A cross-sectional study design to assess the determinants of the nutritional status of children aged 6 to 59 months who returned to Gedeo after being internally displaced in the Guji-Gedeo conflict, in Gedeb district, SNNPR, Ethiopia: Bayesian Binary Logistic Regression Approach

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Abstract

Background: The Guji-Gedeo conflict has gradually become the main cause of displacement in the Gedeb district, with 274,548 internally displaced persons (IDPs). Malnutrition is exacerbated in areas affected by conflict. Children affected by the conflict face an imbalanced burden of malnutrition and health problems. The purpose of the current study was to identify determinant factors associated with the nutritional status of the children (aged 6 to 59 months) who returned to the Gedeb District after being internally displaced in Guji-Gedio.

Methodology: A cross-sectional study involving 6-59 months aged children who returned to the Gedeb district after being internally displaced in Guji-Gedio was conducted from December 2020- to February 2020. A bayesian binary logistic parametric regression model was applied to model the effects of selected demographic, socioeconomic, health, and environmental factors. An inference was made using the Markov chain Monte Carlo (MCMC) approach.

Results: Malnutrition was found to be prevalent in Gedeb district at 45.9 percent. The covariates such as sex: female (OR: 1.358, CI : 0.584, 3.158), birth Interval: less than 24 month (OR: 3.73, CI: 0.6, 22.9), 24 – 47(OR: 2.12, CI: 0.34, 13.263), birth order: 4 – 5(OR: 0.802, CI: 0.19, 3.338), 6 and above (OR: 1.9, CI: 0.479, 7.675), mother's education level: read and write(OR: 0.490, CI: 0.072, 3.346), primary(OR: 0.266, CI: 0.043, 1.664), secondary and above(OR: 0.25, CI: 0.025, 2.45), place of residence: urban(OR:0.399, CI: 0.098, 1.631),toilet: improve(OR: 0.84, CI: 0.265, 2.66), mother body mass index: normal(OR:0.777, CI: 0.332, 1.81) and diarrhea: yes(OR: 1.2, CI: 0.218, 2.354) were the most important determinants of children nutritional status in Gedeb district.

Conclusion: The overall prevalence of malnutrition in Gedeb district is about 46%. Covariates such as sex, birth interval, birth order, mother's education level, place of residence, toilet, mother's body mass index, and diarrhea were statistically related to malnutrition. Creating awareness in society related to those factors associated with child malnutrition should be further motivated. Also, to reduce childhood malnutrition, due emphasis should be given to improving the knowledge and practice of parents on appropriate young child feeding practices and frequent growth monitoring together with appropriate and timely interventions.

1. Introduction

Individuals who have been displaced from their homes due to conflict, violence, or other natural or man-made calamities but have not crossed recognized borders are referred to as internally displaced persons (IDPs). More than 20 million individuals are internally displaced over the world. More than half of them live in Sub-Saharan Africa [17]. Approximately 59% of the world's children live in conflict-affected countries in 2016 [4].

Internally displaced individuals are housed in and out of official camps in several African countries for short or extended periods of time, typically in areas with inadequate shelter and food [12]. Armed conflict is more likely to occur in poorer nations, particularly in thinly populated rural areas, and areas where land and water

are challenged [5, 15]. Many studies demonstrated that such conflicts have negative health consequences for people, particularly children [16].

According to UNICEF data from 2018, an estimated 2.8 million Ethiopians have been evacuated. 1.5 million of the displaced people are children. According to OUNCHA 2018, Gedeb is one of the most conflict-prone districts, with the biggest number of conflict-related displacements. As a result, the Guji-Gedeo conflict has gradually evolved into the district's primary source of displacement, resulting in 274,548 internally displaced persons (IDPs) or returnees.

Women and children are particularly vulnerable in emergencies due to societal, economic, and medical issues. Many internally displaced persons, particularly children, suffer from poor health and malnutrition as a result of the conflict. According to studies, IDP has a high rate of morbidity and death [6, 12, 13]. In poor nations, epidemics of infectious diseases among vulnerable people are connected to the highest levels of malnutrition [9]. Refugees and internally displaced individuals (IDPs) in Ethiopia, particularly women and children, require protection from unequal allocation of humanitarian aid based on ethnicity. A total of 4.2 million youngsters required food assistance. 370,000 persons needed treatment for SAM (severe acute malnutrition) [2].

IDPs totaled 274,548 in Gedeo and were scattered across the Gedeo zone, including the districts of Dilla Zuria, Gedeb, Kochere, Wonago, and Yirgachefe. Approximately 64% of refugees live in host communities in the Gedeb area, and they are occasionally "camp-like," congregating around religious groups such as schools, churches, mosques, and mission houses. The healthcare system has inevitably been impacted by displacement. As a result, in IDPs, the mortality of children under the age of five shows an increase. All of the IDPs in the Gedeo zone were thought to be Gedeos fleeing the Gedeo-Guji conflict [11].

In many poor countries, malnutrition is a major public health issue, especially during times of crisis. It is aggravated in conflict-affected areas. Children in conflict-affected areas bear an unbalanced burden of malnutrition and health issues. Developing countries account for almost 90% of the world's malnourished youngsters. It is one of Ethiopia's most serious health issues for mothers and children and is also thought to be a factor in child deaths [3, 6].

In 2011, one in four children (26 percent, or 165 million) was stunted, one in six (16 percent, or 101 million) was underweight, and one in twelve (8 percent, or 52 million) was wasting. In Ethiopia, 38 percent of children under the age of five were stunted, 24% were underweight, and 10% were wasting. Besides, anthropometric indicators for young children were collected in the 2016 EDHS to provide outcome measures of nutritional status, 38 percent of children under 5 are considered short for their age or stunted (below − 2 SD), and 18 percent are severely stunted (below − 3 SD) [6, 8].

Children's malnutrition in Ethiopia is caused by a number of complex, multidimensional, and interconnected factors operating at many levels [8], such as a lack of clean water, lack of sanitation, inadequate health care, displacement, and instability. All of these factors increase the risk of illness, and mortality among displaced children [13]. Malnourished children continued to be unable to reach their full physical and mental potential. Children with severe malnutrition suffer from a lack of physical growth and motor development, as well as a

lower IQ, increased behavioral issues, and poor social skills [12]. To combat hunger and, to some extent, undernutrition, Ethiopia adopted a national nutrition program, developed an infant and young child feeding manual, and conducted monthly child growth and monitoring programs. Despite the development of several interventions, malnutrition remains a major child health issue, particularly among displaced children [8].

However, there are few data on the factors that influence nutritional status in children aged 6 to 59 months who returned to the Gedeb District after being forced internally displaced in Guji-Gedio. Furthermore, no previous research on the topic has been done in the study area. The study's findings could be used at the regional, national, and international levels to address the issue of children's nutritional status by informing society about the severity of the conflict in the study area.

2. Data And Methodology

2.1 Study Period and Setting

The research was conducted in the Gedeb district from December 2019 to February 2020. The Gedeb district is located in the Gedeo Zone of the Southern Nations, Nationalities, and Peoples Region (SNNPR), 160 kilometers from Hawassa, the SNNPR capital, and 74 kilometers from Dilla (the Gedeo zone administrative seat).

2.2 Study Design and population

The researchers used a community-based cross-sectional study approach. The study population included all children aged 6 to 59 months, those living in the Gedeb district, and those who had returned from displacement. The children were reached by the authors through their mothers, and information about orphan children was acquired through proxy respondents, including their immediate families and younger siblings.

2.3 Sample size and Sampling procedure

Using the sample size determination formula, a sample size of 418 was determined. A pilot study found that 60% of children returning from displacement were malnourished, allowing for the estimation of a single population proportion. The study used a 5% significance level, a 5% margin of error, and a 10% estimated non-response rate in its research study. A multistage stratified sampling technique was used to determine the sample size. The parents/caretakers of each selected household were interviewed to collect information about their children aged 6 to 59 months. If there was more than one child between the ages of 6 and 59 months in the same household, the youngest was selected at random.

2.4 Methods of Data collection and Quality control

Cross-sectional primary data was employed as a research instrument in this study. To ensure consistency and reliability of the data collected, questionnaires were written in English, translated into the local Gedogna language, and then translated back into English. Four enumerators were recruited from health care facilities and trained by main investigators to gather data through face-to-face interviews to reduce data collecting mistakes. A pretest utilizing 5% of the sample size was undertaken to assure data quality. Validity and

reliability were checked. Every day, principal investigators examined the acquired data for inconsistency and incompleteness.

The weighing scales and measurement boards (stadiometers) were all calibrated to the nearest 0.01kg and 0.01cm, respectively. Children under the age of two and children aged two or more years were assessed using the length and height boards. The weighing scale was measured twice and reset to zero after each child was weighed.

2.5 Data Analysis

Height/length-for-age z-scores (HAZ), weight-for-height/length z-scores (WHZ), and weight-for-age z-scores (WAZ) for children 6 to 60 months of age were generated using WHO Anthro Version 3.2.2.12. Children with z-scores of less than 2 standard deviations (SDs) for HAZ, WHZ, and WAZ were classified as stunted, wasted, and underweight, respectively. Values of z-scores between − 3 and − 2 SDs were defined as moderate, and z-scores lower than − 3 SDs were classified as severe.

A Bayesian logistic regression model was applied to estimate the population parameters and the Bayesian priors and number of simulation iterations has been determined for the Markov chains to converge to the stationary distributions. WinBUGS is a statistical tool that was applied for the calculation of the posterior summaries to determine the posterior mean, standard deviation, and quintiles (including the median) for the given generated sample by using non-informative uniform prior for sigma and normal coefficients of parameters specified by the investigator and Bernoulli livelihood for one trial or binomial likelihood for more than one trial. The total number of iterations (generated sample size) and the number of iterations that the generated sample started (hence the burning period) were also provided.

In the analysis of the MCMC output, an important measure that must be reported and monitored is the Monte Carlo error (MC error), which measures the variability of each estimate due to the simulation. MC error must be low in order to calculate the parameter of interest with increased precision. It is proportional to the inverse of the generated sample size that can be controlled by the researchers. The MC errors are low in comparison to the corresponding estimated posterior standard deviations, so the estimated posterior mean was estimated with high precision. Increasing the number of iterations will decrease the MC error.

The posterior summary estimates were assessed by the MCMC algorithm, especially by the Gibbs sampler, and parameters like posterior mean, standard error, Monte Carlo error, and 95% confidence intervals were estimated. The convergence of the chain can be initially checked visually using trace plots and any value within a parallel band without strong seasonality will indicate the convergence of the chain. The MC error for each significant predictor is less than 5% of its posterior standard error. This implies convergence and accuracy of posterior estimates are attained and the model is appropriate to estimate posterior statistics. The time series or history plot showed that the chains resembled a horizontal band with no long upward or downward trends, indicating that MC had converged. The autocorrelation showed that the three independent chains were mixed and disappeared for longer lags, indicating convergence. The density also revealed that the plots are unimodal and bell-shaped, indicating convergence.

3. Results

A total of 418 children were assessed for their nutritional status. Of them, 316 were in urban areas (136 malnourished), and one hundred two were in rural areas (fifty-four were malnourished). Malnutrition was discovered to be 45.9% prevalent in the Gedeb district. According to the demographics of the participants, 228 (54.5%) of them were boys, and 45.45% of the children were females, with 137 (58.8%) and 92 (48.4%) of them being malnourished, respectively. Children aged 24–35 months (60, or 68.2%) and 12–23 months (52, or 35.1%) had the highest rates of undernutrition, whereas children aged 48–59 months have the lowest rates (16, or 44.4 percent). With 44 percent of children born at birth intervals of 2–3 orders, child malnutrition is more widespread in birth orders 4–5 than in other birth orders. In compared to any other group, 242 (57.9%) of the mothers in the research were unable to read or write, and 104 (43%) were underweight. A total of 136 children came from families with four or more members, whereas only 122 came from families with three or less members.

When other variables in the model are controlled for, the odds of malnutrition in females are 1.358 (OR = 1.358). This indicates that female children were about 1.36 times more likely malnourished as compared to female. Child age has significant association with child nutritional status. The odds were higher in the age group 24–35 (OR = 4.995 and CI = 1.26-19:8), age group 48–59 months (OR = 3.119 and CI = 0.52–18.7), age group 12–23 (OR = 1.33 and CI = 0.318–5.584) and age group 36–47 months (OR = 0.566 and CI = 0.13–2.45). The Older age groups are more likely malnourished than younger age 6–11 except age group 36–47 months. This study also found that children who had diarrhea in the last two weeks before survey were significantly associated with children nutritional status. The children who had diarrhea in the last two week were 1.2 time more likely to be severely malnourished as compared to those who had no diarrhea in last two weeks keeping all other covariates constant(Table 1).

Returning children whose mothers could read and write had a 0.5-fold lower risk of malnutrition than children whose mothers did not attend school, and returned children whose mothers did not attend school had a 0.26-fold lower risk of malnutrition than children whose mothers did not attend school [OR = 0.26 and 95 percent CI = 0.043–1.66]. In terms of body mass index, children born to normal moms were less likely to be malnourished than children born to underweight mothers (OR = 0.77, 95 percent CI = 0.332–1.81). When comparing children whose household head worked status was farming to children whose household head worked status was daily workers, traders, and self-employed, the odds of malnourished were 0.2 [OR: 0.198, 95 percent CI: 0.4 – 0.14], 4 [OR: 4.145, 95 percent CI: 0.31–5.14], and 2 [OR: 1.967, 95 percent CI: 0.076–5.845], respectively(Table 1).

There was a link between the children's nutritional status and their place of residence. Children living in cities face 0.4 times the risk of malnutrition as children living in rural areas. Children born from improved toilet user households were less likely to be malnourished after displacement from internal conflict (OR = 0.84, CI = 0.265–2.66) than children born from non-improved toilet user households (Table 1).

Table 1
Factors significantly associated with children's nutritional status

Variable(reference)	Node	Mean(β)	SE	MCerror	95% CI for mean(β)		Exp(mean(β)) or OR
					2.5%	97.5%	
Intercept	Constant	-3.522	0.258	0.0045			0.03
Sex(male)	Female	0.306	0.431	0.0012	0.584	3.158	1.358
Age (6–11)	12–23	0.288	0.731	0.031	0.318	5.583	1.33
	24–35	1.5068	0.703	0.0081	1.26	19.8	4.995
	36–47	-0.569	0.75	0.00231	0.13	2.45	0.566
	48–59	1.137	0.94	0.0087	0.52	18.7	3.119
Birth Order(first)	2–3	0.72	9.48	0.423	-0.32	13.2	2.05
	4–5	-0.22	0.72	0.0102	0.19	3.338	0.802
	6 and above	0.65	0.708	0.0009	0.479	7.675	1.9
Mother's Edu.Lev (No education)	Read and write	-0.713	0.98	0.023	0.072	3.346	0.49
	primary	-1.323	0.935	0.00901	0.043	1.664	0.266
	Secondary and above	-1.38	1.166	0.00017	0.025	2.45	0.25
Birth Interval(48 and above)	Less than 24 months	1.31	0.926	0.02081	0.6	22.9	3.73
	24–47	0.755	0.934	0.00023	0.34	13.263	2.12
Occupational status (Farming)	Daily worker	1.7	0.328	0.0036	0.409	0.14	0.198
	Trader	1.422	0.32	0.0092	0.3125	.146	4.145
	Self employed	0.677	1.659	.00102	0.076	5.845	1.967
	Gov.t Employer	-1.656	1.345	0.00312	0.014	2.662	0.19
Family size (6 and above)	3 and less	-0.528	0.78	0.085	-0.128	2.724	0.59
	4–5	-1.35	0.776	0.00839	0.057	1.188	0.259
Residence(rural)	urban	-0.919	0719	0.00912	0.098	1.631	0.399

Variable(reference)	Node	Mean(β)	SE	MCerror	95% CI for mean(β)		Exp(mean(β)) or OR
					2.5%	97.5%	
Toilet (Not improved)	Improved	-0.174	0.58	0.0201	0.265	2.66	0.84
Mother's BMI(under weight)	Normal	-2.5	0.434	0.00412	0.332	1.81	0.777
Diarrhea before two week(No)	Yes	0.18	0.53	0.000532	0.218	2.354	1.2

4. Discussion

Malnutrition is a major public health problem in many developing countries, especially during times of crisis. It has worsened in areas affected by conflict. Children affected by the conflict face an imbalanced burden of malnutrition and health problems. This study aimed at assessing factors that determine the nutritional status of returned children from internal Gedeo-Guji displacement by applying a Bayesian logistic regression approach. The findings of this study revealed a high prevalence of overall malnutrition (46 percent) in the Gedeb district.Independent variables such as sex, birth interval, birth order, mother's education level, place of residence, toilet, mother's body mass index, and diarrhea were identified as determinant factors of child malnutrition.

The risk of malnutrition increased with the child's age, according to this study. A similar finding has been found in a previous study in Ethiopia [3], and other studies have shown that malnutrition seems to be a problem for all age groups in their study population [10]. The probable reason for this will be that, as the ages of the children increase, the care delivered to the oldest child will be reduced, and this will give due attention to the little child. In addition, as their ages go up, children are eager to play everywhere by using everything they have, for example, mud. Then they come back home and eat the food without washing their hands. Due to this, child contamination, especially in rural areas, will increase. This may lead the child to different infectious diseases such as diarrhea, which has a high capability of malnutrition in children.

In this study, maternal education was found to have a significant relationship with children's nutritional status. The risk of being malnourished among returned children whose mothers could read and write (Primary) was 0.5 (0.26) times lower compared to children whose mothers did not attend school. This could be due to a mother's lack of education (since the majority of the mothers in this study were uneducated), which limited her knowledge of child feeding and care, as well as her low income and lack of activity to think of ways to feed her children. Women's education has various positive effects on the quality of care provided to children, as women are the primary caregivers. Education boosts their ability to process information, acquire skills, and engage in positive caring behavior. This finding is consistent with the findings of other research conducted around the country [3].

According to research on children's nutritional status, the mother's anthropometric status is one of the key determinants of the child's anthropometric results. Women who are malnourished are more likely to give

birth to babies who are underweight. Similarly, our results have shown that children of underweight mothers are more likely to be malnourished than children of normal-weight mothers. Malnutrition has been shown to have an intergenerational cycle of malnutrition. As a result, maternal deficiency leads to newborn deficiency, which would be a risk factor for fetal growth restriction and low birth weight. This finding is similar to a study conducted in Ethiopia [8].

Due to poor nutritional status, illnesses such as diarrhea may be more important determinants of morbidity and mortality among returned children from displacement. It is not surprising that mortality was much higher for residents living in damaged conditions due to the extreme crowding and poor sanitary conditions that existed in the returned area. This study is consistent with a study done in GuineaBissau [1]. The reason behind this may be due to malnutrition, and the prevalence of diarrhea is linked because the sickness suppresses appetite and interferes with the digestion and absorption of food. As a result, malnutrition worsens, making the infant more susceptible to infections like diarrhea and other infectious disorders.

The results of this study revealed that a child's prior birth interval is a strong predictor of nutritional status. Children with a birth interval of less than 24 months and between 24 and 47 months had a higher risk of malnutrition than children with a birth interval of greater than or equal to 48 months. This could be owing to a short birth interval between births, which could cause problems with sharing among living siblings and parents' being unable to provide adequate care for their children, lowering the index child's breastfeeding duration. This result is consistent with research done at the national level [7].

Limitation of the study

The study's ability to draw cause-effect relationships was limited due to its cross-sectional nature. The analysis was based on data collected after migrants or displaced people came back home during a given season of the year. However, the magnitude of household nutritional status may vary during the time of displacement and across seasons, requiring the existence of data at the time of displacement as well as seasonal variations to fully comprehend the nutritional status of children.

5. Conclusion

Malnutrition was prevalent among children age 6 to 59 months in returnees from internal displacement in Gedeb District, Gedeo Zone, and SNNPR. The prevalence of malnutrition in the area is similar to the regional and national level. According to the results of this study, malnutrition is still a significant problem in study area.

According to the study results, covariates such as sex, birth interval, birth order, mother education level, place of residence, toilet, mother body mass index and diarrhea were statistically related to child malnutrition. Creating awareness related to those factors associated to child malnutrition should be further motivated. Also, for reducing childhood malnutrition, due emphasis should be given in improving the knowledge and practice of parents on appropriate young child feeding practice and frequent growth monitoring together with appropriate and timely interventions.

Abbreviations

BMI: Body Mass Index, CI: Confidence interval, EDHS: Ethiopian Demographic Health Survey, HAZ: Height/length-for-age z-scores, IDPs : Internally Displaced Persons, IRB: Institutional Review Board (IRB) MCMC: Markov chain Monte Carlo, OR: Odds Ratio, SAM: Serious Acute Malnutrition, SD: Standard Deviation , SSA: Sub-Saharan Africa, SNNPR: Southern Nations, Nationalities, and Peoples' Region, UNICEF: United Nations International Children's Emergency Fund, WAZ: weight-for-age z-scores, WHO: World Health Organization, WHZ: weight-for-height/length z-scores.

Declarations

- Ethics approval and consent to participate

The Dilla University College of Natural and Computational Science's Institutional Review Board (IRB) reviewed and approved the study. Local languages were used to explain the study's purpose, procedures, possible risks, and benefits to participants. It was received and signed with informed written consent. The confidentiality of the data gathered from each study participant was not disclosed. They were informed that if they had any difficulties, they had the right to withdraw from the study at any time.

- Consent for publication

Not applicable

- Availability of data

The datasets supporting the conclusions of the study are included in the article, and the datasets used for analysis during the current study are available from the corresponding authors on reasonable request.

- Competing interests

Authors declare that they have no conflicts of interest.

- Funding

The authors received financial support from Dilla University.

- Authors' contributions

Belayneh Genoro conceived the study's idea, authorized data collection, analysis, and interpretation, drafted the manuscript, and reviewed it critically. Alemayehu Legese planned and assisted with the study's design, data collection, and analysis, as well as data interpretation, paper critical evaluation, and manuscript preparation. Arega Haile helped with data processing and interpretation, as well as providing critical

feedback on the text. Adane Tesfaye contributed his efforts to data processing and interpretation, as well as providing critical feedback on the manuscript. The final manuscript was read and approved by all authors.

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