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Eating behavior and nutrition malpractices and lack of knowledge about iron rich food and methods which enhance or inhibit iron absorption amongst lactating mothers and their impact on iron status in 6 months-old children in rural area of Lwiro

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Abstract

A follow-up study was conducted in 136 lactating mothers at a pilot maternity in a rural area of South-Kivu, from 10th October to 4th December 2019. Hemoglobin concentration was measured using a HemoCue Hb 201+ system photometer on capillary blood. Ferritin was adjusted for inflammation. C - reactive protein (CRP) was analyzed using spectrometers Genrui P54. Anthropometric parameters of mother and children were measured. Sociodemographic data and household data and, dietary habits information as well were collected using a structured questionnaire. Chis-square, Anova one way and post-Hoc and linear regression were performed to identify factors associated or correlated with anemia children. The overall prevalence of anemia in mothers was 37.1%. Of these, 15.9% had mild anemia and 21.2% had moderate anemia. The prevalence of anemia in 6 months-old children was very high 72.8%. Of these, 37.5% had mild anemia and 34.6% had moderate anemia. ID in lactating mother is 21.6%, with 1% of iron depletion. The chi-square result showed statistically significant between levels of education (p=0.047), having habit of consuming more fruit (p=0.04), selling crops (p=0.046); iron mother's supplementation during pregnancy (p=0.02), anemia of the mother (p<0.001), and children's diarrhea (p=0.012) as well were shown to be linked to anemia in 6 months-old children. In addition, Anova one-way revealed that the means of following variables were different: changing fish during pregnancy (p=0.017, F4.211), knowledge that tea inhibit iron utilization (p=0.046, f=3.147);) knowledge that vitamin C-rich foods (fruits) enhance iron absorption (p=0.024, f=3.83). Education nutrition intervention is needed and health providers must insist on information regarding adequate foods intake of mothers during antenatal-post natal care, and during preschool activities as well.

Keywords : *Dietary malpractice and food habit, Iron rich food and methods, Anemia, Iron deficiency, Rural area.*

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Introduction

Anemia is defined as a low concentration of hemoglobin (Hb) which is incapable for responding to individual physiologic necessity. It is nowadays a worldly important Public Health Nutritional problems [1]. WHO (World Health Organization) applied the following cutoffs for detecting anemia: For children from 6-59 months the hemoglobin lowers than 11.0g/dL and for non pregnant women (15 years and above), lower than 12.0mg/dL of Hb respectively are considered to be anemic. In children, mild, moderate and severe anemia have the following cutoffs (10.0 to10.9 g/dL, 70 to 99g/dL and lower than 7.0g/dL) respectively. On the other hand, for non pregnant women, the thresholds for mild, moderate and severe are (11.0 to 109g/dL, 80 to 109 g/dL and lower than 8.0g/dL) correspondingly [2].

Iron Deficiency Anaemia (IDA) is observed when iron provision is very low and the synthesis of haemoglobin is deteriorated. It is defined as haemoglobin level beneath two standard deviation for age and sex (< 11g/dL for kids between half dozen months and five years). Children below 5 years of age are particularly in danger, and also the main problem is that IDA might have an effect on psychological feature and growth [3]. IDA is a excellent indicator of Iron accumulation in the blood and it helps for diagnose ID in individual who appear healthy [4]. A studies conducted recently shown that the great problem that causes anemia in children in low income countries are eating disorders and health issues [5]. In fact, anemia in earlier post-partum period has an effect on health directly after birth and later in life of children. It causes sickness and, therefore morbidity. Besides, it is known that infants who are suffering from anemia have growth and neurological problems and may not achieve a high education level in the future and, they may also not concentrate on work in adulthood [6,7].

The World Health Organization (WHO) précised that 40% of the third world's population in the world is anemic and are composed by pregnant women. Besides, anemia is due to Iron Deficiency which is major dietary problem in the world [6]. Moreover, it is believed that thereabouts a half of all anemias are due to inadequate dietary intake and low assimilation of iron diet, or losing blood [8]. It is known that breastfeeding is thought to require a high maternal store compared to other stage of a woman's cycle. In addition, during lactation there is a need of many micronutrients. Furthermore, inadequate food intake of lactating mothers may lead to reduction of storage [9]. The lack of knowledge about iron rich food that inhibits the absorption of iron and drink (tea or coffee) also influence the number of serving of food, may also influence IDA in women in Reproductive Health [6,8]. Anemia is regular in lactating mothers who have had history of anemia during pregnancy. Their vulnerability to anemia is due to iron reduction during both pregnancy and lactation because they lose a great quantity of blood during procreation period. This, enhances immunity with the consequences of urinary infection, and increases the quality or quantity of milk in breast. It may also lead to mastitis. Besides, it is connected to the diminution of household revenue globally; it may lead to destruction of neurological, emotional factors and to depression as well. Therefore, it is one of the main concerns in developing countries and in the World [10,11]. In fact, Africa and Asia report more than 85% of the all burden in vulnerable group. West Africa and Central Africa have the highest figure (45%) of anemia in the entire World. According to the DHS(2013-2014 or [12], a poor micronutrient status is common, 59.8 % of children aged 6-59 months and 38.4 % of the women aged 15-49 years are anemic with a high prevalence among pregnant women [12]. WHO wants to reduce anemia in women of childbearing age by 50% by 2025 in order to improve women's life [11].

Meanwhile, data on anemia and/or Iron Deficiency Anemia in lactating women in South-Kivu is scarce. Therefore this study was carried out to estimate the prevalence of anemia in both lactating mothers and their six-month children, and to identifies association between eating behavior of the mothers and the occurrence of anemia in children. On the other hand, the study examines the relationship between iron deficiency in mothers and anemia in children. Besides, the study wants to determine of children born with low weight and small in size compared to their gestational age were exposed or not to anemia at 6months after birth. The study finally wants to know if 6months breastfed exclusively were protected against anemia. We hypothesize that the lack of knowledge about foods and drinks which inhibit the iron absorption as well as inadequate dietary intake will predict whether the anemia Hb is abnormal or the normal.

Methods

Trial design

A follow-up study was conducted from birth to 6 months (from 10th October to 4th December 2019). The present study is a part of a PhD longitudinal study which started at two to seven days after birth (baseline), at forty days after birth (during postnatal appointment), at 3 and, 6 months of life as well. A cohort of 143 mother-infant pairs was recruited at Lwiro maternity and surrounding villages which are included in Lwiro Health Center.

Setting and participants

At baseline, the dyad was eligible if the mother has delivered a single baby without any severe malformation, aged from 18 to 45, with intention to breastfeed the baby and without any diseases at last stage. Furthermore, single infant, healthy without any abnormality at birth was also selected. Mothers who were not living in the study area even thought they were delivered in aforementioned maternity or at Lwiro health Center, were not included in the study. Besides, those who refused to answer the questionnaire and those who were absent the days of the survey (moving in another region) were excluded in the study. At each follow-up, corresponding information was collected. At baseline, data concerning socio-economic and demographic background, and household characteristics was collecting. In addition, information about breastfeeding practices was gathering. Data regarding household characteristic, socioeconomic baseline data and changing food during pregnancy, and main source of nutrition, as well, were also assessed. As it is a follow up study in which we aimed to establish the impact of inappropriate diet on iron status of infants, the data collected at baseline were also considered. The morbidity of the couple mother-infant was assessed. Furthermore, information concerning planning to add food during lactation and like eating more a special food was collected at six months. From baseline to six months, a pres-study testing questionnaires according to local language was applied. The staff members were also intensively trained within one week for coaching before the beginning of the field work. Information about infant feeding practices and morbidity were collected. Interviewers were also trained on how to take anthropometric measurements. Supervisors visited the clinic and did a home visit at least once a week to monitor how interviewers practice and how the work was moving ahead. At 42 days assessment, only information regarding use of crops was considered in this analysis. At 6 months after delivery, during home visit by community workers and supervisors, all followed-up mothers were asked to come with their children at the maternity or at the Health Center for blood collection. Therefore, mother's and infant's finger prick blood was collected by skilled health personal to access hemoglobin using HemoCue Hb 201+ system and to get serum (Iron). Serum samples were analyzed for ferritin (for only mothers) by a spectrophotometer Genrui P54, the criteria for SF(serum Ferritin) was respected and C-reactive protein was analyzed by spectrophotometer BTS-350. . It is known that SF level is increasing in case of infection or inflammation. Therefore, it was adjusted according to individual's status (apparently health and infection/inflammation), based on CRP value. Inflammation was defined as CRP > 5 mg/L. ID was defined as SF < 15 µg/L in case of absence of inflammation, or SF < 70 µg/L in presence of inflammation [13]. Mothers and Infants with Hb concentrations below 8.0 g/dL and 7.0 g/dlL at follow-up were respectively referred and treated at the Health Center or referred at a close Referral Hospital as endorsed by WHO as severe anemia [14]. Some participants took antiparasitics during antenatal care and others after birth or during the appointment. No sickness of both mothers and infants and any hereditary or acquired sickness that influence haemoglobin synthesis were observed. The sample was collecting in the health centers, protecting from sunlight and ultraviolet sensitive substance by using aluminum foil and stored at less than 20°C. After that, during the sample transportation from the health centers to the laboratory, at the same degree, isotherm boxes were used. Then after, the sample (2ml) for each tube (serum and serum backup) was centrifuged in the lab for gaining blood serum at the health centers. Blood samples were transported to the laboratory for analysis. Also the sample was protecting against the sunlight and ultraviolet sensitive substance during transportation and analyzing in the lab. Based on the hypothesis that educate lactating mothers may help to decrease the risk of Ion deficiency anemia in children under-six months. We perform an intervention program targeted on lactating mothers. The education has started at 3 months and has ended at 6 months, but the results will be published elsewhere. At baseline, three and six months, data concerning food intake of lactating mother as follows, staple food, vegetables, legumes, beverage (alcohol, tea and coffee), and mud as well were collected.

Anthropometry

Weight, length, head circumference (HC), Mid Upper Arm circumferences (MUAC) and sex of the infant were recorded from birth to 6 months. Mather Height (cm), Weight (kg) and MUAC (cm) were assessed at 3 and 6 months but at delivery (from 2 to 5 days postpartum) only MUAC were measured. The mother's age at delivery and pre-pregnancy height were asked at delivery. Infant weight was measuring at the nearest of 1kg, with light clothes, using an electronic scale (seca 336) at birth and with a suspended spring scale at 42 days, 3 and 6 months respectively. From 42 days, 3 to 6 months, infant length was measured at the nearest 0.1cm with a recumbent length board. Maternal height (to the nearest 0.1 cm) and weight (to the nearest 0.2kg) were measured also at 42 days, 3 and 6 months. For each measurement, the measure was repeated four times if the difference between the two was > 0.2kg and > 0.2cm, to ensure the high quality of the data.

Sample size

First of all, the areas where the study was conducted were randomly chosen. The sample was selected from lactating women using a systematic sampling at baseline, 143 women were considered at the beginning. During the follow-up, five mothers and their children were not located during the home appointment. Two lactating mothers accept to do questionnaire but refused the blood collection and medical exams for them and for their children. On the other hand, two mothers and their children refused of blood collection and medical exam, but, they accepted to do the questionnaires. Then after removing those who were not reached, the sample was 138 lactating women and their children. However, when searching for outliers for weight of the mothers, four weights of the mothers failed out of the mean. Besides, two outliers failed out of the mean for both Head Circumference and MUAC (Mid Upper Arm Circumference) of the infants. Thus, they were not concerned by the analysis in connection to the anthropometric parameters. When searching for outliers based on the Z score cut-off, two variables were deleted, therefore the sample become 136 mothers- infants pairs for analysis with regard to nutrition status.

Data management and statistical analysis

- *Cleaning data*: The data was cleaned by two different persons. Of 138 women, 25 samples were not sufficient for ferritin analyzes. Besides, 15 women have CRP more an equal to 5 mg/L. Therefore, 30 interviewers were deleted when seeking to exclude inflammation as a confounding factor.

- *Variables transformations*. Both hemoglobin of mothers and infants were transformed into categorical variables. Regarding infants, Hb less than 11.0g/dL and for mother less than 12.0g/dL were considered as anemia respectively, according to WHO [14]. Hb level was adjusted downwards by 5 g/L according to WHO [15]. Adjustment was applied because participants were living at more than 1500m of altitudes above sea level (from 1675m to 1808m altitude, based on GPS). Ferritin level was transform into categories (<= 15; 15 and <=70 and, >70). In addition, Ferritin was adjusted for C - reactive protein (CRP) (<5mg/L and >5) [13], by excluding respondents with CRP more than 5 mg/L [2].

- *Statistical analysis*. The analysis was run using SPSS version 26.0. Chi-square analysis was performed for categorical variables, but Fisher's exact test was used when Chi-square test cannot be performed because cells have less than 5 counts. Variables that were significant with chi-square were all enter in the logistic regression model. However, any studied variables were significant with Hb of the infants. On the other hand, One-way ANOVA test was used to detect differences between means. Statistical significance was $P < .05$ with 95% CIs. Post-hoc analysis was performed for multiple comparisons. Linear regression was run to test the equality of means, and to search for correlations.

Ethical approval

After proceeding for the inclusion in the study, lactating mother obtain an informal consent that was written in Swahili, the local language. As we did not know their illiteracy level, we read the form for them and explained clearly any detail. Thenceforth, the form was signed by both the interviewee (lactating mother) and the interviewer (responsible of Lwiro Maternity or Lwiro Health Center). After signing the form, lactating mother went home with the form in order to reread it with the partner and family members. In fact, those who were not able to sign used the fingerprint. Besides, the proposal was approved by both German and DR Congo ethic committees of Freiburg Ethik Kommission in Germany and the Commission Institutionnelle d'Ethique in Bukavu, respectively. After the approval of the proposal, the contact with the stakeholders at each health level in the South-Kivu Province was undertaken for field work study preparation. Beforehand, some meetings with the Health Division of South-Kivu Province, the head of the Health Zone, the head of Hospitals, and the head of the Health Centers as well were held for study preparation and for community workers security during the home visits. Those chiefs, have informed the government and the local chiefs about the study.

Results

Table 1 gives household and socio-economic data, nutrition status of lactating mother and children and the biological parameters as well.

The families to which the respondents belonged were composed of an average of 6.367 (2.877) persons and the average number of children were 4.286 (2.785) as well. The average age of lactating mothers was 27.417(6.837) and, the average BMI was 25.239 (3.044). The average weight, height, MUAC, HC and BMI of the infant were 7.197(0.656), 61.861(3.251), 14.173(1.043), 43.614(1.280) and 18.912(1.882) respectively. The study highlighted a high prevalence of overweight and obese lactating women in the area (47.7%, 62/134). Almost all HH (97.1%), 133/137) was led by men and more than half (55.6%, 73/138) of lactating mothers have secondary level of education. The altitude-adjusted prevalence of both mother and infant were (37.1%, 49/132) and (72.8%, 99/136), respectively. The average of Hb unadjusted and adjusted Hb were 12.782 (1.477) and 12.283 (1.477), respectively. We noticed a mare prevalence of severe anemia (0.7%, 1/136) in infant. The altitude-adjusted moderate and mild anemia of the mother were (21.2%, 28/132) and (15.9%, 21/132), respectively. Besides, the average of unadjusted and adjusted Hb of infant was 10.794 (1.217) and 10.294 (1.217) correspondingly. The altitude-adjusted moderate and mild anemia of the children were (34.6%, 47/136 and 37.5%, 51/136) respectively. Infant female sex was predominant (52.9%, 72/136), with the sex ratio of 0.88. The C-reactive Protein-adjusted Ferritin mean is 113.145 (53.543). However, after adjusting ferritin to inflammation (C - reactive protein dosage) see table 1, the prevalence of ID in lactating mothers is 21.6%, it is a moderate Public Health Problem in the region. We also highlighted a depletion of iron store in one mother (1%).

Table 1. Household and socio-economic characteristic, anthropometric parameters of the mothers and, biological indicators of mother-infant pairs

Household characteristics	Frequencies/Means
Number of children in the HH(136)*	6.367±2.877
Number of people in the HH(136)*	4.286±2.785
Head of HH (N=137)[a,b]	
Womenship	4(2.9)
Menship	133(97.1)
Mothers characteristic	
Age(y)a: Age asked at baseline(134)[a, *]	27.417±6.837
BMI; Kg/m2(134) [a, *]	25.239±3.044
Less than 18.5 (Underweight)	1(0.8)
18.5 to 24.9 (normal)	67(51.5)
25 and higher (over weight and obese)	62(47.7)
Unadjusted Hb g/dL(132)[a] , *	12.782(1.477)
Adjusted Hb g/dL(132) [a], *,[1]	12.283(1.477)
Moderate	28(21.2)
Mild	21(15.9)
Normal or higher	83(62.9)

Table 1. Household and socio-economic characteristic, anthropometric parameters of the mothers and, biological indicators of mother-infant pairs (continued 2)

Household characteristics	Frequencies/Means
Anadjusted Ferritin (µg/L) (N=114)£	111/762(54.098)
Adjusted Ferritin (µg/L) to inflammation(C-Reactive Protein <5 and ≥ 55 mg/L) (N=102) ¤	113.145(53.543)
≤ 15	1(1)
$> 15\ and\ \leq 70$	21(20.6)
> 70	80(78.4)
Education level of the mother (N=138)	
Never attended school	11(8.0)
Attended school < 3 years	3 (2.2)
Elementary level (attended school 3-6 years)	49 (35.5)
Secondary level (attended school 7-12 years)	73(55.6)
Higher level of education	1 (0.7)
Residence(N=136)[a]	
Infants characteristics	
Sex (N=136)[a]	**Sex ratio=0.88**
Male	64(47.1)
Female	72(52.9)
Weight in kg (N=134)a.b	7.197±0.656
Height in cm	61.861±3.251
MUAC in cm (N=134) [a,b,*]	14.173±1.043
Head circumference(N=134)[a,b, ,*]	43.614±1.280
BMI; Kg/m2(134)*b: Lack of corresponding sum of frequencies with total sample size is due to missing data and to outliers)	18.912±1.882
Unadjusted Hb g/dL(136)[a, *]	10.794(1.217)
Adjusted Hb g/dl (136)[a], *, [1]	10.294(1.217)
Severe	1(0.7)
Moderate	47(34.6)
Mild	51(37.5)
Normal or higher	37(27.2)

[a] ***Lack of corresponding sum of frequencies with total sample size is due to missing data and to outliers*** [b] *Categorical variables are expressed as n(%) and *continuous variables are expressed as mean ±SD,* [1] *Cut-offs were explained in Methods and in introduction. £:* ***Lack of corresponding sum of frequencies with total sample size is due to insufficient blood sample*** *;* ***¤ Lack of corresponding sum of frequencies with total sample size after adjusting by the method of removing all data with C-reactive protein more and equal to 5mg/L.***

Chi square result (Table 2), shows there is a static significance between having habit of consuming more fruit and anemia in children (p=0.04). Although, a weak significance were shown when families have not money to purchase fruits (p=0.057). Whereas, the unavailability of fruit in the market was not shown to be statically significant (p=0.741). Besides, like consuming more vegetables (p=0.184) and like eating more animal food (p=0.793), were not found to be statistically significant. Furthermore, the reason why the vegetables were not consumed for lack of money and for unavailability in the market were not shown to be statically significant (p= 0.125 and p=0.630), respectively. In fact, the statistic significant was observed when the family use crops for sale (p=0.046); but, any relationship was shown when the crops was consumed (p=0.231). On the other hand, mother's supplementation during pregnancy was not shown to be associated with anemia in infants (p=0.328). However, it was significant when the supplementation was given during lactation (p=0.02). Diarrhea was shown to be linked to anemia of children (p=0.012); but, vomiting and fever were not (p=0.147 and p=0.531), respectively; Also, the sickness of the mother was not statistically significance (p=0.31), likewise, the infant gender was not link to infant anemia (p=0.43). Anemia of the mother was more strongly associated with anemia of the infant (p<0.001). Meanwhile, after adjusting for confounders factors using logistic regression model, any factors was predicting anemia in 6 months old infants for adjusting hemoglobin. Therefore, the result of chi-square is applied. In this study, there was no significant effect of the duration of lactation (exclusively Breastfed at 6 months) on anemia in children (p=0.632).

The one-way result (Table 3) shows that, there is a statistically significant difference between the means of the different levels of education (p=0.047, f=2.476). But the difference was not observed for main occupation (p=0.413, f=0.994), ethnic community (p=0.194, f=2.241) and, for age of the mothers (p=0.812, f=0.318) as well. Post-hoc test was not performing for the group of education level, occupation of the mothers and ethnicity community because at least one group of them has fewer than two cases. However, post-hoc comparison test was run for age group and any statistic significant was observed between them (p-value >0.05). The result is not shown in this study. On the same perspective, the one-way result (Table 3) was performed and showed if there is a statistically significant difference of between the means of changing food during pregnancy. In fact, the difference of between the means of changing fish during pregnancy were significant statistically for children p=0.017, f=4.211). On the other hand, any significance was shown between the means of changing other foods (p>0.05). Post-hoc test could not be performed. With the same analysis, the one-way result (Table 3) shows that, there is a statistically significant difference between the means of knowledge of drinking tea for anemia in children (p=0.046, f=3.147). But, any statistical significant was shown between the group of mothers knows that coffee inhibit iron utilization (p=0.745, f=0.295) and between groups of mothers who are aware that milk inhibit iron absorption (p=0.75, f=0.288). Post-hoc test was not performing for the group of coffee drink; because at least one group of them has fewer than two cases. Therefore, the result is not shown in this study. Moreover, the one-way result (Table 3) was perform and shows that, there is a statistically significant difference of between the means of knowledge about vitamin C-rich foods(especially fruits) for anemia in children (p=0.024, f=3.83). Nonetheless, the mean between group of women that Knew that fermentation, roast and grind, and soak enhance the iron utilization, non statistic significance was shown between them(p=0.216, f=1.55; p=0.203, f=1.614). Although, the evidence was marginally significant for the knowledge about acid foods (potatoes, tomatoes and cabbage,ect) increases iron absorption(p=0.08, f=3.113). Post-hoc test was not run for the group of fermentation and roast, grind, soak to germinate as well. This is due to the fact that the groups are fewer than three. For Post-hoc was not performed, therefore the result is not shown here.

From the result (Table 3) so far after multiple comparisons (post hoc test, Table 4), it is shown that there is statistically significant difference between the group that knew that tea inhibit or decrease iron absorption and the group which did not know about that (p=0.048), and vice versa(p=0.048).

Referring to the results (Table 5), a linear regression was perform and shows that there is a low positive correlation between being wasting (ZWH) and being anemic in children (p=0.02, β=-0.973 and R-square= 0.126). In addition, there is a very low positive correlation between Iron Deficiency of the mother and anemia in children at 6 months (p=0.000, β=10.529, R-square= 0.023). The table 6, chi-square results showed that there is no association between anemia in mothers and inflammation (p-value 0.182).

Table 2. Chi-square results: Household characteristics, nutrition factors and Maternal lifestyle, Iron supplementation and infection status and, the effect of coffee or tea consumption and the occurrence of anemia in children (adjusted Hb)

I. Household characteristics by children's anemia				
Variables	**Lower adjusted Hb level (Anamia)[1]**	**Normal adjusted Hb level[1]**		
	N=32	**N=104**	**Total**	**P-value**
Mothers				
HH				
Number of children in the HH asked at baseline(N=134)[a]				
Less than 5 persons				
More than 5 persons	18(56.3)	62(60.8)	80(59.7)	0.648
More than 5 persons	14(43.8)	40(39.2)	54(40.3)	
Head of HH asked at baseline(N=135)				
Menship	31(96.9)	100(97.1)	131(97.0)	0.666¥
Womenship (N=135)[a]	1(3.1)	3(2.9)	4(3.0)	
Size of HH asked at baseline(N=136)[a]				
Less than 5 persons	10(31.3)	33(32.4)	43(32.1)	0.907
More than 5 persons	22(68.8)	69(67.6)	91(67.9)	
II. Nutrution factors and Maternal lifestyle by infant anemia (Adjusted level of Hb)				
Dietary and nutrition factors				
Variables	**Low level of adjusted Hb[1]**	**Normal level adjusted Hb[1]**		
	N=32	**N=104**	**Total**	**P-value**
Main source of nutrition in the HH				
HH with its own vegetable garden(N=134)[a]				
Yes	4(12.9)	24(23.3)	28(20.9)	0.160¥
No	27(87.1)	79(76.7)	106(79.1)	
HH with its own agriculture land(N=134)[a]				
Yes	3(9.7)	17(16.5)	20(14.9)	0.267¥
No	28(90.3)	86(83.5)	112(85.1)	
HH that seek for food in local store at home/ at the market(N=130)[a]				
Yes	31(100.0)	99(96.1)	130(97.0)	0.344¥
No	0(0.0)	4(3.9)	4(3.0)	
Mothers who planned adding food during lactation(136)[a]				
Yes	2(6.3)	4(3.8)	6(4.4)	0.432¥
No	30(93.8)	100(96.2)	130(95.6)	
Like consuming more animals food(135)[a]				
Yes	19(61.3)	61(58.7)	80(59.3)	0.793
No	12(38.7)	43(41.3)	55(40.7)	
Reason for not eating food from animals				
Not having enough money to buy animals food(79)				
Yes	19(100.0)	55(91.7)	74(93.7)	0.242¥
No	0(0.0)	5(8.3)	5(6.3)	
No availability of animal food in the market(80)				
Yes	4(21.1)	11(18.3)	15(19.0)	0.514¥
No	15(78.9)	49(81.7)	64(81.0)	

Table 2. Chi-square results: Household characteristics, nutrition factors and Maternal lifestyle, Iron supplementation and infection status and, the effect of coffee or tea consumption and the occurrence of anemia in children (adjusted Hb) (continued 2)

Variables	Lower adjusted Hb level (Anamia)[1]	Normal adjusted Hb level[1]		
	N=32	N=104	Total	P-value
Like consuming more vegetables (134)[a]				
Yes	15(50.0)	38(36.5)	53(39.6)	0.184
No	15(50.0)	66(63.5)	81(60.4)	
Reason for not eating vegetables				
Having enough money to buy vegetables (53)				
Yes	6(40.0)	24(63.2)	30(56.6)	0.125
No	9(60.0)	14(36.8)	23(43.4)	
Availability of vegetables in the market(53)				
yes	12(80.0)	28(73.7)	40(75.5)	0.630¥
No	3(20.0)	10(26.3)	13(24.5)	
Like consuming more fruits (134)[a]				
Yes	27(90.0)	76(73.1)	103(76.9)	**0.04¥**
No	3(10.0)	28(26.9)	31(23.1)	
Reason for not eating fruits(N=93)				
Having enough money to purchase fruits (103)				
Yes	27(100.0)	67(88.2)	94(91.3)	**0.057¥**
No	0(0.0)	9(11.8)	9(8.7)	
Availability of fruits in the market(105)				
yes	15(55.6)	45(59.2)	60(58.3)	0.741
No	13(44.4)	31(40.8)	43(41.7)	
Mother's Iron supplementation during pregnancy (N=134)[a]				
Yes	31(96.9)	96(92.3)	127(93.4)	0.328¥
No	1(3.1)	8(7.7)	9(6.6)	
Crops used for consumption(N=26)				
Yes	5(83.3)	20(100.0)	25(96.2)	0.231¥
No	1(16.7)	0(0.0)	1(3.8)	
Crops used for sale(N=26)				
Yes	2(33.3)	0(0.0)	2(7.7)	**0.046¥**
No	4(66.7)	20(100.0)	24(92.3)	
III. Iron supplementation and infection status				
Anemia and infection status				
Variables	**Low level of adjusted Hb of the infants**	**Normal level of adjusted Hb of the infants**		
Sickness of the infant (two weeks before the survey)				**P-value**
Fever(N=136)[a]				
Yes	2(6.3)	5(4.9)	7(5.2)	0.531¥
No	30(93.8)	97(95.1)	127(94.8)	

Table 2. Chi-square results: Household characteristics, nutrition factors and Maternal lifestyle, Iron supplementation and infection status and, the effect of coffee or tea consumption and the occurrence of anemia in children (adjusted Hb) (continued 3)

Variables	Lower adjusted Hb level (Anamia)[1]	Normal adjusted Hb level[1]		
	N=32	N=104	Total	P-value
Diarrhea(N=134)[a]				
Yes	4(12.5)	1(1.0)	5(3.7)	**0.012¥**
No	28(87.5)	101(78.3)	129(96.3)	
Vomiting (N=134)[a]				
Yes	3(9.4)	3(2.9)	6(4.5)	0.147¥
No	29(90.6)	99(97.1)	128(95.6)	
INFANTS				
Gender (N=138)				
Male		18(52.9)	47(45.2)	0.43
Female	16(41.7)		57(54.8)	
LBW in g(N=136)				
Less than 2500	3(9.4)	4(3.8)	7(5.1)	0.355¥
More and equal to 2500gr	29(90.6)	100(96.2)	129(94.9)	
SGA(N=136)				
Below 10th percentile	3(9.4)	3(2.9)	6(4.4)	
Above 10th percentile	29((90.6)	101(97.1)	130(95.6)	0.142
Exclusively Breastfed children				
Yes	30(93.3)	100(96.2)	130(95.6)	0.626¥
No	2(6.3)	4(3.8)	6(4.4)	
anemia and sickness of the mother by mother's hemoglobin level				
Illness of the mother				
Yes	1(2.3)	8(7.9)	9(6.8)	0.31
No	31(96.9)	93(92.1)	124(93.2)	
Mother 's anemia(N=133)a				
Low	29(100.0)	21(20.2)	55(37.6)	**0.000¥**
Normal	0(0.0)	83(79.8)	83(62.4)	
Iron supplementation, anemia and sickness of the mother by mothers hemoglobin level				
Variables	**Low level of Hb**	**Normal level of Hb**		
	N=55	**N=83**	**Total=138**	**P-value**
Iron mother's supplementation during pregnancy (N=128)a				
Yes	14(29.8)	11(13.4)	25(19.4)	**0.02**
No	33(70.2)	71(86.6)	104(80.6)	
Illness of the mother (130)				
Yes	2(4.0)	7(8.8)	9(6.9)	0.253¥
No	48(96.0)	73(91.3)	121(93.1)	

Table 2. Chi-square results: Household characteristics, nutrition factors and Maternal lifestyle, Iron supplementation and infection status and, the effect of coffee or tea consumption and the occurrence of anemia in children (adjusted Hb) (continued 3)

IV. Effect of coffee or tea consumption and the occurrence of anemia in children				
Variables	**Low level of unadjusted Hb**	**Normal level unadjusted Hb**		
	N=32	**N=104**	**Total**	**P-value**
Time of coffee/ tea consumption				
Directly before the meal(N=109)				
Yes	10(32.3)	11(14.1)	21(19.3)	**0.032**
No	21(67.7)	67(85.9)	88(80.7)	
With the meal(N=109)				
Yes	7(22.6)	25(32.1)	32(29.4)	0.23
No	24(77.4)	53(67.9)	77(70.6)	
Directly after the meal(N=109)				
Yes	17(54.8)	48(61.5)	65(59.6)	0.333
No	14(45.2)	30(38.5)	44(40.4)	
Between the meals(N=113)				
Yes	1(3.2)	3(3.8)	4(3.7)	1¥
No	30(96.8)	75(96.2)	109(96.3)	

Table 3. Socioeconomic characteristics, changing eating behavior during pregnancy, awareness of drinks (tea, coffee and milk) that reduced/ inhibit iron utilization by anemia in children

I. Socioeconomic characteristic						**F(df)**	**P-value**
Socio-economic characteristic(Asked at baseline)	**Education level(N=136)[a]**						
	Never attended school	**Attended school < 3 years**	**Elementary level (attended school 3-6 years)**	**Secondary level (attended school 7-12 years)**	**Higher level of education**		
Adjusted Hb, infant (N=136)	10.363±1.128	12.2±1.493	10.334±1.172	10.158±1.203	11.6	2.476(4,127)	**0.047**
	Main occupation of the mother(N=138)						
	Farmer at own farm	**Farmer at someone else farm**	**Small business**	**Without employment**	**Others**		
Adjusted Hb, infant (N=131)	10.75±1.352	9.4	10.152±1.224	10.404±1.224	9.930±1.061	0.994(4,131)	0.413
	Ethnicity community(N=138)						
	Bashi	**Rega**	**Bafulero**	**Bahavu**	**Other**		
Adjusted Hb, infant(N=136)	10.24±1.181	10.166±0.757	11.366±2.657	11.5	11.65±0.707	2.241(4,131)	0.194
	Age ranged(Year) (N=134)[a]						
	Less than 25	**25 to 29**	**30 to 34**	**35 and more**			
Adjusted Hb, infant(N=132)	10.367±1.152	10.103±1.262	10.366±1.056	10.263±1.515		0.318(3,128)	0.812
	Marital status (N=136)[a]						
Adjusted Hb, infant(N=132)	**Married, living with husband**	**Married, husband living elsewhere**	**Divorced**	**Living with a partner without marriage**			
	10.078(1.091)	10.4(-)	9.3(-)	10.436(1.288)		1.185(3, 133)	
II. Dietary intake(asked at baseline)		**Changing food habit during pregnancy**					
	Increase meat	Decrease meat	No change(eating meat as usual)				
Adjusted Hb, infant(N=135)	10.54±0.786	10.623±1.07	10.229±1.1236			0.741(2,134)	0.479
	Increase poultry meat	Decrease poultry meat	No change(eating poulty meat as usual)				

Table 3. Socioeconomic characteristics, changing eating behavior during pregnancy, awareness of drinks (tea, coffee and milk) that reduced/ inhibit iron utilization by anemia in children (continued 2)

Adjusted Hb, infant(N=136)	12.1	10.4±1.365	10.273±1.207	1.152(2,135)	0.319
	Increase fish	Decrease fish	No change(eating eggs as usual)		
Adjusted Hb, infant(135)	12.233±1.7	10.271±0.948	10.232±1.18	4,211(2,134)	**0.017**
	Increase legumes	Decrease legumes	No change(eating legumes as usual)		
Adjusted Hb, infant(N=135)	10.155±1.17)	10.62±0.249	10.273±1.896	0.244(2,134)	0.783
	Increase vegetables	Decrease vegetables	No change(eating vegetables as usual)		
Adjusted Hb, infant(N=135)	10.367±1.032	10.4±0.646	10.233±1.311	0.199(2,134)	0.82
	Increase fruits	Decrease fruits	No change(eating fruits as usual)		
Adjusted Hb, infant(N=135)	10.212±1.135	11.3	10.312±1.266	0.469(2.134)	0.627
	Increase dairy products	Decrease dairy products	No change(eating dairy products as usual)		
Adjusted Hb, infant(N=135)	10.72±1.746	10.02±1.033	10.273±1.174	1.012(2,134)	0.366
	Increase staple foods (wheat, rice, beans, soy beans,potatoes,…)	Decrease staple foods	No change(eating staple foods as usual)		
Adjusted Hb, infant(N=135)	10.49±1.62	10.34±0.433	10.258±1.197	0.174(2,134)	0.84
	Increase dietary diversity	Decrease dietary diversity	No change(eating dietary diversity as usual)		
Adjusted Hb, infant(N=136)	10.208±1.182	10.4±	10.311±1.243	0.074(2.135)	0.929
	Increase total food intake	Decrease total food intake	No change(eating total food as usual)		
Adjusted Hb, infant(N=135)	10.305±0.936	10.411±1.504	10.263±1.229	0.066(2.134)	0.936
	Increase mud	Decrease mud	No change(eating mud as usual)		
Adjusted Hb, infant(N=131)	10.403±1.151	10.7±-	10.22±1.265	0.415(2,135)	0.661

Table 3. Socioeconomic characteristics, changing eating behavior during pregnancy, awareness of drinks (tea, coffee and milk) that reduced/ inhibit iron utilization by anemia in children (continued 3)

III. Knowledge about drinks which reduce/inhibit iron utilization					
	Yes	**No**	**I don't know**		
	Coffee				
Adjusted Hb, infant(N=130)[a]	10.4±1.9	10.511±0.959	10.278±1.197	0.295(2,127)	0.745
	Tea				
Adjusted Hb, infant(N=130)[a]	9.55±1.036	10.9±0.829	10.278±1.197	3.147(2,127)	0.046
	Milk				
Adjusted Hb, infant(N=130)[a]	10.54±1.244	10.48±1.061	10.778±1.197	0.288(2,127)	0.75
IV. Methods or food which increase ion by anemia children					
	Yes	**No**	**I don't know**		
Variables	**Vitamin C-rich foods, especially fruits**				
Adjusted Hb, infant(N=130)[a]	8.5±-	11.041±0.881	10.241±1.178	3.83(2,127)	**0.024**
	Eating acid food: Potatoes, tomatoes, cabbage				
Adjusted Hb, infant(N=130)[a]		10.846±1.099	10.241±1.178	3.113(1,128)	0.08
	Fermentation				
Adjusted Hb, infant(N=130)[a]	10.883±1.057	10.814±1.218	10.241±1.178	1.55(2,127)	0.216
	Roast				
Adjusted Hb, infant(N=130)[a]	10.957±0.984	1-.716±1.304	10.241±1.118	1.614(2,127)	0.203
	Grind				
Adjusted Hb, infant(N=130)[a]	11.4	11.341±1.148	10.802±1.181	1.546(2,127)	0.217
	Soak to germinate				
Adjusted Hb, infant(N=130)[a]	10.5±0.424	10.909±1.185	10.241±1.178	1.649(2.127)	0.196

Values are means and SD (Standar deviation). Adjustment is explain in methods, f(Ficher), df(degree of freedom), [a]Lack of corresponding sum of frequencies with total sample size is due to missing data, Significantly different at p-value <0.05

Table 4. Multiple comparison of means of knowledge about drinks which reduce or enhance ion absorption

Knowledge about drinks which reduce/inhibit iron utilization													
Adjusted 6M Hb of infant[1]							**Unadjusted Hb of the infant**						
				95% confidence Interval									
Coffee reduce iron absorption	Coffee reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value	Coffee reduce iron absorption	Coffee reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value
Yes	No	-0.111	0.741	-1.87	1.647	0.988	Yes	No	-0.111	0.741	-1.87	1.647	0.988
	I don't know	0.121	0.693	-1.521	1.765	0.983		I don't know	0.121	0.693	-1.521	1.765	0.983
No	Yes	0.111	0.741	-1.647	1.87	0.988	No	Yes	0.111	0.741	-1.647	1.87	0.988
	I don't know	0.233	0.308	-0.498	0.965	0.73		I don't know	0.233	0.308	-0.498	0.965	0.73
I don't know	Yes	-0.121	0.693	-0.8	1.521	0.983	I don't know	Yes	-0.121	0.693	-1.765	1.521	0.983
	No	-0.233	0.308	-0.965	0.498	0.73		No	-0.233	0.308	-0.965	0.498	0.73
				95% confidence Interval									
Tea reduced iron absorption	Tea reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value	Tea reduced iron absorption	Tea reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value
Yes	No	-1.35	0.565	-2.69	-0.009	**0.048**	Yes	No	-1.35	0.565	-2.69	-0.009	**0.048**
	I don't know	-0.728	0.485	-1.88	0.423	0.295		I don't know	-0.728	0.485	-1.88	0.423	0.295
No	Yes	1.35	0.565	0.009	2.69	**0.048**	No	Yes	1.35	0.565	0.009	2.69	**0.048**
	I don't know	0.621	0.328	-0.157	1.401	0.145		I don't know	0.621	0.328	-1.157	1.401	0.145
I don't know	Yes	0.728	0.485	-0.423	1.88	0.295	I don't know	Yes	0.728	0.485	-0.423	1.88	0.295
	No	-0.621	0.328	-1.401	0.157	0.145		No	-0.621	0.328	-1.401	0.157	0.145

Table 4. Multiple comparison of means of knowledge about drinks which reduce or enhance ion absorption (continued 2)

Adjusted 6M Hb of infant[1]							**Unadjusted Hb of the infant**						
				95% confidence Interval									
Milk reduced iron absorption	Milk reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value	Milk reduced iron absorption	Milk reduce iron absorption	Mean difference(I-J)	Standar Error	Lower bound	Upper bound	p-value
Yes	No	0.06	0.611	-1.39	1.51	0.995	Yes	No	0.06	0.611	-1.39	1.51	0.995
	I don't know	0.261	0.541	-1.022	1.546	0.879		I don't know	0.261	0.541	-1.022	1.546	0.879
No	Yes	-0.06	0.611	-1.51	1.39	0.995	No	Yes	-0.06	0.611	-1.51	1.39	0.995
	I don't know	0.201	0.325	-0.571	0.974	0.81		I don't know	0.201	0.325	-0.571	0.974	0.81
I don't know	Yes	-0.261	0.541	-1.546	1.022	0.879	I don't know	Yes	-0.261	0.541	-1.546	1.022	0.879
	No	-0.201	0.325	0.974	0.571	0.81		No	-0.201	0.3259	-0.974	0.571	0.81

Significantly different at p-value <0.05, Post-Hoc analysis

Table 5. Correlation between nutrition status and anemia in children

I.Anthropometric characteristic by infant anemia (Adjusted Hb)	**β**	**95% CI**		**P-value**	**R square**
		Lower bound	upper bound		
ZWH	-0.973	-1.582	-0.364	**0.02**	0.126
ZWA	0.504	-0.692	1.7	0.406	
ZHA	-0.435	-1.138	0.267	0.223	
ZBMI	0.648	-0.589	1.884	0.302	
ZHCA	0.197	-0.045	0.439	0.109	
ZMUAC	-0.002	-0.027	0.023	0.89	
II. Adjusted Ferritin by infant anemia					
Adjusted Ferritin	10.529	9.956	11.103	0.000	0.023

Β: …., CI: Confidence Interval, R square: Correlation coefficient (when it is different than 0: the linear correlation exist) ; Significantly different at p-value <0.05 in bold, linear regression analysis

Table 6. Association between anemia of the mother and inflammation

Anemia of the mother and inflammation(C-reactive Protein) (N=133) [a]				
Variables	**Low level of adjusted Hb of the mother**	**Normal level of adjusted Hb of the mother**		
C-Reactive protein of the mother(N=133)				
	9(18.0)	9(10.8)	18(13.5)	0.182
No	41(82.0)	74(89.2)	115(86.5)	

[a]Lack of corresponding sum of frequencies with total sample size is due to missing data; total frequencies per variable are given. Significantly different at p-value <0.05 ; chi-square analysis for categorical variables.

Discussion

In this study we examine the associations between mother's nutrition malpractice and food habit and, the awareness about foods and drinks that inhibit or increase iron absorption and the occurrence of anemia in six months children in a rural area of Lwiro, in Eastern of the Democratic Republic of the Congo. For our knowledge, this is the first study which examines the relationship between lactating mother's lifestyle, mother's knowledge about food or drink which increased or inhibited iron deficiency in association with anemia in 6 months old children in South-Kivu. To date, there is limited evidence on the prevalence of anemia in lactating mothers in the region. The study documented a high (37.1%) prevalence of anemia in lactating mothers, and a very high (72.8%) prevalence of anemia in 6 Months-old children. These results are different from 30.5% among mothers and 21.7% among children, published recently by Joana Abou-Rizk and her collaborators, respectively in Syrian Refugee Mothers and Their Children under Five Years [16]. The difference regarding the infant prevalence may be attributed to the fact that children might have received some food as they were vulnerable and in food insecurity situation and they were taking a family food. Whereas, in our study they are 6 months breasted children living in rural area. The prevalence of anemia in lactating women in our study is in line with the DHS result (37.1% Vs 38%); the majority of mothers for both studies has moderate anemia (32% Vs.21.2%). This proves that the problem is still serious in the country and need an emergency intervention. However, the prevalence of anemia in infant is higher (72.8%) than the one published in the DHS (60%), in thereabout a decade; but, for both studies, the majority of children was mild anemia (30% Vs.37.5%) (DHS 2013-2014). The situation is alarming, may be because our study was carried out in a rural area where more than 60% of the population is landless [17]. Furthermore, in the study area, the market work two days a week, therefore the population may have problem of purchasing food. Similar findings were also reported in a study that took into consideration over 50 national surveys in low-and-middle income countries, in which 70% of infant were anemic [18]. A recent study also highlighted a high prevalence (46.6%) of anemia in children less than six months in the region. This figure is lower than the one's reported in this study. The difference observed may be due to the fact that, their study took into consideration a large part with both semi-rural and rural area [19]. Our findings revealed that education level was a factor associated with anemia in children (p=0.047, f=2.476). A prior study conducted in East Africa countries shown that anemia was observed in more than one-third of lactating mothers. The odds of anemia were significantly low among young mothers (15–34 years old), who had primary education, (AOR = 0.87, 95% CI: 0.80, 0.94) compared with uneducated lactating mothers [20]. The difference might be due to a large sample in their study, but ours concern a small region. The results of this study showed that LBW (Low Birth Weight) children and SGA (Small for gestational Age) infants were not anemic (p=<0.05). To our great surprise, it is known that kids with predisposition to some health (prematurity or LBW) are at risk of insufficiency in iron [3]. Lack of knowledge about vitamin C-rich foods (especially fruits) was linked to anemia in children (p=0.024) in this study. In addition, the consumption of tea or coffee directly before meal was associated to anemia in infant (p=0.032). A recent study, focused in pregnant women found contrary results. Pregnant women who drank tea or coffee with meal were less likely to be anemic (AOR: 0.06; 95% CI: 0.03, 0.13; P < 0.001) [8]. However, their study has not examined the effect of drinking tea or coffee before meal. The study showed that children from both lactating mothers who knew and who did not know about the role of these drink with regard to inhibition or decreasing iron absorption were anemic (p=0.048 and (p=0.048), respectively. This showed that an education about food and drink intake content of women in childbearing is need. This may help to conciliate the knowledge and the practice. Or, it is documented that ascorbic acid, meat, fish and poultry increase iron absorption, while, vegetables, tea, coffee and calcium inhibit it. Thus, it is suggested to drink tea or coffee between meals [21]. Prior studies were focused on iron deficiency in pregnant women and, have insisted on iron rich food consumption. But, authors have focused on knowing the proportion of pregnant women who were aware about foods that decrease or inhibit iron absorption and, tea or coffee or vitamin C-rich food consumption, as well, [6]. A recent study searched for the impact of coffee and tea consumption on anemia in pregnant women [6]. This showed that studies in lactating mothers and in 6 months-old children are rare.

Among the children's factors, diarrhea was the only factor which was associated with anemia in infant (p=0.012). Our findings are in consistent with some study [6,18]. This study highlights a high prevalence of overweight and obese lactating women in the area (47.7%, 62/134) but the evidence of relationship with infant anemia was not shown in this study (multinomial logistic was not perform). Whereas, it is known that overweight and obesity are determinants of iron insufficient [22]. Alshwaiyat and his collaborators suggested to screen those women during consultation and to implement community intervention in the future to detect in time low iron and or low ferritin and to combat that issue. The study shows the strong relationship between anemia in mothers and, anemia in children (p<0.001).This was also demonstrated in a recent study conducted in Asia, North-Africa, the Middle East, Sub-Saharan Africa and Latin America [18]. Our findings revealed that lactating mothers who did not receive iron supplementation during pregnancy were anemic (p=0.02). A recent study found a result close to our. Iron supplementation was associated with lower odds of anemia (AOR = 0.82; 95% CI: 0.68, 0.98) [11]. Iron supplementation is still neglected in the study area. Whereas, it is one of protective interventions applied to under five years of age with antecedents of inadequate food intake [3]. This findings showed that breastfed children were anemic when their mothers were not used to eat more fruits ((p=0.04) during pregnancy. Or, it is documented that pregnant women are predisposed to anemia because of pregnancy's physiological weight, then when essential vitamins and iron are not providing, this may lead to a serious problem of anemia [8]. A result of a Demographic and Health Survey carried-up in Ghana focused in adult and non pregnant women reported similar findings: eating less that 5 serving of fruit and vegetables was associated with a high odds of severe (AOR: 9.27; 95% CI:5.15, 16.70) and moderate (AOR:6.63; 95% CI: 4.21, 10.44) anemia [23].

Besides, the fact that families which were not capable to purchase fruit was found to be weakly associated to children's anemia (p=0.05). This might reflect a poor state of the HH and therefore, poor nutrition. However, lactating women were not able to provide information regarding household income in this study. This study showed that there was a low positive correlation between being wasting) and being anemic in infants (p=0.02, β=-0.973 and R-square= 0.126). A prior study has found a contrary result, for this, stunted children have significantly augmented odds of being anemia (Ors:1.76, 95% CI:1.10, 2.83) [24]. This result differed to ours because in their study they have not taken into consideration other indices (wasting and underweight) when searching for their connection to anemia. Iron Deficiency of the mother was correlate with anemia in children at 6 months (p=0.000, β=10.529, R-square= 0.023). A study found similar results, but, they have focused on the history of ID during pregnancy. For them, children who had a maternal history of IDA at pregnancy were at a higher risk of IDA (OR 4.913 (2.934–8.226)) [25]. In this study we have not searched for ID in children as we have only dosed hemoglobin. Studies regarding ID in lactating mothers are rare in the region. Or, it is known that thereabouts 20% of maternal death is automatically due to ID [26]. At last, children from families which used crops for sale were anemic (p=0.046).There is lack of studies in this topic, but in the region, those who sold their crops are getting used to buy other foods with low macronutrients. For instance, they used to sell beans or maize in order to buy cassava flour. This may be the reason why children were anemic in the region.

Conclusion

This study shows that micronutrient deficiencies were prevalent among lactating mothers and their children, with a high prevalence of anemia in children 72%, and a moderate prevalence 21.6% of ID in lactating mothers which is associated to anemia in children(p<0.05). Anemia of the 6 months old children originates from problems related to poor nutritional practices and lifestyles of the mothers. Besides, the lack of information regarding some foods or drinks that enhance or inhibit iron absorption is a serious problem which may lead to malnutrition (anemia in children) in the region. This findings directs towards the importance of implementing effective preventive public health and nutrition projects to resolve both the mothers' and their children's issues. Future interventions should focus on improving maternal nutrition status before, during and after pregnancy as well as educating and supporting mothers to adopt appropriate life style. As far as possible, the authors would like to raise awareness of women in Reproductive Health regarding food and drink intake during pregnancy and lactation and, earlier at school and during routine nutrition educations. We also suggested insisting on anemia screening in clinical practice and public health surveillance guides programs and interventions.

Weakness of the study

However, there are some limitations of the study. In fact, 25 women have given insufficient blood samples; therefore the prevalence of ID was underestimated. In addition, lactating mothers were not capable of giving an estimation regarding their household income. This made that we could not know why the population was not able to purchase food in the study area.

Author's contribution

Celine Kavira Malengera was about concerned in the conception, design, collection, cleaning data, analysis, interpretation, report and manuscript writing. The supervison of the study was done by Prof Theophile Kabesha. He also read and guided the data cleaning. Augustin also implicated in data collection of the data. Prof and Prof …..were concerned in supervision et reading the work. The final manuscript was read and approved by all of us.

Conflicts of interest : Aforementioned authors have considerably contributed to the work, and therefore permitted it for publication.

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