CATHOLIC UNIVERSITY OF HEALTH AND ALLIED SCIENCES.

SCHOOL OF MEDICINE.

GASTROINTESTINAL SYMPTOMS AMONG CHILDREN WITH AUTISM SPECTRUM DISORDER COMPARED TO TYPICALLY DEVELOPING CHILDREN IN MWANZA REGION.

BY

EMMANUEL JULIUS CHALIGHA. CUHAS/MD/4002734/T/19.

SUPERVISOR.

DR. PETER M. CHILIPWELI. B.Sc., M.Sc.

OVERSEER.

DR. DEODATUS RUGANUZA. MD, MSc.

Research Report Submitted in Partial Fulfilment for the Award of Doctor of Medicine Degree in the Catholic University of Health and Allied Sciences. Bugando, Mwanza.

Date of submission; _____

2023.

DECLARATION.

I Emmanuel J. Chaligha, hereby declare that this dissertation is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature_____ Date_____

CERTIFICATION.

The undersigned certify that they have read and hereby recommend acceptance by the Catholic University of Health and Allied Sciences, of a proposal for research titled: "Gastrointestinal symptoms among children with autism spectrum disorder compared to typically developing children in Mwanza region'' for the completion of degree of Doctor of Medicine at the Catholic University of Health and Allied Sciences-Bugando.

SUPERVISOR

Signature _____ Date_____

Peter M. Chilipweli. B.Sc. M.Sc.

Department of Epidemiology.

OVERSEER.

Signature _____ Date_____

Dr. Deodatus Ruganuza. MD. MSc.

Department of parasitology & entomology.

ACKNOWLEDGEMENTS.

I thank my God, the Most Sacred Heart of Jesus, my saviour, for allowing me to accomplish this lifetime ambition. I wish to express my gratitude to everyone who, in one way or another, contributed to the success of this study.

I am profoundly appreciative of my parents and siblings for their unwavering love, as well as their continuous financial, academic, and spiritual support throughout the entire period of conducting this research.

Also, more appreciations to the joint CUHAS/BMC research ethics and review committee for granting me clearance to conduct my research in Mwanza, Tanzania.

I would like to thank my supervisors, Mr. Peter M. Chilipweli. and Dr. Deodatus Ruganuza, whose invaluable contributions, support, challenges and encouragement helped me a great deal in writing this report.

I would like to give my sincere appreciations to my classmates for their invaluable contributions, ideas, strategies and advice that truly helped in achieving this important milestone of completing this research report.

Finally, I extend my sincere appreciation to all the participants in this study, including the children from LiTAFO and SOS Children's Villages, as well as the staff members of these organizations, for their full cooperation and support during the research process.

TABLE OF CONTENTS.

LIST OF FIGURES.

LIST OF TABLES.

LIST OF ABBREVIATIONS AND ACCRONYMS.

ASD- Autism Spectrum Disorder

AGRE- Autism Genetic Resource Exchange

GI- Gastro-Intestinal

GERD- Gastroesophageal Reflux Disease

Li-TAFO- Living Together Autistic Foundation

OPERATIONAL DEFINITIONS.

1. **Children.** - In this study children are individuals aged between 2 to 12 years who are either diagnosed with Autism Spectrum Disorder (ASD) or are typically developing.
2. **Prevalence of GI Symptoms. -** Refers to the proportion of children exhibiting one or more GI symptoms, such as abdominal pain, constipation, diarrhoea, bloating, gastroesophageal reflux, vomiting, nausea, and flatulence.
3. **Factors associated with GI symptoms. –** This refers to the specific conditions that may influence the prevalence, severity, and types of GI symptoms experienced by children**.** These factors include dietary habits, gut microbiota composition, medication use. behavioural factors like eating behaviours and stress levels, parental and family health history, presence of comorbid conditions, physical activity levels, and hydration status.

ABSTRACT.

Background: This study explores the prevalence of gastrointestinal (GI) symptoms in children with Autism Spectrum Disorder (ASD) in Mwanza, Tanzania, revealing higher rates of symptoms like abdominal pain, constipation, and GERD compared to typically developing peers. The findings highlight the need for targeted healthcare interventions in this population.

Methodology: The study was conducted in Mwanza, Tanzania, using a descriptive design involving children aged 2 to 12 years, both diagnosed with ASD and typically developing. Data were collected through a structured questionnaire covering socio-demographic information, GI symptoms, and potential contributing factors such as age, gender, dietary habits, and environmental influences. Ethical standards were strictly followed, including obtaining informed consent from parents or guardians.

Results/discussion: Results showed that 21.8% of children with ASD experienced GI symptoms, significantly higher than the 6.52% in typically developing children. The highest prevalence of GI symptoms was found in the 1-3 years age group, highlighting the need for early diagnosis and intervention. Logistic regression analysis also suggested associations with factors like sex and the source and treatment of drinking water. Despite some limitations, the study emphasizes the need for increased awareness, routine screening, and targeted interventions to improve GI health in children with ASD in Mwanza, Tanzania.

Conclusion: Addressing GI health is crucial for improving overall outcomes in children with ASD. The study recommends increasing awareness, implementing routine GI symptom screening, and providing targeted interventions to support children with ASD and their families in managing these symptoms effectively.

CHAPTER ONE

1.0.INTRODUCTION.

1.1.Background to the study.

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by challenges in social interaction, communication, and repetitive behaviours. According to Zeidan et-al, worldwide prevalence of ASD from 99 estimates from 71 studies were published indicating prevalence that ranges within and across regions, with a median prevalence of 100/10,000 (range: 1.09/10,000 to 436.0/10,000) with median male-to-female ratio of 4.2(1). However few studies indicates the prevalence of ASD in Africa to be similar to the global prevalence despite few researches being conducted in Africa(2).

A growing body of research suggests a connection between ASD and GI problems in children. While the core features of ASD are well-documented, there is increasing recognition of co-occurring medical conditions, including gastrointestinal (GI) symptoms. Various researches suggest that children with ASD may experience higher rates of GI symptoms such as abdominal pain, constipation, diarrhoea, and gastroesophageal reflux disorder (GERD) compared to typically developing children(3,4)(5). The reasons behind this connection are still being explored, but factors like diet and gut bacteria composition, and underlying medical conditions might be involved(6,7).

The association between ASD and GI symptoms is understudied in specific geographic regions. In Tanzania, particularly in the Mwanza region, comprehensive studies on this topic are scarce. This study aims to fill this gap by investigating GI symptoms in children with ASD compared to typically developing children. The study aims to provide insights into healthcare needs and support services for this vulnerable population.

1.2.Problem statement.

According to Holingue et al 2017 review, the prevalence of GI symptoms in ASD in Africa are, constipation: 4.3–45.5% (median 22%), Diarrhoea: 2.3–75.6% (median 13.0%). Any or more than one symptom: 4.2–96.8% (median 46.8%)(8). But on the other side GI symptoms among children with ASD has been reported to be higher compared to typically developing children(9). Despite the growing interest in the association between ASD and GI symptoms, existing research has primarily focused on other regions, and the findings may not fully capture the experience of children with ASD, leaving a gap in knowledge regarding the prevalence, characteristics, and factors associated with GI symptoms among children with ASD in Mwanza, Tanzania. Therefore, comprehensive studies are needed to understand the types and nature of these symptoms and to compare them systematically between children with ASD and typically developing children. This study aims to compare the prevalence, types, and factors associated with GI symptoms among children with autism spectrum disorder to those among typically developing children, providing valuable insights on gastrointestinal health among children with ASD and identifying potential areas for intervention and support for affected individuals and their families(10).

1.3.Rationale of the study.

Given potential cultural, dietary, and environmental differences, investigating the prevalence and nature of GI symptoms among children with ASD in Mwanza, Tanzania, is essential. This research aims to fill this gap by conducting a systematic review of existing literature. By synthesizing available evidence, this study seeks to provide insights into the epidemiology of GI symptoms in ASD within the specific context of Mwanza. The findings of this research will not only contribute to the understanding of ASD comorbidities but also inform clinical practice, public health interventions, and future research activities in the region.

1.4.Research question.

What is the level of knowledge, beliefs, and attitudes towards ID among parents/relatives of intellectually disabled children?

1.5.Research objectives.

1.5.1. Broad objectives.

- To determine the prevalence and factors associated with gastrointestinal symptoms (GI) among children with Autism Spectrum Disorder, as compared to typically developing children in Mwanza.

1.5.2. Specific objectives.

i. To determine the prevalence of specific GI symptoms among children with ASD in Mwanza, Tanzania.

ii. To determine potential factors associated with GI symptoms in children with ASD in Mwanza, such as age, gender, ASD severity, dietary habits, and environmental factors.

CHAPTER TWO.

LITERATURE REVIEW.

2.0.Overview.

2.1.Brief overview of ASD and GI symptoms.

Autism spectrum disorders (ASD) are ranked among the top five developmental disabilities among children younger than 5 years in 195 countries and territories(11). ASD is a spectrum of neurological disorders that present with restrictive, repetitive patterns of behaviour, interests, and activities, and/or deficits in communication and social interactions, which typically manifest within the first three years of life(12). Individuals with ASD frequently have comorbidities(13), and they are at greater risk of experiencing co-occurring GI symptoms, including constipation, diarrhoea, and abdominal pain(13,14).

GI symptoms are a common and debilitating issue among children with ASD. The prevalence of GI symptoms in ASD children varies across studies, with some reporting rates as high as 70%(15). These symptoms can significantly impact the daily lives of children with ASD and their families, causing difficulties in social interactions, communication, and behaviour(16).

The exact causes of GI symptoms in ASD children are not fully understood, but several factors have been implicated, including diet, sleep disorders, and food allergies(17). There is a large association higher levels of sensory over-responsivity to chronic GI symptoms experiences in ASD children(18). A study using data from the AGRE found that parents reported significantly more GI problems in children with ASD than in their unaffected siblings(19). This suggests that there may be a growing evidence of genetic component and environmental risk factors to the development of GI symptoms in ASD children(20,21). However, the aetiology of GIS in ASD remains poorly understood(22). A detailed understanding of the nature of GIS and how they are associated with co-occurring conditions are required to facilitate the diagnosis of ASD and the treatment of GI symptoms(23).

2.2. Prevalence of GI symptoms in children with ASD.

The prevalence of GI symptoms in children with ASD is a topic of significant interest and research. Studies have consistently reported a higher prevalence of GI symptoms in children with ASD compared to typically developing children. However, the prevalence rates vary across studies, ranging from 17% to 70% (8,15). One study found that 24% of children with ASD had a history of at least one chronic gastrointestinal symptom, with diarrhoea being the most common symptom (17%)(8). Another study reported a prevalence rate of 37% for constipation and 21% for abdominal pain among children with ASD(10).

The varying prevalence rates of GI symptoms among children with ASD reported in different studies can be attributed to differences in the definition and diagnostic criteria for ASD which can influence prevalence rates. Additionally, the methods used to assess GI symptoms vary widely. Some studies rely on parental reports, while others use more objective measures such as endoscopy(14,24) or stool tests(25). The age range of the children studied also plays a crucial role, as GI symptoms may present differently at various developmental stages, leading to variability in reported prevalence rates. Furthermore, the presence of co-occurring conditions, such as intellectual disability, sleep disorders, or food allergies, can impact the prevalence of GI symptoms. Holingue et-al (2023) found that children with ASD and intellectual disability were less certain about the presence of more subjective symptoms such as abdominal pain, nausea, and bloating. These factors collectively contribute to the differences observed across studies(26).

2.3. Types of GI symptoms in children with ASD.

Children with ASD often experience a wide range of GI symptoms. The most reported issues include constipation, diarrhoea, abdominal pain, and vomiting. These GI problems can have a profound impact on their daily lives, making it even more challenging for them to navigate social interactions, communicate effectively, and manage their behaviour(27).

Constipation is a common GI symptom in children with ASD, characterized by infrequent bowel movements, hard stools, and straining during defecation, leading to discomfort, pain, and even constipation-related complications such as rectal bleeding, anal fissures, and faecal incontinence. Studies have found that constipation is up to four times more common in children with ASD compared to typically developing children, with prevalence rates ranging from 17% to 50% or more (24,28).Constipation can exacerbate behavioural problems in children with ASD, such as irritability, aggression, and self-injury (28,29). This is due to impairment of the bidirectional communication between the gut and the brain, known as the gut-brain axis. Chronic GI symptoms, especially in infancy and early childhood, may impact neurodevelopment and contribute to the severity of ASD features (24).

Diarrhoea is another common GI symptom, characterized by frequent, loose, or watery stools. Studies have found that diarrhoea is up to four times more common in children with ASD compared to typically developing children,(10) with prevalence rates ranging from 17% to 50% or more (9,24).This symptom can lead to dehydration, electrolyte imbalances, and malnutrition. Like constipation, diarrhoea can exacerbate behavioural problems in children with ASD, such as irritability, anxiety, and sleep disturbances.

Abdominal pain is a common GI symptom characterized by recurring or persistent pain in the abdominal region. It leads to discomfort, pain, and even abdominal complications such as appendicitis, inflammatory bowel disease, and irritable bowel syndrome. Flynn et-al (2022)

emphasize the prevalence of abdominal pain in children and adolescents with ASD, discussing its impact on their behavioural and emotional concerns, as well as its associations with other comorbid disorders and treatment options based on gut bacteria, diet, and probiotic use (30,31). Abdominal pain may also function as a trigger for challenging behaviour (4). Abdominal pain in children with ASD is significant to cause behavioural changes such as exacerbate behavioural problems such as irritability, aggression, and self-injury (30).

Vomiting is a less common GI symptom in children with ASD, characterized by the forceful expulsion of stomach contents through the mouth. This symptom can lead to dehydration, electrolyte imbalances, and malnutrition. Vomiting can exacerbate behavioural problems in children with ASD, such as irritability, anxiety, and sleep disturbances.

The impact of these GI symptoms on the daily lives of children with ASD is significant. GI symptoms can cause discomfort, pain, and even abdominal complications, which can exacerbate Challenging behavioural problems such as irritability, aggression, and self-injury. GIS can also cause pain and distress to individuals who have little to no communication skills and may not be able to tell their caregivers that they are in pain(32). These symptoms can lead to difficulties in social interactions, communication, and behaviour, which can further complicate the diagnosis and treatment of ASD.

2.4. Comparison of GI symptoms in children with ASD and typically developing children.

The comparison of GI symptoms in children with ASD and typically developing children is a crucial aspect of understanding the prevalence and impact of GI symptoms in ASD. Studies have consistently shown that children with ASD experience a higher prevalence of GI symptoms compared to typically developing children.

A study published in Autism Research found that preschool-aged children with ASD were 2.7 times more likely to experience GI symptoms than their typically developing peers(16). Another study reported that 47.8% of children with ASD experienced GI symptoms compared to 17.8% of typically developing children(33). These differences in prevalence rates are significant and highlight the need for clinicians to be aware of the high occurrence of GI problems in children with ASD(16,33).

The types of GI symptoms experienced by children with ASD also differ from those experienced by typically developing children. Children with ASD are more likely to experience multiple GI symptoms, such as diarrhoea, constipation, and abdominal pain, which can lead to discomfort, pain, and even abdominal complications (8,16). Abdominal pain and constipation have also been found to predict challenging behaviour, the presence of diarrhoea predicts tantrum behaviour, and nausea predicts worrying/depression and avoidant behaviour (30,34).

2.5. Factors contributing to GI symptoms in children with ASD.

Children with ASD experience a high rate of comorbid GI problems, impacting a sizeable portion of the population (3,35). The factors contributing to GI symptoms in children with ASD are complex. Studies suggests that diet, sleep disorders, and food allergies are potential contributors to GI symptoms in children with ASD.

2.5.1. Diet, sleep disturbances and food allergies.

Studies suggest a correlation between dietary patterns and GI issues in children with ASD. There is a higher prevalence of poorer dietary quality in this population, with children consuming less fibre and a lower variety of fruits and vegetables compared to typically developing children (3,35). Narzisi et al. (2021) found that children with ASD had a significantly higher intake of unhealthy processed foods and lower intake of fruits and vegetables compared to typically developing controls(35). This unbalanced intake may lack

essential nutrients and fibre, both crucial for gut health and regularity. Evidence from Narzisi et al. (2021) reveals that children with ASD exhibit selective eating behaviours, restricting their food choices and potentially missing important gut microbes or triggering sensitivities to certain foods (35).

Sleep disturbances are common in children with ASD, and research suggests that these disturbances may be associated with GI symptoms. Williams et-al(2010) explained that children with sleep abnormalities are more likely to have GI problems than those who have good sleep quality (36). A study published in Sleep and GI Disturbances in ASD found that children with ASD and GI symptoms had a higher prevalence of sleep disturbances compared to typically developing peers(14).

Food allergies are also a potential contributor to GI symptoms in children with ASD. A study published in Wasiwelska et-al(2015) found that food allergies were common in children with ASD and that these allergies were associated with GI symptoms (14).

McElhanon et-al (2014) found that children with ASD who had a history of GI symptoms were more likely to have a diet that included gluten and dairy products (10). Another study published in Sleep and GI Disturbances in ASD found that children with ASD and GI symptoms had a higher prevalence of sleep disturbances compared to typically developing peers. These studies provide evidence that diet, sleep disorders, and food allergies may contribute to GI symptoms in children with ASD (14).

2.5.2. Implications for Treatment and Management.

Dietary interventions may be effective in reducing GI symptoms in children with ASD. Babinska et-al(2020) found that dietary restrictions were introduced to children with ASD who exhibited food selectivity, and that these restrictions were often based on anecdotal evidence rather than scientific support (37). This study suggests that dietary interventions may be effective in reducing GI symptoms in children with ASD. Additionally, sleep disorders may be treated with behavioural interventions, such as sleep training, and food allergies may be treated with elimination diets (37).

2.6. Research gap and conclusion.

The prevalence of GI symptoms is higher in children with ASD (47.8%) compared to typically developing children (17.8%)(8,10). However, specific data on GI symptoms in children with ASD in Mwanza is limited. Existing studies lack detailed examination of specific symptoms and their impact on daily life, behaviour, and well-being in Mwanza. More research is needed on the causes of GI symptoms in children with ASD in Mwanza, including diet, sleep disorders, and food allergies. Confirming these factors as contributors and exploring other causes is essential for effective interventions and improving the quality of life for children with ASD in the Mwanza Region.

CHAPTER THREE.

RESEARCH METHODOLOGY.

3.0.STUDY AREA.

The study was conducted in the Mwanza region, Tanzania, targeting both urban and rural areas to ensure representation across different socioeconomic and environmental contexts. specifically, the study was done within the Nyamagana district in which it is home to two prominent institutions that will serve as the primary locations for the research: Li-TAFO Mwanza Centre and SOS Children's Villages. Li-TAFO Mwanza Centre specializes in supporting children with developmental needs, including Autism Spectrum Disorder (ASD), offering tailored care, educational programs, and therapeutic services. SOS Children's Villages, an international organization, provides a family-like environment for orphaned and vulnerable children, ensuring comprehensive care, healthcare access, and education. The study will benefit from resources of these institutions, facilitating the examination of gastrointestinal symptoms among children with ASD compared to typically developing peers.

3.1.STUDY DESIGN.

The study was a cross-sectional descriptive study which was employed to collect data at a single point in time. This design was efficient in gathering information on knowledge, beliefs, and attitudes from a large sample of parents/relatives.

3.2.STUDY DURATION.

The study was done for a duration of 6 months (from April to September 2024).

3.3.STUDY POPULATION AND NATURE OF POPULATION.

The population for this study were all parents/relatives having disabled children found in the Nyamagana district during the study period provided.

3.4.SAMPLE SIZE.

To determine the appropriate sample size for comparing the prevalence of GI symptoms between children with ASD and typically developing children in the Mwanza Region. The formula often referred to as the Cochran's formula was used.

$$n = \frac{z^2 p(1-p)}{e^2}$$

Whereas.

n = desired sample size

z = standard normal deviate (z-value) corresponding to the confidence level (1.96 for 95% confidence level)

p = the estimated proportion of GI symptoms in the Mwanza region. Proportion of 50% will be used in this study.

e = margin of error (0.05)

Therefore, the result will be.

$$n = \frac{(1.96)^2.(0.5).(1-0.5)}{(0.05)^2}$$

$$n = \frac{(1.96)^2.(0.5).(0.5)}{(0.05)^2}$$

$$n = \frac{3.8416 \times 0.25}{0.0025}$$

$$n = 384.16 \approx 385$$

The minimum sample size calculated was 385 participants.

3.5.SAMPLING METHOD.

This study used convenience and purposive sampling to recruit children in the Mwanza region of Tanzania, including those with ASD and typically developing children. The ASD group were recruited from specialized healthcare facilities, educational institutions, and community centres, ensuring a range of ASD severity levels and ages. The control group was selected from local schools and community centres, matched for age and gender. Caregivers/legal guardians provided informed consent. The sample size was adjusted iteratively to balance statistical power and feasibility for meaningful GI comparisons.

3.6.SELECTION CRITERIA.

3.6.1. INCLUSION CRITERIA.

i. Age between 2.5 years to 18 years.
ii. Diagnosis of autism, Pervasive Developmental Disorder Not Otherwise Specified (PDD/NOS), or Asperger's for the autism group.
iii. Good mental and physical health without specific stomach/gut problems for the control group.

3.6.2. EXCLUSION CRITERIA.

i. Non-Consent: Lack of parental or guardian consent for participation in the study.
ii. Children who do not reside in the Mwanza region.
iii. Children with other developmental disabilities, neurological conditions, or chronic medical illnesses aside from gastrointestinal symptoms.

3.7.DATA COLLECTION.

Structured questionnaires comprising multiple-choice questions (MCQs) and Likert scales were utilized. The structured questionnaires were precisely designed to gather comprehensive information from caregivers of children with ASD and typically developing children. Caregivers responded to MCQs addressing demographics, medical history, and GI symptoms, while Likert scales assessed the severity and frequency of symptoms, as well as behavioural factors.

3.8.DATA PROCESSING AND ANALYSIS.

The data was obtained, collected, coded, and cleaned using the computer program package for data analysis (SPSS version 27). Descriptive statistical measures ranging from the frequency distribution table to charts were used in the data presentation. The frequency, percentage means, standard deviation, and chi-square were used to assess the degree of validity.

3.9.ETHICAL CONSIDERATION.

Ethical clearance for this study was obtained from the CUHAS research and ethics review committee. Participants will provide informed consent before participation. They will receive instructions before recruitment and can choose to participate voluntarily, provided they meet the inclusion criteria. Participants can withdraw from the study at any time. Confidentiality will be maintained by omitting participant names from questionnaires, ensuring respect for human dignity. The study will prioritize the principle of beneficence.

CHAPTER FOUR.

RESULTS.

4.0. SOCIO-DEMOGRAPHIC INFORMATION.

A total of 412 participants were interviewed with 95% response rate. The mean age of respondents was where it is expanded in age groups as follows: 0-1 years (Infants): There are 6 children in this age group, which constitutes 1.5% of the total. 1-3 years (Toddlers): There are 165 children in this age group, making up 40% of the total. 4-6 years (Preschoolers): There are 138 children in this age group, accounting for 33.5% of the total. 7-9 years (Early Childhood): There are 63 children in this age group, representing 15.3% of the total. 10-12 years (Pre-Adolescents): There are 37 children in this age group, comprising 9% of the total. 13-18 years (Adolescents): There are 3 children in this age group, making up 0.7% of the total. This is as shown in the figure below

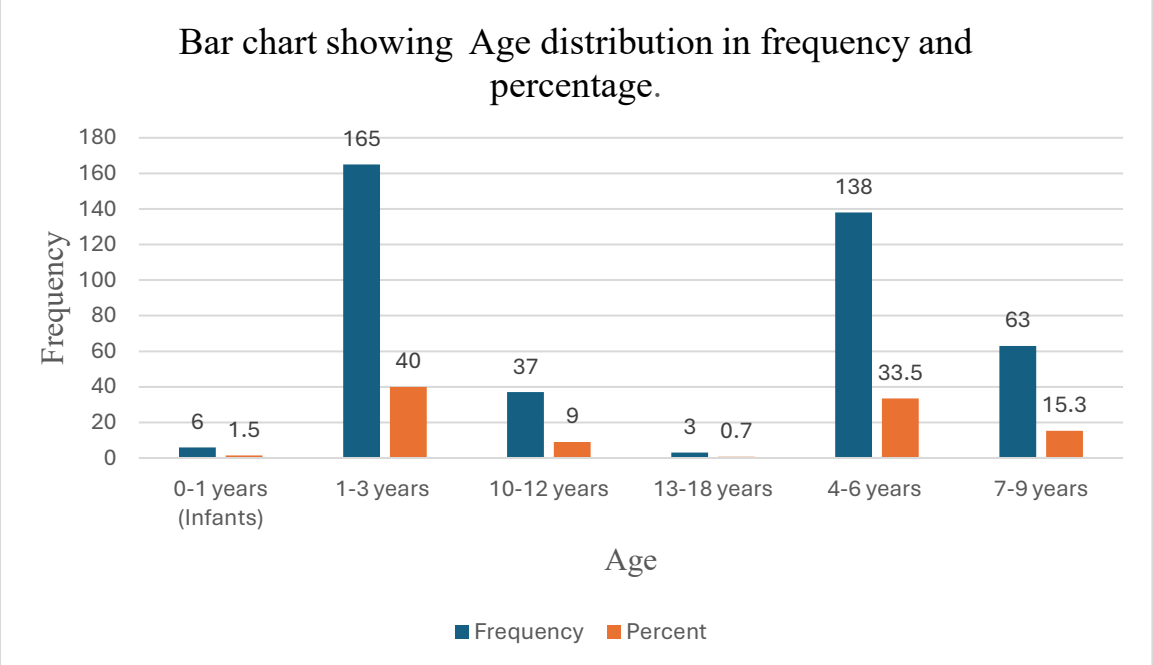

Figure 1: Figure showing Age distribution in this research.

Among 412 participants 227 (55.1%) were female and 184 (44.7%) were males as shown in the table below.

Gender	Frequency	Percent
Female	227	55.1
Male	184	44.7
Total	412	100

Table 1: Table showing gender distribution for this research.

RELATIONSHIP TO CHILD AND THE HIGHEST LEVEL OF EDUCATION COMPLETED.

Most respondents have completed secondary school that are 154 individuals (37.4%). This is the most common educational level among the individuals in the dataset, followed by primary school 114 individuals(27.7%), and a smaller number have a university/college degree 52 individuals(12.6%). Respondents having no education accomplishment were90 individuals(21.8%) and others were 2 individuals(0.5%).

Most of the respondents who are associated with the children are relatives (47.1%), followed by parents (39.1%), and a smaller portion are categorized as other (13.8%). Suggesting that most children in the study are under the care of relatives, with parents being the next most common caregivers. Among the 57 individuals categorized under "Other" in the relationship to the child, the majority are caretakers(82.5%), followed by neighbours (15.8%), and stepfamily members (1.8%). This indicates that caretakers are the predominant group, with neighbours and stepfamily members representing a smaller fraction as explained on the table below.

TABLE OF RELATION TO CHILD DISTRIBUTION.

Relationship to child	Frequency	Percent
Other	57	13.8
Parent	161	39.1
Relative	194	47.1
Total	412	100

Table 2: Table showing distribution in the relationship to child. Other section is further illustrated on the next table.

TABLE OF DISTRIBUTION OF OTHER MEMBERS RELATED TO CHILD.

Others	Frequency	Percent
caretaker	47	82.4
neighbour	9	15.8
stepfamily	1	1.8
Total	57	100

Table 3:Table showing distribution of other members related to child.

4.1. PREVALENCE OF GI AND ASSOCIATED FACTORS AMONG PEOPLE WITH ASD AND TYPICALLY DEVELOPING CHILDREN.

Out of 412 respondents, In this study, 21.8% of the children, representing 90 individuals, have been diagnosed with ASD, while the remaining 78.2%, or 322 children, have not been diagnosed with ASD. This shows that a significant minority of the children in the dataset have ASD, with the majority being typically developing children.

Child being diagnosed with ASD	Frequency
No	322
Yes	90

Table 4: Table showing distribution of Child being diagnosed with ASD.

Prevalence of GI Symptoms:

i. **Children with ASD:** Out of the total number of children with ASD in the study, 21.8% were found to have gastrointestinal (GI) symptoms.

i. **Typically Developing Children:** The prevalence rate of GI symptoms found in typically developing children. 6.52% of typically developing children exhibited GI symptoms.

THE ASSOCIATION BETWEEN GI SYMPTOMS AND ASD IN CHILDREN.

The association between GI symptoms and ASD in children was done using Pearson's Chi-Square test. The results are presented in the format of a contingency table, with the degree of recurrence of each GI symptom categorized as "Always," "Never," "Often," "Rarely," and "Sometimes." The table also includes the Chi-Square value, degrees of freedom (df), and the p-value.

i. Heartburn.

There is a significant association between heartburn and ASD, as indicated by the Chi-Square value of 43.099 and p-value of < 0.05. Children with ASD are more likely to experience heartburn rarely compared to children without ASD.

ii. Nausea/Vomiting.

The results show a significant association between nausea/vomiting and ASD, with a Chi-Square value of 28.853 and a p-value of < 0.05. Children with ASD are more likely to experience nausea/vomiting often compared to children without ASD.

iii. Loss of Appetite.

There is a significant association between loss of appetite and ASD, as indicated by the Chi-Square value of 48.597 and a p-value of < 0.05. Children with ASD are more likely to experience loss of appetite rarely compared to children without ASD.

iv. Gas.

The results demonstrate a significant association between gas and ASD, with a Chi-Square value of 91.655 and a p-value < 0.05. Children with ASD are more likely to experience gas rarely compared to children without ASD.

v. Constipation.

There is a significant association between constipation and ASD, as indicated by the Chi-Square value of 62.897 and a p-value < 0.05. Children with ASD are more likely to experience constipation often compared to children without ASD.

vi. Diarrhoea.

The results show a significant association between diarrhoea and ASD, with a Chi-Square value of 66.438 and a p-value of < 0.05. Children with ASD are more likely to experience diarrhoea rarely compared to children without ASD.

vii. Abdominal Pain.

There is a significant association between abdominal pain and ASD, as indicated by the Chi-Square value of 41.304 and a p-value of < 0.05. Children with ASD are more likely to experience abdominal pain often compared to children without ASD.

From this data, there is a significant association between various GI symptoms and ASD in children. The results indicate that children with ASD are more likely to experience some GI symptoms with varying degrees of recurrence such as heartburn rarely, nausea/vomiting often, loss of appetite rarely, gas rarely, constipation often, diarrhoea rarely, and abdominal pain often compared to children without ASD. The Chi-Square values for all symptoms are statistically significant, with p-values less than 0.05, suggesting a strong association between GI symptoms and ASD.

TABLE OF ASSOCIATION BETWEEN GI SYMPTOMS OCCURRENCE AND ASD.

GI symptom	Degree of recurrence	Has your child been diagnosed with ASD?		Pearson Chi-Square		
		No	Yes	Value	df	p-value
Heartburn	Always	3	1	43.099	5	0
	Never	263	46			
	Often	6	2			
	Rarely	32	33			
	Sometimes	16	8			
Nausea/Vomiting	Always	2	2	28.853	5	< 0.05
	Never	220	38			
	Often	36	21			
	Rarely	32	22			
	Sometimes	31	7			
Loss of appetite	Always	9	0	48.597	4	< 0.05
	Never	260	53			
	Often	20	1			
	Rarely	25	30			

	Sometimes	8	6			
Other	Never	301	86	5.57	4	0.234
	Often	6	0			
	Rarely	2	2			
	Sometimes	6	2			
Gas	Always	4	0	91.655	4	< 0.05
	Never	238	21			
	Often	25	28			
	Rarely	39	37			
	Sometimes	16	4			
Constipation	Always	2	1	62.897	5	< 0.05
	Never	259	39			
	Often	29	29			
	Rarely	15	18			
	Sometimes	11	3			
Diarrhoea	Always	4	6	66.438	5	< 0.05
	Never	233	32			
	Often	25	20			

	Rarely	31	29			
	Sometimes	28	2			
Abdominal pain	Always	11	3	41.304	4	< 0.05
	Never	200	27			
	Often	39	31			
	Rarely	45	24			
	Sometimes	27	5			

Table 5: Table showing the association between GI symptoms occurrence and ASD.

4.2.THE ASSOCIATION BETWEEN AGE DISTRIBUTION AND ASD.

There is a statistically significant association between age group and the diagnosis of ASD. The Chi-Square value of 23.339 with 5 degrees of freedom (df) and a p-value less than 0.05. This suggests that the likelihood of an ASD diagnosis varies significantly across different age categories. Specifically, the distribution of ASD diagnoses is not uniform across the age groups. The test indicates that age is an important factor in the prevalence of ASD diagnoses among children.

Breaking down the age categories, most ASD diagnoses occur in the 1-3 years age group (20 out of 165), while the other age groups show lower frequencies of ASD diagnoses. Infants (0-1 years) and pre-adolescents (10-12 years) show some instances of ASD, but fewer cases are observed in adolescents (13-18 years), with no diagnoses reported in this age group in the sample. This pattern could suggest that ASD is more commonly identified in early developmental stages, and diagnoses may be less frequent or less recognized in older age groups in these findings. Shown in the table below.

TABLE OF ASSOCIATION BETWEEN AGE OF CHILD AND THE TIME OF DIAGNOSIS FOR ASD.

Age of child: _____ years old	Has your child been diagnosed with ASD?		Pearson Chi-Square		
	No	Yes	Value	df	p-value
0-1 years (Infants)	5	1	23.339	5	< 0.05
1-3 years (Toddlers)	145	20			
10-12 years (Pre-Adolescents)	32	5			
13-18 years (Adolescents)	3	0			

Table 6: Table showing association between age distribution and the time of diagnosis for ASD.

FACTORS THAT ARE ASSOCIATED WITH GI SYMPTOMS.

The binomial logistic regression analysis was conducted to examine the association between various factors and the presence of GI symptoms in children. The results are presented in the form of parameter estimates, which include the regression coefficients (B), standard errors, Wald statistics, degrees of freedom (df), significance levels (Sig.), odds ratios (Exp(B)), and 95% confidence intervals for the odds ratios.

Factors Associated with GI Symptoms

1. **Age of child**: The results suggest that children in the 1-3 years (Toddlers), 10-12 years (Pre-Adolescents), and 4-6 years (Preschoolers) age groups are more likely to have GI symptoms compared to children in the 7-9 years (Early Childhood) age group. However, the large standard errors and wide confidence intervals for the odds ratios indicate potential instability in these estimates, likely due to sparse data or separation issues.

2. **Sex of child**: Female children are less likely to have GI symptoms compared to male children (OR = 0.600, 95% CI: 0.170-2.117), but this association is not statistically significant (p = 0.427).
3. **ASD diagnosis**: Children diagnosed with autism spectrum disorder (ASD) are more likely to have GI symptoms compared to those without an ASD diagnosis. However, this variable is set as the reference category, so the odds ratio cannot be directly interpreted.
4. **Main source of drinking water**: Children whose main source of drinking water is bottled water, surface water, or tap water are less likely to have GI symptoms compared to those using well water. However, the odds ratios for bottled water and surface water have very wide confidence intervals due to potential separation issues.
5. **Boiling drinking water**: Children whose drinking water is always, sometimes, or never boiled before use are more likely to have GI symptoms compared to those who are not sure about boiling their drinking water. Again, the odds ratios have very wide confidence intervals, indicating potential instability in the estimates.

   The binomial logistic regression analysis suggests that factors such as age, sex, ASD diagnosis, main source of drinking water, and boiling drinking water may be associated with the presence of gastrointestinal symptoms in children. However, the interpretation of these results should be approached cautiously due to the presence of sparse data, separation issues, and large standard errors for some variables, which can lead to unreliable statistical significance. To enhance the reliability of the analysis, it is advisable to have a larger sample size, ensure adequate representation in each category.

To enhance the reliability of the analysis, it is advisable to have a larger sample size, ensure adequate representation in each category.

Parameter Estimates

Were there any previous similar episodes of GI symptoms?[a]			B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
									Lower Bound	Upper Bound
	Intercept		-21.874	12647.816	.000	1	.999			
	If yes, please specify age at diagnosis: _____ years old		.512	.374	1.874	1	.171	1.669	.802	3.474
	[Age of child: _____ years old=1-3 years (Toddlers)]		1.494	2695.432	.000	1	1.000	4.455	.000	.[b]
	[Age of child: _____ years old=10-12 years (Pre-Adolescents)]		13.320	4151.399	.000	1	.997	609489.701	.000	.[b]
	[Age of child: _____ years old=4-6 years (Preschoolers)]		16.701	1670.751	.000	1	.992	17906055.838	.000	.[b]
	[Age of child: _____ years old=7-9 years (Early Childhood)]		0[c]	.	.	0	.	.	.	.
	[Sex of child:=Female]		-14.811	1646.455	.000	1	.993	3.695E-7	.000	.[b]
	[Sex of child:=Male]		0[c]	.	.	0	.	.	.	.
		[Has your child been diagnosed with ASD?=Yes]	0[c]	.	.	0	.	.	.	.
		[What was the main source of drinking water?=Bottled water]	-1.734	.000	.	1	.	.177	.177	.177
	[What was the main source of drinking water?=Surface water (e.g., rivers, lakes)]		-17.389	5695.128	.000	1	.998	2.805E-8	.000	.[b]
	[What was the main source of drinking water?=Tap water]		-15.036	1329.596	.000	1	.991	2.951E-7	.000	.[b]
	[What was the main source of drinking water?=Well water]		0[c]	.	.	0	.	.	.	.
	[Was the drinking water boiled before use?= Yes, always]		1.116	12979.286	.000	1	1.000	3.052	.000	.[b]
	[Was the drinking water boiled before use?= Yes, sometimes]		1.908	12536.979	.000	1	1.000	6.738	.000	.[b]
	[Was the drinking water boiled before use?=No, never]		-13.984	12718.184	.000	1	.999	8.446E-7	.000	.[b]
	[Was the drinking water boiled before use?=Not sure]		0[c]	.	.	0	.	.	.	.
No	Intercept		-17.742	6411.868	.000	1	.998			
	If yes, please specify age at diagnosis: _____ years old		-.077	.243	.100	1	.752	.926	.576	1.490
	[Age of child: _____ years old=1-3 years (Toddlers)]		.440	1.421	.096	1	.757	1.552	.096	25.173
	[Age of child: _____ years old=10-12 years (Pre-Adolescents)]		-.323	1.457	.049	1	.825	.724	.042	12.592
	[Age of child: _____ years old=4-6 years (Preschoolers)]		-.728	.981	.550	1	.458	.483	.071	3.305
	[Age of child: _____ years old=7-9 years (Early Childhood)]		0[c]	.	.	0	.	.	.	.
	[Sex of child:=Female]		-.511	.643	.630	1	.427	.600	.170	2.117
	[Sex of child:=Male]		0[c]	.	.	0	.	.	.	.
		[Has your child been diagnosed with ASD?=Yes]	0[c]	.	.	0	.	.	.	.
		[What was the main source of drinking water?=Bottled water]	-16.100	6411.867	.000	1	.998	1.018E-7	.000	.[b]
	[What was the main source of drinking water?=Surface water (e.g., rivers, lakes)]		-16.299	3195.621	.000	1	.996	8.348E-8	.000	.[b]
	[What was the main source of drinking water?=Tap water]		.702	.602	1.360	1	.244	2.018	.620	6.566
	[What was the main source of drinking water?=Well water]		0[c]	.	.	0	.	.	.	.
	[Was the drinking water boiled before use?= Yes, always]		17.497	6411.867	.000	1	.998	39708839.261	.000	.[b]
	[Was the drinking water boiled before use?= Yes, sometimes]		17.513	6411.867	.000	1	.998	40354062.914	.000	.[b]
	[Was the drinking water boiled before use?=No, never]		17.344	6411.867	.000	1	.998	34071397.325	.000	.[b]
	[Was the drinking water boiled before use?=Not sure]		0[c]	.	.	0	.	.	.	.

a. The reference category is: Yes.

b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

Figure 2: Figure showing factors associated with GI symptoms.

CHAPTER FIVE.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS.

5.0.DISCUSSION.

There is a significant association between GI symptoms and ASD in children, contributing to the growing body of literature that highlights the prevalence of GI issues within this population. Specifically, the study revealed that 21.8% of children diagnosed with ASD experienced GI symptoms, compared to only 6.52% of typically developing children. This stark contrast suggests that children with ASD are disproportionately affected by gastrointestinal disturbances, which may stem from a combination of biological, behavioural, and environmental factors(10,38,39).

The analysis employing Pearson's Chi-Square test demonstrated significant associations between various GI symptoms and ASD, with heartburn, nausea/vomiting, loss of appetite, gas, constipation, diarrhoea, and abdominal pain all showing statistically significant relationships. For instance, children with ASD were more likely to report experiencing nausea/vomiting often and constipation frequently. These findings are consistent with previous research indicating that children with ASD often present with a higher incidence of GI symptoms, which can adversely affect their overall health and quality of life(40,41).

Moreover, the age distribution of ASD diagnoses in this study reveals that the highest prevalence occurs in the 1-3 years age group, suggesting that early childhood is a critical period for identifying and addressing ASD-related symptoms. This aligns with the notion that early intervention can significantly improve outcomes for children with ASD, as symptoms are often more pronounced during these formative years(26,40,42). The data also indicate that diagnoses become less frequent in older age groups, which may reflect either a decline in the recognition of ASD symptoms or a natural progression of the disorder as children age.

The binomial logistic regression analysis further elucidated the factors associated with GI symptoms, highlighting the importance of considering age, sex, and environmental factors such as the source and treatment of drinking water. The results indicated that children in the toddler and pre-adolescent age groups were more likely to experience GI symptoms compared to their peers in the early childhood age group. Additionally, the analysis suggested that the main source of drinking water may influence the prevalence of GI symptoms, with well water users potentially facing higher risks. This finding raises questions about the safety and quality of drinking water and its implications for children's health, particularly in vulnerable populations(26).

However, the study's limitations, including sparse data and potential separation issues in the logistic regression analysis, warrant caution in interpreting the results. The wide confidence intervals for some odds ratios indicate instability in the estimates, which could impact the reliability of the findings. Future research should aim to include larger sample sizes and more diverse populations to enhance the generalizability of the results. Exploring the underlying mechanisms linking GI symptoms and ASD, such as dietary factors, gut microbiome composition, and environmental exposures, could provide valuable insights into effective interventions for this population(42,43).

5.1.RECOMMENDATIONS.

Based on the findings of this study, several recommendations are proposed to enhance the understanding and management of GI symptoms in children with ASD:

i. **Routine Screening for GI Symptoms**: Healthcare providers should implement regular screening for GI symptoms in children diagnosed with ASD, particularly during early developmental stages. Early identification of these symptoms can lead to timely interventions that may improve overall health and quality of life.

ii. **Parental Education and Support:** Parents and caregivers should receive education about the potential for GI symptoms in children with ASD. Providing resources and support can empower families to recognize symptoms early and seek appropriate medical advice.

iii. **Research on Dietary Factors**: Future studies should investigate the impact of dietary habits and nutritional intake on GI health in children with ASD. Understanding how diet influences GI symptoms can inform dietary interventions that may alleviate these issues.

iv. **Water Quality Assessment**: Given the association between the source and treatment of drinking water and GI symptoms, it is essential to assess water quality in communities with higher rates of GI issues. Public health initiatives should promote safe drinking water practices, including proper boiling methods.

v. **Increased Sample Sizes in Future Research**: Future research should aim for larger and more diverse sample sizes to validate these findings. This will enhance the reliability of the results and provide a more comprehensive understanding of the relationship between GI symptoms and ASD.

vi. **Multidisciplinary Approach**: A multidisciplinary approach involving paediatricians, gastroenterologists, nutritionists, and psychologists should be adopted to address the

complex needs of children with ASD experiencing GI symptoms. Collaborative care can lead to more effective management strategies tailored to individual needs.

5.2.CONCLUSION.

This study investigated the prevalence and associations of GI symptoms in children with ASD compared to typically developing children. The results reveal that 21.8% of children with ASD experience GI symptoms, significantly higher than the 6.52% observed in typically developing children. Pearson's Chi-Square test demonstrates robust associations between various GI symptoms and ASD, with p-values less than 0.05. The analysis highlights the critical role of age, showing the highest prevalence of both ASD and GI symptoms in the 1-3 years age group

This emphasizes the importance of early diagnosis and intervention for children with ASD. Logistic regression identifies additional factors, such as age, sex, and the source and treatment of drinking water, as potential contributors to GI symptoms in children.

However, the study acknowledges limitations, including sparse data and potential issues with regression analysis, which warrant cautious interpretation of the results. To validate these findings and further explore the relationship between GI symptoms and ASD, future research should focus on larger, more diverse samples aiming to explore the underlying mechanisms driving these associations, with a focus on expanding sample sizes and improving the generalizability of findings.

REFERENCES.

1. Zeidan J, Fombonne E, Scorah J, Ibrahim A, Durkin MS, Saxena S, et al. Global prevalence of autism: A systematic review update. Autism Res [Internet]. 2022 May 1 [cited 2024 Mar 30];15(5):778. Available from: /pmc/articles/PMC9310578/
2. Aderinto N, Olatunji D, Idowu O. Autism in Africa: prevalence, diagnosis, treatment and the impact of social and cultural factors on families and caregivers: a review. Ann Med Surg [Internet]. 2023 Sep [cited 2024 Mar 31];85(9):4410. Available from: /pmc/articles/PMC10473371/
3. Fulceri F, Morelli M, Santocchi E, Cena H, Del Bianco T, Narzisi A, et al. Gastrointestinal symptoms and behavioral problems in preschoolers with Autism Spectrum Disorder. Dig Liver Dis. 2016 Mar 1;48(3):248–54.
4. Buie T, Campbell DB, Fuchs GJ, Furuta GT, Levy J, Van De Water J, et al. Evaluation, diagnosis, and treatment of gastrointestinal disorders in individuals with ASDs: a consensus report. Pediatrics [Internet]. 2010 Jan [cited 2024 Apr 10];125 Suppl 1(SUPPL. 1). Available from: https://pubmed.ncbi.nlm.nih.gov/20048083/
5. Frye RE, Rose S, Slattery J, MacFabe DF. Gastrointestinal dysfunction in autism spectrum disorder: the role of the mitochondria and the enteric microbiome. Microb Ecol Health Dis [Internet]. 2015 May 7 [cited 2024 Apr 10];26(0). Available from: /pmc/articles/PMC4425813/
6. Adams JB, Johansen LJ, Powell LD, Quig D, Rubin RA. Gastrointestinal flora and gastrointestinal status in children with autism--comparisons to typical children and correlation with autism severity. BMC Gastroenterol [Internet]. 2011 Mar 16 [cited 2024 Apr 10];11. Available from: https://pubmed.ncbi.nlm.nih.gov/21410934/
7. Parracho HMRT, Bingham MO, Gibson GR, McCartney AL. Differences between the gut microflora of children with autistic spectrum disorders and that of healthy children.

J Med Microbiol. 2005 Oct;54(10):987–91.

8. Holingue C, Newill C, Lee LC, Pasricha PJ, Daniele Fallin M. Gastrointestinal Symptoms in Autism Spectrum Disorder: A Review of the Literature on Ascertainment and Prevalence. Autism Res [Internet]. 2018 Jan 1 [cited 2024 Mar 26];11(1):24. Available from: /pmc/articles/PMC5773354/

9. Al-Beltagi M, Saeed NK, Bediwy AS, Elbeltagi R, Alhawamdeh R. Role of gastrointestinal health in managing children with autism spectrum disorder. World J Clin Pediatr [Internet]. 2023 Sep 9 [cited 2024 Mar 28];12(4):171–96. Available from: https://pubmed.ncbi.nlm.nih.gov/37753490/

10. McElhanon BO, McCracken C, Karpen S, Sharp WG. Gastrointestinal symptoms in autism spectrum disorder: a meta-analysis. Pediatrics [Internet]. 2014 [cited 2024 Mar 26];133(5):872–83. Available from: https://pubmed.ncbi.nlm.nih.gov/24777214/

11. Namuli JD, Nakimuli-Mpungu E, Mwesiga EK, Joyce NS. Knowledge Gaps about Autism Spectrum Disorders and its Clinical Management among Child and Adolescent Health Care Workers in Uganda: A Cross-Sectional Study. EC Psychol psychiatry [Internet]. 2020 Sep;9(9):112–21. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34557878

12. Bowles T. Book Review: Diagnostic and statistical manual of mental disorders, fifth edition. Ment Heal Clin. 2013;3(2):107–107.

13. Matson JL, Goldin RL. Comorbidity and autism: Trends, topics and future directions. Vol. 7, Research in Autism Spectrum Disorders. 2013. p. 1228–33.

14. Wasilewska J, Klukowski M. Gastrointestinal symptoms and autism spectrum disorder: links and risks - a possible new overlap syndrome. Pediatr Heal Med Ther [Internet]. 2015 Sep [cited 2024 Mar 28];6:153–66. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29388597

15. VALICENTI-McDERMOTT M, McVICAR K, RAPIN I, WERSHIL BK, COHEN H, SHINNAR S. Frequency of Gastrointestinal Symptoms in Children with Autistic Spectrum Disorders and Association with Family History of Autoimmune Disease. J Dev Behav Pediatr [Internet]. 2006 Apr;27(Supplement 2):S128–36. Available from: http://journals.lww.com/00004703-200604002-00011

16. Restrepo B, Angkustsiri K, Taylor SL, Rogers SJ, Cabral J, Heath B, et al. Developmental-behavioral profiles in children with autism spectrum disorder and co-occurring gastrointestinal symptoms. Autism Res [Internet]. 2020 Oct 6;13(10):1778–89. Available from: https://onlinelibrary.wiley.com/doi/10.1002/aur.2354

17. Tkachuk EA, Martynovich NN, Globenko NE. [Features of the nutritional status and nutrition of children with autistic disorders]. Vopr Pitan [Internet]. 2021;90(5):67–76. Available from: https://www.voprosy-pitaniya.ru/ru/jarticles_diet/916.html?SSr=090134655313ffffffff27c__07e50a1b0d090a-3d43

18. Mazurek MO. Loneliness, friendship, and well-being in adults with autism spectrum disorders. Autism [Internet]. 2014 Apr 3;18(3):223–32. Available from: http://journals.sagepub.com/doi/10.1177/1362361312474121

19. Wang LW, Tancredi DJ, Thomas DW. The prevalence of gastrointestinal problems in children across the United States with autism spectrum disorders from families with multiple affected members. J Dev Behav Pediatr. 2011 Jun;32(5):351–60.

20. Hsiao EY. Gastrointestinal Issues in Autism Spectrum Disorder. Harv Rev Psychiatry [Internet]. 2014 Mar;22(2):104–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24614765

21. Troisi J, Autio R, Beopoulos T, Bravaccio C, Carraturo F, Corrivetti G, et al. Genome, Environment, Microbiome and Metabolome in Autism (GEMMA) Study Design:

Biomarkers Identification for Precision Treatment and Primary Prevention of Autism Spectrum Disorders by an Integrated Multi-Omics Systems Biology Approach. Brain Sci [Internet]. 2020 Oct 16;10(10):743. Available from: https://www.mdpi.com/2076-3425/10/10/743

22. Ferguson BJ, Dovgan K, Takahashi N, Beversdorf DQ. The Relationship Among Gastrointestinal Symptoms, Problem Behaviors, and Internalizing Symptoms in Children and Adolescents With Autism Spectrum Disorder. Front psychiatry [Internet]. 2019 Apr 9;10:194. Available from: https://www.frontiersin.org/article/10.3389/fpsyt.2019.00194/full

23. Crane L, Batty R, Adeyinka H, Goddard L, Henry LA, Hill EL. Autism Diagnosis in the United Kingdom: Perspectives of Autistic Adults, Parents and Professionals. J Autism Dev Disord [Internet]. 2018 Nov 12;48(11):3761–72. Available from: http://link.springer.com/10.1007/s10803-018-3639-1

24. Krigsman A, Walker SJ. Gastrointestinal disease in children with autism spectrum disorders: Etiology or consequence? World J psychiatry [Internet]. 2021 Sep 19;11(9):605–18. Available from: https://www.wjgnet.com/2220-3206/full/v11/i9/605.htm

25. Sandhu B, Steer C, Golding J, Emond A. The early stool patterns of young children with autistic spectrum disorder. Arch Dis Child. 2009 Jul;94(7):497–500.

26. Holingue C, Pfeiffer D, Ludwig NN, Reetzke R, Hong JS, Kalb LG, et al. Prevalence of gastrointestinal symptoms among autistic individuals, with and without co-occurring intellectual disability. Autism Res [Internet]. 2023 Aug 16;16(8):1609–18. Available from: https://onlinelibrary.wiley.com/doi/10.1002/aur.2972

27. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders [Internet]. American Psychiatric Association Publishing; 2022. Available

from: https://psychiatryonline.org/doi/book/10.1176/appi.books.9780890425787

28. Fu SC, Lee CH, Wang H. Exploring the Association of Autism Spectrum Disorders and Constipation through Analysis of the Gut Microbiome. Int J Environ Res Public Health [Internet]. 2021 Jan 14;18(2):667. Available from: http://www.ncbi.nlm.nih.gov/pubmed/33466802

29. Peters B, Williams KC, Gorrindo P, Rosenberg D, Lee EB, Levitt P, et al. Rigid-compulsive behaviors are associated with mixed bowel symptoms in autism spectrum disorder. J Autism Dev Disord [Internet]. 2014 [cited 2024 May 19];44(6):1425–32. Available from: https://www.autismparentingmagazine.com/child-constipation-causes/

30. Lanyi J, Flynn C, Mannion A, Maher L, Naughton K, Leader G. Abdominal Pain in Children and Adolescents with Autism Spectrum Disorder: a Systematic Review. Rev J Autism Dev Disord [Internet]. 2022 Jun 11;9(2):280–9. Available from: https://link.springer.com/10.1007/s40489-021-00257-8

31. Ayres M, Parr JR, Rodgers J, Mason D, Avery L, Flynn D. A systematic review of quality of life of adults on the autism spectrum. Autism. 2018;22(7):774–83.

32. Jyonouchi H. Food allergy and autism spectrum disorders: Is there a link? Curr Allergy Asthma Rep [Internet]. 2009 May 4;9(3):194–201. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19348719

33. Leader G, Abberton C, Cunningham S, Gilmartin K, Grudzien M, Higgins E, et al. Gastrointestinal Symptoms in Autism Spectrum Disorder: A Systematic Review. Nutrients [Internet]. 2022 Apr 1 [cited 2024 Apr 10];14(7). Available from: /pmc/articles/PMC9003052/

34. Mannion A, Leader G. An analysis of the predictors of comorbid psychopathology, gastrointestinal symptoms and epilepsy in children and adolescents with autism spectrum disorder. Res Autism Spectr Disord [Internet]. 2013 Dec;7(12):1663–71.

Available from: https://linkinghub.elsevier.com/retrieve/pii/S1750946713001980

35. Narzisi A, Masi G, Grossi E. Nutrition and Autism Spectrum Disorder: Between False Myths and Real Research-Based Opportunities. Nutrients [Internet]. 2021 Jun 17;13(6):2068. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34204187

36. Williams KC, Fuchs GJ, Furuta GT, Marcon MA, Coury DL. 511 Clinical Features Associated With GI Symptoms in Autism Spectrum Disorders (ASD). Gastroenterology [Internet]. 2010 May;138(5):S-74. Available from: https://linkinghub.elsevier.com/retrieve/pii/S001650851060337X

37. Babinska K, Celusakova H, Belica I, Szapuova Z, Waczulikova I, Nemcsicsova D, et al. Gastrointestinal Symptoms and Feeding Problems and Their Associations with Dietary Interventions, Food Supplement Use, and Behavioral Characteristics in a Sample of Children and Adolescents with Autism Spectrum Disorders. Int J Environ Res Public Health [Internet]. 2020 Sep 1;17(17):6372. Available from: https://www.mdpi.com/1660-4601/17/17/6372

38. Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015 Aug 22;386(9995):743–800.

39. Guthrie W, Wallis K, Bennett A, Brooks E, Dudley J, Gerdes M, et al. Accuracy of Autism Screening in a Large Pediatric Network. Pediatrics [Internet]. 2019 Oct 1;144(4). Available from: https://publications.aap.org/pediatrics/article/144/4/e20183963/76979/Accuracy-of-Autism-Screening-in-a-Large-Pediatric

40. Wang J, Ma B, Wang J, Zhang Z, Chen O. Global prevalence of autism spectrum disorder and its gastrointestinal symptoms: A systematic review and meta-analysis.

Front Psychiatry [Internet]. 2022 Aug 23;13. Available from: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.963102/full

41. Kern JK, Trivedi MH, Garver CR, Grannemann BD, Andrews AA, Savla JS, et al. The pattern of sensory processing abnormalities in autism. Autism [Internet]. 2006 Sep 30;10(5):480–94. Available from: http://journals.sagepub.com/doi/10.1177/1362361306066564

42. Chawarska K, Macari S, Shic F. Decreased spontaneous attention to social scenes in 6-month-old infants later diagnosed with autism spectrum disorders. Biol Psychiatry [Internet]. 2013 Aug 1;74(3):195–203. Available from: https://linkinghub.elsevier.com/retrieve/pii/S000632231201030X

43. Gan H, Su Y, Zhang L, Huang G, Lai C, Lv Y, et al. Questionnaire-based analysis of autism spectrum disorders and gastrointestinal symptoms in children and adolescents: a systematic review and meta-analysis. Front Pediatr [Internet]. 2023 Jul 26;11. Available from: https://www.frontiersin.org/articles/10.3389/fped.2023.1120728/full

CHAPTER SIX.

APPENDICES.

APPENDIX I: INFORMED CONSENT FORM ENGLISH VERSION.

TITLE: GASTROINTESTINAL SYMPTOMS AMONG CHILDREN WITH AUTISM SPECTRUM DISORDER COMPARED TO TYPICALLY DEVELOPING CHILDREN IN MWANZA REGION.

Introduction. I am a fifth-year medical student at the Catholic University of Health and Allied Science, Mwanza, Tanzania. As part of the course of studies, all students are required to do research. I am researching "Gastrointestinal symptoms among children with autism spectrum disorder compared to typically developing children in Mwanza region." This study will be under the supervision of a specialist in epidemiology at BMC, Mr. Peter M Chilipweli. B.Sc. M.Sc.

Purpose of this study.

The purpose of this study is to investigate the prevalence and characteristics of gastrointestinal (GI) symptoms among children with Autism Spectrum Disorder (ASD) compared to typically developing children in the Mwanza region. The information gathered from this study aims to enhance our understanding of the relationship between ASD and GI symptoms, particularly in the context of the Mwanza region, and may inform future interventions and support services for children with ASD.

How to participate.

If you agree to participate in this study, you will be asked to complete a structured questionnaire. The questionnaire will include questions about your understanding of intellectual disability, perceptions of societal attitudes towards disability, and beliefs about the capabilities of intellectually disabled children. Participation in the study is expected to take five to ten minutes.

Confidentiality.

Your participation in this study will be kept confidential. Your responses will be anonymized and aggregated for analysis purposes. A report will be prepared that will include information obtained from you without your name being mentioned.

Risks.

This study poses no harmful risks.

Costs:

You will not be required to pay any extra amount for your participation in this study.

Right to participate.

Participation in this study is voluntary, and you have the right to withdraw at any time without consequence. No reason will be demanded for either of the decisions. Once you have decided to participate, you are free to terminate your participation at any time. Your decision to participate or not participate will not affect your relationship with the researcher or any organizations involved in the study.

Who to contact?

For any inquiries or concerns regarding this study or your right to participate. Please feel free to contact the researcher, Emmanuel Julius Chaligha at +255 769 901 468 or Peter M Chilipweli at +255 719 667 926.

INVESTIGATOR'S STATEMENT.

I the investigator have educated the research participant on the purpose and applications of this study.

Signature of investigator …… Date…….

PARTICIPANT'S STATEMENT.

I ……. have listened and understood the contents of this consent form and my questions have been sufficiently answered. I therefore consent to participate.

Signature of participant ……... Date ……

APPENDIX II: INFORMED CONSENT FORM KISWAHILI VERSION.

KICHWA CHA UTAFITI: DALILI ZA MAGONJWA YA MFUMO WA MMEN'GENYO (GI) KWA WATOTO WENYE KUPATWA NA UGONJWA WA SPEKTRA YA UTAMBUZI WA USONJI (ASD) IKILINGANISHWA NA WATOTO WA KAWAIDA KATIKA MKOA WA MWANZA.

Utangulizi.

Mimi ni mwanafunzi wa udaktari mwaka wa nne kutoka Chuo Kikuu cha Katoliki cha Afya na Sayansi Shirikishi Mwanza, Tanzania. Katika sehemu ya mafunzo yangu ninapaswa kufanya utafiti. Utafiti wangu kuhusu "ufahamu, imani, na mitazamo kuhusu watoto walio na ulemavu wa akili miongoni mwa wazazi/walezi wenye watoto wenye ulemavu katika wilaya ya Nyamagana." Utafiti huu utakuwa chini ya uangalizi wa mtaalamu utafiti na epidemiolojia katika BMC, Mr. Peter M Chilipweli B.Sc. M.Sc.

Lengo la Utafiti.

Madhumuni ya utafiti huu ni kuchunguza upatikanaji na sifa za dalili za magonjwa ya njia mmeng'enyo (GI) kwa watoto wenye Ugonjwa wa Spektra ya Utambuzi wa usonji (ASD) ikilinganishwa na watoto wa kawaida katika mkoa wa Mwanza. Taarifa zinazokusanywa kupitia utafiti huu zinalenga kuboresha uelewa wetu wa uhusiano kati ya ASD na dalili za GI, haswa katika muktadha wa mkoa wa Mwanza, na inaweza kusaidia katika kuboresha huduma na msaada kwa watoto wenye ASD.

Jinsi ya Kushiriki.

Ikiwa unakubali kushiriki katika utafiti huu, utaulizwa kujaza maswali ya utafiti yaliyoandaliwa kwenye fomu ya utafiti. Maswali yatahusu ufahamu wako kuhusu ulemavu wa akili, mitazamo yako kuhusu tabia za kijamii kuhusu ulemavu, na imani yako kuhusu uwezo wa watoto walio na ulemavu wa akili. Kushiriki kwenye utafiti kunatarajiwa kuchukua kati ya dakika tano hadi kumi.

Uhifadhi wa Siri.

Ushiriki wako katika utafiti huu utahifadhiwa kwa siri. Majibu yako yatafanywa kuwa siri na yatajumuishwa kwa ajili ya uchambuzi wa utafiti. Ripoti itatayarishwa ambayo itajumuisha habari iliyopatikana kutoka kwako bila kutaja jina lako.

Uhakika wa usalama.

Utafiti huu hautahusisha hatari yoyote inayoweza kudhuru.

Gharama.

Hautalazimika kulipa gharama yoyote ziada kwa ushiriki wako katika utafiti huu.

Haki ya Kushiriki.

Kushiriki katika utafiti huu ni hiari, na una haki ya kujiondoa wakati wowote bila madhara yoyote. Sababu haitahitajika kwa uamuzi wako wowote. Mara baada ya kufanya uamuzi wa kushiriki au kutoshiriki, una uhuru wa kusitisha ushiriki wako wakati wowote. Uamuzi wako wa kushiriki au kutoshiriki hautaathiri uhusiano wako na mtafiti au mashirika yoyote yanayohusika katika utafiti huu.

Mawasiliano.

Kwa maswali au wasiwasi wowote kuhusu utafiti huu au haki yako ya kushiriki, tafadhali wasiliana na mtafiti, Emmanuel Julius Chaligha kwa simu +255 769 901 468 au Mr. Peter M Chilipweli kwa simu +255 719 667 926.

TAARIFA YA MTAFITI.

Mimi, mtu anayefanya utafiti, nimewaelimisha washiriki wa utafiti kuhusu madhumuni na matumizi ya utafiti huu.

Sahihi ya Mtafiti …….. Tarehe ……

TAARIFA YA MWANAFUNZI.

Mimi, ……. nimeusikiliza na kuelewa maudhui ya fomu hii ya ridhaa na maswali yangu yamejibiwa kwa kutosha. Hivyo basi, naunga mkono kushiriki.

Sahihi ya Mshiriki ……... Tarehe ……

APPENDIX III: ENGLISH VERSION QUESTIONNAIRE.

Section 1: Participant Information

A. Child Information

1. Age of child: _____ years old
2. Sex of child:
    - Male
    - Female

B. Parent/Guardian Information

3. Relationship to child:
    - Parent
    - Guardian
    - Other (please specify): _____
4. Highest level of education completed:
    - None
    - Primary School
    - Secondary School
    - University/College Degree
    - Other (please specify): _____
5. Contact Information (Phone/Email): _____

Section 2: General Information

6. Has your child been diagnosed with ASD?
    - Yes
    - No
    - If yes, please specify age at diagnosis: _____ years old.
7. Is your child currently on any medication for ASD or other health conditions?
    - [ ] Yes
    - [ ] No
    - If yes, please specify _____

Section 3: Gastrointestinal Symptoms

Please indicate how often your child experiences the following symptoms in the past month:

Symptom	Never (0)	Rarely (1)	Sometimes (2)	Often (3)	Always (4)
Stomach aches					
Diarrhoea					
Constipation					
Gas					
Heartburn					
Vomiting					
Loss of appetite					
Other (please specify): _____					

Section 4: Additional Information

8. Does your child have any diagnosed GI conditions (e.g., Irritable Bowel Syndrome, lactose intolerance)?
    - Yes
    - No
    - If yes, please specify: _____
9. Does your child take any medications for GI problems?
    - Yes
    - No
    - If yes, please specify: _____
10. Describe your child's typical daily dietary intake, including meal types (e.g., breakfast, lunch, dinner) and any snacks:
11. Briefly describe any dietary restrictions your child has (if any): _____
12. Does your child have any food allergies or intolerances? If yes, please specify:

13. What was the main source of drinking water?
    - Tap water
    - Well water
    - Bottled water
    - Surface water (e.g., rivers, lakes)
    - Rainwater
14. Was the drinking water boiled before use?
    - Yes, always
    - Yes, sometimes
    - No, never
    - Not sure
15. How would you rate your child's overall dietary quality?
    - Poor
    - Fair
    - Good
    - Excellent
16. Is there anything else you would like to share about your child's GI health?

    _____

    _____

    _____

APPENDIX IV: DODOSO LA KISWAHILI.

Sehemu 1: Taarifa za Washiriki

A. Taarifa za Mtoto

1. Umri wa mtoto: _____ miaka
2. Jinsia ya mtoto:
    - Kiume
    - Kike

B. Taarifa za Mlezi/Mlezi

3. Mahusiano na mtoto:
    - Mzazi
    - Mlezi
    - Mengine (taja): _____
4. Kiwango cha elimu kilichokamilishwa:
    - Hakuna
    - Shule ya Msingi
    - Shule ya Sekondari
    - Shahada ya Chuo Kikuu
    - Nyingine (taja): _____
5. Taarifa za Mawasiliano (Simu/Barua pepe): _____

Sehemu 2: Taarifa za Jumla

6. Je, mtoto wako amepata uchunguzi wa ASD?
    - Ndiyo
    - Hapana
    - Ikiwa ndiyo, tafadhali taja umri alipogunduliwa: _____ miaka.
7. Je, mtoto wako anatumia dawa yoyote kwa ASD au hali nyingine ya kiafya?
    - Ndiyo
    - Hapana
    - Ikiwa ndiyo, tafadhali taja: _____

Sehemu 3: Dalili za Matumbo

Tafadhali eleza mara ngapi mtoto wako amepata dalili zifuatazo katika mwezi uliopita:

Dalili	Kamwe (0)	Mara chache (1)	Wakati mwingine (2)	Mara nyingi (3)	Mara zote (4)
Maumivu ya tumbo					
Kuhara					
Kupata choo kigumu					
Gesi					
Kiungulia					
Kichefuchefu/ kutapika					
Kupoteza hamu ya kula					
Nyingine (taja):_____ _____					

8. Je, mtoto wako ana matatizo yoyote ya matumbo yaliyogunduliwa (kwa mfano, Ugonjwa wa Utumbo wenye Hasira, uvumilivu hafifu wa laktose)?
   - Ndio
   - Hapana
   - Kama ndiyo, tafadhali taja: _____
9. Je, mtoto wako anatumia dawa yoyote kwa matatizo ya matumbo?
   - Ndio
   - La
   - Kama ndiyo, tafadhali taja: _____
10. Elezea mlo wa kawaida wa mtoto wako kila siku, ikiwa ni pamoja na aina za milo (kwa mfano, kifungua kinywa, chakula cha mchana, cha jioni) na vitafunio vyovyote:
11. Fafanua kwa ufupi vizuizi vyovyote vya mlo ambavyo mtoto wako anayo (kama vipo): _____

12. Je, mtoto wako ana mzio wowote wa chakula au uvumilivu hafifu? Ikiwa ndio, tafadhali taja:
13. Chanzo kikuu cha maji ya kunywa kilikuwa kipi?

- Maji ya bomba
- Maji ya kisima
- Maji ya chupa
- Maji ya uso (mfano, mito, maziwa)
- Maji ya mvua

14. Je, maji ya kunywa yalichemshwa kabla ya kutumiwa?

- Ndio, kila mara
- Ndio, wakati mwingine
- Hapana, kamwe
- Sijui

15. Ungepima ubora wa jumla wa mlo wa mtoto wako kwa viwango vipi?
    - Duni
    - Feki
    - Nzuri
    - Bora

Sehemu 4: Taarifa Nyingine

16. Je, kuna kitu kingine chochote ungependa kushiriki kuhusu afya ya matumbo ya mtoto wako au tabia zake za kula?

_____

_____

_____

APPENDIX V: RESEARCH BUDGET.

This proposal is requesting for conduction of elective research in Nyamagana district, Mwanza, and a total of 410,000/= is being requested to cover for research tools and instruments, data analysis and report writing.

ITEM	**QUANTITY**	**COST PER EACH**	**TOTAL**
Proposal typing and printing	3	@45,000/-	135,000/-
Stationery	4	@6,000/-	24,000/-
Report Printing	3	@12,000/-	36,000/-
Meals and Accommodation	30	@3000/-	90,000/-
Contingency			65,000/-
Transport fare	30	@2,000/-	60,000/-
TOTAL			**410,000/-**

APPENDIX VI : WORK PLAN.

ACTIVITY	SEPT	OCT	NOV	DEC	JAN	FEB	JULY	AUGUST
Concept presentation								
Proposal writing								
Proposal presentation								
Data collection								
Data analysis								
Report writing								
Report analysis								