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Predictability of Nutritional Support in Improving Cognitive Development Outcomes of Children Living With Disabilities in Kakamega County

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Abstract

Nutritional support is essential for children's dietary intake and developmental outcomes. Most crucially needed by children living with disabilities who have a range of feeding complications, thus affecting their dietary intake and nutritional status. Making these children at risk of malnutrition that affects their development, with irreversible effects on cognitive development and lifelong mental health. Thus, the study aimed at assessing the predictive power of nutritional support in improving cognitive development outcomes of children living with disabilities in Kakamega County. This was a longitudinal study that involved collection of quantitative data within the month of September, 2025 to January, 2026. The target population was mother/caregiver-child pair of children living with disabilities aged below five years living with autism, deaf, Attention Deficit Hyperactivity Disorder, blind, physical disabled and diagnosed with cognitive development impairment who were enrolled in an Early Childhood Development (ECD) Center. Kakamega County was purposively sampled while ECD centers were proportionately sampled, with simple random sampling calculated to select 210 mother/caregiver-child pair. Structural Equation Modelling using AMOS version 7 was used to determine the predictive power of nutritional support on cognitive development outcomes through mediating variables with overall model fit being confirmed. Delivery of optimal nutrition had a statistically significant (β=0.74, $p<0.01$, n=210) influence on the developmental processes that predicted the cognitive development outcome. This was followed by identifying nutritional needs (β=0.68, $p<0.01$, n=210) and caregiver involvement (β=0.60, $p<0.01$, n=210). The model fitted data acceptably well RMSEA=0.09, CFI=0.95, CMIN/DF=2.20, with regard to cognitive development outcomes. The study has established that *identifying nutritional needs* as the gateway to understand quality and quantities of individualized disability; *optimal nutrition* as the foundation for brain growth, neural connectivity; *caregiver involvement* to ensure that nutritional interventions are tailored to the child's specific needs, are key components of nutritional support that enhance cognitive development. This is a crucial finding for policy maker to implement in support of cognitive development for children living with disabilities.

Keywords: Nutritional Needs; Optimal Nutrition; Caregiver Involvement

Introduction

In Kenya, disabilities in children include physical, mental, intellectual, or sensory impairments which interact with various barriers that hinder their full and effective participation in society on an equal basis with others' [1]. These barriers include limited social support, poor health systems, lack of access to assistive technology, discriminatory legislation and policies and most importantly nutritional support [2]. Nutritional support is crucial to ensure consistency in adequate intake of essential macronutrients and micronutrients that promotes optimal brain growth, functioning and cognitive performance in children with disabilities [3]. Nutritional support is not just a matter of "feeding more and feeding earlier", it involves identifying the nutritional needs, the provision of optimal nutrition, the human resource of facilitating optimal nutrition in children living disabilities [4]. Many children with disabilities have health issues including slower oral-motor functioning, constipation, picky eaters, acid reflux that can impact their nutritional well-being and eating habits causing malnutrition, thus makes meeting these children' nutritional needs even more important as compared their normal counterparts [5]. Malnutrition, has an immediate impact on brain processes and an indirect impact on children's behavior and perception affecting cognitive development outcomes such as learning abilities, communication skills, problem-solving and reasoning and self-regulation and executive functions [6]. This has dire consequences on cognitive development outcomes of children living with disabilities who already have delayed development milestones (brain impairment, delayed physical growth, and lethargy). Thus, nutritional support including; identifying the nutritional needs, the provision of optimal nutrition, the care giver involvement is very crucial in improving cognitive development outcomes of children living disabilities considering that they have diverse and specialized nutritional needs depending on the nature and severity of their condition [7]. Addressing nutritional needs of children living with disabilities needs an approach that is individualized, inclusive, and multidisciplinary to essentially support optimal cognitive development [8]. Tailored nutritional interventions not only prevents further impairment but also promote equitable developmental opportunities. Caregiver involvement including parents', caregivers', nutritionists' as a component of nutritional support is a cornerstone of nutritional wellbeing for children with disabilities. Strengthened caregivers' involvement (nutrition knowledge, nutrition practices, emotional support, and environmental facilitators of optimal dietary) will not only enhance dietary adequacy in terms of quality and quantity but also contribute to improved health and quality of life for children with disabilities [9]. This will improve their cognitive development outcomes (learning abilities, communication skills, problem-solving and reasoning and self-regulation and executive functions). However, among the most critical yet often overlooked contributor to cognitive development outcomes is nutritional support, yet there has been increasing recognition of its' role in influencing neurodevelopmental outcomes [7]. In low-resource settings such as Kakamega County, Kenya, there is limited data on nutritional support and cognitive development outcomes of children aged below five years living with disabilities, yet it has the 2nd highest prevalence of children living with disabilities in Kenya [10; 11]. Most interventions in this region have focused narrowly on formal academics and medical support, often overlooking the integrated role of nutritional support as a critical component of holistic development in cognitive development [7].

Aim of the Research

To assess the predictive power of nutritional support in improving cognitive development outcomes of children living with disabilities in Kakamega County.

Problem Statement

Despite the existing nutrition programs and rising enrollment of children with disabilities in educational and care institutions in Kakamega County, little is known about how well nutritional support aligns with cognitive development outcomes. Particularly, through their identification of nutritional needs, the provision of optimal nutrition, caregivers' involvement in facilitating optimal nutrition. This knowledge gap makes it difficult for policymakers and health service providers to effectively plan, provide services and implement directives that maximize developmental gains for this vulnerable group, thus making advocacy for

nutrition services remain weak.

Justification of the Study

Children living with disabilities are frequently overlooked in mainstream nutritional research and programs yet they are already at a higher risk of developmental delays. Hence understanding how nutritional support influences their cognitive development outcomes can provide evidence needed for improving parenting support strategies, guiding allocation of resource, planning and policy formulation aimed at enhancing cognitive development outcomes.

Significance of the Study

This study will show how and to what extend nutritional support can impact on cognitive development of children living with disabilities. This will generate actionable insights for families, practitioners, policymakers, and researchers to improve interventions, policies aligned with nutritional support of children living with disabilities.

Conceptual Framework

This **conceptual framework** (figure 1) illustrates how **nutritional support** influences **cognitive development outcomes** among children living with disabilities. Nutritional support is the main independent variable operationalized through: identifying nutritional needs as the gateway to understand quality and quantities of individualized disability; optimal nutrition as the foundation for brain growth, neural connectivity, and overall physiological development; caregiver involvement to ensure that nutritional interventions are consistent and tailored to the child's specific needs. The mediating variables (neurological stimulation, psychosocial development, physical growth and health) connected nutritional support to cognitive development through: building blocks for neural networks; enhancing communication, peer interaction, emotional stability; improving immunity, reducing fatigue, and readiness for learning. The cognitive development outcome was the dependent variable detailed through measurable outcomes (learning abilities, communication skills, problem-solving skills and executive functions) that characterized the ultimate developmental goals of nutritional support intervention. From the conceptual frame three research questions were developed;

- What is the predictive power of identifying nutritional needs on improving cognitive development outcomes of children living with disabilities?
- What is the predictive power of delivery of optimal nutrition on improving cognitive development outcomes of children living with disabilities?
- What is the predictive power of caregiver involvement on improving cognitive development outcomes of children living with disabilities?
- development outcomes of children living with disabilities?

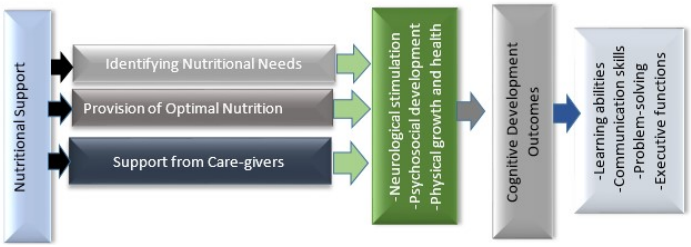

Figure 1: Conceptual Framework

Study Area

Kakamega County located in Western Kenya formed the study area which is made up of 12 sub-Counties namely; Mumias, Matungu, Kakamega Central, Navakholo, Khwisero, Butere, Kakamega North, Kakamega South, Kakamega East, Likuyani, Lugari and Matete [11]. The County has an area of 3,033.8 km^2 and population of 1,867,579 which is projected to increase to 2,658,577 in 2030 [11]. In the County's population, approximately 329,041 are children aged below five years, with 164,393 females and 164,648 males. The area was purposively sampled because limited or no data exists on nutritional support and cognitive development outcomes of children aged below five years living with disabilities, yet it has the 2nd highest prevalence of children living with disabilities in Kenya [10].

Study Design and Population

This was a longitudinal study that involved collection of quantitative data within the month of September, 2025 to January, 2026. The target population was mother/caregiver-child pair of children living with disabilities aged below five years living with autism, deaf, Attention Deficit Hyperactivity Disorder (ADHD), blind, physical disabled and diagnosed with cognitive development impairment who were enrolled in an Early Childhood Development (ECD) Center in Kakamega County.

Sampling Techniques and Sample size

Kakamega County was purposively sampled because; despite national efforts to improve early childhood development, children with disabilities in this region continue to encounter multidimensional challenges in their development most importantly, cognitive development that are linked to poverty and cultural backgrounds [12]. These challenges ultimately hinder their learning abilities, communication skills, problem-solving skills and executive functions. No data exists on how nutritional support can be aligned with cognitive development of these children to improve their cognitive development outcomes thus warrants focused investigation [10]. ECD centers were proportionately sampled according to the 12 sub counties of Kakamega County. Stratified random sampling was then employed on each stratum (Autism, Deaf, ADHD, Blind, Physical disabled) to get the sample population of early childhood educator-child pair; 42 from each stratum [13] was used to calculate a representative sample size of 210 mother/child caregiver-child pair. To ensure heterogeneity, the study embraced an inclusion criteria of children with Autism, Deaf, ADHD, Blind, and Physical disabled and diagnosed with cognitive development impairment.

Data Collection Instrument and Procedure

A pretested questionnaire was divided into sections each measuring; identification of nutritional needs, delivery of optimal nutrition and caregiver involvement on neurological stimulation, psychosocial development, physical growth and health of the children. A seven point Likert scale was constructed along a continuum range from totally disagree/not all/extremely unlikely=1; moderately disagree/not all/extremely unlikely =2; slightly disagree/not all/extremely unlikely =3; undecided=4; slightly agree/very much/extremely likely =5; moderately agree/ very much /extremely likely=6; to totally agree/ very much /extremely likely=7 was used to measure all the variables. Higher scores indicated more positive identification of nutritional needs, delivery of optimal nutrition and caregivers' involvement towards neurological stimulation, psychosocial development, physical growth and health of the children.

Three, 7-point scales, with end points of [7] and [1] were used to elicit the respondents' beliefs on neurological stimulation, psychosocial development and physical growth and health respectively on improving cognitive development of children living with disabilities. Three items with 7-point response scales elicited the respondents' perceptions on nutritional support in cognitive development. The anchors were extremely likely [7] to extremely unlikely [1]. One additional item measured perceptions of confidence in ability on a 7-point scale, ranging from strongly disagree [1] strongly agree [7]. Scores were summed and divided by the number of items for a possible mean score of 1 to 6.5; higher scores reflected greater predictability. Cognitive develop-

ment predictability was measured with one 7-point scale, containing end points of strongly disagree [1] and strongly agree [7]. The midpoint of the scale represented unsure about the cognitive development outcomes. To establish validity, the questionnaire was given to two experts to evaluate the relevance of each item in the instrument to the objectives (content validity). The experts appraised what appeared to be valid for the content, the test attempted to measure (face validity). The degree to which a test measured a sufficient sample of total content that was purported to measure was considered (sampling validity). The questionnaire was administered on respondents and the interview responses filled in by the researcher to gather data. The respondents were then interviewed through previous booked appointments and each interview lasted for a maximum of 1 hour.

Data Analysis

Data was entered into SPSS version 15 to calculate reliability tests where Cronbach's alpha was used to assess the consistency of the questions. Structural Equation Modelling using AMOS version 7 was used to determine the predictive power of nutritional support (identification of nutritional needs, delivery of optimal nutrition and caregiver involvement) on cognitive development outcomes through mediating variables (neurological stimulation, psychosocial development, physical growth and health of the children). The overall model fit was evaluated using chi-square (CMIN) and relative chi-square divided by degrees of freedom (CMIN/df), comparative fit index (CFI), the standardized root-mean-square error of approximation (RMSEA), Hoelter's critical N, and Bollestine bootstrap. Comparative fit index (CFI) and Tucker Lewis index (TLI), values greater than 0.90 were considered satisfactory [14]. RMSEA less than 0.08 was also considered satisfactory (Schumacker & Lomax, 2004). CMIN/df was considered fit when it ranged between 3:1 and was considered better when closer but not less than 1 [15]. Hoelter's critical N for significance level of .05 and .01 was used where bootstrap samples were set at 200 [16].

Results

Standardized factor loadings for each observed variables on its latent constructs was achieved at an acceptable threshold of ≥ 0.70. This revealed that the indicators statistically represented the latent constructs. Composite reliability ensured the internal consistency of the construct indicators, where items with loadings were removed. While, discriminant validity at the threshold: < 0.85 revealed that the constructs were distinct from each other. Predictive power refers to the ability to generate testable forecasts; strong predictive power is highly valued, because the forecasts can often support validity of the concept under investigation (nutritional support and cognitive development outcomes). The concept of predictive power involves a known phenomenon that is retrospectively explained by the concepts under investigation which allows a prospective test of theoretical understanding. In this study, the predictive power of identifying nutritional needs, delivery of optimal nutrition and caregiver involvement in extrapolating cognitive development outcomes was tested through mediating variables; neurological stimulation, psychosocial development, physical growth and health of the children and explained the total variance of these predictors (figure 2).

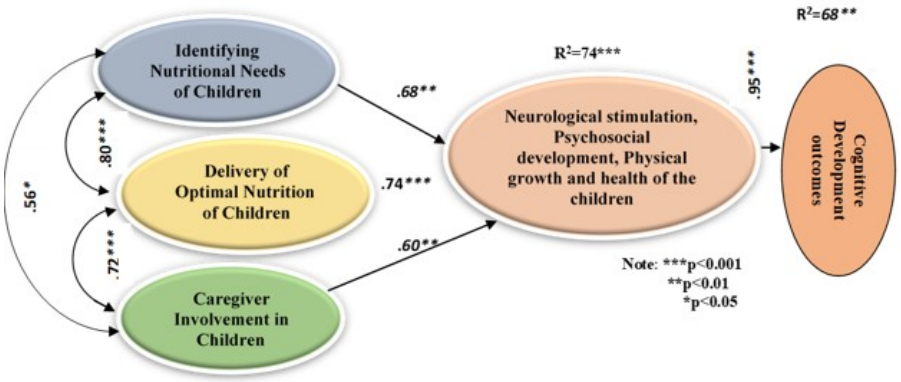

Figure 2: Predictive Power of Nutritional Support on Cognitive Development

Research Question 1: Predictive power of identifying nutritional needs on cognitive development outcomes of children living with disabilities was assessed through mediating variables given by:

Cognitive Development=0.68 identifying nutritional needs of children + mediating variables; Y= 0.68 X +e

Where: Y=Cognitive development; X=Identifying nutritional needs; e=Mediating variables. This finding indicated that a unit change in identifying nutritional needs was associated with a change of 0.68 units in cognitive development outcomes.

Research Question 2: Predictive power of delivery of optimal nutrition on cognitive development outcomes of children living with disabilities was assessed through mediating variables given by:

Cognitive development= 0.74 delivery of optimal nutrition + mediating variables; Y= 0.74 X + e

Where: Y=Cognitive development; X=Delivery of optimal nutrition; e=Mediating variables. This finding indicated that a unit change in delivery of optimal nutrition was associated with a change of 0.74 units in cognitive development outcomes.

Research Question 3: Predictive Power of caregivers' involvement on cognitive development outcomes of children living with disabilities was assessed through mediating variables given by

Cognitive development= 0.60 caregivers' involvement + mediating variables; Y= 0.60 X + e

Where: Y=Cognitive development; X=Caregivers' involvement; e=Mediating variables. This finding indicated that a unit change in caregivers' involvement was associated with a change of 0.60 units in cognitive development outcomes.

Table 1: Fit Indices of Predictive Model

Fit Indices	Recommended fit Measures	Default Measures
RMSEA	0.09 or less is better	0.09
CFI	above 0.9 is good fit	0.95
CMIN/DF	between 2-3	2.2
TLI	>0.8 is good fit	0.93
Hoelter's Critical N	>200 adequate	210
p	> 0.10 good fit	0.14

Note: RMSEA=Root mean square residual; CFI=Comparative fit index; CMIN/DF=Chi-square/degree of freedom; TLI= Tucker-Lewis Index; χ^2= Chi-square

Discussion

The findings depict a structured pathway through which identifying nutritional needs, delivery of optimal nutrition and caregiver involvement interact to influence developmental processes and, ultimately, cognitive outcomes. The relationships shown in the figure 2, indicated by standardized coefficients, provide important insights into the relative strength and significance of each linkage within this developmental system. The model begins with the identification of nutritional needs of children, which shows a strong and statistically significant relationship with the delivery of optimal nutrition ($\beta = 0.80$, $p<0.01$, $n=210$). This suggests that accurate assessment of children's dietary requirements is a critical determinant of whether appropriate nutritional interventions are implemented. In practical terms, when caregivers or health systems are able to correctly diagnose nutritional

deficiencies or requirements, they are far more likely to provide diets that meet children's developmental needs. This finding is consistent with the work of [3], who emphasize that timely identification and management of undernutrition are essential for preventing long-term developmental deficits. Similarly, [17] highlight that early detection of micronutrient deficiencies plays a crucial role in supporting brain development. The findings demonstrated a strong positive relationship between caregiver involvement and the delivery of optimal nutrition ($\beta = 0.72$, $p<0.01$, $n=210$). This indicates that caregivers are not merely passive providers but active agents in shaping children's nutritional environments. High levels of caregiver engagement such as responsive feeding, attention to dietary diversity, and adherence to recommended feeding practices significantly enhances the quality of nutrition children receive. This aligns with findings by [8], who argue that caregiving behaviors are central to ensuring adequate child nutrition, and [9], who identify responsive caregiving as a cornerstone of early childhood development within the Nurturing Care Framework. There was a moderate but significant relationship between identifying nutritional needs and caregiver involvement ($\beta = 0.56$, $p<0.01$, $n=210$). The respondents' delivery of optimal nutrition had a statistically significant ($\beta=0.74$, $p<0.01$, $n=210$) influence on the developmental processes that predicted the cognitive development outcome. This was followed by identifying nutritional needs ($\beta=0.68$, $p<0.01$, $n=210$) and caregiver involvement ($\beta=0.60$, $p<0.01$, $n=210$). This suggests that accurate assessment of children's dietary requirements is a critical determinant of whether appropriate nutritional interventions are implemented. In practical terms, when caregivers or health systems are able to correctly diagnose nutritional deficiencies or requirements, they are far more likely to provide diets that meet children's developmental needs. This finding is consistent with the work of [3], who emphasize that timely identification and management of undernutrition are essential for preventing long-term developmental deficits. Similarly, [16] highlight that early detection of micronutrient deficiencies plays a crucial role in supporting brain development. Beyond these direct relationships, the findings show that the combined effects of identifying nutritional needs, delivery of optimal nutrition and caregiver involvement have a very strong influence on neurological stimulation, psychosocial development, and physical growth and health ($\beta = 0.95$, $p<0.01$, $n=210$). This exceptionally high coefficient suggests that these inputs work synergistically to shape children's overall developmental environment. Identifying nutritional needs is initial and critical step in ensuring timely interventions that address deficiencies. Adequate nutrition supports brain structure and function [3], while caregiver interaction provides the stimulation necessary for cognitive and emotional development [18]. At the same time, proper nutrition promotes physical growth and strengthens immunity, thereby reducing illness-related disruptions to development. This finding is strongly supported by [5], who demonstrated that both nutrition and early stimulation are essential for realizing children's developmental potential, and [19], who showed that integrated interventions addressing both domains yield the greatest developmental gains. The findings also indicated that while neurological, psychosocial, and physical development are important predictors of cognitive abilities, they do not fully account for all the variation in cognitive outcomes, other contextual factors may also play important roles. Nonetheless, the strength of this relationship confirms that early developmental conditions form the foundation for later cognitive functioning. This is consistent with the work of [19], who found that early childhood risk factors, including poor nutrition and limited stimulation, are associated with lower cognitive performance and educational attainment [20]. Further supports this interpretation by demonstrating that early investments in child development yields substantial long-term returns in cognitive skills and productivity. Overall, the results highlight several key insights. First, early identification of nutritional needs and active caregiver involvement are critical entry points for improving cognitive developmental outcomes of children living with disabilities. Second, these factors are not independent; rather, they interact to influence a broader set of developmental processes for children living with disabilities including neurological stimulation, psychosocial development, and physical growth and health that predict cognitive development. Third, neurological, psychosocial, and physical development serve as key mediators linking early inputs to cognitive outcomes of children living with disabilities. The particularly strong relationship between inputs and developmental processes underscores the importance of integrated interventions that combine identification of nutrition needs, delivery of optimal nutrition and caregiving support.

Conclusion

The study underscores that optimizing cognitive development outcomes of children living with disabilities requires more than identifying nutritional needs for adequate food provision; it necessitates a comprehensive strategy that integrates optimal nutrition with active caregiver engagement and supportive developmental environments rather than a single focus intervention. Policies and programs aimed at improving child outcomes should therefore prioritize early assessment of nutritional needs, promote best feeding practices, and empower caregivers with the knowledge and resources necessary to support holistic child development.

Clinical Trial Number

Not applicable

Author Contributions

All authors have participated in the drafting of the manuscript, have proof read and agreed to have it published.

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Institutional Review Board Statement

Ethics approval was obtained from the Masinde Muliro University of Science and Technology, Institutional Scientific and Ethics Review Committee (MMUST-ISERC) that reviewed and approved the research (MMUST/ISERC/087/2025).

Informed Consent Statement

Informed written consent was obtained from the mothers/primary caregivers of all participating children.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of the data; in the writing of the manuscript; or in the decision to publish the results.

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