NUTRITIONAL STATUS: FACTORS INFLUENCING WEIGHT OF CHILDREN – A COMPARATIVE STUDY OF BHAMINI AND VEERAGHATTAM MANDALS OF SRIKAKULAM DISTRICT OF ANDHRA PRADESH

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Abstract

There are about 38 percent of children under age of five are affected by stunting,while 20 percet are classified as wasted.Factors such as a challenging epidemiological environment,insufficient social support,and inadequate Infant Young Child Feeding (IYCF) practices are identified as social determinants contributing to stunting. Nutritional security encompasses access to sufficient food, healthcare services, maternal care, and optimal child feeding practices, improved sanitation, and knowledgeable caregivers. Tackling these challenges necessitates a comprehensive strategy that promotes diverse andnutrient-densediets, enhances food security, raises awareness of feeding practices, improves access to clean water and sanitation, and implements effective public health measure. Furthermore, investing in education and empowering communities to make informed nutritional choices is vital in addressing theseissues and enhancing overall health outcomes.By confronting the underlying causes of nutrional insecurity and micronutrient deficiencies,we can strive to reduce the rates of stunting, wasting and underweight, thereby alleviating the economic burdens linked to inadequatenutrition. In this context, this paper examines the various factors that affect children's weight, taking into account the socio-economic conditions, parental attributes, child feeding practices,and the use of health care services among both tribal and non-tribal population in the study area.

Key words: Infant and Young Child Feeding,Health Services,Nutrient-rich diets, Stunting, Wasting, Underweight

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1.INTRODUCTION

Human development requires nutrition as a crucial component. Energy and nutrients which are insufficient or unequally absorbed, resulting in malnutrition (WHO, 2016). Micronutrient deficiencies, protein-calorie deficits, overnutrition, and malnutrition of secondary type are some of the ways in which malnutrition manifests (Mayer, 1976). Health measures for the public can alleviate secondary malnutrition caused by diseases or disorders that impair food digestion. A high-income country is more likely to experience overnutrition. Thereis about 38 percent of children under five years age stunted, and 20 percent of the children are wasted. Additionally, 35 percent of children under five are overweight or obese (IIPS & ICF, 2017). A troubling trend has been observed in the nutritional status of children across different states and regions in the National Family Health Survey-5 (NFHS-5). Bihar has a prevalence of stunting around 40 percent, while Goa has around 20 percent. As compared to NFHS 4 data, in 13 out of the 22 states/UTs, the prevalence of chronic under nutrition has increased, while in 16 more the prevalence of underweight has increased.

India has recognized the problem of malnutrition quite early in the planning era. Anganwadis were established to provide nutritious food to the children. Over the period of time these centers evolved into providing multiple services to children as well as mothers of the children and pregnant women. In spite of these efforts the problem of malnutrition remains stubbornly significant problem. Taking into account the partially released data, India needs a holistic approach to nutrition instead of a piecemeal one. The performance of states in improving nutritional outcomes is not uniform. Andhra Pradesh was found to have a malnutrition rate that is higher than those in Jammu and Kashmir, Goa, and Tamil Nadu (Government of India & Population Council, 2019) within Andhra Pradesh there is large variation across districts.A poor epidemiological setting, lack of social support, and inappropriate Infant and Young Child Feeding (IYCF) are considered social determinants of stunting. Children in India are naturally shorter even when adequately fed because of genetic differences, according to the genetic potential hypothesis. According to the gradual catch-up hypothesis, Indian children need time to reach their full growth potential, despite being genetically similar to their reference population counterparts.

1.1. Theoretical and Conceptual Framework

Various theoretical frameworks have been suggested to analyze the intricate web of factors impacting nutritional outcomes (UNICEF, 1990; Smith and Haddad, 2000; FAO, 2000; Engle et al., 1999; Benson, 2004). The availability of food, the health status of individuals, and the quality of care they receive are key determinants of nutritional outcomes (UNICEF, 2013). Achieving optimal nutritional status requires a supportive environment, appropriate caregiving practices, and access to healthcare services. Numerous studies classify the causes of malnutrition into demographic variables (such as the child's age and gender, parental age, birth order, birth spacing, family size), socioeconomic factors (including parental literacy and occupation, family income, religion, caste, household composition, living conditions, and sanitation facilities), and child care practices (such as breastfeeding and immunization). Demographic and socioeconomic characteristics are expected to impact caregiving practices. Mothers and children's characteristics are used as predictor variables in this study, as well as socioeconomic factors, parental characteristics, health care utilization, and child characteristics. A number of factors impact the nutritional status of children, and anthropometric indicators such as stunting, wasting, and underweight can be used to determine these outcomes.

1.2. Statement of the Problem

There are challenges significantly faced in India as a result of poverty, hunger, and malnutrition. Malnutrition remains a problem, particularly for children and women, despite income growth. Malnutrition in children has not decreased in tandem with economic progress (Ramalinga swamy et al., 1996; Panagariya, 2013). The lack of access to healthcare services by marginalized women impacts future generations' nutrition, a crucial factor for their health. An increase in infection susceptibility and poor feeding practices exacerbate malnutrition in children. Research has shown that inadequate nutrition during infancy can negatively impact a child's future enrollment in school, educational attainment, cognitive ability, and lifetime earnings (Morgane et al., 1993; Pollitt, 1997). Although it is widely recognized that inadequacies in food are the primary causes of undernourishment, many programs and policies aiming to address this issue are based solely on food-based interventions, neglecting other factors that can affect nutritional outcomes. The inter-generational cycle of poverty can be broken through investment in good nutrition.

1.3. Need for the Study

A significant portion of the research on malnutrition in India relies on data derived from multiple iterations of the National Family Health Survey (NFHS). Only a few studies have examined children's nutritional status at the mandal level in Andhra Pradesh, in spite of the fact that many micro-level studies focus on states with high burdens of malnutrition. A growing concern in Andhra Pradesh is the emergence of the malnutrition which is triple burden, particularly among marginalized groups like the population of tribal ('Adivasis'). Malnutrition is prevalent among under-five children in these communities, as well as low nutritional status among mothers, posing serious health risks. Despite poverty, malnutrition, and the loss of traditional sustenance, tribal populations lag behind in educational and health achievement.

A majority of microlevel studies have predominantly focused on either tribal or non-tribal communities separately, often within a specific district or area. There is a dearth of research on malnutrition in the tribal population of Srikakulam district, with significant variation in the prevalence of this issue across different tribes in the region. Notably, there is a lack of comparative studies among various tribal communities. To address this gap, we conducted an analysis of two tribal-dominated mandals in Andhra Pradesh, aiming to present the first intra-tribal comparison of nutritional outcomes among preschool children. In addition to investigating the health profiles of mothers and disparities in nutritional outcomes between mandals, this study delves into the spatial factors influencing malnutrition.

In Andhra Pradesh, only a few studies investigated the nutritional profile of children under five. In micro-level studies, attention has been paid to the nutritional status of children in specific districts or tribes in Kerala. In spite of Andhra Pradesh's many achievements, malnutrition rates are higher among marginalized groups. In two tribal-dominated mandals viz., Bhamini and Veeraghattam in Srikakulam districts, no study has yet examined the spatial determinants of nutritional status of children. Therefore, a sample study is conducted in two tribal-dominated mandals in Andhra Pradesh. As of yet, no research has been conducted on IYCF practices, mother's nutrition awareness, or qualitative assessments of risk factors for nutritional outcomes. This makes the present study unique.

The current study employs a combination of quantitative and qualitative analyses, which has been the predominant method of analysis in macro and micro-level studies, respectively. The objective of qualitative analysis is to identify potential determinants of under nutrition by in-depth examination of malnourished children.and the feeding practices which reduces the risk factor of under wieight among children.

1.4. Objectives

1. To identify the determinants of nutritional status of children.
2. To study the Relationship between Underweight status and Socio-Economic Factors withcomparative analysis of two selected mandals.
3. To study the practices of Infant and Young Child Feeding and maternal health care indicators across the selected mandals.

1.5.1 Methodology

A three-stage stratified random sampling technique was utilized in the research study to ensure a representative sample from the tribal population in Srikakulam district. This method involved a systematic approach to selecting participants that accurately reflected the demographics of the region. Initially, two specific mandals, Veraghatam and Bhamini, were randomly chosen as the starting point. These mandals were identified as having a significant tribal population, making them ideal for the study.

Subsequently, a detailed list of all Anganwadis in Veraghatam and Bhamini was meticulously compiled. This step was crucial in establishing a comprehensive sampling frame for the research. In the second stage of sampling, ten Anganwadis were randomly selected from each mandal. By doing so, the researchers ensured a diverse representation of different Anganwadis in the study.

Finally,a total of 440 children were selected for the sample, comprising 22 children from each Anganwadi center. The sample was evenly split between the two mandals, with 220 children from each. This sample size was calculated using statistical formulas to ensure it would yield reliable conclusions about tribal children's health and well-being in the region.The careful selection process of participants at each stage of sampling was vital in maintaining the validity and generalizability of the study findings. Such meticulous attention to detail in the sampling process is essential in ensuring the accuracy and credibility of research outcomes.

A comprehensive list of pregnant women and children under five is maintained by each Anganwadi under the Integrated Child Development Services (ICDS) scheme. Researchers worked with Accredited Social Health Activists (ASHAs) and Anganwadi teachers to identify samples for the study.

"Ooru" or tribal hamlets are settlements in Andhra Pradesh where tribal communities reside. With the assistance of tribal promoters and "oorupeddas" (tribal heads), samples from these communities were identified.

1.5.2. Sample Size Determination

Among children aged 0-5 in Andhra Pradesh, 29,65,778 are estimated to exist based on single-year age returns (Government of India, 2011b). We selected the sample size based on precision and confidence intervals for the state. Sample size is determined by the following formula.

$$S = Z^2 \times P \times \frac{(1-P)}{M^2}$$

S = Sample size
Z = Z score
P = Population proportion
M = Margin of error

1.5.3. Data Source

Primary and secondary data sources were combined in this study. Statistics from the 2011 Census, the National Health and Nutrition Examination Survey (NFHS), and the National Nutrition Monitoring Bureau (NNMB) reports of the National Institute of Nutrition are secondary data sources. It is based on information provided by the Andhra Pradesh Institute for Research Training and Development Studies for Scheduled Castes and Scheduled Tribes (APIRTADS), the Scheduled Tribe Development Department Handbook (2017), UNICEF/WHO/World Bank joint estimates of child malnutrition for 2020, and the Comprehensive National Nutrition Survey (CNNS).

An interview schedule has been pre-tested for the collection of primary data. We assessed the questionnaire's effectiveness by conducting a pilot study with 10 percent of the total sample size. Based on the feedback of pilot study participants and expert comments, modifications have been made. In the primary data collection, mothers of preschool-aged children (ages 0 to 59 months) are interviewed.

1.5.4. Methods of Data Analysis

Rank correlation is utilized to ascertain the relationships among the pertinent variables associated with malnutrition based on state-level data provided by the various rounds of NFHS. A comprehensive analysis was conducted to evaluate the performance of the states over time.

An analysis of the effects of explanatory variables on normal height for age, normal weight for age, and normal weight for height among the sample group in the two mandals is carried out using binary logistic regression models.

1.5.5. Logistic regression model

The present studyexamines the association between underweight and selected predictor variables. There is also an investigation of the factors that determine normal weight for an individual's age. Also examined are practices related to IYCF and maternal and child care traditions.

A logistic regression model is a statistical method used for binary classification, which means it is used to predict the probability that a given input point belongs to one of two classes. It works by fitting a logistic function (also known as the sigmoid function) to the data, which transforms the output to range between 0 and 1, representing probabilities. The logistic function is defined as:

$$\log \, Odds(Y=1 \mid X) = \log\left(\frac{P(Y=1/X)}{1-P(Y=1/X)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n$$

and OrdinarLogistic is defined as follows

$$\log \, Odds(Y \le j \mid X) = \log\left(\frac{P(Y \le j/X)}{1-P(Y \le j/X)}\right) = \theta_j - \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n$$

2. DETERMINANTS OF CHILD NUTRITIONAL STATUS-AN OVER VIEW

An attempt is made to review the critical risk factors influencing children under-five's nutritional outcomes. In order to determine nutritional status, individuals, households, and communities must take into account a number of interrelated factors.Under nutrition has a greater impact on marginalized communities compared to more privileged populations. Specifically, children in these communities are more likely to experience underweight and stunting, with maternal BMI playing a significant role in these health outcomes. Studies have indicated that as many as 50 percent of children born to illiterate mothers are underweight, 45 percent are stunted, and 26 percent are wasted. These statistics highlight the stark disparities that exist in terms of nutrition and health outcomes between different socio-economic groups(Fenska N., Burns , 2013). The socio-economic status of a household and the characteristics of the mother have a significant impact on underweight and stunting. Low birth weight (LBW), migrant fathers, maternal education, and toilet facilities significantly contribute to underweight. (Priyanka, R ET , 2016). It is more important for children at higher quantiles to have parental education, electricity, and access to piped water than children at lower quantiles to have access to these resources. It is more effective to provide direct nutritional assistance to lower quantiles to reduce their risk of under nutrition. (Aturupane et al., , 2008).Low socioeconomic status, poor sanitation, LBW, young child age, and maternal age of less than 20 years are associated with wasting, while stunting is associated with low socioeconomic status, poor sanitation, young child age, and maternal age. (Vitolo et al. , 2008). It suggests that overcrowding and limited resources within larger families may contribute to the higher prevalence of stunting among children with three or more siblings. Further research and interventions focusing on improving nutrition and healthcare access for larger families could help address this issue. (Sabu K ,2020). It is important to address the issue of malnutrition by ensuring that children, especially girls, have access to a balanced and nutritious diet to prevent and manage nutritional anemia effectively. By focusing on improving their overall nutritional intake, we can help reduce the prevalence of anemia and promote better health outcomes for female children. (Sabarwal, N., 2011). Higher status for women translates into better child nutrition outcomes through improved caregiving practices, greater control over household resources, and enhanced health-seeking behavior. (Acqua , 2019),Limited access to healthcare services contributes to higher malnutrition rates due to inadequate disease prevention and treatment. (Benjmine,2014). Low birth weight, protein deficiency, and diarrhea are only some of the consequences of under nutrition. Poor sanitation and hygiene practices contribute to malnutrition by increasing the incidence of infections. (Priyanka et al., 2016).Three key issues are identified, the lack of national nutrition surveys, malnutrition (underweight, nutrient deficiencies coexisting with overweight) and poor dietary habits. (Nasreddine et al., 2018)Marginalized children, specifically those belonging to Scheduled Castes (SCs) and Scheduled Tribes (STs), are experiencing low nutritional status. The disparity in nutritional health highlights the importance of addressing social and economic inequalities in order to improve overall well-being and health outcomes for vulnerable populations.(Gangadharan, 2011).The nutritional status of children is greatly influenced by various factors, with a strong correlation found between breastfeeding initiation, the mother's knowledge about colostrum, and the timing of introducing supplementary diets. Breastfeeding initiation sets the foundation for a child's health, while a mother's awareness of colostrum can impact the quality of the child's diet. Additionally, the timing of introducing supplementary diets can affect the overall nutritional intake of the child. Therefore, it is essential for caregivers to be informed about these factors to promote the well-being of children.(Block, 2007). By examining these key determinants, policymakers and stakeholders can better understand the complex dynamics that influence the nutritional well-being of children in the state. This comprehensive approach to assessing nutritional status allows for targeted interventions and strategies to address the root causes of malnutrition and improve the overall health and development of children.

3. FACTORS INFLUENCING WEIGHT OF CHILDREN

An Ordered logistic regression model is used to estimate the determinants of normal weight for age considering underweight and severely underweight status of children in the study area. In addition, it analyzes qualitatively the practices of early childhood development, maternal care, and child care in the study area. Some of the specific characteristics of underweight children and mothers that are examined in this study include socioeconomic status, maternal education level, access to healthcare, and dietary practices. These factors are analyzed to determine their influence on the prevalence of underweight in the study area.

It is considered a child underweight if the Z-score is below negative two standard deviations and severely underweight if the z-score is below negative three standard deviations. Malnutrition in the form of underweight can result from deficiencies in protein and energy. Protein deficiency can lead to a weakened immune system, slow wound healing, and muscle wasting. Additionally, it can impair the growth and development of children, leading to stunted growth and cognitive impairments.

3.1. Relationship between Underweight status and Socio-Economic Factors

The following table presents an analysis of the socio-economic factors associated with underweight prevalence among children in two selected mandals, Bhamini and Veeraghattam. Child malnutrition, often reflected in underweight status, is influenced by a variety of social and economic factors, which can differ significantly across communities. This table explores how characteristics such as social category, family size, type of housing, total family expenditure, asset ownership status, and the presence of other young children in the household are related to the nutritional status of children.

Table 3.1: Children Classified based on Underweight by Selected Socio-Economic Characteristics

Socio-economic characteristics	Category	Underweight (Combined) percent		Underweight (Bhamini) percent		Underweight (veeraghattam) percent	
		No	Yes	No	Yes	No	Yes
social category	ST	65.3	34.7	71.7	28.3	64.9	35.1
	Non ST	78.4	21.6	81.7	18.3	76.0	24.0
	Test Statistic	ξ2 =7.844; df=1, p = 0.005*		ξ2 =1.754; df=1, p = 0.185		ξ2 =0.2407; df=1, p = 0.121	
Size of the Family	Upto 5 members	72.2	27.8	76.9	23.1	68.5	31.5
	Above 5 members	74.8	25.2	83.5	16.5	71.5	28.5
	Test Statistic	ξ2 =0.332; df=1, p = 0.564		ξ2 =2.203; df=1, p = 0.138		ξ2 =0.021; df=1, p = 0.884	
Type of house	Kutcha	74.0	26.0	85.3	14.7	75.7	24.3
	Semi pucca	71.8	28.2	85.8	14.2	69.4	30.6
	Pucca	75.5	24.5	79.5	20.5	77.0	223.0
	Test Statistic	ξ2 =1.199; df=2, p = 0.549		ξ2 =1.717; df=2, p = 0.424		ξ2 =0.942; df=2, p = 0.624	
Total Expenditure	Upto Rs 6000	67.9	32.1	70.0	30.0	69.0	31.0
	Rs 60001- 8000	72.4	27.6	76.8	23.2	71.3	29.7
	Rs 8,001- Rs 10,000	78.2	21.8	80.2	19.8	70.0	30.0
	Above Rs 10,000	79.5	20.5	88.3	11.7	73.6	26.4
	Test Statistic	ξ2 =4.402; df=3, p = 0.221		ξ2 =4.883; df=3, p = 0.181		ξ2 =0.351; df=3, p = 0.950	
	Low asset class	66.9	33.1	65.8	34.2	67.5	32.5
	High asset class	85.2	14.8	90.5	9.5	76.7	23.3

Asset ownership status	Test Statistic	ξ2 =18.807; df=1, p = 0.000*		ξ2 =17.819; df=1, p = 0.000*		ξ2 =2.090; df=1, p = 0.148	
Possibility of another child less than 5 years	No	75.6	24.4	80.7	19.3	70.9	29.1
	Yes	71.9	28.1	84.30	15.7	66.9	33.1
	Test Statistic	ξ2 =0.439; df=1, p = 0.508		ξ2 =0.064; df=1, p = 0.787		ξ2 =0.176; df=1, p = 0.675	

Source: Field Survey, 2019

Note: *significant at 5 percent; ** significant at 10 percent.

When examining social category, a clear pattern emerges, showing that children from Scheduled Tribe (ST) households are more likely to be underweight than those from non-ST households. Overall, 34.7% of children from ST households fall into the underweight category, compared to only 21.6% in non-ST households, a statistically significant difference (p = 0.005). This suggests that social category may play a significant role in nutritional outcomes. However, when looking at each mandal separately, the difference in underweight rates between ST and non-ST children becomes less pronounced. In Bhamini, 28.3% of ST children are underweight compared to 18.3% of non-ST, and in Veeraghattam, 35.1% of ST children are underweight versus 24% of non-ST children. In both cases, the differences are not statistically significant, indicating that the broader trend observed may not hold strongly within each mandal individually.

Family size does not appear to significantly influence the likelihood of children being underweight. In families with up to five members, 27.8% of children are underweight, while in larger families (more than five members), 25.2% are underweight. The slight difference here is not statistically significant (p = 0.564), suggesting that family size may not directly impact children's underweight status. This pattern is consistent across both Bhamini and Veeraghattam, where children from larger families do not show a markedly lower or higher risk of being underweight compared to those from smaller families.

Looking at the type of housing—an indicator of socio-economic status—there is a marginal trend where children from kutcha (less durable) houses tend to be underweight slightly more than those from semi-pucca or pucca (more durable) homes. For instance, 26% of children from kutcha houses are underweight, while 24.5% from pucca houses fall into this category. However, this difference is not statistically significant (p = 0.549), and the trend holds across both mandals, indicating that housing type does not play a strong role in determining underweight status.When considering total family expenditure, we see a decrease in underweight prevalence as household expenditure increases. Among families with monthly expenditures up to Rs. 6,000, 32.1% of children are underweight, while in households with expenditure above Rs. 10,000, only 20.5% are underweight. Although the trend suggests that higher household expenditure may be associated with better child nutrition, this difference is not statistically significant (p = 0.221). The same trend appears in Bhamini and Veeraghattam, though not to a significant degree.

Asset ownership status shows a strong association with underweight prevalence. Children from low asset households are significantly more likely to be underweight, with 33.1% in this category, compared to just 14.8% in high asset households (p = 0.000). This finding suggests that asset ownership—often linked with wealth and stability—may play a key role in nutritional outcomes for children. This significant association is observed in Bhamini (p = 0.000) but not in Veeraghattam, where the difference is less pronounced.

Finally, examining the possibility of another child under five years in the household shows no significant association with the likelihood of being underweight. Households without another young child have 24.4% of children classified as underweight, compared to 28.1% in households with an additional child under five. This minor difference is not statistically significant (p = 0.508) and holds across both mandals, suggesting that the presence of another young child does not substantially affect children's weight status.

3.2.Relationship between Underweight status and Parental Characteristics

Table 3.2 provides an analysis of the distribution of underweight children based on selected parental characteristics, including age, education level, occupation, height, and other demographic and socioeconomic factors. This table compares data from the combined study population and separately from the Bhamini and Veeraghattam mandals, highlighting how various parental attributes correlate with underweight status in children. This information is crucial for understanding the factors that may influence children's nutritional outcomes, thereby offering insights into targeted interventions for child health improvement.

Table 3.2: Distribution of Children Classified based on Underweight by Selected Parental Characteristics (percentage)

Parental characteristics	Category	Underweight in percent		Underweight (Bhamini) in percent		Underweight (Veeraghttam) in percent	
		No	Yes	No	Yes	No	Yes
Age of the mother	Upto 25 years	75.2	24.8	76.4	23.6	70.9	29.1
	25-30 years	76.1	23.9	82.3	17.7	68.2	29.8
	Above 30 years	74.8	25.2	82.6	17.4	68.6	31.4
	Test statistics	ξ2 = 0.088; df=2; p = 0.957		ξ2 = 0.803; df=2; p = 0.669		ξ2 = 0.189; df=2; p = 0.910	
Age at childbirth	<=22 years	74.0	26.0	81.0	19.0	71.0	29.0
	>22 years	75.9	24.1	80.4	19.6	68.0	32.0
	Test Statistics	ξ2 = 0.000; df=1; p = 0.983		ξ2 = 0.052; df=1; p = 0.820		ξ2 = 0.250; df=1; p = 0.617	
Mother's education	Upto 10 th Std	68.9	31.1	80.6	19.4	67.1	32.9
	Higher Secondary	76.2	23.9	78.6	21.4	72.1	27.9
	Graduation &above	82.8	17.2	85.5	14.5	78.9	21.1
	Test statistics	ξ2 = 5.657; df=2; p = 0.059**		ξ2 = 1.087; df=2; p = 0.581		ξ2 = 2.143; df=2; p = 0.342	
Father's Education	Upto 10 th Std	71.6	28.4	77.6	22.40	68.20	31.80
	Higher Secondary	79.6	20.4	83.6	16.40	71.90	28.10
	Graduation &above	89.7	10.3	90.5	9.50	88.90	11.10
	Test statistics	ξ2 = 7.419; df=2; p = 0.024*		ξ2 = 2.308; df=2; p = 0.315		ξ2 = 3.408; df=2; p = 0.182	
Difference in education levels	Education of father< mother	74.3	25.7	77.7	22.3	70.7	29.3
	Education of father= mother	75.7	24.3	84.4	15.6	69.6	30.4
	Education of father> mother	75.0	25.0	88.9	11.1	71.0	29.0
	Test Statistic	ξ2 = 0.103; df=2; p = 0.950		ξ2 = 1.686; df=2; p = 0.430		ξ2 = 0.037; df=2; p = 0.982	
Mother's Height	Short(<155 cm)	70.4	29.6	76.4	23.6	66.7	33.3
	Tall(>155 cm)	83.4	16.6	86.7	13.3	79.4	20.6
	Test statistics	ξ2 = 8.946; df=1; p = 0.003*		ξ2 = 3.223; df=1; p = 0.073**		ξ2 = 3.800; df=1; p = 0.051**	
BMI of mother	Underweight	67.5	32.5	75.0	25.0	65.1	34.9
	Normal	72.4	27.6	77.3	22.7	67.6	32.4

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Parental characteristics	Category	Underweight in percent		Underweight (Bhamini) in percent		Underweight (Veeraghttam) in percent	
		No	Yes	No	Yes	No	Yes
	Overweight	86.3	13.7	86.4	13.6	86.0	14.0
	Test statistics	ξ2 = 12.444; df=2; p = 0.002*		ξ2 = 2.804; df=2; p = 0.246		ξ2 = 6.381; df=2; p = 0.041*	
Occupation of mother	Unemployed	75.1	24.9	83.2	16.8	69.2	30.8
	Employed	74.3	25.7	73.1	26.9	74.0	26.0
	Test statistics	ξ2 = 0.019; df=1; p = 0.890		ξ2 = 1.213; df=1; p = 0.271		ξ2 = 0.581; df=1; p = 0.446	
Sector in which father is working	Not Applicable	60.0	40.0	55.7	44.4	100.0	0.0
	Formal	92.2	7.8	95.3	4.7	85.0	15.0
	Informal	72.3	27.7	78.1	21.8	68.7	31.3
	Test statistics	ξ2 = 12.308; df=2; p = 0.002*		ξ2 = 10.266; df=2; p = 0.006*		ξ2 = 2.734; df=2; p = 0.255	

Source: Field Survey, 2019

Note: *significant at 5 percent; ** significant at 10 percent.

According to Table 3.2, The age of the mother shows minimal impact on underweight status, as similar rates appear across age categories. For instance, mothers up to 25 years have a combined underweight rate of 24.8%, which is nearly identical to the25.2% rate for mothers above 30 years. This trend holds for both mandals, where Veeraghattam mothers above 30 years show a slightly higher underweight rate (31.4%) compared to Bhamini (17.4%). Statistical analysis indicates no significant association between maternal age and underweight status, suggesting age alone is not a strong predictor of a child's nutritional health.

The age at childbirth also appears to have a limited effect, with mothers who gave birth at age ≤22 years showing an underweight rate of 26.0%, slightly higher than the 24.1% rate for those who gave birth after 22. This trend is similar across both mandals, with no statistical significance found. This indicates that age at childbirth may not have a substantial influence on the likelihood of underweight children.Conversely, maternal education seems to have a more pronounced impact on child underweight status. Mothers educated only up to the 10th standard have a higher underweight rate of 31.1%, while those with education beyond secondary school (graduation and above) show a significantly lower rate of 17.2%. This trend is reflected in both Bhamini (14.5%) and Veeraghattam (21.1%), where higher education correlates with lower underweight rates. The combined data show a

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statistically significant association, highlighting the potential role of maternal education in improving child health outcomes.

Father’s education also shows a significant association with underweight status, as seen by the reduction in underweight rates from 28.4% for fathers educated only up to the 10th standard to 10.3% for those with higher education. This trend is consistent in both Bhamini and Veeraghattam, suggesting that parental education is crucial for child nutritional health. In contrast, the difference in educational levels between parents does not show significant associations, indicating that the relative educational attainment of parents may not be as influential as each parent's individual education level.Maternal height appears to be an important factor in underweight prevalence, with shorter mothers (<155 cm) showing a combined underweight rate of 29.6%, compared to 16.6% for taller mothers. This pattern is consistent across both mandals, with statistical significance observed in the combined data. These findings suggest that maternal height, potentially indicative of overall health and nutritional status, could impact children's weight and health.

Mother's BMI also plays a significant role in child underweight status. Children of underweight mothers show a higher rate of underweight (32.5%), while those of overweight mothers have significantly lower rates (13.7% in combined data). This association is statistically significant for both the combined data and Veeraghattam, emphasizing the importance of maternal health as a contributing factor to child nutrition.The mother's occupation shows no significant association with child underweight rates. In the combined data, both unemployed and employed mothers have similar underweight rates, and this trend is observed in both Bhamini and Veeraghattam, indicating that maternal employment may not directly impact child nutrition.

3.3 Relationship between Underweight status and Utilization of Health Care Services

Table 3.3 explores the association between children's underweight status and their access to various health care services. The analysis considers factors such as the number of antenatal check-ups, type of childbirth, intake of iron and calcium supplements, place of delivery, and adherence to the child vaccination schedule. These factors are essential indicators of maternal and child health care utilization, which can have a substantial impact on children's nutritional status. By assessing these variables, the study aims to highlight how the accessibility and utilization of health services may contribute to preventing undernutrition among children in rural and indigenous communities, particularly in Bhamini and Veeraghattam mandals.

The results presented in the table indicate the percentage of underweight children in families with varying levels of health care utilization and the statistical significance of these relationships. Such an analysis can offer critical insights into the gaps in healthcare practices that may need to be addressed to improve children's nutrition and overall health in these regions.

Table 3.3: Underweight children and Excess to Health Care Services

Utilization of Health care services	**Category**	**Underweight (Combined) in percent**		**Underweight (Bhamini) in percent**		**Underweight (Veeraghattam) in percent**	
		No	**Yes**	**No**	**Yes**	**No**	**Yes**
Number of anti-natal check-ups	Less than 4	70.	30	78.8	21.2	67.1	32.9
	More than 4	77.4	22.6	81.5	18.5	72.3	27.7
	Test statistics	ξ2 = 2.211; df=1; p = 0.137		ξ2 = 0.124; df=1; p = 0.725		ξ2 = 0.490; df=1; p = 0.484	
Type of childbirth	Normal	74.1	25.9	80.6	19.4	71.2	28.8
	C section	75.4	24.6	80.3	19.7	70.2	29.8
	Test statistics	ξ2 = 0.287; df=1; p = 0.592		ξ2 = 0.015; df=1; p = 0.902		ξ2 = 0.001; df=1; p = 0.996	
Intake of iron calcium tablet	Never	0.0	0.0	0.0	0.0	0.0	0.0
	Regular	75.0	25.0	81.1	18.9	70.3	29.7
	Irregular	73.7	26.3	77.8	22.2	70.0	30.0
	Test statistics	ξ2 = 0.018; df=1; p = 0.897		ξ2 = 0.063; df=1; p = 0.804		ξ2 = 0.000; df=1; p = 0.986	
Place of Delivery	Home	77.8	22.2	100.0	0.0	71.4	28.6
	Government Hospital	71.9	28.1	77.0	23.0	68.1	31.9
	Private Hospital	89.0	11.0	94.9	5.1	82.4	17.6
	Test statistics	ξ2 = 9.643; df=2; p = 0.009*		ξ2 =6.850; df=2; p = 0.033*		ξ2 = 2.808; df=2; p = 0.246	
Child Vaccination as per chart	No	100.0	41.7	100.0	0.0	0	0
	Yes	74.9	0.0	80.8	19.2	70.1	29.9
	Test Statistic	ξ2 = 0.336; df=1, p = 0.563		ξ2 = 0.238; df=1, p = 0.628		ξ2 = ;df=, p = -	

Source: Field Survey, 2019
Note: *significant at 5 percent; ** significant at 10 percent.

Starting with antenatal check-ups, the results indicate that children whose mothers had fewer than four check-ups were more likely to be underweight, with an underweight prevalence of 30% compared to 22.6% among children whose mothers

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had more than four check-ups. In Bhamini, 21.2% of children in the “less than four check-ups” category were underweight, compared to 18.5% in the “more than four” group. The trend was similar in Veeraghattam, where children with mothers who received more than four check-ups had a slightly lower underweight rate of 27.7%. However, the differences were not statistically significant, suggesting that the number of check-ups alone may not be a strong predictor of child malnutrition, though it might contribute to other health improvements.

The type of childbirth did not show a significant impact on underweight status, with nearly identical underweight rates among children born through normal delivery (25.9%) and those born through C-section (24.6%) in the combined analysis. The results were similarly nonsignificant for Bhamini and Veeraghattam, indicating that childbirth type alone does not seem to influence the likelihood of underweight status among children in these mandals.

Iron and calcium intake during pregnancy also showed minimal impact on child malnutrition. Among mothers who regularly took iron and calcium supplements, 25% of their children were underweight, while for those with irregular intake, it was slightly higher at 26.3%. Although there was no statistical significance in these differences, the slight reduction in underweight rates with regular supplement intake may point to a minor role of nutritional supplements in reducing underweight risk, especially in nutritionally deprived settings.

The place of delivery, however, demonstrated a more noticeable association with underweight prevalence. Children born in private hospitals showed the lowest underweight rate at 11%, while those born in government hospitals had an underweight rate of 28.1%, and those born at home had an even higher rate of 22.2%. In Bhamini, no underweight cases were recorded for home births, which may suggest varied community practices and health conditions. These differences were statistically significant in both the combined analysis ($p = 0.009$) and Bhamini specifically ($p = 0.033$), highlighting that delivery in a private hospital setting might be associated with better initial health conditions and subsequently lower rates of underweight children.

Lastly, child vaccination appeared to correlate with underweight status. Children who were not vaccinated as per the recommended schedule had an underweight rate of 41.7% in the combined analysis, whereas children who received vaccinations on schedule had an improved outcome with a lower prevalence of underweight cases. Although this difference was not statistically significant, it indicates that vaccination adherence could be beneficial for child health outcomes, likely contributing indirectly to better nutritional status by preventing illness.

3.4 Relationship between Underweight status and Child Characteristics

Table 6.4 analyzes the relationship between children's underweight status and selected child characteristics, offering insights into factors that might contribute to or mitigate underweight conditions. The variables studied include age, gender, birth weight, birth order, term of birth, birth interval, and frequency of diarrhea, providing a comprehensive view of child-related factors and their impact on underweight status in the combined data as well as the Bhamini and Veeraghattam mandals.

Table 6.4: Underweight Status and Selected Child Characteristics

Child Characteri-stics	Category	Underweight (Combined) in percent		Underweight (Bhamini) in percent		Underweight (Veeraghattam) in percent	
		No	Yes	No	Yes	No	Yes
Age	≤12 months	74.4	25.6	76.7	23.3	72.8	27.2
	13-36 months	75.9	24.1	84.5	15.5	70.1	29.9
	37-59 months	73.3	26.7	77.5	22.5	68.4	31.6
	Test statistics	ξ2 = 0.313; df=2, p = 0.855		ξ2 =1.667; df=2, p = 0.434		ξ2 = 0.208; df=2, p = 0.901	
Gender	Male	75.0	25.0	79.40	20.6	69.8	30.2
	Female	76.0	24.0	82.60	17.4	70.7	29.3
	Test Statistics	ξ2 = 0.223; df=1, p = 0.637		ξ2 =0.319 df=1, p = 0.572		ξ2 = 0.021; df=1, p = 0.885	
Birth weight	Upto 2.5 kg	61.8	38.2	74.3	25.7	53.7	46.3
	2.5 to 3.5 kg	75.9	24.1	80.5	19.5	71.0	29.0
	>3.5 kg	95.6	4.4	92.0	8.0	100.0	0.0
	Test statistics	ξ2 = 18.476; df=2, p = 0.000*		ξ2 = 2.997; df=2, p = 0.223		ξ2 = 15.796; df=2, p = 0.000*	
Orderof birth	First	75.6	24.4	77.1	22.9	73.9	26.1
	Second	75.7	24.3	85.0	15.0	68.3	31.7
	Third	66.0	34.0	100.0	0.0	62.8	37.2
	Above three	90.0	10.0	0.0	0.0	90.0	10.0
	Test statistics	ξ2 = 3.333; df=3, p = 0.343		ξ2 = 2.779; df=2, p = 0.249		ξ2 = 3.741; df=3; p = 0.291	
Full Term	Yes	75.7	24.3	83.0	17.0	71.1	28.9
	No	65.6	34.4	72.7	27.3	50.0	50.0
	Test statistic	ξ2 = 1.598; df=1, p = 0.206		ξ2 =1.092 ;df=1, p = 0.296		ξ2 = 2.046; df=1, p = 0.153	
	Less than 2 years	81.4	18.6	89.5	10.5	77.5	22.5

Child Characteri-stics	Category	Underweight (Combined) in percent		Underweight (Bhamini) in percent		Underweight (Veeraghattam) in percent	
		No	**Yes**	**No**	**Yes**	**No**	**Yes**
Birth Interval	Greater than 2 years	72.9	27.1	83.7	16.3	64.6	35.4
	Test statistics	ξ2 = 2.092; df=1, p = 0.148		ξ2 = 0.260; df=1, p = 0.610		ξ2 = 2.249; df=1, p = 0.134	
Frequency of diarrhea	Never &Less frequent	76.4	23.6	81.2	18.8	72.1	27.9
	Frequent	62.1	37.9	50.0	50.0	63.0	37.0
	More frequent	59.3	40.7	100.0	0.0	54.8	45.2
	Test statistics	ξ2 = 4.770; df=2, p = 0.092*		ξ2 = 1.484; df=2, p = 0.476		ξ2 = 2.303; df=2, p = 0.316	

Source: Field Survey, 2019
Note: *significant at 5 percent; ** significant at 10 percent.

Age does not appear to significantly influence underweight status across the three groups. Children aged 13-36 months have the lowest percentage of underweight (24.1%) in the combined data, and this trend remains similar in both mandals, with slight variations. Statistical analysis reveals no significant association between age and underweight status, suggesting that age within this range is not a determinant of nutritional health.When examining gender, there is also no notable association with underweight status. In the combined data, the rates for male (25.0%) and female (24.0%) children are nearly identical. In Bhamini and Veeraghattam, the differences are minimal, and statistical tests confirm the lack of significant association. This finding suggests that gender does not substantially affect underweight rates among children in these communities.

Birth weight shows a strong correlation with underweight status. Children with a birth weight of ≤2.5 kg exhibit the highest underweight rate (38.2%), while those weighing over 3.5 kg have a markedly lower rate of 4.4% in the combined data. In Veeraghattam, the pattern is even more pronounced, with no underweight cases in children weighing more than 3.5 kg. Statistical significance in the combined data and Veeraghattam underscores the importance of birth weight as a critical factor for child nutritional outcomes.The order of birth does not appear to have a statistically significant effect on underweight status. While children born third show a higher underweight rate (34.0%) in the combined data, other birth orders vary without a clear trend, especially in Veeraghattam, where third-born children have a high underweight rate (37.2%). The absence of statistical significance suggests that birth order may not play a major role in determining underweight status.

Being a full-term or preterm child also lacks a significant association with underweight status. Full-term children show slightly lower underweight rates (24.3%) compared to preterm children (34.4%) in the combined data, and similar trends are observed in both mandals. However, the statistical tests indicate no significant relationship, suggesting that full-term status alone may not be a defining factor for underweight conditions.

The birth interval shows no statistically significant effect on underweight status, though children with a birth interval of less than two years have a lower underweight rate (18.6%) compared to those with intervals greater than two years (27.1%) in the combined data. This trend is evident in both mandals but without significant association, suggesting that birth interval alone may not be a strong determinant of underweight status.The frequency of diarrhea presents a potential link with underweight status, as children with more frequent diarrhea episodes show a higher underweight rate (40.7%) in the combined data. In Bhamini, children experiencing frequent diarrhea episodes are at a significantly higher risk, with 50.0% being underweight. Though statistical significance is achieved only in the combined data, the observed trend highlights diarrhea frequency as an essential health indicator that could influence children's nutritional outcomes.

3.5. Relationship between Underweight status and Child Feeding Practices

Table 3.5 presents the relationship between underweight status among children and various child feeding practices, including breastfeeding initiation, exclusive breastfeeding for the first six months, breastfeeding duration, timing of complementary feeding, and frequency of child feeding intervals. These practices play a critical role in child nutrition and development, especially during the early stages of life when children are most vulnerable to malnutrition and associated health issues. Early and adequate breastfeeding, timely introduction of complementary foods, and appropriate feeding intervals can contribute significantly to improving a child's nutritional status and preventing underweight conditions.

Table 3.5: Underweight status and Selected Child Feeding Characteristics (percentage)

Child feeding practices	Category	Underweight (Combined) in percent		Underweight (Bhamini) in percent		Underweight (Veeraghatta,) in percent	
		No	Yes	No	Yes	No	Yes
Initiation of breastfeeding	Within 24 hours	74.8	25.2	81.4	18.6	70.1	29.9
	More than 24 hours	77.8	22.2	76.5	23.5	100	0.0
	Test Statistic	x2 =0.080; df=1, p = 0.777		x2 =0.243; df=1, p = 0.622		x2 =0.425; df=1, p = 0.514	
Exclusive breastfeeding for six months	No	75.0	25.0	86.7	13.3	55.6	44.4
	Yes	75.9	24.1	79.2	20.8	72.0	28.0
	Test Statistic	x2 =0.000; df=1, p = 0.983		x2 =0.888; df=1, p = 0.346		x2 =2.178 df=1, p = 0.140	
Duration of breastfeeding	Less than 1 year	77.10	22.9	84.50	15.50	72.70 percent	27.30 percent
	1-2 years	77.70	22.2	82.70	17.30	73.20 percent	26.80 percent
	Greater than 2 years	72.50	27.5	77.90	22.10	66.70 percent	33.30 percent
	Test Statistic	x2 =1.932; df=2, p = 0.381		x2 =0.931; df=2, p = 0.628		x2 =1.084; df=2, p = 0.582	
Initiation of complementary feeding	Less than 3 months	88.9	11.1	88.1	11.9	0.0	0.0
	3 to 6 months	65.2	34.8	76.9	23.1	60.6	39.4
	After 6 months	76.2	23.8	81.2	18.8	72.3	27.7
	Test Statistic	x2 =3.578; df=2, p = 0.167		x2 =0.505; df=2, p = 0.777		x2 =1.888; df=1, p = 0.169	
Child feeding interval	Less than 3 times	63.4	36.6	77.8	22.2	61.9	38.1
	More than 3 times	78.1	21.9	81.2	18.8	74.8	25.2
	Test Statistic	x2 =8.353; df=1, p = 0.004*		x2 =0.061; df=1, p = 0.804		x2 =4.285; df=1, p = 0.039*	

Source: Field Survey, 2019

The initiation of breastfeeding shows a marginal difference in underweight rates. Children who began breastfeeding within the first 24 hours had a combined underweight rate of 25.2%, compared to 22.2% for those who initiated breastfeeding after 24 hours. In Bhamini, the underweight rate was slightly higher among those who

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started within 24 hours (18.6%) compared to those who started later (23.5%). Conversely, in Veeraghattam, no underweight cases were reported among children who initiated breastfeeding more than 24 hours after birth, suggesting a possible community-specific variance. However, these differences were not statistically significant, indicating that the timing of breastfeeding initiation alone may not be a strong predictor of underweight status in this population.

Exclusive breastfeeding for the first six months was also assessed. Among children who were exclusively breastfed, the underweight rate was slightly lower (24.1%) compared to those who were not (25.0%) in the combined analysis. In Bhamini, children who were not exclusively breastfed had a much lower underweight rate (13.3%) than those who were (20.8%), while Veeraghattam showed a higher underweight rate of 44.4% for those not exclusively breastfed, compared to 28.0% for those who were. These results suggest a varied impact of exclusive breastfeeding on underweight status between the two mandals, but the association was not statistically significant in any of the cases.When analyzing the duration of breastfeeding, children breastfed for more than two years had a slightly higher combined underweight rate of 27.5% compared to those breastfed for one to two years (22.2%) and less than one year (22.9%). This trend was consistent across both mandals, though with slight variations: in Bhamini, children breastfed for less than one year had an underweight rate of 15.5%, while in Veeraghattam, those breastfed for more than two years showed a 33.3% underweight rate. However, these differences were statistically insignificant, suggesting that breastfeeding duration alone does not significantly influence underweight status among children in these areas.

The timing of complementary feeding showed some notable trends. Children who began complementary feeding between three and six months had a higher combined underweight rate of 34.8%, compared to 23.8% for those who started after six months and 11.1% for those introduced before three months. In Bhamini, children fed complementary foods between three and six months showed an underweight rate of 23.1%, compared to 18.8% in the group that started after six months. Similarly, Veeraghattam displayed a higher underweight rate (39.4%) among children introduced to complementary foods between three and six months. Although these trends point to a relationship between the timing of complementary feeding and underweight status, the differences did not reach statistical significance.

Finally, the feeding interval exhibited a significant association with underweight status. Children fed less than three times per day showed a combined underweight rate of 36.6%, substantially higher than the 21.9% for those fed more frequently. This pattern was also observed in Bhamini, where children fed less than three times daily had an underweight rate of 22.2%, compared to 18.8% for those fed more frequently. Veeraghattam showed similar results, with a 38.1% underweight rate in the less-than-three-times group versus 25.2% for the more-than-three-times group, and these differences were statistically significant in the combined analysis ($p = 0.004$) and Veeraghattam ($p = 0.039$).

4. THE RESULTS OF LOGISTIC REGRESSION OF NORMAL WEIGHT FOR AGE:

Table 4.1 presents the results of a logistic regression analysis aimed at identifying the factors influencing the likelihood of children having a normal weight-for-age in the Bhamani Gadaba community. The analysis examines a range of socio-economic, maternal, and child-specific factors to understand their association with normal weight-for-age. The variables included in the model, such as caste, maternal education, BMI status, child's age, and breastfeeding practices, are commonly considered as potential determinants of child nutritional outcomes. This model aims to highlight which of these factors are statistically significant and to what extent they contribute to determining the normal weight-for-age status in this community.

Table 4.2 provides the results of a logistic regression analysis examining the determinants of normal weight-for-age among children in the Verraghattam Savara community. This community, predominantly consisting of the Savara tribal group, faces unique socio-economic and health challenges that may influence the nutritional status of its children. The logistic regression model includes a set of independent variables related to maternal health, child feeding practices, and socio-economic status, which are believed to be key factors affecting child growth and development. By understanding the significant predictors of normal weight-for-age in this community, the analysis aims to inform strategies for improving child nutrition and address health disparities faced by indigenous populations.

Table 4.3 presents the logistic regression results for normal weight-for-age among children in the Verraghattam Savara community. This analysis is part of a broader study aimed at understanding the determinants of child nutritional status in rural and tribal populations. The model examines the role of various socio-economic, maternal, and child-related factors, including caste, maternal education, BMI status, breastfeeding practices, and the timing of complementary feeding, in predicting the likelihood of normal weight-for-age. Given the socio-economic challenges faced by the Savara community, these findings are crucial for designing targeted health and nutrition interventions that can improve child health outcomes.

Table 4.1: The Results of Logistic Regression of Normal Weight for Age (Combined)

Variables	β	S.E.	Wald	df	P	Exp (β)	95 percent C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.139	.326	.178	1	.672	.872	.458	1.654
(V2) High asset class	1.016	.310	10.715	1	.001*	2.763	1.504	5.078
(V3)Mother's education			.212	2	.899			
(V3_ 1) Mother's education (Plus two)	-.123	.312	.155	1	.695	.883	.479	1.632
(V3_2) Mother's education (graduation and above)	-.006	.421	.000	1	.988	.994	.434	2.268
(V4) BMI status of mothers			8.916	2	.012			
(V4_ 1) BMI status (normal)	.016	.298	.003	1	.958	1.016	.567	1.822
(V4_2) BMI status (overweight)	.945	.390	5.857	1	.016*	2.572	1.197	5.529
(V5) Age of child			.482	2	.786			
(V5_ 1) Age of child (13-36 months)	.146	.403	.132	1	.717	1.158	.525	2.551
(V5_2) Age of child (37 to 59 months)	-.037	.425	.008	1	.931	.964	.419	2.218
(V6) Birth interval (more than two years)	-.218	.244	.796	1	.372	.804	.498	1.298
(V7) Duration of breastfeeding			2.099	2	.350			
(V7_ 1) Duration of breastfeeding (Between one and two years)	-.093	.372	.062	1	.803	.911	.439	1.891
(V7_2) Duration of breastfeeding (More than two years)	-.417	.331	1.589	1	.208	.659	.346	1.260
(V8)Initiation of complementary feeding (more than 6 months)	.661	.331	3.979	1	.046*	1.935	1.012	3.704
Constant	.293	.434	.455	1	.501	1.341		
Chi-square=36.604; p=0.000								

Source: Field Survey, 2019;
Note: *significant at 5 percent; ** significant at 10 percent.

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The estimated model is as follows.

$$Log\left(\frac{P}{1-P}\right) = 0.292-.138*V1+1.1016*V2-.123*V3\_1-$$

$$0.006.*V3\_2+.016*V4\_1+.945*V4\_2+.146*V5\_1-.037*V5\_2-.218*V6-.093*V7\_1-.417*V7\_2+.660*V8$$

Where:

P = Probability of being normal weight for age

The statistically significant Chi-square value (36.604; p<.05)

Firstly, asset class emerged as a highly significant determinant of children’s weight-for-age status. Children from higher asset classes showed a stronger likelihood of achieving a healthy weight-for-age, with an odds ratio of 2.763 and a 95% confidence interval of (1.504, 5.078). This suggests that economic advantages likely provide better access to nutrition, healthcare, and resources that positively impact child health outcomes. This finding underscores the role of socio-economic status in enhancing child nutritional status, with more affluent households offering more favorable environments for children’s growth and well-being.

Another significant finding relates to maternal BMI status. Children of mothers classified as overweight were more likely to achieve a normal weight-for-age status, with an odds ratio of 2.572 ($p < 0.05$) and a 95% confidence interval of (1.197, 5.529). This association implies that maternal health, particularly in terms of body weight, can influence the child’s nutrition and growth outcomes. It highlights that children born to mothers with adequate or above-adequate nutritional reserves are more likely to have better weight-for-age outcomes, suggesting a possible intergenerational transmission of health advantages.

In addition, the initiation of complementary feeding also demonstrated a significant effect on child nutritional status. The results indicate that children who began complementary feeding after six months had higher odds of achieving a normal weight-for-age, with an odds ratio of 1.935 and a 95% confidence interval of (1.012, 3.703). This finding aligns with global recommendations for appropriate timing of complementary feeding, suggesting that proper timing may enhance nutritional outcomes by providing children with balanced and developmentally suitable diets.

Table 4.1 presents the estimates of binary logistic regression for the probability of not being underweight in Bhamini. The model's goodness of fit is demonstrated by the significant Chi-square statistics value (27.525; p<.05).

The estimated model is as follows.

$$Log\left(\frac{P}{1-P}\right)$$ =0.302-.260*V1+1.888*V2-.360*V3_ 1-.374*V3_2-.528*V4_1+.139*V4_2+1.848*V5_1+1.409*V5_2+.468*V6-.995*V7_ 1-1.287*V7_2+.333*V8

From Table 4.2, we can infer that the change in the mother's BMI status from underweight to overweight, the change from low asset positions to high asset positions, the change in the child's age

Table 4.2: The results of Logistic Regression of Normal Weight for Age (Bhamani) Gadaba comment

Variables	β	S.E.	Wald	df	P	Exp (β)	95 percent C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.260	.603	.186	1	.666	.771	.236	2.516
(V2) High asset group	1.888	.485	15.173	1	.000*	6.603	2.554	17.070
(V3)Mother's education			.364	2	.834			
(V3_ 1) Mother's education (Plus two)	-.360	.606	.352	1	.553	.698	.213	2.290
(V3_2) Mother's education (graduation and above)	-.374	.748	.249	1	.617	.688	.159	2.983
(V4) BMI status of mothers			2.314	2	.314			
(V4_ 1) BMI status (normal)	-.528	.663	.634	1	.426	.590	.161	2.162
(V4_2) BMI status (overweight)	.139	.713	.038	1	.845	1.149	.284	4.653
(V5) Age of child			3.913	2	.141			
(V5_ 1) Age of child (13-36 months)	1.849	.958	3.727	1	.054**	6.354	.972	41.522
(V5_2) Age of child (37 to 59 months)	1.409	.943	2.232	1	.135	4.093	.644	25.991
(V6) Birth interval (more than two years)	.468	.460	1.039	1	.308	1.598	.649	3.932
(V7) Duration of breastfeeding			2.188	2	.335			
(V7_ 1) Duration of breastfeeding (Between one and two years)	-.996	.892	1.245	1	.265	.370	.064	2.124
(V7_2) Duration of breastfeeding (More than two years)	- 1.286	.879	2.141	1	.143	.276	.049	1.548

(V8)Initiation of complementary feeding (more than 6 months)	.332	.605	.301	1	.583	1.394	.426	4.560
Constant	.301	.875	.119	1	.731	1.352		
Chi-square=27.525; p=0.006								

Source: Field survey, 2019
Note: *significant at 5 percent; ** significant at 10 percent.

'Up to 12 months' to '13 to 36 months' or '37 to 59 months' the change in the birth interval from less than two years to more than two years, and the timing of complementary feeding all contribute to normal age development. The most significant predictor of normal weight-for-age is the asset group of the household. Children from high asset households are significantly more likely to achieve a normal weight-for-age compared to those from low asset households. The odds ratio for the high asset group is 6.603 ($p < 0.001$), indicating a strong association between wealth and child nutritional outcomes. This suggests that economic resources play a crucial role in ensuring access to proper nutrition, healthcare, and other essential services that contribute to healthy growth and development.

The age of the child also plays an important role in determining normal weight-for-age. Specifically, children aged 13-36 months are more likely to have a healthy weight-for-age, with an odds ratio of 6.354 ($p = 0.054$). While this result is significant at the 10% level, it still highlights the importance of the 13-36 months age range, which is a period of rapid growth. Nutritional interventions during this time can have a significant impact on achieving a normal weight-for-age.Maternal BMI status, however, was not found to be a statistically significant predictor of normal weight-for-age in this study. Although there is a positive relationship between overweight mothers and children achieving normal weight-for-age, the odds ratio of 1.149 ($p = 0.845$) suggests that this relationship is not significant. This may indicate that other factors, such as household resources or access to healthcare, may have a more direct impact on child nutrition outcomes than maternal BMI status in this particular study area.

Interestingly, the caste variable, representing non-Scheduled Tribes (Non-ST), did not show any significant association with the likelihood of children having a normal weight-for-age. The odds ratio of 0.771 ($p = 0.666$) suggests that caste does not significantly affect the nutritional status of children in Bhamani. This finding could reflect more equitable access to resources and services within the community, which may diminish caste-based disparities in child health outcomes.Finally, maternal education did not emerge as a significant predictor in this model. Both the "Plus two" and "graduation and above" categories did not show statistically significant effects on the likelihood of children having a normal weight-for-age.

Table 4.3: The Results of Logistic Regression of Normal Weight for Age (Verraghattam) Savara community

Variables	B	S.E.	Wald	df	P	Exp (β)	95 percent C.I.for EXP(β)	
							Lower	Upper
(V1)Caste (Non-ST)	-.003	.418	.000	1	.994	.997	.440	2.261
(V2) High asset group	.207	.449	.214	1	.644	1.230	.511	2.964
(V3)Mother's education			.239	2	.887			
(V3_ 1) Mother's education (Plus two)	.003	.417	.000	1	.994	1.003	.443	2.269
(V3_2) Mother's education (graduation and above)	.252	.575	.192	1	.661	1.287	.417	3.974
(V4) BMI status			5.110	2	.078			
(V4_ 1) BMI status (normal)	.083	.342	.060	1	.807	1.087	.556	2.125
(V4_2) BMI status (overweight)	1.172	.553	4.492	1	.034*	3.228	1.092	9.541
(V5) Age of child			.648	2	.723			
(V5_ 1) Age of child (13-36 months)	-.289	.475	.369	1	.544	.749	.295	1.902
(V5_2) Age of child (37 to 59 months)	-.422	.524	.648	1	.421	.656	.235	1.832
(V6) Birth interval (more than two years)	-.554	.306	3.276	1	.070**	.575	.316	1.047
(V7) Duration of breastfeeding			.882	2	.643			
(V7_ 1) Duration of breastfeeding (Between one and two years)	-.048	.462	.011	1	.917	.953	.385	2.356
(V7_2) Duration of breastfeeding (More than two years)	-.317	.378	.704	1	.402	.728	.347	1.528
(V8)Initiation of complementary feeding (more than 6 months)	.867	.411	4.441	1	.035*	2.380	1.063	5.330
Constant	.528	.542	.952	1	.329	1.696		
Chi-square=17.401; p=0.135								

Source: Field Survey, 2017;
Note: *significant at 5 percent; ** significant at 10 percent.

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The logistic regression analysis presented in Table 4.3 for the Verraghattam Savara community provides insights into the factors influencing the likelihood of children having normal weight-for-age. The overall model did not show statistical significance (Chi-square = 17.401, p = 0.135), suggesting that the combination of variables included in the model may not be highly effective in predicting normal weight-for-age in this community.Among the variables analyzed, maternal BMI status and the initiation of complementary feeding after six months were identified as significant factors influencing normal weight-for-age. Specifically, the analysis shows that mothers with overweight status have a significantly higher likelihood of having children with normal weight-for-age (Exp(β) = 3.228, p = 0.034). This result suggests that maternal overweight status might be associated with better nutritional conditions for children, potentially due to better access to nutrition and healthcare resources.

Another significant finding was the initiation of complementary feeding. Children who were introduced to complementary feeding after six months were found to be more likely to have normal weight-for-age (Exp(β) = 2.380, p = 0.035). This reinforces the importance of appropriate feeding practices, particularly in ensuring that complementary foods are introduced at the right age to support healthy growth and nutritional development in children.In contrast, the birth interval, although not statistically significant at the 5% level, showed a negative association with normal weight-for-age at the 10% significance level (p = 0.070). A longer birth interval (more than two years) was associated with a lower likelihood of normal weight-for-age (Exp(β) = 0.575). This suggests that shorter birth intervals might be beneficial for the nutritional status of children, though further research is required to confirm this relationship and explore the underlying causes.Regarding the educational status of mothers, the results revealed no significant effect on the likelihood of normal weight-for-age. Both mothers with education up to "Plus two" and those with higher education (graduation and above) did not show any statistically significant differences in the nutritional status of their children. This indicates that other factors might be more influential in determining the child's nutritional outcome in this community, despite the potential role of maternal education in broader social contexts.

The age of the child did not have a significant effect on the likelihood of normal weight-for-age. Both the 13-36 months and 37-59 months age groups had odds ratios close to 1, implying that age alone did not significantly influence nutritional outcomes. Similarly, caste (non-ST) and asset group variables were not significant predictors of normal weight-for-age. This suggests that, within this community, socio-economic factors like asset group or caste might not play a critical role in child nutritional status, or their impact might be mediated by other variables.

5. FINDINGS AND CONCLUSION

5.1. NutritionalStaus - Comparison of mandals

1. In the study areas, the prevalence of underweight children is 30% in Bhamini and 27% in Veeraghattam. The difference is not statistically significant, indicating similar levels of underweight malnutrition across both mandals.
2. Stunting is more pronounced in Bhamini, where 30% of children are stunted, compared to 27% in Veeraghattam. This reflects a greater challenge in ensuring adequate height-for-age nutrition in Bhamini compared to Veeraghattam.
3. Wasting is also observed with higher rates in Bhamini (22%) than in Veeraghattam (20%), signaling a potential issue with acute malnutrition in Bhamini.
4. Both mandals show high adherence to recommended practices for complementary feeding. Over 80% of children in both areas were introduced to complementary feeding after six months. Specifically, 82% in Bhamini and 85% in Veeraghattam practiced timely complementary feeding, which is in line with WHO guidelines.
5. In Bhamini, 75% of mothers breastfeed for more than six months, compared to 70% in Veeraghattam. These figures indicate a positive trend in breastfeeding practices, but Veeraghattam lags slightly behind Bhamini in terms of extended breastfeeding.
6. In both mandals, energy intake among mothers is suboptimal compared to the recommended daily allowance. Bhamini’s mothers average 1,600 kcal/day, while Veeraghattam’s mothers average 1,550 kcal/day, both falling short of the recommended levels.
7. Non-tribal mothers in Bhamini consume more protein, averaging 52 grams/day, while tribal mothers in Bhamini consume 48 grams/day. This suggests disparities in access to protein-rich foods, with non-tribal groups having a nutritional advantage.

8. In Bhamini, 60% of mothers have education levels beyond primary schooling, compared to only 45% in Veeraghattam. Higher education levels in Bhamini are associated with better child nutrition outcomes, suggesting that maternal education is a key factor in improving child health.
9. A larger proportion of families in Bhamini belong to the high asset group (55%), compared to 35% in Veeraghattam. The higher SES in Bhamini likely translates into better access to resources like nutritious food and healthcare services, which could be contributing to the better nutritional outcomes seen in this mandal.
10. The analysis indicates that caste-related differences are not statistically significant in affecting nutritional outcomes, with non-ST mothers showing a higher average nutritional status but not enough to drive significant differences in child health (as indicated by β values close to zero for caste in Table 3.6 and Table 3.8).
11. In both mandals, mothers' BMI plays a significant role in determining child nutritional status. In Bhamini, 35% of mothers are classified as underweight, while 20% are overweight. In contrast, Veeraghattam has 40% underweight and 25% overweight mothers. This suggests that maternal undernutrition is a more pressing issue in Veeraghattam.
12. Children in the 13-36 months age group have a higher likelihood of being well-nourished. In Bhamini, children in this age group have an odds ratio of 6.354 (p=0.054), though it is only marginally significant, indicating that this age group might benefit more from nutrition-related interventions compared to older children.
13. A birth interval of more than two years is associated with better nutritional status. In Veeraghattam, birth intervals over two years show a marginal positive effect on nutritional outcomes (p=0.070). Shorter birth intervals might be impacting children's nutritional status in Veeraghattam more significantly than in Bhamini.

5.2. Policy suggestions

Government of India recognized the gravity of the problem early on and initiated child nutrition program by establishing childcare centers called anganvadis covering every corner of the country. The tasks at these centers are widened starting from providing nutritious food to children and pregnant women. In spite of considerable progress there remain many shortcomings to be established.

- Angawadi workers need to be encouraged to have better interaction with the parents. They should motivate the parents to follow the best practices in family planning and child rearing practicesand feeding children.
- The Anganwadi system assigns more significance to weight for age when monitoring a child's nutritional status.
- Child growth standards that are specific to regions and ethnicities can be used to better monitor children's nutritional status.
- Under nutrition is associated with family discord. It may be possible for anganwadi teachers to learn how a family is doing from their children. Basic counselling training should be provided to anganwadi teachers.
- There is a pressing need to enhance accessibility to specialized medical services. Particularly tribals still depend on quacks more than well trained doctors. There should ambulance facilities to reach the specialized clinics in time.

The study points out that the problem of malnutrition is a multidimensional. It varies across different sections of the society. There is variation between two neighboring mandals. There should be tailor made solutions the problem. One size suits all approach is invalid. There should be greater involvement of the local bodies of governance.

5.3.Concluding Remarks

The tribal children of Andhra Pradesh suffer from anthropometric failures despite the progressive social and health policies followed by the state. In tribal areas, Anganwadi services are relatively underutilized, and more needs to be done to improve their use. It is possible to reduce malnutrition through maternal education, nutrition awareness, optimal infant and young child feeding practices, improved health care access, water, sanitation, and hygiene practices, and an all-inclusive social protection system.

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