

Household and Food Sensitive Critical Correlates as Predictors of Child Nutritional Status

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Abstract Malnutrition has both short and long term effects and may lead to increased mortality among children under five years. It may also lead to impaired development, poor educational achievement and poor economic productivity if not addressed at an early stage of child growth and development. Rapid growth of urban informal settlement is being experienced in Kisumu city in Kenya and this slum is characterized by overcrowding, filth, inadequate water supply, poor drainage and poverty. These characteristics have negative impact on general health and may compromise nutritional status of children within this setting in addition to staggering economic development. This menace could be attributed to household factors such as food security measures, food consumption frequency and diet pattern, parasitic infection, family size and family diversity. The study attempted to explore the competitiveness of household factor correlates as key predictors of nutritional status. The study targeted a sample of 400 households made up of caregivers with children aged between 6-59 months as sampling units. The study employed use of structured questionnaire with key variables under focus explicitly covered and anthropometric assessments techniques. Statistical analysis explored use of risk estimated odds ratios in multivariate logistic regression. The results revealed that parasitic infections, family size and diet diversity score had significant influence on both Height-for-Age z-score (HAZ) and Weight-for-height z-score (WHZ) ($p < 0.05$) based on odds ratio estimations. Weight-for-age z-score (WAZ) did not show linkage with household factors except for parasitic infection which was inversely associated with underweight in a similar pattern as wasting ($p < 0.05$). In conclusion, it appears that when all the three blocks of factors are put together and considered interactively HAZ is hierarchically predicted by food security, intestinal parasitic infection, family size, diet diversity score and health seeking behavior in that order.

Keywords Household factors, Correlates, Child nutritional status, Slum

1. Introduction

Malnutrition within urban informal settlements continues to rise higher than the rural setting rates. In order to target reduction of malnutrition within urban informal settlement household factors are core in the epicenter of intervention models. Key measures of households in this context included food security measures, food consumption frequency and diet pattern, parasitic infection, family size and family diversity.

Food insecurity may have greater influence on nutritional status. Some authors have attempted to establish the linkage between food insecurity and nutritional status of children at household level. A study conducted in Nepal revealed a strong linkage between food security and malnutrition among children with a focus given to WAZ and HAZ (Singh *et al.*, 2014). A similar linkage was also found in rural

Ethiopia (Hadley *et al.*, 2012) and Malaysia (Ali *et al.*, 2014). However, the two studies had more focus on the strong relationship between food insecurity and WAZ. Critical analysis of these studies reveals an outcome that is inclined towards WAZ. This implies that much of the relationships that exist between food insecurity and nutritional status show limited influence on WHZ and HAZ, but more frequent on WAZ. This therefore shows that further research was needed in different settings to explain this relationship further.

Diet diversity is a measure of quality of diet and a proxy outcome of food security at household level. Diet diversity which is depicted by varied food groups may have a strong linkage with nutritional status of children at household level. Some studies which have been conducted among rural households have revealed strong relationships between diet diversity and nutritional status. Diet diversity had a strong association with HAZ across eleven (11) demographic and health surveys (Arimond and Ruel, 2004). Other studies with similar outcome revealed strong linkage with both HAZ and WAZ within urban setting with slightly lower risk in rural setting (Hatloyet *et al.*, 2000) suggesting that diet diversity and variety could be a major issue in urban setting and hence

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Published online at <http://journal.sapub.org/fph>

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within informal settlements than in rural setting. High diet diversity was associated with reduced odds of HAZ (Rah *et al.*, 2010), Implying a possible influence.

Most household infections target parasitic helminthes infections. These infections are common within informal settlements in Sub-Saharan Africa due to poor sanitary conditions and lack of personal hygiene among households. Many studies have revealed strong linkage between helminthes infection and stunted growth among children (Shang *et al.*, 2010; Moock and Leslie, 1986) and some of these high prevalence of HAZ associated with helminthes were common in urban schools (Amuta and Houmsou, 2009) depicting high risk within urban informal settlement. A study conducted by Luanga *et al.*, (2012) showed that increased incidence of HAZ and WAZ could be attributed to the potential effect on intestinal infections, common at household level with poor hygiene measures put in place. Strong evidence attempts to relate gastrointestinal parasitic infections such as *ascaris lumbricoides*, hookworm and *trichuris trichiara* with low household income, poor handling of personal and environmental sanitation, overcrowding and limited access to clean water (Mengistu *et al.*, 2007). These conditions are typical characteristics of urban informal settlement and could be real for Obunga slum in Kisumu. Poor nutritional status was associated with parasitic infections (Nam *et al.*, 2012) in Ethiopia and this kind of relationship would warrant further investigations in other unique settings and more specific in urban informal settlement that has become a public health concern.

Family size refers to the number of people living in a household to constitute a family. Larger family size may

interfere with food distribution especially among poor households where resources are limited. Large family sizes have been found to be associated with protein-energy malnutrition [PEM] (Ehtishman *et al.*, 2011). This background confirmed that many of the studies seemed to dwell on general rural population with few urban oriented investigations. This indicates limited focus on unique settings of Public Health concern like urban informal settlements. The general research effort ignores competition of these factors as predictors of nutritional status with an integrated predictor model block. These are major gaps that this study intends to close.

2. Materials and Methods

2.1. Study Setting Description

This study concentrated in Kisumu East where under five mortality rate (220/1000) has consistently exceeded the national rates between 2008 and 2014 (52/1000) with minimal decline experienced at the moment (Central Beureu of Statistics *et al.* 2014). Malnutrition remains one of the leading causes of child mortality in poor resource settings. A few studies that have explored the causes of malnutrition in urban setting in Kenya concentrated more on the capital city influence where Nairobi has been on focus, ignoring fast growing cities like Kisumu. Kisumu is currently experiencing high rate of expansion of urban informal settlement including Nyalenda, Bandani, Manayatta, Nyawita and Obunga.

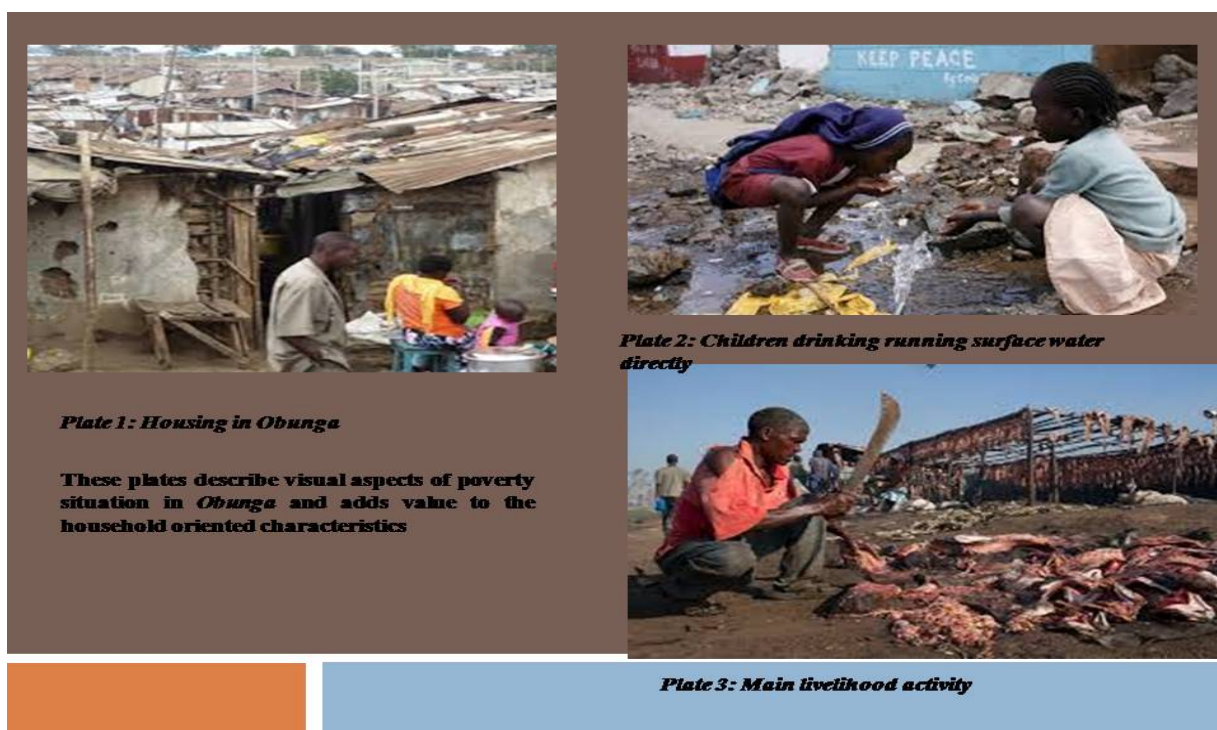


Figure 1. Visual setting description

Among these five slums *Obunga* is expanding at a higher rate in addition to being marred with signs of chronic poverty which could be an underlying cause of poor nutrition status. According to August 2011 sentinel site surveillance; HAZ rate was at 41% against 39.21% national rate while severe acute malnutrition (SAM) rate was 1.8% which compares high against International bench marks where 0-1% is a normal case, 1-1.9% Alert case and 2-2.9% Critical case (Kisumu Medical Education Training, 2011). This calls for urgent need to assess the prevalence of malnutrition and determine an etiological pattern among children within 6-59 months. This study therefore shifted focus from large slums in the City of Nairobi to fast growing slums in Kisumu in order to establish influence of maternal related factors on nutritional status of children between 6-59 months.

2.2. Research Process and Methods

The study targeted a population of 4000 eligible households from which a scientifically determined representative sample size was determined to arrive at 400 eligible households. An eligible household had a child between 6-69 months whose mothers consented to participate. Fishers *et al* formula (Mugenda and Mugenda, 2009; Omondi 2016) was used to determine the sample size. Selection of individual participants was based on systematic randomly sampling techniques.

The study employed use of structured questionnaire which

had household variables and additional anthropometric form for weight, height and age records. The latter were conducted using standards calibrated instruments and acceptable clinical procedure. Household factors included measures such as food insecurity, diet diversity, intestinal infections and family size. The final tool was pre-tested for reliability and validity. Reliability test applied *participating pretest methods* where the respondents were informed that the pretest is a practice run. They were asked to explain reactions to question form, wording and order. This kind of pretest was useful to determine whether the questionnaire was understandable. The second pretest method was an *undeclared pretest*, where the respondents were not informed that the exercise was a pretest. The survey was given just the same way as it would happen for the real survey. This type of pretest was useful in checking choice of analysis and the standardization of the survey. Validity focused on content approach from expert review mechanisms.

Data was analyzed using both descriptive and inferential statistics. Descriptive statistics made use of means and standard deviation, histograms and proportions. Inferential statistics used mainly z-test for single proportion and odds ratio as a test for associated risk estimates. The study put into consideration critical ethical issues of research involving human subjects mainly informed consent, confidentiality and ethical approvals.

Table 1. Distribution of households by household factors

Household Factors	Frequency	Proportion (%)	z-test	Confidence Interval (C.I)
Food Security Measures				
Proportion of household purchasing or producing food enough for members throughout the years(FS 1)*	322	80.5	8.245	0.24:0.38
Proportion with a reference get access to three meals a day for each day in the past one week(FS 2)*	365	91.25	12.5	0.35:0.49
Proportion of with a reference child missing food at all through the day because there was no food within the ast one month(FS 3)*	51	12.75	-11.33	-0.44: -0.31
Proportion with alternative ways of getting food for a reference child without purchase or production (FS 4)*	67	16.75	-9.96	-0.39: -0.27
Food Consumption frequency and Diet Pattern		0		
Foods made from millet, sorghum, maize, rice, porridge or pastes.	126	31.5	-5.29	-0.25: -0.12
Sweet or white potatoes, white yams & cassava.	52	13	-11.12	-0.43: -0.30
Dark green leafy vegetables, sukuma wiki, and mchicha,	121	30.25		
Fruits such as mangoes, wild fruits, pineapple, lemons, and oranges.	156	39	-5.68	-0.26: -0.13
Eggs, Fish, meat, liver, and chicken.	50	12.5	-11.44	-0.44: -0.31
Beans, peas, green grams, and lentils.	44	11	-11.98	-.045: -0.33
Milk, cheese, yogurt or other milk products	39	9.75	-12.3	-0.46: -0.34
Oils, fats, butter, ghee	3	0.75	-	-
Sugar, sugar products, honey	4	1	-	-
Proportion of reference child diagnosed to have bloody diarrhoea in the past one month (parasitic infection)	87	21.75	-	-
				Mean (SD)
Family size				4.07 (±1.35)
Total diet diversity				37.85 (±23.66)

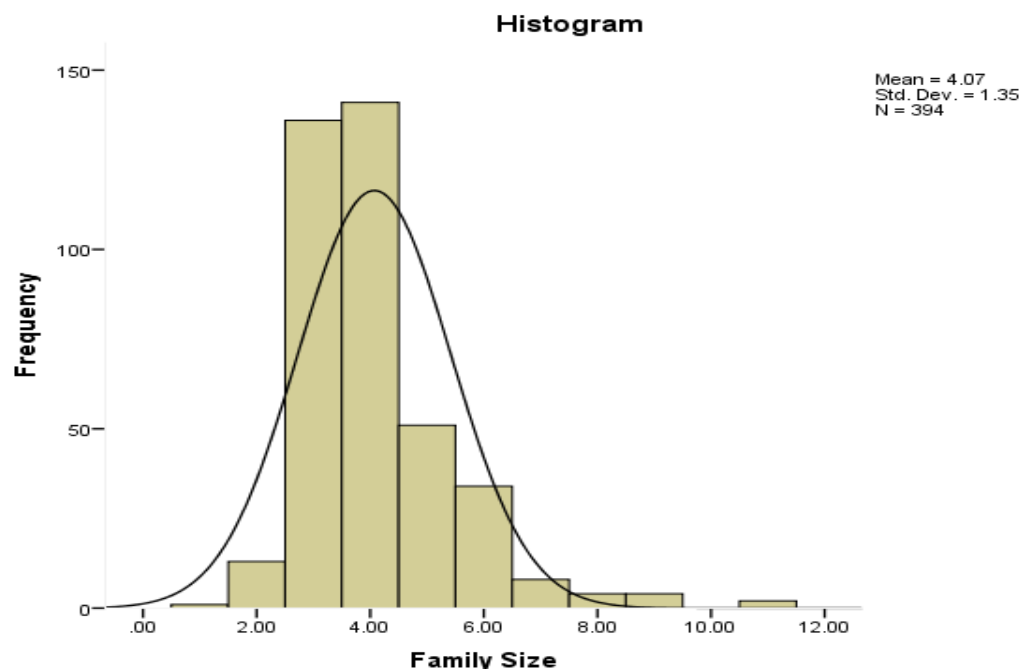


Figure 2. Distribution of the households by family size

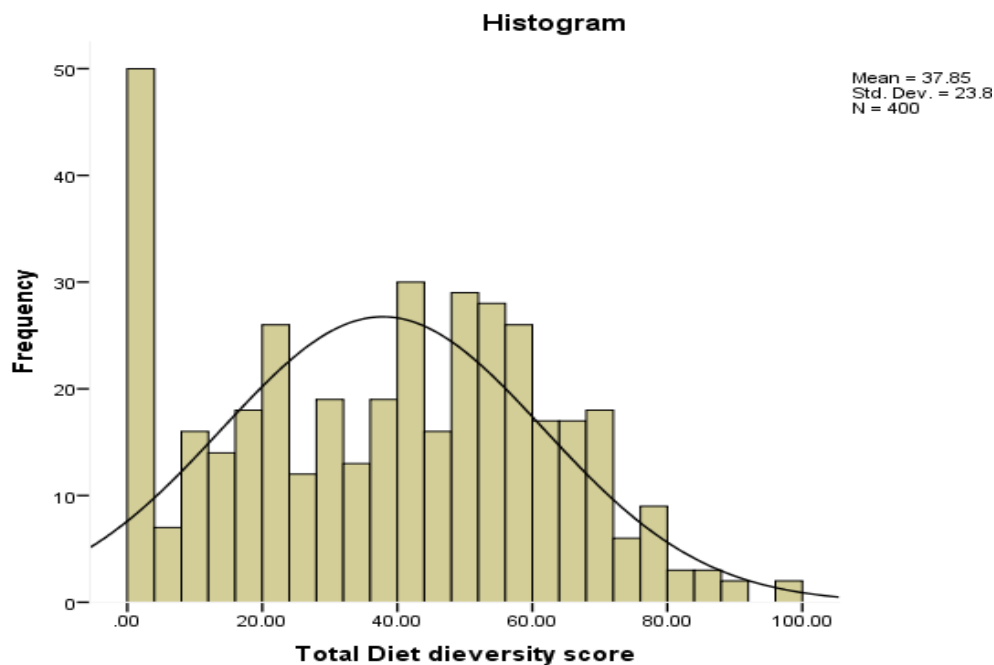


Figure 3. Distribution of households by total diet diversity

3. Results

3.1. Descriptive Summary of Household Factors

The finding in Table 1 shows distribution of selected household factors among eligible households. Food security factor which had four indicators revealed that food access and food production were the most dominant food security measures among households at 91.25% and 80.5% respectively. These proportions were significantly higher than expected frequency.

Food consumption frequency and diet pattern also

revealed dominant consumption of fruits (39.0%), cereal groups (31.5%) and vegetables (30.3%) in that order. Consumption of starches (13.0%), animal meat (12.5%), plant protein (11.0%) and milk and milk products (9.75%) registered low proportions. Other food categories were significantly lower than the expected frequency of 50% ($p < 0.05$) based on z-test for two proportions. Parasitic infection characterized by bloody diarrhea in the past one month revealed a reasonable frequency of 22.7%. This implies that within one month about 21.75% of children had food or water borne infection. Generally, the mean family

size and total diet diversity score was 4.07 (± 1.35) and 37.85 (± 23.66) respectively.

3.2. Family Size Distribution

The findings of this study revealed that each household had at least four members depicted by a mean of 4.07 (± 1.35). The range of family size was 1-11 children with normal distribution (skewness=1.162). This distribution is shown in figure 2. This information implies that a household in Obunga slum will have at least 4 members any time one makes a visit assuming that other factors like fertility rate or death remain the same. Six members were randomly left out in the calculation of mean.

3.3. Total Diet Diversity Score Distribution

The mean diet diversity score calculated by total number of food groups consumed from 7 food group categories was 37.85 (± 23.66). This shows a wider variation of total diet diversity score among households due to a larger size of standard deviation. However, this distribution pattern still displayed a normal distribution (skewness=-0.031) and a range between 0-96. This shows that the diet diversity score for each household had a true representation of the consumption pattern that is ideal and representative of usual

pattern.

3.4. Influence of Household Factors on Nutritional Status

Table 2 shows multivariate binary logistic regression of selected household factors in the equation. Based on the previous coding of stunting an Adjusted multivariate analysis was performed to establish the association between household factors and stunting. The results revealed that intestinal parasitic infection was highly associated with stunting (Adjusted odds ratio=2.79, C.I =1.59-4.89, $p < 0.05$). This implies that an increase in 1 unit of intestinal infection was more likely to increase stunting by 2.79 times. Family size was also significantly associated with stunting (Adjusted odds ratio =1.238, C. I=1.031-1.486, $p < 0.05$). This finding implies that for a 1-unit increase in family size increases stunting by 1.238 times. Total diet diversity score gain was highly associated with stunting (Adjusted odds ratio=1.021, C. I=1.011-1.031, $p < 0.05$). This also implies that 1-unit increase in total diet diversity score increases stunting by 1.021 times. All indicators of food security (FS-1, FS2, and FS4) displayed no significant relationship at all with stunting and food security (F3) was invalid in the equation.

Table 2. Household correlates associated with nutritional status based on crude odds ratio and adjusted odds ratio at 95% level of confidence

Variable	Crude Odds ratio (OR)	95% C. I	Adjusted Odds Ratio (OR)	95% C. I
<i>Stunting</i>				
Food security				
FS-1	.958	.552-1.660	1.154	.628-2.120
FS-2	.879	.384-2.010	1.166	.463-2.939
FS-3	-	-	-	-
FS-4	1.038	.609-1.766	.991	.549-1.790
Intestinal Parasitic Infection	2.450*	1.498-4.005	2.791*	1.593-4.890
Family Size	1.174*	1.003-1.375	1.238*	1.031-1.486
Total Diet diversity score	1.019*	1.010-1.027	1.021*	1.011-1.031
<i>Wasting</i>				
Food security				
FS-1	1.651	.794-3.431	1.641	.770-3.497
FS-2	1.429	.500-4.088	1.065	.349-3.257
FS-3	.711	.313-1.614	.760	.317-1.822
FS-4	.667	.326-1.367	.906	.413-1.988
Intestinal Parasitic Infection	.411*	.218-.775	.500*	.250-1.001
Family Size	1.114	.909-1.364	1.100	.884-1.367
Total Diet diversity score	.992	.980-1.005	.996	.983-1.009
<i>Underweight</i>				
Food security				
FS-1	1.888	.939-3.796	1.991	.963-4.116
FS-2	1.064	.358-3.158	.792	.252-2.486
FS-3	1.327	.534-3.299	1.282	.483-3.402
FS-4	.525	.269-1.024	.777	.372-1.624
Intestinal Parasitic Infection	.482*	.263-.884	.468*	.237-.924
Family Size	1.104	.912-1.337	1.140	.932-1.395
Total Diet diversity score	1.007	.995-1.019	1.008	.996-1.021

* $p < 0.05$

Among the household factors only parasitic infection had a significant association with wasting (Adjusted odds ratio=0.5, C. I=0.25-1.001, $p<0.05$). This implies a 1-unit increase in parasitic infection decreased wasting by 0.5 times. This outcome somehow did not make sense as one would expect infection to increase wasting due to competition in nutrients between the child the (host) and parasites. Somehow it appeared that food security categories indicators (FS1, FS2, FS3 and FS4) had no significant association with wasting ($p>0.05$). Family size and total diet diversity score also showed no significant associational link with wasting.

Similarly, underweight was coded in the format of binary scores. The findings revealed that intestinal parasitic infection was significantly associated by underweight (Adjusted odds ratio=0.468, C. I=0.237-0.924, $p<0.005$). This implies that 1-unit increase in intestinal parasitic infection decreased underweight by 0.468 times. Again this result was unique and would raise concern as it is naturally expected that underweight would increase with infection. Other factors including food security categories (FS1, FS2, FS3 and FS4), family size and total diet diversity score had no significant association with underweight ($p>0.05$).

4. Discussion

The aim of this study was to determine household factors that influence nutritional status among children 6-59 months within households in Obunga informal settlement in Kisumu city, Kenya. Parasitic infections, family size and diet diversity score revealed significant influence on both HAZ and WHZ. This implies that this category of household factors had considerable effect on both chronic and acute malnutrition of children. These results first, concur with previous studies where there has been strong linkage between helminthes infection and HAZ (Shang *et al.*, 2010; Mook and Leslie, 1986). However, parasitic infection somehow decreased wasting and had a significant inverse relationship with wasting. It could be that during infection children who were recovering from symptoms after treatment could have gained weight quickly and during increased level of food intake in view of their condition or parents were becoming more attentive to feed the children. Strong linkage between infections and nutritional status has been a typical outcome in urban schools in slums (Amuta and Housou, 2009) and this concurs and ascertains the outcome for the current study where there are evident relationships. Probably this situation could be explained by a study that identified several environmental related factors such as poor hygiene, overcrowding and culture access to clean water as the theory behind increased menace of common infection-*Ascaris lumbricoides*, hookworm and *trichuris trichiara* (Mengistu *et al.*, 2007).

Secondly, significant effect brought about by family size on status of HAZ and WHZ also occurs with a study especially for WHZ (Eltishman *et al.* 2011). Family size has major influence on intra-household food distribution and this

also determines food distribution which also determines food access by individual children.

Thirdly, diet diversity which is a measure of quality of diet and a proxy outcome of food security as household level significantly influenced HAZ and WHZ. The evidence of this study was a true confirmation of Arimond and Ruel (2004) study as well as Rah *et al.* (2010) study outcome. These scenarios seemed to be recurrent in urban settings, depriving typical situations in urban slum dwellings.

It appears that WAZ did not show linkage with household factors except to parasitic infection which was inversely associated with underweight in a similar pattern as wasting. By proxy explanation, underweight being a short measure for hunger could have been reduced by infection due to possible weight gain during increased level of food intake in view of their condition or parents were becoming more attentive to feed the children. Thus outcome was contrary to the findings of Hatloy *et al.* (2000). However, due to the fact that WAZ is a fluctuating index and a measure of acute hunger, the outcome could be unpredictable in relation to household factors.

5. Conclusions

In conclusion, based on the findings it appears that when all the three blocks of factors are put together and considered interactively HAZ is hierarchically predicted by food security, intestinal parasitic infection, family size, diet diversity score and health seeking behavior in that order. The study recommends that interventions targeting reducing levels of malnutrition within Obunga informal settlement and other informal settlement with similar characteristics should focus on boosting food security, promoting positive hygiene practices, reducing family size through family planning and emphasize on diet diversity.

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