	50(30)	28.3	3	0.001
Form 2	52(38)	22(13)			
Form 3	33(25)	43(26)			
Form 4	27(20)	52(31)			
Age					
13-15	43(32)	50(30)	2.08	2	0.354
16-20	86(64)	114(68)			
>20	06 (04)	03(02)			
Geophagic mother/guardian					
Yes	82(60)	68(41)	11.97	1	0.001
No	53(40)	99(59)			
Mothers Education level					
Primary	06(04)	20(12)	29.3	3	0.001
Secondary	48(36)	83(50)			
Certificate/ diploma	69(51)	37(22)			
Graduate	12(09)	27(16)			
Mothers profession					
House wife	06 (04)	07(04)	14.5	3	0.002
Business woman	44(33)	71(43)			
Farmer	14(10)	35(21)			
Professional job	71(53)	54(32)			
Family size					
≤5 members	55(41)	43(26)	7.66	1	0.007
>5 members	80(59)	124(74)			
Home setting					
Rural	70(52)	106(64)	4.146	1	0.046
Urban	65(48)	61(36)			

Table 1: General characteristics of the respondents at baseline.

Most of the geophageous girls 52 (39%) were members of form two class, while 23 (17%), 33 (25%), 27(20%) were members of form one, three and four respectively. Among the non geophageous group 50(30%), 22(13%), 43 (26%) and 52(31%) were members of form one, two and three respectively. The distribution of the respondents among the classes differed significantly (p=0.001, χ^2 =28.3).

Majority of the respondents both geophageous 86(64%) and non geophageous 114(68%) were of age 16-20. More than half 82(61%) of the geophageous girls indicated that their mothers/guardians were geophageous. However, 68 (41%) of the non geophageous girls also indicated that they had geophageous mothers/guardians, there was a significant difference between the two groups (p=0.001, χ^2=11.97).

The educational profile of the mothers/guardians of the respondents differed significantly (p=0.001, χ^2=29.3). Most 69 (51%) of the mothers/ guardians of geophageous girls had attained either a certificate or diploma course, while most 83(50%) of the non geophageous girls had attained secondary level of education. Few 11(19%) of the mothers/guardians had primary level of education.

Most 71(53%) geophageous girls had mothers with a professional job. While most 71(43%) non geophageous girls had mothers who were business women, the profession of mothers differed significantly (p=0.002, χ^2=14.5) between the two groups.

Distribution of the respondents by family size differed significantly (p=0.007 χ^2 =7.66) between the geophageous group and non geophageous group. Majority of the non geophageous 124 (74%) respondents compared to the geophageous 80 (59%) indicated that they came from families of more than five members.

The respondent's home setting was either rural or urban. Majority of the non geophageous girls 106 (64%) compared to the geophageous girls 70(52%) were from the rural setting. This showed a significant difference between the two groups (p=0.046, χ^2=4.146).

Nutritional characteristics of respondents

Results from an independent sample t–test showed that the mean weight of the respondents in the two groups were not different (p=0.883, t=-0.148). However, a significant difference in height was shown (p=0.038, t=2.084). The mean Mid Upper Arm Circumference (MUAC), Body Mass Index (BMI) and hemoglobin of the two groups did not differ significantly (Table 2).

Attribute	Geophagic Mean(SD)	Non geophagic Mean (SD)	T	Df	P
Weight	57.98(9)	57.85(7.2)	-0.148	300	0.883
Height	162.6(6)	163.96(5.5)	2.084	300	0.038
MUAC	26.5(2.3)	26.3(2)	-0.667	300	0.505
BMI	21.8(3)	21.5(2.4)	-1.13	300	0.260
Hb	11.7(1.9)	12.11(2)	1.679	300	0.094

Table 2: Nutritional characteristics of respondents.

Most respondents 140(84%) in the non geophageous group compared to the geophageous group 95(70%) had normal BMI.

Few respondents 21(16%) and 16(10%) in the geophageous and non geophageous groups respectively were underweight.

Overweight cases were also few with 19(14%) from the geophageous group and 10(6%) from the non geophageous group. There was a significant difference between the two groups on BMI classification (p=0.017, χ^2 =8.127) (Table 3).

Characteristic	Geophagic n=135 n (%)	Non-geophagic n=167 n (%)	p
BMI			0.017
<18-underweight	21(16)	16(10)	
18- 25-normal	95(70)	140(84)	
25-30 -overweight	19(14)	11(06)	
Aneamia Classification			0.058
hb <12 mg/dl-anemic	60(44)	56(34)	
hb >12 mg/dl-non anemic	75(56)	111(66)	

Table 3: BMI classification and Anemia of the respondents

Respondents were classified as having anemia if they had a Hb< 12. Sixty (44%) of the geophageous respondents and 56(34%) of the non geophageous respondents were anemic. There was no significant difference between the two groups (p = 0.058), $\chi2$ =3.757). The prevalence of anemia among all the girls was 38 %.

Diet of the respondents

The respondents adhered to the cyclic school menu. However, there was change of diet only once a month when students would be visited by their parent/ guardians. The two schools had a similar menu since they are from the same region with slight variation on the frequency of eating the foods.

The diet of the learners was limited to porridge, Mixture of maize/ beans and Ugali/kales with only two days of meat in a week. The diet was lacking milk or milk product and fruits (Table 4).

Type of food	Frequency in a week	
	St Anne's school	**Nangili School**
Maize meal porridge	3	4
Bread	2	3
Ugali	8	7
Boiled kales	6	7
Black Tea	2	3
Mixture of maize and Beans	4	4
Rice	1	2
Stewed beans	3	3
Stewed beef	2	2

Table 4: Weekly food intake of the respondents

The kales served was boiled therefore the vitamin C component may have been destroyed. Vitamin C is important in enhancing absorption of iron from foods.

Mean nutrient intake of the respondents

Since the respondents adhered to the same school menu, an independent sample t –test showed no significant difference in the nutrient values taken by the geophageous and non geophageous respondents (p <0.05) (Table 5).

	Geophageous n=135 Mean (SD)	Non geophageous n=167 Mean (SD)	T	df	p
Protein	43.8(27.6)	42.3(23.2)	-0.516	300	0.606
Carbohydrate	1393.4(654)	1397(604)	0.062	300	0.951
Iron	12.3(6.5)	12.2(6.3)	-0.51	300	0.61

Table 5: Mean nutrient intake of the respondents

The mean nutrient intake was 43 ± 25g for protein 1395.5 ± 625g for carbohydrates and 12.36 ± 6.38 mg for iron. The mean nutrient intakes satisfied more than 50% of the RDA requirements, however, the values differed significantly with the RDA values, p =0.0001, 0.041 and 0.0001 for protein, carbohydrates and iron respectively (Table 6).

Nutrient	Mean (SD) n=302	RDA	% RDA	T	df	p
Protein (g)	43(25)	46	93.4	-2.06	301	0.0001
Carbohydrate	1395.5(625)	2200	63.4	-22.2	301	0.041
Iron (mg)	12.36(6.38)	15	82.4	-7.17	301	0.0001

Table 6: Mean nutrient intake of the respondents compared to RDA

Geophageous characteristics of the respondents

Table 7 shows the geophageous characteristics of the respondents. Soils eaten by the respondents was either bought or obtained from ant-hills. Majority of respondents 96(71%) indicated that the source of their soil was ant hills.

Characteristics	Frequency n=135	Percent
Source of soil		
Buy from market	39	29
From ant hill	96	71
Amount eaten/day		
10-20g	51	38
30-40g	55	41
40-50g	19	14
>50	10	07
Start time		
Before menarche	70	52
After menarche	65	48
Frequency of eating/day		
Once	37	28
Twice	68	50
3 or more	30	22
Reasons for eating soil		
Urge		
Yes	120	89
No	15	11
Hunger		
Yes	32	24
No	103	76
To avoid nausea/vomiting		
Yes	07	05
No	128	95
Abdominal distress		
Yes	30	22
No	105	78

Table 7: Geophageous characteristics of the respondents

Regarding the amount of soil eaten, most respondents 55(41%) ate on average 30-40g of soil in a day. On the frequency of eating soil, most respondents 68 (50%) indicated that they ate soil at least twice a day.

Most respondents 70(52%) indicated that they started eating soil before menarche. Urge of eating soil was the major reason for the geophagic behavior. More than three quarters of the respondents 120 (89%) and 62(91%) attested to that.

Most of the respondents 105(78%) did not experience any abdominal distress after eating soil.

Results from analysis of samples for Helminthes ova

Soil from termite mounds from the two schools and that sold in Nairobi and Kitale open air markets were analyzed for presence of helminthes ova. However, no helminthes ova were discovered in any of the soil samples from the three locations.

Stool samples were also taken from the 302 respondents and also analyzed but there were no signs of helminthes infestation.

Predictors of geophagy

The variables which were significant after chi-square analysis were entered into a logistic regression model to determine the significant predictors of geophagy.

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The significant predictors of geophagy from the regression model were mother/ guardian geophagic (p=0.0001, OR=0.357, CI=0.0655-1.026) and family size (p=0.003, OR=0.558, 95%CI=0.327-0.953) (Table 8).

						95% C.I.	
	B	S.E.	df	Sig.	Odds ratio	Lower	Upper
Class	-0.199	0.114	1	0.082	0.820	0.655	1.026
Mother / guardian geophagic	-1.031	0.261	1	0.000	0.357	0.214	0.595
Occupation of mother	0.041	0.186	1	0.826	1.042	0.724	1.500
Education of mother	0.431	0.223	1	0.054	1.538	0.993	2.382
Family size	-0.583	0.273	1	0.033	0.558	0.327	0.953
Home setting	0.357	0.259	1	0.168	1.429	0.860	2.375
BMI class	-0.169	0.267	1	0.525	0.844	0.501	1.423

Table 8: Predictors of Geophagy

Geophagic respondents are 35.7% more likely to be influenced by geophagic mothers/ guardians while, family size was 55.8% more likely to influence the geophagic behavior of the respondents.

Discussion

Prevalence of geophagy and diversity of soils eaten

Clay eating is widespread among women in Africa but in particular five African countries namely Malawi, Zambia, Zimbabwe, Swaziland and South Africa, where an estimated prevalence level in the rural areas of these countries is put at 90% [18].

In this study, out of the 302 respondents interviewed, 135 (45%) were geophagic. Other studies reported prevalence of 73% among adolescents of age 11-18 [2] and 75% among women of age 20-60 [19].

In this study, geophagy was found to be common among rural and urban dwellers, with 52% and 48% from rural and urban setting respectively. In a study in South Africa, prevalence of pica of 38.3% and 44.0% among urban and rural black women respectively was documented [18]. This indicates that geophagy is practiced by people irrespective of their locality. According to other studies [5,20,21] there are indications that the phenomenon of geophagy is not restricted to any particular age group, race, sex, geographic region, or time period. The frequency of consumption varied from more than once daily to occasionally. This is consistent with [19].

Some researchers reported that there are preferred soils as far as soil-eating is concerned, these include red, white, yellow, brown clay types, termite mounds and various other types of soil [22]. Sources and Location of geophagic soils in this study included hill/mountain, termite mound, consistent with [19]. The average amount of soil eaten was 30- 40g per day; these results are consistent with other studies which reported an average of 30-50g per day [23-25].

Predictors of geophagy

In this study, hemoglobin concentration was not significantly higher in geophagic girls compared to the non geophagic girls (p> 0.05); this is not consistent with [2]. This showed that hemoglobin concentration was not a significant predictor of geophagy. Research has shown that the historical origin of geophagy may be originally tied to biological drives triggered by vital minerals in the substances being consumed. Still, in interviews with practitioners, many scholars have found that its contemporary practice seems to be the result of nurture, not nature [26]. Their responses seem to indicate that instead of fulfilling nutritional needs, geophagy is being practiced for psychosomatic reasons.

Research by [27] supports this notion, the study concluded that young children pick up the habit from their mothers, who consider soil as a convenient pacifier. In this study more than half 82(60%) of the geophageous girls indicated that their mothers/guardians were geophageous. In another study it was concluded that very few of the clay eaters acquired the taste without the influence of other individuals [26]. Other authors observed that the practice amongst many of the kaolin eaters emanated from having watched their mothers or close relatives eat the clay [28].

In other studies, pregnant women interviewed said they were "taught" to eat clay because it settles the stomach and reduces the nausea and vomiting associated with morning sickness [29,30]. In similar studies respondents indicated that they ate earth because it tastes good indicating craving as a reason of eating soil [6,26], these studies show consistent results with the present study where urge of eating soil was the major reason for the geophagic behavior. Hunger was not a major reason for eating soil, less than 25% of the respondents cited it. This was consistent with [25]. The researchers compiled reports of 72 cultural studies on geophagy. Geophagy was attributed solely on hunger in only 16(22%) of the reports. Hunger was explicitly not associated with geophagy in 36 reports (50%). If hunger motivated Geophagy, we would expect that enough soil would be eaten to fill the geophagist's stomach. Since the amount of soil eaten per day is small, it's more like a medicament than a meal.

Geophagy and helminthes infestation

Several studies have linked geohelminths infection with soil consumption. Geohelminths infection was linked to iron-deficiency among HIV-infected women who indulge in geophagia [31]. Separate studies on geophagous children in Jamaica [32] and Kenya [2] reportedly gave a quantitative estimate of the level of exposure to intestinal *A. lumbricoides* and *T. trichiura* infection experienced by the children. However, other studies reported little evidence to support the transmission of hookworms by geophagy [33,34]. In this study, results showed no viable helminthes ova in the geophagic soils tested. These results are consistent with results reported by [4]. In the studies [2,32,35] viable helminthes were discovered in geophagic soils. The difference was explained by [4] that the latter was conducted on soils eaten by children who may have been more careless than adults about preparing the soil before consuming. This may not be the case with the present study since participants did not report any form of preparation of soil before eating. Therefore the absence of helminthes in the geophagic soils in this study may be attributed to improved sanitary practices in the area of study.

Prevalence of anemia among adolescent girls

Respondents were classified as having anemia if they had a Hb<12. The prevalence of anemia among adolescent girls in this study was 38%. However, in another study within the same region, a prevalence of 21.1% among adolescent girls was reported [36]. Similarly, studies on prevalence of anemia from different states of rural India reported high prevalence of anemia from 46-98% [38] and 90% [37]. In a study carried out among 265 adolescent girls of Amritsar, a prevalence (70-75%) of anemia including 12.83% girls who had severe anemia was reported [39]. This is also higher than the prevalence reported by [40] and WHO report of a prevalence of 27% for anemia in developing countries [41].

The high prevalence of anemia in this study may be attributed to the diet of respondents which was lacking in fruits, and the frequency of meat intake was low. The kales served were boiled, therefore the vitamin C component may have been destroyed yet, vitamin C is important in enhancing absorption of iron from foods. Dietary factors such as low consumption of red meat, vegetables, cereals and fruits have been reported to be associated with IDA [42]. Heme iron (from meat) provides 10 to 20% of iron intake while non-heme iron (from vegetables, fruits, and cereals) provides 80 to 90%. However, non-heme iron absorption is influenced by the iron status of subjects and the balance between enhancers and inhibitors present in the food, much more than heme iron [43].

Other study revealed similar results that female subject's infrequently consuming red meat and vegetables (less than two servings of red meat and vegetables per week) were at increased risk to develop ID and IDA [44]. According to WHO [45] iron deficiency anemia would be considered a public health problem only when the prevalence of hemoglobin concentration exceeds 5.0% of the population. Therefore, the prevalence in this study indicates a public health problem.

In this study anemia was not associated with geophagy. According to [28], anemia resulting from geophagy, to which the craving for soil is attributed, is believed in some cases to have resulted from the worm or microbial infection encountered by ingestion of soil.

Conclusion and Recommendations

Conclusion

The prevalence of geophagy among adolescent girls was 45%. Aneamia is not a significant predictor of geophagy. Geophagy is practiced for psychosomatic reasons rather than nutritional. In areas where proper hygiene is practiced, geophagy may not be a risk factor of helminthes infestation.

Recommendations

The high prevalence of anemia calls for an in-depth study for the determination of factors associated with IDA. Intervention action programs to combat ID in Kenya should be given a high priority. Screening for iron deficiency in high risk groups should be considered.

Primary nutrition education is needed to ensure a greater awareness of iron deficiency and geophagy and the testing needed to establish diagnosis as well as underlying causes.

Recommendations for further research

Future research is needed to evaluate dietary iron adequacy in Kenyan school diets.

Focus by the Kenyan government's anemia prevention and control program should not just be on pregnant women, but also adolescents.

Research need to be done on interventions for geophagy.

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