DIETARY PATTERNS, NUTRITIONAL STATUS AND DENTAL CARIES EXPERIENCE AMONG CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER ATTENDING CITY PRIMARY SCHOOL IN NAIROBI, KENYA.

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V60/7552/2017

A RESEARCH DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTER OF DENTAL SURGERY DEGREE IN PAEDIATRIC DENTISTRY OF THE UNIVERSITY OF NAIROBI.

DECLARATION

I, Mbaabu Eunice Ngugi, declare that this is my original work and has not been submitted in any other institution.

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SUPERVISORS APPROVAL

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DEDICATION

This work is dedicated to my husband, Mr. Philip Gatongi Maina; A pillar of strength to me.

To the children at City Primary school Autism Unit with whom a special bond was created:

May you keep smiling.

ACKNOWLEDGEMENTS

I am grateful to the Almighty God through whom all things are possible and without whom I can do nothing. I wish to thank my supervisors Prof. Mary Masiga, Dr. Richard Owino and Dr. Edith Ngatia who guided me through this research. Special thanks to Mr. Desmond Owino and Mr. Justin Maranga for their assistance during data analysis. I wish to appreciate the parents, guardians and the teachers of City Primary School who participated in this study. I am also grateful to the Kenyatta National Hospital for sponsoring my graduate studies. I wish to thank the School of Dental Sciences, University of Nairobi, for their logistical support in this study. Finally, I wish to thank my parents and siblings for their unending prayers for me.

LIST OF ABBREVIATIONS AND ACRONYMS.

ADD	Attention Deficit Disorder
ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
ASK	Autism Society of Kenya
BHA	Butylated Hydroxytoluene
BHT	Butylated Hydroxyanisole
CBD	Central Business District
CDC	Centre for Disease control and Prevention
CPS	City Primary School
FDA	Food and Drug Administration
GABA	Gamma Aminobutyric Acid
GFCF	Gluten Free Casein Free
GI	Gingival Index
KNH-UoN ERC	Kenyatta National Hospital and University of Nairobi Ethical and Research Committee
MMR	Measles Mumps Rubella
MOH	Ministry of Health
MSG	Monosodium Glutamate
NACOSTI	National Commission for Science Technology and Innovation
NCC	Nairobi City County
PI	Principal Investigator
PS	Plaque Score

SCD	Specific Carbohydrate Diet
SSRI	Selective Serotonin Re-uptake Inhibitors
TCA	Tricyclic Antidepressants
UoN	University of Nairobi
VEGF	Vascular Endothelial Growth Factor
WHO	World Health Organization

DEFINITION OF TERMS.

Autism Spectrum Disorder.

Children with a neurological and developmental condition that is characterized by challenges in communication, difficulty in social interaction, obsessive interests and repetitive behaviours.

BMI for Age.

Is a measure of body fat based on height and weight of individuals who are 24 months and above, and classifies them as underweight, healthy, overweight and obese. It is expressed as Kg/M^2.

Caregiver

Adult accompanying the child at the time of data collection.

Dental Caries.

Infectious microbiological disease that results in localized dissolution and destruction of the calcified tissues of the teeth.

Dental Caries Experience.

Measured by determining the proportion of decayed, missing or filled teeth.

Dietary patterns.

Types and combinations of foods used in meals at particular times of the day.

Food selectivity.

Is defined as picky eating, frequent food refusals, excessive intake of few foods, and selective intake of certain food groups.

Food neophobia.

Is defined as systemic refusal of new foods.

Height for Age.

Child's height compared with the median height of the reference children of the same age and sex. It is a measure of stunting.

Nutritional status.

Body's condition with respect to body nutrients and the ability of those nutrients to maintain normal body metabolic processes. In this study, nutritional status was determined by measuring BMI for age and Height for age.

Plaque.

Soft white sticky material that forms on the teeth surfaces and is composed of a mass of different bacterial species

Snack.

Food or beverages eaten in between regular meals

Reward Snacks

Foods or beverages given as an incentive for good behaviour

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ABSTRACT

Introduction

Autism Spectrum Disorder is a neurodevelopment condition that is diagnosed in early childhood. Various studies globally, reveal that children with Autism Spectrum Disorder have unique dietary patterns that predispose them to dental caries and nutritional deficiencies and unhealthy weight. There is however, paucity of information on dietary patterns, nutritional status and dental caries experience among children and adolescents with ASD in Kenya.

Study objective

To determine the dietary patterns, nutritional status and dental caries experience among children and adolescents with Autism Spectrum Disorder.

Study population

Eighty two children aged from 6-17 years with ASD attending City Primary School in Nairobi, Kenya.

Study design

This was a descriptive cross-sectional study.

Materials and methods

All the children in the school with ASD, who met the inclusion criteria, were recruited in the study. Data was collected in the form of questionnaires, anthropometric measurements for nutritional status and clinical oral examination of the children and adolescents. The data was entered into a computer database and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0 of Windows, and WHO Anthro-plus statistical programme for nutritional data. The results were presented in tables and figures and various appropriate univariate and bivariate analysis carried out and appropriate statistical inferences made.

Results

A total of 82 children participated in the study. There were 73(89%) male participants and 9(11%) female participants and the mean age was12.29+/- 2.74. Majority of the participants were from Nairobi County (64.6%) while 35.4% were from Kiambu County.

Among the food groups, fruits and vegetables were most consumed on a daily basis (73.2% and 76.8% respectively) consumption of sweets and confectionaries was low amongst participants.

Majority of the participants 75 (91.5%) were advised on a diet to follow, however, only 42(56 %) were strictly adhering to the diet.

The average height of the participants was 149+/- 15.47 with 7.3% being stunted.

The average BMI for Age was 18.42+/- 3.85 where, 11(13.4%) were undernourished, 64(78%) were normal and 7(8.5%) were obese. There was a statistical significant difference between BMI and age groups ((t=3.43, df=80,p=<0.001) and caregivers level of education (F=3.628, df=2, 79, p=0.030).

The mean plaque score was 2.27+/-0.73 defining poor oral hygiene. There was a statistically significant association between plaque score and caregivers average income(X2= 15.799, df=8, p=0.045)

The prevalence of dental caries was 48%. There was a statistically significant association between dental caries prevalence and caregiver's economic status (X2= 9.623, df=2 p=0.008).

The overall dmft and DMFT was 0.20+/- 0.40 and 0.32+/- 0.47 respectively, with decay forming the highest component.

Recommendation

There is need to motivate and encourage parents to follow prescribed diet and limit intake of unhealthy snacks. There is need to innovate ways to improve oral hygiene in children with ASD. Further research on oral health status among children with ASD on a nationwide basis is recommended.

CHAPTER 1

INTRODUCTION & LITERATURE REVIEW

1.1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurological and developmental condition that is characterized by challenges in communication, difficulty in social interaction, obsessive interests and repetitive behaviors. ASD begins in early childhood and persists throughout a person's life(1). It affects both boys and girls though it is four times more commonly seen in boys. The causes of ASD are not known. However, the condition has been linked to genetic and environmental factors, where risk factors such as increased maternal age have been associated with development of autism in children[2,3] .The prevalence of autism has been increasing in recent years. WHO reports that 1 in every 160 children has autism globally[4].In Kenya, it is estimated that 800,000 of individuals in the population have autism[5].

As there is no known cure for autism, various intervention methods have been adopted in management of the condition. They include the use of medication, speech and occupational therapy and applied behavior analysis. Diet modification is also another method that is greatly used. Dietary intervention includes use of gluten free and casein free diet, elimination of foods with artificial colour and preservatives. This diet has been shown to improve the behavioral symptoms in children with ASD. Also, elimination of foods with high sugar has been reported to reduce hyperactivity and irritability in ASD[6,7]. Dietary control in ASD is not only important for behavior management but is also key in maintaining good oral health. Dental caries is associated with consumption of foods with high sugar content.

Feeding problems are very common in children with ASD. They include food selectivity, where children with ASD demonstrate selective intake of certain foods mostly carbohydrates, frequent food refusal and food neophobia. These challenges predispose the children to nutritional problems which may lead to poor health[8,9]. The purpose of this study is to investigate the dietary patterns, nutritional status and dental caries experience of children and adolescents with ASD, at City Primary School in Nairobi City County, Kenya.

1.2. LITERATURE REVIEW

1.2.1. Autism Spectrum Disorder

Autism spectrum disorder is a terminology that is used to describe a group of neurodevelopment conditions that are defined by impairment in three areas; social interaction, communication or use of verbal and non-verbal language and a stereotyped, restricted or repetitive pattern of behavior, interest and activities[1].

Autism was described by Leo Kanner; an American child psychologist at John Hopkins University, in 1943.The disorder was further developed by an Austrian paediatrician, Hans Asperger, in 1944[10].Previously, Autism Spectrum Disorder was classified under Pervasive Developmental disorders that encompassed five diagnostic subtypes namely: Autism, Rett's disorder, Pervasive developmental disorder, Asperger's disorder and Child disintegrative disorder. However, in the Diagnostic and statistical Manual of Mental disorders 5th Edition (DSM-V),all the five subtypes have been merged under a single umbrella known as Autism Spectrum Disorder [11].

1.2.2. Diagnosis of ASD

There is no specific biomarker or diagnostic test for autism. Diagnosis is made purely on basis of the presence of characteristic behaviour. The diagnostic Statistical manual for mental disorders (V) lists specific criteria for diagnosing Autism[11], which are:

1. Persistent deficits in social communication and social interaction

- Delay or absence of spoken language with no compensation from other methods of communication
- Stereotyped and repetitive use of language

2. Restricted, repetitive patterns of behavior including:

- Stereotyped motor movements use of objects
- Insistence on sameness, inflexible adherence to routines e.g. extreme distress at small change.
- Highly restricted, fixated interests that are abnormal in intensity and focus e.g. preoccupation with unusual objects.

The onset of ASD can occur as early as first year of life where abnormalities in behavior are noted[2] .There are two patterns of onset of ASD that have been described; the first pattern is the 'early' onset where the symptoms show in the first year of life. Most common symptom is delay in achieving developmental milestones. The second pattern described is the 'regressive' pattern where the child appears to lose the skills that they had previously learned. This pattern commonly appears from the second year of life onwards[12].However, because it is difficult to differentiate between ASD symptoms and delay in developmental milestones in the first year of life, screening for ASD should be done at 18 and 24 months as recommended by the American Academy for Paediatrics[13] .

1.2.3. Aetiology of ASD

Generally, there is no known aetiology of ASD. Genetic and environmental factors have been linked with the aetiology of ASD[2,3].

1.2.3.1. Genetic factors

Twin studies of monozygotic (identical) twins have demonstrated that where one twin is autistic, then there is 90% likelihood that the other twin will have some form of ASD. However, in dizygotic (fraternal) twins, the likelihood that the other twin will have a form of ASD is about 2-3%[14,15] .This suggests that there is a strong genetic predisposition for ASD. Despite there being no single gene that has been identified as being responsible for ASD, several genes have been linked to the development of the disorder[14] .HOX1A and HOXB1 are part of the HOX genes that are involved in the development of the hindbrain. Mutations in these genes have been associated with ASD[16]. DbetaH (DBH) is another gene that has been linked with development of ASD. The DBH-allele is described as a risk allele in that it is used to determine the risk of a child having ASD. In addition, this gene has also been documented in families with autistic children who have low serum beta- hydroxylase that catalyses the conversion of dopamine to norepinephrine[17]. Micro deletions in SHANK 3, NLGN3 and NLGN4X genes, that code for post-synaptic proteins that bind to transmembrane proteins, have also been linked to developmental delay and autistic behavior[14,15,17]. CHD8 is another frequently mutated gene observed in ASD, and is believed to cause enlarged head circumference and persistent gastrointestinal problems observed in ASD[14].Copy Number Variants(CNVs), both de novo and inheritable, have been observed in ASD[14,15].CNVs are described as submicroscopic genomic deletions or duplications that are larger than 1000 nucleotides. Sanders et.al, demonstrated that the number of de novo CNVs were

associated with lower IQ and increased risk to ASD[15,18].Other genes such as FMRI,TSCI and TSC2 have been associated with syndromic forms of ASD such as Fragile X syndrome and Tuberous syndrome and Retts Syndrome[14,17].

1.2.3.2. Environmental factors

Heavy metals such as mercury have also been implicated in the development of ASD[17].Mercury is neurotoxic and has also been shown to have adverse effects on the immune system and more so on the mast cells[17].Kempuraj et.al., documented that individuals with ASD had ten times greater number of hyperactive mast cells in most tissues. He also stated that mercury stimulates the release of VEGF (vascular endothelial growth factor) and IL-6 (interleukin 6) release from the mast cells leading to the disruption of the blood brain barrier and causing inflammation of the brain[19]. Childhood vaccines such as the Measles Mumps Rubella(MMR) vaccine were believed to contribute to the risk of developing ASD[17].In the past years, Thimerosal, which is 49% ethyl mercury, was used as the preservative agent in the MMR vaccine and was hypothesized to cause ASD[17]. Due to the controversy arising around use of Thimerosal in vaccines and with no conclusive link between it and ASD[20,21], another formulation of the vaccine ,MMR II that did not contain Thimerosal, was manufactured[22]. Aluminium, which is used in vaccines as adjuvant, has been considered as neurotoxic and hence implicated as a risk to ASD[23]. However, there has been no evidence to demonstrate any association between the Aluminium in vaccines and risk of ASD[24,25].Increase in the number of vaccines administered to children below three years, has recently raised scrutiny and has also been thought to contribute to the pathogenesis of ASD[17].However there is lack of concrete evidence to substantiate any link between increased exposure to vaccines and ASD[26].

Nutrition has been suggested to play a role in the pathogenesis of ASD [27].Deficiencies in vitamins, minerals and other trace elements have been reported to cause alterations in the levels of dopamine, serotonin, acetylcholine and gamma aminobutyric acid leading to symptoms of ASD[27].Food additives such as propionic acid, have been demonstrated to cause behavioural changes as seen in ASD through animal studies[28].

Other risk factors to the pathogenesis of ASD are increased maternal age[17],maternal bleeding during pregnancy[15,17] and viral infections such as rubella in the first trimester of pregnancy[17,29].

1.2.4. Epidemiology of ASD

Several studies appear to indicate that the prevalence of ASD is on the increase[30]. According to the WHO report, 1 in every 160 children globally has ASD[4]. In the United states of America, a recent report by CDC has shown that the prevalence of ASD increased by 15% between 2016 and 2018.In 2016, 1 in 69 children was diagnosed with ASD, however, in 2018 the prevalence increased to 1 in 59[31]. A report by the National Autism Spectrum Disorder surveillance System in 2018 in Canada showed that 1 in 66 children and youth between 5 and 17 years had been diagnosed with ASD. In addition, it was documented that the males were four times more frequently identified with ASD than the females[32].In China, an analysis of 44 studies done across China, gave a pooled prevalence of 39.23 per every 10,000 individuals[33].

Little is known about the prevalence of ASD in Africa[34,35] .Sief et al carried out a study on the prevalence of ASD among the Arabic speaking countries that also included two North African countries (Egypt and Tunisia), which explored the prevalence of ASD in Egypt as 33.6% and in Tunisia as 11.5%[36].In another study, Barnevik- Olsson et.al assessed the prevalence of ASD among children born to Somali parents living in Sweden. They reported a prevalence of 0.7 % in

children born to Somali parents which was much higher compared to those from non-Somali parents which was approximately 0.2%[35].

In the East African region, the prevalence of ASD in Uganda according to the 2014 census report was 70 in 10,000 persons. However in 2018, the prevalence was much higher at 88 in 10,000 persons[37].In Kenya, it is estimated that there are 800,000 children with ASD[5].There is no current information on the prevalence of ASD in Tanzania.

Generally, it is observed that boys are four times more commonly diagnosed with ASD though there is no clear explanation for this gender discrepancy[32,33,38,39] .

1.2.5. ASD and general health

Autism Spectrum Disorders is often associated with other co-morbidities. Common co-morbidities observed in ASD are gastrointestinal problems, voiding problems, psychiatric illnesses, Epilepsy and sleep problems[1,4].The prevalence of gastrointestinal problems in ASD individuals ranges from 9 to 70% as compared to healthy individuals[1].The most common symptoms are flatulence, abdominal pain, diarrhoea, and bloating, belching, constipation and gastro- esophageal reflux symptoms[40,41].Though not well understood, these symptoms are believed to arise as a result of genetic influence [4], immune system abnormalities [41,42],abnormal colonization of the enteric microflora [43], high intake of processed foods and lack of fibre containing foods as a result of severe food selectivity as observed in ASD[40].

Psychiatric illnesses such as anxiety, attention deficits, depression psychosis and obsessive compulsive disorders are also commonly observed in ASD[1,2,44].Due to abnormality in the levels of melatonin, sleep disturbances are common in children with ASD[1]. Melatonin is a neurohormone that is synthesized by the pineal gland and is responsible for the regulation of the circadian sleep - wake rhythm. Alterations and disturbances in the levels of melatonin leads to

reduction of total sleep, night and early morning awakenings and insomnia as observed in ASD[45].

Feeding problems are also very common in ASD[46]. The most frequent feeding problems in children with ASD are food selectivity, rituals, hyperactivity, motor and gastrointestinal disturbances[46,47].Food selectivity appears to be an important issue with children with ASD[8].Food selectivity is referred to as 'picky' eating, frequent food refusals, excessive intake of few foods and selective intake of certain foods groups such as carbohydrates[8,48].It is suggested that factors such as texture, smell, colour and temperature of the food as a result of sensory sensitivity [8,49] in ASD contributes greatly to food selectivity which may ultimately lead to nutritional problems in these children[8,9]. Food neophobia, which is defined as systemic refusal of new foods, is also frequent in children with ASD[50].

Genetic syndromes such as Fragile X syndrome, Tuberous sclerosis complex and Cornella de Lange syndrome are associated with ASD[3,51].

1.2.6. Management of ASD

Currently there is no known cure for ASD[4].All interventions are geared towards improving the behavior patterns of autistic children. Pharmacological and non-pharmacological modalities or interventions have been adopted in the management of ASD[52]. Antipsychotic medications are commonly used in the management of ASD[38]. They target on improving the behavior symptoms observed in ASD such as aggression and irritability. Risperidone and Aripiprazol, are the two FDA approved antipsychotic drugs for the management of aggression and irritability symptoms in ASD[53]. Though their mechanism of action is not well established, they are believed to involve a combination of partial agonist activity at dopamine type 2 and serotonin type 1A(5HT1A) receptors and hence improving the ASD behavioral symptoms[38,53,54].Intranasal Oxytocin is also

used in the management of aberrant social behavior in ASD patients. Oxytocin which is an endogenous hormone that is crucial in lactation and parturition has been shown to play a role in relationship forming and social functioning in humans, hence showing to be useful in ASD[54].Administration of melatonin has been shown to improve sleep latency in children with ASD[54].Use of anti-depressants such as selective serotonin re-uptake inhibitors (SSRIs) and Tricyclic Antidepressants (TCAs) are commonly used in managing depression, repetitive behaviors and anxiety in ASD[38,52,54,55].Anticonvulsants such as Valium are used to manage seizure disorders observed in children with ASD[55].

Non pharmacological interventions that have been adopted in management of ASD include: Applied Behaviour analysis [52,56]and Early start Denver model techniques that are focused on bringing about positive change in behavior at an early age. Verbal intervention, speech and language therapy, occupational and physical therapy, Picture exchange communication system and sensory integration are amongst other modalities used [56].

More recently, stem cell therapy has been described as a management modality for ASD[57].

1.2.7. Dietary Intervention in the management of ASD

In recent years, nutritional therapy as a form of management of ASD symptoms is seemingly gaining popularity. However scientific evidence to support its effectiveness as a modality of ASD management is still scarce[27]. Nutritional management of ASD is based on two ways: an additive approach and a subtraction or elimination approach.

In the additive approach, nutrients that are known to be deficient in children with ASD are supplemented. Supplements used include vitamins B, A, D and C, Probiotics, zinc, Magnesium, copper, folic acid, melatonin and dietary fatty acids[6,27].Administration of Vitamin A, which is good for cell growth and maintenance of epithelial integrity, results in better digestion and

uptake of nutrients in the gut, leading to improved symptoms of ASD. Vitamin C being an antioxidant has been shown to reduce oxidative stress that is common in ASD leading to improved ASD symptoms[27].Children with ASD often suffer from gastrointestinal problems such as diarrhea and constipation. Use of probiotics has been shown to relieve some of the gastrointestinal symptoms by altering the composition and activity of the gut microflora[6,43]. As earlier stated, sleep disturbances as a result of abnormal levels of melatonin, are common in ASD[2]. Therefore, melatonin supplementation in ASD has shown improved sleep latency in these children[27,54].Omega 3- Fatty acids are key in normal brain development[6,7,27].Omega 3-fatty acids supplementation in ASD may lead to improvement of symptoms such as irritability and lethargy[27].

In the subtractive approach of dietary intervention for ASD symptoms, various diets have been proposed and used. They include; Gluten free Casein free diet(GFCF), Ketogenic Diet, and Specific Carbohydrate Diet[6,7,27]. Gluten free and casein free (GFCF) diet is the most commonly embraced nutritional intervention. It is based on the "opiod- excess theory"[6,27].It has been hypothesized that incomplete digestion of gluten and casein releases β-casomorphin and β-galadiomorphin products. These opoid-like products are absorbed into the bloodstream and enter the central nervous system causing symptoms of autism like irritability and hyperactivity. Adoption of this GFCF diet has been shown to reduce symptoms of ASD[6,7,27].Ketogenic Diet is based on the idea that abnormalities in cellular metabolism of carbohydrates results in aberrant behavior in ASD[7,27]. A ketogenic diet is usually high in fat and low in carbohydrates with very controlled amount of proteins. The Specific carbohydrate diet (SCD) is not as popular as the Gluten free Casein free diet or the ketogenic diet. It is based on the theory that monosaccharides (glucose, fructose and galactose) are more easily digested than the

disaccharides and the polysaccharides and therefore, beneficial for children with ASD with gastrointestinal symptoms[6,7,27].It is believed that when the undigested complex carbohydrates reach the large intestines, they become fermented resulting in excess production of gas, bloating, constipation and bacterial overgrowth that ultimately results in inflammation[7].

Another diet alteration that is commonly adopted is avoidance or elimination of refined sugar. Sugar, which is a simple carbohydrate, is easily broken down and absorbed into the bloodstream causing a rise in the blood sugar that leads to release of adrenaline which subsequently leads to undesirable behaviour patterns such as hyperactivity, anxiety and irritability. Elimination of refined sugar including artificial sweeteners like aspartame and saccharin and foods with added sugars like high fructose corn syrup in soft drinks and ice cream, has been shown to improve the behavior of autistic children[6,7].

Strickland et.al also suggested that elimination of artificial food colour, flavors and preservatives; improved the behaviour in autistic children[6]. Artificial colours in diets are suggested to contain chemicals such as phenols and polycyclic aromatic hydrocarbons that lead to behavioral changes like irritability and sleep disturbance in ASD. Monosodium Glutamate (MSG) which is a commonly used commercial artificial flavor enhancer in food, is believed to result to neurological damage when taken in excess amounts[6] .Therefore elimination of such artificial flavorings are deemed beneficial. Artificial preservatives more so, Butylated Hydroxytoluene (BHT) and Butylated Hydroxyanisole (BHA) which are commonly used preservatives in foods, are believed to aggravate ASD symptoms[6].

Studies done in Kenya have shown that diet based interventions are most commonly used in management of ASD symptoms. A study done in Nairobi by Lincoln et. al. showed that amongst all interventions, dietary interventions were most popular, with the most frequently used being

the GFCF diet[58]. Another study done in Nairobi by Ouma Onala et.al. showed that mothers of children with ASD , preferred the diet based mode of management for their children[59].

1.2.8. Oral health challenges in ASD

Children with ASD exhibit various dental and oral conditions. Challenges in language, behavior, intellect, social skills, dietary preferences and medications are believed to predispose the ASD patients to oral diseases[60–62].

Self-inflicted oral lesions such as lip biting, bruxism, tongue thrusting and picking at the gingival are commonly observed in ASD[3]. These habits may also lead to malocclusions. Pandey et. al. stated that anterior open bite, dental crowding, spacing, high arched palate and class II molar relationships are more prevalent in children with ASD than normal children[63].

Traumatic dental injuries are also seen in ASD children with enamel fracture and tooth mobility being the most common[3]. These injuries are attributed to different malocclusions observed in ASD and pica activities that are characterized b chronic ingestion of non- food items[63].

Hyper-responsive gag reflex and erosion are also observed in ASD[3]

Gingival hyperplasia is also another oral condition seen in ASD. The gingival hyperplasia is associated with the use of antipsychotic and anticonvulsant medications by ASD patients.. Delay in eruption of teeth is also often seen in ASD as a consequence of the gingival hyperplasia[3,63].Saliva drooling and challenges in swallowing are observed in ASD patients and these have been attributed to poor muscle tone[3].

Xerostomia has also be noted especially on children who are medications[62].

Poor oral hygiene has been reported in several studies on children with ASD[3,60,63,65] .This has been associated with inadequate and irregular tooth brushing[3], lack of manual dexterity [3,61] and poor dental awareness and education[3] and dislike of the toothpaste and toothbrush in ASD

children[61,64]. In a study done by Mansoor et. al in Dubai, reported that in addition to lack of manual dexterity, 83.3% of patients with ASD disliked the feeling of toothpaste and toothbrush on their teeth compared to 15.4% of the healthy children; posing a risk to oral problems[61].This aversion to toothpaste and toothbrush was associated to oversensitivity to sensory stimuli like different sounds, smells and tastes observed in ASD. Visual Pedagogy is a tool that was described by Jaber 2011, to help children with ASD improve their oral hygiene. He suggested that placement of a series of photographs showing a structured method of tooth brushing; where the children performed brushing would eventually lead to better oral hygiene[66].

Gingivitis is also observed in ASD patients. It is linked to poor oral hygiene and also as a side effect of medications used to manage ASD symptoms like stimulants, antidepressants and antipsychotics[3]. A study done by Al- Maweri et al. on oral health of Autistic children in Yemen, showed that the GI score amongst children with ASD was higher (1.3) compared to the non-ASD patients which was1.02 [63].Similarly, in a Study done in Nigeria, showed that children with ASD had a significantly higher PI (2.06) and GI(1.96)scores compared to the normal children.(PI 1.24 and GI 1.22)[62].

1.2.9. Dietary preferences in ASD

Patients with ASD have been found to prefer soft and sweetened foods and tend to pouch food inside the mouth instead of swallowing, thereby increasing their risk of getting dental caries[62,66].,In addition, parents and caregivers give cariogenic snacks such as candy, as a mode of rewarding good behavior in autistic children, which further increases risk to dental caries development[6,62]

Onal et. al. examined the oral health status among children with ASD and found that 73.8% of these children received food rewards to reinforce good behavior and the most commonly and

regularly given was chocolate[62]. A study done by Schreck et al., to examine food preferences in autistic children, showed that more than 50% of the children preferred foods that were high in sugar such as cakes, cookies and ice cream while rejecting those with bitter or sour tastes[67]. Similarly, in a study done in Riyadh, Saudi Arabia, parents of children with ASD reported that 70.9% of children preferred foods that are high in sugar and 96.7% consumed soft drinks regularly[68]. Sahar et.al., carried out a study in Egypt and found that 100% of the children with ASD preferred a carbohydrate rich diet with 77% of them preferred soda drinks[48].

1.3.DENTAL CARIES IN CHILDREN WITH ASD

1.3.1. Aetiology of dental caries

According to the W.H.O. dental caries is a major public health problem and is considered to be the most common non- communicable disease globally[69]. Dental caries occurs through a complex interaction over time involving bacteria and fermentable carbohydrates and many other host factors including teeth and saliva[70].The fermentable carbohydrates which are also known as 'free sugars' are commonly found in confectioneries, cakes, biscuits and sweetened beverages. The bacteria in the mouth metabolize these sugars producing organic acids that eventually lead to dissolution of the dental hard tissues[69,71]. Multiple microorganisms are involved in the pathogenesis of dental caries; they include Streptococcus mutans, bifidobacteria and lactobacilli. However, the most important causative agents of dental caries are the Streptococcus mutans and Streptococcus sobrinus[72]. In the early stages, dental caries presents without symptoms but the advanced stages of the disease may lead to pain, infections, abscesses and even sepsis. . Dental caries can be prevented using various modalities including mechanical removal of plaque through tooth brushing and flossing, use of fluoride and control of sugar intake[72].

1.3.2. Dental caries in children with ASD

Loo et al., examined the caries experience in children with ASD, in Boston, in comparison to children without and found that children with ASD had a lower caries prevalence than the unaffected children. In addition they concluded that children with ASD were 70.5% less likely to have a positive caries history compared to the unaffected. This was suggested to be as a result of good oral hygiene given by the parents and limitation in intake of cariogenic foods and in between meals snacking[73].

In another study done in Hong Kong in patients with autism, Chan et. al examined pre-school aged children and found that 26% of the children had dental caries with 60% of them suffered from severe dental caries. Some of the major causes of dental caries reported by parents were rigidity in choosing cariogenic foods (58%) and holding food in their oral cavity (24%)[74]. On the contrary, in a different study done in Hong Kong on preschool children by Du et al (2014), showed revealed that children with ASD had a lower caries experience compared to those without[75].

In another study done in India on 35 institutionalized children with ASD, Gagandeep et. al showed that the dental caries experience in these children ranged from 0 to 6 and also observed that most of the children had' in between meal' sugar exposure of more than three times a day[76].

In a comparison study done in Istanbul to access the oral health status in children with ASD and non-autistic children, showed that the mean DMFT and dft values in children with ASD were 2+/- 2.26 and 1.65+/- 2.52 respectively. This was much lower than the mean DMFT (2.28+/- 1.78) and dft (2.27+/- 2.75) in the non-autistic children. In addition,67% of the parents in the ASD revealed that they used snacks as positive reinforcement, however no significant relation was found between use of snacks as positive reinforcement and dental caries[77].

In a different comparative study done in Isparta, Turkey, the oral health status of children aged between 6 and 14 years, with ASD and those without, revealed that the total DMFT and dft values in ASD group were3.59+/-3.60 and 4.58+/- 4.22 respectively. In the non-ASD group, the DMFT and dft values were 2.37+/-1.9 and 3.61+/-2.44 respectively. Though the values were higher in the ASD group, they were not statistically significant[62].

1.4.NUTRITIONAL STATUS IN CHILDREN WITH ASD

According to the W.H.O. nutrition refers to the intake of food in relation to the body's dietary needs. Lack of proper nutrition can result in reduced immunity, impaired physical and mental development and increased risk to diseases[78]. On the other hand, nutritional status is described as the body's condition with respect to the body nutrients and the ability of these nutrients level to maintain normal body metabolic processes[79].

Due to the feeding problems such as food selectivity, children with ASD may be at risk of nutritional deficiencies. The nutritional status of a child is gauged using anthropometric measurements. Age, sex, length/height and weight are core in anthropometry. Body mass index which is expressed in kgs/m2 is used to classify individuals who are 24 months and above as; underweight, healthy, overweight, and obese. Other main variables used to assess the nutritional status are weight for age, height for age, and weight for height[80].

In a review of articles (between 1990-2014)on nutritional status of children with ASD, Cerebral palsy and Down syndrome by Nor. et al. showed that children with ASD were more likely to be overweight or obese compared to healthy children. The review revealed that this would have been as a result of the feeding problems that are common in ASD[81]. Sahil et. al assessed the nutritional status of 67 children with ASD across various centers in Khartoum and found that among the pre-schoolers, all the females(100%) were underweight while only 14.29% of the

males were underweight. The nutritional status in the school age children (6-13 years), 46.15% of the females had normal weight and only 7.69% were overweight.44.44% of the males were underweight and 6.67% were obese[82]. In a study done in the United States of America by Egan et.al to assess the nutritional status of children with ASD, showed that 32.96% of the 273 participants with ASD were overweight or obese. That is, 15.38% were overweight and 17.58% were obese[83]. In a different study carried out in the US to compare the nutritional status of adolescents aged 12-17 years, with developmental disorders such as ASD and those without; showed that 31.8% of the adolescents with ASD were obese. This was more than double the prevalence observed in children without developmental disorders. This high prevalence in obesity in children with ASD was attributed to aberrant food preferences where children prefer foods in high calories and sugar content, lack of physical activity and use of medications that are associated with weight gain[84].

1.5.PROBLEM STATEMENT

Studies reveal that children with ASD have a liking towards high calorie foods such as carbohydrates and foods with high sugar content, with little or no preference to other food groups[8,48]. In addition, children with ASD receive frequent food rewards mostly cariogenic snacks to encourage good behavior[62]. This predisposes them to nutritional deficiencies and unhealthy weight which may lead to poor health. Additionally, insistence on foods with high sugar content predisposes the children with ASD to dental caries. This is worsened by the tendency to hold food in their mouth due to poor oro-motor function[62,66]. In developing countries, more so in Kenya, very little is known about the level of dental caries or the nutritional status in these children. Previous studies on the relationship of dietary patterns on nutritional status and dental caries experience have been inconclusive. This study will hence seek to bridge this gap by investigating

and reporting on the dietary patterns, nutritional status and dental caries experience among children and adolescents attending City Primary School, in Nairobi, Kenya.

1.6.JUSTIFICATION

Very few studies have been done on the influence of diet on the nutritional status and dental caries experience in children with ASD. In fact, majority of these studies have been done in the developed countries. No documented data is available on any studies done in Kenya. There is therefore need to research on this area and bridge this gap.

The results from the study will provide baseline information on dietary patterns, nutritional status and dental caries experience related to children with ASD. The results of this study will aid policy makers in planning for intervention programs for children with ASD.. In addition, the findings will contribute to scientific knowledge on dietary practices, nutritional status and dental caries experience in relation to ASD.

1.7.OBJECTIVES

1.7.1. Main objective

To determine the dietary patterns, nutritional status and dental caries experience among children with Autism Spectrum Disorder at City Primary School

1.7.2. Specific objectives

1. To determine dietary patterns among children with ASD at City Primary School
2. To determine the nutritional status of children with ASD at City Primary School
3. To determine dental caries experience among children with ASD at City Primary School
4. To determine the association of dietary patterns with nutritional status and dental caries experience in children with ASD at City Primary School.

1.8.HYPOTHESIS

1.8.1. Null hypotheses

- There is no association between dietary patterns and nutritional status of children with ASD
- There is no association between dietary patterns and dental caries experience in children with ASD.

1.9.VARIABLES

1.9.1. Dependent variables

- Dental caries experience(decayed, missing, filled teeth)
- Nutritional status (height for age, BMI for age)

1.9.2. Independent variables

- Dietary patterns

1.9.3. Socio- demographic variables

- Age
- Sex
- Caregivers economic status
- Caregivers level of education

1.9.4. Confounding variables

- Oral hygiene status

CHAPTER 2

MATERIALS AND METHODS

2.1. STUDY AREA & POPULATION

2.1.1. Study design

This was a descriptive cross sectional study among children and adolescents with ASD attending City Primary School in Nairobi, Kenya.

2.1.2. Study area

The study was conducted in Nairobi City County (NCC). NCC is one of the forty seven counties in Kenya. It is the capital city of Kenya and covers an area of 696 square kilometers. The population of NCC is 3,138,396[85].

Nairobi City County has four government schools with Autism centers (Burburu I, Kasarani, Dagoretti and City Primary Schools). The specific study site was City Primary School (CPS).It is located on Murang'a road, opposite the New Ngara bus terminus in Nairobi and is less than 2km from the central business district. CPS is a public, mixed primary school offering 8-4-4 system of education. CPS has an autism unit that was established in 2003 as part of school integration program by the Government of Kenya and the Autism society of Kenya. It provides educational, nutritional and rehabilitative services to learners with ASD. The selection of the study area was through purposeful sampling as the school has the largest population of children and adolescents with ASD in Nairobi.

2.1.3. Study Population

The study involved children and adolescents aged 6-17 year old with a diagnosis of ASD attending City Primary School during the period of the study.

2.1.3.1. Inclusion Criteria

1. Children and adolescents aged 6-17 years diagnosed with ASD and attending City primary school
2. Children and adolescents whose parents provided written consent allowing them to participate.
3. Children who assented to the study.

2.1.3.2. Exclusion Criteria

1. Children who had diabetes were excluded from the study as this co-morbidity may have an impact on the dietary patterns.
2. Children with other developmental disorders.

2.1.4. Sample Size Determination.

Fisher's formula was used to calculate the sample size for the study as follows[86]:

$$n = \frac{z^2 pq}{e^2}$$

Where;

n=sample size

z=standard normal deviate for alpha (α) = 1.96

p=proportion of ASD children with caries (0.26)[74]

q=1-p (0.74)

e=level of precision (0.05)

Based on the parameters given, the calculated sample size was 295.7≈296. Since the total number of eligible children with ASD was known, that is 110, the finite population correction[87] was used as the sampling frame was less than 10,000,

$$nf = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} = \frac{296}{1 + \frac{(296 - 1)}{110}}$$

Where;

N = finite population = 110

n_0= is the sample size estimate = 296

nf = minimum sample size = 80.40≈81

A non-response rate of 10% was applied, giving a minimum sample size of 90.

2.1.5. Sampling Method

Recruitment of the participants was done by the principal investigator. Since the sample size calculated (90) was close to the number of population children (110) with ASD in the school, all the eligible children were included in the study.

2.1.6. Instruments for data collection

2.1.6.1. Questionnaire

A modified questionnaire adopted from the WHO (2013) simplified Oral Health Questionnaire and the 2012 Youth and Adolescent Food frequency questionnaire was used (Appendix 2a and 2b). The questionnaire contained both open and close-ended questions and was used to record the participants' social demographic variables, individual oral hygiene practices and dietary patterns.

The questionnaire was pre tested on caregivers of children between ages 6-17 at the University Of Nairobi Dental Hospital. This was done to check the suitability, simplicity and ease of understanding as well as to estimate the time taken to complete the questionnaire. On the day of data collection, the questionnaire was administered to the caregivers by the PI in face-to-face interviews.

2.1.6.2. Clinical examination

A clinical exam was carried out to determine the oral health status of the children. The clinical findings were recorded on a modified WHO (2013) clinical assessment examination form for children (Appendix 3). The PI examined dental caries status of the study participants and the findings recorded by a trained assistant. The caregiver and class teacher of the study participants were present at all times during the clinical examination and this helped to reduce anxiety and distress exhibited by some of the children. The dental examination was done inside a classroom near a window using natural light, with the child-seated upright on an office chair. FDI tooth notation system was used for teeth identification. For every participant, the oral hygiene status was assessed first and the findings recorded using plaque index scoring criteria described by Silness and Loe in 1964 .The procedure entailed drying of the tooth by the PI, followed by visual examination. The teeth were examined for accumulation of soft deposits on the free gingival margins and tooth surfaces. Thereafter, visual and tactile examination of the teeth was done to determine presence of dental caries. Individual teeth were isolated and dried using sterile gauze and the examination followed an orderly manner from one tooth to the adjacent tooth in each quadrant. The sterile CPI probe and dental mirrors were used to detect dental caries on the tooth surface(s). Following a systemic approach, each tooth was recorded as decayed/Decayed, missing/Missing or filled/Filled; (dmft /DMFT). Radiographic examination was not carried out.

2.1.6.3. Nutritional status assessment

Anthropometric measurements of the study participants were used in the nutritional status assessment. With minimal clothing, the weights of the children was measured using a Salter scale to the nearest 0.1kg.With the children standing erect and barefoot, their height was measured using a standard height board to the closest 0.5cm.Two readings were both taken for height and weight and the average calculated. The WHO child growth standard reference was used to evaluate nutritional status using the indices of Height for age, and BMI for age.

2.1.7. Data Validity and Reliability

The PI was calibrated by a Peadiatric dentist and nutritionist on diagnosis of dental caries, presence of plaque and anthropometric measurements to ascertain inter-examiner reproducibility. Calibration was carried out on children and adolescents aged between 6-17 years at the University of Nairobi dental Hospital and Lady Northey children's dental hospital. The mean Cohen Kappa scores were: 0.85 for plaque score, 0.81 for dmft and 0.87 for DMFT; and 0.88 for anthropometric measurements. This showed good consistency and minimal variability.

During the period of data collection, every tenth child was re-examined by the PI for the purpose of determining intra-examiner consistency. The mean Cohen Kappa scores obtained were: 0.95 for plaque score, 0.88 for dmft, 0.82 for DMFT and 0.89 for anthropometric measurements. The data clerk who aided in data recording was trained by the PI on proper data recording of the findings made during the examination to ensure that there were minimal errors in the records. All questionnaires were checked for completeness before leaving the school.

2.1.8. Minimization of errors and biases

All instruments were calibrated. The PI carried out all the examination while the trained assistants recorded the findings in the recording schedule.

2.1.9. Data Analysis

The data collected was entered into a computer database and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0 of Windows and WHO Anthro- plus program for analysis of nutrition data.Statistical tests were performed to establish the frequencies, means and the relationship between the different variables. Independent T- tests and ANOVA were used to compare means from the various indices of the study. Pearson's chi-square and Fishers exact test were used to assess bivariate relationships between the dependent, independent and socio-demographic variables in the study. Data was presented using charts and frequency tables.

2.1.10. Ethical considerations.

1. Ethical clearance to carry out the research was obtained from Kenyatta National Hospital and University of Nairobi Ethical and Research Committee (KNH-UoN ERC)-P826/09/2019.
2. Permission to conduct the study was also sought and obtained from the National Commission for Science Technology and Innovation (NACOSTI), Nairobi County Director of Education, Nairobi County Commissioner and City Primary School authorities.
3. Written consent was obtained from the parents or guardians of the study participants.
4. Confidentiality was maintained and information obtained was only used for the purpose of the study and for the benefit of the society. No names were used in the questionnaires.

5. Data collected was coded and input in a password protected computer.
6. Children in need of dental treatment were referred to the University Of Nairobi Dental School Hospital for treatment. Additionally, those with unhealthy nutritional status or in need in of medical treatment were referred to the Paediatric clinic at Kenyatta National Hospital where an arrangement had been made with the hospitals, previously.
7. Results of this study will be published in peer review journal and a copy of findings submitted to relevant government authorities for action.

2.1.11. Expected benefits arising from these results

The results will be used to formulate improved interventions regarding the dietary patterns, nutritional status and oral health of children with ASD attending City Primary School. In addition, the study serves as a partial fulfillment of a requirement of Master of Dental Surgery degree in Peadiatric Dentistry.

CHAPTER 3

RESULTS

3.1. Children's Socio-demographic characteristics.

3.1.1. Age and Sex distribution

Eighty two participants consented to the study. Of the participants, 73 (89%) were male and 9 (11%) were females, giving a male to female ratio of 8.1:1. The age of the study participants ranged between 6-17 years with a mean age of 12.29 years (SD 2.74). The participants were thereafter, grouped into two age groups: 6-12 years (n=30, 36.6%) and 13-17 years (n=52, 63.4%). The age and sex distribution of the participants is shown in figure 1 below.

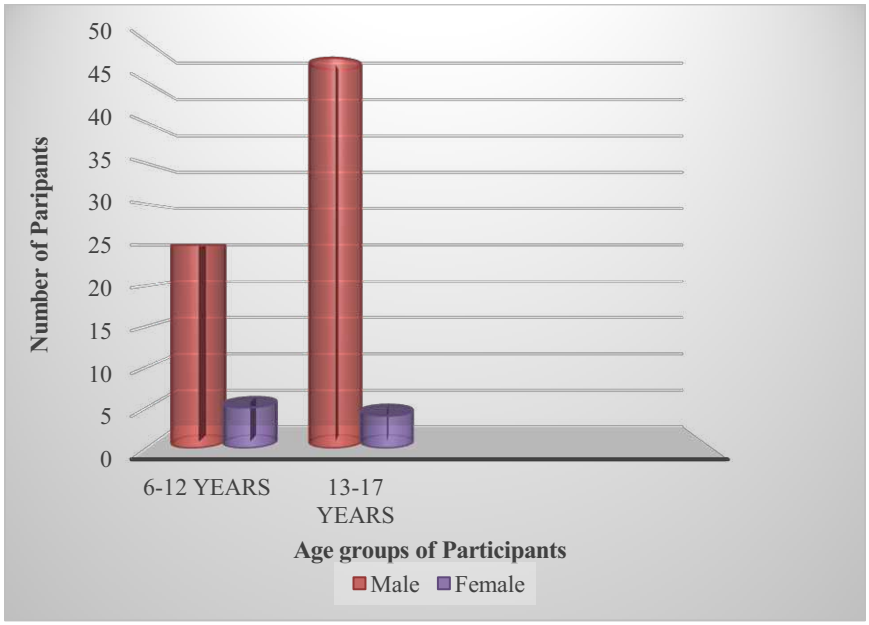

Figure 1 frequencies by Age groups and sex.

3.1.2. County of Residence

The children were drawn from the counties of Nairobi: 53(64.6%) and Kiambu 29 (35.4%).

3.1.3. Birth order of participants

The largest number of children, 35 (42.7%) were the first born in the family, 36 (43.9%) were second born, 10 (7.3%) were third born, 3(3.7%) were fourth born and only 2 (2.4%) were fifth born in the family.

3.1.4. Immunization

Eighty one study participants were fully immunized accounting for 98.8% of the participants. Only one (1.2%) participant had not been fully immunized.

3.2. Caregivers Socio-demographic characteristics

3.2.1. Child Caregivers

Majority of the caregivers (n=70, 85.4%) were biological mothers of the participants while the remaining the biological fathers (n=12, 14.6%).

3.2.2. Education Level

About half (n=42, 51.2%) of the caregivers had attained college level of education. Only one caregiver (1.2%) had no form of formal education.. The caregivers who had less than Primary school education, Primary school education and Secondary school education accounted for 1.2% (n=1), 6.1% (n=5) and 40.2% (n=33) respectively.

3.2.3. Employment status

The caregivers who were unemployed accounted for 15.9% (n=13), those in non- formal employment were 47.6% (n=39) and those in formal employment were 36.5% (n=30).

3.2.4. Household Income

Majority of the caregivers 33(40.2%) had an average household income of between Ksh. 10000 and 25000 while the least 9 (11%) earned more than Ksh. 55 000 as shown in figure 2.

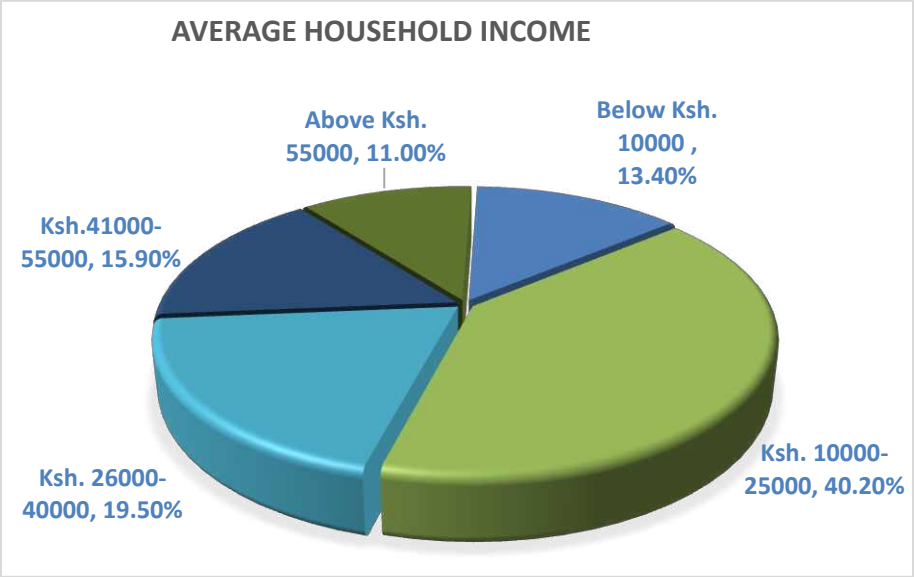

Figure 2: Average Household income of caregivers.

3.3.Dietary Patterns

The dietary patterns of the participants were assessed using a food frequency chart. The foods were categorized into different foods types. These food types were animal proteins, legumes, starchy staples, fruits, vegetables, milk and products, sweets and confectionaries and beverages. The animal proteins category included beef, pork, fish, eggs, goat meat, chicken and sausages. Legumes food group consisted of peas, beans and green grams. The starchy staples consisted of ugali, rice, bread, chips, spaghetti, maize, mashed potatoes and green bananas. Fresh milk and yoghurt were grouped under milk and milk products while the beverages category consisted of porridge, tea and fresh fruit juices. Sweets and confectionaries category consisted of artificial juices, soda, chocolate, cookies, ice cream, sweets and cakes.

3.3.1. Food Consumption by food groups

Fruits and vegetables were the most commonly consumed food group on a daily basis (73.2% and 76.8% respectively). On the other hand, animal proteins, starches milk and milk products were consumed occasionally as shown in table 1.

Table 1: Frequency of food consumption by food groups.

Food group	Once daily (%)	Twice daily (%)	Once a week (%)	Twice a week (%)	Occasionally (%)	Never (%)
Animal Protein	2.1	0.2	16.8	11.2	31.6	38.1
Legumes	15.5	4.1	23.3	33.9	18.4	4.9
Starches	16.1	3.8	11.5	19.9	29.7	19.1
Fruits	73.2	8.5	2.4	8.5	4.9	2.4
Vegetables	76.8	12.2	1.2	4.9	4.9	0.0
Milk and Milk products	6.7	1.2	6.1	4.9	26.8	54.3
Total %=100						

3.3.2. Beverages

Consumption of beverages was high amongst the participants. More than half of the children consumed porridge once daily (73.9%). Additionally, those who consumed tea and fresh fruit juices once daily accounted for 43.9% and 30.5% respectively. On the other hand, nearly half of the children (42.3%) reported to never have consumed tea as shown in table 2.

Table 2: Distribution of children by frequency of consumption of beverages

Beverages	Once daily n (%)	Twice daily n (%)	Once a week n (%)	Twice a week n (%)	Occasionally n (%)	Never n (%)
Porridge	60 (73.9)	5 (6.1)	3 (3.7)	0	8 (9.8)	6 (7.3)
Tea	36 (43.9)	1 (1.2)	2 (2.4)	1 (1.2)	4 (4.9)	38 (42.3)
Fresh fruit juices	25 (30.5)	2 (2.4)	9 (11)	8 (9.8)	26 (31.7)	12 (14.6)

3.3.3. Sweets and confectionaries

The consumption of sweets and confectionaries was low amongst the participants. Majority of the children reported to have never consumed these foods. Those who had never consumed artificial juices, soda, chocolate, cookies/ biscuits, ice cream, sweets and cakes are shown in table 3.

Table 3: Distribution of children by frequency of consumption of sweet and confectionaries

Sweets/ Confectionaries	Once daily n (%)	Twice daily n (%)	Once a week n (%)	Twice a week n (%)	Occasionally n (%)	Never n (%)
Artificial juices	0	0	1 (1.2)	0	15 (18.3)	66 (80.5)
Soda	0	0	1 (1.2)	0	13 (15.9)	68 (82.9)
Chocolate	1 (1.2)	1 (1.2)	0	0	12 (14.7)	68 (82.9)
Cookies/ biscuits	1 (1.2)	0	0	0	20 (24.4)	61 (74.4)
Ice cream	0	0	1 (1.2)	1 (1.2)	9 (11.0)	71 (86.6)
Crisps	5 (6.1)	3 (3.7)	10 (12.2)	17 (20.6)	34 (41.5)	13 (15.9)
Sweets	0	0	1 (1.2)	0	17 (20.8)	64 (78.0)
Cakes	2 (2.4)	0	4 (4.9)	7 (8.6)	23 (28.0)	46 (56.1)

3.3.4. Snacks given at home.

The snacks given at home included biscuits, cakes, chips, popcorn, soda and yoghurt. The most commonly given snack at home was crisps (n=34, 41.5%), popcorn (n=22,26.8%), biscuits (n=11,13.4%) and cakes (n=9, 10.9%) while the least consumed were samosa (n=1, 12.%), egg (n=1, 1.2%), yoghurt (n=1, 1.2%), sweets (n=2, 2.4%) and soda (n=1, 1.2%).

3.3.5. Reward snacks

The caregivers of the study participants reported that they offered snacks to the children as rewards for good behaviour. The type of snacks given were biscuits and cakes (n=12, 20.3%), sweets (n=8, 13.6%), soft drinks (n=4, 6.8%) and chocolates (n=3, 5.1%). Other types of snacks included crisps (n=19), popcorn (n=11, 18.6%), chips (n=1, 1.7%) and pizza (n=1, 1.7%)

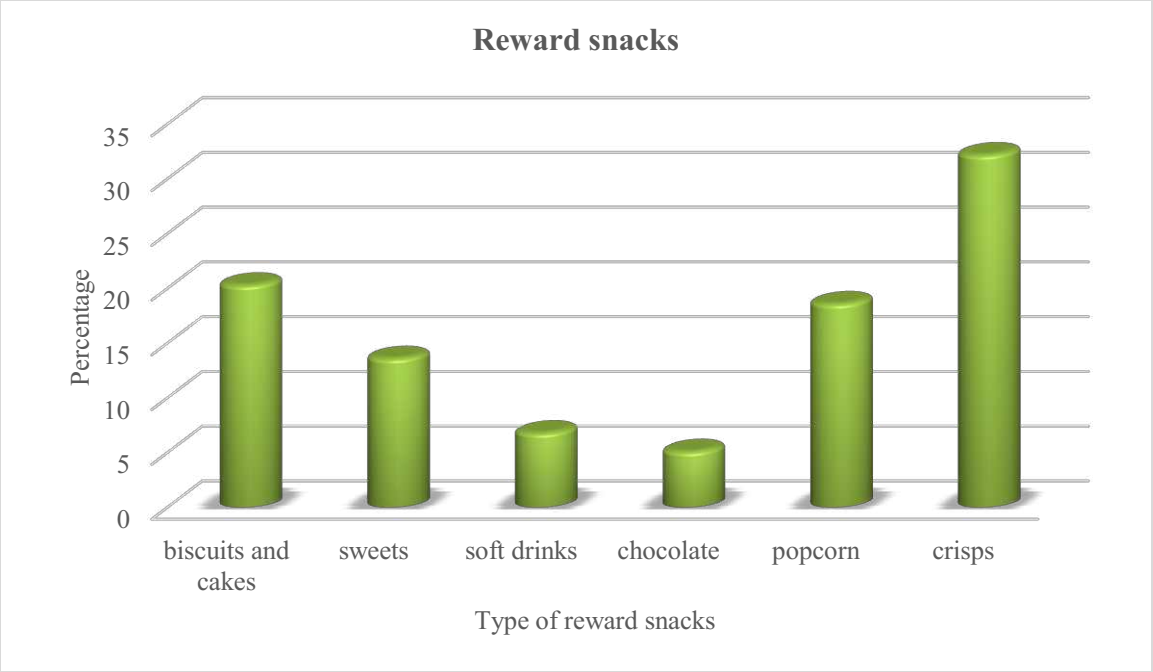

Figure 3: Distribution of participants by the reward snacks given.

3.3.6. Consumption of sugar in foods

The study participants consumed sugar in foods and beverages as shown in figure 4. More than half of the participants consumed sugar in porridge (n=46, 56.1%). Those who consumed sugar in tea or coffee accounted for 27(32.9%) while 5(6.1%) consumed breakfast cereal with sugar added. Only a small percentage of the participants consumed milk with sugar (n=4, 4.9%).

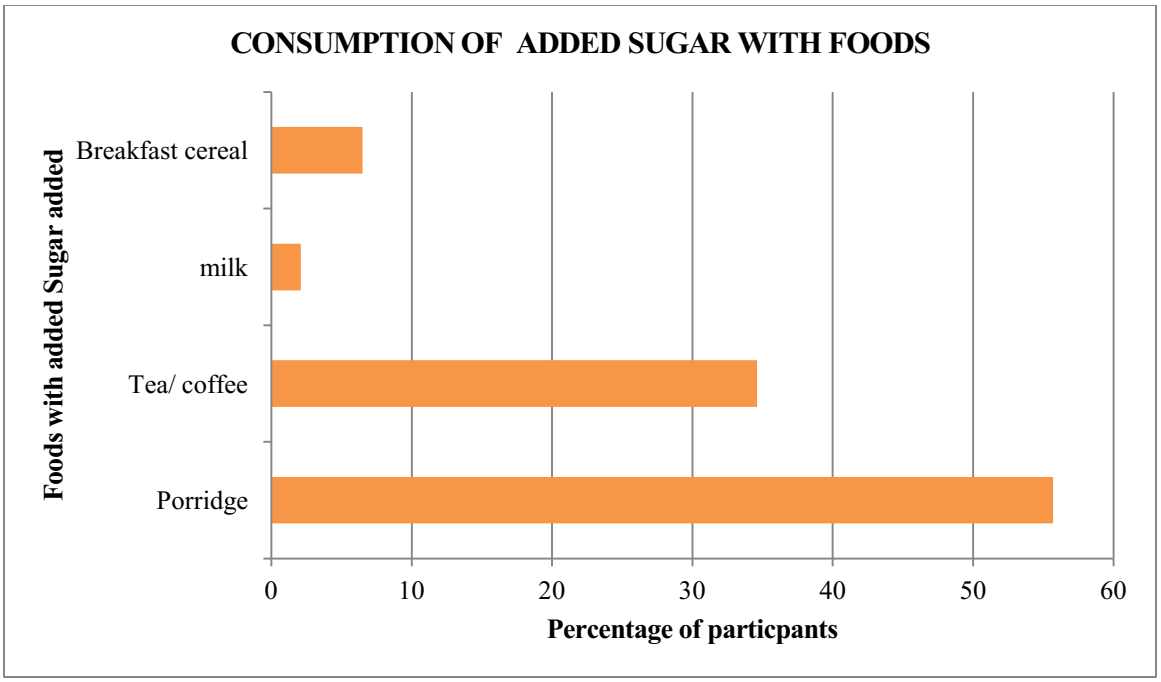

Figure 4: Chart showing distribution of sugar consumption with foods

3.3.7. Prescribed Diet (Autism Society of Kenya)

Seventy five (91.5%) of the caregivers reported that the study participants were on a prescribed diet. Out of these, 42 (56 %) admitted to strictly adhering to the diet while the rest did not (n=33, 44%). Some of the reasons given for not adhering to the diet included high cost of the diet and child unwillingness to accept the diet. The most common reported prescribed diet was gluten free and milk free diet, sugar free diet, consumption of organic foods with artificial preservatives and avoidance of red meats.

3.3.8. Food type Insistence and food neophobia.

Of the 82 participants, 49(59.8%) of them reported to insist on particular food types, while 33 (40.2%) did not. The most preferred food group was the carbohydrates (43.9%), followed by proteins (22.0%), and fruits (13.4%). The least preferred food type was vegetables (11.0%), as shown in figure 5.

With regards to food neophobia, 37 (45.1%) of the participants did not like trying new foods while 45 (54.9%) liked trying new foods.

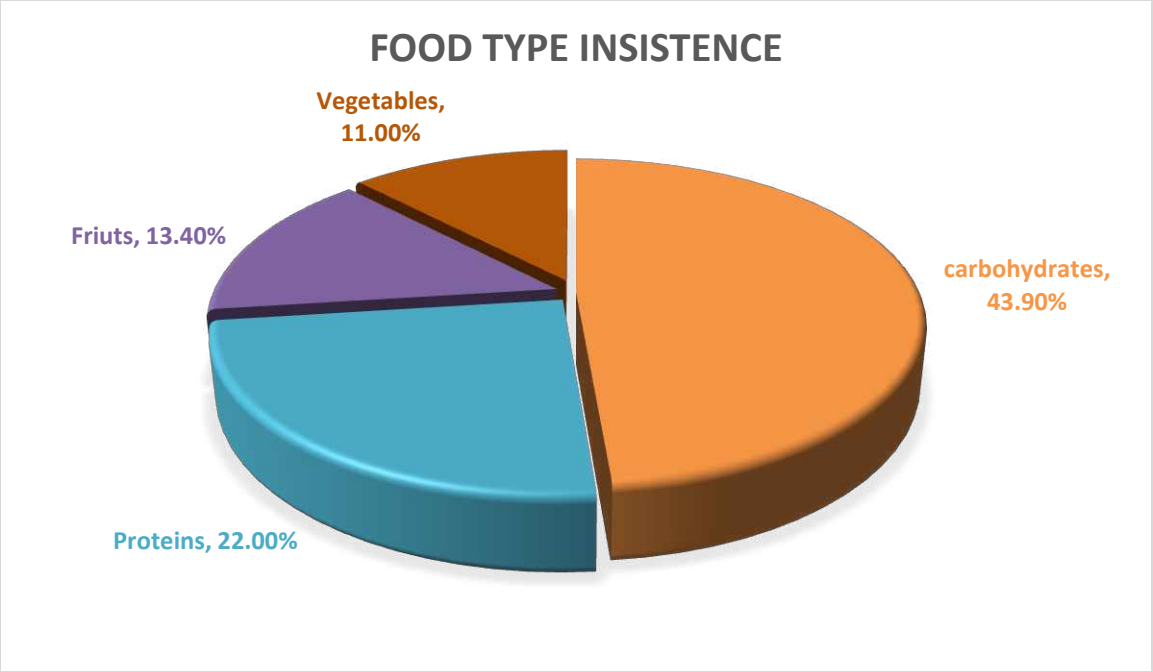

Figure 5: Chart showing Food Insistence among Participants

3.4.Nutritional Status of Participants.

The nutritional status of the study participants was assessed using Height for Age (HAZ) and BMI for Age indicators according to the WHO growth standards.

3.4.1. Height for Age

For the Height for Age, the children were grouped into 2 categories i.e. stunted and normal. Those below -2SD were classified as stunted, while those above -1.99 were classified as normal. The average height of the participants was 149.73 (SD 15.47). The minimum height was 109 cm and maximum was 178.5cm. Six (7.3%) of the children were stunted while 76 (92.7%) were normal as shown in figure 6. The older age category had slightly more participants who were stunted compared to the younger age group. The 6-12 years age group had 2 (2.4%) with stunting while the 13-17 years age group had 4 (4.9%) participants.

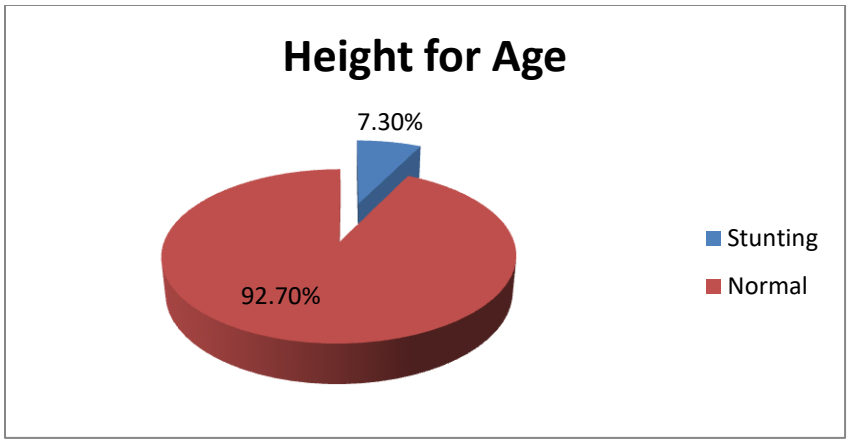

Figure 6: Distribution of participants By HAZ

3.4.2. HAZ by Caregivers' socio-demographic variables

The HAZ was compared to the various caregivers' socio- demographic characteristics. ANOVA test revealed no statistical significance between the HAZ and caregivers' level of education (F= 0.931, df=2, 79, p=0.399), economic status (F= 0.221, df= 2, 79, p=0.802) and average income (F=0.461, df= 4, 77 p=0.764).

Table 4: Comparison of caregivers socio-demographic characteristics distribution by HAZ (n = 82).

Characteristics		n (%)	HAZ		Statistical test (CI 95%)
			M	SD	
Education	<= Primary school	7 (8.6)	-0.56	0.97	F = 0.931,
	Secondary school	33 (40.2)	-0.50	1.20	df = 2, 79,
	College/University	42 (51.2)	-0.17	1.07	p = 0.399
Economic status	Unemployed	13 (15.8)	-0.44	1.08	F = 0.221,
	Self employed	39 (47.6)	-0.38	1.08	df = 2, 79,
	Employed	30 (36.6)	-0.23	1.20	p = 0.802
Income (Kshs)	< 10,000	11 (13.4)	-0.73	1.15	F = 0.461, df = 4, 77, p = 0.764
	10,000 – 25,000	33 (40.2)	-0.34	1.06	
	26,000 – 40,000	16 (19.5)	-0.31	1.53	
	41,000 – 55,000	13 (15.9)	-0.16	0.72	
	> 55,000	9 (11.0)	-0.16	1.01	

3.4.3. BMI for Age

With regards to BMI for Age, the participants were similarly grouped into 3 categories i.e.; undernourished, normal and obese. Those with BMI below -2SD were considered as undernourished, between -1.99 and +2SD as normal and those above +2SD as obese. The average BMI was 18.42 (SD3.85) with a median of 17.62 and mode of 12.8. The maximum BMI was 28.05 and minimum was 12.89. Eleven of the participants (13.4%) were undernourished, 64 (78.0%) were normal and 7 (8.5%) were obese.

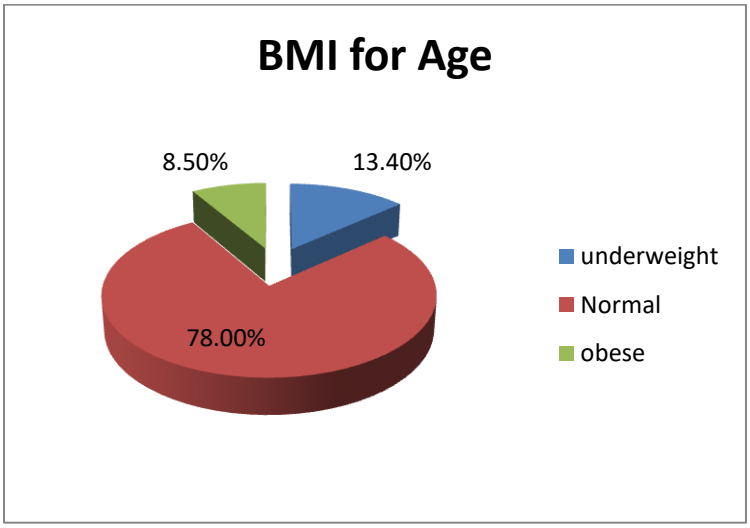

Figure 7:Distribution of participants by BMI for Age

3.4.4. BMI for Age by Age of participants

In terms of age categories, the 6-12 years age group had 5(6.1%) who were undernourished, 5 (6.1%) were obese and the rest were in the normal range. In the 13-17year age group, 6(7.3%) were undernourished, 2(2.4%) were obese while the rest were in the normal range (n=44, 53.7%). The BMI was compared to the age groups. An Independent sample T- test revealed a statistically significant difference between the BMI means and different age categories (t=3.434, df=80, **p=<0.001**).

Table 5:Distribution of participants' BMI by age.

Characteristic	Categories		Undernourished (n/%)	Normal (n/%)	Obese (n/%)	Statistical test (CI 95%)	df	p-value
BMI for Age	Age group	6-12 years	5(6.1)	20(24.4)	5(6.1)	t=3.434	80	**<0.001***
		13-17 years	6(7.3)	44(53.7)	2(2.4)			

3.4.5. BMI for Age by Caregivers' socio-demographic characteristics.

The BMI for Age was compared to the various caregivers' socio- demographic variables. ANOVA test showed a statistically significant difference between the BMI means and caregivers level of education (F=.3.628, df=2, 79,p**=0.030**). There was no statistical differences between the BMI and the socio-economic status (F= 0.540, df=2, 79, p=0.585) and average income (F=1.063, df= 4, 77, p=0.381). The findings are summarized in the tables below.

Table 6: Comparison of caregivers socio-demographic characteristics distribution by BMI (n = 82).

Characteristics		n (%)	BMI		Statistical test (CI 95%)
			M	SD	
Education	<= Primary school	7 (8.6)	19.96	4.50	F = 3.682*,
	Secondary school	33 (40.2)	19.47	4.31	df = 2, 79,
	College/University	42 (51.2)	17.33	3.08	**p = 0.030**
Economic status	Unemployed	13 (15.8)	18.86	4.33	F = 0.540,
	Self employed	39 (47.6)	18.72	3.90	df = 2, 79,
	Employed	30 (36.6)	17.83	3.65	p = 0.585
Income (Kshs)	< 10,000	11 (13.4)	20.25	4.91	
	10,000 – 25,000	33 (40.2)	18.42	3.95	F = 1.063,
	26,000 – 40,000	16 (19.5)	18.62	3.68	df = 4, 77,
	41,000 – 55,000	13 (15.9)	17.42	2.76	p = 0.381
	> 55,000	9 (11.0)	17.23	3.67	

3.5. Oral Hygiene Status

3.5.1. Oral hygiene practices

Out of the eighty two participants, 53 (64.6%) reported to brush their teeth once a day, 23(28%) brushed twice a day while 5 (6.1%) brushed once a week. One participant (1.2%) reported to have never brushed their teeth at all. Most of the children (n=50, 61%) were assisted to brush. Nineteen were assisted occasionally while 24 were assisted daily. 3(6%) were assisted to brush once a week and 4(8%) twice a week. Most of the children brushed their teeth using a conventional toothbrush and toothpaste (n=80, 97.6%). The rest reported the use of toothbrush and salty water (n=1, 1.2%) and tooth brush only (n=1, 1.2%)

3.5.2. Oral hygiene status of the participants

Oral hygiene was evaluated using plaque scores. Theses ranged from 0.50 to 3.00 with a mean of 2.27 (+/-0.73SD), which is indicative of poor oral hygiene. The table below is a summary of the oral hygiene status of the study participants.

Table 7:Distribution frequency of Plaque scores

Plaque category	Frequency(n)	Percentage(%)
Good(PS= 0.1-0.9)	14	17.1
Fair(PS= 1-1.9)	32	39.0
Poor(PS=2-3)	36	43.9

3.5.2.1. Oral hygiene status by Age categories

The 13-17year old group had a slightly higher plaque score(1.96+/- 0.73) compared to the 6-12year old group (1.99+/- 0.73).There was no statistical difference in the plaque scores among participants aged 6-12 years and 13-17 years (t=0.309, df=80, p=0.849).

3.5.2.2. Oral hygiene status by caregivers' socio-demographic characteristics

The plaque scores were compared to the socio-demographic variables of the caregivers. Fisher's exact test elicited a statistically significant association between plaque scores among the participants in relation to their caregiver's average income (X^2=15.799, df=8, **p=0.045**) as shown in table 8. Ordinal logistic Regression showed that the odds of caregivers' with an average income of less than Ksh 10,000 resulting in poor oral hygiene status was 0.662 times that of those of an income greater than Ksh, 10,000 (**OR=0.662**)

There was no statistical significance association between the plaque categories and caregivers' economic status (X^2=2.33 df=4 p=0.675) and caregivers' level of education(X^2=3.158, df=4, p=0.532).

Table 8: Participants' plaque score and caregivers' socio-demographic characteristics.

Characteristics		n (%)	Plaque score			Statistical test
			Good	Fair	Poor	
			n (%)	n (%)	n (%)	
Education	<= Primary school	7 (8.6)	2 (2.4)	3 (3.7)	2 (2.4)	Fisher's = 3.158,
	Secondary school	33 (40.2)	7 (8.5)	10 (12.2)	16 (19.5)	df = 4,
	College/University	42 (51.2)	5 (6.1)	19 (23.2)	18 (22.0)	p = 0.532
Economic status	Unemployed	13 (15.8)	3 (3.7)	5 (6.1)	5 (6.1)	Fisher's = 2.332,
	Self employed	39 (47.6)	8 (9.8)	13 (15.9)	18 (22.0)	df = 4,
	Employed	30 (36.6)	3 (3.7)	14 (17.1)	13 (15.9)	p = 0.675
Income (Kshs)	< 10,000	11 (13.4)	5 (6.1)	2 (2.4)	4 (4.9)	
	10,000 – 25,000	33 (40.2)	1 (1.2)	13 (15.9)	19 (23.2)	Fisher's = 15.799*,
	26,000 – 40,000	16 (19.5)	4 (4.9)	6 (7.3)	6 (7.3)	df = 8,
	41,000 – 55,000	13 (15.9)	3 (3.7)	5 (6.1)	5 (6.1)	**p = 0.045**
	> 55,000	9 (11.0)	1 (1.2)	6 (7.3)	2 (2.4)	

3.5.2.3. Oral hygiene status by oral health practices

The plaque scores were similarly compared to the oral health practices of the participants. ANOVA and independent T- test carried out revealed no statistical differences in plaque scores means among the participants in relation to tooth cleaning frequency (F=0.930, df=3,78, p=0.930), assistance in tooth cleaning (t=0.276, df=80, p=0.784) and use of various tooth cleaning aids (F= 1.149, df=2, 79, p=0.322).

Table 9: Comparison of the children's oral health practice characteristics by mean plaque score (n = 82).

Characteristics		n (%)	Plaque score		Statistical test (95% CI)
			M	SD	
Teeth cleaning Frequency	Never	1 (1.2)	2.75	.	F = 0.930, df = 3, 78, p = 0.430
	Once daily	53 (64.6)	1.99	0.70	
	Twice daily	23 (28.0)	1.86	0.75	
	Once weekly	5 (6.2)	2.31	0.85	
Teeth cleaning assistance	Yes	51 (62.2)	2.00	0.71	t = 0.276, df = 80, p = 0.784
	No	31 (37.8)	1.95	0.76	
Teeth cleaning aid	Toothbrush only	1 (1.2)	3.00	.	F = 1.149, df = 2, 79, p = 0.322
	Toothbrush & Toothpaste	80 (97.6)	1.98	0.72	
	Toothbrush & Salty water	1 (1.2)	1.58	.	

3.6.Dental caries Experience.

The prevalence of dental caries was 48%. The group of 13-17 years had a higher prevalence of dental caries (29.3%) than the 6-12year olds that had a caries prevalence of 18.3%.

3.6.1. Dental caries experience in deciduous dentition

The mean dmft for children was 0.20 (+/- 0.40 SD). The mean decayed teeth among the children was 0.32 (+/- 1.02SD) while the mean missing teeth due to caries was 0.07(+/- 0.34SD). There were no filled in the deciduous dentition. The 6-12year old group had a mean dmft of 0.30(+/- 0.47SD) while the 13-17year old age group had a dmft mean of 0.13(+/- 0.34SD). Independent sample T- test showed a statistical significant difference between the dmft and the two age groups (t=1.835,df=80,**p=0.070**). An ANOVA

test carried out, elicited a statistical significant difference in dmft means for deciduous teeth and caregivers level of education (F=1.548, df=2, 79, **p=0.013**).

Table 10;Comparison of children's Age and caregivers socio-demographic characteristics with dental caries experience (dmft) (n = 82).

Characteristics		dmft		
		n (%)	Mean ± SD	Statistical test (CI 95%)
Age (grouped)	6-12 years	30(36.6%)	0.30±0.47	t=1.835
	13-17 years	52(63.4%)	0.13±0.34	df=80
				p=0.070*
Education	<= Primary school	7 (8.6)	0.43 ± 0.53	F=4.571
	Secondary school	33 (40.2)	0.18 ± 0.39	df=2,79
	College/University	42 (51.2)	0.17 ± 0.38	**p=0.013***
Economic status	Unemployed	13 (15.8)	0.31 ± 0.48	F=1.548
	Self employed	39 (47.6)	0.23 ± 0.43	df=2, 79
	Employed	30 (36.6)	0.10 ± 0.31	p=0.219
Income (Kshs)	< 10,000	11 (13.4)	0.36 ± 0.50	F=0.658
	10,000 – 25,000	33 (40.2)	0.18 ± 0.39	df=4,77
	26,000 – 40,000	16 (19.5)	0.13 ± 0.34	p=0.623
	41,000 – 55,000	13 (15.9)	0.15 ± 0.38	
	> 55,000	9 (11.0)	0.22 ± 0.44	

3.6.2. Dental caries experience in Permanent dentition.

The DMFT for children was 0.32(+/- 0.47SD). The mean decayed teeth among the participants was 1.06(+/- 2.46SD) while the mean missing teeth was 0.05(+/- 0.27SD). The mean filled teeth among the children was 0.02(+/- 0.41SD).

The mean DMFT among the 6-12 year old age group was slightly lower (0.20+/-0.41SD) compared to that of the 13-17year old group (0.38+/- 0.49SD). An Independent sample T- test elicited a statistically significant difference in DMFT means between the two age groups (t=1.741, df= 80, **p=0.015**).

Additionally, an ANOVA test carried out between DMFT and caregivers economic status showed a significant association between the DMFT and caregiver's economic status (F=1.769, df=2, 79, **p=0.015**).

Table 11: Comparison of participants age groups and caregivers socio-demographic characteristics with dental caries experience (DMFT) (n = 82).

			DMFT	
	Characteristic	n (%)	Mean ± SD	Statistical test (CI 95%)
Age(grouped	6-12 years	32 (36.6%)	0.20±0.41	t=1.741
	13-17years	50 63.4%)	0.38±0.49	df=80
				p=0.015
Education	<= Primary school	7 (8.6)	0.14 ± 0.38	F=0.524
	Secondary school	33 (40.2)	0.33 ± 0.48	df=2, 79
	College/University	42 (51.2)	0.33 ± 0.48	P=0.594
Economic status	Unemployed	13 (15.8)	0.54 ± 0.52	F=1.769
	Self employed	39 (47.6)	0.28 ± 0.46	df=2, 79
	Employed	30 (36.6)	0.27 ± 0.45	**p= 0.015***
	< 10,000	11 (13.4)	0.36 ± 0.50	
Income (kshs)	10,000 – 25,000	33 (40.2)	0.27 ± 0.45	
	26,000 – 40,000	16 (19.5)	0.31 ± 0.48	F=1.281
	41,000 – 55,000	13 (15.9)	0.54 ± 0.52	df=4,77
	> 55,000	9 (11.0)	0.11 ± 0.33	p=0.285

3.6.3. Dental caries and oral hygiene practices.

There was no statistical difference between the tooth cleaning frequency(F=1.222, df 3,78, p=0.307), assistance in tooth cleaning(t=0.673, df=80, p=0.503) and use of tooth cleaning aid (F=0.287,DF=2,79,P=0.751) with dental caries.

Table 12: Comparison of tooth cleaning habits and dental caries

Characteristics		Dental caries n (%)	M	SD	Statistical test
Teeth cleaning Frequency	Never	1 (1.2)	3.00	.	F = 1.222, df = 3, 78, p = 0.307
	Once daily	53 (64.6)	1.17	2.11	
	Twice daily	23 (28.0)	1.48	2.52	
	Once weekly	5 (6.2)	3.40	6.54	
Teeth cleaning assistance	Yes	51 (62.2)	1.57	2.96	t = 0.673, df = 80, p = 0.503
	No	31 (37.8)	1.16	2.05	
Teeth cleaning aid	Toothbrush only	1 (1.2)	0.00	.	F = 0.287, df = 2, 79, p = 0.751
	Toothbrush & Toothpaste	80 (97.6)	1.45	2.67	
	Toothbrush & Salty water	1 (1.2)	0.00	.	

3.6.4. Dental caries and Nutritional status

Dental caries prevalence was compared to the nutritional status among the participants, as shown in table 13. A fisher's exact test showed no statistical significance between dental caries with BMI for age(X^2= 3.475, df=2, p=0.176) and HAZ(X^2=1.863, df=2, p=0.394).

Table 13: Association of children's dental caries experience with BMI and HAZ characteristics

Characteristics		n (%)	Caries		Statistical test
			Absent	Present	
			n (%)	n (%)	
BMI	Undernourished	11 (13.5)	5 (6.1)	6 (7.3)	Fisher's = 3.475, df = 2, p = 0.176
	Normal	64 (78.0)	32 (39.0)	32 (39.0)	
	Obese	7 (8.5)	6 (7.3)	1 (1.2)	
HAZ	Stunting	6 (7.3)	3 (3.7)	3 (3.7)	Fisher's = 1.863, df = 2, p = 0.394
	Normal	76 (92.6)	40 (48.7)	36 (43.9)	

3.7. Dietary patterns and its association with dental caries

The participants snacking behaviour and dental caries experience was compared. Fishers exact statistical test showed that there was a statistical significant association between the children who had snacks at home with dental caries (X^2= 4.829, df=1, **p=0.028**). Binomial logistic regression test showed that increase in consumption of snacks resulted in increased of dental caries prevalence **(OR= 0.562).**

There was no significant difference between those who received reward snacks and dental caries prevalence (X^2= 0.214, df=1, p=0.644).

A comparison of dental caries and consumption of sugar with foods was done as shown in figure 15. Those who consumed porridge with sugar had higher dental caries prevalence (29.3%) compared to those who consumed sugar in breakfast cereals (3.7%) and tea/ cocoa/ coffee with sugar (15.9%). However, there was no significant statistical association between the participants consumption of sugar with foods and dental caries prevalence.

Table 14: Association of children's consumption of foods with sugar by dental caries (n = 82).

Characteristics		n (%)	Caries		Statistical test (95%CI)
			Absent	Present	
			n (%)	n (%)	
Breakfast cereals	No	77 (93.9)	41 (50.0)	36 (43.9)	Fisher's = 0.330, df = 1,
	Yes	5 (6.1)	2 (2.4)	3 (3.7)	p = 0.565
Porridge	No	36 (43.9)	21 (25.6)	15 (18.3)	Fisher's = 0.894, df = 1,
	Yes	46 (56.1)	22 (26.8)	24 (29.3)	p = 0.344
Tea/Coffee/Cocoa	No	55 (67.1)	29 (35.4)	26 (31.7)	Fisher's = 0.006, df = 1,
	Yes	27 (32.9)	14 (17.1)	13 (15.9)	p = 0.941

3.8.Dietary patterns and its association with nutritional status

The frequency of consumption of various food groups were compared to the HAZ and BMI for age. A Fishers exact test for association elicited a statistically significant association between the participants HAZ and consumption of cookies / biscuits (X2=7.875, df= 2, **p= 0.019**) and consumption of sweets (X2= 8.803, df=2**, p=0.012**). There was no statistical significance association between the participants HAZ and BMI with snacking behavoiur of the participants, prescribed diet and food insistence, as shown in the tables 16 and 17.

Table 15: Association of children's snacking behavoiur, prescribed diet and food insistence by BMI characteristics (n = 82).

Characteristics		n (%)	BMI			Statistical test
			Under nourished	Normal	Obese	
			n (%)	n (%)	n (%)	
Snacks at home	No	5 (6.1)	1 (1.2)	3 (3.7)	1 (1.2)	Fisher's = 1.214,
	Yes	77 (93.9)	10 (12.2)	61 (74.4)	6 (7.3)	df = 2, p = 0.545
Reward snacks	No	23 (28.0)	5 (6.1)	16 (19.5)	2 (2.4)	Fisher's = 1.947,
	Yes	59 (72.0)	6 (7.3)	48 (58.5)	5 (6.1)	df = 2, p = 0.378
Insists on food type	No	33 (40.2)	4 (4.9)	26 (31.7)	3 (3.7)	Fisher's = 0.093,
	Yes	49 (59.8)	7 (8.5)	38 (46.3)	4 (4.9)	df = 2, p = 0.955
Child on diet	No	40 (48.8)	5 (6.1)	31 (37.8)	4 (4.9)	Fisher's = 0.248,
	Yes	42 (51.2)	6 (7.3)	33 (40.2)	3 (3.7)	df = 2, p = 0.884

Table 16: Association of children's snacking behavoiur, prescribed diet and food insistence by HAZ characteristics (n = 82).

Characteristics		n (%)	Stunting	Normal	Statistical test
			n (%)	n (%)	
Snacks at home	No	5 (6.1)	1 (1.2)	4 (4.9)	Fisher's = 1.362,
	Yes	77 (93.9)	5 (6.1)	72 (87.8)	df = 2, p = 0.506
Reward snacks	No	23 (28.0)	2 (2.4)	21 (25.6)	Fisher's = 0.599,
	Yes	59 (72.0)	4 (4.9)	55 (67.1)	df = 2, p = 0.741
Insists on food type	No	33 (40.2)	2 (2.4)	31 (37.8)	Fisher's = 1.550,
	Yes	49 (59.8)	4 (4.9)	45 (54.8)	df = 2, p = 0.461
Child on diet	No	40 (48.8)	4 (4.9)	36 (43.9)	Fisher's = 3.106,
	Yes	42 (51.2)	2 (2.4)	40 (48.8)	df = 2, p = 0.212

CHAPTER 4:

DISCUSSION

Autism Spectrum Disorders comprise a complex set of developmental disorders which are characterized by impairments in communication, social interaction, and repetitive behavoiur[1.] The affected children are frequently incapable of co-operating in the dental setting, thus reducing their access to dental healthcare. The prevalence of ASD has been shown to be increasing and is currently estimated to affect 1 in 160 children globally[4].In Kenya, ASD is estimated to affect approximately 800,000 children[5.] Literature shows that children with ASD have a liking towards high calorie foods and those with high sugar content, which may predispose them to dental caries and affect their nutritional status. The aim of this study was to determine the dietary patterns, nutritional status and dental caries experience in children with ASD attending City Primary School in Nairobi Kenya. Additionally, the study was set out to determine any association between dietary patterns with nutritional status and dental caries experience. A response rate of 91.1% was obtained.

The male to female ratio in the study population showed a large variance in gender, with the male to female ratio being 8.1:1. Several studies have demonstrated similar sex variance suggesting that ASD is more common in males than females[30,39]. Huxham et. al in England found a male to female ratio of 7:1[88], which is comparable to what was found in this study. Jaber found a male to female ratio of 2.8:1among ASD children in United Arab Emirates[89] which was similar to a study done in South Africa that found a male to female ratio of 2.5:1[90]. Genetic studies have shown that females are 'protected' from the effects of de novo and heritable ASD

risk CNVs. Additionally, it is hypothesized that the female sex hormones may modulate these genetic variations in ASD[91,92]. Because of the skewed male to female ratio in the present study, the sex variable was excluded from most of the analyses in the study. The age range of participants in this study was 6-17 years where the ages were dichotomized into 6-12 age groups and 13- 17 age group. The older age group had more participants (63.4%) compared to the younger age group (36.6%). The caregivers reported that financial constraints hindered most of them from enrolling their children to the school in their early years, and this may have attributed to the low number of children in the lower age group. The caregivers reported that they would prefer to pay fees for their other 'normal' children instead of the autistic ones. Majority of the participants were from Nairobi country (64.6%) where the school is located while the rest (35.4%) were from Kiambu County which is a neighbouring county in close proximity to Nairobi. Majority of the caregivers who attended the interviews were the biological mothers of the children. This may be a reflection of the active role of mothers as caregivers of children in the society[93]. The literacy level among the caregivers was relatively high with more than half (51.2%) having attained university or college education; which is a reflection of a typical urban Kenyan population[93.]

Dietary intervention is one of the modalities that are commonly used in the management of hyperactivity and irritability symptoms in children with ASD. This form of management has recently gained popularity worldwide. Similarly in Kenya, one of the popular methods of management of ASD is dietary intervention[58,59]. The school has adopted the diet that is formulated by the Autism Society of Kenya whereby; gluten free-casein free diet with additional elimination of red meat, sugar and processed foods is advocated for (Appendix 4). In this study,

91.5% of the participants were reported to have been advised on the prescribed diet. Despite this, only 56% of the participants were strictly following the diet. Some of the challenges faced with adhering to the diet were; high cost of the organic foods recommended and unwillingness of the child to accept the diet. These challenges experienced were similar to those suggested by Geraghrty et. al[7]. In the present study, there was a high consumption of fruits and vegetables and relatively low consumption of animal proteins and milk and milk products amongst the participants. Additionally, the consumption of sweets and confectionaries was also low. This type of diet reported could be as a result of influence from the school which encourages prescribed diets as one of the modes of management of ASD symptoms. A similar dietary picture was described by Geraghrty et. al [7], where they found that children who were on GFCF diet, had higher levels of fruit and vegetables intake and lower levels of dairy intake compared to those who were not on any diet.

Food selectivity which involves food neophobia (where a child refuses to try new foods) and insistence on consumption of particular foods, has been found to be a significant issue for many children with ASD. This study showed that 59.8% of the children insisted on a eating a particular food. Several studies have similarly reported same observation among ASD children[62,94]. The most preferred food was carbohydrates (43.9%), where most caregivers reported that the children would insist on eating ugali, rice or chips. Ugali is a Kenyan dish which is made from maize flour and water. Children with ASD have been shown to have a preference for soft foods especially carbohydrates[67,88,95]. In the present study, nearly half of the children (45.1%) did not like trying new foods while the rest did (54.9%). This finding is similar to Klein and Nowak who reported 53% of participants were reluctant to try new foods. It is suggested that factors such as

texture, colour, smell and temperature of food as a result of sensory sensitivity contributes greatly in food selectivity in ASD[8,97].

Majority (92.7%) of the participants in the study were within the normal range of BMI and HAZ (78%), respectively. However, 13.4% were found to be undernourished, 8.5% were obese and 7.3% were stunted. These findings differ from two studies reported in the US, where one study by Philips et. al.[84] reported a higher percentage(31.8%) of participants to be obese and a lower percentage(5.6%) as underweight. Egan et. al. on the other hand, reported similarly high percentage of children with obesity (32.9%) while 3.66% were underweight[83]. Unlike in the present study, participants in the two American studies were not on any prescribed diet and this may have influenced the differences in the observations. Additionally, the American studies had much larger sample sizes compared to the present study which may also have contributed to the differences in observations. The present study found a significant relationship between BMI and caregivers' level of education (F=3.628, df=2, 79, **p=0.030**).Majority of the caregivers were highly educated. Studies have found that caregivers' education and literacy increases the knowledge and skills in childcare, consequently enhancing good nutritional status of the children[98]. The present study also found a significant relationship between the age categories of the participants with the BMI (t=3.434, df=80, **p=<0.001**). The average BMI was higher among the older age group than in the younger one. Though significant, this was an incidental finding.

The mean plaque score of the study participants was 2.27+/- 0.73, which is indicative of poor oral hygiene according to Silness and Loe 1964 plaque index. These findings are similar to previous studies among children with ASD that recorded poor oral hygiene[61,62,89.] Parents

reported difficulties while brushing their children's teeth resulting from lack of cooperation from the children. Onol et. al reported a plaque score of 2.06+/-0.73 which is comparable to the present study[62]. This was attributed to inadequate brushing habits because of compromised manual dexterity in the children and difficulties the caregivers encountered when they brushed the children's teeth. Studies show that aversion to toothpaste and toothbrush in children with ASD sue to sensory sensitivity, also results in inadequate brushing habits[62]. To try and overcome these challenges, Jaber, recommended the use of visual pedagogy as a tool in helping children with ASD to improve their oral hygiene[89]. He argued that placement of a series of pictures showing structured method of brushing, where tooth brushing was performed, would eventually lead to better oral hygiene. The current study found a statistical significant association between plaque scores among the participants in relation to the caregivers' income (X^2= 15.799, df=8, **p=0.045**). A possible explanation to this finding would be that, caregivers who earn more have more purchasing power and hence able to afford tooth cleaning implements and oral healthcare services which result in better oral hygiene.

The overall prevalence of dental caries among the participants was 48%. This finding is lower compared to what was reported in other studies[89]. Jaber reported a dental caries prevalence of 77% among Autistic children in UAE[89]. Similarly, Hariyani et. al recorded a prevalence of 78.6% among ASD children in Indonesia[99.] These two studies attributed the high caries prevalence to inadequate brushing techniques, pouching food inside mouth instead of swallowing and snacking behaviour of the children. Poor reflexes during mastication and poor coordination of the tongue prevent normal swallowing and this result in a tendency to store food in the mouth[100]. The low dental caries prevalence in the current study can be attributed to the

prescribed diet that the children are on, that encourages elimination of sugar from the diet. Surprisingly, Chan et. al recorded a much lower caries prevalence of 26% among children with ASD in Hong Kong compared to the present study[74]. The low caries prevalence was attributed to twice daily tooth brushing habit that had been established in the children with ASD.

Caries experience has demonstrated varied results in different studies [62, 77].In the present study, the dmft was 0.20+/-0.40 and DMFT 0.32+/-0.47. These findings were much lower compared to Kalyoncu et. al in Instanbul where they recorded a dmft and DMFT of 1.65+/-2.57 and 2.0+/-2.26 respectively[77]. A different study done by Onal et. al showed a higher DMFT/dmft of 3.59+/-3.60 and 4.58+/-4.22 respectively[62]. The two studies related they findings to the snacking behaviour where parents would give cariogenic snacks to enhance positive behaviour in the children. The low DMFT and dmft in the present study would be attributed to the diet that the children are on that encourages elimination of sugar from the diet. The role of diet in the occurrence of dental caries has long been established in the consumption of fermentable carbohydrates that provide substrate for bacteria to act on[71]. Elimination of these fermentable carbohydrates, found in confectionaries and sweetened beverages would consequently lead to low dental caries. Despite the relatively low DMFT/dmft, the present study showed that the number of decayed teeth was relatively high, with few missing and filled teeth. This was similar to what was recorded in other studies[61,62,89], highlighting unmet dental needs amongst children with ASD in the study population. This also further supports previously reported studies of unmet dental needs in children with ASD, where factors such as poor access to dental facilities, poor preventive care or an aversion to dental treatment were recorded as barriers to seeking treatment[89].

The present study showed significance in the age categories and the dmft (t=1.835, df=80**, p=0.070**) and DMFT (t=1.741, df=80, **p=0.015**).This could be that in the older age group the permanent first molars have been in the mouth for longer time hence susceptible to dental caries. Bivariate analysis showed no association between the nutritional status of the participants and dental caries. This may probably be because the severity of dental caries may not be enough to affect the intake and mastication of food. It would also be because the low rates of undernourished and stunted made it difficult to establish any statistical association between the nutritional status and dental caries prevalence.

The present study established a significant association between dental caries and snacking among the participants (F=4.829, df=1**, p=0.028**). Majority of the snacks given at home were potato crisps, popcorn and biscuits. Diet plays a major role in the development of dental caries[71]. The micro-organisms in the mouth metabolize the fermentable sugars that are found in foods such as biscuits producing organic acids that eventually lead to the dissolution of hard tissues of the teeth [71]. Potato crisps are thin slices of potatoes that have been fired or baked till crunchy. Potato crisps have also been found to exhibit a high cariogenic potential due to their retentive nature on tooth surface hence allowing more time for bacterial breakdown and acid production leading to dental caries[101,102]. Therefore, the null hypothesis that there was no association between dietary patterns and dental caries experience was rejected.

The dietary patterns among the participants were compared to their nutritional status in the present study. A statistically significant association was established between the participants' HAZ and consumption of cookies/biscuits (X2=7.875, df=2, **p=0.019**) and consumption of

sweets (X2=8.803, df=2, **p=0.012**). Stunting which is measured using HAZ is a form of malnutrition that occurs when a child fails to gain sufficient height relative to their age. Stunting results from poor nutrient intake that can be influenced by consumption of junk food such as sweets and biscuits. A report by USAID in 2016 revealed that consumption of junk food frequently led to poor nutrient uptake in children resulting in stunting[103].

Therefore, the null hypothesis that there is no association between dietary patterns and nutritional status in children with ASD was rejected.

STUDY LIMITATIONS.

1. Because children attending City Primary school were on a diet, the results cannot be generalized to the entire population of children with ASD.
2. Dietary assessment was subject to bias recall as it depended on the memory of the caregivers.
3. Medical history of the children was not captured in the questionnaire. This would a source of bias as syrup medication with sugar may be used by these children.
4. Disparity in figures. The low female numbers led to exclusion of the sex variable from various statistical tests.

CONCLUSION

1. The children consumed a wide variety of foods. However the consumption of animal proteins, milk and milk products, sweets and confectionaries was low. This was greatly influenced by the prescribed diet that majority of the children were following. There was a high consumption of sugar in porridge, which was the most frequently consumed beverage among the children.
2. Majority of the participants were within normal range of BMI (92.7%) and HAZ (78%). The rate of stunting, undernutrition and obesity was low. There was a significant relationship between HAZ with consumption of sweets (X^2=8.803,df=2,**p=0.012**) and cookies (X^2=7.875, df=2**, p=0.019**). There was a statistically significant relationship between BMI and age groups (t=3.434, df=80, **p=<0.001**) and caregivers level of education (F=3.628, df=2, 79, p**=0.030**).
3. The dental caries prevalence was 48% with dmft of 0.20+/-0.40 and DMFT of 0.32+/-0.47.There was a statistically significant relationship between snacking at home and dental caries prevalence (F=4.829, df=1,p=**0.028).** Increase in consumption of snacks resulted in increase of dental caries (OR=0.568)

RECOMMENDATIONS.

1. There is need to motivate and encourage parents to follow prescribed diet and limit intake of unhealthy snacks.
2. There is need to innovate ways to improve oral hygiene in children with ASD.
3. Further research on oral health status among children with ASD on a nationwide basis is recommended.

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APPENDICES

APPENDIX 1a: CONSENT FORM (ENGLISH)

PROJECT TITLE: DIETARY PATTERNS, NUTRITIONAL STATUS AND DENTAL CARIES EXPERIENCE IN CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER ATTENDING CITY PRIMARY SCHOOL IN NAIROBI, KENYA.

Dear Parent/Guardian of……..

I am Dr.Eunice Ngugi Mbaabu currently pursuing a Masters degree in Paediatric Dentistry at the University Of Nairobi, Kenya.

Purpose of the Study: In partial fulfillment of my degree, I am working on a dissertation entitled: Dietary patterns, Nutritional Status and Dental caries experience in children with Autism Spectrum Disorder attending City Primary School in Nairobi, Kenya.

This study will provide baseline information on dietary patterns, nutritional status, and dental decay among children and adolescents with Autism Spectrum Disorder. Dental caries is considered to be the commonest oral diseases affecting children and adolescents worldwide.

Procedure: The parent/guardian shall be given a questionnaire while being interviewed on the dietary patterns and oral hygiene practices of the child, by myself. The questionnaire will include both open and closed ended questions on the intake of various food groups, food frequency and oral hygiene practices of the child. Your child shall then have dental examination which will be followed by nutritional assessment. This will be carried out by myself. The nutritional assessment will involve taking the height and weight of the child. The child will stand upright, bare foot and with minimal clothing on a height board and thereafter on a weighing scale to have

their height and weight measures taken respectively. The dental examination will involve checking for presence or absence of plaque and tooth decay using sterile instruments and materials.

Risks: There are no risks in this study since no invasive procedures shall be performed on your child.

Benefits:

1. The parent/guardian will obtain free oral health education for the child, on the day of data collection.
2. The results of this study shall assist in sensitizing you and other Kenyans on Dietary patterns, nutritional status and dental caries experience of children with Autism Spectrum Disorder.
3. The results shall also be used to advice relevant health planners in formulation of oral health programs targeting children with Autism Spectrum Disorder, with the aim of promoting and providing continuous and sustainable oral health care.

Assent process: Your child will not be forced to participate in the study if they are unwilling or unable to.

Cost and referral: Children and adolescents with dental problems and in need of elective and emergency care will be referred to the University Of Nairobi Dental School Hospital. Additionally, those in need of emergency and elective medical treatment/care will be referred to the Peadiatric emergency clinic in Kenyatta national Hospital. I will make personal arrangements with the hospital for smooth referral of the study participants. Further, a referral system will be set up for future consultation and treatment of the study participants at the hospital.

Confidentiality: All the information that will be obtained about your child will be confidential to protect their privacy. This shall be done by giving codes to their questionnaire and examination form thereby avoiding using their name when gathering information. The information shall only be accessed by authorized professionals involved in the study but they will not recognize your child's identity. There is no identity of any participant that shall be disclosed in any public conferences, reports or publications.

The right of withdrawal: You may withdraw your child from participating at any time without suffering any consequences.

This letter is to kindly request you to accept and allow your child to participate in the study. Read it and make sure you have understood it before signing if you agree to your child's participation in this study

Participation

I…….parent/guardian of ..…… do hereby freely consent/do not consent to my child participation in the said study.

Signature/Thumb Print: ..... Signature of investigator……

Date: ..... Date…….....

For further information or inquiries please contact: -

Dr. Eunice Ngugi Mbaabu,eunicembaabu@gmail.com

Tel: +254 723232304

Lead supervisor:

Prof. Mary Masiga, ati_masiga@yahoo.com

Tel: +254 721562606

The Chairperson, Kenyatta Hospital/University of Nairobi Ethics and Research Committee, uonknh_erc@uonbi.ac.ke

Tel: 00202 726300-9

APPENDIX 1b: CONSENT FORM (KISWAHILI)

FOMU LA KUKUBALI- MAELEZO YA KUTAFUTA IDHINI KUTOKA KWA WATOTO WATAKAOSHIRIKI KATIKA UTAFITI.

KICHWA CHA MRADI: MLO, HALI YA LISHE NA HALI YA AFYA NA MASUALA YA MENO MIONGONI MWA WATOTO WALIO NA UGONJWA WA WIGO WA AUTISM WANAOSOMA KATIKA SHULE YA MSINGI YA CITY, NAIROBI, KENYA.

Kwa mzazi au mlezi wa …….

Mimi, Daktari EuniceNgugi Mbaabu, mwanafunzi wa shahada ya uzamili wa masuala ya meno ya watoto katika chuo kikuu cha Nairobi.

Sababu kuu ya utafiti: Katika hali ya kutaka kutimiza mahitaji ya shahada yangu,ninafanya kazi katika tasnifu inayohusu:Mlo, Hali ya lishe na Hali ya afya na masuala meno miongoni mwa watoto walio na ugonjwa wa wigo wa Autism. Utafiti huu utaweza kutoa msingi wa habari kuhusu mlo, hali ya lishe na hali ya afya na maswala ya meno miongoni mwa watoto walio na ugonjwa wa wigo wa Autsm. Ugonjwa wa meno kuoza unachukuliwa kuwa ugonjwa wa mdomo unawaathiri sana vijana kote ulimwenguni.

Utaratibu: Nitahoji mzazi au mlezi wa mtoto na kisha kukagua hali ya lishe na hali ya meno yake. Urefu na Uzito wa mtoto utachukulwa ili kutadhmini hali ya lishe.Mtoto atasimama kidete kwenye uzani wa kilo na urefu akiwa na nguo chache na bila viatu, ili kutadhmini hali ya lishe ya mtoto.Kisha uchunguzi wa kutadhmini hali ya afya ya meno utafuata kwa kuangalia kuwepo au kutokuwepo kwa meno kuoza. Hakuna matibabu yatakayopewa watoto japo wale ambao watapatikana na matatizo na wanahitaji usaidizi wa dharura wataweza kuelekezwa katika

hospitali ya Meno ya chuo kikuu cha Nairobi. Kwa wale ambao watahitaji matitbabu ya dharura ya mwili wataelekewa kwa kliniki ya watoto katika hospitali kuu ya Kenyatta.

Hatari: Hakuna hatari katika utafiti huu kwa sababu utaratibu wa upasuaji hautafanywa kwa mtoto wako.

Manufaa: Matokeo ya utafiti huu yatasaidia katika kukuhamasisha wewe na wakenya wengine kuhusu mlo, hali ya lishe na hali ya afya ya meno kwa watoto walio na ugonjwa wa wigo wa Autism.Licha ya hayo matokeo haya yatasaidia katika kutoa ushauri kwa wapangaji husika wa shughuli za matibabu katika kuweka mikakati ya afya ya meno inayolenga walio na ugonjwa wa wigo wa Autism kwa lengo la kuendeleza na kutoa huduma zinazoendelea na endelevu katikahali bora ya lishe na utunzi wa afya ya meno.

Siri: Habari yote itakayochukuliwa kutoka kwa mtoto wako itakuwa siri ili kukinga hali yao yasiri. Jambo hili litawezekana kwa kutoa nambari maalumu katika rekodi zao za matibabu na vijikaratasi vya maswali hivyo basi kuepuka kutumia majina yao habari inapokusanywa kutoka kwao.Habari itakaguliwa na wataalamu walohusika katika uchunguzi na wale ambao wameruhusiwa kufanya hivyo lakini hawawezi kutambua jina la mtoto wako. Hakuna kitambulisho cha mshiriki yeyote ambacho kitatolewa katika mikutano ya umma,ripoti au chapa.

Hifadhi ya nakala ya habari utakayotoa: Habari yote nitakayokusanya kutoka kwa mtoto wako itahifadhiwa kwa siri na kutumiwa katika utafiti huu. Majina ya watoto binafsi watakaoshiriki hayataandikwa mahali popote wakati wowote. Nakala zote za habari kuhusu mtoto wako zitafungiwa katika makabati maalum wakati wote wa utafiti huu.Tutasistiza usiri huu katika kusimamia habari tutakazopewa ili kuzuia kujulikana kwa watakaoshiriki katika utafiti huu. Hakuna majina yatakayotumika katika vikao vya sayansi kwa umma na ripoti zitakazochapishwa katika majarida haya.

Ushiriki: Hakuna atakayekulazimisha kushiriki kwenye utafiti huu. Mtoto au mzazi ana uhuru wa kujiondoa kutoka kwenye utafiti huubilakupata adhabu yoyote.

Idhini yako na sahihi: Nimesoma maelezo yaliyoko hapa juu na nimekubali kwa hiari yangu kuwa mtoto wangu ashiriki katika utafiti huu;

Mimi…… mzazi wa……...

nakubali / nakosa kukubali mtoto wangu kuhusishwa katika huu utafiti.

Sahihi/Alama ya kidole: ..... Sahihi ya mtafiti…….

Tarehe: ..... Tarehe……...

Kwa maswali zaidi tafadhali wasiliana na: -

Dkt.Eunice Ngugi Mbaabu, eunicembaabu@gmail.com

Namba ya simu; +254 723232304

Msimamizi mkuu:

Prof. Mary Masiga, ati_masiga@yahoo.com

Namba ya simu: +254 721562606

Mwenyekiti, Kenyatta Hospital/University of Nairobi Ethics and Research Committee

uonknh_erc@uonbi.ac.ke

Tel: 00202 726300-9

APPENDIX 2a: QUESTIONNAIRE (ENGLISH)
QUESTIONS TO BE ANSWERED BY THE CAREGIVER

The information obtained will be confidential and only used for the purpose of this study.

Sex ☐

Date of birth ☐☐☐

Day month year

Residence_____

ANTHROPOMETRY

	First Reading	Second Reading	Average
Height in centimetres			
Weight in Kilograms			

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

a) Type of caregiver

Mother…….. ☐

Father……..….. ☐

Aunt……..... ☐

Uncle…….……... ☐

Others (specify)…….…… ☐

b) Caregiver's level of Education.

No formal schooling…… ☐

Less than primary school…… ☐

Primary school completed…….. ☐

Secondary school completed…… ☐

College/ university……. ☐

c) Caregivers economic status.

Unemployed…… ☐

Self-employed……..… ☐

Formal Employed…….……. ☐

d)What is the average household income?

Below Ksh. 10000…….….. ☐

Ksh.10000-25000……..….. ☐

Ksh.26000-40000……..….. ☐

Ksh.41000-55000…… ☐

Above 55000……... ☐

e) What is the birth order of the child? Please state…….

f) Is the child fully immunized?

Yes…….. ☐

No……. ☐

SECTION B: ORAL HYGIENE PRACTICES

a) How often does the child clean his/her teeth?

Never……. ☐

Once a day……...….. ☐

Twice a day……... ☐

Once a week ……. ☐

b) Is the child helped to clean his teeth by any of the parents or caregivers?

Yes ……..… ☐

No……..…. ☐

If yes, how often? .....

c) What do you use to clean the child's teeth?

Toothbrush only …….. ☐

Toothbrush and toothpaste …….…. ☐

Toothbrush and salty water…….…. ☐

Wooden toothpicks……... ☐

Charcoal……. ☐

Others, specify …….

SECTION C: DIETERY PATTERNS (modified from the 2012 Youth Adolescent Food Frequency questionnaire)

a) Below is list of foods, please indicate how often you feed this child on the foods listed. Please tick in the appropriate box.

Food	Once daily	Twice daily	Once a week	Twice a week	occasionally	Never
ANIMAL FOODS						
Beef						
Pork						
Fish						
Eggs						
Goat meat						
Chicken						
Sausages/ smokies						
LEGUMES						
Beans						
Green grams						
Peas						
STARCHES						
Ugali						
Rice						
Bread						
Spaghetti/macaroni						
Chips						
Maize						
Bananas						
mashed potatoes						
VEG/FRIUTS						
Fruits						
Vegetables						
BEVERAGES						
Porridge						
Tea						
Fresh fruit juices						
Artificial juices						
Soda/soft drinks						
Fresh Milk						
Yorghurt						
CONFECTIONARIES						
Chocolates						
Cookies/biscuits						
Ice cream						
Crisps						
Sweets						
Cakes						

b) What snacks does the child have at home?

Snack

1. ……..…. …….…….....

2. ……..… ……..……..

3. ……... ……..……

c) Which snacks do you give to the child as a reward?

1. Sweets…….. ☐
2. Chocolate ……..……..... ☐
3. Soft drinks…….…… ☐
4. Biscuits/ cakes……..…. ☐

Others (please indicate)…….

d) Do you add sugar to these foods when you give them to this child?

1. Breakfast cereal e.g. cornflakes, weetabix…… ☐
2. Porridge…….. ☐
3. Milk…….…… ☐
4. Tea/coffee/ cocoa…… ☐
5. Other meals……..... ☐

e) Have you ever been advised on specific foods /diets for this child?

Yes ☐ No ☐

If yes, which one? .....

.....

.....

Do you strictly follow/ adhere to these foods? Yes ☐ No ☐

If no, state why?.....

f) Does the child insist on a particular food type?

Yes ☐ No ☐

If yes, please tick which one below;

Carbohydrates……..……. ☐

Fruits……..… ☐

Vegetables……. ☐

Proteins……..… ☐

Others, specify…….....

g) Does this child like trying new foods?

Yes ☐ No ☐

h) Have you ever been advised not to give this child certain foods

Yes ☐ No ☐

If yes, which ones?

.....

.....

.....

.....

.....

.....

.....

.....

.....

APPENDIX 2b : QUESTIONNAIRE (KISWAHILI)

MASWALI YA KUJIBIWA NA MLEZI.

Taarifa zitakazopatikana zitakuwa siri na zitatumika kwa madhumuni ya utafiti huu.

Jinsia …… ☐

Tarehe ya kuzaliwa ya mtoto…… ☐☐☐

siku mwezi mwaka

Eneo cha kijiographia……

	Kipimo cha kwanza	Kipimo cha pili	Wastani
Urefu			
Uzito			

SEHEMU YA 1:KIWANGO CHA UCHUMI NA ELIMU CHA MLEZI

a)Aina ya mlezi

Mama…… ☐

Baba……..... ☐

Mjomba…….…… ☐

Shangazi…….…. ☐

Wengine……. ☐

b)Kiwango cha elimu cha mlezi

Hakuna elimu rasmi……..….. ☐

Chini ya shule ya msingi…..…. ☐

Shule ya msingi……. ☐

Shule ya upili……..… ☐

Chuo kikuu……. ☐

c)Hali ya uchumi ya mlezi

asiye na kazi…… ☐

kujiajiri……☐

aliyeajiriwa……...☐

d)Kiwango cha mapato cha familia

Chini ya Ksh.10000……. ☐

Ksh.10000-25000…….....☐

Ksh.26000-40000…….☐

Ksh.41000-55000…….☐

Zaidi ya Ksh.55000……☐

e)Je, mtoto wako amepata chanjo zote?……..

f)Je, mtoto wako ni wangapi kwa familia?.....

SEHEMU YA 2 : MAZOEA YA USIFISHAJI WA KINYWA

a)Mtoto wako husafisha meno yake mara ngapi?

Kamwe…… ☐

Mara moja kwa siku…… ☐

Mara mbili kwa siku…… ☐

Mara moja kwa wiki…… ☐

Nyingine…… ☐

b) Je, wewe humsaidia motto wako kusafisha meno yake?

Ndio ☐ La ☐

kama ndio,mara ngapi?.....

c)Je, mtoto wako hutumia nini kusafisha meno yake?

Mswaki pekee…….. ☐

Mswaki na dawa ya meno…… ☐

Mswaki na maji yenye chumvi……. ☐

Kichokoleo meno……. ☐

Makaa…….. ☐

SEHEMU YA 3: MIFUMO YA MALAZI

a) Mara ngapi mtoto wako hula au kunywa vyakula vifuatavyo.

Chakula	**Mara moja kwa siku**	**Mara mbili kwa siku**	**Mara moja kwa wiki**	**Mara mbili kwa wiki**	**Mara kwa mara**	**Kamwe**
Nyama						
Nyama ya ng'ombe						
Nyama ya nguruwe						
Samaki						
Mayai						
Nyama ya mbuzi						
Nyama ya kuku						
Sausage/smokies						
Aina ya jaza au pigo						
Maharagwe						
Ndengu						
Wanga						
Ugali						
Wali						
Mkate						
Spaghetti/macaroni						
Chips						
Matunda na Mboga						
Matunda						
Mboga						
Vinywaji						
Uji						
Chai						
Soda						
Maziwa						
Maziwa ya mgando						
Tamu tamu						
Chokoleti						
Biskuti						
Barafu						
Crisps						
Peremende						
Keki						

b) Je, wewe humpa mtoto wako vitafunio vipi akiwa nyumbani?

Vitafunio

1……..… ……..

2……...…… …….

3……... …….

c) Je, wewe humpa mtoto wako vitafunio vipi kwa zawadi?

Peremende……...…… ☐

Chokoleti…… ……..... ☐

Biskuti……..…… ☐

Keki…….…… ☐

Soda…….…… ☐

Nyingineyo, taja ….……..…..

d) Je, wewe huongeza sukari kwa vyakula hivi vya mtoto wako?

Nafaka ya kufunguwa kinywa kama weetabix…… ☐

Uji…….…….. ☐

Maziwa…… ☐

Chai/kahawa…… ☐

e) Je mtoto wako anafuata aina ya mlo yoyote?

Ndio… ☐ La…. ☐

Kama ndio, taja ipi……..

Je unafuatilia mlo huwa kwa kina? Ndio ☐ La ☐

Kama la,taja sababu……

f) Je mtoto wako husisitiza kula aina moja ya chakula ? Ndio ☐ La ☐

kama ndio,kipi ?

kabohadreti……. ☐

mboga……..…. ☐

Matunda…….……. ☐

Protini……..……. ☐

g) Je, mtoto wako hupenda kujaribu vyakula vipya na tofauti ? Ndio ☐ La ☐

APPENDIX 3: CLINICAL EXAMINATION FORM

DATE OF BIRTH: --/--/----

(dd/mm/yy)

SEX: Male ☐ Female ☐

ORAL HYGIENE STATUS: Plaque Index (Silness-Löe, 1964)

Tooth / surface	**55/16**	**52/12**	**64/24**	**75/44**	**72/32**	**84/36**
Facial						
Lingual						
Meso-facial						
Disto facial						
Total score						

Score criteria:

0- No plaque detected

1- A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which can only be seen by applying a probe on to the tooth surface.

2- Moderate accumulation of soft deposits within the gingival margin which can be seen with the naked eye.

3- Abundance of soft matter within the gingival pocket and /or the tooth and gingival margin.

DENTAL CARIES ASSESSMENT (modified WHO 2013 oral assessment form)

		55	54	53	52	51	61	62	63	64	65		
17	16	15	14	13	12	11	21	22	23	24	25	26	27
		85	84	83	82	81	71	72	73	74	73		
47	46	45	44	43	42	41	31	32	33	34	35	36	37

TOOTH STATUS	CODE FOR DECIDUOUS TEETH	CODE FOR PERMANENT TEETH
Sound	A	1
Decayed	B	2
Filled with D=decay	C	3
Filled with no decay	D	4
Missing as a result of caries	E	5
Sealant varnish	F	6
Bridge abutment or special crown	G	7

APPENDIX 4: ASD DIET

AUTISM SOCIETY OF KENYA

AUTISM SPECTRUM DISORDER DIET

A list of food items, which Autistic persons react negatively to:

Gluten and Casein **MUST** be eliminated completely at the start of the diet.

GLUTEN is a protein in the plant kingdom subclass of monocotyledon, which are members of the grass family and their derivatives. These include: Malt, grain starches, hydrolyzed vegetable/plant proteins, textured proteins, grain vinegar, soy sauce, grain alcohol and flavoring. Binders and fillers found in vitamins and medications.

Look out also for the following, which contain Gluten:

Whole wheat	Wheat flakes	Wheat germ	Bulger wheat	Oat bran	Oats Chapati
Mandazi	Cakes	Spaghetti	Barley	Pearl barley	Barley flakes
Rye	Flour	Rolled oats	Weetabix	Biscuits	Bread(brown, white)
Scones	(Anything made from wheat flour including brown, atta)				

CASEIN is a phosphors-protein of cow and goat milk, which has a molecular structure that is extremely similar to that of Gluten.

Eliminate:

Milk	Cheese	Cocoa	Boumvita	Nesquick	Blue Band(& Choco)
Yogurt	Milo	Ovaltine	Drinking Chocolate		

And all other beverages as long as they contain milk and sugar and preservatives. **Read labels before purchasing your p[roducts**

Sugar **MUST** be eliminated and substituted with pure natural honey.

Avoid **Caffeine** in coffee, tea, sodas and jam.

Also **avoid** food high in **Salicylates** such as:

Apples	Grapes	Apricots	Peaches	Plums	Lemons
Oranges	Tomatoes	Berries	Raisins	Tangerines	Grapefruits

Eliminate:

Sausages	Ham	Salamis	Frankfurters	Tomato sauce	Peanut butter
Cashew nuts	Peanuts and all other nuts				

Eliminate all **food additives, flavorings, colorings** and **preservatives** including:

Soya sauce	Soya flour	Soya milk	Soya oil.

Eliminate **animal based cooking fats.**

Eliminate:

Ripe bananas	Pawpaw	Avocado	Tomatoes	Sugarcane	Hoho
Ginger	Apple mangoes				

These may trigger hyperactivity. You **MUST** remove all from the diet. After your child is calm, re-introduce each one of them at a time and observe any reaction. If there is hyperactivity or agitation, remove for good.

Remember, autistic children are very different, what is bad for one child may not affect another. You must carry out your own investigations to determine the best for your child.

Eliminate coconut cream, flavorings and **all milk derivatives** e.g.

Powder	Solids	Malted milk	Low-fat milk	Non-fat milk	Pizza
Cookies	Crackers	Ice cream	Mustard	Mayonnaise	Packed and Canned
soups	Gravy mixes and cubes		Commercial fruit juices.		

APPENDIX 5: KNH-UON ETHICS BOARD APPROVAL

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
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Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/7

9th January 2020

KENYATTA NATIONAL HOSPITAL APPROVED 09 JAN 2020 KNH/UoN-ERC P. O. BOX 20723 - 00202 NAIROBI

Dr. Mbaabu Eunice Ngugi
Reg No.V60/7552/2017
Dept of Paediatric Dentistry and Orthodontics
School of Dental Sciences
College of Health Sciences
University of Nairobi

Dear Dr. Ngugi

RESEARCH PROPOSAL: DIETARY PATTERNS, NUTRITIONAL STATUS AND DENTAL CARIES EXPERIENCE IN CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER ATTENDING CITY PRIMARY SCHOOL IN NAIROBI, KENYA (P826/09/2019)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above research proposal. The approval period is 9th January 2020 – 8th January 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. 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*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Protect to discover

APPENDIX 6: NACOSTI LICENCE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **823112**

Date of Issue: **24/January/2020**

RESEARCH LICENSE

This is to Certify that Dr.. Eunice Mbaabu of University of Nairobi, has been licensed to conduct research in Nairobi on the topic: DIETARY PATTERNS, NUTRITIONAL STATUS AND DENTAL CARIES EXPERIENCE IN CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER ATTENDING CITY PRIMARY SCHOOL IN NAIROBI, KENYA. for the period ending : 24/January/2021.

License No: **NACOSTI/P/20/3480**

823112

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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APPENDIX 7: NAIROBI CITY COUNTY APPROVAL

NAIROBI CITY COUNTY

Telegraphic Address
Email: info@nairobi.go.ke
Web: nairobi.go.ke

CITY HALL ANNEXE:
P .O. BOX 30298 GPO – 00100.
NAIROBI, KENYA

EDUCATION, SOCIAL SERVICES & GENDER

Ref: GL/NC/142/VOL VI/331

3rd February, 2020

Dr. Eunice Mbaabu
University of Nairobi
P.O. Box 30197 00100
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application to carry out Research and Subsequent approval by National Commission for Science, Technology and Innovation vide letter Ref: NACOSTI/P/20/3480 dated 24th January, 2020.

I am pleased to inform you that authority has been granted to you to carry out research on ***"Dietary Patterns, Nutritional Status and Dental Caries experience in Childhood and Adolescents with Autism Spectrum Disorder attending City Primary School in Nairobi, Kenya".***

On conclusion of the study, you are expected to submit a copy of the research findings to the undersigned.

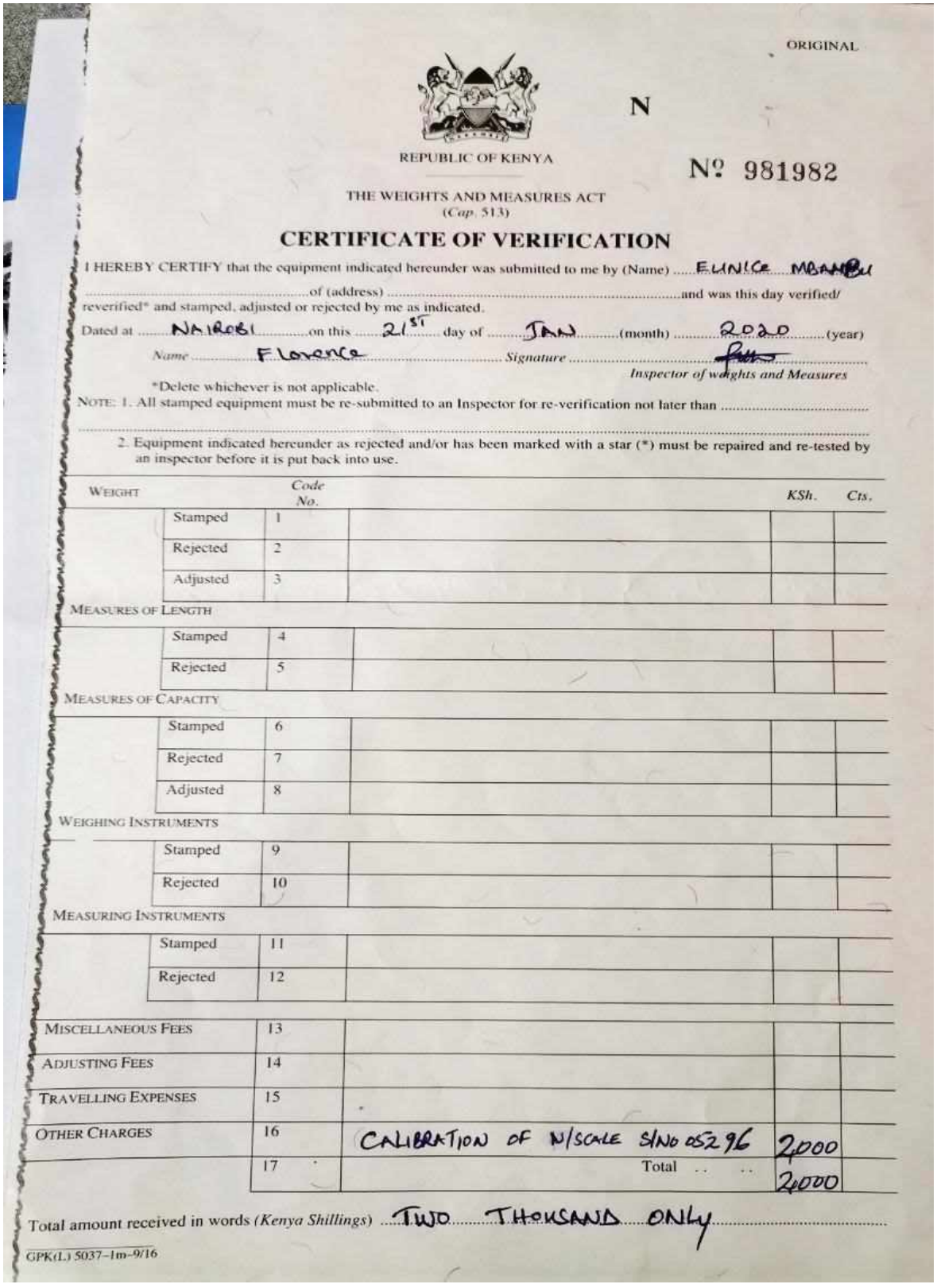
03 FEB 2020

RAPHAEL K. KINYUNGU
DEPUTY DIRECTOR – EDUCATION, PLANNING, PROJECTS & PARTNERSHIP.

Copy to: Chief Officer – Education, Social Services & Gender
Director City Education

"The City of Choice to Invest, Work and Live in"

APPENDIX 8: CERTIFICATE OF CALLIBRATION OF WEIGHING SCALE



ORIGINAL

N

REPUBLIC OF KENYA

Nº 981982

THE WEIGHTS AND MEASURES ACT
(*Cap.* 513)

CERTIFICATE OF VERIFICATION

I HEREBY CERTIFY that the equipment indicated hereunder was submitted to me by (Name) ELINICE MBANBU
of (address) and was this day verified/reverified* and stamped, adjusted or rejected by me as indicated.

Dated at NAIROBI on this 21ST day of JAN (month) 2020 (year)

Name FLORENCE *Signature*

Inspector of weights and Measures

*Delete whichever is not applicable.

NOTE: 1. All stamped equipment must be re-submitted to an Inspector for re-verification not later than

2. Equipment indicated hereunder as rejected and/or has been marked with a star (*) must be repaired and re-tested by an inspector before it is put back into use.

		Code No.		*KSh.*	*Cts.*
WEIGHT	Stamped	1			
	Rejected	2			
	Adjusted	3			
MEASURES OF LENGTH	Stamped	4			
	Rejected	5			
MEASURES OF CAPACITY	Stamped	6			
	Rejected	7			
	Adjusted	8			
WEIGHING INSTRUMENTS	Stamped	9			
	Rejected	10			
MEASURING INSTRUMENTS	Stamped	11			
	Rejected	12			
MISCELLANEOUS FEES		13			
ADJUSTING FEES		14			
TRAVELLING EXPENSES		15			
OTHER CHARGES		16	CALIBRATION OF W/SCALE S/NO 05296	2000	
		17	Total	2000	

Total amount received in words *(Kenya Shillings)* TWO THOUSAND ONLY

GPK(L) 5037–1m–9/16

Dr. E. Ngatia

CHAIRMAN
DEPARTMENT OF DENTAL SCIENCES
UNIVERSITY OF NAIROBI
P.O. BOX 19676, NAIROBI

DIETARY PATTERNS, NUTRITIONAL STATUS AND DENTAL CARIES EXPERIENCE AMONG CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER ATTENDING CITY PRIMARY SCHOOL IN NAIROBI, KENYA

ORIGINALITY REPORT

13%	7%	9%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Nairobi Student Paper	1%
2	Comprehensive Guide to Autism, 2014. Publication	1%
3	www.tandfonline.com Internet Source	<1%
4	brainm.com Internet Source	<1%
5	Aniket Bansod, Sushma S. Sonavane, Nilesh B. Shah, Avinash A. De Sousa, Chittaranjan Andrade. "A Randomized, Nonblind, Naturalistic Comparison of Efficacy and Cognitive Outcomes With Right Unilateral, Bifrontal, and Bitemporal Electroconvulsive Therapy in Schizophrenia", The Journal of ECT, 2018 Publication	<1%