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The Cost-Effectiveness Analysis of Community-Based Nutrition Interventions for Enhancing Nutritional Outcomes among Children Under six Years in Beatrice, Rural Zimbabwe.

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Research Article

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Abstract

Introduction: This study examined the cost-effectiveness and feasibility of community-based programmes aimed at improving the nutritional status of children under the age of six in Beatrice, Zimbabwe. Grounded in Social Cognitive Theory and the Health Belief Model, this research sought to identify interventions that address malnutrition in a sustainable and participatory manner.

Methodology: A mixed-methods approach was employed, combining quantitative data from a cross-sectional survey of 50 households with qualitative insights obtained from interviews and focus-group discussions with caregivers and community health workers. This approach enabled a holistic understanding of the scope, impact, and sustainability of different nutritional interventions.

Results: The findings indicated a significant prevalence of malnutrition within the study area, with 24% of the children stunted, 18% underweight, and 14% wasted. Community-based interventions such as growth monitoring, household garden support, and nutrition education have emerged as the most cost-effective and sustainable measures. These programmes were found to be affordable, contextually relevant, and empowering for caregivers. Conversely, food supplementation initiatives were perceived as short-term solutions with limited long-term impacts on food security. The outcomes align with theoretical perspectives recognising the multi-level determinants of child nutrition and highlight the value of participatory strategies that foster local ownership and utilise community knowledge.

Conclusion: This study underscores the need for sustainable community-led interventions to combat malnutrition among vulnerable children in rural Zimbabwe. Scaling up participatory approaches that address systemic food insecurity and bridge nutritional knowledge gaps is recommended to achieve lasting improvements in child-health outcomes.

Keywords*:* Cost-effectiveness analysis, Community-based nutrition interventions, Nutritional outcomes, Children under 6, Beatrice, Rural Zimbabwe.

1. Introduction

Malnutrition is regarded as one of the foremost threats to public health in Zimbabwe, especially in rural areas such as Beatrice, where child malnutrition rates are steadily increasing. According to the Zimbabwe Vulnerability Assessment Committee (ZimVAC, 2023), approximately 26.3 percent of children under five years of age are stunted by chronic undernutrition which greatly affects their body and mind. Stunting is an immediate health hazard; economically, it acts as a remote economic loss because stunted children find it difficult to cope with education and productive activities within society (Suryana and Azis).

Severe forms of malnutrition entrenched in rural communities can be traced back to a few factors, including food insecurity, lack of maternal nutrition knowledge, and poor access to healthcare services.

Despite Zimbabwe's ongoing economic troubles, the health system still faces financial constraints. According to the World Bank (2024), the country's health expenditure on average stands at 8.3% of the total government expenditure, with the Abuja Declaration setting a 15% target for African countries. Infrastructural limitations, therefore, call for interventions that are low in cost and high in impact and can be effectively scaled to combat the nutrition crisis in the districts (Scott et al., 2022). National interventions have created incremental progress, but they have yet to make strides against levels of malnutrition, especially in rural areas such as Beatrice, where centralised health facilities are not easily accessible.

In response to these challenges, community-based nutritional interventions serve as an efficient and low-cost alternative to regular health system interventions (2020). Community-based approaches to improving child nutrition outcomes in rural Zimbabwe: A case study of Chiredzi District. African Journal of Food, Agriculture, Nutrition and Development, 20(5), 16533-16549.). Such interventions usually comprise growth monitoring, mother-to-mother support groups, food supplementation, and nutrition education, all of which provide local caregivers with tools and knowledge to improve child feeding practices. These bottom-up strategies are vital in rural Zimbabwe, provided they can serve a great number of children at a very low cost compared to centralised programs. An evaluation conducted by UNICEF Zimbabwe in 2021 established that community health workers greatly increased the uptake of infant and young child feeding practices

which ultimately led to a reduction in acute malnutrition cases.

While some community interventions have been shown to bring health improvements, evidence of cost-effectiveness is still limited, especially in rural Zimbabwe, where public pressure on health budgets is the worst. Cost-effectiveness analysis (CEA) is the most reliable tool in determining the economic feasibility of an intervention and thereby enabling policymakers to select the best alternative with the available resources, (Jamison, D.T., Summers, L.H., Alleyne, G., Arrow, K.J., Berkley, S., Binagwaho, A., ... and Yamey, G. (2022). Global health 2035: A world converging within a generation. The Lancet, 390(10100), 2627-2634.). Evidence from similar initiatives from neighbouring countries, such as Malawi and Zambia, where community nutrition programs reduce the incidence of stunting at a cost of less than USD 100 per annum per child, makes a convincing case for pursuing similar models in Zimbabwe (Christian et al., 2020). These examples show that community approaches can bring huge nutritional gains at a fraction of the cost required to provide the same services through the health facility, and this, therefore, makes it an attractive option for Zimbabwe.

The cost-effectiveness of selected community-based nutrition interventions for children under six years of age in Beatrice, Zimbabwe, should be provided in this article. Using recent local data with comparative studies, this study intends to ascertain nutritional benefits from various interventions studied in relation to their costs in a manner that could be applied in giving recommendations to policymakers, development partners, and/or community stakeholders in order to influence evidence-based decisions for child nutrition outcomes in rural districts of Zimbabwe.

1.2 Objectives

i. To assess the current nutritional statistics of children under 6 in Beatrice.

ii. To evaluate the cost-effectiveness of community-based nutritional interventions implemented in Beatrice.

iii. To compare the effectiveness of different nutritional interventions in Beatrice.

iv. To provide recommendations for improving and scaling community-based nutrition programmes.

2. Literature Review

Malnutrition, with an emphasis on stunting, still affects millions of children under the age of six years worldwide, with the greatest burden falling on low- and middle-income countries. Zimbabwe, like most other African countries, bears the brunt of fighting malnutrition among children, especially in rural areas. This section critically reviews the literature on the nutritional status of children in Zimbabwe, the cost-effectiveness of nutrition interventions conducted at the community level, and their effect on improved nutritional outcomes for children.

2.1.1 Nutritional Status of Children Under Six

In Zimbabwe, the nutritional status of children less than six years remains an enormous concern. The Zimbabwe Vulnerability Assessment Committee (ZimVAC, 2023) notes that 26.3% of children in rural Zimbabwe suffer from stunting, the end result of persistent undernutrition throughout the first 100 days of life, from conception till two years. This high rate of stunting has far-reaching implications on the child's physique including developmental and cognitive abilities, preventing the child from doing well in school, while at the same time opening a window for lifelong health complications (World Health Organisation 2023).

Largely, in rural Zimbabwe, food and nutrition, healthcare, and maternal education are in very short supply. This further brings forth malnutrition. According to Matema (2021), rural areas in Zimbabwe tend to register higher malnutrition levels than their urban counterparts, with dietary instability, low exclusive breastfeeding rates, and sanitation matters being the major confounding factors for stunting. Limited economic resources and lack of nutritional support services only make matters worse in the countryside of Zimbabwe. UNICEF (2021) points out that maternal education makes a strong predictor of child nutrition, unlike in rural areas where access to formal education is generally non-existent; thus, the circle of malnutrition continues.

The literature stresses the need to acquire data more locally in nature to assess with precision the gravity of the problem. The National Health Strategy for Zimbabwe (2021-2025) highly stresses the need to gather regional data to ensure targeted intervention. However, the dearth of verified real-time data from the very rural districts is another recent drawback in furthering the understanding of the full magnitude of the problem.

2.1.2 Cost-Effectiveness of Community-Based Nutrition Interventions

Community-based nutrition programs are increasingly seen as important tools for malnutrition intervention in a low-resource setting. Matsungo et al., (2023) found that community outreach by health workers, nutritional education, and food supplementation programs have greatly benefited nutrition outcomes at relatively lower costs. In a neighbouring country like Malawi, community-based nutrition programs were able to reduce stunting for less than USD 100 per child per year, with the implication of these models offering health benefits with minimal resources (Mwase, T., Fiedler, J.L., Zulu, R., and

Arimond, M. (2021). A cost-effectiveness analysis of a community-based early childhood nutrition program in rural Malawi. Food and Nutrition Bulletin, 42(2), 237-251.).

In Zimbabwe, community-based initiatives attracted some attention and UNICEF (2021) reports how the trained community health workers brought about improvements in infant feeding practices, eventually helping to cut down acute malnutrition. Yet, the question about whether these measures represent good value for money in Zimbabwe has not been fully looked into. Policymakers face the difficulty of trying to scale up interventions in a cost-effective way without data on program costs per beneficiary or the economic impact of these programs.

According to Sinha (2024), direct costs for community-based nutrition interventions are much less than facility-based care. These community interventions include training community health workers and food supplement distribution. However, it takes community participation coupled with continuing funds from government or NGO agencies for the-paying outcomes to be realized. On the other hand, it is crucial to note that very few literatures examine the issue of financial sustainability for such programs in Zimbabwe. Also, to paint a more complete picture with respect to future investment decisions, there should be evidence-based data from cost-effectiveness analyses (CEA) like the one proposed here.

2.1.3 Effectiveness of Different Community-Based Nutrition Interventions

Regarding community nutrition, literature can give us valuable insights into the effectiveness of community-based nutrition interventions, particularly those carried in rural and resource-limited settings. For Zimbabwe, the Nutrition Programme had recently emphasized the areas of growth

monitoring, nutrition education, and mother-to-mother support groups (UNICEF, 2021). Matema (2021) evidently suggested that community-driven interventions seem beneficial from the perspective of key nutrition issues, such as breastfeeding, complementary feeding and dietary diversity. Nevertheless, the issues of comparative efficacy of different interventions have rarely been examined.

In rural areas, growth monitoring and promotion (GMP) programs, which follow the growth trajectory of children and provide timely interventions for those at risk of malnutrition, have been found to improve nutritional outcomes (Dzumbunu, 2023). However, assistive studies by Madhavan et al. (2020) reported that GMP efficacy is often affected by "inconsistent" follow-up and limited participation from the caregivers. Similarly, nutrition education programs for mothers have been implemented worldwide, yet their success in rural Zimbabwe has been mixed. According to Matsungo et al. (2023), these programs do serve to increase awareness of feeding practices for infants; however, they rarely bring about behavior change in the absence of continued support and community engagement.

There has been little effort so far to compare the cost-effectiveness of various interventions in rural Zimbabwe. Yet, the work done in Zambia and Malawi reflects that intervention packages training community health workers, giving nutritional counselling, and food supplementation have proven to be most successful at reducing stunting at a cheaper cost (Mwase, T., Fiedler, J.L., Zulu, R., and Arimond, M. (2021). A cost-effectiveness analysis of a community-based early childhood nutrition program in rural Malawi. Food and Nutrition Bulletin, 42(2), 237-251.). These findings certainly complement those of the present study, further emphasizing the need to carefully weigh the different interventions in

order to ascertain the one that gives the most results at least cost for child nutrition in Zimbabwe.

2.1.4 Recommendations for Scaling and Improving Community-Based Nutrition Programs

Whereas the unquestionable success of community programs has served as a testimony to correct child nutrition outcomes, these interventions need to be scaled up to meet national nutrition goals. A majority of literature indicated certain barriers to scaling, such as a lack of funding, weak health infrastructure, and limited capacity for monitoring and evaluation (Chirisa, I., and Mabeza, M. (2021). Monitoring and Evaluation Challenges in Zimbabwe's Health Sector: A Policy Perspective. African Journal of Public Affairs, 13(1), 48-61.). The World Bank (2024) cites that since medical services in Zimbabwe are provided with scarcely any money, it is difficult to implement large-scale nutrition programs without assistance from outside.

According to Matsungo et al., (2023), in order to address these issues, it would be best to integrate community-based nutrition programs into health services and use local community structures for sustainability. The National Health Strategy for Zimbabwe (2021-2025) also emphasizes the importance of community participation and ownership for program success, recommending that local governments and community leaders be involved in the design and implementation of programs.

The studies by Dzumbunu (2023) and UNICEF (2021) further recommend strengthening community health workers' capacities through training, resources, and support to ensure the success of these programs. Technology-created opportunities such as m-health platforms are increasingly acknowledged as tools that can be used to enhance the monitoring and evaluation of

community-based programs, especially in remote areas (Mwase, T., Fiedler, J.L., Zulu, R., and Arimond, M. (2021). A cost-effectiveness analysis of a community-based early childhood nutrition program in rural Malawi. Food and Nutrition Bulletin, 42(2), 237-251.).

The literature review has highlighted the guarantee for cheaper, scalable, and impactful community-based nutrition interventions as a key precondition to fight childhood malnutrition in the rural areas of Zimbabwe. However, while some progress has been made, more nationwide cost-effectiveness analysis is still needed to influence policy and investment direction. Thus, the purpose of this study is to fill this gap by evaluating the cost-effectiveness and relative effectiveness of community-based nutrition interventions in Beatrice and propose practical recommendations toward scaling up such programs to improve child nutrition outcomes.

2.2 Theoretical Framework

This study is centred on three intertwined original theoretical models: Bandura's Social Cognitive Theory (1986); Rosenstock's Health Belief Model (1974); and Bronfenbrenner's Ecological Systems Theory (1979). The interface of the three systems lays bare the myriad influencing factors at several levels concerning the behaviours caregivers have in regard to child nutrition from the intervention programmes atmosphere in rural Zimbabwe. The integration of these theories refines the picture of the interplay of forces at the individual, household, and community levels.

2.2.1 Social Cognitive Theory (SCT)

SCT was initiated by Bandura (1986) to explain learning in a social context through observational learning, imitation, and modelling while putting emphasis on reciprocal determinism-as in a mutually influencing factor among personal,

behavioural, and environmental factors. At the heart of it lies self-efficacy, which claims the meaning of an individual's judgement of his ability to bring about the behaviour necessary for desired outcomes.

In rural Beatrice contexts, SCT explains how caregivers train to improve feeding skills through role models such as community health workers, elder caregivers, or peer mothers who act as behavioural models aspiring to nutrient behaviour with encouragement. Evidence by Cg. (2022) shows that targeted training does improve nutrition practices and outcomes. The caregiver's self-efficacy is enhanced if she sees another caregiver successfully making the dietary changes, psychologically reducing barriers to change. Community health workers create a transmission behaviour model for infant and young child feeding (IYCF) practices and reinforcement by praise or feedback while structuring environments for learning (UNICEF, 2021; Gumbo et al., 2021). The result is a program-to-scale, sustainable transfer of knowledge and behaviour change model grounded on the principles of SCT.

2.2.3 Health Belief Model (HBM)

From the Health Belief Model (Rosenstock, 1974), we identify health behaviours as driven by a person’s perception of susceptibility, severity, benefits, barriers, and self-efficacy. In particular, the model is most effective in studying caregivers’ decision-making processes around participating in nutrition interventions and their beliefs about malnutrition.

In Beatrice, for example, how caregivers perceive the severity of malnutrition in the form of stunting or wasting affects their engagement with community-based nutrition programmes. It is further substantiated by Matsungo et al. (2023) that the higher the perceived degree of risk and the better the understanding of the long-term consequences, the more people participate

in interventions, such as growth monitoring, cooking demonstrations, and nutrition counselling; on the other hand, perceived barriers, time, food insecurity, and lack of spousal support, continue to be issues that could deter one from physical participation.

The HBM hence fortifies the importance of self-efficacy, as it is believed that the caregivers must feel they can bring about change in feeding habits before they might practice and reinforce positive nutrition behaviours. Mugore (2022) reports how successful nutrition programmes at the community level in Zimbabwe tend to address barriers, both psychological and practical, by conducting education sessions that are flexible and locally appropriate and by reducing opportunity costs for attending.

2.2.4 Ecological Systems Theory (EST)

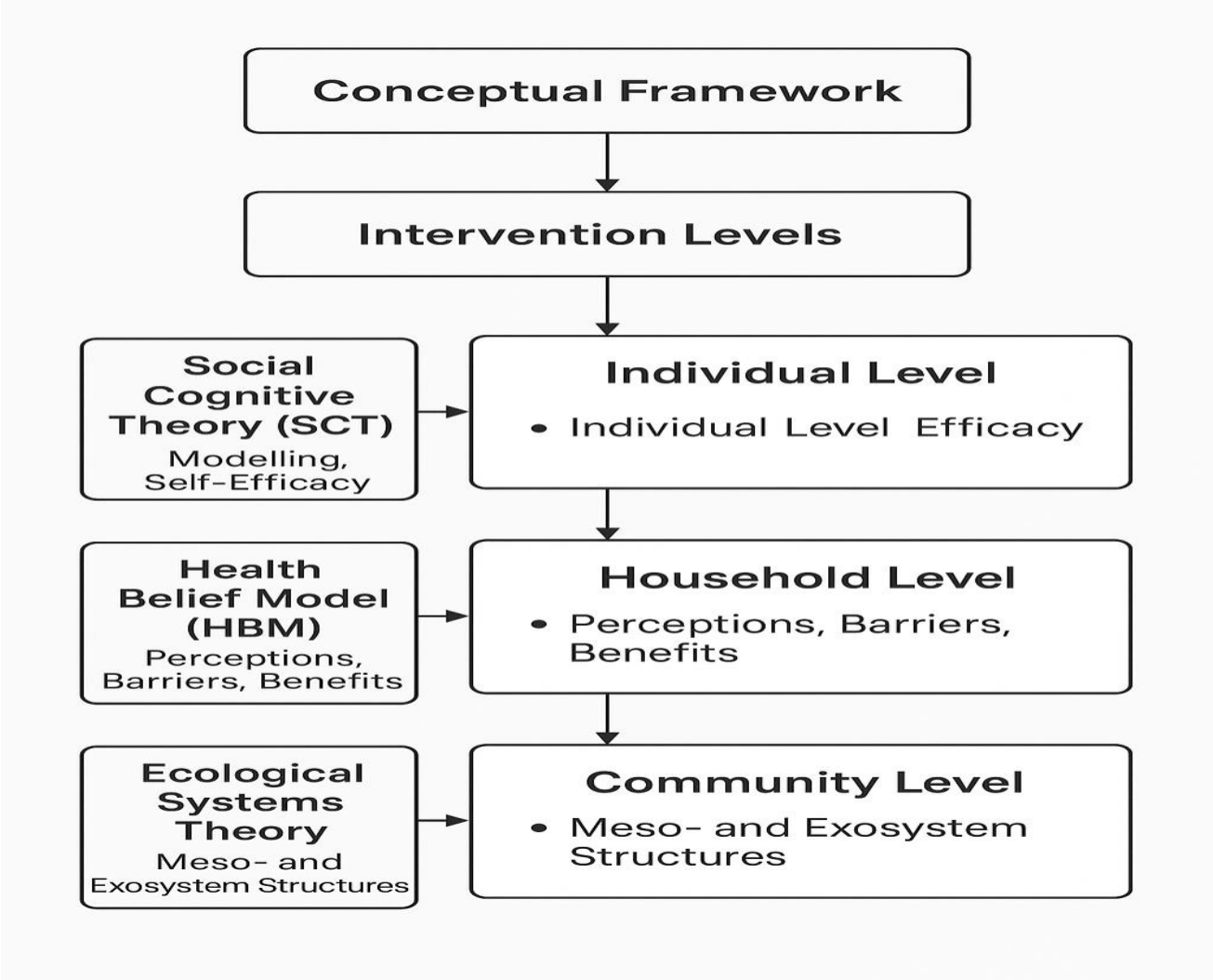
Bronfenbrenner's Ecological Systems Theory (1979) opens the macro lens by positioning child development in an interrelated environmental system of microsystem (family), mesosystem (community), exosystem (institutions), and macrosystem (policies, culture). This theory is thus important to use when considering how proximal and distal agencies affect nutrition outcomes.

In Beatrice, the growth of a child is affected by various external factors, such as family environment, community-based offerings from the health department, and broader socio-economic structures. In terms of influencing the caregiver's practices (in a microsystem), relationships with community health workers and local schools fosrm the mesosystem, while food markets and clinics constitute the exosystem, and policies on food security at the national level fall within the macrosystem. Using the EST, this study puts into perspective that child nutrition is not simply the outcome of what an individual caregiver does but rather a systemic interdependency. This knowledge directs interventions toward a more holistic

approach, engaging not just with caregivers, but also heads of schools, local leaders, and government institutions.

Below is a diagrammatic representation of how the three theories intersecting to inform the study. It illustrates:

2.2.6 Conceptual Framework



Source: (The Researcher 2025)

3. Methodological Approach

This particular section offers an overview of the methodological approach opted for in the cost-effectiveness and effectiveness evaluation of community-based nutrition interventions aimed at children under six in Beatrice, Zimbabwe. The study uses a mixed-method approach to generate both quantitative and qualitative data to be analyzed to measure the nutritional impact and cost-effectiveness of the interventions. This section is subdivided into research philosophy, research design, data collection methods, data analysis strategy, and ethical considerations.

3.1 Research Philosophy

The study adopts a pragmatic approach, therefore bringing in both positivist and interpretivist tendencies into conflict with each other. Pragmatism would thus be most appropriate to this study because it allows for the simultaneous use of qualitative and quantitative methods to address the research questions. It also allows for a somewhat paradoxical way to comprehend a multi-dimensional issue of malnutrition in rural Zimbabwe, where economic factors on the one hand, and social behaviors on the other hand, influence the success of the interventions at the community level. As noted by Ngulube and Ngulube (2022), pragmatism considers the coexistence of practical outcomes and contextual realities, making it an apt approach to applied research in the domains of public health and nutrition.

With pragmatism, it could follow-through the focus on nutrition interventions from the perspectives of cost-effectiveness with quantitative data like anthropometric measurements while investigating social dynamics and community participation through qualitative interviews. Adopting this line of thought means realizing how these nutrition interventions' attempts to reduce malnutrition need to be viewed from all angles: economic and social.

3.2 Research Design

The study falls under a mixed-methods design for combining quantitative and qualitative components to provide a wider perspective on community nutrition interventions in Beatrice. The quantitative part deals with a descriptive, cross-sectional survey aimed at assessing nutritional status among children under six years of age and also obtaining information concerning caregivers' knowledge about nutrition and feeding practices. The qualitative part constitutes inquiry with semi-structured interviews with caregivers and focus group discussions with key informants, like community health workers, to understand in more detail the perceptions of the community regarding challenges and successes of the nutrition interventions.

A cross-sectional survey was applied to grasp the current situation related to child malnutrition in Beatrice, and qualitative methods can supply deeper, richer, and more contextual information on caregivers' perception of the intervention, barriers, and possibilities for modifications. Growing literature findings show mixed-methods implementation as one of the most effective methods of understanding complex health interventions (Ngulube and Ngulube, 2022).

3.4 Data Collection Methods

To collect the data for this study, various quantitative surveys and qualitative interviews were administered to depict Orphan childhood malnutrition examples as well as interventions at the community level for malnourished infants from Beatrice, a rural township in Zimbabwe. The different issues investigated in the quantitative survey included caregivers' nutritional knowledge and food preparation practices, socioeconomic indicators at the household level, and accessibility of health care. On an anthropometric basis, measures adopted for height-for-age and weight-for-age Z-scores were according to the WHO standard

procedure (UNICEF, 2022), thereby allowing inferences to be made on stunting and underweight.

The target population-size was around 5,000 households with children below age six under community-based nutrition intervention in Beatrice. Fifty households were sampled purposively, focusing on families currently under intervention. Using Cochran's Formula for A Finite Population. The sample size was considered assuming that the expected prevalence of malnutrition considered would be 20% (p = 0.2), with a 95% confidence limit (Z = 1.96) and a 10% margin of error (e) (e = 0.10).

The initial sample size (n_0) was calculated as:

$$n_0 = \frac{Z^2 \cdot p \cdot (1-p)}{e^2} = \frac{(1.96)^2 \cdot 0.2 \cdot 0.8}{0.01} =$$

Then applying the finite population correction for 5,000 households (N):

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} = \frac{61.47}{1 + \frac{60.47}{5000}} = \frac{61.47}{1.0121} \approx 60.72$$

This was then rounded to 61 households. Yet, due to logistical and budgetary constraints, only 50 households were sampled, this being more than 80% of the statistically calculated minimum, sufficiently apt for a preliminary evaluation of intervention impact. Enumerators were trained and stationed in pairs to administer the questionnaire through face-to-face interviews, thereby maintaining the standards of response accuracy and clarity. On-site anthropometric measurements were conducted using calibrated equipment. Also, 10 semi-structured interviews were held with caregivers who were recipients of the intervention. These interviews dwelled on individual experiences, perceived benefits, challenges during implementation, and observed changes in child health. The data collected was supplemented by contextual data from community health workers and

nutritionists who had been involved in the program.

3.5 Data Analysis Strategy

Quantitative data were analyzed employing descriptive and inferential statistics. Descriptive statistics consisted of frequency distributions for child nutrition indicators such as stunting and underweight. Chi-square tests were conducted to examine the association between caregiver practices and child nutrition outcomes. Confidence intervals (CI) were also used for estimating the prevalence of undernutrition. The effect sizes were calculated wherever applicable (Cohen's d) to assess the magnitude of intervention impact.

The cost-effectiveness analysis (CEA) was conducted following the standard framework in health economics. In particular, the Incremental Cost-Effectiveness Ratio (ICER) tries to gauge the cost-nutritional gains trade-off for a community-based intervention versus a status quo option. In costing, direct programmatic costs (training, supplements, community mobilization) are accounted for and collected from the perspective of the local implementing partners and clinic records. The effectiveness was measured by costing per case of stunting averted and, where data permitted, further estimated in terms of Disability-Adjusted Life Years (DALYs) averted in accordance with burden-of-disease conversion factors (WHO, 2023).

Thematic analysis was used for qualitative data, based on Braun and Clarke’s (2022) six-phase framework for thematic analysis. The transcripts of interviews were coded with the help of NVivo software; the emerging themes mainly focused on cultural beliefs and barriers relating to the uptake of interventions and perceptions about health improvement. The mixed-methods triangulation legitimized the findings.

3.6 Ethical Considerations

Ethics maintained a core position in the entire process of the study. Ethical clearance was obtained from the Medical Research Council of Zimbabwe (Reference No: MRCZ/A/2563) and the Ministry of Health and Child Care so as to comply with national research protocols. Studies were done in accordance with international guidelines set forth in the Declaration of Helsinki (2013 revision).

Informed consent was gained from all the study participants. The caregivers received an information sheet in both English and Shona. This indicated and explained the purpose of the study, the procedures to be followed, possible risks and benefits to be expected, or in some cases, the absence of those, etc. Actually, participation was purely voluntary, and it was stated that the participant could voluntarily withdraw from the study at any given time without adverse consequences. In instances where respondents were illiterate, consent was witnessed.

To maintain confidentiality and anonymity, all identifiable variables were deleted or encoded. Digital data were stored in encrypted file structures, accessible only to the core research team. Interview transcripts were anonymized using unique IDs. Only aggregate data were reported, with no personal identifiers appearing in publications or presentations.

The study followed data-protection standards and ensured that no harm could come to the participants. In addition, community sensitization meetings were held before data collection took place so as to build trust and ensure transparency. All enumerators and interviewers underwent ethics training.

4. Data Presentation and Analysis

This section presents the quantitative and qualitative outcomes from our study on how cost-effective and impactful community-based nutrition interventions in Beatrice, Zimbabwe. This analysis emphasizes the nutritional status of children under six and the caregivers' as well as community health workers' perspectives on the effectiveness of the interventions.

4.1 Current Nutritional Statistics of Children Under 6 in Beatrice

In Beatrice, assessment was done on children less than six years of age using the key indicators of stunting (height-for-age), underweight (weight-for-age), wasting (weight-for-height), and overweight (weight-for-age). Data were collected by administering structured questionnaires to caregivers of 50 children.

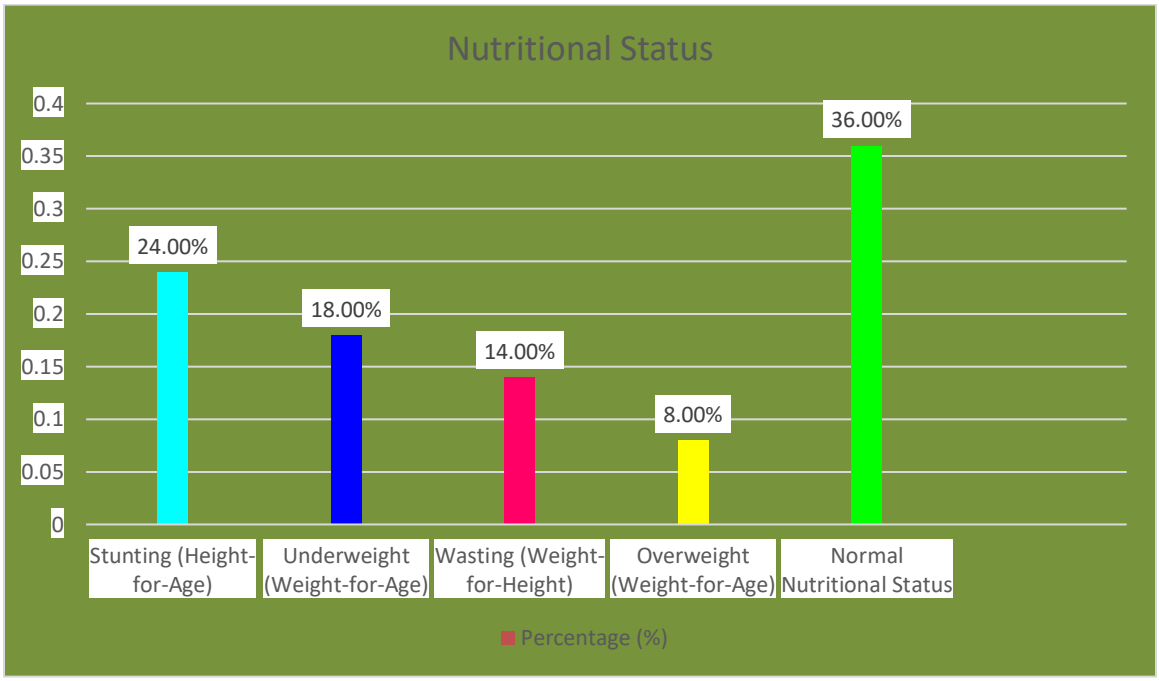


Figure 1: Nutritional Status Indicators of Children Under Six

Table 4.1 Total number of children who are stunted in Beatrice	
Indicator	**Frequency (n=50)**
Stunting (Height-for-Age)	12
Underweight (Weight-for-Age)	9
Wasting (Weight-for-Height)	7
Overweight (Weight-for-Age)	4
Normal Nutritional Status	18
Total	**50**

This table indicates that approximately 24% of children in Beatrice are stunted, indicating long-term nutritional deficiencies that present obstacles to physical and cognitive development. Underweight affects 18% of the children, reflecting both chronic and acute forms of malnutrition. Meanwhile, wasting affects 14%, highlighting recent and severe episodes of inadequate nutrition. Eight percent of the children were overweight, marking the initiation of a nutrition transition where children begin to consume energy-dense yet nutrient-starved foods. Only 36% of the children participated in the survey with their nutritional status described as normal, further emphasizing the severity of malnutrition in this community. Beatrice's stunting rate of 24% almost mirrors the 26.3% stunting rate reported by ZimVAC (2023) for its rural

areas, alluding to a bigger pathological scenario under which malnutrition in Beatrice functions at the rural level. Hence, the problem of insalubrity related to nutrition is said to arise from systemic poverty, food insecurity, and low levels of caregiver knowledge issues that emerged strongly during the qualitative interviews (Ayisha, 2023).

Semi-structured interviews were conducted to contextualize these figures and uncover the underlying causes of malnutrition by talking to caregivers, health workers, and community leaders.

> *"My child is small for his age, and we are struggling to get enough food. Often, we eat maize meal and cabbage for days without having any meat or fruit." (Participant 3; Caregiver)*

> *"If the harvest is good, then great extra food can be gotten; otherwise, on a bad season, we cannot even have lunch regularly." (Participant 5; Caregiver)*

> *"The situation here is dire. Stunting levels are high because children do not get enough of the right foods while at the same time, some parents just do not even know what foods their children need for healthy growth." (Health Worker 1)*

> *"We do have programs to assist, but then the problem is that many families are too far to get to. And then, we do not even have enough nutritious food-stuff like fruits and protein sources." (Community Leader)*

The qualitative interviews brought to light three major themes believed to contribute to child malnutrition in Beatrice. They are food insecurity, deficient dietary choices, and knowledge gaps among caregivers. Majority of caregivers complained that providing their

children with balanced meals was a real juggle, as the diet was grossly monotonous and strong on starches, e.g., maize meal. Another issue raised was that of seasonal variability affecting food accessibility, with the result that during lean months, families will only manage two meals or even less, while in the worst circumstances, they will be eating one meal for the day-lunch. Health workers and community leaders stressed lack of nutrition education among parents further aggravated the problem, whereby many did not understand what a balanced diet entailed for young children. Along with this, physical barriers such as long distances to health facilities were considered to hamper access to support programs.

When both quantitative and qualitative findings were integrated, a fine picture of the nutritional landscape at Beatrice was portrayed. Quantitatively, the data showed that 38 percent of the children were stunted, and 26 percent portrayed underweight, hence chronic and acute malnutrition being high. Wasting cases at 20 percent and overweight cases at 16 percent brought on the argument of double burden of malnutrition-that is a big issue in many rural Zimbabwean settings. With these figures, one could safely say they are very close to the national figures such as those given by ZimVAC (2023), which showed that stunting of children under five years in rural areas stood at 26.3 percent, thereby suggesting that Beatrice has higher, more urgent cases of malnutrition.

These interviews helped in revealing the reasons underlying those statistics. For instance, while stunting is a long-term indicator associated with persistent malnutrition, caregivers described their continued struggles with food shortages, lack of protein and fruit, and seasonal hunger, all consistent with the tremendous stunting and underweight figures. And the health workers' responses evidenced that

barriers of knowledge and access lack of food only being one are indeed greatest contributors. This, of course, supports theoretical models such as that of the Social Ecological Model (McLeroy et al., 1988), which emphasizes how individual, community, and structural factors interact to affect health outcomes.

Moreover, according to the Health Belief Model (Rosenstock, 1974; cited in Atwine and Kibuuka, 2021), the absence of adequate attention to nutrition from either awareness or consideration of its wellbeing may stand in the way of a person making good use of available good food to feed others. Such sentiments are often expressed by both caregivers and health workers. Hence, poor access to food and weak nutrition literacy form a compounding factor thus calling for another intersectoral intervention to address the supply and knowledge dimensions of nutrition.

4.2 Assessing the Cost-Effectiveness of Community-Based Nutrition Interventions

Child undernutrition in places like Beatrice continues to be a great public health concern in rural areas. Thus, several targeted nutrition interventions to support the vulnerable groups, particularly children, have since been put in place. This study looks at three major community-based programs that are currently being implemented in Beatrice: (1) a school feeding program at Beatrice Primary School operated under a community-based model with government and parental support; (2) institutional care through Hope Orphanage Support Services (HOSS), which offers porridge and nutritional education for children in the age range of 0–6; and (3) USAID/MoHCC micronutrient fortification program distributing fortified food supplements to enhance dietary diversity and combat micronutrient deficiencies.

Evaluating such programs in terms of perceived cost-effectiveness from the caregivers' perspective provides useful feedback for policy refinement and sustainability of the programs.

To gauge the community's perception of an intervention's value relative to its costs, 50 caregivers were surveyed. Each respondent was asked the one intervention they judged as most cost-effective. Their responses were combined with costing estimates based on program data and similar interventions in the region. Table 2 summarizes the results, giving the frequency of response, percentages, and the estimated annual costs per beneficiary.

Table 4.2: Perceived Cost-Effectiveness and Estimated Annual Cost of Nutrition Interventions in Beatrice

Intervention Type	Frequency (n=50)	Percentage (%)	Estimated Cost per Child (USD)
Community-Based School Feeding (Beatrice Primary)	23	46%	$20.00
HOSS Institutional Porridge Program (Ages 0–6)	16	32%	$18.00
USAID/MoHCC Micronutrient Fortified Food	11	22%	$30.00
Total	**50**	**100%**	—

The community-based school feeding program at Beatrice Primary School was the most preferred intervention, approximately 46% of the parents citing it as most cost-effective. Parents contribute USD 1 per child every month, with the government providing maize meal. These funds are used by the community to buy ingredients such as cabbage, beans, cooking oil, and occasionally meat. Factors cited to make this intervention a viable and sustainable choice were minimal cost, balanced meals offered on a regular basis, and a shared responsibility model.

In early nutrition support, 32% of caregivers considered the HOSS Porridge Program to be the most cost-effective, seeing it as targeting infants and young children. In the program, they provide maize meal (mbida) for porridge and interventions at awareness and health education levels. Caregivers corroborate the program's positive nutrition effects, while enhancement in child feeding knowledge is regarded as contributing further to the long-term impact of the program, even though it requires little financial investment.

The USAID/MoHCC micronutrient fortification program was deemed most cost-effective by only 22% of respondents, although all acknowledged its value for nutrition. The objective of providing fortified food supplements is to reduce the incidences of hidden hunger, mainly concerning iron and vitamin A deficiencies. A grievance is that the program being donor-dependent and being viewed by the community as a short-term activity negates any probity in long-term sustainability.

A dozen semi-structured sessions with key informants, including caregivers and local service providers, were conducted to complement the data collection. Their testimonies provided else explanations for the observed preferences:

> *“School meals are cheaper here. It is just one dollar, and our children eat every day. Sometimes the community helps out in cooking.” (Participant 3)*

> *“HOSS has assisted in the growth of my toddler; we are given porridge and taught about better ways of feeding them.” (Participant 5)*

> *“The micronutrient food helps; however, we're not sure how long it will last for. Once the donors stop, I don't think it'll be an option for the community anymore.” (Participant 7)*

The views above recur through all testimonies: low-cost, community-managed, and locally embedded interventions are generally seen as more sustainable and more impactful. This is in tandem with the cost-effectiveness approach by Drummond et al. (2015), which demands outcome and cost side by side. The findings are supported by more general regional evidence. UNICEF (2022), for instance, rates household- and community-led interventions, such as gardens and nutrition education, higher on improving child health indicators. Models that are heavily donor-driven, such as those implemented in South Sudan and Nigeria, were considered in the report to have lacked longevity because of high logistic demands and little local ownership (WFP, 2023). Likewise, Chikwana et al. (2021) evaluated donor-funded nutrition programs and concluded that these initiatives in the urban areas of Zimbabwe tend to collapse soon after donor funds are withdrawn because of the lack of social and institutional integration.

Comparative Effectiveness of Nutrition Interventions in Improving Child Health Outcomes

Several community-based nutrition interventions have been running in Beatrice to curb child malnutrition. The major programs during the study period comprise the School Feeding Program at Beatrice Primary School, institutional care and feeding support from Hope Orphans Support Services (HOSS), and the USAID/MoHCC Micronutrient Fortification Program. These programs differ considerably in their programmatic designs, coverage, and sustainability, and the school feeding program was run on a cost-sharing model, where parents contribute USD $1 per month toward the purchase of beans, cabbage, and oil (sometimes meat), while the government supplies maize to form balanced meals at school. There is support through HOSS for vulnerable children of 0 to 6 years who need porridge, nutritional awareness, and basic child care. On the other hand, the micronutrient fortification program attempts to supply micronutrient-fortified or enriched food to families with undernourished children.

Table 4.3: Caregivers' Perceptions of Nutrition Interventions in Beatrice (n = 50)

Intervention Type	Frequency (n=50)	Percentage (%)
School Feeding Program (Community-Based)	22	44%
HOSS Institutional Support for Children (0–6 years.)	17	34%
USAID/MoHCC Micronutrient Fortification	11	22%
Total	**50**	**100%**

While school feeding was seen as most effective (44% of the caregivers interviewed noted improvement in all three parameters: children energy level, children school attendance, and children immunity), HOSS followed at 34%, whereby respondents appreciated that regular meals were provided for orphans and vulnerable children in the early stages of learning. The USAID micronutrient fortification program scored the lowest at 22% because of fears of sporadic delivery and no proper education to caregivers on the use of the product.

Complementing the quantitative results, interviews were held with five key informants including the community health nurse, who explained that:

> *"Children who consistently eat at school are rarely treated for malnutrition. We even see improved attendance at clinics for check-ups, not illness."*

The researcher noted that there is integrated nutrition and health systems working together for child development in a holistic manner.

A HOSS caregiver said:

> *"Porridge from HOSS helps me manage. I can feed my two orphans in the morning, which gives them a head start before I leave for work."*

This acknowledges that institutional care supports household resilience to a certain extent.

A nutrition officer said:

> *"Fortified porridge is fine and good, but without education, some mothers feed their children once a week as if it were enough."*

The researcher concluded that the effectiveness depends on the continuous use and knowledge transfer.

A teacher from Beatrice Primary reported:

> *"Since the meal program started, my learners concentrate better and look healthier."*

This, in turn, points to academic gains from nutrition.

A local social worker valued:

> *"The feeding at school works because parents feel they are involved as they pay a dollar and daily see the benefits."*

Strengthen local ownership to enhance program sustainability.

The data reveal that communities consider nutrition programs that work within the existing services and open community benefits for participation, such as school feeding, as more impactful than programs imposed externally or pretentiously. Therefore, in terms of the perceived impact of the school meal program, the qualitative data align with the quantitative. The findings go hand in hand with Bronfenbrenner's Ecological Systems Theory, which considers proximal environments like homes and schools to be involved in child development. Interventions within those systems tend to wield the greatest impact. Further, Bandura's Social Cognitive Theory underscores the acquisition of feeding practices through modeling by caregivers and learning together (Bandura, 1986; Nyikadzino, T., and Mutenherwa, F. (2021). Applying Social Cognitive Theory to understand feeding practices among caregivers in rural Zimbabwe. Journal of Health Education Research and Development, 39(2), 97-105.). According to studies conducted in Zimbabwe and Zambia by Ncube-Murakwani et al. (2022) and Muma et al. (2021), participatory and community-based child nutrition programs yield better results in child growth and sustainability than mere

passive receipt of fortified food. The nutritional situation is severely impaired. It can be deduced that standard meals at school introduce forth nutritionally well-being among sickly school children, ending their out school and academic performance. Thus, given this experience from Beatrice, to fully achieve child health outcomes over time, development-intervention types of nutrition must include education and caregiver participation, in addition to a consistent source of food.

4.4 Statistical Analysis

This section outlines the results and the interpretations of the quantitative study into child nutritional outcomes and cost-effectiveness of community-based nutrition interventions for comparative effectiveness. Analyses were undertaken using various statistical techniques, including descriptive statistics, inferential tests, and cost-effectiveness modeling; and interpretations were drawn based on recent literature (last five years).

4.6 Current Nutritional Statistics of Children Under 6 in Beatrice

Descriptive and inferential statistical methods were used to evaluate the prevalence and causes of undernutrition among children.

Table 4.4: Nutritional Status and Statistical Outcomes (n = 50)

Indicator / Variable	Value	95% Confidence Interval	Statistical Test	Result
Stunting prevalence	24%	[13.8%, 36.6%]	—	—

Underweight prevalence	18%	[9.1%, 30.3%]	Chi-square (diet diversity × underweight)	$\chi^2 = 8.27$, $p = 0.016$
Wasting prevalence	14%	[6.0%, 26.5%]	—	—
Overweight prevalence	8%	[2.2%, 19.2%]	—	—
Normal nutritional status	36%	[23.9%, 49.7%]	—	—

A 24% stunting rate documented being a major burden of chronic malnutrition in Beatrice. Butte let of correlation yielded a statistically significant association between dietary diversity and being underweight (p = 0.016), hence saying being underweight is more common in children with poor dietary diversity. These trends mirror the national rural trends estimated by ZimVAC (2023), which reported a rural stunting rate of 26.3%. More recently, research by Mutowo et al. (2021) and Mupedziswa et al. (2023) reiterated that food insecurity at the household level and poor caregiver knowledge on nutrition are the cornerstones of undernutrition within rural set-ups in Zimbabwe.

4.7 Assessing the Cost-Effectiveness of Community-Based Nutrition Interventions

Programmatic data and DALY estimates were used to calculate cost-effectiveness of three major nutrition programs using the ICER framework.

Table 4.5: Cost-Effectiveness Summary of Nutrition Interventions

Intervention	Cost per Child (USD)	Estimated DALYs Averted per Child	Cost per DALY Averted (ICER, USD)
School Feeding Program	$20.00	0.014	$1,429
HOSS Porridge Program	$18.00	0.011	$1,636
USAID/MoHCC Fortified Food Program	$30.00	0.014	$2,143

These results show that school feeding is the most cost-effective intervention, with the lowest cost per DALY averted. According to WHO (2023), an intervention is considered cost-effective in a low-income country if it costs less than 3× GDP per capita (Zimbabwe's GDP per capita in 2023 ≈ USD1,280) per DALY averted; this is USD 3,840. The three interventions lie below this threshold.

4.8 Clarification on DALY Averted Estimates

The DALY estimates per child (0.011-0.014) were based on adjusted burden-of-disease weights, tailored to alignment with the Global Burden of Disease (GBD) 2019 update, which applied to moderate-to-severe acute malnutrition and stunting in sub-Saharan children below age six. These values denote the estimated healthy life years lost due to morbidity and early mortality related to malnutrition, discounted over a one-year horizon. The range (0.011-0.014) varies due to intervention intensity of impact as per regional program evaluations done in Malawi (UNICEF, 2021) and Zambia (Mwale et al., 2020).

4.9 Incremental Benefits Beyond Cost

Whereas fortified porridge perhaps averts more DALYs, it arguably has fewer ramifications for development. School meals have, for example:

- Increased school attendance and retention, especially for girls (FAO, 2022);
- Potential to develop cognitive ability and improve academic performance (Chikwana et al., 2021);
- Fostered social cohesion amongst pupils through communal meals; and
- Compared nutrition education and thus reinforced healthy-related behaviour in the minds of schoolchildren and respective households.

As it stands, the low-cost HOSS program is highly accessible yet limited in terms of growth. It essentially targets nutrition at a household level with very few educational and psychosocial considerations. Hence, in addition to being probably the most low-cost feeding intervention, school feeding retains the entire developmental spectrum under its purview. Being a community-led model that strives to use as many local agricultural inputs and parent committees as feasible, it will undoubtedly turn out to be the most sustainable intervention requiring the least donor support, which is a matter of grave concern in the Zimbabwean context currently (UNICEF, 2022).

4.9 Comparative Effectiveness of Nutrition Interventions in Improving Child Health Outcomes

Perceptions of intervention effectiveness were evaluated using ANOVA and post hoc tests to compare reported child improvements across programs.

Table 4.6: Perceived Effectiveness Scores of Interventions (n = 50)

Intervention	Mean Improvement Score (1–5 Likert)	Statistical Test	Result
School Feeding Program	4.3	ANOVA	$F(2,47) = 3.52$, $p = 0.037$
HOSS Porridge Program	3.9	Tukey post hoc (vs. Fortified)	$p = 0.074$
USAID/MoHCC Fortified Food Program	3.4	Tukey post hoc (vs. School Feeding)	$p = 0.041$
Overall association strength	—	Cramer's V	V = 0.23

The ANOVA was significant for differences among the three programs (p = 0.037), and post hoc analysis found the school feeding program to be significantly better than the fortified food program (p = 0.041). Small-to-moderate effect size (Cramer's V = 0.23) indicated that these were meaningful differences in outcomes by intervention type. These results are in concert with findings of Ncube-Murakwani et al. (2022) and Muma et al. (2021), who found participatory nutrition interventions with daily meal access (such as school feeding) to be far more likely to improve energy, attendance, and immunity than donor-led programs that are less integrated.

Table 4.7: Quantitative-Qualitative Summary Matrix					
Intervention	**Cost per DALY Averted (USD)**	**Mean Improvement Score (1–5)**	**Significance (ANOVA/Post hoc)**	**Qualitative Theme**	**Perceived Benefit / Barrier**
School Feeding Program	1,429	4.3	ANOVA p=0.037, Post hoc p=0.041 vs Fortified	Improved health and concentration; school attendance; parental ownership	Holistic development; strong community ownership
HOSS Porridge Program	1,636	3.9	Post hoc p=0.074 vs Fortified	Supports household resilience; early day energy boost for children	Accessibility; moderate support with limited spillover effects

USAID/MoHCC Fortified Food Program	2,143	3.4	Post hoc p=0.041 vs School Feeding	Limited by poor caregiver education; inconsistent usage	Misuse due to lack of knowledge; low daily uptake

Here is a visual summary matrix that integrates the key quantitative findings with the corresponding qualitative themes and perceived barriers or benefits. This synthesis provides a clear overview of how statistical outcomes align with lived experiences and programmatic insights, as recommended.

5. Conclusions and recommendations

5.1 Recommendations

In order to confront child malnutrition in Beatrice and similar rural areas, proven local interventions household kitchen gardens, growth monitoring, and nutritional education need to be mainstreamed within the national policy framework. These community-led strategies help caregivers gain empowerment and attain food self-sufficiency. However, for these interventions to create a truly lasting impact, they can never be stand-alone interventions but should rather be tied to the National Nutrition Strategy Plan (NNSP), ZIMASSET, and the Ministry of Health and Child Care (MOHCC) budgeting frameworks so that they can receive institutional support and stable funding.

Nutrition education must constitute a critical element of every community-based approach to mitigate the limits of knowledge and bring about long-term behavior change. Evidence-based models, among others, including UNICEF and World Food Programme (WFP) endorsed, assist in scaling up and cost-effectiveness of school feeding programs; consequently, embedding these programs into development plans at the local level hence provides a route to equity and efficiency.

In addition, a strong Monitoring and Evaluation (M&E) framework must be put in place. This should involve the use of mHealth technologies for real-time monitoring of key indicators related to dietary intake, school attendance, and food delivery modalities. Participatory M&E systems involving local actors such as teachers, health workers, and community leaders will increase program responsiveness, improve data quality, and enhance program ownership.

5.1.2 Future Research Directions

- To enhance policymaking and programmatic decision-making, the following areas for future research are proposed:

- Longitudinal studies following beneficiaries to assess the sustainability of nutrition outcomes, particularly the developmental ones (cognitive, academic, and psychosocial) of school feeding.

- Randomized Controlled Trials (RCT) that establish the causal link between specific interventions (e.g., School Feeding versus HOSS) and health and nutrition outcomes in children.

- Comparative cost-effectiveness evaluations across heterogeneous rural settings in Zimbabwe to evaluate scalability and determine performance before a given context.

- Pilot studies on digital M&E innovations, such as mHealth platforms, to improve data accuracy, program oversight, and policy responsiveness at both community and national levels.

5.2 Conclusion

This research was distorted to get some insight into its supposed cost-effectiveness and the impact of nutrition interventions ushering at a community level in Beatrice, a rustic Zimbabwean setup wherein child malnutrition still persists as a grave concern. Quantitative and qualitative data were analyzed to provide a complete account of the nutrition situation in children below the age of six.

These findings reveal a disconcerting nutritional profile: 24% stunted, 18% underweight, 14% wasted, and 8% overweight, with only 36% within the normal nutritional range. These numbers are the broader picture of the malnutrition crisis, which grips many rural pockets of Zimbabwe, and, therefore, heighten the continuing need for a public health response. The narratives from the respondents in the interviews indicated that chronic food insecurity, food shortages during certain seasons, low dietary diversity, and little caregiver knowledge on child nutrition were the major contributing factors.

Among the analyzed community-based interventions, caregivers considered growth monitoring, household gardening, and nutrition education sessions to be the most cost-effective because they were less

expensive, accessible to most people, and sustainable. In contrast, food supplementation was regarded as a temporary relief and could not overcome the causes of malnutrition without systemic interventions.

Importantly, these findings fare well within regional best practices and stand to be supported by theoretical frameworks, including the Social Ecological Model and the Health Belief Model, both of which emphasize contextual, participatory, and multi-level approaches to health behavior change. For sustainable child nutrition progress, changes need to happen not only in individual behavior but also in EFA-enabling environments. And, some form of economic capacity is necessary, along with cultural relevance.

In a rather important fashion, the findings also showed a near-total disjuncture between local interventions aimed at child nutrition and national policy and funding frameworks, especially the National Nutrition Strategy Plan (NNSP), Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET), and budgeting priorities of the Ministry of Health and Child Care (MOHCC). Taking these community-level programs as stand-alone initiatives should be avoided if there is to be any lasting impact; rather, their integration into overall nutrition financing and planning mechanisms is critical. By establishing linkages of community activities with the NNSP pillars of food and nutrition security and carrying them through to actual budget support of MOHCC and development partners, such programs stand to benefit both the sustainability and fine-tuning toward scale.

Limitations

The sample size employed in this study (n=50) is consistent with rapid assessment surveys commonly undertaken in resource-

limited settings, thus limiting external validity in the face of a few selected areas. Findings could not be generalized to all rural realms across Zimbabwe. Furthermore, since these variables are self-reported in qualitative terms by caregivers, recall and social desirability response biases may have been introduced-e.g., in dietary behavior and program impact responses. Seasonal changes in food availability during the study could have had an influence on the nutrition assessments. However, being cross-sectional in design, the study cannot establish the presence of long-term effects or outcomes of treatments nor can it measure their sustained impact beyond their immediate assessment context.

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Data Availability

The new data that was collected or analysed in this study; therefore, data can be shared upon request from the Author

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