AJPS

ISSN 2989-011x
Open access biannual refereed journal
Volume 01 | Issue 02 | July-December 2023
Article 04

Identifying Social Risk Factors of Child Undernutrition in the Nuwara-Eliya District, Sri Lanka

R. M. L. Rathnayake, Department of Economics and Statistics, Sabaragamuwa University of Sri Lanka, rathna@ssl.sab.ac.lk

Received: 10 October 2023 / **Revised:** 26 November 2023 / **Accepted:** 05 December 2023

Abstract

Undernutrition is continuing to be a serious socio-economic problem in many developing countries. It is a condition arising from inadequate consumption of needed nutrients such as protein, calories, or micronutrients. The main three forms of undernutrition; wasting, stunting, and underweight are measured through the Weight for Age (WFA), Height for Age (HFA) and Weight for Height (WFH) Z score respectively. Undernourished children are highly exposed to morbidity and mortality, with the risk of less cognitive and social-emotional development. Identifying risk factors for child undernutrition is important for policy implications to reduce child undernutrition. The objective of this study is to investigate the social risk factors of child undernutrition in Sri Lanka based on the Nuwara-Eliya district. Nuwara-Eliya district was selected as the study area due to the highest prevalence of undernutrition in terms of Height for Age (HFA). The study employed primary data collected from a sample survey. The sample size of 378 schoolchildren was decided based on Morgan's table. Multi-stage stratified random sampling technique was applied to draw the sample. Multiple binary logit model, descriptive statistics, the chi-square test, the Hosmer-Lemeshow test, and likelihood ratio statistics were used in the data analysis. The results show that electrification, marital status, and mothers' education are social risk factors for child undernutrition. The model predicts that the probability of suffering from undermatron is higher for the children of households without electricity (0.51), parents who never married (0.51), and mothers with no schooling (0.66). Relevant authorities should emphasize being concerned with these social risk factors in the attempt to reduce child undernutrition.

Key words: *Binary Logit Model, Electrification, Social Factors, Undernutrition, Weight for Height*

Introduction

Many developing countries have been experiencing child undernutrition as a serious socio-economic problem. Theoretically, undernutrition is referred to as one of the two forms of malnutrition (Das and Gulshan, 2017). Undernutrition is the inadequate consumption of needed nutrients such as protein, calories, or micronutrients. It is the adverse situation resulting from consuming an insufficient quantity of food over an extended period of time (Jelliffee, 1966). The main signs of undernutrition are weight loss, loss of fat and muscle mass, a swollen stomach, dry hair and skin, etc. Undernutrition is identified as a situation arising from poor nutritional status caused by reduced food intake or impaired metabolism, and assessment of nutritional status is essential to determining the severity of undernutrition (Bhattacharya et al., 2019). According to Gibson (2005), the major categories of nutritional assessment strategies are (a) dietary, (b) anthropometric, (c) biochemical status, and (d) functional and clinical status. Compared with the dietary, biochemical, functional and clinical status methods, anthropometry may provide a relatively quick and inexpensive means for the assessment of undernutrition. The widely used anthropometric indices available to assess the incidence of undernutrition are Weight For Age (WFA), Height For Age (HFA), Weight For Height (WFH), Body Mass Index (BMI), Mid Upper Arm Circumference (MUAC), Weight at birth. (Casadei and Kiel, 2021). The main three forms of undernutrition; wasting, stunting, and underweight are measured through the WFH, HFA, and WFA Z scores respectively (WHO, 2010). According to WHO, a child is considered as undernourished if any of these (WFA, HFA, WFH) falls below refers minus two standard deviation (<-2SD) of the WHO child growth standard median (WHO, 2010). Globally, the incidence of child undernutrition remains high with 144 million of under 5 years of age children estimated to be stunted and 47 and 14.3 million of under 5 years of age children estimated to be wasted and severely wasted respectively (WHO, 2020). Annually, undernutrition causes for about more than 3 million of child deaths that are preventable (Cunningham, 2015). In Sri Lanka, child undernutrition among under 5-year children remain with 17.3% of Stunting, 15.1% of Wasting, and 20.5% of Underweight according to the Sri Lanka Demographic and Health Survey 2016 conducted by the Department of Census & Statistics (DCS, 2017). Comparing the prevalence of child undernutrition among districts, undernutrition is the highest in the Nuwara Eliya district in terms of Height For Age (HFA) (DCS, 2017). It is 32.4% and 10% below -2 SD and below -3 SD respectively. The prevalence of undernutrition in terms of wasting measured through WFH z score below -2 SD is 11.8% in Nuwara Eliya district (DCS, 2017). Undernourished children are highly exposed to morbidity and mortality with the risk of less cognitive and social-emotional development. Identifying risk factors of child undernutrition is important in policy

implications to reduce child undernutrition. This study investigates the social risk factors of child undernutrition in Sri Lanka based on the Nuwara-eliya district.

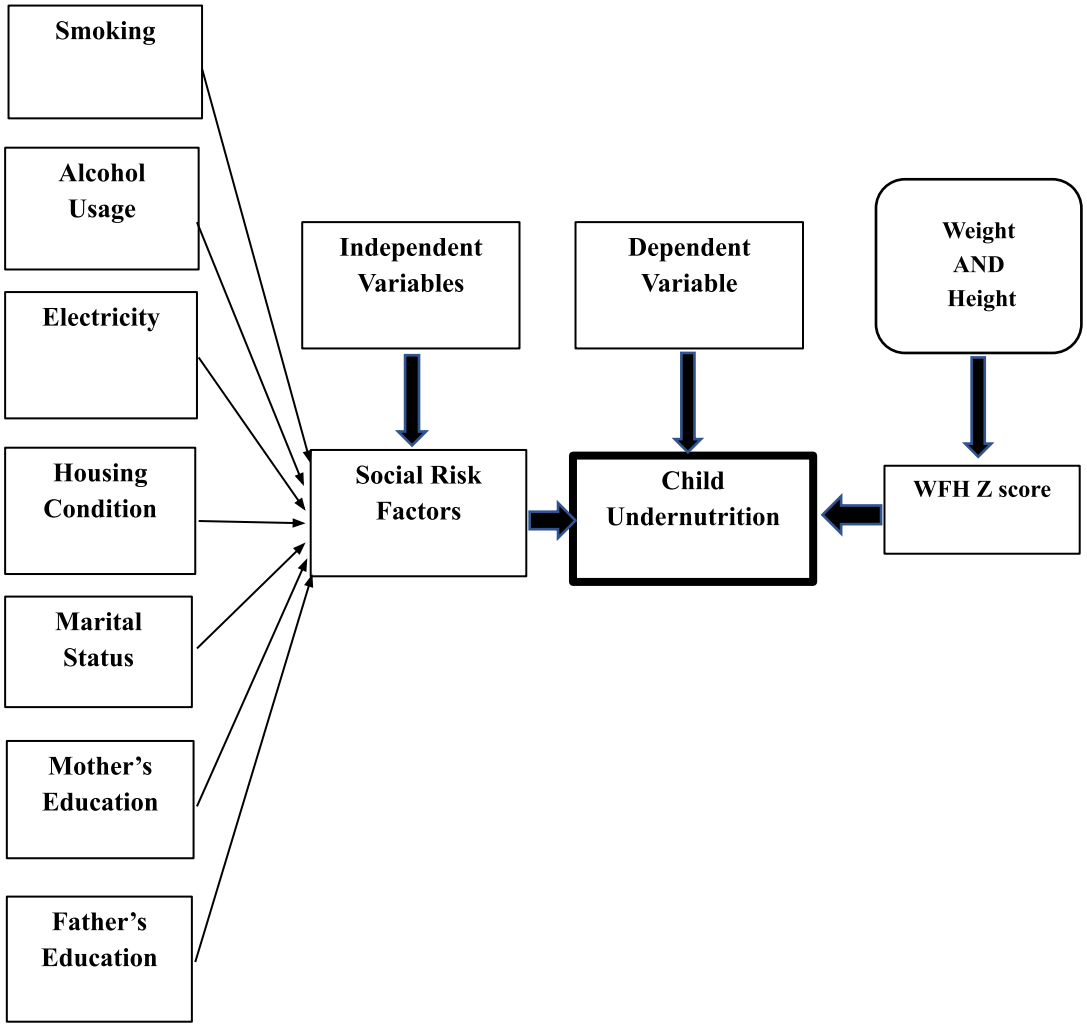
Literature Review

Child undernutrition is much talked about in terms of wasting, stunting and underweight. Low Weight-For-Height (WFH), low Height-For-Age (HFA), and low Weight-For-Age (WFA) are known as undernutrition in the aspects of wasting, stunting, and underweight respectively (Casadei and Kiel, 2021). Studies have been conducted in the past on child undernutrition and its risk factors. The relationship between socioeconomic class and nutritional status has been established, and children from the middle and lower socioeconomic classes had lower nutritional status than children from the upper class (Igbokwe et al., 2017). Considering the social risk factors, a study conducted in 2008 found that the evidence of a negative effect of the weak social status of the mother measured as a significant age difference to the head of the household on nutrition (Linnemayr et al., 2008). A significant association between the socioeconomic status of parents and the nutritional status of children has been established (Yadav and Dixit, 2017). Children in the lower socioeconomic class were more likely to be undernourished in terms of wasting than those in the upper socioeconomic class (Getaneh et al., 2019). Paternal smoking has a high probability of increasing the under nutritional risk among children in terms of stunting (Bella et al., 2022). Considering the different habits, Getaneh et al. (2019) indicated that alcohol drinking habits at home appeared to have a higher risk of increasing undernutrition in the aspect of wasting than their counterparts. According to Schilp et al. (2011), no alcohol use and light alcohol use were found to be related to the risk of undernutrition. Electrification of the household was found to have a positive impact on children's nutritional status (Fujii et al., 2018). Ali Khan and Azid (2011) proved that the provision of electricity has affected child malnutrition. Family education has a significant effect on the regularity of the eating habits of the children as it relates to nutritional status (Sargana and Mohyuddin, 2013). The parents' education, specifically mothers' education, can play an important role in a child's nutritional status (Ali Khan and Azid, 2011). Maternal education has been identified as a protective factor to decrease the risk of undernutrition (Zhang et al., 2016). Maternal education and knowledge are critical for improved maternal and child nutrition efforts (Ajieroh, 2009). Mothers of undernourished children are not well educated (Rathnayake and Weerahewa, 2005). Nutritional status, as measured by wasting was significantly associated with paternal education (Ayana et al., 2015). Considering marital status, according to Dodos et al. (2018), marriage status of not married or lives alone of mothers or caretakers were more likely to be severely acutely malnourished compared to their counterparts. Further, Oliveira Assis et al. (2008) found that a family headed by a woman was a main determinant of mild-to-moderate weight-for-age and height-for-age deficits in the studied children. According to Rahman and Chowdhury (2007) and Rahman et al. (2009), in Bangaladesh, mass media exposure is strongly related

to the severe, moderate, and wasting of children. According to Ayana et al. (2015), a significant association between the nutritional status as measured by wasting and the type of roof of the house made from was evident. Galgamuwa et al. (2017) investigated that living in small houses appeared to be an important factor associated with the undernutrition of school children in plantation communities in Sri Lanka. However, the relationship between the types of wall, roof, and floor and nutritional status was not significant as established by Galgamuwa et al. (2017).

The conceptual framework given in figure 1 was developed by studying the previous literature on undernutrition among children.

Figure 1: The Conceptual Framework



Source: Developed by the Researcher, 2023

Materials and Methods

This study conducted a sample survey to collect primary data. The main data collection instrument is the structured questionnaire. The grade 6 school children of government schools in the Nuwara Eliya district, Sri Lanka were considered as the study population. At first, the Nuwara Eliya district was selected purposively due to the higher incidence of undernutrition than the other districts. The total sample size was 378, based on Morgan's table. Multi-stage stratified random sampling technique was applied to draw the sample. Three types of schools; type 1 AB, type 1C and type 2 which hold grade 6 classes in government schools were considered as strata to draw the sample. From each type of school, three schools were selected for the sample randomly. In the next stage, both male and female children of grade 6 classes in selected schools were selected proportionately to the sample. The ethical approval to conduct the research was obtained from the ethics review committee, University of Kelaniya, Sri Lanka and they agreed not to reveal individual identities of both children and schools.

Table 1: Types of Social Factors Used in the Study

Variables	Type of variable			Measurement Scale
	Dependant (D) Or Independent (I)	Categorical (Binary)	Categorical (Multi-category)	
Smoking	I	√		Nominal
Alcohol Usage	I	√		Nominal
Electricity	I	√		Nominal
Housing Condition	I		√	Nominal
Marital Status	I		√	Nominal
Mother's Education	I		√	Ordinal
Father's Education	I		√	Ordinal
Undernutrition	D	√		Nominal

Source: Developed by the Researcher, 2023

Table 1 clarifies the social factors (independent variables) and undernutrition (dependent variables) used in this study, alone with their types, and measurement scales. The dependent variable was measured on a binary nominal scale. Suffering from undernutrition was coded as 1, while not suffering from undernutrition as 0.

Undernutrition in term of wasting was considered in this study. Wasting was measured using Weight for Height (WFH) Z score. The undernutrition classifications were based on global standards: <−3 z score, <−2 z score, and ≥−2 z score (WHO, 2017). Children with WFH z score below −2 SD of the median of reference population were considered as undernourished (wasted) and others are not undernourished (not wasted). The independent variables used in this study are social factors. Smoking, alcohol usage, and electricity were used as binary categorical independent variables, while housing condition, marital status, mothers' education, and fathers' education as multi-categorical independent variables.

The key statistical technique for investigating social risk factors for child undernutrition is the multiple binary logistic regression analysis (Multipole binary logit model). Descriptive statistics were used to identify undernutrition with respect to different social characteristics. In addition, the chi-square test was used to check the assumptions of the key analysis technique. The goodness of fit of the fitted model was evaluated using Hosmer-Lemeshow test, likelihood ratio statistics, and omnibus test. SPSS 21 software was utilized for data analyzing.

The Multiple Binary Logit Model (Multiple Binary Logistic Regression Model) was used in the analysis as follows.

Model for undernutrition and social risk factors

$$logit\ P(x) = log\left(\frac{P(x)}{1-P(x)}\right) = \propto + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots + \beta_n X_n$$

$\propto = intercept$

$\beta_i = Slop\ coefficients$

$Binary\ dependant\ variable = Undernutrition$

$X_i = Social\ independant\ variales$

$i = 1, 2, \ldots \ldots \ldots \ldots, n$

$n = Number\ of social\ independant\ variables$

$X_1 = Smoking$

$X_2 = Alcohol\ usage$

$X_3 = Electricity$

$X_4 = Housing\ condition$

$X_5 = Marital\ status$

$X_6 = Mother's\ education$

$X_7 = Father's\ education$

Results and Discussion

Descriptive Statistics

The study analysed the data gathered from a sample of 378 grade 6 school children drawn from government schools in the Nuwara-Eliya district, Sri Lanka. The incidence of undernutrition was measured using the WFH index. The children with z scores less than –2 for WFH were considered as undernourished and others were not undernourished.

Table 2: The Prevalence of Undernutrition among Children in the Sample

Undernutrition	Having Undernutrition	Not having Undernutrition	Total
Number of children	104	274	378
Percentage (%)	27.5	72.5	100

Source: Sample Survey Data Analysis, 2023

As shown in table 2, the percentage of children suffering from undernutrition is 27.5%. It is higher than 20%, indicating more than one-fifth of the sample has become victims of undernutrition. The undernourished percentage of 27.5% found in this study is higher than the undernourished percentage of 11.8% (for under five-year children) provided by the Department of Census and Statistics in 2017 in terms of wasting, which was measured through the WFH z score for the Nuwara-Eliya district (DCS, 2017).

Table 3: Child Undernutrition by Selected Social Factors

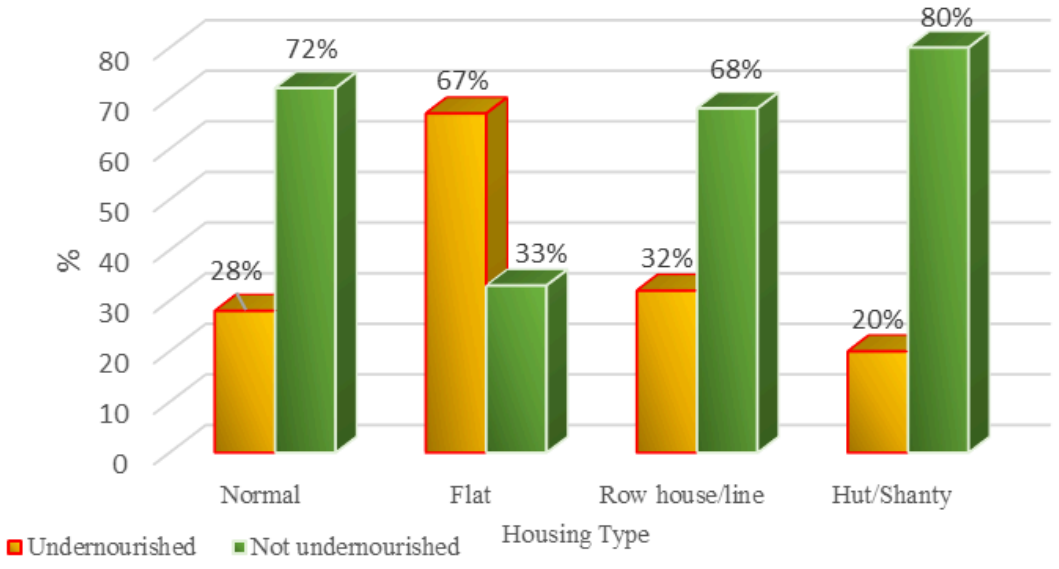
Characteristics	Categories	Having Undernutrition		All (%)
		Yes (%)	No (%)	
Smoking	Yes	31	69	70
	No	19	81	30
Alcohol Usage	Yes	33	67	38
	No	24	76	62
Electricity	Yes	26	74	98
	No	78	22	2
Marital status	Married	27	73	85
	Divorced/separated	16	84	8
	Widowed	43	57	6
	Never Married	80	20	1
Mother's education level	No Schooling	71	29	5
	Primary	33	67	21
	Secondary	18	82	61
	Tertiary	48	52	13
Father's education level	No Schooling	74	26	5
	Primary	33	67	23

	Secondary	18	82	60
	Tertiary	45	55	12

Source: Sample Survey Data Analysis, 2023

According to table 3, the highest undernutrition (31%) is seen among the children whose fathers smoke compared to those whose fathers do not (19%). For both groups of smoking and not smoking fathers, the percentages of children without undernutrition (69%, 81%) are higher than the percentages of children with undernutrition (31%, 19%). Obviously, the incidence of child undernutrition is higher among children whose fathers are addicted (33%) to alcohol than those who are not addicted to alcohol (24%). The percentage of suffering from undernutrition among the children who live in the houses without electricity (78%) is much higher than those who live with electricity (26%) in their houses. Considering the martial status, the percentage of suffering from undernutrition is the highest (80%) among the children of the parents with never married. The percentage of children suffering from undernutrition is low among children with parents who are divorced/separated (16%) and married (27%) relative to the children who never-married parents. Regarding mothers' educational level, the highest undernutrition (71%) appeared among the children whose mothers with no schooling. The lowest undernutrition (18%) is seen among the children of mothers who had secondary education. Same as for mothers, for fathers' educational level too, the highest undernutrition (74%) was found among the children whose fathers with no schooling. The lowest undernutrition (18%) is seen among the children of fathers who had secondary education similar to mothers.

Figure 2: Child Undernutrition by Housing Condition



Source: Sample Survey Data Analysis, 2023

Figure 2 highlights that the highest percentage of child undernutrition (67%) is seen among the children who live in flat houses, and it is much higher than the children who live in other types of houses. Undernutrition has appeared to be the lowest among the

children who live in huts/shanties (20%) and normal houses (28%). However, there is a slight similarity in undernutrition among the children living in three types of houses, row/line, normal, and hut/shanty.

Multiple Binary Logit Model

The key requirement (assumption) for running a multiple binary logit model is no multicollinearity (independence) among independent variables. All social variables tested are categorical variables, and chi-square test was applied to check multicollinearity.

Table 4: Multicollinearity among Social Independent Variables

Determinants	Smoking	Alcohol usage	Electricity	Housing condition
Alcohol usage	Chi-Square (p value=0.013)			
Electricity	Chi-Square (p value=0.218)	Chi-Square (p value=0.766)		
Housing condition	Chi-Square (p value=0.042)	Chi-Square (p value=0.150)	Chi-Square (p value=0.580)	
Marital status	Chi-Square (p value=0.037)	Chi-Square (p value=0.870)	Chi-Square (p value=0.384)	Chi-Square (p value=0.000)
Mother's education	Chi-Square (p value=0.008)	Chi-Square (p value=0.117)	Chi-Square (p value=0.582)	Chi-Square (p value=0.675)
Father's education	Chi-Square (p value=0.030)	Chi-Square (p value=0.090)	Chi-Square (p value=0.701)	Chi-Square (p value=0.071)
Determinants	**Marital status**	**Mother's education**	**Father's education**	
Mother's education	Chi-Square (p value=0.085)			
Father's education	Chi-Square (p value=0.349)	Chi-Square (p value=0.000)		

Source: Sample Survey Data Analysis, 2023

Table 4 provides the results of the chi-square test for the relationship among all social variables used for multiple binary logistic regression analysis. The highlighted cell clearly shows the statistically significant relationships between corresponding variables at 0.01 and 0.05 levels. The relationship among other variables is not significant. Based on these relationships the variables; smoking, housing condition, and father's education were removed from the model due to the violation of the assumption of no multicollinearity. Finally, a binary logit model was fitted for undernutrition using the variables, alcohol usage, electricity, marital status, and mother's education as independent variables.

Table 5: Estimated Multiple Binary Logit Model for Undernutrition
Source: Sample Survey Data Analysis, 2023

Explanatory Variables		B	S.E.	Wald	df	Sig.	Exp(B)
Alcohol usage		.425	.257	2.728	1	.099	1.529
Electricity		-2.447	.842	8.451	1	.004	.087
Marital status				10.653	3	.014	
	Married	-2.583	1.177	4.822	1	.028	.076
	Divorced/ separated	-3.635	1.299	7.825	1	.005	.026
	Widowed	-1.794	1.263	2.016	1	.156	.166
Mother's education				30.116	3	.000	
	No schooling	.634	.634	.998	1	.318	1.884
	Primary	-.576	.385	2.233	1	.135	.562
	Secondary	-1.518	.350	18.859	1	.000	.219
Constant		.055	0.017	10.383	1	.001	1.056

Base category (Reference group):
For alcohol usage – not using alcohol, For electricity – not having electricity, For marital status – never married, For mothers' education- tertiary education

Table 5 discloses the results of the multiple binary logistic regression model estimated to find out social risk factors for child undernutrition. Wald statistic provides a test of the statistical significance of each variable in the model of child undernutrition. If the p value (Sig.) of Wald statistic is less than 0.05, the variable of the corresponding parameter is significant. The above results verify that the parameters of the variables; electricity, marital status and mother's education are statistically significant implying that these variables have direct impact on child undernutrition. However, the variable alcohol usage is not statistically significant. Hence, there is no direct impact of this variable on child undernutrition.

Goodness of Fit of the Fitted Model

Table 6: Results of Goodness of Fit Tests

Type of Malnutrition	Goodness of Fit Test	Test statistics value	df	P value
Wasting	Hosmer-Lemeshow Test	2.864	5	0.721
	-2 Log likelihood	385.549		
	Omnibus test Chi-square	59.203	8	0.000

Source: Sample Survey Data Analysis, 2023

Hosmer-Lemeshow Test

Hypothesis:

Null: Fitted model for undernutrition and social risk factors is adequate (Model is significant)

Alternative: Fitted model for undernutrition and social risk factors is not adequate (Model is not significant)

Table 6 discloses that Hosmer–Lemeshow test statistics and corresponding p value for the model for undernutrition and social risk factors. P value is greater than 0.05, and the null- hypothesis is not rejected. It justifies that the selected logit model for undernutrition is adequately fit in the data in this study emphasizing the selected model with social risk factors to explain undernutrition is significant.

-2 Log Likelihood Ratio Statistics

Hypothesis:

Null: Added social risk factors are not significant in the fitted model for undernutrition

Alternative: Added social risk factors are significant in the fitted model for undernutrition

As shown in table 6, Omnibus test illustrated that adding the selected risk factors to the null model has reduced the -2 Log-likelihood by 59.203 (Chi-square values) with 0.000 p-value for the fitted model of undernutrition, rejecting the null hypothesis. It concluded that selected social risk factors for the fitted models are statistically significant, justifying the fitted model as adequate

The above results verify that the parameters of the social factor, electricity are statistically significant implying that this variable has a direct impact on child undernutrition. Supporting this result, Ali Khan and Azid (2011) proved that the provision of electricity has affected child malnutrition. The odds ratio between the children from the houses having electricity reference to the children from the houses not having electricity for child undernutrition is 0.087. It indicates that odds of having undernutrition is lower among the children from the houses with electricity compared to the children without electricity holding other social predictors constant. The model predicts the probability of being undernourished among the children from the houses having electricity is 0.08 while the probability of being undernourished of the children from the houses without electricity is 0.51. Further it shows that 8% of the children from

the houses with electricity and 51% of the children from the houses without electricity are undernourished. It is predicted that the probability of being undernourished for the children from the houses without electricity is approximately six times greater than it is for the children from the houses with electricity.

The above results verify that the parameters of the social factor, marital status are statistically significant, implying that this variable has a direct impact on child undernutrition. Similar findings were observed by Dodos et al. (2018) and Tette et al. (2016) illustrating an important relationship between the marital status of parents and the prevalence of malnutrition in their children. The odds ratio between the children whose parents are married reference to the children whose parents are never married for child undernutrition is approximately 0.076. It indicates that the odds of having undernutrition is lower among the children of married parents compared to the children of never married parents, holding other social predictors constant. The model predicts that the probability of being undernourished for the children of married parents is 0.07. Further, it shows that 7% of children of married parents are undernutrition. The odds ratio between the children whose parents are divorced or separated compared to the children whose parents are never married for child undernutrition is approximately 0.026. It shows that odds of having undernutrition is lower among the children whose parents are divorced or separated compared to children whose parents are never married. The probability of being undernutrition for the children of divorced or separated parents is 0.03. Further, it shows that 3% of children of divorced or separated parents are undernutrition. Odds ratio between the children whose parents are widowed and parents are never married for child undernutrition is 0.166 and it reveals that the odds of having undernutrition is lower among the children whose parents are widowed compared to children whose parents are never married. The probability of being undernutrition for the children of widowed parents is 0.15. Further it shows that 15% of children whose parents are widowed are undernourished. Further, the probability of being undernourished for the children whose parents who are never married is 0.51 and it shows that only 51% of children are undernourished among parents who are never married. According to Dodos et al. (2018), marriage status of not married or lives alone of mothers was more likely to be severe acute malnourished compared to their counterparts. Tette et al. (2016) have observed that being an unmarried or cohabiting mother increases the prevalence of malnutrition in their children according to multivariate analysis.

This study verifies that the parameters of the social factor, mothers' education are statistically significant implying that this variable has a direct impact on child undernutrition. These findings are similar to the findings of previous studies conducted by Igbokwe et al. (2017), Zhang et al. (2016), Tette et al. (2016) and Ayana et al. (2015). They found a significant relationship between maternal education and the nutritional status of children. In contrast, Pravana et al. (2017) found that mother's educational level

was not significantly associated with severe acute malnutrition among children. Similarly, in the adjusted model, no evidence was found to have a relationship between mother's education level and severe acute malnutrition among children by Ghimire et al. (2020).

The odds ratio of children whose mothers have no schooling compared to the children whose mothers with tertiary education for child undernutrition is 1.884. It reveals that the odds of having undernutrition is higher among children whose mothers with no schooling compared to children with tertiary education, holding other social predictors constant. The model predicts that the probability of being undernourished for the children of mothers with no schooling is 0.66. Further, it shows that 66% of children whose mothers have no schooling are undernourished. The odds ratio between children whose mothers have primary education and children whose mothers have tertiary education for child undernutrition is 0.562. It shows that odds of having undernutrition is lower among the children whose mothers have primary education compared to children whose mothers have tertiary education. The probability of being undernourished for the children whose mothers have primary education is 0.37. Further it shows that 37% of children whose mothers have primary education are undernourished. The odds ratio between the children whose mothers have secondary education and tertiary education for child undernutrition is 0.219. It reveals that odds of having undernutrition is lower among the children of mothers who have secondary education compared to children whose mothers have tertiary education. The probability of being undernourished for the children of mothers who have secondary education is 0.18. Further, it shows that 18% of children whose mothers with secondary education are undernourished. Further, the probability of being undernourished for the children whose mothers with tertiary education is 0.51, and it shows that 51% among children of mothers with tertiary education are undernourished. According to these findings, among different levels of mothers' education, the highest undernutrition is seen among the children whose mothers with no schooling, while for the children with secondary education, the probability of having undernutrition is least. Similarly, in the previous study by Duru et al. (2015) established that underweight was highest among children of mothers with no formal education. Further, Chowdhury et al. (2018) found that children of mothers with incomplete secondary education and mothers with completed secondary education were less likely to be underweight than children of uneducated mothers who had no formal schooling. Das and Gulshan (2017) found that no or primary education of mother as a key factor for malnutrition. Endris et al. (2017), pointed out that having uneducated mother is related to increased malnutrition. However, according to Getaneh et al. (2019), the probability of getting thin was lesser for the children whose mothers had no formal education than for those whose mothers had secondary and above education.

Conclusion and Recommendations

In conclusion, the logit model for undernutrition found that electricity, marital status, and mother's education are important social risk factors for child undernutrition. The variable, father's alcohol usage is not statistically significant. Hence, there is no significant impact of this variable on child undernutrition. Having a statistically significant relationships among smoking, housing condition, and father's education, they were removed from the model due to the violation of the assumption of no multicollinearity.

The study highlighted that children from the houses that do not have electricity are more likely to be exposed to undernutrition than the children from the houses do have electricity. Accessing electricity enables to improve the child's nutritional status through different ways such as increased wealth, improved knowledge and information through new technology and improved access to health services. Watching television has the potential to make people aware of nutritional information and improve their food habits. Refrigerators are associated with better preparation and conservation of food, improving the health of children. Electrification may support households in becoming wealthier through increasing income sources with longer lighting times. The government should evaluate infrastructure programmes for electrification and be encouraged to invest in electrification with a well recognition of its direct and indirect benefits.

The children with never married parents are more likely to be exposed to undernutrition than children of parents belong to other categories of marital status. The percentage of having undernutrition is greater than the percentage of not having malnutrition for the children whose parents are never married. The opposite is seen among the children of the married parents, divorced or separated parents, and widowed parents. Father plays a main role in income earning in a household. The economic power of the family with a single mother decreases purchasing power of food, leading to child undernutrition. Mothers should be economically empowered by providing income generating opportunities since the fathers are not available in the income earning process.

Considering the mothers' education, the highest undernutrition is seen among the children whose mothers have no schooling, while it is the least for the children whose mothers have secondary education. Uneducated mothers have a higher risk of malnutrition in their children than educated mothers. Low or no education among mothers is associated with less understanding of their children's correct food practices and health-related issues. They are absent with better knowledge about the nutritional requirements and protection of food nutrition that they give their children. Educational authorities should emphasis the education of girls who are future mothers since they directly contribute to breaking the malnutrition circle. School curricula should be

developed with the subject of health to improve food and nutritious knowledge, health behaviours, skills, and practices.

References

Ajieroh, V. (2009). *A Quantitative Analysis of Determinants of Child and Maternal Malnutrition in Nigeria*., Nigeria Strategy Support Program (NSSP) supported by the CGIAR, Background Paper No. NSSP10, International food policy research institute, sustainable solution for ending hunger and poverty.

Ali Khan, R. E. & Azid, T. (2011). Malnutrition in primary school-age children: A case of urban and slum areas of Bahawalpur, Pakistan. *International Journal of Social Economics,* 38(9), 748-766

Ayana, A. B., Hailemariam, T.W., &, Melke, A. S. (2015). Determinants of acute malnutrition among children aged 6–59 months in Public Hospitals, Oromia region, West Ethiopia: a case–control study. *BMC Nutrition,* 1(34), 1

Bella, A., Dartanto, T., Nurshadrina, D.S., Kusnadi, G., Moeis, F.R., Nurhasana, R., Satrya, A. and Thabrany, H. (2022). Do parental smoking behaviours affect children's thinness, stunting, and overweight status in Indonesia? Evidence from a large-scale longitudinal survey. *Journal of family and economic issues*, 44(2023), 714-726

Bhattacharya, A., Pal, B., Mukherjee, S. & Roy, S.K. (2019). Assessment of nutritional status using anthropometric variables by multivariate analysis. *BMC Public Health,* 19, 1045 (2019)

Casadei, K, & Kiel, J. (2021). *Anthropometric Measurement*. [Updated 2021 Apr 25]. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing

Cunningham, K., Ruel, M., Ferguson, E. &_Uauy, R. (2015). Women's empowerment and child nutritional status in South Asia: a synthesis of the literature. *Maternal and child nutrition*, 11(1), 2015, 1-19

Das, S. & Gulshan, J. (2017). Different forms of malnutrition among under five children in Bangladesh: a cross sectional study on prevalence and determinants. *BMC Nutrition,* 3(1)

DCS (Department of Census and Statistics) (2017). Demographic and Health Survey Report - 2016 Retrieved from line http://www.statistics.gov.lk/page.asp?page=Health

Dodos, J., Altare, C., Bechir, M., Miyatt, M., Pedro, B., Bellet, F., ... Altmann, M. (2018). Individual and household risk factors of severe acute malnutrition among under-five children in Mao, Chad: a matched case-control study. *Arch Public Health,* 76(1), 35

Fujii, T., Shonchoy, A.S. and Xu, S. (2018). Impact of Electrification on Children's Nutritional Status in Rural Bangladesh. *World Development*, 102(2018), 315-330

Galgamuwa, L.S., Iddawela, D., Dharmaratne, S.D., & Galgamuwa, G.L.S. (2017). Nutritional status and correlated socio-economic factors among preschool and school children in plantation communities, Sri Lanka. *BMC Public Health,* 17, 377

Getaneh, Z., Melku, M., Geta, M., Melak, T., & Hunegnaw, M. T. (2019). Prevalence and determinants of stunting and wasting among public primary school children in Gondar town, northwest, Ethiopia. *BMC Pediatr,* 19(1), 1-11

Gibson, R.S. (2005). *Principles of nutritional assessments (*2nd ed), Inc: 198, Madison avenue, New York, Oxford University Press

Igbokwe, O., Adimorah, G., Ikefuna, A., Ibeziako, N., Ubesie, A., Ekeh, C., & Iloh, K. (2017). Socio-demographic determinants of malnutrition among primary school aged children in Enugu, Nigeria*. Pan African Medical Journal, 28(*1), 248

Jelliffe, D.B. (1966). *The assessment of the nutritional status of the community*. WHO Monograph, Series No. 53, Geneva, World Health Organization, 50-84

Sargana, S.I., & Mohyuddin, A. (2013). Malnutrition among school going children in Pakistan. *Indian Journal of Health and Wellbeing*, 4(9), 1654-1659

Linnemayr, S., Alderman H, & Ka, A. (2008). Determinants of malnutrition in Senegal: Individual, household, community variables, and their interaction. *Economics & Human Biology*, 6(2), 252-263

Oliveira Assis, A., Barreto, M. L., De Oliveira, L.P.M., De Oliveira, V.A., Prado, M.D.S., Gomes, G.S.D.S., Pinheiro, S.M.C., Santos, N.S.D., Da Silva, R.D.C.D., Sampaio, L. R. & Santos, L.M.P. (2008). Determinants of mild-to-moderate malnutrition in preschoolers in an urban area of Northeastern Brazil: A hierarchical approach. *Public Health Nutrition,* 11 *(*4), 387-394

Rahman, A., & Chowdhury, S. (2007). Determinants of Chronic Malnutrition among pre-school children in Bangladesh. *Journal of Biosocial Science,* 39*(*02), 161-173

Rahman, A., Chowdhury, S., & Hossain, D. (2009). Acute Malnutrition in Bangladeshi Children: Levels and Determinants. *Asia Pacific Journal of Public Health (APJPH),* 21(3), 294-302

Rathnayake, I.M., & Weerahewa, J. (2005). Determinants of Nutritional Status among Pre-School Children in Sri Lanka. *Tropical Agricultural Research,* 17:148-161

Schilp J, Wijnhoven, H.A.H., Deeg, D.J.H., and Visser, M. (2011). Early determinants for the development of undernutrition in an older general population: Longitudinal Aging Study Amsterdam. *British Journal of Nutrition*,106(5),708-717

WHO (World Health Organization) (2010*). Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide*. World Health Organization, Geneva

WHO (World Health Organization) (2017), *Guideline: assessing and managing children at primary health-care facilities to prevent overweight and obesity in the context of the double burden of malnutrition,* World Health Organization
https://apps.who.int/iris/bitstream/handle/10665/259133/9789241550123-eng.pdf

WHO (World Health Organization), (2020). *Malnutrition*, World Health Organization https://www.who.int/ news-room/fact-sheets/detail//malnutrition

Yadav, A. & Dixit, A. (2017). A study to assess the prevalence of malnutrition among under 5 year children at selected Anganwadi centres of Jaipur district with a view to develop an information booklet for parents. *International Journal of Medical and Health Research,* 3(11), 78-79

Zhang, N., Bécares, L., & Chandola, T. (2016). Patterns and Determinants of Double-Burden of Malnutrition among Rural Children: Evidence from China. *PloS one,* 11(7), e0158119