



HEALTHCARE ENTREPRENEURSHIP: APPROPRIATE DIET IN THE MANAGEMENT OF CHILDREN WITH SPECIAL NEEDS

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ABSTRACT

Healthcare entrepreneurship awesome and blooming which is appropriate diet in the management of children with special need such as autism. This study focused balancing healthcare entrepreneurship with innovation skills on the development of gluten-free and casein-free diets for the management of nutritional challenges of children with autism in Rivers State.. The study adopted the Research and Development (R and D) and qualitative designs. The population for the study comprised of 38 participants. The 9-point hedonic scale and two sets of questionnaires were used to collect data. All chemical. All the diets were accepted by the judges. The findings revealed therapeutic benefits in managing symptoms such as food refusals (M=2.87), constipation diarrhea (M=3.35), bloating/gas (M=2.63), sleep disturbances (M=2.50), pale skin (M=3.35) and food allergies (2.81). Findings highlight varying levels of therapeutic effectiveness, with distinct benefits associated with each diet. The study has shown that limited food variety leads to nutrient deficiencies, as certain essential vitamins and minerals may be lacking in their diet. The study concluded that the developed diets present potentials in the management of autism-related problems in children. The study recommended a healthcare entrepreneurship support and educational programs for special needs children.

KEYWORDS: *Sleep Disturbances, Food Disturbances, Food Allergies, Bloating, Healthcare Entrepreneurship, Innovation*



Introduction

Children at all age even in infancy should be prepared for entrepreneurial activities. Special care children should delve into entrepreneurial function as play and games with interest, opinion and lifestyle. This is pointed to the paneling row as Healthcare entrepreneurship. This is the consciousness of wealth creation and value creation with innovation.

Healthcare entrepreneurship occurs when healthcare-minded professionals create new businesses, often through developing services, tools or ideas. Successful business ventures typically meet or supplement a current unfilled need in the marketplace or identify a previously unseen problem and potential solution (Ogunde et al, 2025).

Now, more than ever, healthcare is a business and a booming one. It is the fastest-growing sector of the U.S. economy and represents the largest employer. According to the Centers for Medicare and Medicaid Services (CMS), health spending accounts for 17.6% of the nation's gross domestic product, totaling \$4.9 trillion. Moreover, the sheer size and impact of the healthcare industry make it ideal for innovation that can streamline care, foster engagement and improve outcomes.

Plus, a significant crossover exists between business and healthcare. For example, healthcare administrators utilize similar skills as businesspeople to keep their organizations afloat: product development and innovation, marketing, fiscal responsibility, leadership and human resources management (Lamar University, 2025).

Health Entrepreneurship Dialogue by Amref Health Africa brings together bold thinkers, innovators, and changemakers shaping the future of health across Africa and beyond. This engaging webinar dives into the real journeys behind successful health ventures the challenges faced, the lessons learned, and the resilience that fuels impact-driven innovation.

Participants will connect with inspiring health entrepreneurs and sector leaders as they share practical insights on building sustainable, scalable solutions that transform health systems and communities. Whether you're launching your first idea or growing your enterprise, this session offers a roadmap for thriving in Africa's dynamic health innovation space. Nutrition is the paneling role for fundamental healthcare.

Nutrition plays a crucial role in the management of health challenges across a spectrum of conditions. The relationship between nutrition and health is intricate, with dietary choices influencing the risk, development, and progression of various health issues. Effective nutrition management can contribute significantly to the prevention of diseases, aid in the treatment and recovery process, and improve overall well-being (Akoma et al., 2016). Proper nutrition is fundamental in preventing a multitude of health challenges. A balanced diet that includes essential nutrients, vitamins, and minerals helps maintain a robust immune system, reducing susceptibility



to infections and chronic diseases. Diets rich in antioxidants, found in fruits and vegetables, can neutralize free radicals and lower the risk of conditions.

Nutrition plays essential roles in the management of health challenges. Whether in the prevention of diseases, supporting treatment and recovery, managing chronic conditions, addressing nutrient deficiencies, or promoting general health functioning, the role of nutrition is central to overall well-being (Nali et al., 2018). A holistic approach to healthcare that includes dietary interventions, education on healthy eating habits, and personalized nutritional guidance is essential for individuals to effectively manage and overcome challenges such as autism spectrum disorder throughout their lives.

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by challenges in social interaction, communication, and repetitive behaviors. It is referred to as a "spectrum" because it can manifest in various ways and to different degrees in different individuals. Some may have mild symptoms, while others might have more severe challenges. ASD affects each person differently, leading to a wide range of strengths and challenges. Common symptoms include difficulties in social interaction, repetitive behaviours, challenges in communication, and sensitivity to sensory stimuli. Some individuals with ASD might excel in certain areas like art, music, or mathematics due to their unique way of thinking and processing information (Al-Shahib & Marshall, 2023).

Children with ASD might face difficulties in interpreting social cues, making eye contact, engaging in reciprocal conversations, or showing empathy. Their communication might vary from being non-verbal to having rich vocabularies with atypical language patterns (Akoma et al., 2016). Additionally, they might engage in repetitive movements, fixate on specific interests, or exhibit sensory sensitivities, experiencing the world in a way that can be overwhelming. While the exact causes of autism remain elusive, there is a growing body of research suggesting that nutrition may play a significant role in influencing the development and management of autism (Ahmad et al., 2020). The early stages of life are crucial for brain development, and nutrition plays a pivotal role during this period. Research has shown that certain nutrients, such as omega-3 fatty acids, vitamins, and minerals, are essential for optimal brain function (Nali et al., 2018). Inadequate intake of these nutrients during pregnancy and early childhood may contribute to an increased risk of neurodevelopmental disorders, including autism (Al-Shahib & Marshall, 2023).

Omega-3 fatty acids, particularly *docosahexaenoic* acid (DHA) and *eicosapentaenoic* acid (EPA), are crucial for brain health. They are integral components of cell membranes and play a role in neurotransmitter function (Nali et al., 2018). Some studies have suggested that individuals with autism may have lower levels of omega-3 fatty acids, prompting interest in the potential benefits of supplementation. On the other hand, vitamins and minerals, such as vitamin D, vitamin B6, vitamin B12, zinc, and magnesium, have also been implicated in the development of autism



(Akoma et al., 2016). Deficiencies in these nutrients may affect various biochemical pathways in the brain, potentially contributing to the manifestation of autistic traits. Consequently, dietary interventions aimed at addressing these deficiencies have been explored as a complementary approach in the management of autism.

Despite the increasing interest in the relationship between nutrition and autism, the field is not without its challenges and controversies. Individual responses to dietary interventions vary, and what works for one person may not be effective for another. Moreover, the limited consensus on the most appropriate dietary interventions and the lack of standardized protocols hinder the development of evidence-based nutritional guidelines for autism. However, the exploration of nutrition and its impact on autism is a dynamic and evolving field. While research has provided insights into the potential role of certain nutrients and dietary interventions, more rigorous studies are needed to establish clear links and guidelines for nutritional management in autism. Hence the need to focus on diets that address specific nutrition challenges associated with autism in especially children. Such diets may include gluten-free and casein-free diets.

Conceptual Review

Healthcare Entrepreneurship

Traditionally, entrepreneurship involves the complex activity of developing and establishing a new business venture by identifying opportunities and finding innovative solutions to generate wealth and value. Categorise entrepreneurship into diverse types: subsistence entrepreneurship, self-employed entrepreneurs, traditional business entrepreneurship, and innovation-driven entrepreneurship. A common aim among these is profitability, which is crucial for a business venture's survival, growth, and sustainability. To achieve profitability, an entrepreneur must understand and adapt to the specific realities of their operating context.

Typically, entrepreneurship is considered at the individual and business levels. However, its competitive, self-centred nature contrasts with its positive societal impact. Entrepreneurship directly supports the United Nations Sustainable Development Goals (SDGs), as it can help to alleviate poverty (SDG 1), drive economic development and reduce unemployment (Ovharhe & Chukwuemeka, 2025), enhance infrastructure and innovation (SDG 9), and promote social equality and inclusion (SDGs 5 and 10) and sustainable production and consumption (Ovharhe, 2022). Therefore, it is important to establish more robust entrepreneurial ecosystems and entrepreneurial courses in university settings to help drive these goals at a national level.

Furthermore, entrepreneurs often work outside traditional, established organisations, setting up new ventures from scratch.



However, the same innovative thinking can thrive within corporate structures, unencumbered by bureaucracy, a practice known as intrapreneurship. Intrapreneurship is described as “in-house entrepreneurship, where an employee develops and implements new and innovative ideas within an established organisation” (Ovharhe, 2025a, 2025b, 2025c, 2025d), Therefore helping students develop an intrapreneurial mindset can also be beneficial to existing corporations.

15 healthcare business ideas.

Startups are in a prime position to benefit from the significant transformation in the healthcare sector. With the population getting older and health issues becoming more prevalent, you have the chance to have a positive influence. Startup opportunities are presented by the healthcare industry’s rapid adoption of new technologies. Medical business ideas also have a lot of potential because people are becoming more interested in staying healthy.

Digital health solutions, remote care, and artificial intelligence (AI) are transforming our understanding of wellness. Healthcare AI is not a sci-fi dream, it is already a reality. AI-driven platforms are lowering costs, increasing accuracy, and facilitating access to healthcare for everything from mental health support to diagnostics.

Why Healthcare Startups Matter in 2025

There are many strong reasons to start a healthcare startup. You may make a major difference by supporting the elderly and those dealing with substance misuse. Furthermore, advances in science and technology, together with an increased interest in health and well-being, have resulted in a thriving market for healthcare businesses. There is a great need for creative startup solutions that give business owners the chance to address pressing issues and create profitable, long-lasting healthcare projects.

Analysts predict that the healthcare market will expand, both in terms of overall monetary value and share of GDP. The healthcare industry accounted for more than **18% of the US GDP in 2023**, and healthcare expenditures are expected to approach **20% by 2031**, according to the Peter G. Peterson Foundation. Oleg, K. O. (2025);

1. AI-Powered App for Symptom Checking

An application that suggests possible conditions based on user input using artificial intelligence (AI) and natural language processing (NLP). Excellent for triage before medical consultation. See how NLP is changing the medical field.

2. Rural Teletherapy Platform

There are few mental health services available in rural areas. This enormous gap might be filled by a secure teletherapy solution. With such a platform, you can receive secure and comfortable



virtual consultations, eliminating geographical barriers. Imagine Zoom combined with mental health.

3. Subscription for Wearable Health Monitoring

Give consumers wearable technology that monitors vital signs and instantly notifies physicians. Make money with recurring subscriptions. A simple and widely appealing healthcare business to launch.

4. Customized Meal Planning for Chronic Illnesses

An AI-powered app that develops meal plans for people with heart disease, diabetes, and other dietary needs. Excellent for a medical business startup idea.

5. Virtual Reality Pain Management Tool

For non-opioid pain relief, use virtual reality. It has been shown to lessen procedure-related anxiety and is immersive and non-invasive. From immersive pain management to cognitive therapy, such a tool empowers clinicians and transforms patients' lives worldwide.

6. Marketplace for Healthcare Staffing

Uber for medical professionals, such as nurses. A digital platform that allows hospitals to make on-demand reservations for qualified professionals. A great business in health care.

7. Remote Patient Monitoring Dashboard

Create a B2B SaaS solution that enables hospitals to remotely monitor patients with chronic illnesses. Analytics, alerts, and real-time vitals in one location.

8. Mental Health Chatbot Service

A 24/7 chatbot that provides emotional check-ins, CBT-based answers, and reminders to take care of oneself. Excellent for corporate wellness initiatives as well as individual users.

9. Blockchain-Based Medical Records System

Bid farewell to misplaced files. Blockchain guarantees patient data that is safe, decentralized, and readily exchangeable. Are you curious about its technological aspects? This is the evolution of medical software.

10. Elderly Care Coordination App

Use a single app designed for family members and carers to manage appointments, medications, and home care services. An idea for a healthcare startup that is in high demand.



11. Fitness App for Post-Surgery Recovery

A mobile application that can help patients monitor their progress to recovery after surgeries and feed information back to their care teams.

12. On-Demand Lab Test Booking Platform

Such platforms let you order lab tests from home. Convenient, quick, and secure blood tests help you better understand your overall health and wellness.

13. AI Diagnostic Tool for Skin Conditions

Develop a machine learning model to use images to identify skin conditions. It's accessible and scalable

14. Health Education Gamification Platform

An app that uses entertaining, interactive games to teach adults and children about fitness, nutrition, and hygiene. Excellent for corporate wellness or educational initiatives.

15. Subscription-Based Telemedicine for Startups

Provide a flat-rate subscription for 24/7 virtual doctor access as an inexpensive health benefit for small businesses. Highly scalable and simple to implement

Gluten-Free and Casein-Free (GFCF) Diets

Gluten-free and casein-free (GFCF) diets have been explored as dietary interventions for individuals with Autism Spectrum Disorder (ASD), primarily based on anecdotal reports and some studies suggesting that certain individuals with ASD may experience improvements in behaviour and symptoms when following these diets. Gluten is a protein found in wheat, barley, rye, and their derivatives. It provides elasticity to dough and helps baked goods maintain their shape (Ahmad et al., 2020; Akoma et al., 2016). Some caregivers and practitioners have reported improvements in behaviour, communication, and gastrointestinal symptoms in a subset of individuals with ASD when gluten is eliminated from their diet. However, it is essential to ensure that the diet is nutritionally balanced and meets the individual's dietary needs.

On the other hand, casein is a protein found in milk and dairy products. It is a common component in many foods, including cheese, yogurt, and milk-based products. Similar to the gluten-free diet, some anecdotal reports and studies have suggested improvements in behaviour and symptoms for certain individuals with ASD when following a casein-free diet (Akeem et al., 2016). Removing dairy products from the diet may lead to a reduction in calcium and vitamin D intake. Hence, it becomes crucial to find alternative sources for these nutrients or consider supplementation.



The decision to implement a gluten-free, casein-free, or combined diet for individuals with ASD should be made in consultation with healthcare professionals. These diets should be carefully planned to ensure they are nutritionally adequate, and any potential benefits should be balanced against the potential challenges and restrictions they may pose to the individual's diet and lifestyle (Akoma et al., 2016). When following a gluten-free diet, it is essential to ensure a well-balanced intake of nutrients. Incorporating a variety of grains, vegetables, fruits, proteins, and other gluten-free whole foods is key to obtaining a diverse range of nutrients (Al-Shahib & Marshall, 2023). Research in this area focuses on the utilization of food crops that are gluten-free and casein free. Such food crops include millets, unrefined raw rice, guinea corn, sweet potato, almond nut, walnut, flax seeds, chia seeds and date fruit.

Millet (*Pennisetum glaucum*) is considered a naturally gluten-free grain and can be a suitable option for individuals following a gluten-free diet, including those with celiac disease or gluten sensitivity (Akeem et al., 2016). It is a small-seeded, ancient grain that is nutritionally rich and versatile in cooking. Millet is also a good source of nutrients such as magnesium, phosphorus, manganese, and fibre (Ahmed et al., 2015). It is also rich in antioxidants and may contribute to heart health and digestion. In this study, two types – pearl and finger millets was adopted because of their high nutritional value and popularity in parts of Africa, and Nigeria in particular, where unrefined rice is also very available.

Unrefined raw rice (*Oryza sativa*) is naturally gluten-free and is a staple in gluten-free diets. Rice in its natural form, whether it is brown, black, red, or white rice, does not contain gluten. It is an excellent option for individuals who need to avoid gluten due to celiac disease, gluten sensitivity, or other reasons. Unrefined rice, especially brown, black, or red rice, contains more nutrients and fibre compared to white rice (Ahmad et al., 2020). These varieties retain the outer bran layer, providing additional vitamins, minerals, and antioxidants. Incorporating a variety of unrefined rice types into a gluten-free diet can provide essential carbohydrates, energy, and a range of nutrients.

Apart from unrefined raw rice which is readily available in many parts of Nigeria, guinea corn (*Sorghum bicolor*) is naturally gluten-free and is considered a safe grain for individuals following a gluten-free diet. It is a versatile cereal grain widely used in various culinary traditions and is a staple in many regions around the world. Guinea corn is used in diverse culinary applications. It can be ground into flour for baking gluten-free bread, cakes, and other baked goods. It is also used to make porridges, soups, beverages (such as sorghum-based drinks), and as a whole grain in various dishes. Guinea corn is nutritious and rich in antioxidants, fiber, and certain minerals like magnesium and iron (Nali et al., 2018). It offers a range of health benefits and can be part of a balanced diet as other foods such as sweet potato.

Sweet potato (*Ipomoea batatas*) is naturally gluten-free and this makes sweet potatoes a great option for those who need to avoid gluten in their diet due to conditions like celiac disease or



gluten sensitivity. One can enjoy sweet potatoes in various dishes without worrying about gluten content. Sweet potatoes are also a nutritional powerhouse, containing rich in vitamins, minerals, and fiber (Ahmad et al., 2020). The exact nutritional content can vary based on factors like the variety of sweet potato and its cooking method. Overall, sweet potatoes are a nutrient-dense and versatile food choice. Apart from these food crops, there are several nuts and seeds which are gluten-free and include almond nuts, walnut, flax seeds, chia seeds and date fruit.

Almond nuts (*Prunus dulcis*) are naturally gluten-free and can be safely consumed by individuals following a gluten-free diet. Almonds are tree nuts that are widely used in various culinary applications and as a source of nutrition. They do not contain gluten, making them a suitable option for those with celiac disease, gluten sensitivity, or individuals adhering to a gluten-free lifestyle (Ahmad et al., 2020). Almonds are versatile and can be consumed in various forms. They are commonly eaten raw, roasted, or as an ingredient in foods such as almond butter, almond flour, almond milk, and almond oil. Almond flour, in particular, is used as a gluten-free alternative in baking. They are nutrient-dense and contain healthy fats, protein, dietary fiber, vitamins (such as vitamin E), minerals (such as magnesium), and antioxidants (Nali et al., 2018). Almonds offer numerous health benefits and can be part of a balanced diet, and is also compared to tiger nuts in terms of nutritional benefits.

Coconut (*Cocos nucifera*) in its natural form – whether it is coconut meat, coconut milk, coconut oil, or coconut flour – is generally considered safe for those who need to avoid gluten in their diet, and are highly nutritious and offer various health benefits. Certain components in coconuts, such as lauric acid, may have antimicrobial and antifungal properties that can support the immune system, while the antioxidants present in coconuts may help reduce oxidative stress and inflammation in the body (Ahmad et al., 2020).

Walnut (*Juglans regia*) and the date fruit (*Phoenix dactylifera*) are naturally gluten-free, so they do not contain gluten. They are safe for consumption by individuals with celiac disease or gluten sensitivity. However, cross-contamination can occur if walnuts are processed in facilities that also handle gluten-containing products (Borchani et al., 2020). In such cases, there might be a risk of trace amounts of gluten, but in general, walnuts themselves are inherently gluten-free. Walnuts and dates are both nutrient-dense foods, each offering a unique set of nutrients. When consumed together, they can create a balanced snack or addition to a meal. The combination of walnuts' healthy fats and protein with the natural sugars, fiber, and various nutrients in dates can provide a good mix of energy, nutrients, and satiety.

Certain dietary approaches or the inclusion of specific nutrients might complement therapies and support overall health for individuals with ASD (Nali et al., 2018). Herbs and vegetables as carrots, ginger, cinnamon, cloves, nutmeg, turmeric, black pepper, basil leaf, sage leaf, oregano, rosemary, mint leaf, thyme, lavender flower/buds, and chamomile flower buds possess essential nutrients



which provide the required nutrients in diets for individuals with ASD. For example, carrots (*Daucus carota*), ginger (*Zingiber officinale*), and cinnamon (*Cinnamomum verum*) are nutritious foods that offer various health benefits. They do contain nutrients that can contribute to overall health and well-being.

More so, cloves, nutmeg, turmeric, black pepper, basil leaf, sage leaf, oregano, rosemary, mint leaf, thyme, lavender flower/buds and chamomile flower buds carries their own array of potential health benefits, often due to their unique compounds, antioxidants, and essential oils. These herbs and spices are often used in culinary dishes and traditional medicine for their potential health benefits, but it is important to note that individual responses can vary, and they are not substitutes for medical treatments (Akoma et al., 2016). Yet they provide essential nutrients together with some necessary proteins for autistic children's growth and development such as chicken breast, beef, shell fish and crayfish.

Each of these protein sources has its own nutritional advantages. Chicken breast and shellfish tend to be lower in calories and fat, while beef, depending on the cut, might have higher fat content. All of them provide essential nutrients like protein, vitamins, and minerals necessary for various bodily functions. These food crops offer diversity and nutritional benefits in gluten-free diets. They can be used in various culinary applications, providing alternatives for individuals who need to avoid gluten-containing grains like wheat, barley, and rye. However, as with any dietary considerations, it is essential to check the nutritional values which helps to determine the nutrient-density of diets. This is also followed up with an organoleptic assessment which determines the acceptability of the new diets by the target population such as the children or their parents and caregivers.

Methodology

This study adopted the Research and Development (R and D) and qualitative designs. R and D includes activities to innovate and introduce new products to specific consumers. It is often the first stage in the development process. Research and Development study usually involves a number of phases which are generally called R and D cycle. Research and Development design was chosen for this study because the study involved recipe and diets development.

However, the study was carried in Port Harcourt which is the largest zone in the state. The area has three autism centers namely – Our Lady of Guadalupe (OLG) Health Foundation/Autism Center (8, Faith Avenue, Woji, PortHacourt); Blazing Heart Autism Center (31c, Ohiamini Close, Behind Hospital Road, Rukpakulosi Town, Port Hacourt); and, and Otana Inclusive Center (Alakahia, East/West Road, Before UPTH junction Port Hacourt). The availability of these centers and the number of autistic children culminated in the choice of the area for the study. The population for the study comprised 38 subjects in three categories. Ten (10) autistic children (6 males and 4 females) undergoing management processes in three autism centers in Port Harcourt,



Rivers State (Autism Centers Records, 2023). Eighteen (18) caregivers in the three autism centers under study. Ten (10) parents (8 mothers and 2 fathers) of the children in the autism centers in Port Harcourt. The sample for the study was 38 respondents and participants which are distributed into three categories. In the first category, all the 10 autistic children in the centers. Hence there was no sampling. In the second category, all the 10 parents of the autistic children in the centers. The minimal size of this population informed the non-sampling. In the third category, all the 18 caregivers in the centers were utilized for the study, indicating non-sampling.

The instruments for data collection included the 9-point hedonic scale used to conduct the sensory evaluation, a questionnaire form, and a Discussion Guide. The 9-point hedonic scale was used to collect data for the sensory evaluation and the criteria will be in terms of flavour, tastes, colour, texture and general acceptability. It is a standard measure for sensory attributes designed on a 9-point scale. In the hedonic scale method, the stimuli (actual samples or food names) are presented singly and are rated on a scale where the 9 categories range from "dislike extremely" to "like extremely."

Two sets of questionnaires were developed for the study. The first was a 4-point rating scale questionnaire titled 'Autism and Feeding in Children Questionnaire' (AFCQ) was used to collect data for research questions 1 and 2 which dwelt on the nutritional challenges faced by parents for autistic children and the appropriate foods suitable for autistic children. The second questionnaire was a 4-point rating scale questionnaire titled 'Efficacy of the Gluten – casein-free Diets on Nutrition'. These questionnaires were divided into two sections for parents (Section A) and for caregivers. They were designed on a 4-point rating scale of Strongly Agree (SA); Agree (A); Disagree (D) and Strongly Disagree (SD) with scores 4,3,2,1 respectively. The second questionnaire was designed to solicit information from the caregivers and parents on the effectiveness of the five (5) gluten and casein-free diets after the administration of the diets and close observations on the nutritional wellbeing of selected autistic children.

A crucible was dried at 550°C for 30 min and cooled down in a desiccator for 1 h. The weight of crucible was measured (M1). Five grams of powdered sample was added in the dried crucible and the crucible containing sample was measured (M2). Then the sample was burned by using Bunsen burner until the steam of and then in oven at 550°C for 5 h. Ash is an inorganic residue remaining after the material has been completely burnt. The crucible containing ash was cooled in a desiccator and then re-weighted (M3) (AOAC, 2019). The % of ash contents in the cocoyam sample was calculated as:

$$\text{Ash (\%)} = \frac{M3 - M1}{M2 - M1} \times 100.$$



Determination of Total Carbohydrate: Total carbohydrate content was calculated adding the total values of crude protein, crude fat, crude fiber and total ash contents of the sample and subtracting it from 100%.

$$\begin{aligned} \text{Total carbohydrate (\%)} = & \frac{100 - \% (\text{Crude fiber} \\ & + \% \text{Crude protein} \\ & + \% \text{Crude fat} + \% \text{Ash})}{\phantom{100 - \% (\text{Crude fiber}}} \end{aligned}$$

Determination of Energy Value: Gross energy value (kcal/100 g) of the samples was determined by multiplying the protein content by 4, carbohydrate content by 4 and fat content by 9 (AOAC, 2005).

$$\begin{aligned} \text{Energy value} = & (\text{Crude protein} \times 4) \\ & + (\text{Total carbohydrate} \times 4) \\ & + \frac{(\text{Crude fat} \times 9)}{\phantom{(\text{Crude fat} \times 9)}} \end{aligned}$$

Determination of Vitamins and Mineral Contents: Vitamin D, B6, B12, Omega 3 fatty acids, Iron, Zinc, Magnesium, and Calcium were determined according to the standard method of AOAC (2019) using an Atomic Absorption Spectrophotometer (Varian SAA-20 Plus). Ashing of the samples was followed by digestion and absorption. Phosphorus was determined by AAS method of AOAC.

Data Presentation and Analysis

Research Question 2: Proximate values of five (5) gluten and casein-free diets for children with autism in Rivers State?

Table 1: Proximate values of five (5) formulated gluten and casein-free diets for children with autism in Rivers State

	Moisture	Protein	Fat	Crude Fibre	Ash	Carbohydrate	Gross
Energy	(%)	(%)	(%)	(%)	(%)	(%)	(kcal/100g)
PBP	32.63±0.12 ^c	7.64±0.39 ^a	17.31±0.13 ^b	18.23±0.02 ^a	4.20±0.04 ^a	19.99±0.21 ^a	228.41±0.21 ^c



SPRB	35.39±0.07 ^d 244.20±0.11 ^b	2.72±0.93 ^b	20.56±0.22 ^a	19.26±0.12 ^a	2.49±0.02 ^b	19.54±0.13 ^a	
SPBP	70.11±0.12 ^c 0.21 ^a	2.87±0.39 ^b	4.35±0.13 ^c	8.81±0.02 ^b	2.29±0.04 ^b	11.56±0.21 ^b	258.41±
LRCB	74.14±0.02 ^b 221.51±0.02 ^d	1.44±0.03 ^c	2.96±0.07 ^d	7.47±0.08 ^b	0.61±0.12 ^c	13.37±0.04 ^c	
CCGD	89.72±0.24 ^a 149.20±0.14 ^e	0.65±0.11 ^d	0.81±0.02 ^e	NIL	0.33±0.05 ^c	8.49±0.02 ^d	

Values are mean ± SD of quadruplicate results. Letters in superscript on the same column indicate the statistical differences among the samples

Legend

1. PBP – Plantain Broth Pancake (Fresh unripe plantain, ripe plantain, Chicken bone broth, eggs, chia seeds, chicken seasoning, spice herbs, coconut oil)
2. SPRB – Sweet Potato Roll Bite (Sweet potato, eggs, almond, chicken broth, chia seeds, coconut oil)
3. SPBP – Sweet Potato Broth Pottage (sweet potato, beef bone broth, carrot, spinach, prawn seasoning, spice blends, palm oil)
4. LRCB – Lavender Rice Cereal Blend (Unrefined raw rice, walnut, flax seed, coconut, date fruit, ginger, cloves, lavender)
5. CCGD – Chamomile-Carotene Grain Drink (Guinea corn, guinea corn, millet, chamomile, carrot, potato, date fruit, ginger, gloves, almond nut, spouted whole rice)

Table 2 shows the proximate values of five (5) gluten and casein-free diets developed for children with autism in Rivers State. The table shows that the moisture values of the diets ranged from 32.63% in the Plantain Broth Pancake (PBP) to 89.72% in the Chamomile-Carotene Grain Drink (CCGD), while the protein values ranged from 0.65% in the CCGD to 7.64% in the PBP. The fat values of the diet samples indicated that the CCGD had the least value of 0.81% while the Sweet Potato Roll Bite (SPRB) had the highest value of 20.56%. The crude fibre values ranged from 7.47% in the Lavender Rice Cereal Blend (LRCB) to 19.26% in the SPRB sample, while CCGD had no crude fibre value. The table also showed that the ash values ranged from 0.33% in the CCGD sample to 4.20% in the PBP sample. The table also shows that the carbohydrate values of



the samples ranged from 8.49% in the CCGD sample to 19.99% in the PBP sample, while the gross energy values ranged from 149.20kcal/100g in the CCGD to 258.41kcal/100g in the SPRB.

Test of Hypothesis

There is no significant difference in the mean responses of caregivers and parents on the nutritional challenges faced by parents for autistic children in Rivers State.

Table 2 T-test analysis of the mean responses of caregivers and parents on the nutritional challenges faced by parents for autistic children in Rivers State

Group	N	$\bar{X}$	SD	P-value	DF	t-Cal	t-Tab	Decision
Caregivers	18	3.33	0.87	0.03	26	1.34	1.52	Accepted
Parents	10	2.95	0.75					

Table 4.9 shows the T-test analysis of the mean responses of caregivers and parents on the nutritional challenges faced by parents for autistic children in Rivers State. The t-test analysis indicates that the t-tab (table value of 1.52) is greater than t-calculated value (t-cal) of 1.34 ($1.52 > 1.34$) at 0.08 level of significance, and at 278 degree of freedom (df). The implication of this finding is that there is no significant difference in the mean scores of the caregivers and parents on the nutritional challenges faced by parents for autistic children in Rivers State.

Summary, Conclusion and Recommendations

This chapter presents the summary, conclusion and recommendations. The chapter was organized under the following sub-headings: restatement of the problem, summary of procedures used, summary of major findings, implications of the findings of the study, conclusion, recommendations and suggestion for further studies.

Restatement of the Problem

Autism imposes serious nutritional challenges such as heightened sensory sensitivities on children consequently interferes with their nutritional status. These sensitivities create nutritional problems for these children and their families coupled with major symptoms such as tantrums throwing, tip-toeing, hand-flapping, meltdown, lack of coordination, lack of eye contact, screaming, and picky food habits. These children exhibit selective eating habits, preferring a narrow range of foods and resisting new or unfamiliar items, thereby depriving themselves of essential nutrients. Common deficiencies include those in vitamin D, calcium, iron, and omega-3 fatty acids, which are vital for bone health, energy levels, and cognitive function. Some autistic children i experience



gastrointestinal problems, such as constipation or diarrhea, which can affect their eating habits and nutrient absorption. Addressing and managing these gastrointestinal issues is essential for promoting a healthy diet through diets from local crops which remain underutilized. Hence, need to adopt interventions which are aimed at improving their nutritional wellbeing. Interventions in helping children with autism spectrum disorder have focused on medical strategies. Meanwhile research on the utilization of gluten – casein-free foodstuffs in promoting nutrition among these children remain scanty.

This study developed gluten-free and casein-free diets for the management of nutritional challenges of children with autism in Rivers State. To achieve this, the study determined the nutritional challenges faced by parents for autistic children; prepared five (5) gluten and casein-free diets for children with autism; determined the proximate, anti-nutrient, mineral, vitamin, organoleptic characteristics, and the efficacy of the five (5) gluten and casein-free diets on symptoms of nutrition problems with autistic children.

Summary of Procedures Used

This study adopted the Research and Development (R and D) and qualitative research designs. The ten phases of the R and D were modified into six in this study. The population for the study comprised of 38 subjects (10 autistic children (6 males and 4 females) undergoing management processes in three autism centers in Port Harcourt, Rivers State, 18 caregivers in the three autism centers under study, and 10 parents (8 mothers and 2 fathers) of the children. The sample for the study was 38 participants: 10 autistic children, 10 parents of the autistic children and 18 caregivers in the centers.

Summary of Major Findings

The following are the major findings of the study.

- i. The nutritional challenges faced by parents of children with autism included: selective eating behaviours, nutritional deficiencies for child, many autistic children experience gastrointestinal problems, higher prevalence of food allergies, refusal to try new foods, mealtime behaviours can be challenging, nutritionally restrictive diets if not well-balanced, complicating mealtime planning
- ii. The moisture values of the diets ranged from 32.63% in the Plantain Broth Pancake (PBP) to 89.72% in the Chamomile-Carotene Grain Drink (CCGD); protein values ranged from 0.65% in the CCGD to 7.64% in the PBP.
- iii. CCGD had low protein content



- iv. the CCGD had the least value of 0.81% while the Sweet Potato Roll Bite (SPRB) had the highest value of 20.56% for fat;

Conclusion

Autism remains a major impediment to children's development. This is because the diets showed promise in managing secondary symptoms like digestive issues, sleep disturbances, and anxiety, their effectiveness in addressing autism-specific behaviors remained unclear. This reflects a broader consensus in the literature that while dietary interventions can be beneficial for co-occurring conditions, further research is needed to confirm their role in managing autism itself. The lack of widespread availability of these resources can limit the potential benefits of dietary interventions for families dealing with autism.

Recommendations

Based on the findings of the study, the following recommendations were made:.

- i. There is need for more research into the long-term effects of these therapeutic diets, particularly their impact on core autism symptoms to sharpen healthcare for the future innovation.
- ii. There is need for more resources and support in implementing these diets, including meal planning, access to affordable ingredients, and educational programs for parents and caregivers prepare child health for entrepreneurship.

Contribution to Scholarship

This is the outlays;

1. New paradigm for special needs innovation
2. New dimension for healthcare harmony with entrepreneurship

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