ASSESSEMENT OF NUTRITIONAL STATUS, MEALTIME BEHAVIOUR AND DIETARY INTAKE IN CHILDREN AND ADOLESCENTS WITH AUTISM IN BIRTAMODE, JHAPA

by

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November, 2025

Assessment of Nutritional Status, Mealtime Behaviors and Dietary Intake in Children and Adolescents with Autism in Birtamode, Jhapa

A dissertation submitted to the Department of Nutrition and Dietetics, Central Campus of Technology, Tribhuvan University, in partial fulfilment of the requirements for the degree of B.Sc. Nutrition & Dietetics

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Approval Letter

This *dissertation* entitled ***Assessment of Nutritional Status, Mealtime Behavior and Dietary Intake of Children and Adolescents with Autism in Birtamode, Jhapa*** presented by **Swechchha Golay** has been accepted as the partial fulfillment of the requirements for the ***B.Sc. degree in Nutrition and Dietetics.***

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November, 2025

Acknowledgements

First and foremost, I would like to express my deepest gratitude to my supervisor and Head of Department, Professor Pallavi Vyas Jaisani, for her invaluable guidance, continuous support, and encouragement throughout the course of my research work. I am equally thankful to Professor Basanta Kumar Rai, Campus Chief of the Central Campus of Technology, for providing an excellent academic platform and for the technical and administrative assistance extended during the study period.

I am sincerely grateful to Founder Rinky Ray of Creative School of Special Child for her kind permission and cooperation in facilitating my research. My heartfelt appreciation also goes to Founder and Principal Bhim Bohora of Aayu Child Care Center for his generous support during data collection. I would like to extend my thanks to Principal Kharka Kheral of Mahendra Ratna Secondary School for allowing me to conduct fieldwork and for his valuable cooperation. My sincere appreciation is extended to Coordinator Kumar Chudal of Autism Care Society Jhapa, Birtamode, for granting permission to collect data and for his valuable support and cooperation, which greatly contributed to the successful completion of this research.

Finally, I am profoundly grateful to my family and friends Sonika Rai, Dr. Reshma Rijal, Jamun Rai, and Nischal Kunwar for their consistent support, encouragement, and unconditional love throughout my academic journey. Their continuous motivation and belief in me have been instrumental in sustaining my dedication and ensuring the successful completion of this research.

I would also like to express my heartfelt appreciation to all those who, directly or indirectly, contributed their support and assistance toward the successful completion of my research.

Date of submission: November 2025

Swechchha Golay

Abstract

A cross-sectional descriptive study was conducted to assess nutritional status of 74 autistic children aged 2–15 years using census sampling. Data were collected with a pretested semi-structured questionnaire to obtain information on socio-demographic characteristics, child and maternal factors, caregiving practices, health and immunization history, mealtime behavior, gastrointestinal symptoms, and dietary intake. Anthropometric measurements (height, weight, and MUAC) were taken and analyzed according to WHO growth standards to assess underweight, stunting, thinness, overweight, and obesity. Data analysis was performed using IBM SPSS version 26, WHO Anthro, and WHO Anthro-Plus, Univariate logistic regression, Chi-square test, Fisher's exact test, ANOVA, and the Kruskal Wallis test were applied to examine associations between nutritional outcomes and explanatory variables.

Among the study participants, the assessment of nutritional status revealed that a small proportion were affected by undernutrition, with 3.2% classified as moderately underweight and 2.7% as moderately stunted. In terms of thinness, 8.1% were moderately thin, while 5.4% were severely thin. Conversely, indicators of overnutrition were also observed, with 9.5% of participants classified as overweight and 4.05% as obese, highlighting the coexistence of both undernutrition and overnutrition within the study population. The dietary assessment of the study population revealed notable patterns in food consumption. A small proportion of participants (1.4%) reported never consuming rice, while a majority (87.8%) consumed dal on a regular basis, and half of the participants (50%) included green leafy vegetables (GLV) in their diet regularly. Analysis of nutrient intake showed that protein consumption among the children was higher than the recommended dietary allowance (RDA), whereas calcium intake was observed to be insufficient, indicating potential imbalances in macro- and micronutrient intake. Most socio-demographic, dietary, and feeding behavior variables were not significantly associated with nutritional status ($p > 0.05$). The child's age ($p = 0.024$) was significantly associated with underweight, indicating that younger children were more likely to be underweight. Age and weight-for-age z-score (WAZ) were significantly associated with thinness and obesity, suggesting that age is an important determinant of nutritional status.

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List of Abbreviations

Abbreviation	Full Form
ASD	Autism Spectrum Disorder
ACN	Autism Care Nepal
BAMBI	Brief Autism Mealtime Behavior Inventory
BMI	Body Mass Index
BAZ	BMI-for-Age Z-score
CRPD	Convention on the Rights of Persons with Disabilities
CRC	Convention on the Rights of the Child
CDD	Childhood Disintegrative Disorder
CDC	Centers for Disease Control and Prevention
DHA	Docosahexaenoic Acid
EAR	Estimated Average Requirement
EPA	Eicosapentaenoic Acid
EFA	Education for All
FGID	Functional Gastrointestinal Disorder
FFQ	Food Frequency Questionnaire
FAO	Food and Agriculture Organization
GI	Gastrointestinal

GIS	Gastrointestinal System
HAZ	Height-for-Age Z-score
H/A	Height-for-Age
MUAC	Mid-Upper Arm Circumference
MAM	Moderate Acute Malnutrition
NESP	National Education System Plan
OCM	One-Carbon Metabolism
PDD-NOS	Pervasive Developmental Disorder – Not Otherwise Specified
RNI	Recommended Nutrient Intake
RDA	Recommended Dietary Allowance
SSDP	School Sector Development Plan
SPSS	Statistical Package for the Social Sciences
SAM	Severe Acute Malnutrition
TD	Typically developing
USDA	United States Department of Agriculture
W/A	Weight-for-Age
W/H	Weight-for-Height
WHO	World Health Organization

Part I

Introduction

1.1 Background of study

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental disorder characterized by difficulties in the social-communication domain, and the presence of restricted and/or repetitive interests and/or behavior (Talantseva *et al.,* 2023). It is a complex, pervasive, and multifactorial neurodevelopmental conditions. Observation of aberrant behavior forms the basis of diagnosis, with criteria focused on impairments in social communication and interaction, and restricted, repetitive patterns of behavior, interests, or activities (Masi *et al.,* 2017). It is typically presents during early childhood (before 30 to 36 months of age), though its full range of symptoms may not become apparent until later, particularly when increasing social demands exceed the child's developmental capacities (Zaky, 2017). Asperger syndrome, Pervasive Developmental Disorder, not otherwise specified (PDD-NOS), Autistic disorder & Childhood disintegrative disorder are different types of Autism Spectrum Disorder (Matthew, 2025).

Epidemiological studies have shown a rapid increase in the prevalence of ASD in recent years, with a prevalence of four to five times more in boys than girls. The average prevalence of autism spectrum disorder in Asia, Europe and North America is estimated at 1% (Salari *et al.,* 2022a). Approximately 1/100 children are diagnosed with autism spectrum disorder around the world. The World Health Organization estimates that autism affects 0.76% of children globally, with higher incidence rates in developed countries. According to the 2023 Centers for Disease Control and Prevention (CDC) report, the United States prevalence of ASD is 1 in 36 children (Compañ-Gabucio, *et.al,* 2023). More recently, the Autism and Developmental Disabilities Monitoring Network found prevalence rates of 67 to 230 cases per 10,000, reflecting a 24.3% increase in the USA (Issac *et al.,* 2025). The prevalence of Autism Spectrum Disorders (ASDs) differs considerably between countries. In the United States, autism is reported at a rate of 34 cases per 10,000 individuals, while the United Kingdom shows a notably higher prevalence, with 99 cases per 10,000 individuals (Shrestha *et al.,* 2024).

The United Nations General Assembly unanimously declared 2 April as World Autism Awareness Day to highlight the need to help improve the quality of life of children and adults, who are affected by autism, so they can lead full and meaningful lives. Sri Lanka has reported an autism prevalence rate of 10.7 per 1,000 individuals (1.07% or approximately one in every 93 people), which is relatively higher compared to other countries in the region but aligns with rates observed in Western nations. The prevalence of ASD ranged from 0.15–0.8% in Bangladesh (Hossain *et al.,* 2017).

According to Nepal's 2021 Census, 4,886 individuals were identified with autism among a surveyed population of 647,744, representing approximately 0.8% of the sample (Koirala, 2023). To date, there have been only a handful of studies on the nutritional status of these children in Nepal. On April 2nd 2008, Autism Care Nepal was founded by a group of parents of children with autism to provide support to families with children on the autism spectrum.

The nutritional status of autistic children depends not only on intake but also on digestion, absorption, metabolic processing and metabolic demand. Regarding dietary intake, children with ASD consume 16% less calories, a greater percentage of carbohydrates, 37% less protein, and 29% less fats (Molina-López *et al.,* 2021). Recent studies suggest that certain nutritional approaches can help reduce core ASD symptoms like repetitive behavior, social and communication challenges, self-harm, tantrums, and aggression. However, evidence linking specific diets to symptom improvement remains limited. Children with ASD often face significant nutritional challenges due to gastrointestinal issues (e.g., constipation, diarrhea), food allergies, metabolic disorders, picky eating, food refusal, obsessions, and hyperactivity, all of which can negatively impact their nutritional status. Individuals with ASD commonly experience deficiencies in minerals like zinc, iron, calcium, selenium, iodine, magnesium, and chromium, as well as vitamins such as A, B1 (thiamine), B3 (niacin), B5 (pantothenic acid), biotin. They may also lack essential amino acids and omega-3 fatty acids. Multivitamin and mineral supplements have been shown to help improve autism symptoms, including cognitive, sleep, and GIS-related problems (Cekici and Sanlier, 2019).

This study aimed to evaluate the nutritional well-being of children with autism, while also exploring the prevalence of gastrointestinal issues and their mealtime behaviors. The findings can serve as a valuable resource for guiding nutritional counseling and can help parents take informed steps toward improving their child's overall nutritional health.

1.2 Problem statement and justification

Increased food selectivity among children with autism spectrum disorder (ASD) may lead to nutritional inadequacy. Epidemiological studies have shown that feeding difficulties are common among children with Autism Spectrum Disorder (ASD), affecting between 46% and 89% of this population. One of the most frequently observed challenges is food selectivity, or picky eating, which often involves refusing certain foods, sticking to a very limited variety, or frequently consuming the same food repeatedly. Such selective eating habits can result in a restricted diet, which may in turn lead to nutritional deficiencies (Tsujiguchi *et al.,* 2020). Children with autism spectrum disorders (ASD) or autism are more prone to gastrointestinal (GI) disorders than the general population. These disorders can significantly affect their health, learning, and development due to various factors such as genetics, environment, and behavior. It has been observed that patients with ASD commonly experience GI problems, with a prevalence rate between 46% and 84% in children with ASD. These problems manifest in numerous ways, including food intolerance and/or sensitivities, nausea and/or vomiting, chronic constipation, chronic diarrhea, gastroesophageal reflux and/or disease, chronic flatulence, abdominal discomfort, ulcers, inflammatory bowel disease, colitis, and/or failure to thrive (Al-Beltagi *et al.,* 2023).

Children on the autism spectrum are five times more likely than non-autistic children to have feeding problems, including food refusal, diets restricted in variety and rigid behavioral patterns which impact mealtimes. They often have a more limited range of foods they're willing to eat, which can lead to nutritional deficiencies. These feeding challenges can also affect their weight, making some children underweight while others may become overweight. While certain eating difficulties may get better as they grow older, many continue into the teenage years and even adulthood (Mathew *et al.,* 2022).

Since autism is still relatively unfamiliar in Nepal, many children with the condition often go without proper medical care. As a result, public awareness and understanding of autism remain quite limited. Detecting, diagnosing, and managing autism among children in Nepal is very challenging due to the low level of awareness about the condition. The situation is aggravated by various factors including nonscientific beliefs about health and the low level of education among the people in Nepal.

On April 2, 2008, Autism Care Nepal was founded by a group of parents of children with autism in order to provide support to families with children on the autism spectrum (Autism Care Nepal). ACN is the only organization in the entire country which attempts to address the needs of children with autism. Besides direct care, the organization also focuses on awareness programs through various media campaigns including education for teachers, doctors, psychologists, and students. With help from international experts, the organization is building its own resources (Shrestha and Santangelo, 2014a).

The study aimed to assess the nutritional status of children with Autism Spectrum Disorder (ASD) in the eastern region of Nepal, focused on evaluating the nutritional status, mealtime behaviors, and the prevalence of various gastrointestinal issues among children with Autism Spectrum Disorder (ASD) in Birtamode, Jhapa.

1.3 Objectives of the study

1.3.1 General objective

To assess nutritional status of autistic children in Birtamode, Jhapa.

1.3.2 Specific objective

1. To assess nutritional status of autistic children using anthropometric measurement
2. To assess the dietary intake and mealtime behavior in children and adolescents with autism.
3. To identify factors associated with malnutrition (stunting, underweight, thinness/obesity).

1.3.3 Research question

1. What is the current nutritional status of children and adolescents with autism in Birtamode, Jhapa?
2. What is the dietary intake and mealtime behaviors of children and adolescents with autism?

3. What factors are associated with (stunting, underweight and thinness/obesity) in children and adolescents with autism?

1.3.4 Significance of study

1. To provide insight into nutritional status of children and adolescents with autism.
2. To examine dietary intake patterns and mealtime behaviors, helping to identify factors contributing to malnutrition in autistic children.
3. Raises awareness among parents, caregivers, and the community about the importance of proper nutrition and positive mealtime practices for children with autism.
4. It provides a baseline data and evidence for healthcare professionals, nutritionists, educators, and policymakers to develop targeted nutrition and behavioral interventions.

1.3.5 Limitations

1. Being a cross-sectional study, it captures information at a single point.

2. This study was conducted with limited resources, which restricted the inclusion of other important assessments, such as biochemical and clinical evaluations.

Part II

Literature review

2.1 Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder defined by social communication impairments and restricted, repetitive behaviors it consists of a spectrum of symptoms reflecting impaired social communication and restricted, repetitive behaviors and ranges in severity from mildly impairing to severe (Hirota and King, 2023). The etiology of Autism Spectrum Disorder (ASD) remains unclear; however, current research highlights both genetic and environmental contributions. Prevalence rates indicate that 1 in 59 children is diagnosed with ASD, with males being four times more likely to be affected than females. ASD is observed across all racial, ethnic, and socioeconomic groups. Comorbidity is common, with 83% of individuals presenting with an additional developmental disorder and 10% with a psychiatric condition. Although the average age of diagnosis is around five years, early behavioral indicators such as poor eye contact, limited social engagement, reduced imitation, and delayed language development can be identified in infancy, particularly in high-risk populations (Kodak and Bergmann, 2020).

The term autism (from the Greek autos) was introduced in medicine a few decades earlier in 1906 by Bleuler, to indicate some negative symptoms (closure) of schizophrenia (Parisi and Parisi, 2019). Leo Kanner, a psychiatrist at Johns Hopkins Hospital during the 1930s and 1940s, is widely recognized as the first clinician to formally describe autism. Around the same time as Kanner, Viennese pediatrician Hans Asperger independently identified a condition he termed “autistic psychopathy,” later known as Asperger syndrome. He described individuals who exhibited normal early language development but showed significant social challenges, intense, focused interests, and often above-average intelligence (Mintz, 2017).

The autism spectrum includes a variety of related conditions, such as autistic disorder, Rett syndrome, Asperger syndrome, and pervasive developmental disorder (Salari *et al.,* 2022). Rett syndrome was once classified under autism spectrum disorders due to similar behaviors, but it is now excluded after being linked to a specific genetic mutation. Autism Spectrum Disorder (ASD) was previously categorized into different subtypes, each representing varying levels of severity and characteristics. Asperger's syndrome, considered to be at the milder end of the spectrum, typically involved individuals who were intellectually capable and could manage their daily routines. These individuals often developed intense interests in specific topics and engaged in extensive conversations about them, but commonly experienced significant difficulties with social interactions.

Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS) was a broader diagnostic category used for children who exhibited more pronounced challenges than those with Asperger's, but whose symptoms were not as intense or clearly defined as those seen in classic autism.

Autistic Disorder, an older diagnostic label, was used for individuals who demonstrated the core symptoms of autism such as difficulties in communication, behavior, and social interaction at a more severe level than those with Asperger's or PDD-NOS.

At the most severe end of the spectrum was Childhood Disintegrative Disorder, a rare condition characterized by typical early development followed by a sudden and dramatic regression in social, language, and cognitive skills, usually between the ages of two and four. In many cases, these children also developed seizure disorders, adding further complexity to their condition (Matthew, 2025a).

2.2 Causes

Autism does not have a single identifiable cause; rather, it is associated with a complex interplay of genetic, neurological, and environmental factors. These include brain structure and function abnormalities, imbalances in neurotransmitters, as well as psychological influences and complications during prenatal, perinatal, and postnatal development (Araújo, 2023). Several studies have found that siblings of children with autism are at an increased risk of being diagnosed with the condition themselves (Upadhyay *et al.,* 2021). Several prenatal and perinatal factors have been linked to increased risk of autism spectrum disorder (ASD). Exposure to teratogens like thalidomide and valproic acid during pregnancy is associated with higher ASD risk, while folic acid supplementation, particularly in those using antiepileptic drugs, may offer some protection. A small trial on folinic acid showed promise, but broader recommendations are premature. Advanced maternal and paternal age have consistently been associated with increased ASD risk. Maternal autoimmune conditions (e.g., diabetes, thyroid disease) and prenatal infections or immune activation are also potential contributors, though findings are mixed. Both short and long intervals between pregnancies, as well as premature birth, have been linked to elevated risk for ASD and other neurodevelopmental disorders (Hodges *et al.,* 2020).

2.3 Prevalence

The average prevalence of autism spectrum disorder (ASD) in Asia, Europe, and North America is around 1%. In the U.S., the Centers for Disease Control and Prevention (CDC) reported that 1 in 59 children aged 8 had ASD in 2014, increasing to 1 in 54 by 2016, with an overall prevalence of 2.5% among children and adolescents during 2014 – 2016. In Italy, ASD affected 1.15% of children aged 7–9. In Asia, the rate has reached 3.9%, while in Gulf Arab countries it ranges between 0.14% and 2.9% (Salari *et al.,* 2022). An analysis of 23 studies conducted in Asian countries such as China, Japan, Iran, Indonesia, Israel, and Taiwan reported that the prevalence of autism spectrum disorders (ASDs) varied widely, ranging from 1.1 to 21.8 per 10,000 individuals. Initially, autism was found to be four to five times more common in males than in females, but this gender gap narrowed among those with co-occurring intellectual disabilities. The prevalence of ASD in Southeast Asia has been determined to be six cases per 1000 individuals, with a greater prevalence among males in comparison to females (Shrestha *et al.,* 2024).

2.4 Onset

Autism spectrum disorder (ASD) can be identified as early as 18 months; however, the average age of diagnosis globally ranges between 3 to 10 years. Early detection plays a crucial role in enabling timely intervention, which significantly contributes to improved language development, cognitive functioning, and reduction in core symptoms. This highlights the importance of early screening and awareness among caregivers and professionals for better outcomes in children with ASD (Hof *et al.,* 2021). Recent research using brain imaging and eye-tracking technology has identified autism-related traits in infants as young as 2 to 6 months. Brain scans show differences in brain growth and connectivity, while eye-tracking reveals reduced attention to faces and social cues. These early signs help identify infants at risk for autism, allowing for earlier intervention and support, which can improve long-term developmental outcomes (Russell, 2020). The onset of behavioral signs in autism spectrum disorder (ASD) is generally described in two patterns.

The first is early onset, where children exhibit delays and atypical development in social and communication skills from an early age. The second is a regressive pattern, where children initially develop typically but later experience a significant loss or decline in skills they had previously acquired (Ozonoff and Iosif, 2019).

2.5 Nutritional status of autistic children

Findings on the nutritional status of children with autism spectrum disorder (ASD) have shown mixed results, particularly regarding overweight and obesity. Some studies suggest similar rates of overweight and obesity between autistic and non-autistic children, while others report a higher prevalence of excess weight among children with ASD. As children with autism grow older, there tends to be an increase in both underweight and overweight cases. For instance, overweight rates may rise significantly between early childhood and middle childhood. Children with ASD are also reported to be at a higher risk of obesity compared to their typically developing peers. These concerns highlight the importance of monitoring nutritional health in autistic children. Contributing factors may include restricted or selective eating habits, sensory sensitivities, and limited opportunities for physical activity, all of which can affect dietary intake and energy balance (Ranjan and Nasser, 2015).

A study by (Eow *et al.,* 2021) conducted among Malaysian children with ASD reported a dual burden of malnutrition, with the prevalence rates of underweight, stunting, wasting/thinness, and overweight/obesity being 9.3%, 8.0%, 4.0%, and 21.5%, respectively. The proportion of overweight and obesity was significantly higher among boys (12.4%) than girls (2.6%), indicating a gender disparity in nutritional outcomes. Although total energy and protein intakes were adequate for most of the participants, it was noted that calorie intake from fat exceeded the recommended levels. Furthermore, a significant nutritional gap was observed as 99.6% of children did not meet the Recommended Nutrient Intake (RNI) for dietary fiber, highlighting potential long-term health risks associated with poor diet quality among children with ASD.

2.6 Mealtime Behavior and dietary patterns of autistic children

Children with autism frequently experience nutritional deficiencies, largely due to their limited and repetitive eating habits. This is often linked to food selectivity and food neophobia an aversion to trying new foods. As a result, they are estimated to have a two to three times higher risk of obesity compared to neurotypical peers. Food neophobia, although common in early childhood among all children, tends to persist longer and appear more severely in individuals with autism. Its intensity is often connected to the degree of cognitive, social, and communication challenges present. This restrictive eating behavior typically leads to a limited dietary variety, characterized by reduced intake of nutrient-dense foods like fruits and vegetables and increased consumption of less nutritious items, thereby contributing to poor overall nutrition (Silva and Gomes, 2024) Eating is among the most affected daily activities in children and adolescents with ASD due to sensory hypersensitivities to food textures, colors, or tastes. These sensitivities often lead to repetitive and challenging mealtime behaviors, resulting in restricted and unvaried diets. Such dietary limitations can cause nutrient inadequacies and increase the risk of overweight, impacting long-term health (Compañ-Gabucio *et al.,* 2023). Although it is not unusual for typically developed children to present signs of food selectivity, selective eating has a much higher prevalence in children on the autism spectrum and it is usually presented differently in this population. Children with ASD are five times more likely to have mealtime challenges such as tantrums and extreme food selectivity. Several studies have reported that the prevalence of food selectivity and mealtime behavior issues among children in the United States ranges from 40% to 70%. In contrast, the occurrence of mealtime behavioral challenges is estimated to be between 30% and 50% in the U.S., while studies from Asian countries such as Hong Kong, China, and India have shown prevalence rates ranging from 48% to 65% (Dhungel and Ghimire, 2019).

2.7 Nutrient intake of autistic children

The feeding problem and food selectivity associated with ASD have given rise to nutritional vulnerability among autistic children. Due to this, they are more likely to have restricted intakes, which can lead to deficiencies in essential minerals or vitamins.(Li *et al.,* 2024) conducted a case-control analysis involving 121 children with ASD and an equal number of typically developing peers, revealing that ASD was associated with significantly poorer dietary quality including lower fruit/vegetable intake, reduced food variety, and higher rates of unbalanced nutritional patterns. Notably, compulsive and self-injurious behaviors, as well as taste/smell sensitivities, were identified as independent predictors of reduced produce intake and dietary variety. These dietary limitations corresponded with more severe gastrointestinal symptoms in the ASD cohort. A recent study examining children under three years old with ASD versus age-matched controls found a large proportion in both groups not meeting EAR thresholds for vitamin D, vitamin E, and calcium. Crucially, ASD children had markedly lower intake of EPA and DHA nutrients essential for neurodevelopment compared to their peers. These findings underscore the need for targeted research into early-life nutrient deficits in ASD and suggest that parent-centered nutrition education could support improved intake of these critical nutrients (Young *et al.,* 2024).

2.8 Gastrointestinal problems in autistic children

Children with Autism Spectrum Disorder (ASD) frequently experience gastrointestinal (GI) symptoms such as constipation, diarrhea, and abdominal pain, with prevalence ranging from 9% to 91%. These symptoms are linked to lower quality of life, especially in nonverbal children who cannot express pain. GI issues often trigger challenging behaviors constipation and pain predict irritability and aggression, diarrhea is linked to tantrums, and nausea to anxiety and withdrawal. Sleep problems are also more common in ASD children with GI symptoms, indicating a close link between GI distress, behavior, and sleep (Leader *et al.,* 2022). (Ferguson *et al.,* 2019) reported a high prevalence of gastrointestinal symptoms among children with ASD, with constipation (65%), stomach pain (48%), diarrhea (30%), and nausea (23%) being most common. Gastrointestinal issues, commonly reported in children with ASD, can affect nutrient absorption and metabolism (Marinov *et al.,* 2024).Gastrointestinal (GI) issues are commonly observed in children with ASD, with research showing they experience these symptoms more frequently than their typically developing peers. The most reported GI problems include constipation, abdominal bloating, diarrhea, presence of undigested food in stool, and mouth sores. Furthermore, children with ASD are more likely to have irregular weight patterns. The study also suggests a possible genetic component, as GI symptoms were more prevalent among children with a family history of ASD (Alqoaer *et al.,* 2024).

2.9 Relationship between nutrition and autism

Children with Autism Spectrum Disorder often show deficiencies in key micronutrients such as iron, magnesium, zinc, and selenium, which may affect neurodevelopment. These altered nutrient levels suggest metabolic differences contributing to ASD symptoms. Routine screening and targeted nutritional support are recommended to address these deficiencies (Kaczmarek *et al.,* 2024).

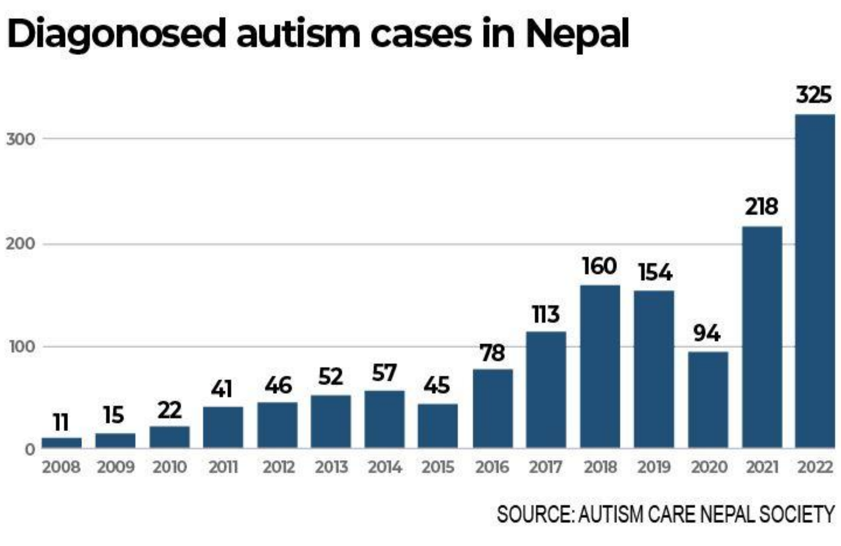
Nutritional interventions have shown potential benefits for managing Autism Spectrum Disorder (ASD) symptoms. Omega-3 fatty acid supplementation improves behaviors such as stereotypy, hyperactivity, social communication, and cognitive abilities. Combined gluten-free and casein-free diets with vitamin, mineral, and enzyme supplements also show promise in enhancing nonverbal intellectual skills and reducing ASD symptoms. Folinic acid targets neural pathways related to language and communication, offering a focused therapeutic option. Vitamin supplementation, particularly vitamins A and D, has demonstrated improvements in social responsiveness, hyperactivity, and irritability in children with ASD. Probiotics and prebiotics may alleviate gastrointestinal and behavioral symptoms, although evidence from high-quality trials remains mixed, showing limited overall efficacy. Further rigorous research is needed to confirm these findings and develop standardized nutritional guidelines for ASD (Pancheva *et al.,* 2024).

One-carbon metabolism (OCM) is a critical biochemical pathway involved in DNA and RNA synthesis, protein production, and gene regulation through methylation. Emerging evidence indicates that the intake of nutrients linked to OCM such as vitamins B1, B2, B6, folate, B12, choline, and zinc may affect sensory signaling and sensorimotor responses, which influence sensory symptoms in children with Autism Spectrum Disorder (ASD). OCM supports the production of neurotransmitters like serotonin, dopamine, and norepinephrine, which are essential for sensory processing, and OCM related metabolites differ between autistic and neurotypical children. In particular, choline plays a significant role in sensory processing, with animal studies showing that choline deficiency leads to sensory impairments, while supplementation improves auditory processing, social interactions, and repetitive behaviors in ASD models. These findings suggest a plausible link between dietary choline and sensory symptoms in autism (Olson *et al.,* 2025).

Emerging evidence highlights that targeted nutritional interventions such as supplementation with omega-3 fatty acids, vitamins A and D, folinic acid, and one-carbon metabolism nutrients like choline can significantly improve behavioral, cognitive, and sensory symptoms in children with Autism Spectrum Disorder by supporting critical neurodevelopmental pathways and addressing common micronutrient deficiencies.

2.10 Autism in Nepal

Autism spectrum disorder (ASD) is increasingly recognized in Nepal, with reports indicating a significant rise in diagnosed cases. The 2021 Census identified 4,886 individuals with autism out of 647,744 surveyed, representing 0.8% of the sample population. However, this figure is believed to underestimate the true prevalence. The Autism Care Nepal Society estimates that approximately 300,000 children in Nepal are living with autism (Koirala, 2023a). Since autism is still a "new disease" in Nepal and children with this condition typically do not receive medical attention for it, there is limited public knowledge about it. Identifying and treating autism in children in Nepal is difficult, largely due to limited public awareness. Autism Care Nepal (ACN) was established on April 2, 2008, by a group of parents seeking to support families of children on the autism spectrum. As the only organization in Nepal dedicated specifically to autism, ACN faces ongoing challenges, particularly due to limited financial resources, relying primarily on contributions from parents and well-wishers. Despite these constraints, the organization offers a range of services including counseling, mother-child training, and a day care program. In addition to providing direct care, ACN actively promotes awareness through media outreach and educational initiatives targeting teachers, doctors, psychologists, and students. With the support of international experts, ACN is also working to enhance its internal capacity. Notably, the organization employs a full-time special educator who is also a parent of a child with autism (Shrestha and Santangelo, 2014).



(Upadhyay Dhungel and Ghimire, 2019) conducted the research in Nepal addressing food selectivity and mealtime behavior issues in children with autism. The study assessed various aspects including food preferences, behavioral patterns during meals, dietary intake, and weight status among children and adolescents on the autism spectrum. Findings revealed that the majority of participants were overweight and consumed excessive calories. Out of 70 children studied, 36 (51.43%) exhibited food selectivity, while 34 (48.57%) did not. Additionally, 48.57% of the participants displayed mealtime behavior challenges, whereas 51.43% did not show such issues (Dhungel and Ghimire, 2019).

In Nepal, mothers of children with autism encounter significant multidimensional burdens. (Acharya and Sharma, 2021), in a phenomenological study of nine mothers, found pervasive physical fatigue, emotional turmoil including denial and societal shame and financial hardship due to therapy costs and employment disruption. To manage these challenges, mothers employed a variety of coping strategies: respite care, problem focused actions such as forming support groups or care centers, positive reframing of their circumstances, and reliance on religious faith. The authors advocate for enhanced healthcare awareness, policy initiatives supporting families (including financial and respite care), and public awareness to destigmatize autism.

Autism Spectrum Disorder (ASD) is increasingly recognized in Nepal, especially after its inclusion in the Disability Rights Act (2017). However, awareness and services remain limited. (Koirala, 2018) found 10.8% of autistic children were stunted and 6.25% were underweight, with higher prevalence in boys and none among children under five. These findings highlight age and gender disparities in nutritional status, emphasizing the need for early intervention and inclusive support in Nepal.

Nepal has ratified key international agreements such as the Convention on the Rights of the Child (CRC, 1989), Education for All (EFA, 1990), the Salamanca Statement and Framework for Action on Special Needs Education (1994), and the Convention on the Rights of Persons with Disabilities (CRPD), reflecting its commitment to inclusive education. Nationally, the Constitution of Nepal (2015) ensures free, compulsory basic and secondary education for all, including children with disabilities. Policies like the National Education System Plan (NESP, 1971–76), National Policy and Action Plan Related to People with Disabilities (2006), Inclusive Education Policy for Persons with Disabilities (2016), and the

Compulsory and Free Education Act (2018) promote inclusive, accessible learning. The School Sector Development Plan (SSDP, 2016–2023) aims to improve participation and support systems, while the Disability Rights Act (2017) mandates inclusive education through curriculum adaptation and equal opportunity. Despite these efforts, children with disabilities especially in rural areas face barriers to education due to weak implementation, lack of trained teachers, and insufficient resources (Acharya, 2024).

2.11 Assessment of nutritional status

Nutritional assessment is a systematic approach that integrates dietary intake, biochemical indicators, anthropometric data, and clinical evaluations to evaluate the nutritional status of individuals or population groups, reflecting how effectively nutrients are consumed and metabolized. The process is commonly categorized into four types: nutritional surveys, surveillance, screening, and intervention assessments, each serving distinct roles in identifying, monitoring, and addressing nutritional issues. It's methods are based on dietary, laboratory-biochemical, anthropometric and clinical observations. Correct interpretation of the results of nutritional assessment usually requires consideration of other factors, such as socioeconomic status, cultural practices, health and vital statistics (ecological; factors). Nutritional status represents satisfaction of the human body with nutritive and protective substances and the reflection of this to the physical characteristics, biochemical composition, physiological characteristics, functional capability, and the health status (Vitti *et al.,* 2015).

It is a systematic process involving the collection and interpretation of data spanning dietary intake, biochemical markers, anthropometric measurements, and clinical evaluation to identify and understand nutrition-related health issues in individuals (BAPEN, 2012). Nutritional status can be evaluated using two main approaches: direct methods, which involve assessing individuals through measurable, objective criteria, and indirect methods, which rely on broader community health indicators and dietary related factors to infer nutritional conditions.

A. The direct method of nutritional survey

The main types of nutritional assessment methods include:

a) Anthropometric measurements

b) Dietary assessments
c) Biochemical evaluations
d) Clinical and functional assessments (Bates *et al.,* 2017).

B. The indirect method of nutritional survey

Indirect methods evaluate the nutritional status of populations using broader, community-level indicators rather than measuring individuals directly. The World Health Organization's 1966 monograph on community nutrition assessment highlights three sets of indirect indicators:
a) Ecological variables - trends in crops yields, national food balance data and the coverage of healthcare and educational services

b) Socio-economic factors- household size, main occupation, per capita income, population density, schooling levels and prevailing cultural practices.

c) Vital health statistics – especially under five mortality and morbidity tied to protein energy malnutrition, growth faltering (stunting and wasting) among school aged children, and the prevalence of anemia, goiter, diarrhea, measles, and parasitic infections (WHO, 1996).

2.11.1 Anthropometric method of nutritional assessment

Anthropometric measurements are one of the most widely used and reliable methods for assessing the nutritional status of individuals and populations. This method involves the systematic measurement of the physical dimensions and composition of the human body, including height, weight, body mass index (BMI), mid-upper arm circumference (MUAC), and skinfold thickness (WHO, 1995).

According to the World Health Organization (1995), anthropometry is essential for assessing growth and development in children, identifying undernutrition and overnutrition, and monitoring changes in nutritional status over time. It is non-invasive, relatively inexpensive, and suitable for large-scale surveys. For instance, indicators like weight-for-age, height-for-age, and weight-for-height are commonly used to diagnose underweight, stunting, and wasting among children under five years of age.

BMI is a widely accepted index for assessing adult nutritional status, where a BMI below 18.5 indicates undernutrition, and values above 25 and 30 reflect overweight and obesity, respectively (WHO, 2000). In addition to BMI, MUAC is particularly useful in field settings for rapid screening of acute malnutrition, especially in children aged 6–59 months. A MUAC less than 115 mm is an indicator of severe acute malnutrition in children (Picot *et al.,* 2012).

2.11.2 Height for age (H/A)

Height-for-age (HFA) is one of the key anthropometric indicators used to assess long-term nutritional status and growth retardation in children. According to the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), HFA is particularly useful for identifying stunting, a condition that reflects chronic undernutrition during the most critical periods of growth and development, particularly in the first 1,000 days of life (WHO, 2006; UNICEF, 2021).

Stunting is defined as a height-for-age Z-score (HAZ) more than two standard deviations below the WHO Child Growth Standards median. Children with HAZ < -2 SD are classified as stunted, while those with HAZ < -3 SD are considered severely stunted (WHO, 2006). This indicator reflects not only nutritional deficiencies but also socioeconomic conditions, repeated infections, and poor maternal health and nutrition.

According to (UNICEF, 2021), stunting affects approximately 22% of children under five globally, with the highest prevalence in South Asia and Sub-Saharan Africa. Persistent stunting is associated with poor cognitive development, lower educational attainment, and reduced economic productivity in adulthood.

Although height-for-age is not useful for detecting acute malnutrition, it remains a critical indicator for assessing long-term nutritional challenges and guiding multisectoral interventions aimed at improving child growth and development (UNICEF, WHO and World Bank, 2021).

2.11.3 Weight for age

Weight-for-age (WAZ) is a commonly used anthropometric indicator that reflects a child's body weight relative to their age and sex. It serves as a general marker for undernutrition, capturing both chronic and acute malnutrition, but it lacks the specificity to distinguish between the two (WHO, 2006). Children with WAZ values below -2 standard deviations (SD) from the WHO Child Growth Standards median are classified as underweight, while those below -3 SD are considered severely underweight. WAZ is most appropriate for assessing children under ten years of age and is widely applied in growth monitoring and public health surveys to evaluate the overall nutritional status of populations (WHO, 2006).

2.11.4 Weight-for-height (W/H)

Weight-for-height (W/H) is an anthropometric indicator used to assess acute malnutrition, particularly in children under five years of age. It reflects body mass relative to height, independent of age, and is especially useful in identifying wasting a form of malnutrition caused by recent and severe weight loss due to insufficient food intake or illness. A child is considered wasted when their weight-for-height z-score (WHZ) is below -2 standard deviations from the median of the WHO reference population, and severely wasted if below -3 SD (WHO, 2006). W/H is also used to identify overweight in children when the WHZ exceeds +2 SD. According to UNICEF, WHO, and the World Bank (2023), wasting is a strong predictor of mortality among children under five, especially in emergency or humanitarian settings. Because it provides immediate insight into a child's current nutritional state, W/H is widely applied in nutritional screening, clinical assessments, and feeding program admissions in both community and health facility settings.

2.11.5 Mid-upper arm circumference (MUAC)

Mid-upper arm circumference (MUAC) is a simple, rapid, and reliable anthropometric tool used to assess acute malnutrition, particularly in children aged 6–59 months, as well as pregnant women in some contexts. It involves measuring the circumference of the upper arm at the midpoint between the shoulder and the elbow. MUAC is highly practical in field settings because it requires minimal equipment, training, and time. According to the WHO, a MUAC of less than 11.5 cm indicates severe acute malnutrition (SAM) in children, while values between 11.5 cm and 12.5 cm suggest moderate acute malnutrition (MAM) (WHO, 2013). MUAC is strongly correlated with child mortality and is considered a better predictor of death in malnourished children than weight-for-height in some settings (Myatt *et al.,* 2006).

2.11.6 BMI

Body Mass Index (BMI) is a widely used anthropometric index to assess body fatness and categorize nutritional status across age groups. It is calculated by dividing a person's weight in kilograms by the square of their height in meters (kg/m^2). BMI is interpreted using BMI-for-age Z-scores (BAZ) based on WHO growth reference data. A BAZ of < -2 SD indicates thinness, > +1 SD indicates overweight, and > +2 SD indicates obesity (WHO, 2007). For adults, BMI classifications are fixed: underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), and obese (≥30) (WHO, 2023). BMI is favored for its simplicity and cost-effectiveness in large-scale health assessments. However, it does not distinguish between fat and muscle mass, nor does it account for fat distribution, which can limit its accuracy in some individuals (Prentice and Jebb, 2001). Despite its limitations, BMI remains a central tool in monitoring population-level nutritional trends and the global burden of undernutrition and obesity.

2.12 Dietary method of nutritional assessment

The dietary method of nutritional assessment involves evaluating an individual's or population's dietary intake to understand nutritional adequacy and potential health risks. It is one of the direct methods of nutritional assessment and is widely used in both clinical and public health settings.

Common dietary assessment techniques include:

1. 24-Hour Dietary Recall
2. Food Frequency Questionnaire (FFQ)
3. Food Diary/Record (3-day or 7-day)
4. Weighed Food Records

The World Health Organization (WHO), in collaboration with FAO and UNICEF, emphasizes the importance of dietary assessment in its global guidance for monitoring healthy diets. The report outlines standardized approaches for collecting dietary data and highlights the role of such assessments in preventing non-communicable diseases, ensuring food security, and promoting sustainable healthy eating habits (WHO, FAO and UNICEF, 2024). Moreover, the use of validated dietary assessment tools is encouraged to enhance data reliability across different populations and settings.

A) 24- Hour Dietary recall

The 24HR method is valued for being relatively quick, inexpensive, and low in respondent burden, particularly when administered by trained interviewers using standardized protocols such as the USDA's Automated Multiple-Pass Method (AMPM**).** The AMPM improves accuracy by using multiple passes or rounds of questioning to help respondents remember forgotten items and clarify portion sizes (Moshfegh *et al.,* 2008). However, limitations include reliance on memory, potential underreporting or overreporting, and day-to-day dietary variation, which may require multiple recalls to assess usual intake reliably. Despite its limitations, the 24HR remains a cornerstone of dietary assessment, particularly when combined with statistical modeling to estimate usual intake across populations (NCI, 2022).Technological innovations, such as mobile dietary recall tools and computer-assisted interviews, have also improved its feasibility and validity in both developed and low-resource Food frequency questionnaire settings.

B) Food Frequency Questionnaire (FFQ)

The Food Frequency Questionnaire (FFQ) is a widely used dietary assessment method designed to capture habitual dietary intake over an extended period, typically weeks, months, or even years. It provides an efficient and cost-effective approach to assessing dietary patterns in both clinical and epidemiological studies (Thompson and Subar, 2017). FFQs are particularly useful in large population-based studies as they can efficiently estimate the intake of specific nutrients, food groups, and overall dietary quality. According to (Willett, 2012), FFQs assess how often a participant consumes specific food items by asking standardized questions, which can then be translated into nutrient intake using food composition databases. Despite some limitations, such as reliance on memory and potential misreporting, FFQs remain a valuable tool for understanding the association between diet and chronic diseases (Cade *et al.,* 2002).

2.13 Brief Autism Mealtime Behavior Inventory (BAMBI)

Feeding problems in children with Autism Spectrum Disorder (ASD) should be routinely assessed, and health professionals need greater awareness of these issues. Food selectivity can be evaluated through direct observation, specialized tools, or general assessments like food diaries. However, many existing tools were designed for typically developing children and lack validation for the ASD population. To address this gap, the Brief Autism Mealtime Behavior Inventory (BAMBI) was developed as the first tool specifically created to assess mealtime behaviors in children with ASD. BAMBI effectively distinguishes feeding problems in ASD from those in typically developing children but does not cover sensory or gastrointestinal issues. Due to the absence of validated tools in Italy, a recent study focused on translating and validating BAMBI for the Italian population. The Brief Autism Mealtime Behavior Inventory (BAMBI) is an assessment tool originally developed in English and validated for children between the ages of 3 and 11, both with and without Autism Spectrum Disorder (ASD). It is a caregiver-reported measure specifically designed for parents or primary caregivers to assess mealtime behaviors that are commonly seen in children with ASD. The BAMBI uses a 5-point Likert scale, where a score of 1 means the behavior "never" happens and a score of 5 means the behavior "always" happens during meals. Four of the items, which assess positive mealtime behaviors, are reverse scored. The total score is calculated by summing all 18 items, with higher total scores indicating more severe mealtime behavior challenges. Through exploratory factor analysis, three primary behavior categories were identified: Limited Variety, Food Refusal, and Features of Autism (Lamboglia *et al.,* 2023).

2.14 RDA for children and adolescents

Recommended Dietary Allowance (RDA) refers to the average daily intake level of a nutrient that is sufficient to meet the nutritional requirements of nearly all (97–98%) healthy individuals in a specific age and gender group. RDAs are established by expert committees based on scientific evidence and are intended to prevent deficiencies, promote optimal growth, and maintain overall health (Institute of Medicine [IOM], 2006; ICMR-NIN, 2020).

Table 2.1: The recommended daily allowance (RDA) of nutrients for pre children (1- 15 years)

NUTRIENT	PRE SCHOOL		SCHOOL CHILDREN				
	1-3 yr	4-6 yr	7-9 yr	10-12 yr		13-15 yr	
				BOYS	GIRLS	BOYS	GIRLS
Body weight (kg)	12.9	18.3	25.3	34.9	36.4	50.5	49.6
Calories (kcal)	1110	1360	1700	2220	2060	2860	2400
Protein (gm)	12.5	16	23	32	33	45	43
Calcium (mg)	500	550	650	850	850	1000	1000
Fiber (g)	15	20	26	33	30	43	36
Fat (gm)	25	25	30	35	35	45	40
Magnesium(mg)	90	125	175	240	250	345	340
Iron (mg)	8	11	15	16	28	22	30
Zinc (mg)	2.8	3.7	4.9	7	7.1	11.9	10.7
Thiamine (mg)	0.6	0.8	1	1.3	1.2	1.6	1.

Source: ICMR-NIN (2020)

Part III

Materials and methods

3.1 Study area

The data collection for this study was carried out from April 24 to May 15, 2025, at various institutions situated in Birtamode, Jhapa. These included Autism Care Society Nepal Birtamode, Mahendra Ratna Secondary School, Creative School of Special Child, Aayu Child Care Center, and Devya Speech and Rehabilitation Center.

3.2 Study population

The study population comprised children and adolescents aged 2 to 15 years diagnosed with Autism Spectrum Disorder (ASD). These individuals regularly attended autism centers for various therapies and participated in school-based activities designed to support their development.

3.3 Selection criteria

a. Inclusion criteria:

- Children who have been already diagnosed to have ASD
- Children who were present at the schools and centers of Birtamode, Jhapa.

b. Exclusion criteria

- Children whose caretakers do not wish to take part in the survey.

3.4 Research design

A cross-sectional study was conducted, including all children and adolescents with ASD present at each center during the fieldwork period. The data collection process involved administering structured questionnaires to parents or caregivers, followed by essential anthropometric measurements to assess the nutritional status of the participants.

3.5 Sampling technique

This study utilized a census sampling technique, where all children and adolescents aged 2 to 15 years diagnosed with ASD and present at the selected autism centers during the fieldwork were included. Census method involves studying the entire target population without exclusion. This approach was chosen to ensure that comprehensive and representative data were collected from all eligible participants.

3.6 Sample size

A total of 74 children and adolescents who attended the selected organizations for various therapies and school activities during the study period were included in the study using census sampling technique.

3.7 Research instruments

a) Weighing Scale: A digital weighing scale was used, with a maximum capacity of 180 kg and a precision of 0.1 kg (one unit).

b) Stadiometer: Height was measured using a stadiometer with a maximum range of 197 cm and a minimum measurement increment of 0.1 cm.

c) MUAC Tape: A standard MUAC tape was used to measure the mid-upper arm circumference (one unit).

d) Questionnaire: A structured and pretested questionnaire was utilized for data collection.

e) Measuring Cups: Measuring cups of varying capacities (250 ml, 125 ml, 80 ml, 60 ml, and 30 ml) were used for estimating portion sizes.

3.8 Study variables

The study variables were divided into two categories: dependent variables and independent variables. The dependent variable was the nutritional status of children with autism, assessed through indicators such as stunting, wasting, and underweight. The independent variables included factors that might influence these nutritional outcomes.

A. Socio-economic and Demographic Factors: These included family structure, ethnic background, father's occupation and education level, mother's occupation and education level, the head of the household, total family size, annual household income, and the primary person responsible for purchasing food.
B. Child characteristics: Age, sex, birth order, and birth weight.
C. Child care practices: This included factors such as breastfeeding immediately after birth, the timing of breastfeeding initiation, provision of colostrum, frequency of breastfeeding, exclusive breastfeeding status, use of pre-lacteal feeds, complementary feeding habits, and bottle-feeding practices.
D. Health and immunization practices: complete vaccination of child, intake of Vitamin A and deworming tablets, and health service-seeking practices.
E. Maternal characteristics: age during first delivery, pregnancy-related factors: vaccinations, iron and folate intake, knowledge about child malnutrition.
F. BAMBI questionnaire: information about the eating behaviors and nutritional intake of children with ASD

3.9 Data collection techniques

Data collection was conducted in two phases with initial support from the coordinator of the Autism Care Society organization. The first phase involved contacting school administrators and parents to complete a semi-structured questionnaire. In the second phase, anthropometric measurements of the children were taken. Informed consent was obtained from all participants prior to data collection.

The following techniques were used for data collection:

A. A general questionnaire regarding the socio-demographic information, child description, child caring practices, health and immunization, and maternal characteristics was used.
B. Anthropometric measurements
   i. Weight: The weight of participants was measured using a portable digital weighing scale positioned on a stable, flat surface. Participants were asked to remove their shoes and socks, wear light clothing, stand upright on the scale with one foot on each side, face forward, keep their arms relaxed at their sides, and remain still until instructed to step off (WHO,2023).

i. Height: Height was measured using a portable, standardized stadiometer. Participants were instructed to remove their shoes, hats, and any hair accessories. They were positioned standing on a flat surface, facing the interviewer, with their heels touching the backboard, feet together, and knees straight. They were asked to look straight ahead, ensuring their head was level with their eyes and ears aligned. Height was documented in centimeter (WHO,2023)
ii. MUAC: Mid-Upper Arm Circumference (MUAC) was measured using a standard MUAC tape. Clothing covering the child's left arm was removed. The midpoint of the upper arm was identified by first locating the tip of the shoulder with the fingertips, then bending the child's elbow at a right angle to find the midpoint. After locating the midpoint, the child's arm was straightened, and the MUAC tape was wrapped around the arm at the marked point. The measurement was recorded in centimeter (WHO,2019).

C. The BAMBI is a standardized, parent-completed questionnaire commonly used in clinical settings to assess feeding difficulties in children with Autism Spectrum Disorder (ASD). The current version includes 18 items rated on a 5-point Likert scale (1 = Never/Rarely to 5 = Almost Every Meal). It measures behaviors across three domains: Limited Variety, Food Refusal, and Features of Autism (Lukens and Linscheid, 2008).
D. Dietary Assessment
   To evaluate dietary intake, both a Food Frequency Questionnaire (FFQ) and 24hour dietary recall method was utilized.

3.10 Data analysis

First, all the collected data were carefully checked to ensure they were complete and consistent. The quantitative data were then coded and entered into statistical software for analysis. In the same way, qualitative data, such as interviews and observations, were transcribed and organized by assigning labels to different categories. Finally, suitable statistical tests were used to explore the relationships between the study variables and the participants' nutritional status.

3.11 Pretesting

A pretest was conducted with 10 children with ASD and their caregivers to evaluate the feasibility and practicality of the data collection tools. The questionnaire was initially reviewed by the research supervisor. Both the draft questionnaire and anthropometric measurement tools were tested on ASD children from the study site. This process helped to improve the clarity and accuracy of the questionnaire, refine interviewing techniques, and standardize anthropometric procedures. Based on the pretest results, ambiguous or confusing questions were removed, and the questionnaire was revised accordingly.

3.12 Validity and reliability of the study tools

Validity refers to the extent to which the instruments used in data collection accurately measure the intended variables. To ensure validity, the weighing scale was calibrated by comparing its measurements against standardized weights. Similarly, the stadiometer's accuracy was verified by cross-checking its readings with those of a UNICEF approved stadiometer. The measuring tape used for anthropometric assessments was also calibrated against a standard stadiometer to maintain measurement precision. All instruments were inspected and recalibrated daily to maintain consistent validity throughout the study. For dietary assessment, foods were standardized using measuring cups to ensure accurate portion size estimation during 24-hour recalls.

Reliability pertains to the consistency and dependability of the data collected using the study tools. The questionnaire underwent a pretesting phase to evaluate its content reliability and to identify any ambiguous or unclear questions. During the actual data collection, the questionnaire was routinely reviewed for completeness, consistency, and clarity in responses. To further confirm reliability, the test-retest method was applied, assessing whether the instruments could produce stable results when administered repeatedly under similar conditions.

Part IV

Result and discussion

The study was conducted at several schools and organization, in Birtamode Jhapa that provide therapies and educational care support for children with autism. These included Autism Care Society Birtamode, Aayu Child Care Center, Creative School for Special Children, Mahendra Ratna Secondary School, and Devya Speech and Rehabilitation Center. The participants were children and adolescents aged between 2 and 15 years. The findings of the survey are presented in the following sections:

Table 4.1 (a) demonstrates the socio-demographic characteristics of the study population (n = 74) indicated that more than half of the children belonged to nuclear families (56.8%), while 43.2% were from joint families. In terms of ethnicity, the majority were Khas-Arya (66.3%), followed by Janajatis (25.7%), Madhesi (4.1%), and Dalit (1.4%). These distributions reflect the predominant representation of nuclear family structures and Khas-Arya ethnicity within the study sample.

Table 4.1 (a): Socio-demographic characteristics of the study population (n=74)

Variables	Frequencies	Percentages (%)
Family type		
Joint	32	43.24
Nuclear	42	56.76
Ethnicity		
Khas-arya	49	66.31
Janajatis	19	25.67
Dalit	1	1.4
Madhesi	3	4.05

Table 4.1 (b): Socio-economic and demographic characteristics of the study population

Variables	Frequency	Percentages (%)
Father's education		
Secondary	24	32.4
Higher secondary	23	31.08
University	27	36.5
Father's occupations		
Business/employment	52	68.9
Foreign employment	16	21.6
Agriculture	2	2.7
Jobless	5	6.8
Monthly income classification		
Above 30,000	68	91.8
Below 30000	6	8.1

Most fathers of the study participants had attained university-level education (36.5%), followed by secondary (32.4%) and higher secondary education (31.1%). The majority were engaged in business or employment (68.9%), with smaller proportions in foreign employment (21.6%), agriculture (2.7%), or deceased/jobless (6.8%). Nearly all households (91.8%) reported a monthly income above NPR 30,000. These findings suggest that the study population predominantly came from relatively educated and economically stable families, which may influence child nutritional status and caregiving practices.

4.2 Child Characteristics

Table 4.2: Child characteristics of study population (n = 74)

Variables	**Frequencies**	**Percentages (%)**
Gender		
Male	58	78.4
Female	16	21.6
Age		
(1-3) years of age	5	6.8
(4-6) years of age	30	40.5
(7-9) years of age	27	36.5
(10-12) years of age	9	12.2
(13-15) years of age	3	4.05
Birth order		
First	46	62.2
Second third	28	37.8
Birth weight		
Less than 2.5 kg	7	9.5
More than 2.5 kg	67	90.5

Table 4.2 reveals that among the 74 participants in the study, 78.37% were male, whereas only 21.6% were female. The majority of participants belonged to the 4–6 years age group, followed by 36.5% in the 7–9 years group. Additionally, 6.75% were in the 1–3 years group,

and only 4.05% fell within the 13–15 years age range. Findings indicates that a higher proportion of autistic children were first born, with 62.2% of the cases reported as first order birth whereas 37.8% were identified as second/third order of birth among study population.

4.3 Child caring practices

Table 4.3 (a): Child caring practices of the study population (n = 74)

Variables	Frequency	Percentages (%)
Breastfeeding after birth		
Yes	68	91.8
No	6	8.01
Initiation of breastfeeding (n = 68)		
Within 1 hour	36	52.9
Within 8 hours	18	26.5
Within 24 hours	7	10.3
After 24 hours	7	10.3
Colostrum feeding		
Yes	66	89.2
No	8	10.8
Breastfeeding frequency		
<8 times	12	17.6
11-12 times or more	33	48.5
8-10 times or more	23	33.8

As shown in Table 4.3 (a), the majority of the participants 91.8% had been breastfed after the birth. Among them, 52.9% were breastfed within the first hour, while 26.5% received breastfeeding within 8 hours. Additionally, 10.3% were breastfed within 24 hours, and another 10.3% were fed only after 24 hours. A large proportion 89.2% of the participants were provided with colostrum, commonly referred to as the first milk. Regarding breastfeeding frequency, 16.2% of the participants were breastfed fewer than eight times per day, 29.7% were breastfed 8-10 times daily, and 44.6% received breastfeeding 11-12 times a day.

Table 4.3 (b): Child caring practices of the study population (n=74)

Variables	Frequency	Percentages (%)
Exclusive breastfeeding		
Yes	36	48.6
No	38	51.4
Reasons for non-exclusive breastfeeding (n=38)		
Insufficient milk production	23	60.5
Medical condition	10	26.3
Job	5	13.2
Age at which breastfeeding was stopped (n=62)		
Before 2 years	14	22.6
After 2 years	48	77.4

As shown in table 4.3 (b) only 48.6% of the participants were exclusively breastfed for the recommended first six months, while a slightly higher proportion 51.4% did not follow exclusive breastfeeding practices. The primary reasons cited for non-exclusive breastfeeding included insufficient breast milk production 60.5%, maternal medical complications 26.3%, and work-related responsibilities 13.2%. Among the 62 children who had stopped breastfeeding, 22.6% were waned before 2 years, while 77.4% continued breastfeeding beyond 2 years.

Table 4.3 (c): Child caring practices of the study population (n=74)

Variables	**Frequency**	**Percentages (%)**
Received pre-lacteal feeds		
Yes	16	21.6
No	58	78.4
Bottle feeding		
Yes	25	33.8
No	49	66.2
Knowledge of the preparation of lito		
Yes	66	89.2
No	8	10.8
Completed vaccination of the child		
Yes	74	100
No	0	0
Intake of vitamin A and deworming tablet		
Yes	74	100
No	0	0

Table 4.3 (c) represents child caring practices among the study population (n = 74) showed that 21.6% of children received pre-lacteal feeds, whereas the majority (78.4%) did not. Bottle feeding was reported in 33.8% of cases, while 66.2% of mothers did not practice bottle feeding. Knowledge of preparing lito, a traditional complementary food, was reported by 89.2% of caregivers, while 10.8% lacked this knowledge. Furthermore, all children in the study had completed their vaccinations (100%), and additional information was collected regarding the intake of vitamin A and deworming tablets to assess broader child health practices.

4.4 Maternal characteristic

Table 4.4: Maternal characteristics of the study population (n=74)

Variables	Frequency	Percentages
Mother's education		
Secondary	24	32.4
Higher secondary	23	31.08
University	27	36.5
Mother's occupation		
Business /Employment	25	33.8
Foreign employment	4	5.4
Housewife	42	56.8
Dead	1	1.4
Age at marriage		
Before 20 years	21	28.4
After 20 years	53	71.6

Age at first pregnancy		
Before 20 years	10	13.5
After 20 years	64	86.5
Intake of iron folate tablets		
Yes	72	97.3
No	2	2.7
Initiation of intake (n=72)		
1st trimester	17	23.6
2nd trimester	54	75
3rd trimester	1	1.4
Knowledge on malnutrition		
Yes	74	100
No	0	0

Table 4.4 indicates the maternal characteristics of the study population (n = 74) indicated that the majority of mothers had attained higher education, with 36.5% completing university, 32.4% secondary education, and 31.08% higher secondary education. In terms of occupation, most were housewives (56.8%), followed by those engaged in business or employment (33.8%), foreign employment (5.4%), while one mother (1.4%) was deceased. A large proportion of mothers married after the age of 20 years (71.6%) and had their first pregnancy after 20 years (86.5%). Nearly all mothers (97.3%) reported taking iron and folate supplements during pregnancy, with the majority initiating intake in the second trimester

(75%), while 23.6% began in the first trimester and only 1.4% in the third trimester. All mothers (100%) reported knowledge of malnutrition.

4.5 Prevalence of malnutrition

Anthropometric indicators serve as key tools in evaluating the nutritional status of children. In this study, nutritional status was assessed using three main indices: weight-for-age to identify underweight, height-for-age to detect stunting, and BMI-for-age to determine thinness, overweight, and obesity. These measures were used to examine the prevalence of various forms of malnutrition among the participants.

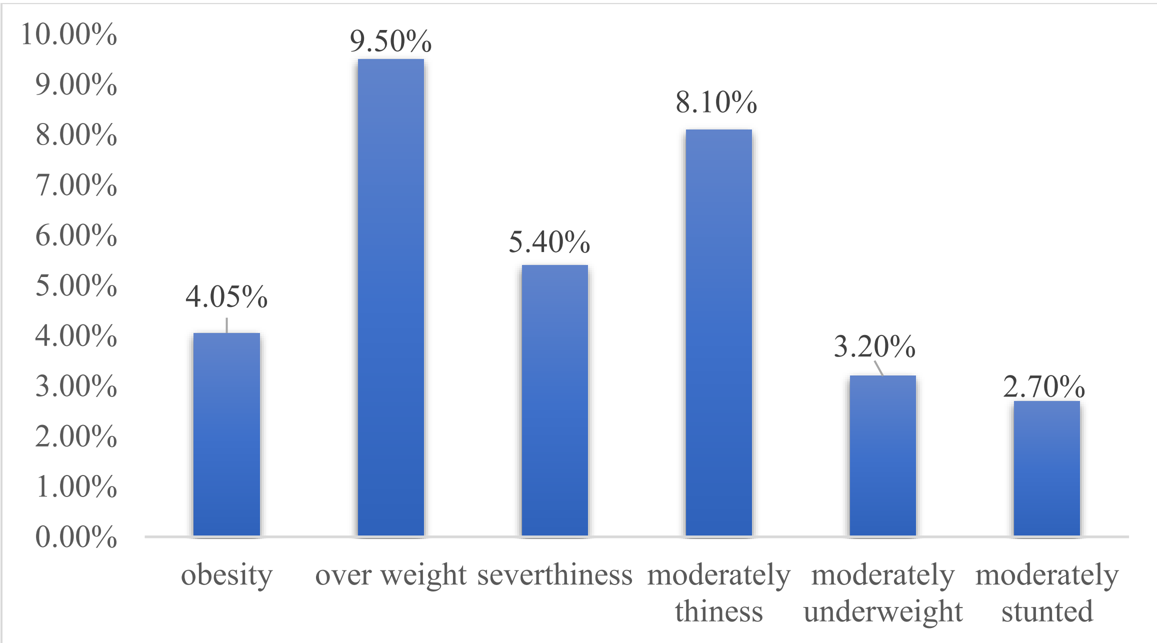


Figure 4.1: Prevalence of underweight, stunting, thinness, overweight and obesity among the survey population.

Figure illustrates the distribution of different forms of malnutrition among the study population. The most prevalent condition was overweight, followed by moderate thinness, severe thinness, and obesity. Lower proportions were observed for moderate underweight and moderate stunting. These findings indicate a dual burden of malnutrition, with both undernutrition (thinness, underweight, and stunting) and overnutrition (overweight and obesity) coexisting within the sample.

4.5.1 Distribution of malnutrition based on gender

Table 4.5 indicates that among the 74 children with autism, 58 were males (78.4%) and 16 were females (21.6%). Based on WAZ (n = 64), 2 children (3.1%) were moderately underweight, while 62 (96.8%) were found normal. For HAZ, 2 children (2.8%) were moderately stunted, including 1 male (1.4%) and 1 female (1.4%), whereas 72 (97.3%) had normal height-for-age. In terms of BAZ, 4 males (5.4%) were severely thin, and 6 children (8.2%), comprising 5 males (6.8%) and 1 female (1.4%), were moderately thin. The majority (n = 55, 74.9%) fell within the normal category, while 7 males (9.5%) were overweight and 3 males (4.1%) were obese. These findings indicate that although most children were classified as normal across all indices, both undernutrition and overnutrition were present, with males showing a higher prevalence of severe thinness, overweight, and obesity compared to females.

Table 4.5: Distribution of malnutrition based on the gender of the study population (n=74)

	Characteristics	**Male (%)**	**Female (%)**	**All (%)**
WAZ	Moderately underweight	3.1%		3.1%
	Normal	73.4%	23.4%	96.8%
HAZ	Moderately stunted	1.4%	1.4%	2.8%
	Normal	77.02%	20.3%	97.3%
BAZ	Severe thinness	5.4%		5.4%
	Moderate thinness	6.8%	1.4%	8.2%
	Normal	54.05%	18.9%	74.9%
	Over weight	8.1%	1.4%	9.5%
	Obesity	4.05%	0	4.05%

Similar findings have been reported in other countries, though with some differences. A recent meta-analysis reported that children with autism are more likely to have shorter stature compared to their peers (Alhrbi *et al.,* 2025). An Egyptian national survey also found higher odds of both stunting and obesity in children with autism (Metwally *et al.,* 2024) while a study in Bangladesh observed higher rates of overweight and obesity linked to low dietary diversity (Nazrul Islam *et al.,* 2020). Compared to these studies, thinness was more pronounced in the present study, especially among boys, while overweight and obesity were less common. This difference may reflect the overall nutritional environment in Nepal, where undernutrition continues to be a major public health concern.

4.5.2 Distribution of malnutrition based on age

Table 4.6 shows that in (4-6) year age group one child (3.3%) was found to be moderately stunted, while in the (7–9) year group, two children (7.4%) were under weight. Additionally, in the (10–12) year age group, one child (11.1%) was moderately stunted, indicating that underweight and stunting were primarily observed in the mid-childhood to early adolescent age ranges. It was found that 4–6 years age group, 3.3% of children were classified as underweight, while 3.3% were overweight.

Table 4.: Distribution of WAZ, HAZ and BAZ based on the age of the study population (n=74)

Age group	**N**	**WAZ**		**HAZ**		**BAZ (%)**	
		<-3	<-2	<-3	<-2	<-3	<-2
(2-3) years	5	_	_	_	_		
(4-6) years	30	_	_	_	1 (3.3%)	1 (3.3%)	1 (3.3%)
(7-9) years	27	_	2 (7.4%)	_	_	2 (7.4%)	2 (7.4%)
(10-12) years	9	_	_	_	1 (11.1%)	1 (11.1%)	2 (22.2%)
(13-15)	3	_	_	_	_		

The results are in line with international trends of similar studies. In a cross-sectional study of 94 low and middle-income countries, it was also found that the prevalence of stunting was higher in older children up until approximately 28 months of age, then declined, which may be explained by the catch-up growth and decreased adverse exposures (Black *et al.,* 2023).

4.5.3 Nutritional status in comparison with WHO standard

4.5.3.1 Nutritional status of 2 to 5 year autistic children

Distribution of underweight, stunting and BMI-for-age among autistic children 2 to 5 years of age based on WHO standards are shown in the figures below respectively.

a. Weight for age

The assessment of weight-for-age among the study participants indicated that 3.1% of children were moderately underweight, all of whom were male. This finding is lower than previous reports in Nepal, where (Bhattarai *et al.,* 2019) observed that 21.8% of male adolescents in Dang district were underweight, and national data show that 17% of adult men are underweight (Rk *et al.,* 2020). The lower prevalence in the present study may be attributed to the specific age range and characteristics of the study population, as well as differences in sampling methods. These results suggest that, although the prevalence of underweight is relatively low in this sample male children remain at higher risk for undernutrition compared to females.

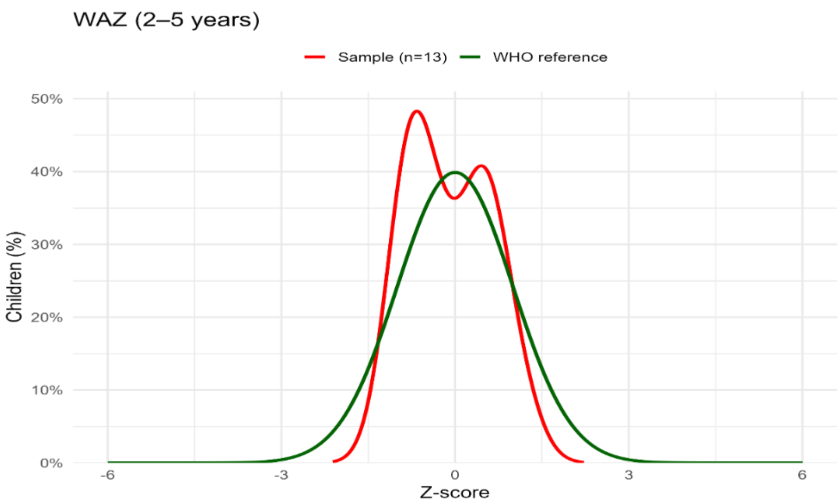


Figure 4.2: Distribution of underweight among 2 to 5 years old children based on WHO standard (n=13)

b. Height for age

In the present study, the prevalence of moderate stunting was 2.8%, with equal representation among males and females (1.4% each). In contrast, a cross-sectional study of children with autism in Dhaka, Bangladesh, reported a stunting prevalence of 3.2%, suggesting a slightly higher burden of linear growth faltering in this group (Sultana Bari *et al.,* 2020).

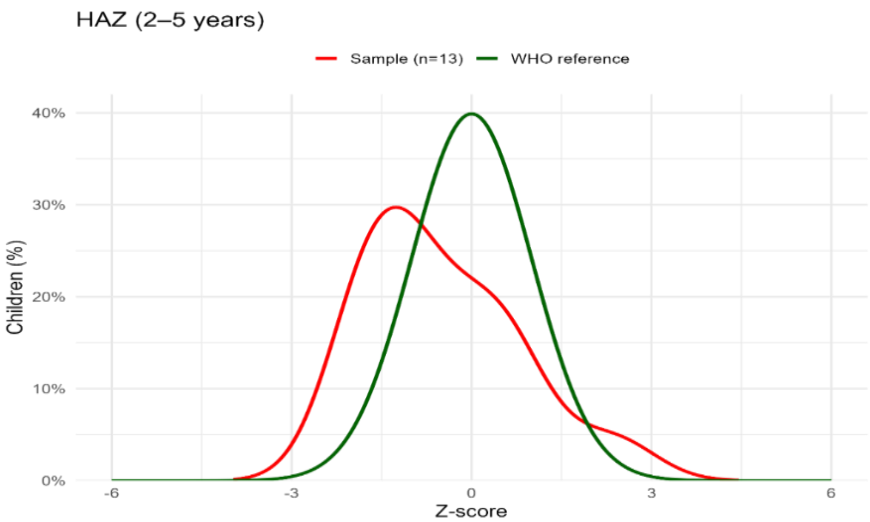


Figure 4.3: Distribution of stunting among 2 to 5 years old children based on WHO standard (n=13)

Figure 4.3 illustrates the distribution of HAZ among children with autism compared to the WHO reference standard. The WHO curve (green) shows a symmetrical distribution centered around the median (Z = 0), with the majority of children falling within the normal range. In contrast, the study population (red) curve is shifted to the left, indicating a higher proportion of children with lower HAZ values. This suggests that children in the study were more likely to experience stunting compared to the WHO reference group. The peak of the red curve is lower and wider than the reference curve, reflecting greater variability and a higher prevalence of below-average height-for-age in the study population.

4.5.3.2 Nutritional status of 5 to 15 years autistic children

a. Weight for age

In this study, 3.9% of 51 children with Autism Spectrum Disorder (ASD) were identified as underweight. This finding is comparable to a cross-sectional study conducted in Ontario, which reported an underweight prevalence of 3.5% among children and adolescents with ADS (Kinlin *et al.,* 2025).

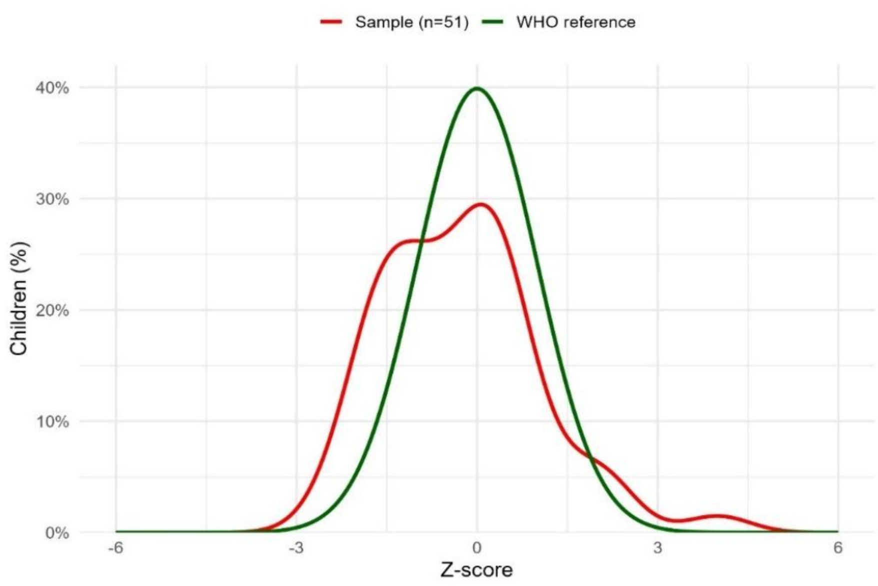


Figure 4.5: Distribution of underweight among 5 to 15 year old children based on WHO standard (n=51).

b. Height for age

In this study, 3.9% of 51 children with Autism Spectrum Disorder (ASD) were identified as stunted, with equal representation of 1.95% each among males and females. This prevalence is notably lower than the 45% reported in a study by (Sapkota *et al.,* 2023), which found that children with disabilities, including ASD, had a significantly higher risk of stunting compared to their typically developing peers**.**

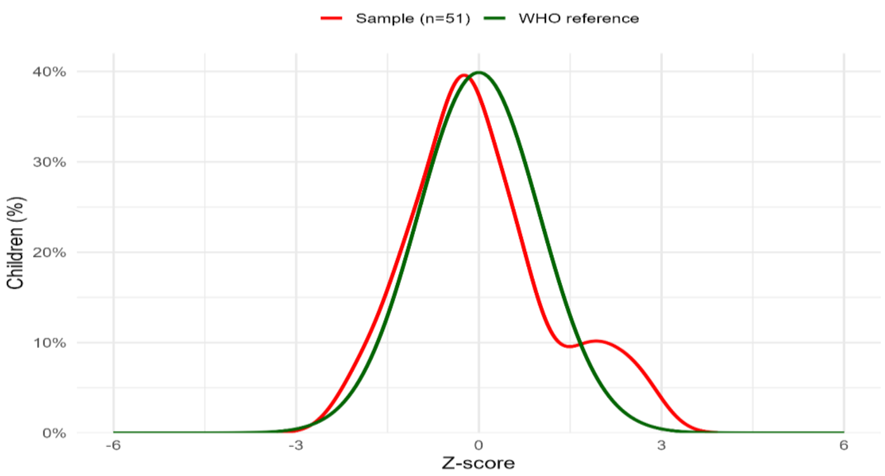


Figure 4.6: Distribution of stunting among 5 to 15 years old children based on WHO standard (n=51)

c. BMI for age

In this study, 11.8% of 51 children with Autism Spectrum Disorder (ASD) aged 5–15years were classified as overweight, 7.8% as severely underweight, 5.9% as obese, and 11.8% as underweight. These findings are consistent with recent research indicating a higher prevalence of both underweight and overweight conditions in children with ASD.

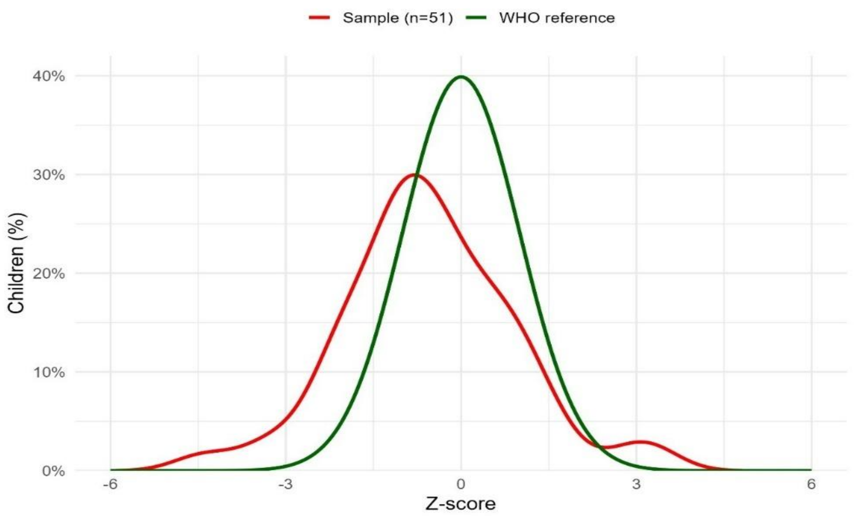


Figure 4.7: Distribution of BMI-for-age among 5 to 15year old autistic children based on WHO standard

4.6 Food frequency questionnaire

As shown in table 4.7, rice was the most commonly consumed cereal product, with 98.6% of participants reporting regular intake, while 1.4% did not consume rice at all. In contrast, only 8.2% and 10.8% of children regularly consumed wheat and maize/millet/barley products, respectively. Dal (lentils) was consumed regularly by 87.8% of the study population. Regarding vegetable intake, 50% of children regularly consumed green leafy vegetables; however, 28.4% reported disliking and never consuming them. Regular consumption of other vegetables was higher, at 68.9%. Additionally, 51.4% of participants frequently consumed fruits.

Dairy product consumption varied among participants. While only 17.6% of children regularly consumed milk, 54.05% reported disliking and avoiding it. Curd was regularly consumed by 24.3% of participants, whereas 45.9% never consumed it. Ghee was more widely accepted, with 56.8% reporting regular consumption and 14.9% reporting complete avoidance. Animal protein intake was relatively low. A total of 39.2% of children did not consume chicken or fish, and 54.05% did not consume red meat. Egg consumption was also limited, with only 4.05% consuming eggs regularly, 16.2% frequently, and 29.7% never. Processed and fast-food items were rarely consumed by the majority, with only 2.7% reporting frequent consumption and 24.3% never consuming such foods.

A comparable recent FFQ based study from Lahore, Pakistan (Haider *et al.,* 2025), similarly observed that eggs 12.9%, cheese 9.9%, and milk 15.8% were consumed infrequently among autistic children aged 3–11 years, with frequent intake of staples such as rice and whole wheat chapatti. This alignment underscores consistent patterns of high staple grain consumption and low intake of animal-source proteins and dairy among children with autism across diverse cultural settings. Similarly, it was found that children with ASD consumed legumes more frequently but had lower intake of starchy roots, sugars, preserves and syrups, meat, fish and eggs, as well as milk and milk products, compared to children without ASD (Islam *et al.,* 2024).

Table 4.7: Distribution of food intake (n = 74)

Variables	Regular	Frequent	Rare	Never
Rice	73(98.6%)			1(1.4%)
Wheat	6 (8.2%)	1 (1.4%)	54 (72.8%)	13 (17.6%)
Maize /millet/ barley	8 (10.8%)	2 (2.7%)	41 (55.4%)	13 (17.6%)
Dal	65 (87.8%)		7 (9.5%)	2 (2.7%)
Grames / brans /peas	19 (25.8%)	1 (1.4%)	45 (60.8%)	9 (12.2%)
GLV	37 (50%)	1 (1.4%)	15 (20.3%)	21 (28.4%)
Other vegetable	51 (68.9%)	2 (2.7%)	7 (9.5%)	14 (18.9%)
Roots and tubers	12 (16.2%)	3 (4.05%)	40 (54.05%)	19 (25.7%)
Fruits	4 (5.4%)	38 (51.4%)	20 (27.02%)	12 (16.2 %)
Milk	13 (17.6%)	10 (13.5%)	11 (14.9%)	40 (54.05%)
Curd	18 (24.3%)	8 (10.8%)	14 (18.9%)	34 (45.9%)
Ghee /butter	42 (56.8%)	3 (4.05%)	18 (24.2%)	11 (14.9%)
Paneer			29 (39.2%)	45 (60.8%)
White meat (chicken/fish)	9 (12.2%)		36 (48.6%)	29 (39.2%)
Red meat	9 (12.2%)		25 (33.8%)	40 (54.05%)
Egg	3 (4.05%)	12 (16.2%)	37 (50%)	22 (29.7%)
Processed foods	4 (5.4 %)	2 (2.7%)	50 (67.6%)	18 (24.3%)

4.7 Dietary intake

Table 4.8 illustrates, dietary intake among autistic children aged 2–3 years, the mean calorie intake was 1191.68 ± 198.75 kcal/day compared to the RDA of 1110 kcal, representing 107.36% of the requirement. Protein intake was 33.23 ± 5.78 g/day, which was much higher than the RDA. In contrast, calcium intake was 336.50 ± 213.15 mg/day, below the RDA of 500 mg. Fiber intake was also low at 50.29 ± 91.88 g/day, covering only 67.30% of the RDA.

These findings indicate that while calorie and fat intake were generally adequate, protein intake was significantly higher than recommended levels. Conversely, calcium and fiber intakes were inadequate, highlighting nutritional gaps. Similar patterns of excessive protein intake but insufficient micronutrient intake (e.g., calcium and fiber) have also been reported in autistic children in previous research (Nygren *et al.,* 2021).

Table 4.8: Nutrient intake by (2-3) year old autistic children (n=5)

	Intake	**RDA**	**% of RDA**	**T**	**Two side p value**
Calories (Kcal/day)	1191.68 ± 198.75	1110	107.358	0.822	0.457
Protein (g/day)	33.23 ± 5.78	12.5	265.82	7.17	0.002
Fat (g/day)	29.23 ± 6.75	25	116.78	1.242	0.282
Calcium (mg/day)	336.50 ± 213.15	500	67.30	-1.329	0.276
Fiber (g/day)	50.29 ± 91.88	15	67.30	0.768	0.485

Table 4.9 summarizes the dietary intake for autistic children aged 4–6 years, the mean protein intake was 45.33 ± 23.62 g/day compared to the RDA of 16 g, which accounted for 285.10% of the requirement and was statistically significant (t = 6.576, p < 0.001). Fat intake was

slightly higher than the RDA of 25 g (119.09%). The mean calorie intake was 1546.84 ± 735.03 kcal/day, providing 113.74% of the RDA (1360 kcal), but again, the difference was not significant ($p = 0.189$). Fiber intake was notably low at 10.53 ± 22.14 g/day, representing only 52.66% of the RDA (20 g).

These findings suggest that while protein intake was significantly higher than recommended, both fiber and calcium intakes were significantly lower, pointing toward dietary imbalances.

Table 4.9: Nutrient intake by (4-6) year old autistic children (n=30)

	Intake	RDA	% of RDA	T	Two side p value
Calories (kcal/day)	1546.84 ± 735.03	1360	113.74%	1.345	0.189
Protein(gm/day)	45.33±23.62	16	285.10%	6.576	<0.001
Fat (gm/kg)	29.72 ± 21.69	25	119.09%	1.152	0.259
Calcium (mg/day)	182.92 ± 228.38	550	731.71%	-6.394	<0.001
Fiber(gm/day)	10.53 ± 22.14	20	52.66%	-2.222	0.035

Table 4.10 represents dietary intake for autistic children aged 7–9 years, the mean protein intake was 49.42 ± 21.40 g/day compared to the RDA of 23 g, providing 214.84% of requirements, and this difference was statistically significant ($t = 6.704$, $p < 0.001$). Fat intake was closely matching the RDA of 30 g (101.88%). Calorie intake was slightly below the RDA. Fiber intake was markedly insufficient at 5.24 ± 4.59 g/day, only 20.17% of the RDA (26 g), and the deficit was highly significant ($t = –23.22$, $p < 0.001$). Similarly, calcium intake was inadequate, with a mean of 261.28 ± 284.92 mg/day, meeting only 40.19% of the RDA (650 mg).

These results indicate that while protein intake was significantly higher than recommendations, both fiber and calcium intakes were severely deficient, reflecting poor dietary quality in this age group.

Table 4.10: Nutrient intake by (7-9) year old autistic children (n= 27)

	Intake	RDA	% of RDA	T	Two side p value
Calories (kcal/day)	1574.02±537.65	1700	92.59%	-1.001	0.325
Protein (gm/day)	49.42± 21.40	23	214.84%	6.704	<0.001
Fat(gm/day)	30.56± 16.87	30	101.88%	-0.03	0.976
Calcium (mg/day)	261.28 ± 284.92	650	40.19%	-7.009	<0.001
Fiber(gm/day)	5.24± 4.59	26	20.17%	-23.22	<0.001

Table 4.11 represents a dietary intake of male children aged 10–12 years, the mean protein intake was 48.53 ± 17.65 g/day, exceeding the RDA of 32 g (151.67%). Fat intake was 25.74 ± 14.32 g/day, below the RDA of 35 g (73.55%), with no significant difference ($p = 0.881$). Calorie intake averaged 1776.64 ± 635.18 kcal/day, representing 80.02% of the RDA. Fiber intake was insufficient covering only 31.30% of the RDA (33 g), and this deficit was statistically significant ($t = –7.506$, $p < 0.001$). Calcium intake was also extremely low fulfilling only 17.76% of the RDA. In the study, boys with autism aged 7–12 years were found to have significantly lower calcium and vitamin D intake compared to the recommended DRI values, suggesting a higher risk of deficiency likely due to selective eating patterns, food texture sensitivities, and restricted dietary variety (Hooker *et al.,* 2013)

These results indicate that while protein intake remained above the recommended levels, energy, fat, fiber, and particularly calcium intakes were below recommendations, suggesting persistent dietary imbalances in older autistic male children.

Table 4.11: Nutrient intake by (10-12) year old male child

	Intake	**RDA**	**% of RDA**	**T**	**Two side p value**
Calorie (kcal/day)	1776.64±635.18	2220	80.02%	-1.375	0.218
Protein (gm/day)	48.53±17.65	32	151.67%	2.086	0.082
Fat (gm/day)	25.74±14.32	35	73.55%	0.156	0.881
Calcium (mg/day)	150.96±94.54	850	17.76%	-16.714	<0.001
Fiber (gm/day)	10.34±7.55	33	31.30%	-7.506	<0.001

Among female participant aged 10–12 years, the average daily protein intake was 49.08 g/day, which accounted for 148.70% of the Recommended Dietary Allowance (RDA) of 33 g/day. Fat intake was 36.54 g/day, slightly exceeding the RDA of 35 g/day and contributing 104.40% of the recommended value. In contrast, the mean energy intake was 1,515.25 kcal/day, which was below the RDA of 2,060 kcal/day, covering only 73.60% of the requirement.

The intake of dietary fiber was considerably low, with an average of 1.22 g/day, meeting just 4.07% of the RDA (30 g/day). Similarly, calcium intake was also inadequate, averaging 269.40 mg/day only 31.70% of the RDA of 850 mg/day. These findings highlight insufficient intake of energy, fiber, and calcium, despite relatively adequate intake of protein and fat.

Among male participants aged 13–15 years, the average daily protein intake was 47.91 ± 9.65 g/day, which accounted for 106.47% of the Recommended Dietary Allowance (RDA). This difference was not statistically significant (p >0 .05), indicating that protein intake was adequate and closely aligned with recommended levels. The mean fat intake was 41.79 ± 19.94 g/day, which represented 92.86% of the RDA and also did not differ significantly from the recommended value (p >0 .05).

In contrast, the average energy intake was 1,949.37 ± 148.32 kcal/day, which fulfilled only 68.16% of the RDA (2,860 kcal/day). This deficit was statistically significant ($p < 0.05$), indicating insufficient caloric intake. Similarly, fiber intake was markedly low at 4.69 ± 3.07 g/day, covering only 10.90% of the RDA (43 g/day), and was found to be significantly below the recommended level (p <0 .05). Calcium intake was also inadequate, with a mean value of 209.49 ± 203.62 mg/day just 20.94% of the RDA (1,000 mg/day) and this difference was statistically significant as well (p <0 .05).

4.8 Mealtime behavior problem

The assessment of mealtime behaviors revealed that food refusal was present among some participants. More than half of the children never exhibited crying or screaming during mealtimes (60.8%), although a smaller proportion displayed such behavior occasionally (17.6%) or almost at every mealtime (5.4%). Similar patterns were observed in other refusal behaviors such as turning the face or body away (58.1% never, 17.6% occasionally, 8.1% almost always) and expelling food (55.4% never, 16.2% occasionally, 10.8% almost always). Disruptive behaviors and tightly closing the mouth were relatively rare, with the majority of children never engaging in these actions (74.3% and 75.7%, respectively).

With regard to autism-related features during meals, sitting behavior was inconsistent. While one-third of the children never remained seated throughout mealtime (33.8%), a similar proportion did so almost every time (31.1%). Aggressive and self-injurious behaviors were uncommon, with most children never exhibiting aggression (82.4%) or self-harm (68.9%) during meals. Flexibility toward mealtime routines was more evident, as the majority of participants were flexible almost every time (63.5%). However, food texture posed challenges for some, with nearly one-fourth refusing foods requiring extensive chewing at almost every meal (23.0%).

Food selectivity and limited variety were prominent. Almost half of the participants were often willing to try new foods (45.9%), while a substantial majority consistently disliked and refused certain foods (71.6%). Preference for sameness was also reported, with over one-third of children frequently preferring the same food (37.8%). Sensory-related choices were notable, as some children often preferred crunchy foods (25.7%) or sweet foods (25.7%). In contrast, a sizable proportion consistently accepted a variety of foods (32.4%). Nevertheless, rigid mealtime practices were observed, as some children frequently demanded that foods be prepared (12.2%) or served (13.5%) in a particular way.

Overall, these findings indicate that while disruptive mealtime behaviors such as aggression and self-injury were less common, rigid food preferences and selective eating behaviors were highly prevalent. Such selectivity is consistent with previous literature that highlights food refusal, texture sensitivity, and insistence on sameness as characteristic mealtime challenges among children with autism.

Table 4.12: Mealtime behaviors of the study population (n=74)

Mealtime behavior	**Never (%)**	**Rarely (%)**	**Seldom (%)**	**Occasionally (%)**	**0ften at almost every meal time (%)**
Food refusal					
crying screaming	60.8	9.5	6.8	17.6	5.4
Tuning face, body	58.1	6.8	9.5	17.6	8.1
Expel out food	55.4	10.8	6.6	16.2	10.8
Showing disruptive behavior	74.3	4.05	1.4	17.6	2.7

closing mouth tightly	75.7	4.05		17.6	2.7
Features of autism					
remain seated	33.8	6.8	9.5	18.9	31.08
Shows aggressive behavior	82.4	4.05	2.7	9.5	1.4
Shows self- injurious behavior	68.9	8.1	2.7	17.6	1.4
Flexible about mealtime	25.7	1.4	4.05	5.4	63.5
Refuges food that requires a lot of chewing	54.05	5.4	6.8	10.8	23
Limited variety					
willing to try new foods	25.7	10.8	4.05	13.5	45.9
Dislike certain food and won't eat them	10.8	4.05	4.05	9.5	71.6
prefers same food	52.7	4.05	4.05	1.4	37.8
prefers crunchy foods	27.02	5.4	9.5	32.4	25.7
Accepts or prefers variety of foods	45.9	5.4	4.05	12.2	32.4
prefers a food served in particular way	78.4	1.4		6.8	13.5
prefers only sweet foods	33.8	6.8	9.5	24.3	25.7
prefers food prepared in a particular way	75.7	4.05		6.8	12.2

These findings align with previous studies showing that children with autism often exhibit selective eating, food refusal, and strong preferences for specific textures or preparation styles (Cermak *et al.,* 2010). Such behaviors may contribute to nutritional imbalances, including inadequate intake of fiber, calcium, and variety in the diet. In the survey of 37 children, 21% exhibited no aggressive behavior, while 16.2%, 8.1%, 8.1%, and 10.8% displayed aggression seldom, occasionally, often, and almost at every meal, respectively (Koirala, 2019). The study, conducted by researchers from various institutions in China, aimed to validate the Chinese version of the Brief Autism Mealtime Behavior Inventory (BAMBI) and examine dietary patterns among young Chinese children with ASD. Using data from 103 children with ASD and 331 typically developing counterparts, the study confirmed BAMBI as a reliable and valid assessment tool. Results showed that children with ASD displayed significantly more problematic mealtime behaviors, particularly rigidity in routines and reluctance to try new foods (Zhang *et al.,* 2025).

4.10 Factors affecting malnutrition

Malnutrition was evaluated using indicators of underweight, stunting, and thinness/obesity. The factors associated with each of these conditions were analyzed separately through the univariate logistic regression, chi-square test, Fisher's Exact Test and Kruskal–Wallis, as presented below.

4.10.1 Factors affecting underweight

A total of 74 children were included in the underweight analysis. Results from the univariate logistic regression indicated that child age was significantly associated with underweight (OR = 0.79, 95% CI [0.63, 0.96], p = 0.024), suggesting that younger children were more likely to be underweight.

None of the factors were associated with the underweight except child age with p value 0.024 suggesting that younger children were more likely to be underweight.

4.10.2 Factors affecting stunting

There was no significant association between child feeding behaviors, socio-demographic characteristics, and stunting. The analysis did not reveal any independent predictors of stunting within the present dataset. The limited number of stunted cases and relatively small sample size may have constrained the statistical power to identify significant associations.

4.10.3 Factors affecting thinness/obesity

The significant associations were found for continuous variables, namely age (Kruskal Wallis, $p = 0.03774$), weight-for-age z-score (WAZ; ANOVA, $p = 2.26E-08$). Fisher's Exact Test indicated no significant associations with categorical factors such as processed food intake, and food refusal behaviors like disliking certain foods.

In the present study age and weight-for-age z-score are the only variables that showed statistically significant associations with thinness/obesity, suggesting that growth and age-related processes rather than isolated mealtime behaviors primarily distinguish weight status in this sample. At the same time, classic studies of feeding behavior in ASD have repeatedly shown higher rates of food selectivity and restricted food repertoires that place children at risk for nutrient inadequacies, even when BMI is normal a finding that helps explain why feeding behaviors may affect micronutrient status without always producing clear bivariate associations with weight categories (Bandini *et al.,* 2010).These data imply that routine anthropometric monitoring (WAZ/BAZ) and age-sensitive screening should be prioritized in clinical follow-up, while feeding-behavior assessments remain important for identifying micronutrient risk and guiding individualized dietary interventions.

Table 4.13: Factors associated with thinness/obesity among autistic children

Variables	Thinness	Obesity	Normal	P value
Age				0.03774
2-6	2.7%	6.8%	39.2%	
7-9	6.8%	2.7%	27.02%	
10-12	4.05%	4.05%	4.05%	
13-15			4.05%	
WAZ				2.26E-08
Normal	9.4%	12.5%	64.7%	
Underweight	2.7%			
Processed foods				0.403182
Never	2.8%	4.05%		
Frequent		1.4%	1.4%	
Rare	9.5%	6.8%	51.4%	
Regular	1.4%	1.4%	2.8%	
Dislike certain food and won't eat them				0.67165
Never		2.8%	8.1%	
Rarely		1.4%	2.8%	
Seldom	1.4%		2.8%	
Occasionally	1.4%	1.4%	6.8%	
Almost at every meal	10.8%	8.1%	52.7%	

Part V

Conclusions and recommendations

5.1 Conclusions

This study assessed the nutritional status of autistic children and adolescents aged 2 to 15 years. The findings indicate that malnutrition remains a concern in this population, with multiple factors working together to contribute to the problem.

The following points were concluded from the study:

1. The study concludes that children with autism experience a dual burden of malnutrition, with overweight (9.5%), followed by moderate thinness (8.1%), severe thinness (5.4%), obesity (4.05%), moderate underweight (3.1%), and moderate stunting (2.7%).

2. The dietary patterns of children in the study population were characterized by high consumption of rice (98.6%) and lentils (87.8%), moderate intake of vegetables (50–68.9%) and fruits (53.4%), limited dairy intake (milk 17.6%, curd 24.3%, ghee 56.8%), and low consumption of animal protein sources, including chicken, fish, red meat, and eggs. Processed and fast foods were rarely consumed, indicating a diet largely based on staple cereals and legumes with minimal animal protein and occasional high-fat items.
3. In autistic children aged 2–3 years, calorie and protein intake exceeded the recommended daily allowance (107.4% and 265.8%, respectively), and fat intake was slightly above RDA (116.8%), whereas calcium and fiber intakes were insufficient (67.3% each), highlighting adequate energy and protein consumption but poor micronutrient and fiber intake.
4. Mealtime behaviors in children with autism were generally flexible and non-disruptive, but food selectivity, limited variety, and sensory-based preferences were common, with some children showing rigid demands for food preparation or serving.
5. Childs age and WAZ were found to be significantly associated with thinness/obesity. Also child age found significantly associated with underweight.

5.2 Recommendations

Future research on the nutritional status and associated factors in children with autism should employ larger sample sizes and include broader geographic areas to enhance the generalizability of the findings. Based on the results of the current study, specific recommendations can be made to improve the nutritional status of children with autism in the surveyed region.

1. Nutrition education and intervention programs should be developed for caregivers of children with autism to improve dietary diversity and overall nutrient intake.
2. Caregivers, teachers, and community programs should be supported with training and resources to manage mealtime behaviors and promote healthier eating habits among children with autism.
3. Female Community Health Volunteer (FCHV) should be mobilized to visit every child's home. These volunteers need to be well-trained with the necessary skills so that they can effectively raise awareness among people.

Part VI

Summary

This study aimed to evaluate the nutritional status, mealtime behaviors, and gastrointestinal disorders among children with autism aged 2 to 15 years attending various Autism Centers and schools in Birtamode, Jhapa.

The study included 74 children and adolescents selected through a census sampling technique. A cross-sectional descriptive survey was conducted, which involved measuring weight and height and collecting 24-hour dietary recalls to assess nutritional status. Additionally, a structured questionnaire was administered to parents to gather information on socio-demographic characteristics, mealtime behaviors, and gastrointestinal disorders. The prevalence of malnutrition among the children was analyzed based on gender, age, and WHO reference standards, along with an assessment of mealtime behaviors and the occurrence of gastrointestinal disorders. Collected data were analyzed using WHO Artho WHO Anthro-Plus and SPSS software, and a Chi-square test, Fisher's exact test, univariate logistic regression, ANOVA, and the Kruskal Wallis was applied to examine the nutrient adequacy of the children to identify factors associated with nutritional status.

Of the 74 children included in the study, 58 were boys and 16 were girls. The study population exhibited a dual burden of malnutrition, with both undernutrition and overnutrition present. Overweight was the most common condition 9.5%, followed by moderate thinness 8.1%, severe thinness 5.4%, and obesity 4.05%, while moderate underweight 3.1% and moderate stunting were less common 2.7%. These results highlight the coexistence of nutritional deficiencies and excesses among children with autism in the sample. Cases of moderate stunting and underweight were primarily seen in the 4–12-year age range, with 3.3% of children aged 4–6 years moderately stunted, 7.4% of those aged 7–9 years underweight, and 11.1% of children aged 10–12 years moderately stunted. These findings suggest that undernutrition was more prevalent in mid-childhood to early adolescence among the participants. The nutritional status of children in the study population revealed a dual burden of malnutrition, assessed using BMI-for-age z-scores (BAZ). No cases of malnutrition or overweight were observed in the youngest (2–3 years) and oldest (13–15years) age groups. Additionally, children aged 4–12 years exhibited both

undernutrition, including severe and moderate thinness, and overnutrition, including overweight and obesity, with prevalence varying across age groups.

The dietary patterns of children with autism in the study population were largely based on staple cereals and legumes, with high consumption of rice (98.6%) and lentils (87.8%), moderate intake of vegetables 50–68.9% and fruits 53.4%, limited dairy (milk 17.6%, curd 24.3%, ghee 56.8%), and low intake of animal protein, while processed and fast foods were rarely consumed. It was found that children with ASD generally met or exceeded recommended daily allowances for protein and fat, but intake of calories, calcium, and fiber was frequently inadequate, particularly among older children and adolescents. Younger children (2–3 years) consumed sufficient calories and protein but insufficient calcium and fiber, whereas adolescents (10–15 years) had adequate protein and near-recommended fat intake but markedly low energy, calcium, and fiber consumption. Mealtime behaviors were generally flexible but often characterized by food selectivity, limited variety, and sensory-based preferences. No consistent socio-demographic, dietary, or feeding behavior predictors of underweight or stunting were identified, indicating multifactorial influences and the need for larger studies. In this study, a significant association was observed between the child's age and weight-for-age z-score (WAZ) with thinness and obesity, indicating that age plays a crucial role in influencing nutritional status among children. Furthermore, the child's age was also significantly associated with underweight suggesting that the prevalence of wasting across age groups.

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Appendices A

INFORMED CONSENT

Namaste!

I am Swechchha Golay graduate student in Department of Nutrition and Dietetics conducting a dissertation work for award of Bachelor's degree in Nutrition and Dietetics.

I understand that any information provided by me or my child during this interview will be kept confidential and will not be disclosed to anyone outside the survey team. My name and identity will not appear in any report or publication.

I hereby give my voluntary consent to participate in this study. I understand that I can withdraw my consent at any time without giving any reason. My participation in this study is entirely voluntary.

Participant / Parent / Guardian Name:

Signature:

Date:

Place:

I hereby state the study procedures were explained in the detail and all questions were fully and clearly answered to the above-mentioned participant /his/her relative.

Investigator's sign:

Appendix: B

Questionnaire

Survey title:

Date of visit: ………………………….. Code no: ………………

Name of the child: …………………… Age: …………………….

Date of birth: ………………………….

SECTION A: Socio-demographic information

1. Informant	Mother/ Father/ Others specify
2. Head of the household	Mother/ Father/ Others specify
3. Family size: Total number of family members	
4. Family type:	Nuclear/ joint
5. Ethnicity:	Khas-arya Janajati/ others specify
6. Major source of income	Business/Employment Remittance/ Agriculture/ Labor/ Other Specify:…
7. Father's education	Secondary (6-10)/ Higher secondary University None
8. Mother's education	Secondary (6-10)/ Higher secondary University None
9. Father's occupation	Business/Employment Agriculture/ Labor/ Remittance/ Other Specify………………
10. . Mother's occupation	Business/Employment Agriculture/ Labor/ Remittance/ Other Specify: …
11. . Annual income of the family	above 30,000 below 30,000

SECTION B: Child description and anthropometric measurements

1. a. What is the present childbirth order? b. if not first, what is the difference between an existing child and an earlier child	1/ 2/ 3/ 4/ 1yr/ 2yr/ 3yr/ 4yr/ >4yr
2. Birth weight of the child:	
3. Anthropometric measurements Height (cm) ………. Weight (kg) ……. MUAC (cm)…….. BMI………	

SECTION C: Child caring practices

1. Did you breastfeed your child after birth? If yes, when did you initiate breastfeeding after birth?	Yes / No/ Within 1 hr./ Within 8 hr./ Within 24 hr./ After 24 hr.
2. When did you stop breastfeeding? At what age?	
3. Did you exclusively breastfeed or are you breastfeeding your child for the first six months? If no what is the reason you can share:	Yes/ No/ not sufficient milk production/ medical complication/ If other …………………………….
4. How many times did you breastfeed your child in a day?	< 8 times/ 8-10 times/ 11-12times or more
5. Did you continue or are you still breastfeeding your child? (if the child is >6 months) If no, when did you stop breastfeeding your child?	Yes No ………………. Yrs
6. Do you know how long children are recommended to be continuously breastfed?	…………………………… months
7. Did you feed colostrum milk (first yellow milk) to your child?	yes / No/
8. . Did you introduce any kind of pre-lacteal feeds to	Yes / No / Animal milk/ honey/

your child? If yes, what type was given?	
9. Did you ever bottle-feed your child? If yes, can you share the reason for the bottle feeding?	Yes / No/
10. Do you know the preparation of litto? If yes, how?	Yes/ No/

Section C: Health and immunization

1. Have you gotten your child vaccinated according to schedule? If no, why did you miss it?	Yes/ No/ Thought it was not necessary/ There was a shortage of vaccines in the centre/ Child cried a lot/had a fever after getting the previous one/
2. Did your child have vitamin A and deworming tablets?	Yes / No/
3. Were you vaccinated during pregnancy? If yes, which one?	Yes / No/
4. How do you recognize that your child is ill?	Lazy / Increase in body temperature/ Irritability/
5. Where do you take your child when he/she is ill?	Health centre/ Pharmacy Jhakri None

Section D: Maternal Characteristics

1. At what age did you get married?	
2. At what age did you get first pregnant?	
3. Did you have iron/folate tablets during pregnancy? If yes, when did you start to take them?	Yes/ No/ 1st trimester/ 2nd trimester/ 3rd trimester
4. From where did you receive the iron/folate tablets?	Health post/ hospital/ Yourself/
5. Do you know what malnutrition is? If yes, how does it happen?	Yes / No/ Less food intake/ curse of god/ due to witch / other/

	don't know
6. What amount of food did you eat during pregnancy?	More than usual/ less than usual/ as usual
7. How many times per day did you eat?	< 3time / 3-4 times/ > 4 times
8. What salt is used in your home?	Iodized salt/ Normal salt/ Dhikke

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Section E: BAMBI questionnaire

Think about mealtimes with your child over the past 3 months. Rate the following items according to how often each occurs, using the following scale: Never/Rarely/ Seldom/ occasionally/ Often at Almost Every Meal 1 2 3 4 5 Circle YES if you think an item is a problem for you or NO if you think it is not a problem.

1. My child cries or screams during mealtimes.	1 2 3 4 5 YES/NO
2. My child turns his/her face or body away from food.	1 2 3 4 5 YES/NO
3. My child remains seated at the table until the meal is finished.	1 2 3 4 5 YES/ NO
4. My child expels (spits out) food that he/she has eaten.	1 2 3 4 5 YES/NO
5.My child is aggressive during mealtimes (hitting, kicking, scratching others)	1 2 3 4 5 YES/NO
6. My child displays self-injurious behaviour during mealtimes (hitting self, biting self).	1 2 3 4 5 YES/NO
7. My child is disruptive during mealtimes (pushing/throwing utensils, food).	1 2 3 4 5 YES/NO
8. My child closes his/her mouth tightly when food is presented.	1 2 3 4 5 YES/NO
9. My child is flexible about mealtime routines (e.g., times for meals, seating arrangements, place settings).	1 2 3 4 5 YES/NO
10. My child is willing to try new foods.	1 2 3 4 5 YES/NO
11. My child dislikes certain foods and won't eat them.	1 2 3 4 5 YES/NO
12. My child refuses to eat foods that require a lot of chewing (e.g., eats only soft or pureed foods).	1 2 3 4 5 YES/NO
13. My child prefers the same foods at each meal.	1 2 3 4 5 YES/NO
14. My child prefers "crunchy" foods (e.g., snacks, crackers).	1 2 3 4 5 YES/NO
15. My child accepts or prefers a variety of foods.	1 2 3 4 5 YES/NO
16. My child prefers to have food served in a particular way.	1 2 3 4 5 YES/NO

17. My child prefers only sweet foods (e.g., candy, sugary cereals).	1 2 3 4 5 YES/NO
18. My child prefers food prepared in a particular way (e.g., eats mostly fried foods, cold cereals, and raw vegetables).	1 2 3 4 5 YES/NO

Section E: Dietary intake

a. Food frequency table:

Type of food	**Frequent (at least once a day)**	**Regular (3\4 times a week)**	**Rare (once in a week or less)**	**Never**
1. Cereals				
Rice\brown rice				
Wheat				
Maize/millet/barley				
2. Pulses/Legumes				
Whole dal				
Grams/beans/peas				
3. GLV				
4. Other vegetables				
5. Roots and tubers				
6. Fruits				
7. Dairy Products				
Milk				
Curd				
Ghee/Butter				
Paneer/cheese				

8. Meat				
White meat (chicken/fish)				
Red meat (mutton/beef/pork)				
Egg				
8. Processed, packaged foods/fast food				

c. **24-hour dietary recall**

Timing	**Time**	**Description of food**	**Brand (if possible)**	**Quantity/Serving size**
Breakfast				
Lunch				
Snacks				
Dinner				

Photos

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