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Haemoglobin Level and Associated Factors among Children Age 6 To 59 Months in Central Highland of Ethiopia

Ferede A[1]*, Abera M[2] and Belachew T[2]

[1]Department of Public Health, Arsi University, Ethiopia

[2]Department of Population and Family Health, Jimma University, Ethiopia

***Corresponding author:** Abebe Ferede, Department of Public Health, Arsi University, College of Health Science, Asella, Ethiopia

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Abstract

Iron deficiency anaemia in their children has less attention in developing countries where illiteracy is burden is high. There is not study that assessed Haemoglobin level of the children in the central high lands of Ethiopia.

Methods: Community based cross sectional study was carried out among women and their index children to determine haemoglobin level of children age 6 to 59 months in Central Highland of Ethiopia from January to July 2018.

A multistage sampling involving random sampling 8 districts and then 16 clusters *Kebeles* (smallest unit of administrations) from distracts. Finally, 1012 households, mothers/care givers, and their children 6 to 59 months were selected with systematic sampling technique. Study participants were interviewed using structured interviewer administered questionnaire to assess their knowledge and attitude about prevention of IDA. Child anthropometric measurements and blood samples were collected and analysed. Binary and linear logistic regressions were analysed using IBM SPSS Statistics version 21. Statistical significance was declared at P<0.05.

Results: High proportion (76.7%, n=776) of women had age 20 to 35 years. Low proportion (41.3%, n=418) of women knew the use of specific foods rich on iron. The mean haemoglobin concentration of children was 128.23g/L (+17.3) and 184 (18.4%) of had anemia, which was higher (24.1%) among age group 6-23 months. Multivariable linear regression analysis showed that age was positively associated with haemoglobin level (β = 0.172, CI=0.01, 0.33). For one month increase in age Hb concentration increased by 0.170 mg/dl.

Conclusion: The magnitude of anemia was moderate among young children. Milk consumption and young children was associated with to poor dietary intake behavior increased the risk of anemia. High proportion of young children was the most vulnerable group of IDA. Educating and empowering women will prevent children from developing IDA at their early life. Datary intake Behavioural Change Communication (BCC) is one of an attentive approach in increasing women's knowledge attitude in self monitoring view of routinely modification of used household foods making into complementary food with efficient iron nutrient.

Keywords: Anemia; Children; Dietary behavior; Central highland; Ethiopia

Abbreviations

B: β-Coefficient; CI: Confidence Intervallic; C: Centimetre; SD: Standard Division; ENA: Emergency Nutrition Assessment; HAZ: Height-For-Age Z Scores; MUAC: Mid Upper Arm Circumference; WHZ: Weight For Height Z Score; WHZ: Weight for Height; HAZ: Height for Age Z Score; Pv: P-Values; VIF: Variance Inflation Factors

Introduction

Iron Deficiency (ID) among children is also associated with impaired mental and physical development and could cause cognitive disturbances without clinical situation of anemia [1]. The risk of iron deficiency is high among children 2-6 months due to their rapid growth failure of dietary iron intake in meeting their needs [2]. Untreated iron deficiency can affect a child growth and development [3]. The prevalence of anemia among children in Africa was estimated to be 46% [4]. Iron deficiency anemia affected 45% of children aged less than 5 years in developing countries [5].

According to WHO global database sources, currently the prevalence of IDA in children 6 to 59 months excesses to 46% in selected countries in east and southern Africa. From Africa countries, Uganda leading by 72.6% [6] and followed by Malawi was 625% [7]. However, a trend analysis for anemia indicated that in East Africa the trend of anemia among children aged 6–59 months declined from 74% in 1995 to 55% in 2011 [8].

According to WHO out of 0.8 million deaths, 1.5% can be attributed to iron deficiency each year. In terms of the loss of healthy

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life, expressed in disability-adjusted life years (DALYs), iron-deficiency anemia results in 25 million DALYs lost (or 2.4% of the global total) [4].

Few studies showed that iron supplementation predicts greater increase in weight gain [9]. Currently, a significant reduction in prevalence of anemia among children became 7% in developed countries and even in same European countries estimated to 2%–6% among children. It is stated that enhancing enriched foods and the use of supplements contributed for the reduction IDA [10].

In Ethiopia, the prevalence of anemia among children 6 to 59 months is increasing from time to time ranging from 44% in 2011 to 56% in 2016 [11,12]. From limited study, a study conducted in districts of Kilte Awulaelo, Northern Ethiopia indicates that about 37.3% of children were anaemic [13]. There was no study was conducted in the study area knowledge and attitude of mothers about anemia and haemoglobin level of children.

Methods

Study design and area

Community based Cross sectional study design was used for initial assessment for behaviour change communication intervention in Central highland of Ethiopia from January to July 2018.

Study population

All mothers or care givers who had children age 6 to 59 months lived in the selected kebles where found in central highland of Ethiopia considered as study population. One hundred twelve mothers with their children 6 to 59 months were study subjects.

Sample size estimation: Sample size was determined using Gpower computer software version 3.0 with the following assumptions. A desired precision of 0.05, a power (1-β err probability) of 0.95 and design effect of 2 a final size of 1012 was estimated.

Sampling procedure

Multistage sampling method was used to select 8 districts (5 distracts and 3 rural towns), 16 *Kebeles* (smallest unit of administration) were randomly selected from selected districts in the Central Highland of Ethiopia. At the final stage, 1012 mothers/care givers and their pair children age 6 to 59 months were selected with systematic sampling from selected *Kebeles*.

Blood sample analysis for hemoglobin: Each child's blood sample properly taken and collected by trained laboratory technologists and Hb was determined using HemoCue Hb 301® analyzer. Each participant's hand was warmed and relaxed. Study participant's mother or guardian was informed about required blood sample from child to analysis hemoglobin concentration, the need safe and precise finger prick at child's finger to prevent minimum risk. Consequently, after mother / guardian agreed, she was asked to have firm comfortable hold of her child, and immobilize the finger to be punctured, to prevent sudden movement and accidental injury.

The hemoglobin results were adjusted for altitude and categorized into no Anemia (Hb >110g/L) as normal, anemic (Hb < 110 g/L) and Hb<70 g/L was defined asd severe abemia [14].

Anthropometric measurements: weight and height measurements were taken and converted into Weight for Height Z score (WHZ) to measure thinness and Height for Age Z score (HAZ) to measure stunting based on the cut-off values of the WHO standard [15].

Weight measured in kilogramme without shoes and with slight cover dress, using a battery-powered digital scale for children for who were able to stand and hanging spring scale for children < 2 years to the nearest 100gm. The weight scale was calibrated to zero before taking the next measurement.

Height was measured makin the child barefooted to the nearest 1cm using a stadiometer (a vertical tape fixed perpendicular to the ground on the wall) used for children age >24 months. Recumbent length board was used for children age less than 24 months. During measurement, the individual child relaxed with no shoes and lied on the length board parallel to the long axis of the board and then measurement was taken using 2 trained data collectors.

Data processing and analysis

HAZ and WHZ were analysed using Emergency Nutrition Assessment (ENA) software and communicated according to the World Health Organization (WHO) Child Growth Standards.

Stunting is defined as height for age (HAZ) < −2 Z score (standard deviation (SD)). Wasting was defined as Weight relevant to Height (WHZ) < −2SD [15].

Data were entered into EpiData: 3.0 version and transferred into Statistical Package for Social Science statistical (SPSS) software for windows, version 21 for analysis. Descriptive statistical methods were used for presenting data using proportions and frequencies. Bivariate and multivariable logistic regression models were used to identify the likelihood of anemia among children. Odds ratios with 95% of Confidence Intervals (CIs) were computed to assess the presence and degree of association between independent variables and anemia. A P-value less than 0.05 was used to declare a statistically significant association with anemia.

Linear regression model was used to assess predictors of children's haemoglobin concentration and correlation was declared at beta coefficient (B) and 95% CI. About the assumptions of linear regression analysis, variables linearity, homoscedasticity and normality of the distribution were checked with scatter plot and histogram graphs. Finally, independence of the predictor variables and the absence of their intercorrelation assessed with collinearity statistics where Variance Inflation Factors (VIF) less than 10 and tolerance greater than 0.1 were used as sign of model fitness.

Results

A total of 1012 women and their pair children participated in the study with a response rate of 100%. High proportion (76.7%, n=776) of women found at age 20 to 35 years, but 51.38% of them were attended elementary school or illiterate. Most (81.3%, n=823) of mothers participated in this study had family members <5 and 447(44.2%) had considerable monthly income <1000 Birr (Table 1).

Children demography and health care

About halve (50%, n= 506) of the children participated in the study were younger (age 6 to < 24 months) and their average age was

Table 1: Socio demographic status of mothers and children in Central Highland of Ethiopia.

Variables	Frequency (n=1012)	Percent
Maternal Age		
Age <20	88	8.7
Age 20 to 35	776	76.7
Age>35	148	14.6
Education level		
Illiterate	171	16.9
Read and write	141	13.9
Primary education	307	30.3
Secondary education	393	38.8
Marital Status		
Single	29	2.9
Married	919	90.8
Divorced	43	4.2
Widowed	15	1.5
Separated	6	.6
Occupation		
House wife	465	45.9
Farmer	170	16.8
Business women	157	15.5
Gov.employee	99	9.8
Daily labourer	68	6.7
NGO employee	14	1.4
Student	11	1.1
House servant	13	1.3
None	15	1.5
Family size		
<5 members	823	81.3
5-8 members	67	6.6
9 and more members	122	12.1
Monthly income (Birr)		
<1000	447	44.2
1000-5,000	484	47.8
5001-10,000	78	7.7
>10,000	3	3.0
Children sex		
Male	548	54.2
Female	464	45.8
Age of the children in month		
age <24	506	50.0
age >24 to 59	506	50.0

Et Birr: Ethiopian Currency; NGO: None Governmental Organisation; n, total study subject.

27.27(+ 14) moths with median of 24.5 months. Most (54.2%, 548) of the children were male (Table 1).

Table 2: Knowledge of women about prevention of IDA among children in Central Highland of Ethiopia, 2019.

Variables		Frequency (n=1012)	Percent (%)
Awareness about IDA			
	Yes	505	49.9
	No	507	50.1
Recognition to causes of IDA			
	Yes	452	44.7
	No	560	55.3
Time for complementary feed introduction			
	On 6 month	815	80.50
	Before 6 months	111	11.00
	After 6 months	86	8.50
Still breast-feeding the child			
	Yes	503	49.70
	No	509	50.30
Bottle feeding prohibited			
	No	624	61.70
	Yes	388	38.30
Meal frequency per day			
	less than thrice	189	18.70
	Thrice	808	80.00
	More than thrice	13	1.30
	Yes	829	81.92
Only cow milk consumption			
	No	512	50.59
	Yes	500	49.41
Ripe mangoes/ papayas			
	No	395	39.00
	Yes	617	61.00
Had have pineapple			
	No	523	51.70
	Yes	489	48.30
Animal organ meat intake			
	No	294	29.05
	Yes	718	70.95
Egg intake			
	No	183	18.08
	Yes	829	81.92
Use diversified animal and plant foods			
	Yes	184	18.20
	No	828	81.80
IDA: Iron Deficiency Anemia			

Knowledge of feeding child

High proportion 49.9% (n=505) of women do not know about

Table 3: Attitude about prevention of IDA among women in Central highland of Ethiopia, 2018.

Variables	Frequency (n=1012)	Percent (%)
Habited fruit intake after meal		
Yes	236	23.32
No	776	76.67
Custom for flesh foods intake		
Yes	321	31.72
No	691	68.28
Learned fruits/vegetables intake		
Yes	676	66.80
No	336	33.20
Habit of tee/ coffee intake with or after meal		
Yes	768	75.89
No	244	24.11
Custom to cow milk intake with or after meal		
Yes	878	86.76
No	134	13.24

IDA and low proportion (44.7%,) of women knew the causes of IDA. Over half (54.2%) of children

Women's attitude in prevention of IDA: About dietary diversification, only 184 (18.2%) mothers/caregivers recognised using animal and plant sources of food mutually for as complementary food for children. As regards the consumption of animal organ meat, 718 (70.95%) mothers/caregivers were well thought-out to provide for their children (Table 2).

Women who had habitually have fruit intake after meal was 23.32% and their flesh food intake was 31.72%. In reverse of these, high proportion (75.89%) of women had an approach to use tee/ coffee with or after meal. Milk consumption with meal was high (86.76%) among study group (Table 3).

Child nutritional status: The mean value of Haemoglobin (Hb) for blood samples taken from children participated in the study was 12.55+1.73, while the prevalence of anemia was 184(18.20%). The prevalence of anemia was higher (24.1%, n=122) among children who were younger than age 24 months (6 to<24) compared to children age 24 to 59 months (12.3%, n=62). High proportion (40.6.3%, n=411) of children participated in the study were stunted. On the other nutritional status children, 24.8% (n=251) of study participants were wasted (Table 4).

Association of variables

On multivariable linear regression analysis, the concentration haemoglobin was considered as dependent variable and more than 12 independent explanatory factors of haemoglobin concentration were analysed. Regarding the model summary conformation, adjusted R square = 0.084 in which the model explains 8.4% of variations in haemoglobin concentration and also in model summary Durbin-Watson statistic showed that haemoglobin predictors are independent (Durbin-Watson=1.74).

Being in the age group >24 months was positively associated with

Table 4: Nutritional status of study subjects in central highland of Ethiopia, 2018.

Variables	n=1012	percent
Anemia		
Yes	184	18.20
No	828	81.80
HFA Z score (SD)		
< -1SD: stunted Growth	620	61.30
≥-1SD: normal growth	392	38.70
WFH Z score(SD)		
≥-1SD wasting	251	24.80
<1SD : normal	761	75.20
MUAC in cm		
<12 cm	114	11.30
≥12 cm	898	88.70

cm: centimetre; SD: Standard Division: HAZ: Height-for-Age Z scores; WFZ; Weight for Height Z score.
Note Book: ENA (Emergency Nutrition Assessment) computer software used to calculate these anthropometric measurements.

Table 5: Linear logistic regression model predicting variables either have positive or negative or no association in increasing the haemoglobin concentration in mg/dl among children in Central Highland of Ethiopia.

Variables	P	β (95.0% CI)
Age of mother or care giver	0.670	0.015 (-0.012, 0.019)
Household Income In year	0.474	0.022 (0.000, 0.000)
Family Size	0.118	0.050 (-0.012, 0.103)
No. Children born alive	0.320	-0.035 (-0.100, 0.033)
Age of the children	<0.001	0.172 (0.01, 0.33)*
Duration of breastfeed in months	0.320	0.033 (-0.006, 0.018)
Starting time complementary food	0.378	0.028 (-0.016, 0.041)
Weight in kg	0.005	0.066 (-0.003, 0.057)
Height in cm	<0.001	0.170 (0.14, 0.329)*

P: P-value; B: B-coefficient; CI: Confidence Interval; MUAC: Mid Upper Arm Circumference; WFH: Weight For Height; HFA: Height Relative to Age. Maximum VIF (Variance Inflation factors) = 2.466. *significant (P < 0.05)

their haemoglobin concentration (B=0.17, P<0.001). For one month increase in age the average haemoglobin concentration increased by 0.172mg/dl. There was a positive association between height of children and their haemoglobin concentration (B=0.167, P=0.0001). For a cemtimeter increase in height, haemoglobin concentration increased by 0.167mg/dl. Likewise, for a kilogram increase in weight that haemoglobin concentration increased by 0.066 mg/dl (Table 5).

Discussion

This study showed that the prevalence of anemia among children of age 6 to 59 months group was 18.2% and according to world Health Organization it seemed to mild public health problem [16]. In contrast to the national prevalence of anemia, this finding far lesser than the report of Ethiopian Demographic Health Survey (EDHS) which was 56% and 44% in that order of five years trend [11,12]. However, a study conducted in districts of Kilte Awulaelo Northern Ethiopia the prevalence of anemia among children was 37.3% which has incomparable finding with our finding [13]. However,

the prevalence of anemia among children in developed and in some transition countries was low 16% (12 to 22%) which had comparable report with this finding [8].

The mean haemoglobin was 12.55(+1.73mg/dl) in the current finding than the mean of Hb reported at national 11.1mg/dl (11.0–11.3mg/dl), however in this finding lower than the reports from income countries 13.0mg/dl [8]. This discrepancy could be related to the differences in socioeconomic development between count roes.

Younger children in the age group 6 to <24 months had higher (24.1%) proportion of anemia than the older children those age 24–59 months (12.3%). This study finding was consistent with the EDHS report in 2016, that young children were more likely to be anaemic (77%) and this decreased among older children accounted to 40% [11]. Similarly, a study conducted in the state of Minas Gerais, Brazil reported that 43.0 % of young children age 6 to <24 months had anemia compared to children who were age 24 to 59 months had 32.9% [17].

Hence, this study finding had relatively less prevalence of anemia and higher Hb concentration might indicate the presence of extension health workers in the study area. However, a lot of work remains to be improved to encourage mothers or caregivers to learn more infantile and young child feeding to prevent anemia from young children those have at risk group for anemia.

On the multivariable linear regression analyses, age, weight and height were significantly and positively associated with haemoglobin level. These could basically be associated with increasing children's age relatively increasing their opportunity to access for diversified food and their datary intake could meet the daily requirement of iron. At the same condition, bioavailability of iron increased its enzymatic function and synthesise of haemoglobin increased. These go ahead haemoglobin concentration assistant to children growth and age weight and height do a vicious cycle with datary intake.

Conclusion

The prevalence of anemia among children was mild (18.2%), but moderate among children age 6- <24 months old. Children who had better height (longer) and older age had increased their Hb concentration at list by 0.17gm/dl compared to those children who had short height (low height) and younger age children. Similarly, height and weight were positively associated with haemoglobin.

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Ethical Approval

This research was approved by Ethical Review Committee of Jimma University. Letter of permission was obtained from Arsi Zone administrative and health department offices. At the end, we obtained permission from 8 district administrative offices 16 Kebeles (Smallest Administrative Units) which were site for data collection administrations offices. In addition, all of the study participants (children's mothers/ caregivers) were informed about the purpose of the study.

Each child's mother or caregiver was informed about required blood sample from child to analysis hemoglobin level. For the purpose of finger prick at child's finger became safe, all percussions were taken to prevent minimum risk. Consequently, mother / guardian were asked to have a firm comfortable hold of the child, and immobilise the finger to be punctured, to prevent sudden movement and accidental injury.

The respondents were notified that they have the right to refuse or terminate at any point of our request of table salt. The information provided by each respondent was kept confidential.

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Author Contribution

A. Ferede: The conception of the design of the research project, data collection, data entry, analysis, preparation and write up manuscript and appraisal. Belachew T., and M. Abera participated in the analysis of data, write up and preparation of manuscript for publication. All authors read and approved the final manuscript I read and approved the final manuscript for publication.

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