DIETARY HABITS AND NUTRITION STATUS OF CHILDREN 5-12 YEARS WITH AUTISM AT CITY PRIMARY SCHOOL NAIROBI COUNTY, KENYA

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A research thesis submitted to School of Public Health, Biomedical Sciences and Technology in partial fulfillment for the requirements of the award of a Master's of Science Degree in Public Health Nutrition of Masinde Muliro University of Science and Technology

NOVEMBER,2024

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DECLARATION

This research thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

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The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro University of Science and Technology thesis entitled **Dietary Habits and Nutrition Status of Children 5-12 years with Autism at City Primary School Nairobi.**

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ABSTRACT

The complex neurodevelopmental disease known as Autism Spectrum Disorder (ASD) is mostly linked to food refusal, a restricted food repertoire, and excessive single-meal intake in ASD children. Children with ASD are frequently described by their parents and caregivers as fussy, limited, troublesome eaters who also frequently have gastrointestinal issues which compromises their nutritional state. The current study aimed at determining the dietary habits and nutrition status of children with Autism aged 5-12 years at City Primary School in Nairobi County, Kenya. The specific objectives were; to assess the dietary habits, to assess the nutrition status and to determine the relationship between dietary habits and nutrition status of children with Autism aged 5-12 years attending City Primary School, Nairobi. A cross-sectional study was conducted at City Primary School among 44 ASD children with their caregivers/parents as respondents. Data was collected using a self-administered semi-structured questionnaire. A 24-hour recall was used to collect and assess data on food consumption, dietary diversity score and food variety score. The nutrition status was determined using BMI-for-age scores and Mid Upper Arm Circumference (MUAC), categorized according to the WHO cut-offs. Nutrient deficiency was collected through clinical signs and symptoms checklist. Statistical Package for Social Sciences (SPSS) software version 26 was used in the entry and analysis of the data. Sociodemographic characteristics and dietary habits were analyzed descriptively using frequencies, percentages and means. Pearson's chi-square and Spearman's Correlation were used to determine the relationship between the age of the child, dietary habits, nutrition status and the strength of the relationships between the variables respectively. Out of the 44 children with Autism 33(75%) were male while 11(25%) were female, the mean age was 10.4. Among the food group's fats and oils, grains, grain products, other starches and other vegetables were the most consumed daily (97.7%, 95.5% and 93.2 % respectively). The children had an adequate Dietary Diversity Score (DDS). Food variety scores showed that more than half had fair food variety scores 24(54.5%), 8(18.2%) good and 10(22.7%) very good. The majority of children showed disruptive behaviors during mealtimes (77.3%), 90.9% of the caregivers indicated that they prepared special meals for children with Autism. The mean height and weight were 140.8cm and 35.3 kg. According to BMI -for-Age Z-Scores, less than half (n=18, 40.9%) of the children were normal, 29.7% (n=13) were moderately malnourished, 22.7% (n=10) were overweight and 6.8% (n=3) were severely malnourished. There was no significant association between nutrition status and age in children with Autism, x^2(1, n=44) =1.337, with a p-value of 0.720. However, there was a significant relationship between picky eating and nutrition status x^2(3, n=44) =8.255 with a p-value of 0.041. IIn conclusion, picky eating behaviors significantly influence the dietary habits and nutritional status of children with autism, increasing the risk of malnutrition. Addressing these challenges requires specialized training for healthcare providers and teachers to manage feeding difficulties effectively. Additionally, further research with larger sample sizes is necessary to better understand the relationship between food preferences and nutritional status among children with Autism in Kenya and globally.

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DEFINITION OF OPERATIONAL TERMS

Attitude: A mix of emotion, beliefs and behaviors that guides an individual's thoughts, feelings and actions towards food choices and nutritional activities and events.

Autism: It is a disorder in brain development that is manifest with challenges in social interaction, communication, and confined and repetitive behavior.

BMI for Age: An index for determining how healthy a child aged 5-19 years of age.

Caregiver: A parent or guardian consistently taking care and full responsibility for a child

Dietary Diversity Score: This indicator determined nutrient adequacy in different food groups.

Dietary habits: These are eating preferences, food consumption patterns, and frequency of intake.

Dietary practices: The habits and choices that children with autism make about what, when, and how they eat.

Food Variety Score: This is an indicator that was used to identify nutrient adequacy among ASD children based on individual foods from different food groups.

Lifestyle: Way of life or level of living that is typically chosen for survival or amusement, or imposed by the environment, economics, or religion.

Malnutrition: Malnutrition is any physical condition resulting either from an excess or inadequate nutrients in diet resulting in over or undernutrition.

Nutrient Adequacy: The level of intake of an essential nutrient in relation to the WHO/UNICEF recommended daily intake.

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Nutrition Knowledge: The proven ability to recall nutrition-related information and principles related to a person's general health from memory.

Nutrition status: The conditions of the body as a result of intake, absorption and utilization of nutrients to maintain optimal health status.

Obesity: Excessive amount of body fat in the body which is well-defined by a BMI equivalent to or more than 30 kg/m^2 and a BMI for age Z-score of more than +1 for children.

Overweight: Weight over the permitted limit as determined by height, it is defined by a BMI for age of +1 or higher.

Undernutrition: Was defined by a child's BMI for age of -3 or less and they are not getting enough of the essential nutrients from diet.

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LIST OF ABBREVIATIONS

AD: Autistic Disorder

ASD: Autism Spectrum Disorders

ASK: Autism Society of Kenya

BMI: Body Mass Index

CDC: Centers for Disease Control and prevention

CNS: Central Nervous System

DRI: Dietary Reference Intake

FFQ: Food Frequency Questionnaire

GFCF: Gluten Free Casein Free

GI: Gastrointestinal

IMAGE: Autism Integrated Metabolic and Genomic Endeavor

KES: Kenya Shillings

MMUST: Masinde Muliro University of Science and Technology

MOH: Ministry of Health

SPSS: Statistical Package for Social Science

UNICEF: United Nations Children's Fund

WHO: World Health Organization

X^2: Chi-Square

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CHAPTER ONE: INTRODUCTION

1.1 Background information

Autism spectrum disorder (ASD) is a general phrase that defines a range of developmental diseases, including Asperger syndrome, childhood disintegrative disorder, and autism (WHO, 2019). Among the primary psychological symptoms are a limited repetitive range of interests and activities and a variable combination of impaired capacity for reciprocal socio-communicative involvement (WHO, 2019). Additional symptoms of ASD include intestinal metabolic conditions that impact nutrition and eating patterns such as dietary hypersensitivity, the dread of trying new foods (Neophobia) and firmly established preferences for particular meals and outright rejection of other food's flavors and textures (Id *et al*., 2022).

In most cases, ASD manifests itself within the first 5 years of age. The disorder begins early in infancy and then persists into adolescence and adulthood (WHO, 2019). Therefore, early diagnosis of ASDs and other developmental disorders poses a great challenge especially for children below 5 years (WHO, 2019). Since the 1970s, the prevalence of autism has significantly risen (Sun, Xia, Zhao, Li1, et al., 2013). Approximately 1 out of 100 children are diagnosed as having ASD around the world (WHO, 2023).

Estimates indicate that the prevalence of ASD in Asia is about 0.4%, America 1%, Europe 0.5%, Africa 1%, and Australia 1.7% (WHO, 2023). Official data on Autism in Kenya are not available however the Autism Society of Kenya (ASK) established in 2022 that it could be about 4% of Kenyans are thought to be affected by autism; more than 500 youngsters in the Nairobi region alone have been evaluated and determined to be autistic (ASK, 2013). ASDs are approximately five times more frequent in boys than in girls (Dworzynski *et al*., 2012).

According to (CDC, 2021), ASD is one of the most prevalent developmental illnesses worldwide, autism is thought to affect more children than pediatric cancer, diabetes, and AIDS combined. Additionally, the World Health Organization and the United Nations have identified it as a global public health risk (WHO, 2013). Consequently, despite a noticeable

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rise in the frequency of autism in recent years there is limited knowledge about the screening and diagnosis, effectiveness, and therapy for autism in Africa and Kenya. As a result, although the precise origin of autism remains unknown, hypotheses and empirical data suggest a potential interaction between genetic, prenatal and postnatal aspects regarding a child's development (Almsmary *et al*., 2022).

The majority of ASD field research has mostly concentrated on assessing its causative agents; with minimal attention on children with Autism dietary habits and nutritional status (Katelynn, 2017). The parents and caregivers of many children with Autism lament their child's unpredictable health and unpredictable eating patterns. Numerous studies that demonstrated children with Autism are more likely than typical children to become malnourished lend credence to the allegations (Alotaibi, 2017, Salari *et al*., 2022).

In addition, these children also have gastrointestinal (GI) symptoms that are highly prevalent, such as frequent diarrhea and constipation which greatly affects their nutritional status (Abdelrahim *et al*., 2017) due to changes in dietary intake both in quantity and quality. However, an expanding body of research has shown a high intake of calorie-rich foods and insufficient fruit and vegetable intake among children with autism versus to their neurotypical peers which would help explain the high rates of obesity that have been observed among these children (Raspini *et al*., 2021).

The unusual eating habits which may be a result of oral sensory sensitivity highly affect their dietary patterns, and food preferences and lead to food stigma. As a result, such eating habits generally aggravate their imbalanced nutritional status, resulting from either over or under-nourishment (Islam *et al*., 2020). However, research on the prevalence of malnutrition status among children with Autism is inconsistent with some studies showing high cases of overweight and obesity while some indicating severe wasting among these children (Islam et al., 2020; Nur Hamiza Ruzaini *et al*., 2017; Sun, Xia, Zhao, Li1, *et al*., 2013).

Nur Hamiza Ruzaini *et al*., (2017), indicated a higher prevalence of obesity among children with Autism which tends to increase with age. These findings are similar to studies by Ranjan and Nguyen who found that children with Autism exhibited high rates of obesity

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and overweight (Nguyen *et al.*, 2022; Ranjan & Nasser, 2015). Cases of underweight and wasting were found to be moderate as compared to typically growing children of their ages (Nguyen et al., 2022). High incidences of overweight and obesity reported by several researchers are attributed to the binge eating nature of most children with Autism (Kittana *et al.*, 2023).

The nutrition status of an autistic patient is crucial because it can avoid the development of gastrointestinal problems, which could exacerbate the illness and make it more difficult to treat (Mona, 2021). Though, Diet alone cannot manage autistic symptoms, diet and or nutrient therapy is a vital element of the Autism care plan (Hafid & Touhamiahami, 2018). Due to the fact that people with ASD disorders frequently display repetitive interests, which can lead negative impact on an individual's general health, diet and nutrition therapy are crucial for autistic patients, especially children (Ismail et al., 2020).

Changing to a healthy eating plan is crucial to reducing the intensity of symptoms associated with ASD. Evaluating the dietary health of children with autism facilitates the implementation of suitable dietary modifications to address any metabolic imbalances or deficiencies (Alotaibi, 2017). Furthermore, past and present research highlights that it is important to address gaps in nutrition for children with Autism, through diet therapy administered by a dietitian with individual nutrients or a combination of nutrients (Alotaibi, 2017). This study was intended to evaluate the dietary habits and nutrition status of Kenyan children with autism to understand the overall changes in their nutritional status and food preferences as they age to be able to accurately establish the nutrient deficiencies and inadequacies in dietary diversities and varieties.

1.2 Problem statement

Autism Spectrum Disorder (ASD) begins early in infancy; within the first 5 years of life then persists into adolescence and adulthood (WHO, 2019). ASD children have dietary behaviors that hinder adequate intake of food and nutrients which puts them at risk of developing malnutrition. They are finicky eaters, gag on non-food items, avoid new foods, strict on intake of certain foods due to texture, and struggle with gaggling, and have

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difficulty eating in regular hotels or schools, resist sitting at the table and throwing food (Mona, 2021).

Therefore, children with ASD tend to take less or more than the recommended amount of food and or nutrients than their peers due to their peculiar eating habits. Their selective eating habits endanger both the range and variety of their diet and thus their nutritional health. Hence, they are forced to eat just particular meals with particular tastes, textures, or food kinds leading to restricted diets. These unpredictable, unregulated, and unusual eating habits put these children at greater danger of infections, nutrient deficiencies and illness including death.

Additionally, they frequently experience gastrointestinal (GI) issues such as constipation and diarrhea, which generally worsen their nutrition status. As a result, ASDs parents adopt the gluten-free and casein-free (GFCF) diet as an additional form of treatment (Ismail et al., 2020). The idea of gluten sensitivity among children with autism was first introduced in 1979 (Erickson et al., 2005). However, a gluten-free diet has been found to lack adequate amounts of iron, zinc, B vitamins, and folate. Dairy free diet is deficient in Calcium Vitamin B2 and protein (Ismail et al., 2020). Thus, the need for nutritional intervention in ASD children has received a lot of attention, but little attention has been paid to studying or highlighting the food patterns and nutrition status of these children.

1.3 Research Objectives

1.3.1 Broad Objective

To assess the dietary habits and nutrition status of children between 5-12 years with Autism attending City Primary School, Nairobi County, Kenya

1.3.2 Specific objectives

The specific objectives of the study were;

1. To establish the dietary habits of children 5-12 years with autism attending City Primary School, Nairobi County, Kenya

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2. To assess the nutrition status of children 5-12 years with autism attending City Primary School, Nairobi County, Kenya
3. To determine the correlation between dietary habits and nutrition status of children with autism attending City Primary School, Nairobi County, Kenya

1.4 Research Questions

1. What are the dietary habits of children with autism attending City Primary School, Nairobi County, Kenya?
2. What is the nutrition status of children 5-12 years with autism attending City Primary School, Nairobi County, Kenya?
3. What is the correlation between dietary habits and nutrition status of children with autism attending City Primary School, Nairobi County, Kenya?

1.5 Justification of the study

In Kenya, there is limited data on dietary practices and nutrition status of children with autism. ASD children possess a very unique behavior with varied eating disorders such as picky eating, fussy eaters, gagging on food and even completely avoiding certain foods due to intolerance and GI problems. These behaviors result in poor dietary habits that lead to poor nutrition status among this population. they may either overeat on some foods and nutrients and under-eat on some leading to nutrient imbalances which may lead to either overweight and obesity or undernutrition to some. there are very few studies that have been conducted among this group addressing their eating behavior and nutrition status.

This research was crucial as it provided insights about the poor eating behaviors of ASD children and their nutrition status at large. It also provides healthcare professionals, community leaders, caregivers to understand dietary patterns and the nutrient needs of different children with Autism. Therefore, research on this population is highly essential and may ultimately allow the development of programs to combat malnutrition among children with Autism and educate the population on proper dietary practices among ASD children.

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1.6 Significance of the study

The findings of this study will broaden the understanding of autism and diet among the general population. Numerous organizations and people including the Ministry of Health, stakeholders and policy makers, non-governmental organizations, health professionals, dietary counselors and communities with children with Autism will make use of this material to improve the lives of children with Autism.

This paper will also help in planning intervention programs and influencing the creation of policies that impact communities positively. Consequently, it would help fulfill the third Sustainable Development Goal (SDG), which encourages good health and wellbeing, as well as the successful counseling of mothers or other caregivers of children with Autism. One approach to get the word out to the community is for the moms or caregivers to put what they have learned in counseling into practice at home.

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1.7 Conceptual Framework

The conceptual framework is based on the understanding of the factors that contribute to inadequate nutrition in children with Autism and provides conceptual clarity on the enabling, underlying and immediate determinants of Malnutrition, their interconnectedness to the nutrition status of these children. Figure 1.1 presents the conceptual framework.

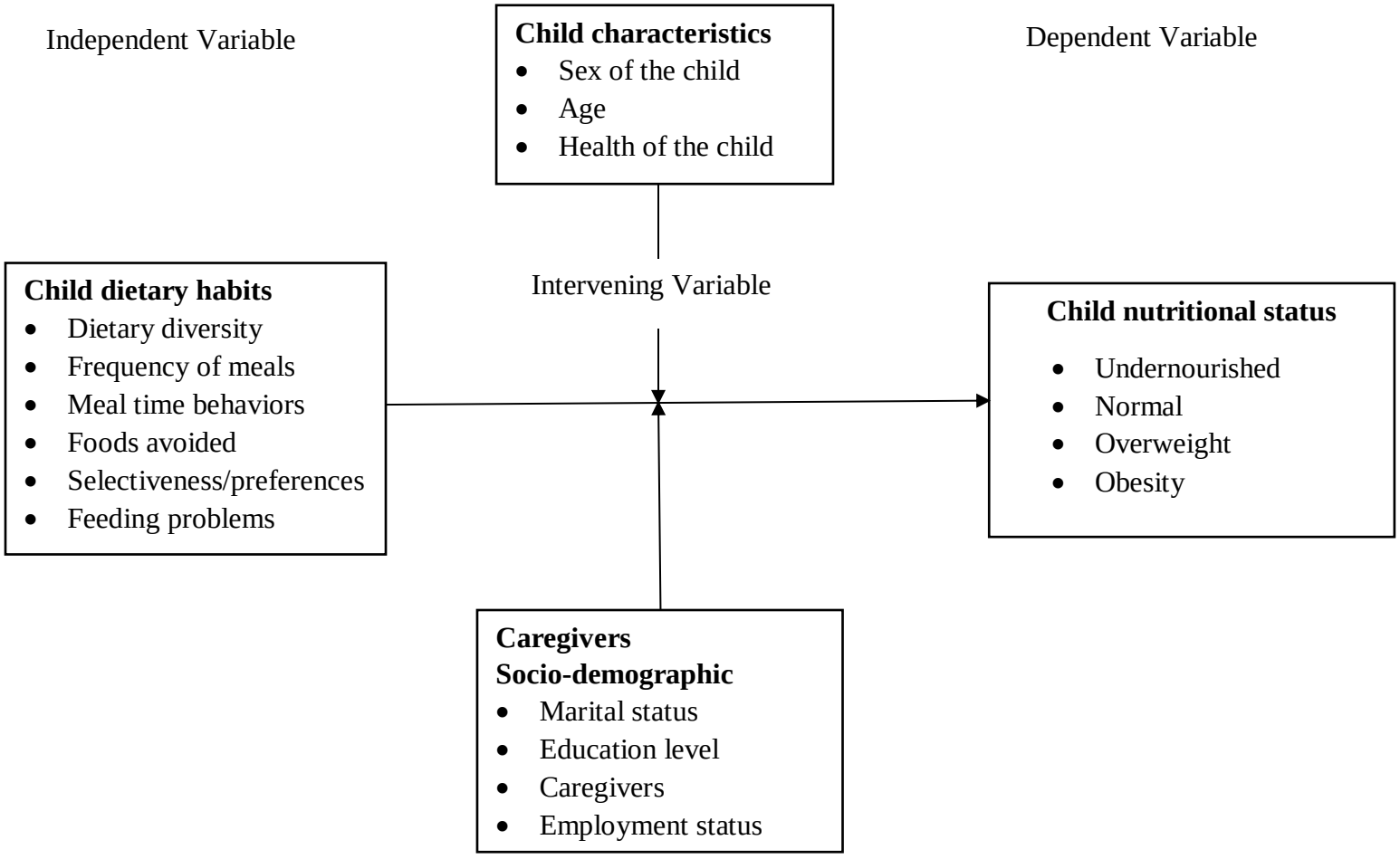

Figure 1:1: *Conceptual Framework on the link between dietary habits and nutrition status of children with Autism. Adopted from UNICEF Conceptual Framework of Maternal and Child Nutrition (UNICEF, 2021).*

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CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents literature on the background information of autism spectrum disorder, the socio-demographic characteristics of children with Autism, autism and dietary habits, nutrition status and the relationship between dietary habits and nutrition status of children with Autism.

2.1 Background Information on Autism Spectrum Disorder.

The United States Center for Disease Control (CDC, 2021) reports that the neurological condition that causes ASD is a complicated developmental problem that manifests within the first five years of life. It affects normal brain function and hampers the development of social interaction and communication skills. Autism spectrum disorders typically manifest in both verbal and nonverbal communication, social relationships, and play or recreational activities in children and adults

Approximately one in 160 children across the globe has ASD according to the World Health Organization (WHO, 2021). In the United States, 1 in 54 children in the United States has ASD as per (CDC, 2021) data while the United Kingdom National Autistic Society, 2021) show that 1 in 100 people have ASD. In Australia, it is estimated that 1 in 70 people have ASD based on the estimates from the Australian Bureau of Statistics (ABS, 2017). Approximately one in sixty-six children have been diagnosed with ASD as per the Government of Canada (GOC report, 2021).

Approximately 1% of the population is affected by ASD, which is highly heritable and persistent throughout life (Mandy & Lai, 2016). One striking and consistent feature of ASD according to the Diagnostic and Statistical Manual (DSMT) of the American Psychiatry Association (APA, 2015) of mental disorders is that it is commonly prevalent in males than females.

Experts now refer to the signs of autism as a “triad of deficits” which include challenges with social interaction, communication skills and social comprehension. This noted

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differences in numbers of ASD cases in different Countries may be due to variations in the diagnostic criteria used by these organizations, or differences in how data is collected and analyzed. Additionally, the reported rates of ASD may also be affected by cultural and social factors, as different cultures may have different understandings of autism and may have varying levels of awareness about the condition. This makes it difficult to diagnose or categorize it.

Despite these variations, there is a growing awareness and understanding of autism worldwide. More research is being conducted on the causes and treatments of autism, and there is a growing movement to increase awareness and support for individuals with autism and their family members. By continuing to gather and analyze global statistics on ASD, we can gain a better understanding of this complex condition and work towards better supporting people with autism and improving their quality of life. However, there is inadequate research on how diet impacts the health of ASD children or rather its development.

About 1-2% of the African population is estimated to be affected by ASD, which is similar to global estimates (Fombonne, 2003). However, according to certain research, the prevalence may be higher in certain African countries. A systematic review conducted by (Wannenburg & van Niekerk, 2018) identified 26 studies on ASD in Africa, with the majority of studies reporting prevalence rates ranging from 0.5% to 2%. However, a few studies reported higher prevalence rates, such as 2.7% in Ethiopia and 3.8% in South Africa. However, the real estimates in Africa are believed to be still a mystery since the majority of children with Autism are hidden away from home and often remain undiagnosed (Owalabi Bakari *et al*., 2009). This is attributed to lack of awareness amongst caregivers of these children.

The gap in knowledge and comprehension of ASD in many African nations makes it hard to estimate its prevalence on the continent, this can lead to under-diagnosis and misdiagnosis (Owalabi Bakari *et al*., 2009). Additionally, there is a shortage of trained professionals and tools for diagnosing ASD in many African countries (Franz et al., 2017). Despite these obstacles,further research is needed to enhance the diagnosis and management options for children with ASD in this region as well as to gain insight into the prevalence, causes, and traits of ASD in Africa

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The 2013 estimate from the Autism Society of Kenya suggested that around 800,000 people (about 4% of the population) were affected by autism. However, recent studies reveal more refined insights. A population-based survey in 2022 found that 0.98% of Kenyan youth exhibited high autistic traits, comparable to rates found globally. Additionally, 14.9% of the youth showed borderline autistic traits, indicating that while autism awareness is growing, precise statistics on autism prevalence remain elusive in Kenya and Africa overall.

These findings highlight the need for further studies to comprehend autism's prevalence and characteristics within diverse cultural contexts and to guide healthcare policies effectively. There is also an ongoing effort by organizations like Autism Awareness Kenya to bridge gaps in knowledge and provide more effective support systems for children and families with autism in Kenya.

2.2 Social demographic characteristics among children with Autism

ASD affects individuals from all racial, ethnic, and socioeconomic backgrounds. Nonetheless, certain socio demographic traits have been connected to a rise in incidence of ASD in various researches. A subsequent study found that autism was more prevalent in boys than in girls, with a high prevalence of 2.8% in boys and 0.65% in girls, and a boy-to-girl ratio of 4.3:1. (Elsabbagh *et al*., 2012; Roman-urrestarazu *et al*., 2022). In addition, boys are five times as likely than girls to have an ASD during diagnosis. (CDC, 2012). The higher prevalence of autism spectrum disorder (ASD) in boys compared to girls has been widely documented, with studies consistently showing a male-to-female ratio of approximately 4:1 (Elsabbagh et al., 2012; Roman-Urrestarazu et al., 2022). One explanation for this disparity lies in biological and genetic factors, such as differences in brain structure and function between males and females. Researchers suggest that boys may be more vulnerable to neurodevelopmental conditions due to variations in sex-linked genetic expressions, such as those involving the X chromosome (Fombonne, 2009). Another hypothesis is that girls may exhibit a "protective effect," requiring a higher burden of genetic mutations or environmental stressors to develop ASD (Lai et al., 2015). Additionally, diagnostic biases may play a role, as girls with ASD often present with more

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subtle symptoms or develop stronger compensatory behaviors, making their condition harder to identify (Loomes, Hull, & Mandy, 2017). Consequently, boys are five times more likely than girls to be diagnosed with ASD, as reported by the CDC (2012).T

Additionally, there are regional differences in the prevalence of ASD, with North America and Europe reporting greater rates than other regions (Wang et al., 2019). A School census among 7 million pupils in the United Kingdom (UK) showed that 119,821 pupils were diagnosed with autism spectrum disorder (ASD) out of which 18.1% had learning difficulties. The results also suggested a racial component to the vulnerability to ASD, with black and Chinese students having corresponding higher rates of 26 and 38 percent likely to be autistic, and also had a 60 percent higher likelihood of experiencing severe social disadvantage with black children having the highest prevalence, at 2.1 percent. (Roman-urrestarazu *et al*., 2022). De Vinck-Baroody *et al*., (2015) discovered that children with Autism from lower socioeconomic origins had reduced daily macronutrients intakes (energy, proteins, fats, and carbohydrates) than did children from higher socioeconomic backgrounds.

ASD parents with high income and education level have been shown to be more likely to seek a diagnosis for their child, which may contribute to higher prevalence rates in these populations (Zeidan et al., 2022). The expense of schooling ASD children frequently resulted in lower-quality home meals, which may have led to aberrant growth. (Hodgetts et al., 2015). Parental age and autism are strongly correlated, with mother age being riskier than father's age. (Al-Mamari *et al*., 2021; Lee & Mcgrath, 2015).

The risk of autism increases with maternal age. However, the community's socioeconomic standing influences both the severity of autism and the diet that is consumed. Additional research reveals that the rates of autism have been linked to dietary practices at the community level, to resources available for screening, increased service delivery, the number of pediatricians per school, environmental toxicity, and the percentage of students receiving free lunches at school. (Kim *et al*., 2021; Palmer *et al*., 2006)).

In Kenya, families with children with Autism bear the additional hardship of not knowing the precise origin or prognosis regarding their child's health, which causes caregivers to experience unimaginable levels of stress on a daily basis. According to a study in Kilifi,

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Kenya, parents of children with Autism must deal with mental stress, guilt, financial difficulties, and strained family dynamics (Gona, 2010).

Parents of children with Autism must decide whether to educate their child or not. In many Kenyan communities, parents would prefer to invest in children who are able-bodied than try to pay for therapy for a handicap such as autism (Barasa & Taiswa, 2021). This has been exacerbated by the idea that autism has spiritual causes brought on by enraged ancestral spirits, sinful wrongdoing, primarily by the mother, or the deeds of some malevolent entity (Barasa & Taiswa, 2021).An already challenging home setting is made worse by the widespread belief throughout parts of Africa that children with autism are possessed or cursed (Gona *et al*., 2011). This is the result that communities across Kenya will continue to experience owing to a perceived lack of potential productivity until they have access to appropriate knowledge and reasonably priced solutions (Bakare M. & Munir K., 2011).

In Kenya, parents are frequently counseled to adopt a diet free of gluten and casein in order to address behavioral issues and lessen the traditional signs of autism. This kind of diet can help children with autism who occasionally have irritated digestive systems, however, it is not always a cure for autism. Parents who are recommended to follow this diet frequently have to make significant financial sacrifices because of the cost of specialized milk alternatives and gluten-free items. (Riccio, 2011)

Children from wealthy versus low-income homes, which are mistakenly believed to be associated with families in cities versus those in rural areas, also have substantially unequal access to educational resources to support children with Autism . If a family can afford the costs associated with private, specialized programs, many of which are managed by foreigners living and working in Kenya, where the majority of autism services are only available in urban areas (Nguu, 2018). The majority of these people provide more western therapy alternatives, such as speech and language therapy, applied behavior analysis, behavior therapy, and occupational therapy. They are professionals with qualifications in special education. Although the increase of experts treating autism in Kenya is a positive development, many families still view these services as a luxury and cannot afford the high cost of private care (Whiteley *et al*., 2013).

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It's actually unknown exactly what causes autism. Numerous kids with this illness are kept hidden at home because there aren't many or any schools that can accept them for educational purposes (Riccio, 2011). Over time, Kenya has not provided any educational programs for those with autism. But this all changed in an instant when the City Primary School in Ngara, Nairobi, created an autistic section in September 2003 thanks to a donation of specialty catering supplies from the Safaricom Foundation (Speaks, 2017). Since then, other units in Nairobi have opened at Ruthimitu School, Buruburu, Kasarani, Mathare Special, and Kasarani, but there aren't enough of them, and the ones that are don't encourage autistic students to receive inclusive education.

2.3 Autism and Dietary Habits

There is ongoing research investigating the relationship between autism and dietary habits, particularly in regard to whether specific diets or dietary supplements may improve symptoms or lower the likelihood of being autistic. Several dietary components may contribute to the onset of autism, according to certain research. For instance, there is evidence that a higher chance of autism in offspring has been linked to maternal obesity and diabetes during pregnancy (Xiang *et al*., 2021). Furthermore a different study suggests that the gut microbiota of children with Autism may be unbalanced, and this can be impacted by nutrition (Taniya *et al*., 2022)

This is thought to be the case since feeding difficulties are known to be more common in autistic kids than their normal counterparts. These difficulties could include food refusal and resistance to trying new meals, which have been identified as two of the main difficulties faced by children with Autism (Islam et al., 2020a). Food rejection is more common in children with Autism and can be influenced by color, consistency, fragrance, taste, combinations, and brand. Because of their limited dietary options, these kids don't consume enough nutrients because their diets aren't as diverse and varied (Raspini *et al*., 2021).

Although research on nutritional consumption of children with Autism has shown inconsistent findings (Sun, Xia, Zhao, Li1, *et al*., 2013), most studies indicates that children diagnosed with autism consume fewer nutrients than the recommended daily consumption

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of certain vitamins and minerals (Raspini *et al*., 2021). In comparison to youngsters without autism, they might also choose fewer food categories, endangering their dietary diversity and variety (Seda Senguzel *et al*., 2021). Furthermore, children with Autism may experience indigestion due to a high prevalence of gastrointestinal disorders (Zhu *et al*., 2020).

Different genetic backgrounds, food, and nutrients can interact to produce varied metabolic processes and nutrient utilization levels, even with identical quantities and qualities of food and/or nutrients consumed (Plaza-diaz *et al*., 2021). For example, inadequate dietary iron intakes were considered among the primary reasons for iron insufficiency which is prevalent in children with autism (Sun, Xia, Zhao, Li1, *et al*., 2013). This was highly associated with food selectivity, a behavior commonly seen in children with Autism Consequently, some scientists have looked at the possibility that dietary interventions could help people with autism. For instance, some research suggests that a gluten-free and casein-free (GFCF) diet may help certain people with autistic symptoms (Baspinar and Yardimci, 2020; Saxena *et al*., 2018; Whiteley *et al*., 2012). Other studies, however, did not discover evidence to bolster this assertion; the authors pointed out that additional research is necessary as there is now little proof for the efficacy of GFCF diets (Aponte and Romanczyk, 2016; Buie *et al*., 2010; Puglisi, 2005; Saxena *et al*., 2018b).

Currently, parents/caregivers of children with ASDs are turning to the GFCF diet as a popular additional and alternative therapy option (Baspinar & Yardimci, 2020). In 1978, the idea that children with autism may be gluten sensitive was first presented by Mccarthy (Mccarthy, 1978), thus, according to theories, when autistic youngsters eat GFCF, their autistic tendencies decrease.

According to the leaky gut theory, peptide metabolites of gluten and casein can move through the digestive system and enter the bloodstream and cerebrospinal fluid. These peptides disrupt central nervous system function by acting in the brain like opiates, hence causing autism. Literature indicates a significant improvement in autistic behaviors among those who consumed GFCF diet (Saxena *et al*., 2018; Whiteley *et al*., 2012)

According to the Kenya Ministry of Health, children with autism exhibit the following dietary habits: they prefer dry, crunchy foods; they reject soft, smooth textures; they detest fruits and vegetables; they prefer finger foods; they have a preference for specific brands

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and preparation techniques; and they have a preference for food of a particular color or colors (MOH,2010). There is a higher chance of food selectivity for children. "Eating a few different foods, hesitation to try different dishes, complete avoidance of particular food groups and a strong preference on the way food is prepared and presented" are some characteristics of selective eating."(Williams *et al*., 2011) .

According to other research, children with ASD consume enough calories and macronutrients in their meals, but they may consume too much or too little of specific micronutrients. Despite this, they get enough energy from their diets, which are less diversified than those of a group of children without ASD (Beisser, 2012; Emond *et al*., 2010; Leader *et al*., 2022; Sharp *et al*., 2013). It was shown that children diagnosed with autism had lower-than-recommended daily intakes of calcium, potassium, vitamin E, vitamin D, and fiber. It was shown that children diagnosed with autism had lower-than-recommended daily intakes of calcium, potassium, vitamin E, vitamin D, and fiber (Herndon *et al*., 2009).

The average amount of vitamin D consumed by ASD children was barely 25% of the DRI. Given that vitamin D insufficiency, particularly in early life, may be associated with an increased risk of autism, these low levels may call for additional research. Glutathione levels are raised by vitamin D, enhancing antioxidant capacity. Deficits could therefore affect glutathione metabolism and contribute to the pathophysiology of ASD (Bakare *et al*., 2015). The average amount of dietary fiber consumed was 41% of the DRI. This shows the reason for the high prevalence of constipation among kids with autism (Blankenship *et al*., 2010).

children with Autism are thought to have a high intake of foods rich in some micronutrients. Herndon *et al*., (2009) discovered that levels of consumption of a number of micronutrients, including vitamin A, thiamin, riboflavin, vitamin C, and vitamin B6, were above the DRI. This could be because children with ASD tend to consume more enriched foods and fruit juices. Thus, higher consumption of vitamins B6 and C were observed in this group. (Aponte and Romanczyk, 2016).

Vitamin and mineral intake may appear inadequate in children with autism; some of these minerals include calcium, vitamin A, vitamin K, and vitamin D. However, the consumption of calories and protein seemed to be unaffected among children with Autism. (Canals-Sans

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et al., 2022). Using 3-day diet records, Janik, (2016) found that when compared to children with usual development, children with Autism consumed significantly less calcium and riboflavin and ate less foods from the dairy food group.

Further studies have looked at the potential benefits of omega-3 fatty acids, probiotics, and vitamin D for individuals with ASD. For example, (Mazahery *et al*., 2020) concluded a meta-analysis and comprehensive review of randomized controlled trials and discovered that taking supplements containing omega-3 fatty acids may help with social interaction and hyperactivity, two signs of ASD.

The authors did point out that additional study is required to validate these results. It's crucial to take into account any potential difficulties that people with ASD could have with their eating habits. For instance, certain people with ASD may have selective or restrictive eating patterns, which can result in dietary deficits. Bandini *et al.,* (2010), identified that children with ASD were more likely to have a restricted diet and to consume less fiber and more fat than normally developing children. Nutritional counseling and dietary supplements may be helpful in addressing these issues. Therefore, the study's goal was to determine the dietary practices of children with Autism at City Primary School to enable parents and teachers to take necessary precautions in promoting proper dietary practices among the children with Autism.

2.4 Nutrition concerns of children with Autism

There is a scarcity of worldwide data regarding the state of nutrition in kids with autism, yet several research have found that this population is more likely to experience feeding issues and nutritional deficits. Studies by (Alhammad *et al*., 2020 & Al-Mamari *et al*., 2021) sought to find out how common feeding issues were and how well-nourished children with Autism were. It was discovered that 41.9 percent of children diagnosed with autism had a history of feeding issues, such as selective eating, aversion to specific foods, and refusal of certain foods. Furthermore, according to measures of their body mass index (BMI), 28.4% of the youngsters were discovered to be underweight. The authors concluded that this could be attributed to the feeding problems that are common among children with Autism in Saudi Arabia and recommended early intervention to address these issues.

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Another study conducted in India by Zulkifli *et al*., (2022) evaluated the dietary status of kids with autism and found that 70% of them had at least one nutritional deficiency. The authors suggested that nutritional deficiencies in children with Autism may be due to several factors, including restricted food intake, poor appetite, and gastrointestinal problems.

In the US, a study conducted in 2016 by Aponte and Romanczyk examined the food consumption of kids with autism and kids with usual development. It was discovered that children with Autism had a higher probability of having an unbalanced diet, consisting of more dairy items and sweetened beverages than fruits and vegetables (Aponte and Romanczyk, 2016).

Research has shown that children with Autism may have nutritional issues that could affect their nutritional status. However, there have been differing reports regarding the severity of nutritional deficiencies in this population, with some suggesting that the macronutrient intake of children with Autism was similar compared to kids who have a regular development (Aponte and Romanczyk, 2016; Emond *et al*., 2010). According to reports from other studies, children diagnosed with autism were not achieving the recommended daily intakes (DRIs) of certain nutrients. This may include proteins, calcium, vitamin B12, and vitamin D, when compared to usual controls. A more thorough examination of two subsets of children with Autism, selective and non-selective eaters, demonstrated that there was no discernible difference in nutrient intake of non-selective eaters with autism from that of typical control group. The dietary consumption of selective eaters with autism, however, was not the same as that of the group of autistic people who were not selective eaters or the normally developing controls.

Other studies indicate that children with ASD experienced a greater cumulative incidence of constipation (33.9 percent versus 17.6 percent) than children without ASD (Leader *et al.*, 2022). It has been discovered that PICA exists in children with Autism; which is eating of non-food items, this can make them ingest toxic substances and Ingest substances that interfere with normal digestions and absorption. They also have food cravings of Specific food or have food preparation (Canals-Sans *et al.*, 2022). ASD children tend to experience more GI problems than normal kids. Chandler *et al*., (2013) compared the GI symptoms of children with Autism to those with special education requirements and kids with average

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development. The findings revealed that, children with ASD showed considerably greater incidence of gastrointestinal symptoms, such as diarrhea and constipation than averagely developing kids.

The study by Chandler et al. (2013) verified that children with Autism parents said that their kids only had bowel movements three times a week. The study found that parents of children with ASD experienced stomach pain more frequently than parents of children who needed special schooling. Compared to children who are usually developing, children with ASD also reported more episodes of vomiting and diarrhea (Baspinar & Yardimci, 2020). Children with more severe autism frequently exhibit more severe gastrointestinal issues. ASD children might not be able to express their discomfort since GI issues might cause it, which can result in self-harm and violent outbursts. This leads to so many nutritional deficiencies such as micronutrient deficiency, underweight or overweight issues among children.

According to the Kenyan Ministry of Health MOH (2010), children diagnosed with autism have multiple nutritional concerns, including vitamin and mineral deficiencies, digestive issues (reflux, constipation, diarrhea), and symptoms like vomiting and diarrhea that lead to the body losing nutrients, fluids, and electrolytes. Additionally, a high fever increases the body's need for energy as it increases energy absorption. Due to their selective eating habits and dairy-free diets, youngsters are more likely to suffer from calcium and vitamin D deficiencies, which is why most of them have weaker bones. The MOH report also stated that drug-nutrient interactions are a major worry for children with autism. Medications have the potential to either increase hunger and weight (anti-psychotics like Risperdal) or decrease it (stimulants like Ritalin), hinder growth, or both. Antibiotics may alter the gut flora, and drugs used to treat seizures (such as Tegretol and Dilantin) may alter the metabolism of calcium, vitamin D, and folate. The findings agree with other related studies (Williams *et al*., 2011; Zimmer *et al*., 2013; George *et al*., 2018; Baspinar & Yardimci, 2020)

In view of the myriads of challenges facing the nutrition of children with Autism. The researcher aimed at finding out the areas of nutritional concern among children with Autism at City Primary School and come up with new information on nutrition status of the children with Autism.

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2.5 Nutrition status of children with Autism

A person's ability to reach their full potential both cognitively and physically largely depends on their diet. Subclinical nutritional deficiency illnesses are the direct result of undernutrition, and a healthy nutritional status is dependent on an appropriate nutrient supply. High rates of sickness and mortality in early childhood, delayed mental and physical development, decreased vitality resulting in decreased productivity, and shortened life expectancy are the indirect repercussions (Zeidan *et al*., 2022). Studies conducted globally have reported varying rates of nutritional deficiencies and feeding problems amongst children with Autism.

Wang *et al*., (2019) in their methodical review, researchers found that malnutrition was more prevalent among children with autism compared to typically developing children. Specifically, 14.4% of children with autism were underweight, 14.1% were stunted, and 10.4% were wasted. The study also highlighted a reduced intake of essential nutrients, including protein, fat, fiber, and various vitamins and minerals, among children with Autism.

A United States study by (Sharp *et al*., 2013) Research has shown that children with autism experience a higher rate of nutrient deficiencies compared to their typically developing peers. Additionally, the study noted that children with autism consume more processed foods and sugar-sweetened beverages than fruits and vegetables. Studies also associate autism with an increased risk of being underweight, overweight, or obese, along with an altered nutrient profile and unusual feeding behaviors. The nutritional status of children with autism reflects their physical development and indicates whether they face risks of underweight, overweight, or obesity. In Saudi Arabia, research found that children with autism have a higher prevalence of overweight and obesity than typically developing children, with 20% of children with autism classified as overweight and 10% as obese. The study also highlighted a reduced intake of essential nutrients, including protein, fat, and fiber, among children with autism (Taniya *et al*., 2022). Unlike children without autism, children with autism have a higher prevalence of obesity. According to a study, 30.4 percent of all the children who were evaluated had autism, compared to 23.6 percent of children without autism (Zimmer *et al*., 2013). This could be because Children with Autism have increased fat intake as compared to a control group.

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Children with autism who are malnourished may subsequently have impaired motor function, skeletal health, social engagement, and healthcare utilization (Herndon *et al*., 2009). Autism prevention and treatment may really benefit from an emphasis on nutrition. Additionally, children with ASD aged 5–11 years are more likely to be underweight compared to their non-ASD peers, while those aged 2–5 years have a higher likelihood of being overweight or obese. (Sun *et al*., 2013). However, (Sun, Xia, Zhao, Li, *et al*., 2013) found that the average BMI of children with ASD in Harbin, China, was higher, suggesting an increased likelihood of overweight and obesity among children with autism. Curtin *et al*., (2014) furthermore discovered that children with ASD had a higher probability of obesity in comparison to a nationwide sample.

Overall, this research indicates that kids with autism might be more vulnerable to nutritional deficiencies, feeding issues, and obesity than normally developing children. It is essential for healthcare professionals to monitor the nutritional status of children with autism and offer interventions to address any identified deficiencies or feeding challenges. The findings underscore the importance of assessing the dietary habits and nutritional status of children with ASD to implement early dietary interventions, helping to prevent undernutrition, overnutrition, and associated health issues among children at City Primary School and throughout the country.

2.6 Relationship between dietary habits and nutrition status among children with autism

The role of nutrition in the development and management of ASD is gaining increased attention. Research suggests potential links between the dietary status and eating habits of children with autism. The rise in ASD prevalence has coincided with various changes, such as increased obesity rates, higher processed food consumption, a greater ω-6 to ω-3 fatty acid ratio, folic acid fortification, and more frequent cesarean deliveries (Sharp *et al*., 2013). While associations exist between some of these factors and ASD development, they may not imply causation (Bandin*i et al*., 2010; Cornish, 2002). ASD likely has multiple causal factors, and research indicates that these causes may differ among individuals with the condition.

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While some may have a genetic predisposition to ASD, social and environmental factors also contribute (Saxena *et al*., 2018). Some forms of ASD involve inflammation and changes in the gut-brain axis, where the immune system and gut microbiome, both influenced by diet, are shaped during fetal development and early childhood—making these periods critical for addressing factors potentially impacting ASD (Hyman *et al.*, 2016).

Complex relationships link maternal diet before, during, and after pregnancy, human milk feeding practices, early childhood diet, gut microbiome composition, and the development of neurodevelopmental conditions such as ASD (Johnson *et al.*, 2011; Zazpe *et al.*, 2015). Considering diet and nutrition-related factors' potential to influence ASD development, future studies should explore these relationships, especially during early developmental periods, as they could inform ASD prevention, treatment, and quality of life strategies.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents the research methods used for the study. The sections include a description of area of study, study design, population size, study variables, sampling design, sampling strategy, inclusion and exclusion criteria, sample size determination, data collection instruments, procedure and equipment, validity and reliability, pretest, data analysis, logistical and ethical issues.

3.1 Study area

The study was carried out at City Primary School in Nairobi County, Kenya. The school is located in Starehe Constituency, Juja Road Zone, Ngara West Ward. City Primary School is a public County Council Day school with an approximate enrollment of 682 students, operating under the City Education Department.

City Primary School was chosen for this study because it became the first public school in Kenya to support students with autism after the Ministry of Education officially recognized autism as a distinct impairment in 2003 (Autism Society of Kenya, 2013). This pioneering role makes City Primary an ideal setting for the study, as it has a longstanding commitment to serving children with autism. Additionally, the school offers a structured learning environment with dedicated autism units, providing a representative sample for research on this population in comparison to other schools.

3.2 Study Design

The research used a cross-sectional survey design, ideal for collecting data from a population at a single point in time. This approach was suitable as it enabled efficient data collection from caregivers or parents of children with autism without requiring follow-up, making it both cost-effective and time-efficient (Setia, 2016). Using questionnaires aligns

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well with this design, as they allow for standardized data collection across respondents, ensuring consistency and comparability.

3.3 Study Population

The participants in the study comprised children aged 5-12 years with autism from City Primary School, along with their parents or caregivers. This age range was chosen because most children with autism are typically fully diagnosed by the age of five. The children were enrolled in special classes tailored for students with autism. Parents or caregivers were approached by the school leadership and invited to visit the school to give informed consent for their children's participation in the study. The research assistant, administered and filled out the questionnaires based on the responses provided by the parents or caregivers during the interview sessions.

3.3.1 Inclusion Criteria

The inclusion criteria for the study comprised all children aged 5-12 years with a confirmed diagnosis of autism, enrolled in the specialized autism program at City Primary School. Participation was contingent upon their parents or caregivers providing informed consent by signing a consent letter. Only children whose parents or caregivers agreed to the study's terms and procedures were included, ensuring ethical compliance and safeguarding the rights and well-being of the participants. This approach ensured that the sample accurately represented the population of children with Autism within the school while respecting the autonomy of the families involved.

3.3.2 Exclusion Criteria

The exclusion criteria for the study were children aged 5-12 years with autism whose parents or caregivers declined to provide informed consent by signing the consent letter. Additionally, children who were absent from school during the data collection period or whose caregivers were unavailable for the consent process and interviews were excluded.

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3.4 Study variables

3.4.1 Independent variables

In this study the independent variables were; dietary habits of children with Autism including dietary intake and diversity assessed using a Food frequency table.

3.4.2 Dependent variables

The dependent variable was nutrition status of children with Autism.

3.5 Sample size determination

The prevalence of autism among children reported by the Autism society of Kenya (2013) was used to determine the sample size. The sample size at the 95 percent significance level was determined using the Fisher's formula (Fisher's *et al.,* 1998).

$$n = \frac{Z^2 Pq}{e^2}$$

Where;

n was the desired sample size (if the targeted population is greater than 10,000)

Z was the critical value associated with level of significance at 95%

P was the proportion of the target population estimated to have a particular characteristic. The prevalence of autism spectrum disorder (ASD) among children in Kenya is estimated to be 4% (Autism Society of Kenya, 2013).

q was the population lacking the feature to be measured (1-0.04 =0.96)

e was the margin of error i.e., 5%=0.05.

q=1-p

$n=1.96^2 \times p\ (1-p) \div d^2$=sample size required

$n=1.96^2 \times 0.04\ (1-0.96) \div 0.05^2$

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= 59 children

The sample size calculated using Fisher's formula was 59 children with autism. However, since the population of children with Autism at city primary school was known to the researcher, the finite population correction formula was used.

$nf = no \div 1 + \frac{(no-1)}{N}$

Where;

nf = the corrected sample size

no =The sample size estimate = 59

N= the finite population

$nf = 59 \div 1 + \frac{(59-1)}{90}$

=35 children with autism

A non-response rate of 10% of the finite population was applied giving a sample size of 44 children with autism

3.6 Sampling strategy

A non-probabilistic convenience sampling design was used to select participants from Nairobi County, chosen for its geographical proximity and ease of access. City Primary School was specifically selected for the study as it was the first public school in the county to implement an integrated system for students with autism, following the Ministry of Education's recognition of autism as a distinct disability category in 2003. The school's location near Nairobi City also offers access to a wide variety of food choices, which is beneficial for the dietary needs of children with autism.

According to the school registry, City Primary School enrolls 90 children with autism, aged 5 to 12 years. A census approach was used to select participants, with 44 children chosen to meet the required sample size. Children with autism spectrum disorder (ASD)

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were identified based on school records, and a questionnaire was administered to their parents or caregivers to collect relevant data for the study

3.7 Data Collection

3.7.1 Data collection instruments

Semi-structured questionnaires were administered to parents and caregivers (Appendix II) to gather information on socio-demographic characteristics, dietary habits, and nutrition status. This included observation checklists for clinical signs and symptoms.To ensure the accuracy of data collected from the observation checklists, data collectors received training on recognizing and documenting specific clinical signs and symptoms of malnutrition. The data collectors used standardized definitions and criteria to assess these clinical signs. To assess children's meals in the 24 hours preceding the interview, a 24-hour dietary recall questionnaire was utilized (Appendix III). For supplemental feeding, the standard WHO 24-hour dietary recall questionnaire was also employed.

Additionally, a Food Frequency Questionnaire (FFQ) was administered to determine the frequency of specific food item consumption by the child over the seven days leading up to the data collection. The FFQ is an effective tool for assessing dietary quality by measuring the quantity of food groups included in the diet over a specified period.

For anthropometric measurements, an electronic weighing scale was used to record weight, while a calibrated stadiometer was employed to measure height. Mid-Upper Arm Circumference (MUAC) was also measured using a flexible measuring tape to assess nutritional status and identify potential malnutrition in the children.

3.7.2 Data collection procedures

Two research assistants, who were familiar with the study area, were recruited to assist with data collection and trained in nutrition assessment and questionnaire administration to assist with data collection. A letter of invitation was sent to parents and caregivers through the school's administration, requesting their attendance at the interview sessions.

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During these sessions, the research assistants administered questionnaires to parents, gathering comprehensive information on dietary habits, health, and nutritional status. Anthropometric measurements, including weight, height, and Mid Upper Arm Circumference (MUAC), were taken according to WHO guidelines. Weight was measured to the nearest 0.1 kg using a calibrated digital scale, height to the nearest 0.01 cm with a stadiometer, and MUAC with a MUAC tape. Each measurement was taken three times, and the average was recorded in the questionnaire, serving as indicators of the children's nutritional status. The raw data were then processed to compute BMI-for-Age Z-scores using WHO Anthro version 3.2.2 software.

Dietary intake was assessed through a 24-hour dietary recall and a Food Frequency Questionnaire (FFQ). Parents and caregivers reported all foods and beverages consumed by the child in the previous 24 hours, estimating portion sizes with standard measuring tools. The mean kilocalorie intake was calculated and compared to the Recommended Dietary Allowances (RDA) for school-age children (2,300 Kcal for females and 2,500 Kcal for males, according to UNICEF, 2020) to evaluate nutrient adequacy. Food frequency was analyzed by categorizing foods into groups such as grains, meats, dairy products, legumes, vegetables, fruits, and fats to ascertain the frequency of consumption among children with Autism Spectrum Disorder (ASD). Additionally, research assistants utilized an observation checklist to identify clinical signs and symptoms of nutritional insufficiency. They examined the eyes, skin, hair, nails, legs, teeth, and lips for indications of micronutrient deficiencies, noting observations as "yes" for signs observed and "no" for those not observed.

3.7.3 Reliability

Reliability refers to the extent to which a research tool produces consistent results when used repeatedly. (Orodho, 2003). To guarantee reliability, the study employed the split half approach. Participants are given the instrument once, and the questionnaire items are then divided into two categories, to evaluate reliability of the data (Mugenda, 2003). To determine the degree to which the questionnaires' content was consistent in generating the same replies, the scores from the first and second half were correlated. Following

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correlation, unclear questions were eliminated, and moderation was done. To find out the degree to which the questionnaire material was dependable in eliciting consistency, the spearman correlation product moment formula was utilized to compare the dependability outcomes of the two parts. Spearman Correlation Coefficient of r = 0.850 was found to be significant at (P=0.021).

3.7.4 Validity

The research utilized well-established instruments, including semi-structured questionnaires and observation checklists informed by expert guidelines, which comprehensively capture relevant socio-demographic, dietary, and clinical data. The implementation of standardized definitions for clinical signs of malnutrition, such as wasting and stunting, enhances construct validity by providing clear criteria for assessment, thereby minimizing subjective interpretation and observer bias. Furthermore, the dietary assessment was conducted using recognized tools, including the 24-hour dietary recall and Food Frequency Questionnaire (FFQ), known for their effectiveness in accurately measuring dietary intake. Rigorous training of data collectors further bolstered data consistency and reliability, while pilot testing of the instruments allowed for iterative refinement based on initial feedback. The incorporation of multiple data collection methods—such as anthropometric measurements, dietary recalls, and clinical observations—facilitated data triangulation, enriching the overall findings.

A pretest was conducted prior to the primary trial at Mathare Special School, which accommodates children with autism spectrum disorder (ASD). The purpose of this pretest was to ensure that the research instruments were effective in yielding the intended data. Five school-aged students with ASD participated in the pilot study, alongside their parents and caregivers, who served as the primary respondents. During the visit to the school, the researcher explained the study's purpose and the data collection process to the participants. It was important to note that the sample used in the pilot study was believed to share similar characteristics with the sample intended for the primary investigation.

Through the pilot test, the researcher was able to identify any weaknesses in the instrument and make necessary adjustments. Specifically, some items in the semi-structured

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questionnaire were revised for clarity and ease of understanding. Importantly, the primary study did not include participants from the pilot school, ensuring that the findings of the pretest did not influence the outcomes of the main investigation.

3.8 Data Analysis

Using the original data collection instrument, data was cleaned, coded, and corrected of all errors before being loaded into an Excel data sheet on a computer. Versions 26 of the Statistical Package for Social Sciences (SPSS) and 3.2.2 (2011) of WHO Anthro for personal computers, aided in analysis of the data. Descriptive statistics such as frequencies, percentages and means socio-economic characteristics were described and dietary habits of the ASD children. To assess dietary diversity, the Dietary Diversity Score (DDS) was calculated by tallying the number of distinct food groups consumed by the children. A score of less than three indicated low dietary diversity, a score between three and five represented moderate dietary diversity, and a score above five signified high dietary diversity. This scoring system allowed for a comprehensive evaluation of the nutritional variety in the diets of the participants (FAO, 2010).

The food variety score (FVS) was determined using the number of individual food items consumed in each category for the past 7 days. This helped in determining dietary adequacy for these children from the scores (<20, marginal, 20-24 was fair, 25-29 good and >30 very good FVS) (*Dietary Assessment & Education: Tool 2 - Weekly Food Variety Score*, 2001).

Children's nutritional status was assessed in terms of wasting, stunting, and underweight using Body Mass Index (BMI) for Age Z-scores. The classifications were based on specific cut-off indicators: a Z-score of less than -2 indicates wasting, reflecting acute malnutrition; a Z-score of less than -2 also signifies stunting, which denotes chronic malnutrition; and a Z-score of less than -2 for BMI-for-age identifies underweight, indicating overall nutritional deficiencies. Additionally, Mid-Upper Arm Circumference (MUAC) measurements were analyzed and categorized according to the cut-offs established by the World Health Organization (WHO) and UNICEF (2009). Specifically, a MUAC of less than 11.5 cm indicates moderate acute malnutrition, while a measurement of less than 11.0 cm denotes severe acute malnutrition.

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Table 3:1: The summary of data analysis methods

Objective	**Independent variable**	**Dependent variable**	**Data analysis**	**Data presentation**
1. To establish the dietary habits of children 5-12 years with autism attending City Primary School, Nairobi County, Kenya	Food intake, Dietary diversity, Food frequency preferences/selectiveness, Foods avoided, feeding problems	Nutrition status (BMI for age Z-scores), MUAC	Descriptive statistics. i.e. percentages, frequencies, means Chi-square test, spearman correlation analysis	Tables Bar graphs
2. To assess the nutrition status of children 5-12 years with autism attending City Primary School, Nairobi County, Kenya	24hr Recall, Dietary diversity score, feeding problems	BMI for Age Z Scores, Micronutrient deficiency signs and symptoms	Descriptive analysis i.e. frequencies, percentages	Tables Bar graphs
3. To determine the correlation between dietary habits and nutrition status of children with autism attending City Primary School, Nairobi County, Kenya	Dietary habits	Nutrition status	Chi-square tests Spearman's correlation	Tables

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3.9 Logistical and ethical considerations

The research was cleared by the Directorate of Postgraduate Studies, and ethical approval from Masinde Muliro University of Science and Technology, Institutional Ethics and Research Committee (MMUST-IERC) approval number **MMUST/IERC/003/2022** (Appendix IV), and the permit from the National commission of Science, Technology and Innovation (NACOSTI) license number **224895** (Appendix V). Permission to collect data from City primary was also sought from the Ministry of Education, Nairobi County government. Informed Consent (Appendix 1) was sought from the participating caregivers after an explanation of among others, all the research procedures.

The researcher ensured that participants, along with their parents (due to the participants being under 18 years of age), understood the activities they were requested to perform, made informed judgments about the effects of their participation, and chose to participate without coercive influence. In this regard, an informed consent process was implemented, during which the researcher provided potential participants with thorough information about the study's purpose, potential risks, and benefits, as well as a sufficient amount of time for them to ask questions before committing to the study. The goal was to ensure the participants' autonomy.

The administration of the structured questionnaires was done in a private setting to guarantee privacy and confidentiality, at least in a secluded room for purposes of convenience. Participant’s names were not indicated in any of the questionnaires; rather, in the questionnaire number slot, each respondent was given a participation identification number. All of the information gathered for this study was private.

Fair participant selection is necessary to uphold justice, meaning that participant populations who might be unjustly compelled into participation must be avoided. The target population was treated equally and the benefits and/or burdens of the study were distributed fairly.

To comply with beneficence, the researcher ensured that the study was of more benefit (individual, family or community) than harm to the participants. Therefore, the significance of the study in shaping policy for the management of children with ASD was clearly

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communicated to the participants.Data storage and protection is the researcher's duty to protect the research data from the participants. Strict adherence to security protocols was maintained during the collection, processing, and analysis of this data. The data material and field notes were solely accessible to the researcher and those directly participating in the research endeavor.

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CHAPTER FOUR: RESULTS

4.0 Introduction

This chapter presents the findings of the study, which aimed to assess the dietary habits and nutritional health of children with autism. The specific objectives were to evaluate the nutritional status of children with autism, examine their dietary habits, and explore the relationship between these dietary habits and their nutritional status at City Primary School. A total of 44 children with autism participated in the study at City Primary School.

4.1 Socio-Demographic characteristics.

4.1.1 Socio-demographic characteristics of the caregivers

The study assessed the demographic characteristics of the caregivers/parents. Table 4.1 presents the findings, which show that the majority of caregivers (56.8%, n=25) had a college or university level of education, 25.0% (n=11) had secondary education, and only 18.2% (n=8) had primary education. The findings also revealed that 61.4% (n=27) of the respondents were employed, while 38.6% (n=17) were unemployed. Most respondents (63.6%, n=28) had 2–3 children, 22.7% (n=10) had more than three children, and only 13.6% (n=6) had one child in the household.

Table 4:1: Socio-Demographic Characteristics of Caregivers of children with Autism at City Primary School

Characteristic	**Category**	**Frequency (n)**	**Percentage (%)**
Caregiver/parents level of education	Primary	8	18.2
	Secondary	11	25.0
	College/University	25	56.8
Caregiver/parents occupation	Employed	27	61.4
	Unemployed	17	38.6
No. of children	1	6	13.6
	2-3	28	63.6
	>3	10	22.7

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4.1.2 Demographic characteristics of children with autism

Table 4.2 shows that the majority of the children were male (75.0%, n=33), while females constituted 25.0% (n=11) of the study population. Most children were aged 10–12 years, accounting for 52.3% (n=23), while 47.7% (n=21) were aged 5–9 years. Among the children with autism, 70.5% (n=31) were diagnosed between 0–4 years of age, 25.0% (n=11) were diagnosed between 5–12 years, and 4.5% (n=2) could not recall the time of diagnosis.

Table 4:2: Demographic characteristics of children with Autism at City Primary School

Characteristic	**Category**	**Frequency (n)**	**Percentage (%)**
Sex	Male	33	75.0
	Female	11	25.0
The age group	5-9 years	21	47.7
	10-12 years	23	52.3
Age at which diagnosis was done.	0-4 years	31	70.5
	5-12 years	11	25.0
	Can't recall	2	4.5

4.2 Objective 1: Dietary habits of children with autism.

4.2.1 Dietary diversity of children with autism.

The study assessed the dietary diversity of children with Autism aged 5–12 years at City Primary School. The researcher examined various food groups based on the Food and Agriculture Organization (FAO) and World Health Organization (WHO) guidelines, which recommend assessing a minimum of eight food groups to evaluate the quality and variety of diets (FAO & FHI 360, 2016; WHO, 2008).

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4.2.2 Food groups consumed by children with autism.

The results show that 95.5% (n=42) of the children consumed grains, grain products, and other starches; 72.7% (n=32) ate dark green leafy vegetables; and 93.2% (n=41) consumed other vegetables. Only 52.3% (n=23) of the children ate Vitamin A-rich foods. Almost half of the study population, 47.7% (n=21), consumed flesh foods, while only 27.3% (n=12) ate eggs. Additionally, 54.5% (n=24) of the children with autism consumed pulses and legumes, and 34.1% (n=15) consumed milk and milk products. A significant 97.7% (n=43) of the children consumed oils and fats, but only 4.5% (n=2) reported eating nuts and seeds.

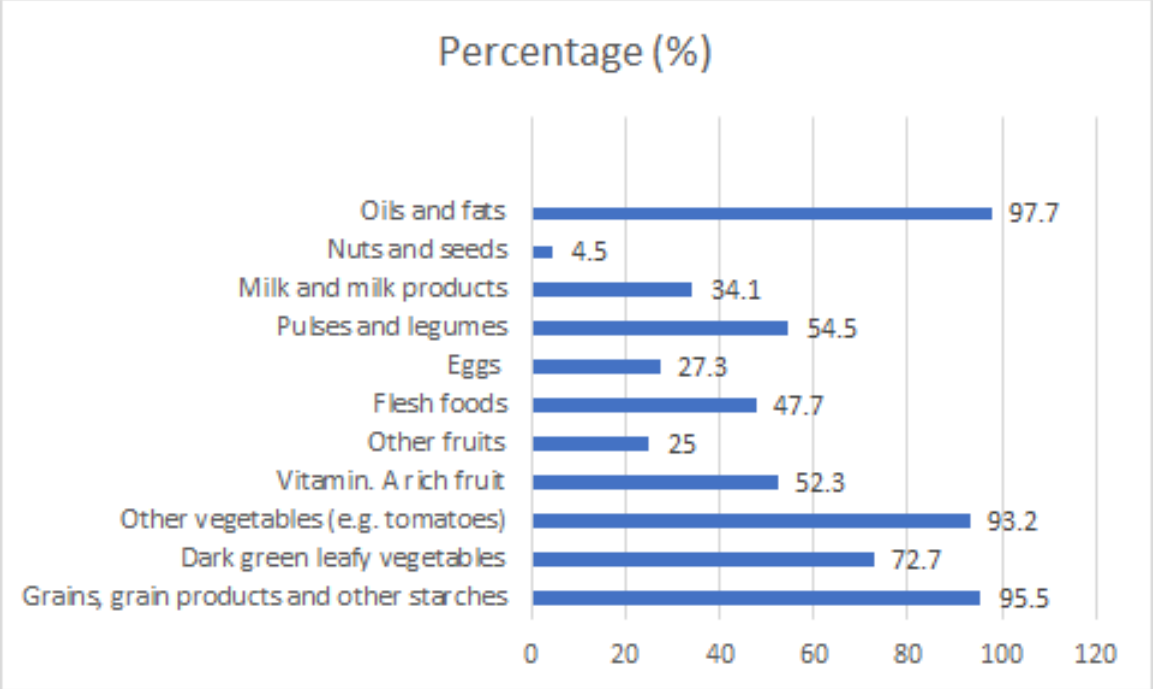

Figure 4:1: Proportion of children with Autism who consumed foods from different food groups

4.2.3 Dietary Diversity

The Dietary Diversity Score (DDS) was calculated by summing the number of distinct food groups consumed by the children within the 24 hours preceding the survey, providing insight into the diversity of their diets. The total DDS ranged from 3 to 8, with a mean score of 3.64 The findings reveal that the majority (63.6%) of the children consumed foods

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from more than five of the assessed food groups. Notably, none of the children consumed foods from fewer than three food groups, as illustrated in Figure 4.2

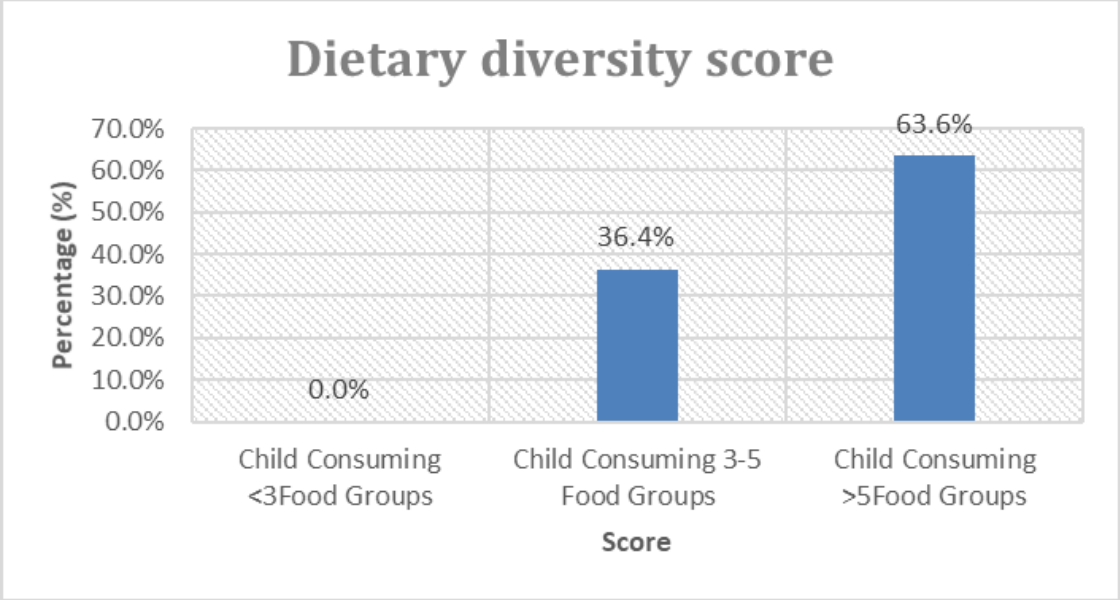

Figure 4:2: Dietary Diversity Score

4.2.4 Food Variety Scores

Further, the researcher looked at the food variety score to find the variety of foods consumed by the children with Autism. A score was assigned to each food item based on its food group category including grains, grain products and other starches (3 points), fruits (1 point), vegetables (1 point), legumes (4 points), meat/poultry/fish (4 points), Milk and milk products (4 points) to determine the food variety score (FVS). A score of < 20 was classified as marginal, 20-24 as fair, 25-29 as good and >30 very good (*Dietary Assessment & Education: Tool 2 - Weekly Food Variety Score*, 2001). The variety scores for various foods were accumulated to give the score for each child with Autism. From the findings, more than half, 24(54.5%) had fair FVS, 8(18.2%) had good FVS, 10(22.7%) had very good FVS, only 2(4.5%) had marginal FVS. This further confirms the good dietary diversity score observed. Incorporating a variety of foods improves dietary diversity. The results are shown in Figure 4.3.

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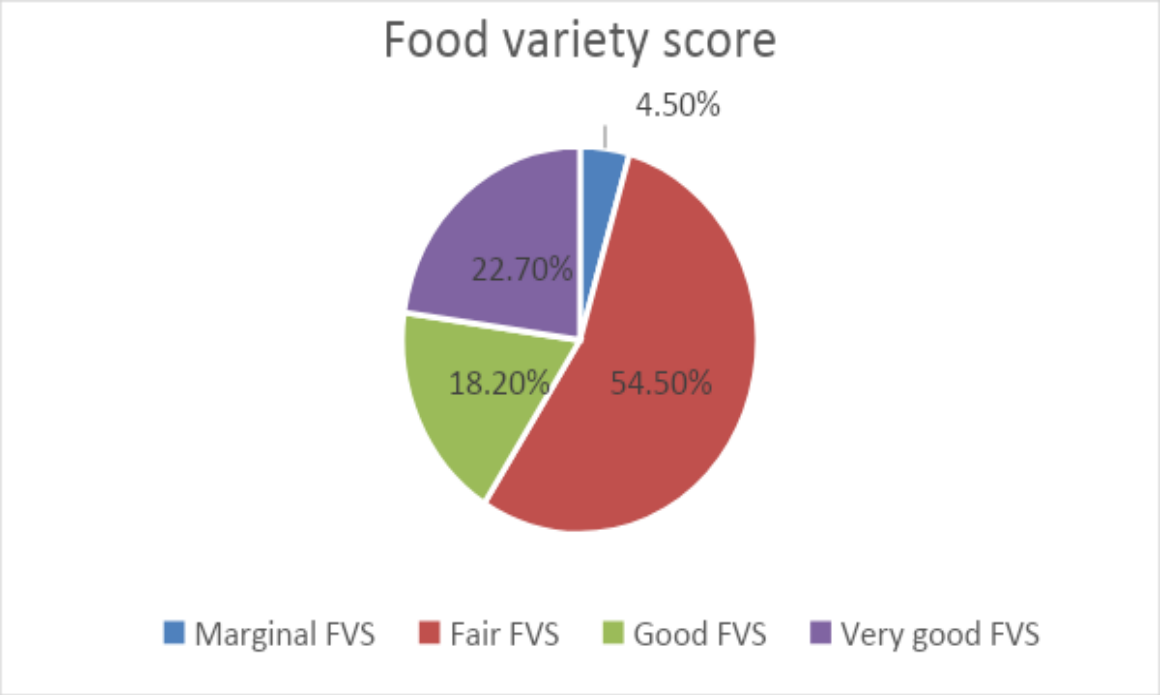

Figure 4:3: Food Variety Score (FVS)

4.2.5 Minimum Meal Consumption

This study assessed the daily minimum meal consumption among children aged 5-12 years with autism to determine their eating patterns. According to the World Health Organization (WHO) and pediatric dietary guidelines, children in this age group are recommended to consume at least three balanced meals per day, supplemented by 1-2 healthy snacks, to meet their nutritional needs and support growth and development (WHO, 2020).

The findings revealed that a majority of the children (54.5%) consumed five or more meals per day indicating a high frequency of meal intake. Additionally, 43.2% of the children reported consuming between three to four meals daily, which aligns with these recommended guidelines. However, a small proportion (2.3%) of the participants consumed only two meals per day, suggesting potential challenges in meeting their nutritional needs.

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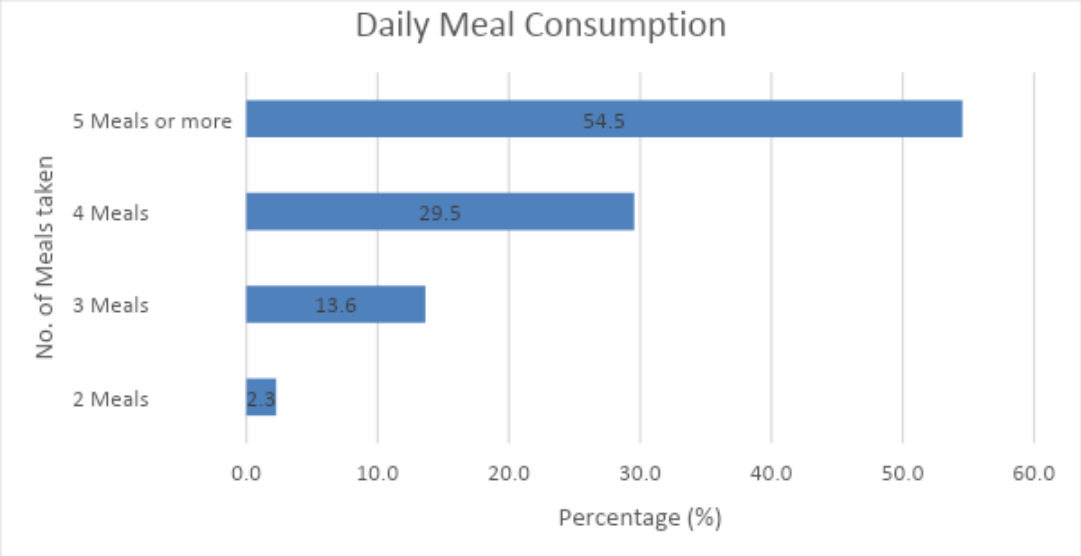

Figure 4:4: Number of meals consumed

4.2.6 Nutrient Adequacy of children with autism

Another significant aspect of dietary consumption examined in the study was nutrient adequacy. The specified standards by UNICEF, (2020) of 2,500 Kcal/day for males and 2,300 Kcal/day for females of this age group were used to compare the nutrient adequacy depending on the mean kilocalorie intake. The mean kilocalorie consumption among the children was 2,064.89 Kilocalories in a day with the mean consumption for boys being 2,132.26 Kilocalories in a day and for female pupils 2,062.35 Kilocalories in a day. The results reveal that, of the 44 respondents, about a half of them had adequate dietary intake (n=28, 63.6%), while 36.4% (n=16) had inadequate dietary intake in a day as recommended for their age group.

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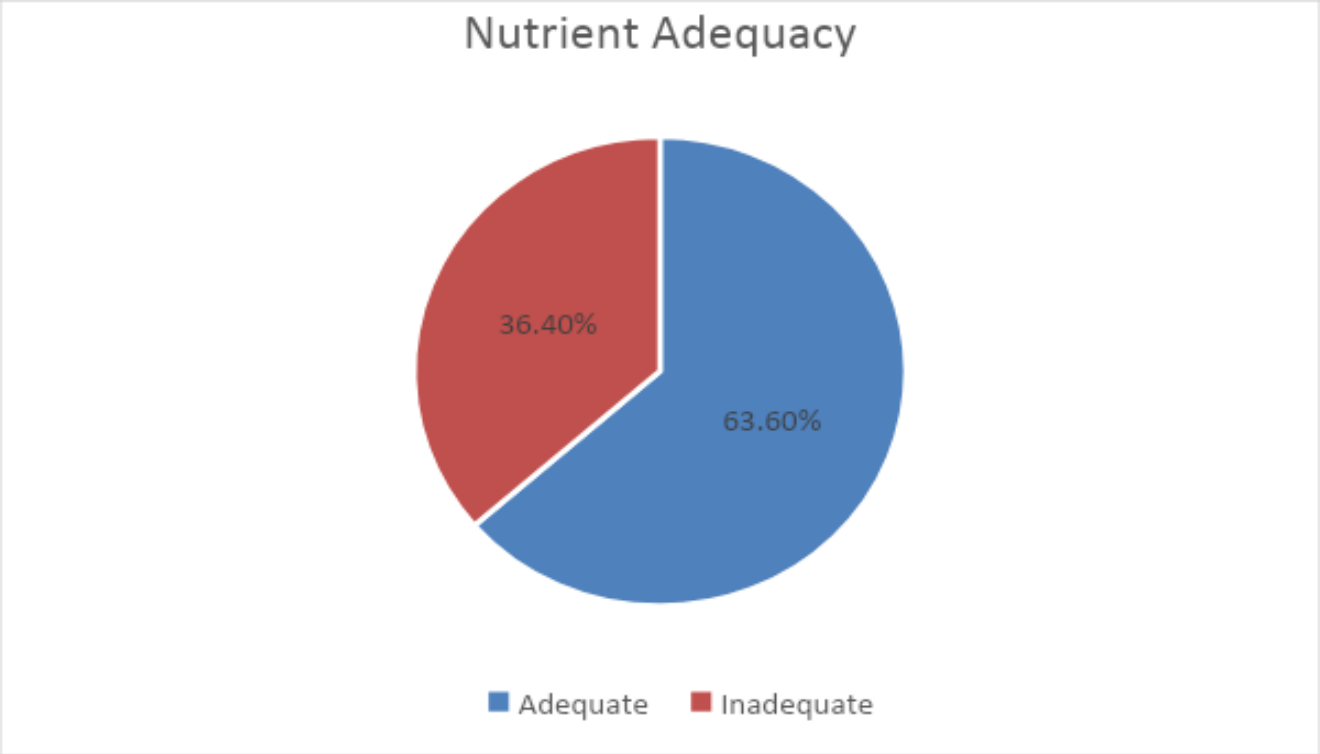

Figure 4:5: Nutrient adequacy

4.2.7 Food Frequency

Additionally, the study ascertained how frequently various foods were consumed in the seven days prior to the survey. In general, children with Autism consumed from all the food groups frequently within the past week preceding the study. Oils and fats were the most consumed food group (97.7%, n=43) followed by vegetables (84.1%, n=37) and Vitamin A-rich fruits and vegetables (81.8%, n=36 in a week. The food types that are least frequently consumed during the course of a week were Nuts and seeds (86.4%, n=38) and Milk and milk products (65.9%, n=29).

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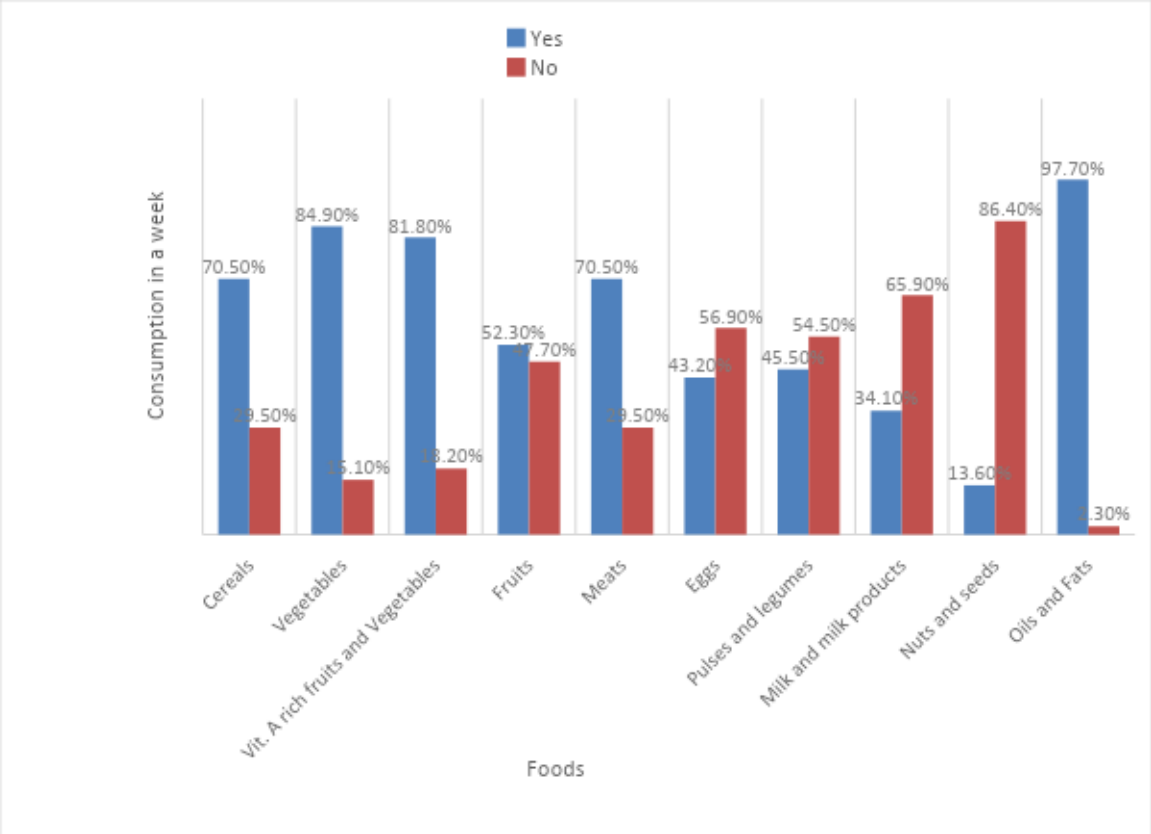

Figure 4:6*:* Frequency of weekly food group consumption

4.2.8 Feeding problems associated with children with Autism.

The study sought to investigate feeding problems encountered by children with autism in the past month. The findings show that the majority of the children (88.6%, n=39) did not suffer from constipation, consequently (93.2%, n=41) and didn't have any complaints or symptoms of diarrhea in the past one month. The study also looked at medical conditions that could be affecting children's feeding patterns such as stomach aches or pains and only 4.5% (n=2) were found to have such problems.

Food allergies were also assessed and 79.5% (n=35) of the children were found to have food allergies. Guardians/parents were asked if they always set a specific feeding schedule/routine for the child, only 25.0% (n=11) agreed. On rewarding the child for positive feeding behavior majority of the respondents agreed to doing so representing

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72.7% (n=32), with 79.5% (n=35) indicating that there are foods that the child refuses to eat when cooked. Asked whether the children always insist on the same type of food most of the time, 68.2% (n=30) reported that their children insisted on the same meal with only 31.8% (n=14) eating what they are offered.

The study also assessed whether there are any special foods that parents of these children have to prepare for them, if the child often refuses to eat regular foods eaten by the family and whether they showed any disruptive behavior while eating. The findings reveal that only 90.9% (n=40), 65.9% (n=29) and 77.3% (n=34) respectively agreed to encounter such problems from their children. However, the majority of the respondents 86.4% (n=38) agreed to have changed their child's diet as a result of the child's ASD treatment.

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Table 4:3: Feeding problems associated with children with Autism

Characteristic	Category	Frequency (n)	Percentage (%)
child suffered from constipation in the past one month	Yes	5	11.4
	No	39	88.6
Symptoms or complains about diarrhea in the past one month	Yes	3	6.8
	No	41	93.2
medical condition affecting the child's feeding pattern.	Stomach Aches/pains	24	54.5
	Constipation	9	20.5
	Acid reflux	1	2.3
	None	10	22.7
Food allergies	Yes	35	79.5
	No	9	20.5
Set any feeding schedule/routine for the child	Yes	11	25.0
	No	33	75.0
Rewarding positive feeding behaviors for the child.	Yes	32	72.7
	No	12	27.3
Foods that the child refuses to eat	Yes	35	79.5
	No	9	20.5
Child insist on the same foods most of the times	Yes	30	68.2
	No	14	31.8
Prepare special foods for the child	Yes	40	90.9
	No	4	9.1
Food family eats regularly that the child refuses	Yes	29	65.9
	No	15	34.1
Child show any disruptive behavior	Yes	34	77.3
	No	10	22.7
Changed diet as part of the child's ASD treatment	Yes	38	86.4
	No	6	13.6

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4.3 Objective 2: Nutrition status of children 5-12 years with autism

4.3.1 BMI for Age of children with autism.

The study investigated the nutritional status of children with autism, including the mean age, weight, height, and mid-upper arm circumference of the children was 10.4 ,35.3kgs, and 137.2cm respectively. WHO reference chart for nutrition diagnosis was used to categorize BMI for age of children with autism, (where Z-score of +1 meant overweight, -1 Mild/Normal, -2 Underweight, -3 Severely malnourished). The findings shows that almost half of the children had mild/normal nutritional status representing 40.9% (n=18), 29.5% (n=13) had moderate acute malnutrition, 22.7% (n=10) were overweight and only 6.8% (n=3) had severe acute malnutrition.

Table 4:4: BMI for age of children with Autism aged 5-12 years.

Category of Malnutrition	Frequency (n)	Percentage (%)
+1 Overweight	10	22.7
-1 Mild/Normal	18	40.9
-2 Moderate	13	29.5
-3 Severe	3	6.8

4.3.2 MUAC Status of children with Autism

The MUAC cut of points according to the UNICEF/WHO 2009 recommendations were used to categorize the nutrition status of children with Autism (<11.5cm SAM, 11.5-12,5cm MAM >12.5cm Normal/Overweight). The mean MUAC was 20.1cm, the results indicated that, majority 75% (n=33) of the children had normal nutrition status, while 15.9% (n=7) had Moderate Acute Malnutrition (MAM). Only 9.1% (n=4) of the respondents were severely malnourished.

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Table 4:5: MUAC for children with Autism

Category of Malnutrition	Frequency (n)	Percentage (%)
Severe Acute Malnutrition	4	9.1
Normal	33	75.0
Moderate Acute Malnutrition	7	15.9

4.3.3 Clinical signs and symptoms.

The researcher further investigated the presence of clinical signs and symptoms in children with autism to assess nutrient deficiencies among them. Various signs and symptoms were examined, including ulceration of the eyes, Bitot's spots, and paleness. Table 4.7 provides a summary of the results. **Table 4.6** shows a summary of the results.

Table 4:6: Clinical signs and symptoms of children with autism.

Clinical signs and symptoms	Characteristics	Frequency (n)	Percentage (%)
Eye (Pallor, bitot's spot, ulceration)	Yes	10	22.7
	No	34	77.3
Skin (Dry flaky, pallor, cracked)	Yes	2	4.5
	No	42	95.5
Hair (Thin, sparse, discolored)	Yes	2	4.5
	No	42	95.5
Nails (Spoon shaped, pallor)	Yes	4	9.1
	No	40	90.9
Legs (Bow shaped, knocked knees)	Yes	1	2.3
	No	43	97.7
Teeth (Discolored)	Yes	9	20.5
	No	35	79.5
Lips (Cracked)	Yes	11	25.0
	No	33	75.0

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4.4 Objective 3: The relationship between age, dietary habits and nutritional status of children with autism.

The third goal of the study was to evaluate the relationship between the child's age, food habits, and nutritional status.

4.4.1 Relationship between age and nutrition status of the children.

The relationship between nutrition status and the age of the children was determined using Chi-square test. **Table 4.7** presents the Pearson's Chi-square test on age nutrition status and age of the children gave x^2(1, n=44) =1.337, with a p-value of 0.720 which shows that there was no relationship between nutrition status and age of the children.

Table 4:7: Age and nutrition status of children with Autism

Independent variable	Chi square value	df	p-value
Age	1.337	1, n=44	0.720

Note: The dependent variable is nutrition status. The relationship is not significant at p>0.05

Further, a correlation analysis was done to check the strength of the association between age and nutrition status. The findings showed a very weak association between the two variables that is age and nutrition status (r=0.173, P-value of 0.262 which is greater than 0.05). With regard to these results, the researcher further confirmed and accepted the null hypothesis that nutrition status is not dependent on the age of the child.

4.4.2 Relationship Between Dietary Habits and Nutrition Status of Children with ASD.

The study employed various parameters to assess the dietary habits of children with autism. These factors included, but were not limited to, the number of meals taken, food allergies, medical conditions affecting feeding patterns, picky eating behavior during meal times,

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and any other disruptive behaviors exhibited by these children during meals. A chi-square test was conducted to determine the relationship between these factors and nutrition status. The researcher found a significant relationship only between the children's picky behavior and their nutrition status, indicated by the chi-square value $\chi 2(3,n=44)=8.255\backslash chi\hat{}2(3,$ $n=44) = 8.255\chi 2(3,n=44)=8.255$ and a p-value of 0.041. This indicates that there is an association between nutrition status and picky behavior among children with autism, as presented in Table 4.9 below. status and picky behavior of children with autism, as presented in **Table 4.8** below.

Table 4:8: Dietary habits and nutrition status of children with Autism

Independent variable	Chi-square value	df	p-value
children's picky behavior	8.255	3, n=44	0.041

Note: The dependent variable is nutrition status. The relationship is significant at $p<0.05$

Further assessment of the strength of association between the variables, the study found a moderate association between picky eating and nutrition status of children with autism. The results (r=0.345, p-value 0.022 which is less than 0.05) Thus the researcher reject the null hypothesis that nutrition stats are not dependent on dietary habits and accepted the alternative.

4.4.3 Relationship between Caregivers' level of education and nutritional status of children with Autism.

The study found a positive relationship between the mother's/caregiver's level of education and nutrition status of children with Autism. Pearson's Chi-square indicates $x^2(6, n=44)$ =22.945, with a p-value of 0.001. However, the strength of association was weak r=0.254, P=0.096 which is <0.05.

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CHAPTER FIVE: DISCUSSION.

5.0 Introduction.

This chapter provides an interpretation and explanation of the results reported in Chapter 4. It analyzes the study's findings in relation to the literature reviewed in Chapter 2, drawing connections between the current study's outcomes and existing research. It also demonstrates the relationship between the results of this study and other comparable research on children with Autism 5.1 Demographic characteristics of children aged 5-12 years with autism.

According to (Bhuiya *et al*., 2017), ASD is highly heritable, in his study he believes that both genetic and environmental factors are highly responsible. The socio-demographic characteristics directly influence the autistic nature of a child. The likelihood of having a third kid with autism climbs to roughly 50 times over in the general population due to the 2–8% recurrence rate among siblings of children with Autism, (Bhuiya *et al*., 2017). Thus, caregivers' level of education, their occupation, age of diagnosis, sex and time when the diagnosis was made were some of the important factors that were insightfully looked at.

The study found that male children with autism were three times more likely to be diagnosed than female children. This aligns with findings from a 2017 descriptive cross-sectional study conducted in Khartoum State, Sudan, which also observed a higher prevalence of autism among male children compared to females. Additionally, the study examined the nutritional health of children with autism and assessed their mothers' level of awareness regarding these health aspects. Furthermore, the socio-economic status of both parents showed that most of the parents came from a middle-class income, with most males being employed (Abdelrahim *et al*., 2017). Similarly, in this study most of the caregivers were employed; however, the study did not look into their financial records to determine their social class. This significant difference in autism prevalence between sexes has been noted in multiple studies, which suggest that autism spectrum disorder is more common in males than in females. (Mbaabu, 2017; Abdelrahim *et al*., 2017; Almsmary *et al*., 2022; Fombonne *et al*., 2022).

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The age at which the children received their autism diagnosis was also examined in the study, the findings indicated that the most of the children were diagnosed between the ages 0-4 years of age. A similar study conducted in Morocco, also found that the initial diagnosis of autism was done majorly at the age of 3.4 years (Oneib *et al*., 2022). Another study conducted among Chinese children also indicated that diagnosis of autism was mainly done between 24-34 months (Long *et al*., 2022).

Bhuiya *et al*., (2017), also conducted a cross-sectional study in Bangladesh, where they found that autism spectrum disorder was more common among males as compared to females. The results also showed that the children were from middle-class family with the majority of the parents having achieved a tertiary level of education (Bhuiya *et al*., 2017). This is at par with the current study where most caregivers had a University/College level of education. However, unlike the current study which did not look at the background family history to assess whether autism is inherited or not, the Bangladesh study looked at the background family history of these children of which the majority of them were found to have one or two of their ancestors having been diagnosed with autism. The study also looked at the variations between urban and rural set ups where they found that the majority of children with Autismwere found to be living in urban areas unlike the current study which was conducted with the urban setup only.

5.2 Dietary habits of children with autism.

Optimum nutrition among children is highly dependent on their dietary habits, as this will highly influence their food diversity, nutrient adequacy, and their nutrition status at large. Thus, to assess dietary habits of these children the researcher looked at various aspects which include dietary diversity score and intake of nutrients amongst children with Autism.

5.2.1 Dietary diversity of children with autism.

The study assessed dietary diversity by examining 11 food groups according to Food and Agriculture Organization (FAO) guidelines for dietary diversity (FAO, 2016). The results showed that most children with autism consumed grains, starches, green leafy vegetables, oils and fats, vitamin A-rich fruits, as well as pulses and legumes, covering over half of

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the study population. However, these findings differ somewhat from a study in Libya, where 50% to 77% of children with autism consumed nearly all food groups, with the exception of fish and items like junk foods and highly salted foods, which were consumed less consistently(Almsmary *et al*., 2022). The study also found less consumption of fatty and fast foods among these children, unlike our findings, which indicated that fats and oils were highly represented, with about 97.7% of the study population consuming them. Similarly, another study (Zhu et al., 2020) showed variation, suggesting that children with autism consumed fewer whole grains, dairy products, beans and soy products, vegetables, and fruits than neurotypical children.

Regarding nutrient adequacy, several studies report low levels of various micronutrients, including but not limited to iron, folate, calcium, vitamin A, vitamin D, B vitamins, zinc, and vitamin C (Almsmary et al., 2022; Ranjan & Nasser, 2015; Zhu et al., 2020). This contrasts with our findings, which indicated adequate nutrient consumption among children with Autism across most food groups, except for seeds, nuts, and milk and milk products. A study by Ranjan & Nasser (2015) revealed that inadequate micronutrient intake among children with Autism was largely attributed to insufficient consumption of green leafy vegetables and fruits. However, this finding differs slightly from Zhu's study, which observed that children with Autism consumed fewer whole grains, fruits, and seafood (Zhu et al., 2020). In our study, however, the intake of foods from these groups was relatively high. This is further supported by the high number of children with Autism who achieved fair to good food variety scores.

5.2.2. Feeding problems associated with children with Autism.

The current study highlights several behavioral outcomes among children with autism, including food allergies, constipation, diarrhea, food refusal, preference for limited types of foods, and disruptive behavior, especially during mealtimes. Most of these behaviors were prevalent in the study group. These results align somewhat with findings from a similar study conducted in the USA, which examined behavioral patterns and nutritional status in children with autism. That study found that many children with autism exhibited

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picky eating habits, disruptive behaviors, tantrums, and, at times, aggressive reactions when refusing certain foods (Sharp *et al*., 2009).

In another study, clinical complications such as constipation and food allergies were observed among children with Autism (Almsmary et al., 2022). However, only a few participants complained about constipation related to certain types of food, while the majority of the study group showed hypersensitivity to various foods, including wheat and sugary items (Almsmary et al., 2022). Sun et al. (2013) also conducted a descriptive-analytical study among children with Autism, finding that, compared to their neurotypical peers, children with Autism had a higher frequency of clinical issues such as constipation, diarrhea, and food allergies. These results differ slightly from the current findings, where most of the children experienced constipation and diarrhea but only showed allergic reactions to specific types of food.

Zhu et al. (2020), in their study on the nutritional status and symptoms of preschool children with autism spectrum disorder (ASD), researchers examined gastrointestinal disorders and picky eating behaviors, which are more prevalent among children with autism. Similarly, the current study found an association between picky eating habits and poor nutritional status in children with autism, indicating that the restrictive diets commonly followed by these children may lead to insufficient nutrient intake and worsen nutritional deficiencies.

5.3 Nutrition status of children with Autism.

Proper nutrition is crucial for children's growth and development, and malnutrition highlights weaknesses in social and economic systems. Inadequate physical and mental growth is one of the adverse effects of stunted development, which can have lifelong consequences (UNICEF, 2017). In this study, it was found that 40.9% of the children had normal nutritional status, while 29.5% were classified with moderate acute malnutrition, 6.8% with severe acute malnutrition, and 22.7% were overweight. Children with ASD frequently face more intense feeding challenges compared to their neurotypical counterparts(CDC, 2021). Meal refusal and the introduction of substitutes are some of the behavioral factors that hinder nutrient adequacy in this group. According to Islam et al.

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(2020 children with Autism are prone to rejecting foods based on factors such as consistency, texture, flavor, brand, and appearance. This behavior results in a limited food repertoire and inadequate intake of essential nutrients. Consequently, the study highlighted that children with Autism exhibited low nutritional status, exacerbated by poor eating habits, food preferences, and stigma, leading to either undernutrition or overnutrition (Ismail et al., 2020).

The nutritional status was measured using BMI-for-age for children aged 5 to 12 years, and they were grouped into four categories: overweight, normal, moderately malnourished, and severely malnourished. Those with a BMI of $\geq +1$ were considered overweight, -1 was classified as normal, -2 indicated moderate malnutrition, and -3 indicated severe malnutrition. The current study indicated that the majority of children had a normal nutritional status, with only a few being classified as moderately malnourished or overweight. These results slightly align with findings from Mbaabu (2017), who also found that the majority (78.0%) of the study population was normal, 13.4% were underweight, and only 8.5% were overweight. However, these findings differ from those of Ismail et al. (2020), who reported that most children were overweight and obese, with only a small percentage classified as underweight.

The prevalence of obesity among children with autism has varied over time, with different studies reporting differing figures. However, some research suggests that the rates of overweight and obesity are similar between children with autism and their neurotypical counterparts (Abdelrahim et al., 2017; Islam et al., 2020a; Ranjan & Nasser, 2015a; Raspini et al., 2021; Seda Senguzel et al., 2021). Ranjan and Nasser (2015) reported that, despite the high prevalence of obesity and overweight among children with Autism, there is also a concerning trend toward increasing rates of underweight among children aged 2 to 5 years and those aged 6 to 11 years. Furthermore, their likelihood of obesity was found to be twice that of individuals without autism.

In a different study, the nutritional status of children with Autism varied by gender, with the majority of underweight children being female, while males represented about half of the study population (Sun et al., 2013; Abdelrahim et al., 2017). The study also revealed

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that most male children with Autism tended to be classified as normal, with only a few appearing overweight. A similar study conducted in Jordan indicated a high prevalence of both underweight and obesity among children with autism spectrum disorder (Alkhalidy et al., 2021). This study found that boys with autism had a higher likelihood of being overweight, while autistic girls exhibited a greater incidence of underweight and stunting compared to their neurotypical peers (Alkhalidy et al., 2021). These gender differences in nutritional status among children with Autism may be attributed to several factors, including differences in dietary preferences, eating behaviors, and social influences. Boys with autism may exhibit less restrictive eating patterns, allowing them to maintain a more typical weight. In contrast, girls may be more prone to selective eating behaviors, which could contribute to insufficient nutrient intake and, subsequently, a higher prevalence of underweight and stunting. Additionally, societal and cultural factors may also play a role, as girls might face different pressures regarding body image and dietary habits, influencing their nutrition and overall health. Recognizing these gender-specific factors is essential for creating targeted interventions that cater to the distinct nutritional needs of children with autism. The study also assessed clinical signs and symptoms of children with Autism; physical examinations were conducted by research assistants who examined various body parts for nutritional deficiencies among these children. The current findings indicated that the majority of the children did not show any clinical signs of nutrient deficiencies. This contrasts with findings by Sun et al. (2013), who reported that many children with Autism exhibited various forms of nutritional deficiencies, evident from physical examinations. Their study reported lower levels of vitamin A, vitamin B6, zinc, serum calcium, and folate. The implications of these findings suggest that while the current study indicates a relatively good nutritional status among the majority of children with Autism assessed, it highlights the importance of continued monitoring and assessment for nutrient deficiencies in this population. Given the variability in nutritional health outcomes among children with Autism reported in the literature, healthcare providers should remain vigilant in conducting regular nutritional evaluations. Early detection of deficiencies is crucial for implementing timely interventions, which can help improve the overall health and development of children with Autism. Furthermore, the contrasting findings with Sun et al. (2013) underline the need for context-specific studies to better understand the nutritional needs

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and risks faced by children with Autism in different settings, ensuring that tailored dietary and health interventions can be effectively developed and implemented.

5.4 The relationship between nutrition status, age and dietary habits

5.4.1 Relationship between nutrition status and age.

The study investigated the connection between children's ages and their nutritional health but found no significant correlation between the two factors. There is limited research examining the link between age and nutritional status; most studies, instead, focus on the relationship between nutritional status and the age at which children are diagnosed (Long et al., 2022; Oneib et al., 2022). Oneib et al. (2022) found a significant correlation between children's nutritional status and their socioeconomic position at the time of screening. A related study conducted in Kenya observed differences in the age and behavioral characteristics of children with autism, but it did not establish a connection between age and nutritional status (Plaza-Diaz et al., 2021).

The findings suggest that behavioral challenges in children with Autism tend to diminish with age, potentially leading to improved nutritional status as they gain a better understanding of the role of nutrition in their lifestyle (Plaza-Diaz et al., 2021). Additionally, the study assessed the strength of association between age and nutritional status and found it to be weak, indicating that nutritional status is not dependent on age, regardless of the child's development status. Thus, the primary factors affecting children with autism and typically developing children are their behavioral patterns and the age at which they are first diagnosed with autism spectrum disorder (Id et al., 2022).

5.4.2 The relationship between nutrition status and dietary habits.

The researcher also assessed the nutritional status and dietary habits of children with Autism. However, the findings revealed that only one behavioral pattern—picky eating, which is common among most children with Autism —had a significant effect on their nutritional status. These findings slightly differ from those of Kittana et al. (2023), who reported a substantial correlation between eating behaviors and the nutritional state of

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children with Autism. Kittana further suggests that the restrictive diets, particularly elimination diets, commonly followed by these children have detrimental effects on their nutritional status.

Additionally, some research indicates that children with Autism exhibit strong food preferences and altered sensory perception, which can significantly impact their health and nutritional status (Dubourdieu & Guerendiain, 2022).

5.4.3 Relationship between caregiver's level of education and nutrition status of children with Autism.

Kittana *et al*., (2023), in their study in the Middle East and North Africa found a very strong relationship between education level of the mother/caregiver and nutrition status of children with Autism. It is believed that caregiver's education is key in identifying the delayed milestones of experience among children with Autism, hence take them for early screening and diagnosis (Nur Hamiza Ruzaini *et al*., 2017). This finding aligns with the results of this study, where a positive relationship was observed between the caregiver's level of education and the nutritional status of children with autism. However, the strength of the association between caregiver education level and the children's nutritional status was weak in this study. This could be due to several factors, including variations in sample size, socio-economic background, and access to nutrition-related resources within the study population. Additionally, cultural practices and varying levels of caregiver involvement in meal preparation and dietary management could have diluted the expected impact of education. In contrast, studies such as those by Bhuiya et al. (2017), Islam et al. (2020a), Natércia et al. (2021), and Nguyen et al. (2022) reported a stronger relationship, likely due to their larger and more diverse samples, as well as greater access to caregiver education programs or support systems that promote better nutritional practices for children with Autism.

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CHAPTER SIX: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of the findings

6.1.1 Demographic characteristics of the caregivers and children with autism.

The socio-demographic characteristics are very important as they may affect the behavioral patterns, and influence the knowledge and understanding of health and nutritional requirements of children with autism. The results from this research revealed that more than half of the caregivers (56.8%) had attained a college/university level of education with only 18.2% having dropped out in primary school. In addition, majority (61.4%) were employed and had 2-3 children representing 63.6% in the household.

Majority of the children assessed were male with 75.0% of the study population, girls represented 25%. Age groups were categorized into two, those who were 5-9 years old and 10-15 years of age, the results showed that age group 10-15 years were the most with 52.3%. The study also looked at when the initial diagnosis was done, and 70.5% were diagnosed between 0-4 years, followed by those who were between 5-12 years with 25.0% only two of the study participants were not diagnosed.

6.1.2 Dietary Habits of children with Autism.

6.1.2.1 Dietary Diversity, minimum daily meal consumption and nutrient intake.

The study on the dietary habits of children with autism highlights key aspects of dietary diversity, meal frequency, and nutrient intake. While most children demonstrated good dietary diversity, with 63.3% having a high dietary diversity score (DDS) by consuming foods from more than five food groups in a 24-hour period, certain nutrient-dense foods were notably under-consumed. Only 34.1% of children consumed dairy and milk products, 27.3% ate eggs, 47.7% consumed flesh foods, and a mere 4.5% included nuts and seeds in their diets. This limited intake of essential foods raises concerns about potential nutrient deficiencies, such as calcium, iron, and protein, which are crucial for healthy development. In terms of meal frequency, most children (54.5%) ate five or more meals per day, with only 2.3% consuming fewer than three meals, suggesting that meal adequacy was generally

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well maintained. The study also found that most children consistently consumed foods from the 11 food groups 6-7 days per week, indicating relatively good overall nutrient intake. However, the limited intake of certain food items highlights the need to encourage a more balanced diet to better address the nutritional needs of children with autism, who may exhibit selective eating patterns.

6.1.2.2 Feeding problems associated with children with Autism.

Autism spectrum disorder has been associated with distinct feeding preferences and disruptive behaviors, particularly during mealtimes. The study looked at some of the behaviors and how the majority of the children reacted towards mealtime. The majority (79.5%) of the children had allergic reactions to various foods during mealtimes and refused to eat completely. Similarly, 77.3% showed disruptive behavior and therefore had to be prepared a special diet that suits their preference. The majority of the respondents (86.4%) also reported having changed diets for their children as part of their child ASDs treatment.

6.1.3 Nutrition status of children with Autism in city primary

The study found that 40.9% of the children had normal nutritional status, while 29.5% were classified with moderate acute malnutrition, and 6.8% with severe acute malnutrition. Additionally, 22.7% of the children were overweight, highlighting concerns about both undernutrition and overnutrition within this population. The average height, weight, and mid-upper arm circumference (MUAC) were 140.8 cm, 35.3 kg, and 20.1 cm, respectively.

6.1.4 Relationship between nutrition status, age and dietary habits.

There was no significant relationship between age and nutrition status of the children $x^2 x^2$(1, n=44) =1.337, with a p-value of 0.720. However, there was a weak association between age and nutrition status (r=0.173, P-value of 0.262 which is greater than 0.05). Consequently, only one factor, that is picky behavior was found to have significant impact on the nutrition status of these children $x^2 x^2$(3, n=44) =8.255 with a p-value of 0.041.

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Assessing the strength of association, there was moderate association between dietary habits and nutrition status (r=0.345, p-value 0.022 which is less than 0.05).

6.2 Conclusion

The study found that most children with autism exhibited various behavioral characteristics during mealtimes, which significantly influenced their nutrient intake and nutritional status. The study highlighted an increased frequency of eating disorders, selective food choices, and mealtime challenges, such as a preference for starchy foods and low consumption of eggs, milk, seeds, and nuts. Methodological inconsistencies in numerous studies have led to conflicting results regarding the nutritional health and feeding habits of children with autism globally. Additionally, a moderate association was found between dietary habits and nutritional status. While many studies have explored the relationship between nutritional status and eating habits in children with autism, findings have been mixed, with some showing a strong correlation and others showing no significant relationship.

Based on clinical signs and symptoms, most children in the study were found to have normal nutritional status, with only a small number showing signs of malnutrition or nutrient deficiencies. However, earlier studies have shown that children with autism are more likely to be overweight or obese compared to their peers, which is often attributed to their high consumption of energy-dense foods. The study did not explore gender differences in nutritional status, although most studies suggest that girls are more likely to be underweight, while boys tend to have a higher prevalence of overweight and obesity.

These findings contribute to a better understanding of food consumption patterns in children with autism and may offer insights into the underlying factors contributing to nutritional deficiencies. Further research with a larger sample size is needed to determine if children with autism meet their dietary needs and to explore the reasons behind any nutritional inadequacies. This research is essential for developing appropriate interventions. The results have important implications for the health of children with autism, but more studies are necessary to further investigate the connection between food intake, nutritional status, and mealtime behaviors.

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6.3 Recommendations.

6.3.1 Practice.

Caregivers/parents of ASD children should monitor their children' s eating habits in order to ensure they provide them with adequate and varied nutrient rich foods.

In order to reduce food allergies, caregivers/parents' ought to use elimination method to eliminate inflammatory foods, and those that their children are allergic to.

6.3.2. Policy.

A policy endorsing the education of nutritionists, school cooks, and caregivers on the proper food for children with autism should be developed by the government. The government should also establish forums to raise awareness about food intervention among parents, educators, and other caregivers of children with autism.

6.3.3 Further research.

The study recommends further investigation into the relationship between dietary habits and nutritional status of children with autism, especially in Sub-Saharan Africa, using larger sample sizes. To support early diagnosis of nutrition-related health issues and the development of targeted therapies for autism spectrum disorder (ASD) in the region, additional research is needed. This research should focus on providing robust data through well-designed studies to better understand the nutritional status and feeding behaviors of children with ASD

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APPENDIX I:

INFORMED CONSENT FORM FOR THE RESPONDENTS

Hello, my name is Faith Mwangi a Masters student in Human Nutrition and Dietetics at the Masinde Muliro University of Science and Technology (MMUST). It is my pleasure to notify you that you have been identified to participate in this study on **Dietary Habits and Nutrition Status of Children Aged 5-12years with Autism at City Primary School Nairobi.**

Procedures to be followed

With your consent and with that of your parents/guardians, we (the principal investigator and research assistants) intend to ask you questions about the dietary habits and nutrition status. With your permission, you will undergo a nutrition assessment session where your weight, height and MUAC will be taken. Please note that all the above activities will be conducted in the school setting with the approval of the school headmaster. We will endeavor to make the sessions as short as possible and make sure that you and the participant are comfortable. I assure you that the research team has been trained appropriately to take an approach that protects you by making discussions as wholesome, discreet and confidential as possible.

Purpose of the study

The purpose of this study is to assess the dietary habits and nutritional status of children aged 5-12 years with autism at City Primary School, Nairobi County, Kenya. It aims to identify dietary patterns, nutrient intake, and any nutritional deficiencies within this population, recognizing the unique challenges children with autism face in meeting their nutritional needs. The findings will help inform targeted interventions, enhance dietary practices, and promote optimal nutrition for children with autism, ultimately contributing to their overall health and well-being.

Confidentiality

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The participant should note that any information given to the researchers will be treated with care, respect and strict confidentiality. The information will be used solely for statistical purposes and records relating to the participant's identity such as name will not be revealed to any community members.

Liability/termination

Please note that participation in this study is voluntary and for this reason, the participant shall release all researchers involved in the study from any liability for any arising issues subsequently occurring in connection with the study. If for any reason you do not wish to participate in the study, you may choose not to.

Voluntarism

Participants will be informed of the purpose of the study and participation will be purely voluntarily. The study will implore the use of participants who are 5-12 years old, who are healthy and whose parents have given consent for them to take part in the study. All this will be voluntarily and no one will be coerced to take part in the study

Beneficence

Concerning the study, no rewards will be given for one to take part in the study. The respondents will be informed that no benefits will be accrued from the research as it is meant to generate data that could influence future policies and programs. Feedback from the data collected and analyzed will be shared with the relevant stakeholders in the Ministry of education, Nairobi County and the head teacher.

Person to Contact

You are welcome to ask questions before consenting and at any time thereafter. The principal investigator (Faith Wangeci) and other research team members will be available to answer your questions anytime during the data collection. In case of further queries regarding the study, you may contact me or the MMUST Ethical Review Secretariat at the contact information given below. Your participation will be highly appreciated.

Contacts

Faith Wangeci (Principal researcher)
Masinde Muliro University of Science and Technology

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P.O Box 190-50100, Kakamega
Tel: +254-707790270

Respondent's consent

I have understood the above information as fully explained to me by the principal investigator, and I voluntarily consent to participate in this study (Please indicate by signing your willingness to participate in this study).

Yes _____ No _____

Signature _____ Date _____

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APPENDIX II: SEMI-STRUCTURED QUESTIONNAIRE

QUESTIONNAIRE ON DIETARY HABITS AND NUTRITION STATUS OF CHILDREN WITH AUTISM 5-12YEARS AT CITY PRIMARY SCHOOL NAIROBI

(To be answered by parents/caregivers of children with Autism within City Primary)

A. SOCIO-ECONOMIC STATUS OF PARENTS /CAREGIVERS

Tick (√) the one that describes your most appropriate answer to the questions

1. What is the guardian's highest level of education?

1=Primary education

2=Secondary education

3=College/ University Education

4=Never went to school

2. What is the occupation status of your guardian?

1=Employed

2=Not employed

3. How many children are there in your household?

a) 1

b) 2-3

c) More than 3

4. At what age did the diagnosis happen?

a) 0-4 years

.

b) 5-12 years (at primary school)

c) N/A

5. Is your child verbal or nonverbal?

A) Verbal B) Non verbal

.

APPENDIX III: DIETARY INTAKE

SECTION A: 24 HOUR DIETARY RECALL

Please think back to when the child woke up yesterday morning to the time he/she went to sleep in the evening. I would like you to try and remember what the child ate or drank yesterday from the moment he/she got up until they went to sleep. Run through the whole day in your mind and try to remember everything that the child ate or drank. Now I would like you to tell me/research assistants what the child ate and drank for the following meals in the table below.

Food or drink taken (List all foods, beverages or snacks for every meal during the last 24 hour period including, tea, or coffee	Food item	Ingredients	Portion size (Household measures: cup, plate, spoon)
Breakfast			
Morning snack			
Lunch			
Afternoon snack			
Supper			
Late night snack			

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Was this your usual intake or it is was an unusual intake? _____

SECTION B: FOOD FREQUENCY QUESTIONNAIRE

Has your child consumed any of these foods in the past week? **(If *yes*, mark days the food was consumed in the last 7 days? Day 1 being yesterday going backward)** ***1=Yes 0=No***

No.	Food groups	Examples	Yes=1 No=2	D1	D2	D3	D4	D5	D6	D7	Total Num of days
1	**Grains and grain products and other starches**	Maize, rice, wheat, sorghum, millet/foods made from these (ugali, porridge etc.) White potatoes, white yam, white cassava or other foods that are tubers									
2	**Dark green leafy vegetables**	Kale, spinach, amaranths and any other									
3	**Other vegetables**	Tomatoes, cucumber onions, eggplant and any other									

.

4	**Vitamin A-rich fruits(yellow /orange flesh)**	Ripe mango, ripe pawpaw, watermelon and any other/ their juices									
5	**Other Fruits**	Other fruits and their juices									
6	**Flesh foods**	Liver, kidney, heart and any other Beef, goat, fish, chicken, pork, rabbit etc.									
7	**Eggs**	Eggs from ducks, chicken, guinea fowl									
8	**Pulses-Legumes,**	Beans, lentils, Lentils, chickpeas, dry beans, and cowpeas butter)									
9	**Milk &milk products**	Milk, yogurt, cheese, fermented milk									
10	**Nuts and seeds**	Cashew nuts, macadamia, peanut, sesame, simsim									
11	**Oils and fats**	Oils, butter/margarine added to food /during cooking									

.

C: FEEDING PROBLEMS (last 4 weeks)

1) How many meals does your child consume daily excluding snacks?

a)1 meal

b)2 meals

c)3 meals

d)4 meals

e)5 meals or more

2. In the last month, has your child suffered from constipation (defined as bowel motion/passage less than 3 times a week)?

A. Yes B. No

3. In the last month, has your child shown symptoms of, or complained about diarrhoea (which is bowel motion /passage more than 3 times per day

A. Yes B. No

4. Which feeding problem(s) is common to your child? you can choose more than one

a) leave the table and play after refusing food they do not like

b) unwilling to try new foods

c) child cannot report what they want or dislike

d) Not able to chew food properly

e) Others, Specify_____

5. Are there medical conditions that the feeding of your child?

a) Stomach aches or pains

b) Constipation

c) acid reflux

6. Does your child have a food allergy? A) No B(yes)

.

If yes which foods?…….

7. Have you set a Feeding Schedule and Routine for your child?

A. Yes B. No

8. Do you Reward Positive feeding Behaviors of your child? (e.g. trying new food, finishing meal portion)

A. Yes B. No

9. Are there any food that your child refuses to eat? A. Yes B. No

If yes, please give details…….

10. Does your child insist on the same foods at most meals? A. Yes B. No

If yes, please give details…….

11. Do you have to prepare any special foods for your child (compared with other family members)? A. Yes B. No

If yes please give details……..

12. Are there foods that your family regularly eats that your child refuses to eat?

A. Yes B. No

If yes please give details……..

13. Has your child shown any disruptive behavior during mealtimes? (Such as pushing/throwing utensils/ throwing food)

A. Yes B. No

If yes, give examples…….

14. Have you changed your child's diet as part of ASD treatment? (Such as excluding certain foods)

A. Yes B. No

.

If yes, give examples…….

D: NUTRITIONAL STATUS

Date of Interview _____ Sex _____

Date of Birth: Day_____ Month _____ Year _____

Section I: Anthropometry

	Measurement 1	Measurement 2	Measurement 3	Average
Weight (0.1kg)				
Height (0.1cm)				
MUAC (0.01cm)				

Section ii: Observation Checklist for Clinical Signs

BODY PART	**CLINICAL FEATURES**	**YES=1, NO=2**
EYE	Pallor, Bitot spot, Ulceration	
SKIN	Dry, flaky, pallor, cracked	
HAIR	Thin, sparse, discolored	
NAILS	Spoon-shaped, parlor	
LEGS	Bow shaped, knocked knees	
TEETH	Discolored	
LIPS	Cracked	

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APPENDIX IV: IERC CERTIFICATE

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

Tel: 056-31375
Fax: 056-30153
E-mail: ierc@mmust.ac.ke
Website: www.mmust.ac.ke

P. O. Box 190,
50100.
Kakamega,
KENYA

Institutional Ethics and Review Committee (IERC)

REF: MMU/COR: 403012 Vol 5 (01)

Date: February 11th, 2022

To: Ms. Faith Mwangi

Dear Sir,

RE: DIETARY HABITS AND NUTRITION STATUS OF CHILDREN AGED 5-12 YEARS WITH AUTISM AT CITY PRIMARY SCHOOL NAIROBI.

This is to inform you that ***Masinde Muliro University of Science and Technology Institutional Ethics and Review Committee (MMUST-IERC)*** has reviewed and approved your above research proposal. Your application approval number is **MMUST/IERC/003/2022.** The approval period is ***February 11th, 2022-February 11th, 2023.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MMUST-IERC.***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MMUST-IERC*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MMUST-IERC*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MMUST-IERC.***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours Sincerely,

Prof. Gordon Nguka
Chairperson, Institutional Ethics and Review Committee

Copy to:
- The Secretary, National Bio-Ethics Committee
- Vice Chancellor
- DVC (PR&I)

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APPENDIX V: NACOSTI CERTIFICATION

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 224895

Date of Issue: 09/April/2022

RESEARCH LICENSE

This is to Certify that Ms.. FAITH WANGECI MWANGI of Masinde Muliro University of Science and Technology, has been licensed to conduct research in Nairobi on the topic: DIETARY HABITS AND NUTRITION STATUS OF CHILDREN AGED 5-12 YEARS WITH AUTISM AT CITY PRIMARY SCHOOL NAIROBI for the period ending : 09/April/2023.

License No: NACOSTI/P/22/16785

224895

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

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APPENDIX VI: ACTIVITY TIMELINES

Time (Months)	September 2022	Octobe r 2022	November 2022	Dec 2022	Feb 2024	Sept 2024	DEC 2024
Activity							
Progress report							
Data collection							
Data analysis							
ITS							
Presentation							
Publication							
Defense							
Graduation							