EFFECTS OF DIET ON STUNTING AND WASTING AMONG CHILDREN 6-59 MONTHS LIVING IN MUKURU SLUM, NAIROBI COUNTY

Author(s) / Szerző(k):
Morris Mbuthia Wagaki
University of Debrecen

E-mail:
morris.wagaki@outlook.com

Cite: Morris Mbuthia Wagaki (2026). Effects Of Diet On Stunting And Wasting Among Children 6-59 Months Living In Mukuru Slum, Nairobi County. . *OxIPO – Interdiszciplináris tudományos folyóirat*, VIII. évfolyam 2026/1. szám. 9-31.
Idézés:
Doi: https://www.doi.org/10.35405/OXIPO.2026.1.9

EP / EE: Ethics Permission / Etikai engedély: KFS/2026/O1-0001

Reviewers: *Public Reviewers / Nyilvános Lektorok:*
Lektorok:
1. Olteanu Lucián Liviusz (Ph.D.), Gál Ferenc Egyetem
2. Lestyán Erzsébet (PhD.), Gál Ferenc Egyetem

Anonymous reviewers / Anonim lektorok:
3. Anonymous reviewer (Ph.D.) / Anonim lektor (Ph.D.)
4. Anonymous reviewer (Ph.D.) / Anonim lektor (Ph.D.)

Abstract

The age of 6-59 months is a period that numerous children are stunted and wasted due to low nutritional intake. Child undernutrition is one of the underlying causes of child mortality, which accounts for about 45% of deaths reported for children under 5 years of age. The purpose of the study was to assess the effects of diet on stunting and wasting among children 6-59 months living in Mukuru Slum, Nairobi County. A descriptive cross-sectional study was carried out with 108 mothers as respondents. Cluster sampling method was used to select the villages. A systematic random sample of 108 households with 118 children between the ages of 6-59 months old was studied. Data collection tools and methods included a structured interviewer administered questionnaire which was used to collect data on socio demographic and socioeconomic characteristics, dietary assessment, a seven-day food group diversity and food frequency

questionnaire and anthropometry. Weight and height were measured for 118 children (100% of the sample) and analyzed according to the World Health Organization Weight-for-height Z-scores (WHZ) and Height-for-age Z-scores (HAZ) tables (WHO 2006) to classify nutritional status of children. The data were captured on an *Excel* spreadsheet by the researcher and analyzed for descriptive statistics on the Statistical Package for Social Sciences (SPSS v 22.0) 2018. Research findings revealed the prevalence of stunting and wasting among children aged 6-59 months in Mukuru Slum were (14%) and (6%) respectively. Children aged 12-23 months old had the highest prevalence of stunting (41.2%). Wasting was low at 24-47 months old children (14.3%), however it increased steadily up to 59 months. (62.7%) of children were exclusively breast fed while (37.3%) had mixed feeding for the first 6 months. Only (76.3%) of the children were timely initiated to complementary food between 6-7 months. Majority of the households (72.2%) had a low food group diversity score and (21.2%) consumed meals less than 3 times per day. Dietary practices had an effect on stunting and wasting; higher odds of stunting were observed among children who did not exclusively breast fed for the first 6 months; children who did not meet the minimum dietary diversity as well as those who fed less than 3 times per day were more likely to be stunted and wasted. The study indicates that (47.2%) of the households interviewed had knowledge of complementary feeding while (33.3%) did not have any knowledge at all. This could be due to the fact that mothers in the slum of Mukuru had little access to nutrition related information. For the socio-economic and demographic characteristics considered, poor education of the parents, family size and low household income all contributed indirectly to stunting and wasting in children. The findings of this study conclude that the diet of infants and young children has an effect on their nutritional status. The magnitude of stunting and wasting among the children in this study demonstrates the need for effective and sustainable food and nutrition interventions, such as awareness campaigns aimed at educating the community on the importance of infant and young child nutrition, as well as appropriate feeding practices designed to improve dietary intake, dietary diversity, and overall nutritional status.

Keywords: child undernutrition; stunting; wasting; infant and young child feeding; dietary diversity; breastfeeding; complementary feeding; socioeconomic factors; urban slums; Nairobi County.

Diszcipline: medicine

Absztrakt

AZ ÉTREND HATÁSA A 6–59 HÓNAPOS GYERMEKEK NÖVEKEDÉSBEN VALÓ ELMARADÁSRA ÉS A SOVÁNYSÁGRA A MUKURU NYOMORNEGYEDBEN, NAIROBI MEGYÉBEN

A 6–59 hónapos életkor kritikus időszak, amely során számos gyermeknél alakul ki növekedésben való elmaradás és sovány ság az elégtelen tápanyagbevitel következtében. A gyermekkori alultápláltság a gyermekhalandóság egyik alapvető oka, amely az öt év alatti gyermekek körében jelentett halálesetek mintegy 45%-áért felelős. A vizsgálat célja az étrend hatásának felmérése volt a növekedésben való elmaradásra és a soványságra a Mukuru nyomornegyedben (Nairobi megye) élő 6–59 hónapos gyermekek körében. Leíró, keresztmetszeti vizsgálat készült 108 anya bevonásával. A falvak kiválasztására klaszteres mintavételi módszert

alkalmaztak. Szisztematikus véletlen mintavétellel 108 háztartást vontak be, összesen 118, 6–59 hónapos gyermekkel. Az adatgyűjtés strukturált, kérdezőbiztos által felvett kérdőív segítségével történt, amely a szociodemográfiai és szocioökonómiai jellemzőkre, az étrendi értékelésre, a hét napos élelmiszercsoport-diverzitásra és az ételfogyasztási gyakoriságra, valamint az antropometriai mérésekre terjedt ki. A testtömeget és testmagasságot mind a 118 gyermek esetében megmérték (a minta 100%-a), és az adatokat az Egészségügyi Világszervezet (WHO) testsúly–testmagasság Z-pontszám (WHZ) és testmagasság–életkor Z-pontszám (HAZ) referenciaértékei alapján elemezték (WHO, 2006) a tápláltsági állapot besorolásához. Az adatokat a kutató Excel-táblázatban rögzítette, majd leíró statisztikai elemzésnek vetette alá az SPSS (v22.0, 2018) statisztikai szoftver segítségével. Az eredmények szerint a növekedésben való elmaradás és a sovány ság prevalenciája a 6–59 hónapos gyermekek körében a Mukuru nyomornegyedben rendre 14% és 6% volt. A 12–23 hónapos gyermekek körében volt a legmagasabb a növekedésben való elmaradás előfordulása (41,2%). A sovány ság előfordulása alacsony volt a 24–47 hónapos korcsoportban (14,3%), azonban 59 hónapos korig fokozatosan emelkedett. A gyermekek 62,7%-át az első hat hónapban kizárólag szoptatták, míg 37,3%-uk vegyes táplálásban részesült. A gyermekek 76,3%-ánál történt meg időben, 6–7 hónapos korban a kiegészítő táplálás bevezetése. A háztartások többségében (72,2%) alacsony volt az élelmiszercsoport-diverzitási pontszám, és 21,2%-ban a gyermekek naponta háromnál kevesebb alkalommal étkeztek. Az étrendi gyakorlatok hatással voltak a növekedésben való elmaradásra és a sovány ságra: magasabb volt a stunting esélye azoknál a gyermekeknél, akiket az első hat hónapban nem kizárólag szoptattak; továbbá azoknál, akik nem érték el a minimális étrendi diverzitást, illetve akik naponta háromnál kevesebbszer étkeztek, nagyobb valószínűséggel fordult elő növekedésben való elmaradás és sovány ság. A vizsgálat azt is kimutatta, hogy a megkérdezett háztartások 47,2%-a rendelkezett ismeretekkel a kiegészítő táplálásról, míg 33,3% egyáltalán nem rendelkezett ilyen tudással. Ez összefügghet azzal, hogy a Mukuru nyomornegyedben élő anyák korlátozott hozzáféréssel rendelkeznek a táplálkozással kapcsolatos információkhoz. A vizsgált szocioökonómiai és demográfiai tényezők közül a szülők alacsony iskolai végzettsége, a nagyobb családméret és az alacsony háztartási jövedelem közvetett módon mind hozzájárultak a gyermekek körében megfigyelt növekedésben való elmaradáshoz és sovány sághoz. A tanulmány megállapítja, hogy a csecsemők és kisgyermekek étrendje jelentős hatással van tápláltsági állapotukra. A növekedésben való elmaradás és a sovány ság ebben a populációban tapasztalt mértéke rávilágít a hatékony és fenntartható élelmezési és táplálkozási beavatkozások szükségességére, beleértve a közösségi szemléletformáló kampányokat a csecsemő- és kisgyermektáplálás fontosságáról, valamint azokat a megfelelő táplálási gyakorlatokat, amelyek célja az étrendi bevitel, az étrendi diverzitás és az általános tápláltsági állapot javítása.

Kulcsszavak: gyermekkori alultápláltság; növekedésben való elmaradás; sovány ság; csecsemő- és kisgyermektáplálás; étrendi diverzitás; szoptatás; kiegészítő táplálás; szocioökonómiai tényezők; nyomornegyed; Nairobi megye.

Diszciplína: Orvostudomány

Introduction

Childhood is a period in which major growth spurt happens, which require macronutrients and micronutrients in adequate quantity and quality (Terati et al., 2018). The age of 6-59 months is a golden period characterized by rapid growth and development, thus it is at this period that numerous children are stunted and wasted due to low nutritional intake (Terati et al., 2018). Undernutrition, according to Panigrahi and Das (2014) manifests itself in various forms such as stunting, wasting and underweight (Panigrahi & Das, 2014). Stunting and wasting are indicators of the extent of child under nutrition (Matanda et al., 2014). These two forms of malnutrition are closely related and often occur together in the same populations and often in the same children (Matanda et al., 2014). Effects of stunting include delayed motor development, impaired cognitive function and poor school performance which are largely irreversible after the age of two years, on the other hand wasting, or low weight for height, is a strong predictor of mortality among children under five (Briend et al., 2015).

According to WHO-UNICEF-World Bank report, it was estimated that in 2012 about 162 million and 51 million of under five children were stunted and wasted, respectively, worldwide (Panigrahi & Das, 2014). Child undernutrition is one of the underlying causes of child mortality which accounts for about 45% of deaths reported for children under-5 years of age (Akombi et al., 2017).

East Africa and Kenya in particular, child under nutrition is a highly salient issue which is among the 20 countries that account for 80% of the worlds under nourished children (National Bureau of Statistics-Kenya & ICF International, 2015). Following statistics from National Bureau of Statistics-Kenya and ICF International (2015) stunting prevalence has slightly reduced from 35% to 26%, while wasting has remained constant in the last 20 years at 7% as stated in the Global Nutrition Report (Kimani, 2014). In Kenya, the persistence of high levels of under nutrition in children, is reflected by poor prioritization and commitment to nutrition by the Government (Kimani, 2014).

This suggests that to decrease the high levels of undernutrition in children, interventions should aim at preventing both stunting and wasting, which often share common causes. Thus, the purpose of this study was to highlight how inadequate dietary intake contributes to persistent undernutrition among children living in Kenyan slums, emphasizing the need for improved infant and child feeding practices. The aim of this study was to assess the effects of diet on stunting and wasting among children 6-59 months living in Mukuru Slum, Nairobi County.

Methodology

Location of Study. The study was conducted at Mukuru Slum, Nairobi County. Mukuru Slum is strategically located, within 20-30 minutes' drive from the city Centre of Nairobi. Mukuru Slum is one of

the largest slum in Nairobi with an estimated population of about 700,000 people (Imoto & Otsuki, 2018). The study area is generally flat at an altitude of 1618-1623m above sea level. There is a gentle smooth slope towards the stream that water passes through the slum a reason why most of the areas remain flooded during the rainy season (CURI, 2012).

Study Design. This study employed a descriptive cross-sectional study design that used a structured questionnaire to collect quantitative data. Data was collected from mothers/care givers who were respondents of whom each represented a household with children 6-59 months old to assess the effects of dietary intake on stunting and wasting in children 6-59 months living in Mukuru Slum, Nairobi County.

Sample Size Determination. The sample size was calculated using Cochran (1977) formula as follows;

$n_0 = z^2pq/e^2$. Where, n_0 is the sample size

Z = the standard normal deviation which is 1.96 at 95% confidence interval.

p = proportion of children under five years with acute malnutrition in Nairobi County; estimated at 5.7% (Lupao & Mogusu, 2019).

Acute malnutrition prevalence is used because it represents the short term effects of malnutrition in a population and is sensitive to recent dietary changes (Ndambuki, 2015).

$q = 1 - p$; $1 - 0.057 = 0.943$

e = the desired level of precision (the margin of error) of +/-5% = 0.05

Therefore; $n_0 = (1.96)^2(0.057)\ (0.943)\ /\ (0.05)^2 = 82.6$; Hence, 83 households are needed

The sample size was increased by 30% to compensate for households where children went somewhere with the mother (Singh & Masuku, 2014).

Thus;

30% of 83 = 24.9 + 83 =107.9; therefore 108 households each with a mother with a child 6-59 months was considered adequate for the sample study.

Study Sample. The study sample was 108 households each with a mother and 118 children under-five years 6-59 months of age. The difference between the number of households and the number of children is due to the fact that some households had more than one child under five, and both were taken for the study.

Sampling Procedure, Cluster sampling was used to identify the study villages in Mukuru Slum. The population was divided into groups consisting of nine villages namely, Mukuru Kwa Reuben, Mukuru Kwa Njenga, Sinai, Paradise, Jamaica, Kingstone, Mariguini, Futata Nyayo and Kayaba. Each village (group) was assigned a unique number from 1 to 9, after which a simple random sample of villages was conducted to select 3 villages. Each of the selected villages comprised 36 households. Systematic Random Sampling was used to

recruit households using the formula; R = N/n
Where; R is the sampling interval,
N is the total number of households,
And, n is the actual sample size of households.
Therefore, R= 108/36=3. The 1st household was selected randomly and the rest of the households fell on a fixed interval of 3, therefore every household that fell on the 3rd number was selected.

Data Collection Tools and Procedures. An interviewer administered questionnaire was used to collect data and it included socio demographic and socioeconomic characteristics, seven days food frequency and anthropometric measurements (weight and height/length) and age of the child.

The Length or height was measured and reported to the nearest 0.1cm length/height using a length/height board. Length measurement (<2 years) and height measurement (>2 years).

Weight measurement was reported to the nearest 0.1 kg. The weight was taken when the child wore no clothing or just one layer of undergarments. The weight was measured using a digital bathroom scale for measuring weight of children.

In this study a seven-day food group's diversity and food frequency questionnaire for children 6-59 months was used.

Ethical Consideration. Research clearance was sought from the Head of Department Office, Department of Human Nutrition and Dietetics, Technical University of Kenya. Informed consent was sought from the Chief of Mukuru Slum area before undertaking the research. Participation was voluntary through informed consent from the mother/ caregiver. The purpose of the study was clearly explained to the mother/ caregiver and confidentiality of their response was assured. There was no incentive to participate in this study, and no mother/ caregiver was forced to answer question(s) they did not wish to answer.

Data Analysis, The computer program Statistical Package for Social Sciences (SPSS v 22.0) 2018 and MS Excel, were used in analyzing the data collected. The data was organized, presented, analyzed and interpreted using frequencies, percentages, tables, graphs and charts. The WHO (2006) WHZ and HAZ tables were used to classify children's nutritional status (World Health Organization, 2006). Children were classified as stunted or wasted if their respective Z-scores fell below -2SD.

Prevalence was calculated by dividing the number of children 6-59 months categorized as being stunted and wasted by the Target Population multiplied by 100 to obtain a percentage rate.

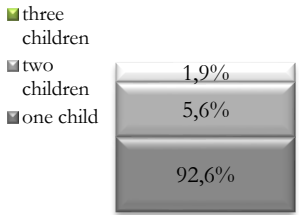
Results

Socio Demographic Characteristics of the Households

The study included one respondent who were mothers for children 6-59 months from each household and in total 118

children were studied. The youngest child was 6 months old, while the oldest was 59 months old. Of the households studied, 92.6% had 1 child between 6-59 months old, and 5.6% had 2 children while 1.9% had 3 children between 6-59 months old, accounting for the difference between the number of households and that of the children studied (Figure1).

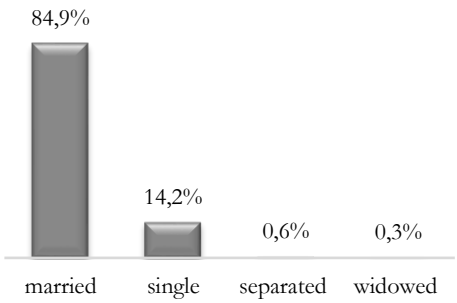
Figure 1. Proportion of household's vs number of children aged between 6-59 months old per household



Marital Status

Majority of the mothers in the households were married 84.9%, while a few single 14.2%, separated 0.6% and widowed 0.3% (Figure2).

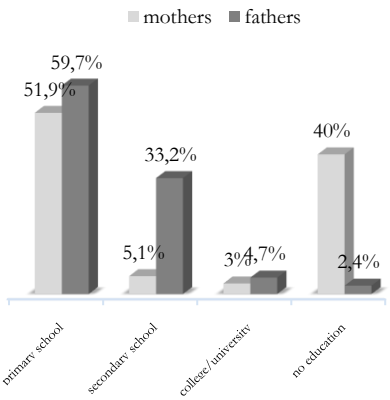
Figure 2. A graph of marital status



Education Level

Out of 108 households 92 households had both parents, most of the respondents were not well educated, for the 92 households 59.7% of males completed primary school while 33.2% had secondary education, 4.7% had gone past secondary education and 2.4% were not educated. Up to 5.1% of the mothers had attained secondary education, while 51.9% had completed primary school, only 3% of the mothers had gone past secondary and those with no education were 40%. (Figure3).

Figure 3. A graph of education level



Family Size

A total of 108 households were included in the study. Table 1 describes the distribution of the study households by size. The largest household had 9 members while the smallest had 2 members. Majority of the households 37% had 4 members, 33.3% had 3 members, 13% had 5 mem-

bers respectively and only 1 household 0.9% had 9 members (Table1).

Table 1. Distribution of the sample population by size of household

Family Size	Number of Households (frequency)	Percent (%)
2	5	4.6
3	36	33.3
4	40	37
5	14	13
6	6	5.6
7	4	3.7
8	2	1.9
9	1	0.9
TOTAL	**108**	**100**

Socio-Economic Characteristics of the Households

Household's Main Sources of Livelihood

The main source of livelihood for the study sample was casual labour 54.6%, self-employed 32.4%, salaried employment 9.3% and others 3.7% (Table2).

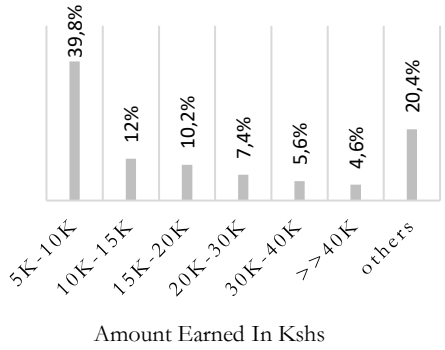
Table 2. Households main sources of livelihood

	Number of Households (frequency)	Percent (%)
Casual Labour	59	54.6
Self-Employed	35	32.4
Salaried Employment	10	9.3
Others	4	3.7
TOTAL	**108**	**100**

Household's Income

Figure 4 below shows the proportion of household income in the study area.

Figure 4. A graph of household income



All households (108) were interviewed for their monthly income. Most of the households 39.8% earned between 5,000-10,000Kshs, 12% earned between 10,000-15,000Kshs, 10.2% earned between 15,000-20,000Kshs, 7.4% earned between 20,000-30,000Kshs, 5.6% earned between 30,000-40,000Kshs, 4.6% earned above 40,000Kshs while 20.4% did not disclose their income. Majority in the slum only had hand to mouth salary.

Prevalence of Stunting and Wasting Anthropometric Results

Weight and height were measured for 118 children (100 percent of the sample) and analyzed according to the World Health Organization (WHO) standards and were classified as stunted or wasted if the respective z-scores fell below -2SD of the reference population for the age and sex (World Health Organization, 2006).

The results of the anthropometric measurements are reflected in table 3 below (Table3).

Table 3. Anthropometric measurements of the study children

Parameter	Z-Score	Population (n=118)	Percent (%)
Stunting	<-2	17	14
Wasting	<-2	7	6
Normal	≥2	94	80
TOTAL		**118**	**100**

The results in the above table show that the prevalence of stunting and wasting in the slum of Mukuru was 14% and 6% respectively.

Nutritional Status of Children

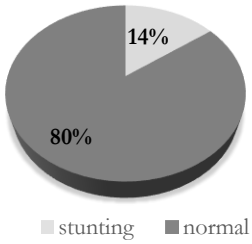
Anthropometric data of 6-59 months children which included the weight and height was taken and used in the evaluation of nutritional status of children. Two indices were used in the evaluation of nutritional status; height-for-age which measures stunting and weight-for-height which reflects wasting.

Stunting (height-for-age) of Children

The chart below shows the proportion of stunted children 14% in Mukuru Slum (Figure5).

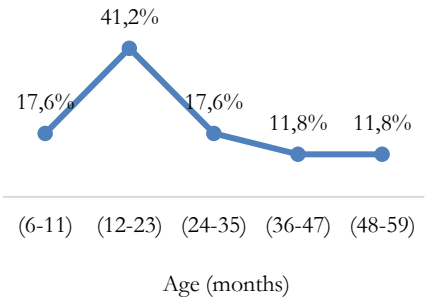
The results of this study indicated that the number of well-nourished children was relatively high standing at 80% of the study population. In this study, 14% of children 6-59 months were stunted.

Figure 5: Population of stunted children



Findings for stunting by age showed that in the study population, children aged 12-23 months old were more stunted (41.2%) (Figure6).

Figure 6. Proportion of stunted children by age

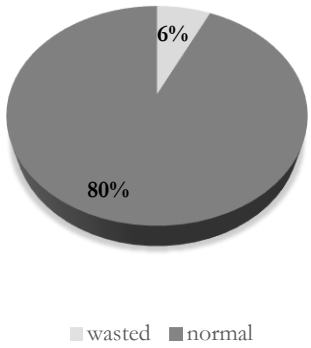


Wasting (weight-for-height) of Children

The chart below shows the proportion of wasted children 6% in Mukuru Slum (Figure7).

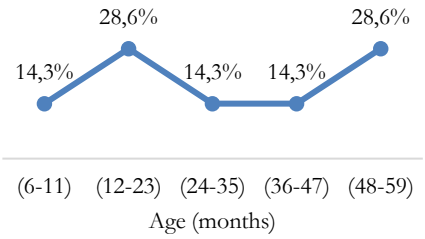
Results from this study show that a smaller percentage of children 6-59 months were wasted 6%.

Figure 7. Population of wasted children



Findings for wasting by age showed that wasting is very low at 24-47 months old children (14.3%); however, it increases steadily up to 59 months (Figure8).

Figure 8. Proportion of stunted children by age

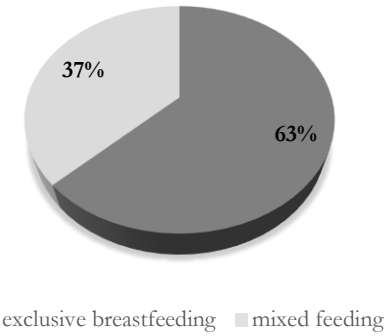


Effects of Diet on Stunting and Wasting Among Children

Breast Feeding

The results of the study indicated that 62.7% (n=74) of children were exclusively breast fed while 37.3% (n=44) had mixed feeding for the first 6 months. The results showed that the exclusive breast feeding rate was above the 50% national target (Figure9).

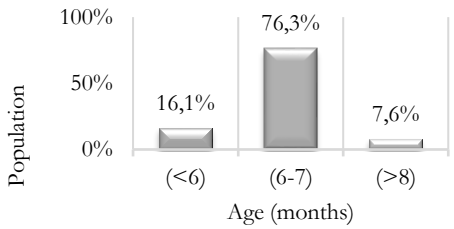
Figure 9. Population of breast fed children



Complementary Feeding Practices

The chart below shows the age at which complementary feeding began (Figure10).

Figure 10. Age at which complementary feeding began



Out of 118 children 16.1% (n=19) started complementary feeding below 6 months and 7.6% (n=9) began complementary feeding from 8 months. Only 76.3% (n=90) of the children were timely initiated to complementary food between 6-7 months, though this is below the national recommended 80%.

Frequency of Feeding

In assessing the frequency of meal consumed, the study results showed that majority of children 78.8% (n=93) fed at

least 3 times per day while 21.2% (n=25) fed less than 3 times per day (Figure11).

Figure 11. A graph of frequency of feeding of the study children

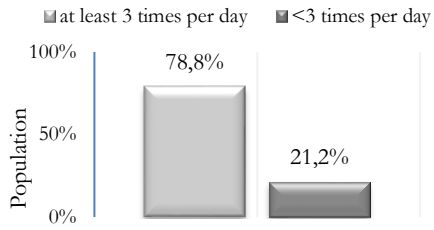
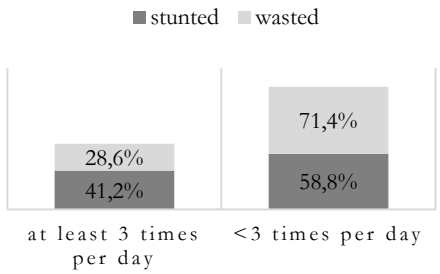


Figure 12. Proportion of children that were stunted and wasted based on the frequency of feeding



The Figure 12 above shows the proportion of children that were stunted and wasted based on the frequency of feeding. The proportion of children who were stunted and wasted that had consumed meals at least 3 times per day were 41.2% and 28.6% respectively while those who were stunted and wasted that had fed less than 3 times per day were 58.8% and 71.4% respectively.

Knowledge on Dietary Diversity

The results of the study show that 47.2% of the households interviewed had knowledge of complementary feeding, 33.3% were not aware of any activity, 11.1% heard about importance of diversified diet and 8.3% had knowledge that a child should eat four or more food groups (Table4).

Table 4. Knowledge on dietary diversity by size of household

	Number of Households (frequency)	**%**
Complementary Feeding	51	47.2
Importance of Diversified Diet	12	11.1
Child Should Eat Four or More Food Groups	9	8.3
Don't Know	36	33.3
TOTAL	**108**	**100**

Dietary Diversity

The Table 5 below shows food group diversity score

Table 5. Summary of food group diversity score

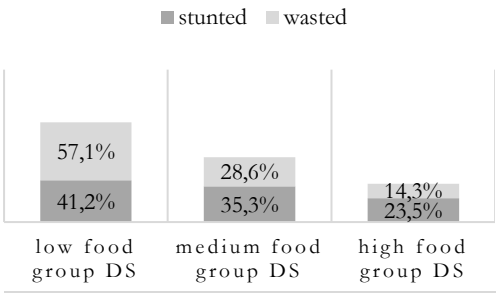
Food Group Diversity Score		**Number of Households (frequency)**	**%**
Level	**Range**		
Low	1-3 Food Groups	78	72.2
Medium	4-5 Food Groups	23	21.3
High	6-9 Food Groups	7	6.5
TOTAL		**108**	**100**

The majority of the households 72.2% had a low food group diversity score (1-3

food groups consumed in a period of seven days). This was followed by 21.3% with a medium food group diversity score (4-5 food groups) and 6.5 % with a high food group diversity score (6-9 food groups).

The Figure 13 below shows the proportion of children that were stunted and wasted based on the food group diversity score. The proportion of children who were stunted and wasted that had a low food group diversity score were 41.2% and 57.1% respectively. 35.3% stunted and 28.6% wasted had a medium food group diversity score, while 23.5% stunted and 14.3% wasted had a high food group diversity score.

Figure 13. Proportion of children that were stunted and wasted based on the food group diversity score



Discussion

Socio-Demographic and Socio-Economic Characteristics

Poor nutritional status of children in most developing countries is due to the presence of overwhelming of poverty that leads to unequal distribution of food at the household level, poor nutrient quality and diversity of diets (Muiruri et al., 2012). Every child has the right to have food, therefore there is a heavy burden to the household to be able to meet their basic requirements especially adequate food for all members in the family (Mofokeng, 2013). In a study carried out in Kwale, the demographic and socio-economic factors were implicated as the underlying causes of the poor nutritional status of children in Kenya (Gichana, 2013).

The demographic and socio-economic characteristics identified in the study population were; marital status of the mothers, education of the parents, household size, household's main source of livelihood and household's income. The results of the study show that 84.9% of women were married indicating that majority of the households had both parents hence upholding the moral values of the family and creation of conducive environment for upbringing of children. This is in agreement with Yalew et al. (2014) who noted that the environment has significant association with the nutritional status of children (Yalew et al., 2014).

Out of 108 households 92 households had both parents, for the 92 households only 4.7% of males had gone past secondary education while 2.4% were not educated. While for mothers only 3% had gone past secondary and those with no education were 40%. The study showed that more men had gone past secondary education and few had no education compared to women. Previous studies

indicate that greater education for mothers contributes to new skills, beliefs and choices about sound health and nutritional practices (Gichana, 2013). The Kenya Demographic and Health Survey of 2014 highlighted that children of no educated mothers are more likely to be stunted and wasted than those of highly-educated mothers (National Bureau of Statistics-Kenya & ICF International, 2015). The lack of attainment of appropriate education levels observed in the respondents who were mothers requires to be addressed if the nutritional status of children has to improve; indeed an educated woman has a positive impact to the household and national development.

The findings of this study show that the largest household had 9 members. Majority of the households 37% had 4 members, 33.3% had 3 members, 13% had 5 members and only 1 household 0.9% had 9 members. Other studies have shown that more children in a household are associated with more competition for scarce resources, which could affect children's dietary intake (Gichana, 2013).

The study showed that the income earned by household's respondents was not enough to enable them afford a diversified diet. 54.6% of the households were casual laborers, for which 39.8% of the households earned less than 10,000Kshs per month an indication that most families were struggling to afford even a single day's meal which is essential for good nutritional status of children. This study is in agreement with Bakalemwa (2014) whose findings indicated that the risk of malnutrition was increased when the monthly income was between 5,000-10,000Kshs and below per month (Bakalemwa, 2014).

Prevalence of Stunting and Wasting

The results of this study revealed that the prevalence of stunting (height-for-age) and wasting (weight-for-height) among children was 14% and 6% respectively. This study conquers with a study carried out by Mekonnen et al. (2017) who indicated that under nutrition among children continues to be a major public health problem in developing countries, which is often associated with inappropriate feeding practices that accounts for the rapid increase in the prevalence of stunting and wasting in children (Mekonnen et al., 2017).

Nutritional Status of Children

Stunting (height-for-age) of Children

The results of the study showed that the prevalence of stunting in the slum of Mukuru was 14%. It was noted that the level of stunting was highest among 12-23 months old children (41.2%). These results shows similar trend with a study by Kumar and Singh (2015) who found out that at the age of 12-23 months, when many children are being weaned from breast milk, 30% of children were stunted (Kumar & Singh, 2015). Terati et al. (2018) stated that stunting was most prevalent above 12 months of age, that the more children age, the more they stray from normal linear growth (Terati et al., 2018). Terati et al.

(2018) further explained that growth of children will continue to deviate from the normal course with inadequate dietary supply (quantity and quality) (Terati et al., 2018).

Stunting (height-for-age) is an indicator of chronic malnutrition arising from food and nutrition insecurity such as micronutrient deficiencies among other factors which interrupt normal growth. Height-for-age, therefore, is not sensitive to recent, short-term changes in dietary intake (Gichana, 2013). Therefore, unlike wasting, stunting is not affected by seasonality but by long-term effect of low socio-economic status and long-standing food and nutrition insecurity situation both at national level and household level.

Wasting (weight-for-height) of Children

Wasting (thinness) or weight-for-height of below -2SD is an indicator of recent and severe malnutrition (Mofokeng, 2013). In this study the prevalence of wasting or low weight-for-height was 6%, which is indicative of a poor nutrition status in the area based on the classification of the acceptable levels for acute malnutrition (wasting) which should be <5% (De Onis et al., 2018). Previous reports show that in Sub-Saharan Africa, nearly 1 in 10 children under the age of five years are wasted (Gichana, 2013). Thus, there is need for concerted efforts by all stakeholders to address the major drivers of malnutrition in the slums. Findings from this study show that wasting was very low at 24-47 months old children (14.3%); however, it increased steadily up to 59 months. This findings are in line with Ndambuki (2015) who noted that wasting increased steadily from 24-60 months of age (Ndambuki, 2015). Ndambuki (2015) further explained that the increase in the prevalence of wasting from 24 months of age is because of after weaning the child, most caregivers engage in economic activities outside the household hence giving less care to the children (Ndambuki, 2015).

Effects of Diet on Stunting and Wasting Among Children

Breast Feeding

Breastfeeding is a crucial determinant of the nutritional status of children, particularly those under the age of two years. The results of this study indicated that 62.7% of children were exclusively breast fed while 37.3% had mixed feeding for the first 6 months. These findings show that majority of children in the slum were being breast fed exclusively for the first six months. In a related study to determine implication of exclusive breastfeeding on nutrition status of under-fives, it was established that exclusive breastfeeding was protective against stunting (Ayisi & Wakoli, 2014).

In order to improve breastfeeding practices in the slums, there is a need to put several measures in place that are geared toward behavior change among mothers/ caregivers of children. While intensive counselling on Infant and Young Child Nutrition at health facilities (during

antenatal clinic visits and post-delivery visits) is one avenue for improvement, this should be supplemented with investment at the community level to reach mothers of children under two years of age, as well as expectant mothers during the first 1,000 days.

Complementary Feeding Practices

Diversification in complementary feeding is an important factor in meeting the need for essential nutrients. Lack of diversity is particularly a severe problem among poor populations in the developing world, where diets are based predominantly on starchy staples and often include few or no animal products and only seasonal fruits and vegetables (Solomon et al., 2017). For infants and young children, the problem is highly sensitive because they need energy and nutrient-dense foods to grow and develop both physically and mentally.

The prerequisites for complementary food are correct time, correct amount, safety and correct methods of intake (Terati et al., 2018). On timely introduction of complementary feeding (at 6 months or 180 days of age), the results show that 76.3% (n=90) of the children were timely initiated to complementary food between 6-7 months though this is below the national recommended 80%, while 16.1% (n=19) started complementary feeding below 6 months. However this contrasts with findings to a study done by Muchina and Waithaka (2010) that showed that by the fourth month a majority 63.1% of children had started receiving complementary feeds (Muchina & Waithaka, 2010). Similarly, a study in Bangladesh indicated that 16 % of women exclusively breastfed their children for less than 6 months, out of which 38.1% of the children were stunted (Kumar & Singh, 2015).

Type and amount of solid foods first introduced into the diet are strongly associated with the growth and development of the child (Kumar & Singh, 2015). The results of this study show that 7.6% (n=9) began complementary feeding from 8 months. According to Kumar and Singh (2015) higher prevalence of malnutrition among older children (6-12 months) may be related to prolonged exclusive breastfeeding. Growth of children will continue to deviate from the normal course with inadequate dietary supply (quantity and quality) (Terati et al., 2018).

These findings are consistent with numerous other studies that have documented early introduction of complementary feeds before the age of six months as a persistent negative practice regardless of the efforts put forward in improving the trend.

Frequency of Feeding

According to the results of this study, 78.8% of the study population consumed meals at least 3 times per day while 21.2% less than 3 times per day. From the study the proportion of children who were stunted and wasted that had consumed meals at least 3 times per day were 41.2% and 28.6% respectively while those who were stunted and wasted that had fed less

than 3 times per day were 58.8% and 71.4% respectively. The findings in this study indicate that children who fed less than 3 times per day are twice as likely to be stunted and wasted than those who fed at least 3 times per day. Similarly, a study done by Ndanu (2013) found that 20.5% of children had not met the WHO recommendation for frequency of feeding while 79.5% had met the recommendation for frequency of feeding, out of 85 children 16.7% who were wasted were those children who had not met the WHO recommendation for frequency of feeding (Ndanu, 2013). In a similar study done in Ethiopia, it was noted that the number of meals per day the child ate was found to be a significant determinant of WHZ, when the number of meals the child ate per day increased by 1 unit, the weight of the child increased by 0.035kg (Motbainor et al., 2015).

From the study it was observed that there was a high proportion of stunted children among children who consumed meals less than 3 times a day as compared to those children who consumed meals at least 3 times a day. This study is concordant with that of Yalew et al. (2014) who noted that higher proportion of stunted children (49.5%) were found among those who were fed less than 3 times a day (Yalew et al., 2014). Stunting is a form of chronic protein energy malnutrition which results from chronic deficiency of energy, protein, and micronutrients (Troesch et al., 2013). Thus, the findings in this study demonstrated that children who fed less than three times a day had inadequate intake of energy, protein and micronutrients. This contributed to the high proportion of stunting in children who consumed meals less than three times a day.

Frequency of feeding is an important indicator for the attainment of adequate dietary intake and therefore important determinant of the health and nutritional status of children. After weaning the child, most caregivers engage in economic activities outside the household, giving less care to the children which further contributes to the child consuming less than three meals a day (Ndambuki, 2015).

Knowledge on Dietary Diversity

The results of this study show that 47.2% of the households interviewed had knowledge of complementary feeding that it should be started at six months of age while 33.3% did not have any knowledge at all. This compares closely to the study done by Ndambuki (2015) that 75% of the caregivers indicated that complementary feeding should be started at the age of six months (Ndambuki, 2015). The extent to which complementary foods are provided depends on the available resources to the caregiver at the household level (Ndambuki, 2015).

In line with the above explanations, food diversity or dietary diversity and number of meals the child eats per day is significantly associated with stunting and wasting (Motbainor et al., 2015). In this study a small percentage 11.1% heard about importance of diversified diet and 8.3% had

knowledge that a child should eat four or more food groups, this could be due to the fact that mothers in the slum of Mukuru had little access to nutrition related information and if this information would have been more available it would have enabled mothers to feed their children properly. This is concordant with Motbainor et al. (2015) who noted that culturally the community does not give attention to child nutrition and simply feed one common kind of food because of lack of awareness regarding balanced diets. It is not lack or shortage of food that predisposes young children to malnutrition but also lack of knowledge of appropriate infant and young child feeding practices (Motbainor et al., 2015).

In other previous studies mothers with higher levels of nutrition knowledge, acquired primarily outside of school, are able to choose a more diversified diet for their children and, broadly speaking, to utilize food more effectively (Gichana, 2013). Therefore, it is equally important that the mother understands the importance of child nutrition in addition to the household becoming food secure. Hence, to reduce the burden of childhood stunting and wasting, awareness campaigns aimed at educating the mother/ caregiver on the importance of child nutrition and appropriate infant and young child feeding practices should be designed and implemented.

Dietary Diversity

Overall dietary quality was assessed using the dietary diversity score. The food group's frequency questionnaire was used to quantify child dietary intake. Mothers were asked to recall the number of times certain foods in each food group were consumed by the child in the last seven days. The WHO (2010) children's minimum dietary diversity indicator was adopted and nine food groups were used, the dietary diversity score therefore ranged from 0 to 9 with minimum of 4 (WHO, 2010).

Most of the households 72.2% had a low food group diversity score (1-3 food groups consumed in a period of seven days). This was followed by 21.3% with a medium food group diversity score (4-5 food groups) and 6.5 % with a high food group diversity score (6-9 food groups). In this study it was observed that majority of households were not consuming foods rich in vitamin A and animal proteins. Cultural beliefs such as eggs are not given to children because it would delay the child in developing his/ her speech as well as low income earned by the household and inadequate nutrition knowledge of mothers are the main contributing factors that are associated with the low consumption of vitamin A rich foods and animal protein (Gichana, 2013). In this study, the findings demonstrated that only a few foods from each group were consumed, the commonly consumed foods were rice, *ugali,* porridge (millet), potatoes, bread, milk, *sukumawiki*, spinach, *terere*, *managu*, cabbage, onions, tomatoes, beans/ legumes, banana and watermelon. The most used oil

was the salad oil, but a few households used the solid fat in cooking. Mofokeng (2015) pointed out that consuming one or two foods from each of the food groups does not constitute a varied intake (Mofokeng, 2015). From the study it was observed that majority of children consumed less animal protein but more beans/ legumes and vegetables high in phytates. Data from other studies show that diets in developing countries are typically monotonous and plant-based, containing little or no animal products (Troesch et al., 2013).

Achievement of the minimum dietary diversity is associated with better nutritional status of children. The results of the study showed that the majority (57.1%) and (41.2%) of the wasted and stunted children respectively were those not consuming the recommended 4 or more food groups. Thus, the odds of wasting and stunting were higher among children who did not meet the minimum dietary diversity as compared to children who met the minimum dietary diversity. This finding was supported by Ali et al. (2017) who stated that infant and young child feeding practices as measured by dietary diversity score are positively associated with WHZ and HAZ of young children (Ali et al., 2017).

From the findings of the study, it was observed that there was a high proportion of children who were stunted as compared to those who were wasted even though they had a high food group diversity score. This suggests that increasing the diversity of a child's diet may have greater and more immediate impact on wasting than stunting as stunting is a result of long-term dietary inadequacy. The short stature is primarily due to chronic deficiency of energy, protein and micronutrients, particularly of iodine or zinc (Troesch et al., 2013). When the diet is monotonous, lacks diversity and is largely cereal, legume or tuber-based, the inherent micronutrient content may be low, even if the micronutrients are present in substantial quantities, as in some cereals or legumes, their bioavailability may be very curtailed due to the high fiber and phytate content of traditional staples, which form insoluble complexes (Troesch et al., 2013).

Summary

From the socio-demographic and socio-economic data collected, it was clear that education level, family size and income were the major challenges observed in Mukuru Slum. This was confirmed by the actual foods consumed, as measured by the food group's frequency questionnaire which was used to quantify child dietary intake. Poor dietary diversity was observed in this community as there was low consumption of foods rich in vitamin A, animal protein and fruits. This resulted in poor nutrient intakes for almost all of the macro- and micro-nutrients. This was due to resource depletion which exposed majority of the households to poverty and decrement in food availability and more competition for available food when the household was large.

High numbers of children (62.7%) were exclusively breastfed for six months, while 16.1% of children started complementary feeding below 6 months. 47.2% of the households said they knew the foods should be introduced to the child at six months of age. It was observed that a high percentage of children (78.8%) fed at least 3 times per day while a low percentage (21.2%) fed less than 3 times per day. Children who fed less than 3 times per day were twice as likely to be stunted and wasted than those who fed at least 3 times per day.

The findings of this study imply that both acute and chronic malnutrition are prevalent in this group of children. Although micronutrient deficiencies have been improved, poor dietary diversity and poor micronutrient intakes are still predominantly the cause of stunting in many children (Mofokeng, 2013). Stunted children usually grow up as stunted adults and at an increased risk of becoming obese and developing chronic lifestyle diseases (Mofokeng, 2013). On the other hand, was-ting typically reflects the inadequacy of diet. Thus, the findings in this study reflect poor nutritional intake of children in the slum.

Conclusion

The result of this study demonstrates that the prevalence of stunting and wasting among children of age 6-59 months is relatively high. Malnutrition continues to be a substantial burden in children of age 6-59 months old in Mukuru Slum.

Optimal infant and young child feeding practices are unparalleled ways of enhancing the health and survival of infants and young children. These include exclusive breastfeeding, timely initiation of complementary feeding, appropriate feeding frequency, and adequate dietary diversity to meet the nutritional needs of children under five years of age. Therefore, improving the diets of infants and young children is essential to mitigate the high burden of stunting and wasting in the slum.

Overall, breastfeeding rates were high. This could have contributed to the high number of well-nourished children. However, exclusive breastfeeding for the first six months was not practiced by all households as was indicated by early introduction of complementary feeds.

The findings of this study conclude that the diet of infants and young children has an effect on their nutritional status. Moreover, socio-demographic and social economic factors like poor education of the parents, family size and low household income all contribute indirectly to under nutrition in children.

Hence, to reduce childhood malnutrition, nutritionists and other health practitioners should conduct more awareness campaigns aimed at educating the community on the importance of infant and young child nutrition and appropriate feeding practices, in order to improve parental practices related to infant and young child feeding. However, nutritional intervention measures should be carefully tailored to specific residential localities.

Recommendations

The high prevalence of undernutrition (stunting and wasting) amongst children in this study exhibits the need for effective and efficient sustainable food and nutrition interventions aimed at improving dietary intake and diversity as well as countering undernutrition. The future of our nation depends on the quality of health of our children in the present.

For The Community

Early or late initiation of complementary feeding was common among the study population. Such habits need to be tackled by practicing appropriate feeding.

Breast feeding after six months of age needs integration with appropriate complementary feeding.

Household diversification is important for the achievement of a balanced meal intake through food production strategies such as household gardening. Household vegetable gardens should be implemented accompanied with nutrition education to empower mothers/ caregivers to provide balanced meals for their children. Nutrition education should include handling and storage of food as well as preparation methods, such as healthy cooking methods for the preservation of essential nutrients. Furthermore, mothers/ caregivers should consider the available indigenous foods such as *terere*, *managu*, *sagaa*/ *sageti*, *mchicha* and *mrenda* as part of the dietary intakes of the households as these often grow wild and do not cost anything but can contribute to the nutrient intakes of both the mothers/ caregivers and their children. The produce from indigenous and home vegetable and fruit gardens are less expensive than buying these items from the market.

For The Health Sector

Encouraging and strengthening appropriate complementary feeding and integration with breast feeding after six months. Community Health Volunteers should initiate participatory nutrition education to create awareness and to develop behavior change communication for better infant and young child feeding practices in the community. Health care providers are called upon to stress on the importance of a nutritionally adequate diet in children less than five years of age. During clinical visits, health care providers can assess children under five years for signs of stunting and wasting.

For The Policymakers

The 2012-2017 National Nutrition Action Plan came to an end in 2017 and one of its objectives was to improve the nutrition status of children under five years. After its review, malnutrition in children is still high, due to population growth. Therefore, there is need to develop a new plan that will guide nutrition interventions for the next phase in order to reduce childhood malnutrition. The challenge of childhood malnutrition is enormous and cannot be addressed by one sector. Therefore, the Ministry of Health and Nutrition Stakeholders including the

Non-Governmental Organizations should work together to efficiently address childhood malnutrition. This multipronged approach will aid in reducing childhood malnutrition. Nutrition education should be considered at all levels from the health facilities down to the community in order to improve the nutrition knowledge of mothers/ caregivers and change dietary intake behavior of children from an early age. Inadequate knowledge of nutrition contributes significantly to the development of malnutrition. Hence, dietary habits in childhood have an impact on growth, development and the prevalence of disease(s) throughout the lifecycle.

For Further Research

The associations between socio-economic status, food intake patterns and nutritional status of the children with suitable interventions to improve the overall dietary intake patterns and diversity. Impact of nutrition education of mothers and dietary intake behavior of children in Mukuru Slum.Studies to ascertain whether ethnic and regional variations lead to the high prevalence of under nutrition in children 6-59 months old.

References

Akombi, B. J., Agho, K. E., Merom, D., Renzaho, A. M., & Hall, J. J. (2017). Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006-2016). *PLOS ONE*, 12(5), e0177338. DOI https://doi.org/10.1371/journal.pone.0177338

Ali, Z., Saaka, M., Adams, A.-G., Kamwini-naang, S. K., & Abizari, A.-R. (2017). The effect of maternal and child factors on stunting, wasting and underweight among preschool children in Northern Ghana. *BMC Nutrition, 3*(1), 31. DOI https://doi.org/10.1186/s40795-017-0154-2

Ayisi, R., & Wakoli, A. (2014). *Exclusive breastfeeding practice: Its implication on nutrition status, growth and morbidity pattern among infants aged 0-6 months.*(Link)

Bakalemwa, R. (2014). *Association between malnutrition and feeding practice among children aged six–twenty four months at Mbagathi District Hospital-Kenya* [Thesis, University of Nairobi]. (Link)

Briend, A., Khara, T., & Dolan, C. (2015). Wasting and Stunting—Similarities and Differences: Policy and Programmatic Implications. *Food and Nutrition Bulletin, 36*(1_suppl1), S15–S23. DOI https://doi.org/10.1177/15648265150361S103

CURI. (2012). *Mukuru Kwa Njenga Slum Upgrading Project. Centre for Urban Re-search and Innovations.*(Link)

De Onis, M., Borghi, E., Arimond, M., Webb, P., Croft, T., Saha, K., De-Regil, L. M., Thuita, F., Heidkamp, R., Krasevec, J., Hayashi, C., & Flores-Ayala, R. (2018). Prevalence thresholds for wasting, overweight and stunting in children under 5 years. *Public Health Nutrition, 22*(1), 175–179. DOI https://doi.org/10.1017/S1368980018002434

Gichana, M. B. (2013). Nutritional knowledge of Mothers and nutritional status of their children 6-59 Months under Malezi Bora Programme in Kawangware Sub Location, Dagoretti, Nairobi County [Thesis, University of Nairobi].(Link)

Imoto, S., & Otsuki, T. (2018). Establishment and development process of nonformal

school environments in a Nairobi slum: Focusing on the relationship between the school and the local community. Japan *Architectural Review*, 1. DOI https://doi.org/10.1002/2475-8876.12026

Kimani, E. (2014). *The Nutrition Paradox in Kenya: What Are We Doing?* - Global Nutrition Report. (Link)

Kumar, A., & Singh, V. K. (2015). A Study of Exclusive Breastfeeding and its impact on Nutritional Status of Child in EAG States. *Journal of Statistics Applications & Probability, 4*(3), 435–445.

Lupao, K., & Mogusu, E. (2019). Scale up of high-impact nutrition interventions in the informal settlements of Nairobi, Kenya (pp. 2–5) [Field Article]. (Link)

Matanda, D. J., Mittelmark, M. B., & Kigaru, D. M. D. (2014). Child undernutrition in Kenya: Trend analyses from 1993 to 2008–09. *BMC Pediatrics, 14*(1), 5. DOI https://doi.org/10.1186/1471-2431-14-5

Mekonnen, T. C., Workie, S. B., Yimer, T. M., & Mersha, W. F. (2017). Meal frequency and dietary diversity feeding practices among children 6-23 months of age in Wolaita Sodo town, Southern Ethiopia. *Journal of Health, Population, and Nutrition, 36*(1), 18. DOI https://doi.org/10.1186/s41043-017-0097-x

Mofokeng, M. J. (2013). *Nutritional status and dietary intake patterns of children aged 7-13 years in Qwa-Qwa*. (Link)

Motbainor, A., Worku, A., & Kumie, A. (2015). Stunting Is Associated with Food Diversity while Wasting with Food Insecurity among Underfive Children in East and West Gojjam Zones of Amhara Region, Ethiopia. *PLOS ONE, 10*(8), e0133542. DOI https://doi.org/10.1371/journal.pone.0133542

Muchina, E. N., & Waithaka, P. M. (2010). Relationship between breastfeeding practices and nutritional status of children aged 0-24 months in Nairobi, Kenya. *African Journal of Food, Agriculture, Nutrition and Development, 10*(4). DOI https://doi.org/10.4314/ajfand.v10i4.55329

Muiruri, J., Hulcome, P., Schumacher, B., Parveen, M., Bilkes, F., & Mehjabeen, S. S. (2012). WFP Bangladesh Nutrition Strategy 2012-2016. (Link)

National Bureau of Statistics-Kenya & ICF International. (2015). 2014 KDHS Key Findings [Demographic and Health Survey]. (Link)

Ndambuki, S. K. (2015). Caregiver feeding practices and socio-economic factors that influence the nutritional status of children under-five years in Mlolongo, Kenya. (Link)

Ndanu, M. M. (2013). Feeding practices and nutrition status of child aged 0-59 months accompanying incarcerated mother selected women's prisons in Kenya [Kenyatta University]. (Link)

Panigrahi, A., & Das, S. C. (2014). Undernutrition and Its Correlates among Children of 3–9 Years of Age Residing in Slum Areas of Bhubaneswar, India. *The Scientific World Journal, 2014*(1), 719673. DOI https://doi.org/10.1155/2014/719673

Singh, A., & Masuku, M. (2014). Sampling Techniques and Determination of Sample Size in Applied Statistics Research: An Overview. *International Journal of Commerce and Management, 2*, 1–22.

Solomon, D., Aderaw, Z., & Tegegne, T. K. (2017). Minimum dietary diversity and associated factors among children aged 6-23 months in Addis Ababa, Ethiopia. *International Journal for Equity in Health, 16*(1), 181. DOI https://doi.org/10.1186/s12939-017-0680-1

Terati, Yuniarti, H., & Susanto, E. (2018). Effects of Diet and Breastfeeding Duration on the Stunting Status of Children under 5 Years of Age at Maternal and Child Health Centers of the Palembang Regional Office of Health. *Pakistan Journal of Nutrition, 17*(2), 51–56. DOI https://doi.org/10.3923/pjn.2018.51.56

Troesch, B., Jing, H., Laillou, A., & Fowler, A. (2013). Absorption Studies Show that Phytase from Aspergillus niger Significantly Increases Iron and Zinc Bioavailability from Phytate-Rich Foods. *Food and Nutrition Bulletin, 34*(2_suppl1), S90–S101. DOI https://doi.org/10.1177/15648265130342S111

WHO. (2010). Indicators for assessing infant and young child feeding practices: Part 2 measurement. (Link)

World Health Organization. (2006). WHO child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development.(Link)

Yalew, B. M., F, A., & D, B. (2014). Prevalence and Factors Associated with Stunting, Underweight and Wasting: A Community Based Cross Sectional Study among Children Age 6-59 Months at Lalibela Town, Northern Ethiopia. *Journal of Nutritional Disorders & Therapy, 04*(02). DOI https://doi.org/10.4172/2161-0509.1000147