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ANAEMIA AMONG BREASTFEEDING INFANTS (0-6 MONTHS) AND ASSOCIATED FACTORS IN A LOW INCOME URBAN SETTING OF KENYA

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ABSTRACT

Controversies surrounding exclusive breastfeeding for the first six months of life and the risk of developing anaemia exist. Studies worldwide have indicated uncertainties on the way forward given the World Health Organization's firm stand on exclusive breastfeeding as the most appropriate practice for infants less than six months old. In Kenya, research on anaemia status of infants below six months old is scanty. The main objective of the study was to determine the prevalence of anaemia and its associated factors among breastfeeding infants 0-6 months old in Kangemi Slums, Kenya. One hundred and thirty nine (139) breastfeeding infants aged 0-6 months and their respective mothers were recruited into a cross-sectional study. Infants' blood was drawn from the heel while mothers' blood was from a finger prick. Anaemia was assessed using HemoCue® (Hemo-control, EKF-diagnostic GmbH, Barleben/Magdeburg, Germany) and defined as haemoglobin levels <11.0 and <12.0g/dl for infants and mothers, respectively. Logistic regression was used to model the associations. Anaemia prevalence (35.3%) was of moderate public health significance and was not statistically different between exclusively (36.8%) and non-exclusively (28%) breastfed infants (χ^2=0.702, 1df, p=0.402). There was no significant difference in mean haemoglobin levels between infants exclusively and those non-exclusively breastfed (t=-1.040, p=0.300). A reduced estimated relative risk of anaemia (OR=0.713, 0.95 CI: 0.34-1.50) was observed among infants <4 months versus 4-6 months old. Key factors of significant positive association with anaemia among the infants included maternal nutritional status (Body Mass Index (p=0.015), haemoglobin levels (p=0.018)) and proportion of household income spent on food (p=0.026). This study concluded that there is a likelihood of exclusively breastfed infants below 6 months to be anaemic in Kenya to the extent of moderate public health significance and special attention is warranted. The study reveals maternal nutritional status, haemoglobin levels and proportion of household income as key predictors of anaemia in infants.

Key words: anaemia, exclusive breastfeeding, infants, low income, associated factors

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INTRODUCTION

The Global Strategy for Infant and Young Child Feeding recommends exclusive infant breast feeding (EBF) for the first six months of life [1]. Breast milk is crucial during this period to achieve optimal growth, development and health of the infant. It further recommends complementary feeding to start at six months where appropriate, safe and nutritionally adequate complementary food should be introduced with continued breastfeeding up to two years and/or beyond [1]. Among the well documented and articulated benefits of breast milk include its uniqueness in composition and function. It has been found to contain an ideal balance of nutrients that are easily digested by the infant [1]. It is recommended that breastfeeding be initiated within the first one hour of birth. Some studies indicated that extended and continued exclusive breastfeeding is associated with a reduced risk of the sudden infant death syndrome [2]. Previous studies indicated that iron deficiency may not be ruled out for some exclusively breastfed infants below six months particularly in vulnerable and/or high-risk populations [3]. In Kenya prevalence of anaemia among infants less than 6 months old has been estimated to be in the range of 79-100% [4-5].

There is continued controversy that exclusively breastfed infants are also at risk of developing anaemia. Some experts recommend the use of supplemental iron at the age of 4 months to reduce this possible risk [6-7]. Others have recommended exclusive breastfeeding for six months with iron supplementation for low term, low birth weight infants [8-9]. This is contrary to the WHO recommendation which recommends provision of iron supplements to infants and children 6-24 months only in those areas with anaemia prevalence exceeding 40% [10]. On the other hand, other studies have revealed no such evidence of anaemia among exclusively breastfeeding infants [11-12]. Iron deficiency and Iron Deficiency Anaemia (IDA) in young children is an important health problem whose consequences are dire. The consequences include delivery of premature and low birth weight babies; impaired cognitive and physical growth and/or poor development of infants, pre-school and school-age children. Anaemia has multiple causes, some of which include haemolysis (due to malaria infection), haemoglobinopathies, other micronutrient deficiencies (Vitamins A, B12, C, folic acid), heavy blood loss resulting from hookworm infestation and child delivery. However, the most common cause of anaemia is IDA [10]. Inappropriate infant feeding may lead to malnutrition which may in addition lead to increasing child mortality and consequently affect future productivity and economic progress of a country [13].

Given that this age is within the window of opportunity beyond which certain interventions may not work and any growth retardations and/or health problems may be irreversible [14], and in the light of these controversies, this study was conducted to find out the prevalence of anaemia and its associated factors among breastfeeding infants 0-6 months in a low-income urban setting of Kenya.

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MATERIALS AND METHODS

The study was conducted in the informal settlement of Kangemi location, Nairobi County, Kenya. Nairobi's population is over 3.5 million people with an estimated 60-70% of this population living in informal settlements [15]. Kangemi has an estimated population of 650,000 residents of multi-ethnic origin [16]. A total of 139 breastfeeding infants and their respective mothers selected through multi-stage cluster sampling were recruited into a cross-sectional study. Figure 1 illustrates the sampling schema. Applying a prevalence of 90%[1], a standard normal deviate of 1.96 and a 5% error rate[2], the sample size was 139. Mt View sub-location was deliberately excluded from the final sample since it was considered of a higher socio-economic category than the other two. Equal women-infant pairs were identified from 10 randomly selected villages using the Epi-random walk method.

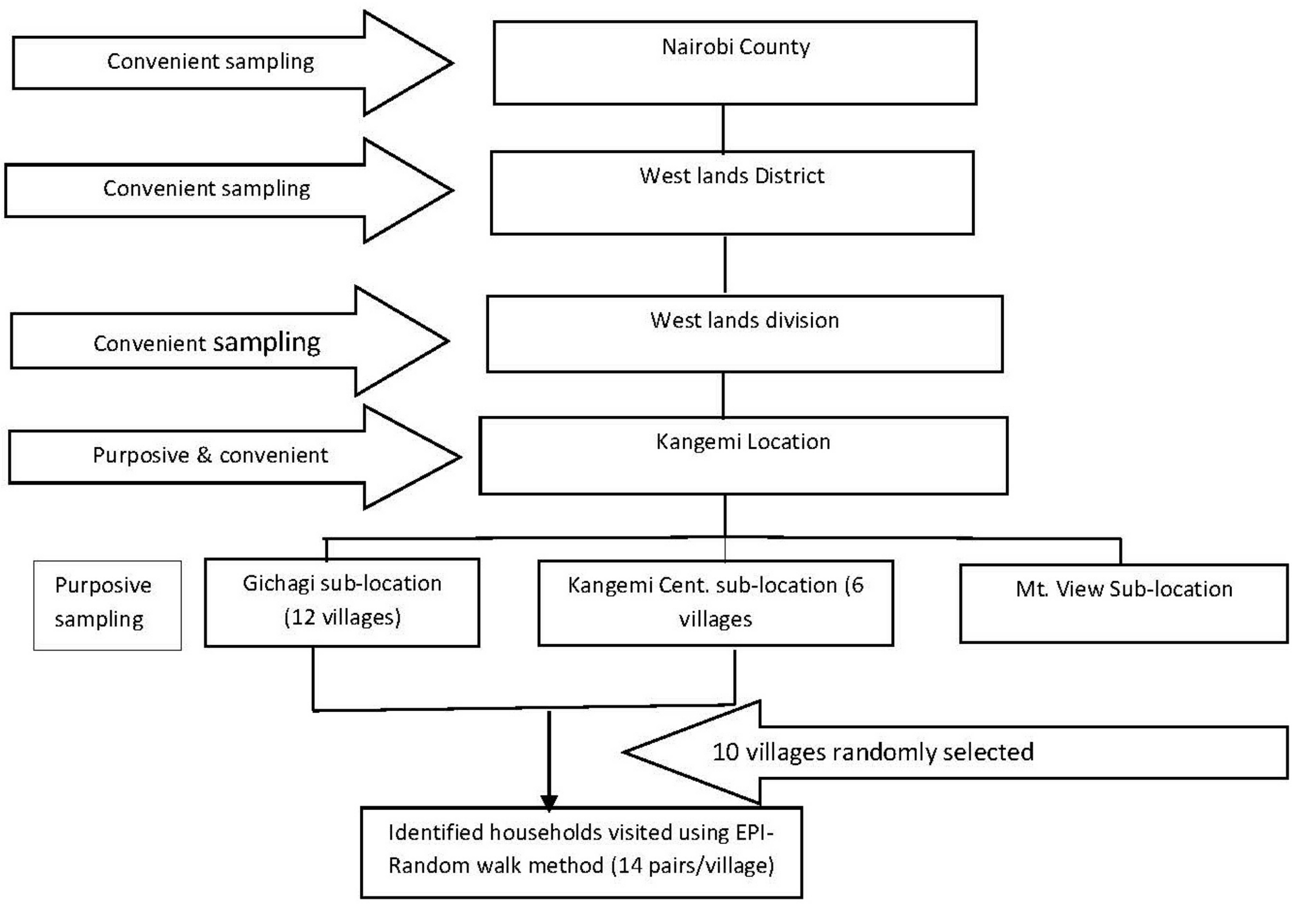

Figure 1: Sampling schema for study households

[1] Since there were no current data on anaemia prevalence among infants <6 months in Kenya at the time of this study, this figure was estimated from studies conducted by [4-5]
[2] Fisher's et al., 1991 formula: Estimated prevalence of anaemia among infants less than 6 months in Kenya (p)=90%; required degree of precision (d)=0.05; standard normal deviate (95% CI) (Z)=1.96

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A semi-structured questionnaire was used to capture data on socio-economic and demographic characteristics of the study subjects; iron and folic acid intake patterns of the mothers during their last pregnancy; infant feeding practices, and nutritional and anaemia status. The weight of the infant was measured using an electronic scale (Seca GmbH & Co. KG, Hamburg, Germany). This was done by first weighing the mother, and then the scale tared; she was made to hold the infant, who was lightly dressed, and infant's weight was subsequently determined.

Anaemia was determined using capillary blood drawn from the heel and finger prick for the infants and their mothers respectively. A HemoCue® machine (Hemo-control, EKF-diagnostic GmbH, Barleben/Magdeburg, and Germany) was used. After collection, the haemoglobin levels were immediately determined and samples disposed following standard procedures. Haemoglobin cut-off points of <11.0 and <12g/dl were used to define anaemia in infants and mothers respectively [17]. The measured haemoglobin values were adjusted for altitude (1834 meters above sea level) where a correction factor of (-5) g/L was used. EBF was defined as per the WHO/UNICEF global strategy [1]. Measurement was based on reported responses from the mothers, which may have been prone to reporting biases, but an attempt was made by study team to verify this information indirectly by probing what solid foods/drinks, including water that the mother may have fed the infant since birth, excluding prescribed medicines, vitamins and mineral supplements.

Data were analysed using Statistical Package for Social Sciences (v.20) and Microsoft Excel. Descriptive statistics were used to analyse socio-demographic data. Infants' nutritional status was determined using Z scores and classification based on the WHO 2006 Growth standards [18].Chi-square tests were used to test for associations between proportions; independent t tests were used to test for differences between means of two groups while Analysis of Variance (ANOVA) was applied for differences between means of more than two groups. Odds ratios were used to estimate the relative risk of anaemia depending on the different exposure factors.

Ethical Clearance

This study was reviewed and approved by Kenyatta National Hospital/UoN Ethics Review Committee under approval number P383/07/2013. The study participants were informed of the study purpose, objectives, possible benefits and risks prior to collecting any information. They were then requested to voluntarily give consent by signing informed consent and child assent forms. The information provided was treated with utmost confidentiality by the study team.

RESULTS AND DISCUSSION

Socio-demographic and economic characteristics of study households/respondents

Table 1 shows selected socio-demographic and economic characteristics of the study households.

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Majority (84.2%) of the households were of monogamous family set up. The mean household size was 3.8 ± SD (1.12) ranging from 2 to 7 members. This mean household size is significantly larger ($p<0.001$) than that of a typical urban area (3.1) but smaller than that of a rural area (4.6) as reported by the Kenya Demographic and Health Survey (KDHS) 2008-09 [19]. On the other hand, it corresponds to the Total Fertility Rate (TFR) in the country (3.9) as indicated by the 2014 Kenya Demographic and Health Survey. The majority of the women (68%) were in the age category of 20-29 years where TFR is highest. The estimated number of children per woman was 2± SD (1.0) which could be attributed to the high prevalence of contraceptive use (61%) among women with one to two children in Kenya. Furthermore, the percentage of contraceptive use among urban women in Kenya is 6% higher than that of their rural counterparts [20].

The average age of the lactating mothers was 26.7± SD (4.1) years with the youngest and oldest being 18 and 42 years respectively. The most common source of livelihood was casual labour (45%), and two out of every five (41%) of the respondents were either salaried or waged. On average, the households spent approximately 40% of their monthly income on food which is a reflection of poverty and typical of developing country settings where households tend to spend a significant proportion of their income on food as compared to developed countries. Globally, out of the nine countries that spend more than 40% of their household income on food, four are in Africa and Kenya is one of them at 46.7% [21].

Characteristics of study infants

Out of the 139 infants studied, 41.7% were males and 58.3% females (Table 2). Two thirds (66.2%) of the infants were aged less than 4 months while the rest were between 4 and 6 months. Majority of the infants (92%) had normal birth-weight (greater or equal to 2.5 kg) while only a few (8%) had low birth weight (less than 2.5 kg) indicative of optimal maternal nutrition and care pre-pregnancy and during pregnancy period for the index child. Majority of the infants (82%) were reported to be on EBF with the mean duration of exclusive breastfeeding (for those on exclusive breastfeeding) being 2.6 months.

Nutritional status of study infants

The median weight and length of the study infants was 6.0 kg and 58.7 cm, respectively with the modal weight and length being 6.0 kg and 60.0 cm, in that order. The lightest and heaviest infant weighed 2.8 and 9.8 kg respectively. Table 3 shows levels of malnutrition among the infants by sex. Overall, the Global Acute Malnutrition (GAM) rate for the study was 5.8% which represents a poor nutrition situation as per the WHO classification [22]. On the other hand, prevalence of stunting (19.5%) and underweight (2%) was low based on the global standards. There was no significant difference with respect to gender in the proportions of infants with GAM ($p=1.000$), stunting ($p=0.750$) and underweight ($p=0.571$).

Prevalence of anaemia among study infants

Table 4 shows the anaemia status of the study infants with regard to feeding mode.

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The mean haemoglobin level of the infants was 11.55g/dl with lowest and highest levels recorded as 4.3 and 16.6g/dl respectively. The overall prevalence of anaemia was 35% but was not significantly different between EBF (36.8%) and non-EBF (28%) infants. Slightly more than two thirds of the anaemic infants (69.4%) were females. The prevalence of anaemia among exclusively breastfed infants (36.8%) found in this study is significantly higher ($p<0.05$) than what Meinzen-Derr and others [23] observed (24%) though the latter employed a prospective study design. On the other hand, these results reflect those of a Brazilian study [3] which reported a prevalence of 8.3 to 37.5% among low income exclusively breastfed infants from 3 to 6 months. According to the World Health Organization's classification of anaemia prevalence in populations [17], this figure (36.8%) is of public health importance and should be given special focus.

Factors associated with infant anaemia

Table 5 indicates associations and relationships of infant anaemia with selected variables. In concurrence with other related studies [23-25], this study found a significant inverse relationship between the duration of EBF and haemoglobin levels of the infants. In addition, there was an increased estimated relative risk of infant anaemia associated with longer duration of EBF as evidenced by other previous studies [23-24]. Therefore, this issue of anaemia among EBF infants requires special attention given that exclusive breast feeding for the first six months continues to be promoted and supported by both global and national policies. There was no significant association ($p>0.05$) between the mode of feeding (EBF versus mixed feeding) and infant anaemia, which is similar to results of a Brazilian study which concluded that feeding type did not exhibit difference in haemoglobin levels among 6 months old infants [25].

Haemoglobin levels of infants in this study had a significant inverse relationship with their age ($r=-.346$, $p<0.0001$) which means that the older the infant, the lower the haemoglobin levels and vice versa. This trend is expected as delayed cutting of the cord (for about 2-3 minutes) at birth goes a long way towards preventing an early decline in infant iron status [26]. This extra blood forms its iron store; breast milk is low in iron, probably as a way to prevent bacterial growth.

The significant negative relationship of household size and haemoglobin concentration of the infants is an indirect one. Recent evidence has shown that household food insecurity and larger household sizes have been linked to increased risk of anaemia among low-income households [27].

Infants from anaemic mothers had more than double risk of anaemia as compared to those from non-anaemic mothers (OR=2.46, 0.95CI: 1.17-5.20), which is a common phenomenon and mirrors findings by other researchers [28-29].The finding in this study on exclusively breastfed infants having a more likelihood of anaemia as compared to those on mixed feeding is somewhat controversial and is similar to that of Luo *et al*. [7] who argued that infants on mixed feeding, besides breast milk, could be receiving additional iron from infant foods especially formula foods, of which most are known to be fortified with micronutrients including iron. However, another study in

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rural China revealed that lack of predominant/exclusive breastfeeding in the first 4 months of life was associated with infant anaemia [30].

Maternal education level indicated a significant inverse association with infant anaemia. Maternal nutritional knowledge is critical in influencing micronutrient status of children (including haemoglobin levels) and has a greater impact as opposed to education level alone. According to Block [31], maternal schooling has an indirect impact on micronutrient status of children (including haemoglobin levels) through its influence on maternal nutritional knowledge and probably household expenditure. Less maternal education has been associated with increased risk of infant anaemia [27,30]. However, Meinzen-Derr *et al.* [23] found no significant association between maternal education and infant anaemia indicating that maternal education is not always sufficient in addressing infant anaemia and that nutritional knowledge is key in doing so. According to the Kenya Demographic and Health report [20], mothers with at least post primary education are more likely to feed their children according to the recommended infant and young child feeding practices (including micronutrients) as compared to those with no education.

There was no association between maternal age and infant anaemia, which was unexpected. Young maternal age has previously been associated with increased risk of negative pregnancy outcomes such as small for gestational age, premature and low birth weight, including infant anaemia [32]. There is evidence that first-born children from younger women (from adolescents to 27 years) are more likely to be stunted, experience diarrhoea including severe or moderate anaemia as compared to those born to older women (27-29 years) [33]. However, it is acknowledged that there was a very small proportion of respondents (<5%) in the lowest and highest age categories which may have been insufficient to illustrate the expected relationship. Nonetheless, age seems not to have a significant influence on maternal and infant anaemia, implying that other factors with no link to maternal age may have a greater impact.

To ascertain the factors associated with infant anaemia, logistic regression was performed where a statistically significant model emerged (χ^2 (7) = 33.629, $p < 0.001$) (data not shown). All the factors which were found to have significant associations with the dependent variable, 'infant anaemia' were included in the model where more than one-third (35%) of the variation in anaemia cases in the infants was explained by the model (Nagelkerke R^2=0.354). The regression model highlighted three key factors associated with infant anaemia which included: maternal BMI, haemoglobin levels and proportion of household income spent on food. High pre-pregnancy BMI (above the normal BMI range) has been shown to increase the risk of maternal anaemia post-partum, which has a subsequent indirect impact on infant anaemia [34]. Besides the risk of anaemia, a higher maternal BMI (overweight and/or obesity) is also associated with an increased risk of infant mortality [35]. Meinzen-Derr *et al.* [23] also observed a three-fold increased risk of infant anaemia associated with maternal anaemia. Socioeconomic status, including increased income has been shown to impact positively on anaemia [36], and this could also be interpreted that as household income increases this also increases purchasing power of iron rich foods such as meat. This could subsequently and indirectly be protective against infant anaemia.

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Factors that were not significant and as such non-predictive of infant anaemia in the regression model included: exclusive breastfeeding duration, birth weight, and infant's age. Studies by Meinzen-Derr *et al.* [23] and Wang *et al.* [37] have revealed increased risk of anaemia among infants and young children with extended exclusive breastfeeding duration beyond 6 months. This study only focused on infants 0-6 months and some past studies have observed that breast milk iron, including iron stores at birth are adequate for the exclusively breastfed infant. However, beyond 6 months, the iron stores are depleted, with increased iron needs due to rapid growth of body tissues [38]. Breast milk iron content has also been shown to decrease over the course of lactation [39].

Birth weight of 2500-2999g has previously been associated with a higher risk of infant anaemia than that more than 2999g [29]. During the foetal period and at birth, total body iron positively correlates with body weight but iron stores slightly changes during the first 6 months for exclusively breastfed infants [29]. Generally, full term infants, with normal birth-weight and born from non-anaemic mothers have adequate iron stores between 4-6 months of life [29]. The small proportion (8%) of infants reported to have low birth-weight in this study could be insufficient to illustrate a significant association with infant anaemia.

CONCLUSION

The study confirms the existence of anaemia among infants less than 6 months old (including those on exclusive breastfeeding) in Kenya, which is of moderate public health significance. Maternal nutritional status, haemoglobin status and amount of household income spent on food are significant predictors of anaemia in infants. On the other hand, the study has found no association between the mode of feeding (EBF versus mixed feeding) and infant anaemia. There is need for special focus on this issue from both global and national authorities to review existing policies in regard to infant anaemia and breastfeeding, especially among low income and/or poor households before the problem escalates which may result in irreversible effects.

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Table 1: Social demographic characteristics of study households in Kangemi slums, Nairobi, Kenya

Household characteristics	Frequency (No.)	Per cent of households (N=139)
Household Profile		
Monogamous	117	84.2
Single parent	19	13.7
Polygamous	3	2.2
Education level of household head		
Completed primary	28	33.8
Primary drop out	17	12.2
Completed secondary	52	37.4
Tertiary	23	16.5
Primary care giver's details		
Relationship to the child		
Mothers	134	96.4
Others	5	3.6
Age (years)		
15-19	4	2.9
20-29	95	68.3
30-39	38	27.3
40-49	2	1.4
Education level of main caregiver		
None	2	1.4
Completed primary	69	49.6
Primary drop out	19	13.7
Completed secondary	33	23.7
Tertiary	16	11.5
Main Source of Livelihood		
Casual labour	62	44.6
Salaried/waged	57	41.0
Petty trade/business	15	10.8
Others	5	3.6
Occupation of household head		
Casual labour	61	43.9
Formal employment	48	34.5
Business	27	19.4
Unemployed	2	1.4

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Table 2: Characteristics of study infants in Kangemi slums, Nairobi, Kenya

Infant characteristic	Frequency (no.) (N=139)	Per cent of infants (N=139)
Sex		
Male	58	41.7
Female	81	58.3
Age (months)		
0-1.99	49	35.3
2-3.99	43	30.9
4-5.99	47	33.8
Weight at birth		
Low birth weight (<2.5kg)	11	7.9
Normal birth weight (≥2.5kg)	128	92.1
Mode of feeding		
Exclusive breastfeeding	114	82
Non Exclusive breastfeeding	25	18

Table 3: Malnutrition prevalence among the infants in Kangemi slums, Nairobi, Kenya

Malnutrition category	All (%) N = 139	Males (%) n = 58	Females (%) n = 81	p value
Acute malnutrition				
Global	5.8	5.2	6.2	1.000
Moderate	2.9	3.4	2.5	
Severe	2.9	1.7	3.7	
Stunting				
Global	19.5	20.7	18.5	0.750
Moderate	13.7	13.8	13.6	
Severe	5.8	6.9	4.9	
Underweight				
Global	2.2	3.4	2.4	0.571
Moderate	0.7	1.7	1.2	
Severe	1.4	1.7	1.2	

Global=< -2 Z score; Moderate=< -2 and ≥ -3 Z score; Severe=< -3 Z score and/or oedema

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Table 4: Feeding type and anaemia prevalence among infants in Kangemi slums, Nairobi, Kenya

Mode of feeding	Anaemia status (%)		Test
	Anaemia	Non-anaemia	
EBF (n=114)	36.8	63.2	$\chi2$=0.702, 1df p=0.402
Non EBF (n=25)	28.0	72.0	

EBF=Exclusive breastfeeding

Table 5: Associations and relationship between infant anaemia/low haemoglobin concentration and selected variables of infants in Kangemi slums, Nairobi, Kenya

Variable	χ^2 value	Correlation coefficient (r)	Sig.	Odds ratio (OR)	95% CI for OR
Sex of infant (male/female)	3.845	0.166	0.05	0.48	0.23-1.01
Age category of infant	10.148	-0.346	0.006*	-	-
WAZ	0.005**	-	1.000	-	-
WLZ	0.409**	-	0.712	-	-
LAZ	0.047	-	0.829	-	-
EBF/Non EBF	0.702	0.071	0.402	1.50	0.58-3.90
EBF duration	2.986	-0.417	0.008*	2.04	0.22-1.11
Birth weight	7.112	0.228	0.017*	5.53	1.39-21.94
Immunization	0.304	0.047	0.770	1.40	0.42-4.74
Vit. A supp. Post partum	1.157	0.091	0.282	1.47	0.73-2.95
IFA supp (yes/no)	0.285	0.046	0.594	1.24	0.56-2.77
IFA supp. Duration	1.811	-0.180	0.834	-	-
Maternal anaemia	5.735	0.203	0.017*	2.46	1.17-5.20
Maternal BMI		0.182	0.032*		
Maternal education	13.865	-0.004	0.011*	0.98	0.49-1.98
Total number of pregnancies	-	-0.236	0.005*		
Total income	-	0.246	0.003*		
Income spent on food	-	0.276	0.001*		
Household size	-	-0.203	0.016*		

*Association significant at p<0.05 **Fisher's Exact Test
WAZ=Weight-for-age Z score; WLZ=Weight-for-Length Z score; LAZ=Length-for-Age Z score; EBF=Exclusive Breastfeeding; IFA= Iron Folic Acid supplements; BMI=Body Mass index

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