Mothers' Perceptions of their Autistic Children's Dietary Habits in Hail, Saudi Arabia: A Cross-Sectional Study

Albandari Bin Ammar[1,*], Abd Elmoneim Elkhalifa[1], Nagat Eltoum[1], Momen Elshazley[2], Leo Rathinaraj Antony Soundararajan[3], Majid Alkhalaf[4] and Sara Seifeldin[1]

[1]*Department of Clinical Nutrition, College of Applied Medical Sciences, University of Ha'il, Hail, Saudi Arabia*

[2]*Pulmonology Unit, Department of Internal Medicine, King Salman Specialist Hospital, Hail Health Cluster, Hail, Saudi Arabia*

[3]*Physiotherapy School of Health and Social Care Profession, Buckinghamshire New University, UK*

[4]*Public Health Authority, Health Improvement and Promotion Sector, Riyadh, Saudi Arabia*

Abstract: *Background:* Children with autism spectrum disorder (ASD) often experience feeding difficulties that may affect their nutritional status and health outcomes, with mothers playing a central role in shaping dietary practices. The Health Belief Model (HBM) is a framework explaining health behaviors based on perceived susceptibility, severity, barriers, benefits, and self-efficacy.

Objective: This study aimed to assess mothers' perspectives on healthy eating practices among autistic children aged 4–12 years.

Methods: This cross-sectional study was conducted between March and April 2022 in Hail, Saudi Arabia, using face-to-face questionnaires to assess maternal nutrition-related perceptions and information sources, along with children's anthropometric data, among 80 mothers of children with ASD. A total of 100 mothers were approached, of whom 80 met the eligibility criteria and agreed to participate, yielding a response rate of 80%.

Results: The majority of mothers reported great concern for their children's future health, and strong interest in obtaining nutrition information, while cost- and time-related challenges were not commonly reported barriers. Overall perception scores did not differ by the child's gender or body mass index. Perceived severity differed by the mother's source of nutrition information, while overall perceived barriers scores varied by household income and the mother's education.

Conclusions: Mothers of children with ASD reported varied nutrition-related perceptions, characterized by significant concern for their children's future health alongside limited professional guidance. The findings highlight the importance of delivering structured, accessible, evidence-based nutrition education and improving access to professional dietary support within autism centers.

Keywords: Autism spectrum disorder (ASD), perceptions, children, mothers, Saudi Arabia, dietary habits.

1. INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by impairments in social communication and repetitive and restricted behaviors. The Autism and Developmental Disabilities Monitoring (ADDM) Network has reported biennial estimates of ASD prevalence for children aged 8 years old since 2000. The prevalence increased from 1 in 150 children in 2000 [1] to 1 in 36 children in 2020 [2]. Furthermore, the male-to-female ratio is approximately 3:1 [3, 4].

The Saudi General Authority for Statistics indicates that ASD affects 49,016 children in Saudi Arabia, corresponding to an estimated prevalence of 1 per 160 children in the population [5]. In addition to its behavioral features, ASD is frequently associated with medical comorbidities, including gastrointestinal disorders, epilepsy, sleep disturbances, and immune-related dysfunctions. Children with ASD often experience feeding challenges such as selective eating and sensory sensitivities, along with gastrointestinal symptoms including constipation, diarrhea, abdominal pain, and reflux, which may negatively influence dietary intake and nutritional status [6]. Adequate nutrition is fundamental for normal growth, development, and overall health. However, the sensory-related feeding difficulties and selective eating behaviors frequently observed in children with ASD are often characterized by a preference for familiar, energy-dense foods and limited consumption of fruits and vegetables, which can restrict dietary variety, increase the risk of nutritional deficiencies, and contribute to gastrointestinal disturbances, with potential adverse effects on long-term health outcomes [7]. Consistent with these concerns, Kamal *et al*. reported a high prevalence of overweight (21.9%) and obesity (11.3%) among children with ASD, with 91.4% of the overall ASD

*Address correspondence to this author at the Department of Clinical Nutrition, College of Applied Medical Sciences, University of Ha'il, Hail, Saudi Arabia; Tel: +966 50 487 6100; E-mail: Ab.benammar@uoh.edu.sa

sample exhibiting food selectivity-related eating behavior problems [8, 9].

Mothers and caregivers play a central role in managing children with ASD's dietary practices, applying nutritional education, meal planning, and behavior-based feeding strategies learned from healthcare professionals. Their perceptions, knowledge, and awareness directly influence food selection, meal preparation, the consistency of dietary interventions, and the use of professional guidance, thereby affecting children's nutritional status, gastrointestinal health, and overall well-being [7]. Several studies have shown that parental perceptions and knowledge regarding nutrition positively influence children's dietary behaviors and overall dietary intake, regardless of whether the child has ASD or is typically developing. Children whose parents have higher levels of nutritional knowledge tend to have nutrient intakes closer to recommended levels [10]. Blaine *et al*. noted that parents of children with ASD frequently rely on informal or non-specialist sources for nutrition information and have limited access to referrals or guidance from dietitians or other nutrition professionals, raising concerns about the credibility and adequacy of the advice they receive [11]. Given the central role of caregivers in shaping children's dietary practices, theoretical models that explain health-related decision-making are useful for understanding parental behaviors. The Health Belief Model (HBM), originally developed in the 1950s, is a widely used framework for explaining health- and nutrition-related behaviors based on individuals' perceptions of health risks and the expected outcomes of preventive actions. The model comprises key constructs including perceived susceptibility (beliefs about the likelihood of developing a health condition), severity (beliefs about the seriousness of its consequences), barriers (perceived obstacles to taking action), and benefits and self-efficacy (beliefs regarding the effectiveness of actions and confidence in one's ability to perform them). HBM has been widely used in studies of parental and caregiver behaviors to understand decision-making regarding children's nutrition, disease prevention, and other health-promoting practices [10, 12].

Despite the relevance of the HBM in explaining nutrition-related and preventive health behaviors, limited research has examined how maternal perceptions influence the dietary practices of children with ASD, particularly in Saudi Arabia. Furthermore, there is a lack of region-specific data providing insight into the factors influencing parental understanding of ASD and nutrition-related practices among affected children. Although studies have reported that individuals in Saudi Arabia demonstrate moderate knowledge regarding the needs of children with autism [13], few have applied a structured theoretical framework such as the HBM to assess caregivers' perceptions of susceptibility, severity, barriers, and benefits in this context. This study addresses this gap by applying HBM to systematically examine mothers' perceptions and their association with sociodemographic factors, thereby providing context-specific insight into nutrition-related decision-making among caregivers of children with ASD. Accordingly, this study explored mothers' perceptions of healthy dietary practices for their autistic children aged 4–12 years.

2. MATERIALS AND METHODS

2.1. Study Design and Eligibility Criteria

A descriptive, cross-sectional observational study was conducted between March and April 2022, targeting the mothers of children with ASD in Hail, Saudi Arabia, analyzing their impressions of their children's nutritional condition. To ensure relevance to the goals of the study, participants were eligible to participate if they were mothers of Saudi children aged 4–12 years who had been diagnosed with ASD for at least 6 months. One hundred mothers were contacted to participate in the study; only 80 met the eligibility criteria and consented. The participants' ASD diagnoses were primarily confirmed by the research team through screening of medical records provided by centers specializing in the care of children with autism. In addition, some children were referred by their schools with physician reports confirming their ASD diagnosis.

We excluded mothers of children with other types of syndrome such as Rett syndrome, Williams syndrome , Prader-Willi syndrome ,or other inherited conditions such as inborn coronary disease or recurrent seizures as well as mothers of children with ASD who had severe or ongoing full-body discomfort in the last 90 days, food or medication allergies, or had used nutritional supplements or prescription medication for behavioral problems in the past six months.

2.2. Sampling Method and Recruitment Process

Mothers of children with ASD (N = 80) were included in the study, with each mother representing one child with ASD; the study focused on assessing their perceptions of their children's nutritional status. The sample size was determined using the following formula:

$$n = Z2 \times p\ (1 - p)/E2$$

where "n" represents the required sample size; "Z" corresponds to a 95% confidence level with a standard value equal to 1.96; "p" denotes the estimated prevalence of ASD in Saudi Arabia; and "E" represents the margin of error (5%). However, it was estimated to be 1.8 per 1,0007,22 by studies that were mainly descriptive or single-hospital-based [14].

Participants were recruited using convenience sampling. Mothers who met the eligibility criteria were recruited from two centers-Tawasol Autism Medical Center and the Charitable Society for the Care of the Disabled Hail-Hdka Medical Center for Autism-and enrolled in the study based on their willingness to participate.

2.3. Data Collection

We used a pre-tested questionnaire to collect data through face-to-face interviews with the participating mothers at the autism centers in a quiet setting in the absence of the children. Children's anthropometric measurements were conducted and assessed in a separate room.

The instrument comprised two sections. The first section collected demographic and clinical information, including children's age, sex, weight, height, and gastrointestinal symptoms. Information on gastrointestinal symptoms (e.g., abdominal bloating, constipation, and diarrhea) was obtained by reviewing the children's medical records at the participating autism centers, where clinical information is regularly updated during follow-up visits. This data was further confirmed through maternal reports during the interview. Maternal characteristics such as marital status, education level, employment status, household income, and sources of nutrition-related information. The second section assessed mothers' beliefs and perceptions regarding their children's health conditions using the previously validated Nutrition and Health Awareness Questionnaire, which demonstrated reliability and internal consistency [10, 15]. The questionnaire was reviewed by experts in nutrition and behavioral health to ensure clarity and appropriateness of content. This tool evaluated key constructs of the HBM relevant to this study and comprised four sections, with each section measuring a different domain: perceived susceptibility (8 items), perceived severity (5 items), perceived barriers (6 items), and perceived benefits and self-efficacy (8 items). All items were rated on a five-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Some items were negatively worded; however, scoring was performed according to the original validated questionnaire. Scores on the scale ranged from 27 to 135, with higher scores indicating stronger perceptions across the HBM domains. For example, higher perceived susceptibility reflects greater awareness of the child's condition; higher perceived severity indicates greater awareness of healthy eating and overall well-being; higher perceived benefits reflect better financial resources, time availability, and management of co-occurring symptoms; and higher self-efficacy represents greater family and social support, guidance, governmental aid, and awareness of healthy eating.

2.4. Anthropometric Measurements

Anthropometric measurements were obtained for all participating children. Height was measured in an upright position without shoes using a stadiometer, and body weight was measured to the nearest 0.1 kg using a calibrated scale, with participants wearing light indoor clothing and barefoot or in stockings. All weight and height measurements were taken twice, and the average values were used. The body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters). These anthropometric measurements were interpreted using the Growth Charts for Saudi Children and Adolescents [16] based on sex- and age-specific percentiles.

2.5. Data Management and Statistical Analysis

The data were analyzed using SPSS version 25.0. For the univariate analysis, the mean ± SD (standard deviation) was used for continuous variables, and the frequency (N) and percentage (%) were used for categorical variables. For the bivariate analysis, independent-sample t-tests, chi-squared tests, and one-way ANOVA were used to compare groups. A p-value of < 0.05 was considered statistically significant. When ANOVA results were significant, post hoc tests were used to determine differences.

2.6. Ethical Considerations

The study protocol was reviewed and approved by the Ethical Committee at the University of Ha'il (H-2022-054) and was conducted in compliance with the

ethical principles set forth in the Declaration of Helsinki. Prior to participation, informed consent was obtained from all participants, and they were informed that their involvement was voluntary and that they could withdraw at any time.

3. RESULTS

3.1. Children's Characteristics

The demographic characteristics of the participating children with ASD, their anthropometric measurements, and their gastrointestinal symptoms are presented in Table **1**. The mean age of the children was 8.5 ± 2.38 years, and most were male (n = 54, 67.5%). The mean weight of the children was 26.0 ± 7.8 kg, with males having a significantly higher mean weight (27.5 ± 8.0 kg) than females (22.9 ± 6.2 kg, p = 0.013). Similarly, the mean height was 121.83 ± 12.69 cm, with males being significantly taller (124.76 ± 12.03 cm) than females (115.73 ± 12.03 cm, p = 0.002). Almost two-thirds (n = 54, 67.5%) of the children had a normal BMI (≥5th to <85th percentiles), while 23 (28.8%) were overweight (BMI ≥85th to <95th percentiles) or obese (BMI ≥95th percentile); a minority (3.8%) were underweight (BMI <5th percentile). In addition, 52 (65%) children with ASD experienced abdominal bloating, 43 (53.8%) experienced constipation, and 19 (23.8%) experienced diarrhea, with some children presenting with more than one gastrointestinal symptom.

3.2. Mothers' Demographic Characteristics

Sociodemographic characteristics of the mothers of children with ASD are presented in Table **2**. More than half (n = 45, 56.3%) of the mothers were married, while 26 (32.5%) were divorced and 9 (11.3%) were widowed. In addition, 24 (30%) reached high school, 6 (7.5%) were enrolled in primary education, and 12 (15%) in secondary education. A majority (n = 53, 66.3%) were unemployed; only 26 (32.5%) were employed. Most mothers (n = 43, 53.8%) reported a household income of SR 10,000–15,000, followed by 26 (32.5%) with an income of ≤ SR 10,000, while fewer had incomes of SR 15,000–20,000 (n = 9, 11.3%) or > SR 20,000 (n = 2, 2.5%). Family and friends were the most frequently reported sources of nutritional information (n = 48, 60%), followed by media (n = 18, 22.5%).

3.3. Health Belief Model Perceptions of Mothers Regarding their Children's Dietary Habits

3.3.1. Mothers' Perceptions of their Autistic Children's Susceptibility to Health Conditions

The mothers' perceptions of their children's susceptibility to health conditions, reflecting their awareness and knowledge, are presented in Table **3**. More than one-third (n = 30) agreed or strongly agreed that their child may develop serious health conditions in adulthood, while a similar proportion reported neutral responses (n = 25). Almost half of the mothers (n = 37) strongly agreed or agreed that their child may not be able to live independently due to their health condition.

Table 1: Health Characteristics of Participating Children with Autism, Overall, and by Gender

Variables		Overall (n = 80)		Male (n = 54)		Female (n = 26)		P-Value
		Mean	±SD	Mean	±SD	Mean	±SD	
Weight of the Child (kg)		26.0	7.8	27.5	8.0	22.9	6.2	0.013*
Height of the Child (cm)		121.83	12.69	124.76	12.03	115.73	12.03	0.002*
		n	%	n	%	n	%	
BMI	Underweight	3	3.8%	2	3.7%	1	3.8%	0.968
	Normal	54	67.5%	37	68.5%	17	65.4%	
	Overweight	16	20.0%	10	18.5%	6	23.1%	
	Obese	7	8.8%	5	9.3%	2	7.7%	
Digestive Problems								
Constipation	No	37	46.3%	25	46.3%	12	46.2%	0.990
	Yes	43	53.8%	29	53.7%	14	53.8%	
Diarrhea	No	61	76.3%	43	79.6%	18	69.2%	0.306
	Yes	19	23.8%	11	20.4%	8	30.8%	
Abdominal Bloating	No	28	35.0%	18	33.3%	10	38.5%	0.652
	Yes	52	65.0%	36	66.7%	16	61.5%	

* p-value < 0.05 is significant.

Table 2: Sociodemographic and Related Characteristics of Mothers of Children with Autism

Variables		n	%
Marital status	Married	45	56.3%
	Divorced	26	32.5%
	Widowed	9	11.3%
Level of education	Primary	6	7.5%
	Secondary	12	15.0%
	High school	24	30.0%
	Bachelor's	32	40.0%
	PhD	6	7.5%
Employment status	Employed	26	32.5%
	Unemployed	53	66.3%
	Retired	1	1.3%
Household income (SR)	Less than or equal to SR 10,000	26	32.5%
	SR 10,000-15,000	43	53.8%
	SR 15,000-20,000	9	11.3%
	More than SR 20,000	2	2.5%
Source of nutrition-related information	Family and friends	48	60.0%
	Physicians	4	5.0%
	Media	18	22.5%
	Books and journals	3	3.8%
	Dietitians	7	8.8%

Table 3: Mothers' Perceptions of their Children's Susceptibility to Health Conditions

Perceived Susceptibility	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Average Score
	n	%	n	%	n	%	n	%	n	%	
1. My child will probably develop serious health conditions as an adult	13	16.3%	12	15.0%	25	31.3%	26	32.5%	4	5.0%	2.95
2. My child probably cannot live an individual life with his health condition	11	13.8%	7	8.8%	25	31.3%	31	38.8%	6	7.5%	3.18
3. There is very little chance for my child to develop any complications as an adult	1	1.3%	7	8.8%	51	63.8%	15	18.8%	6	7.5%	3.23
4. My child will not develop any health complications as an adult	2	2.5%	9	11.3%	55	68.8%	11	13.8%	3	3.8%	3.05
5. I am worried about my child's future health conditions	4	5.0%	4	5.0%	6	7.5%	28	35.0%	38	47.5%	4.15
6. I am confident about my nutrition knowledge	23	28.8%	25	31.3%	17	21.3%	7	8.8%	8	10.0%	2.04
7. I would like to obtain more nutrition information	4	5.0%	0	0.0%	7	8.8%	33	41.3%	36	45.0%	4.21
8. I have seen a registered dietitian for my child	18	22.5%	28	35.0%	7	8.8%	16	20.0%	11	13.8%	2.68

Concerns were high regarding the children's future health, with most mothers expressing worry (n = 66; mean score = 4.15) and a strong desire to obtain additional nutrition-related information (n = 69; mean score = 4.21). This may be attributed to the low proportion of participants who reported confidence in their nutrition knowledge (n = 15; mean score = 2.04). Only 27 (33.8%) reported having consulted a registered dietitian for their child (mean score = 2.68). Consistent with these item-level findings, the cumulative HBM domain analysis revealed that perceived susceptibility had the highest average score among all domains (mean = 3.23 ± 0.45). This suggests that, overall, the mothers demonstrated moderate to high awareness of potential future health risks, despite limited confidence in their nutritional knowledge and limited access to professional consultation.

3.3.2. Mothers' Perceptions of the Severity of their Autistic Children's Health Conditions

The mothers' perceptions of the severity of their children's health conditions are presented in Table **4**. These perceptions may reflect their level of awareness regarding healthy eating and overall well-being. Less than half of the mothers (n = 36) agreed that their child was well-nourished, while 10 (12.5%) reported neutral responses and 34 (42.6%) disagreed or strongly disagreed. Concerns regarding micronutrient adequacy were common; more than half of the mothers agreed or strongly agreed that their child was not receiving adequate vitamins or minerals (n = 42; mean score = 3.40). Additionally, 28 (35%) believed that their child was receiving enough to eat.

Perceptions of body weight varied: 48 of the 80 mothers (60.1%) believed that their child was underweight (mean score = 3.61), and more than half disagreed that their child was overweight (n = 69; mean score = 1.60). Consistent with these mixed perceptions, the overall perceived severity domain showed a moderate mean score (2.86 ± 0.48), indicating moderate concern about the health consequences of dietary practices.

3.3.3. Mothers' Perceptions of Barriers to Managing their Autistic Children's Health

Mothers' perceptions of barriers to managing their children's health conditions, encompassing financial constraints, time limitations, and cooking-related challenges, are presented in Table **5**. Overall, most mothers disagreed that financial constraints (n = 48), transportation difficulties (n = 48), or lack of cooking skills (n = 53) represented major barriers, as reflected by low mean scores across these items (ranging from 2.20 to 2.36). A minority (n = 13) agreed that long working hours limited their ability to cook during the week. Similarly, a few mothers considered their child's condition a barrier to engaging in physical activities (n = 13). These findings are reflected in the low overall score for the perceived barriers domain (mean = 2.31 ± 0.73), suggesting that structural or practical obstacles were not widely viewed as major impediments to healthy practices.

3.3.4. Mothers' Perceptions of Benefits and Self-Efficacy for their Autistic Children

The mothers' perceptions of benefits and self-efficacy regarding their children's health conditions, focusing on food assistance, dietary practices, nutrition knowledge, and sources of support, are presented in Table **6**. More than half agreed or strongly agreed that food assistance would enable them to obtain fresh

Table 4: Mothers' Perceptions of the Severity of their Children's Health Conditions

Perceived Severity	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Average Score
	n	%	n	%	n	%	n	%	n	%	
9. I believe my child is well nourished	19	23.8%	15	18.8%	10	12.5%	36	45.0%	0	0.0%	2.79
10. I do not believe my child is getting adequate amounts of vitamins/minerals	5	6.3%	11	13.8%	22	27.5%	31	38.8%	11	13.8%	3.40
11. I believe my child is getting enough to eat	11	13.8%	18	22.5%	23	28.8%	26	32.5%	2	2.5%	2.88
12. I believe my child is underweight	4	5.0%	10	12.5%	18	22.5%	29	36.3%	19	23.8%	3.61
13. I believe my child is overweight	46	57.5%	23	28.8%	8	10.0%	3	3.8%	0	0.0%	1.60

Table 5: Mothers' Perceptions of Barriers to Managing their Children's Health Conditions

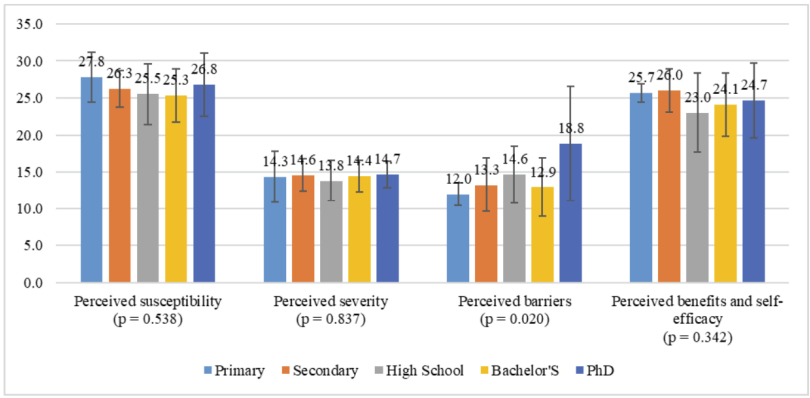
Perceived Barriers	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Average Score
	n	%	n	%	n	%	n	%	n	%	
14. I cannot afford to get fresh produce	22	27.5%	26	32.5%	17	21.3%	13	16.3%	2	2.5%	2.34
15. I do not have transportation to get to places	23	28.8%	25	31.3%	15	18.8%	14	17.5%	3	3.8%	2.36
16. I do not know how to cook	25	31.3%	28	35.0%	12	15.0%	11	13.8%	4	5.0%	2.26
17. I cook on weekends	21	26.3%	37	46.3%	8	10.0%	13	16.3%	1	1.3%	2.20
18. I work long hours, and so cannot cook on weekdays	14	17.5%	37	46.3%	16	20.0%	6	7.5%	7	8.8%	2.44
19. My child cannot do any physical activities due to his condition	28	35.0%	22	27.5%	17	21.3%	7	8.8%	6	7.5%	2.26

Table 6: Mothers' Perceptions of Benefits and Self-Efficacy Related to their Children's Health Conditions

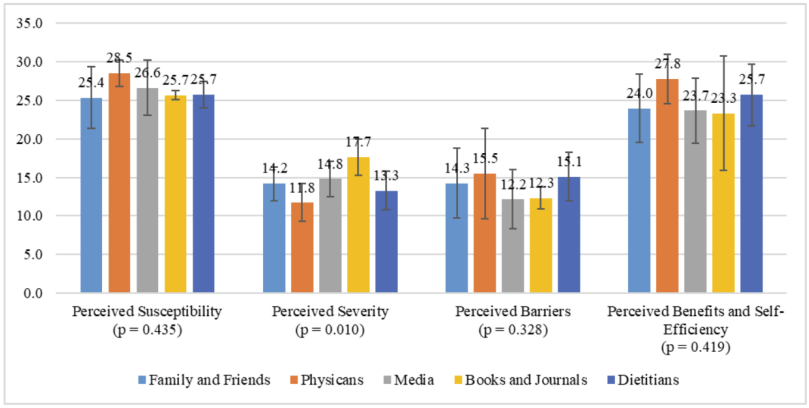
Perceived benefits and self-efficacy	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Average Score
	n	%	n	%	n	%	n	%	n	%	
20. I get food assistance	26	32.5%	7	8.8%	11	13.8%	33	41.3%	3	3.8%	2.75
21. I will get fresh produce with food assistance	11	13.8%	7	8.8%	11	13.8%	42	52.5%	9	11.3%	3.39
22. I do not know about any special diets	16	20.0%	4	5.0%	8	10.0%	34	42.5%	18	22.5%	3.43
23. Would like to try special diets (Gluten/casein-free) for my child	6	7.5%	2	2.5%	12	15.0%	24	30.0%	36	45.0%	4.00
24. I would obtain nutrition information from family and friends	27	33.8%	14	17.5%	17	21.3%	14	17.5%	8	10.0%	2.53
25. I do not feel I am well informed about nutrition for my child	9	11.3%	5	6.3%	19	23.8%	21	26.3%	26	32.5%	3.63
26. I am part of a support group for nutrition related information	14	17.5%	15	18.8%	34	42.5%	13	16.3%	4	5.0%	2.73
27. I will not be part of any nutrition support group for my child	39	48.8%	22	27.5%	19	23.8%	0	0.0%	0	0.0%	1.75

produce (n = 51; mean score = 3.39). While 52 (65%) did not know of any special diets, 60 (75%) were willing to try such diets, including gluten- or casein-free regimens (mean score = 4.00).

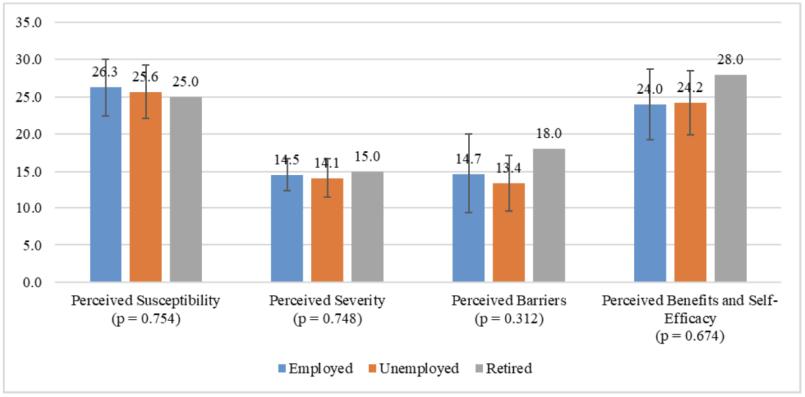
Confidence in nutrition-related knowledge varied, with 47 out of 80 (58.8%) mothers agreeing or strongly agreeing that they did not feel well-informed about nutrition for their child (mean score = 3.63). Additionally, participation in nutrition support groups was moderate. Specifically, 29 mothers (36.3%) disagreed or strongly disagreed that they were part of a support group for nutrition-related information, while only 17 mothers (21.3%) agreed or strongly agreed with this item. In contrast, most mothers (n = 61; 76.3%) indicated that they would be willing to join a nutrition support group for their child, reflecting a high level of interest despite varying levels of current participation.



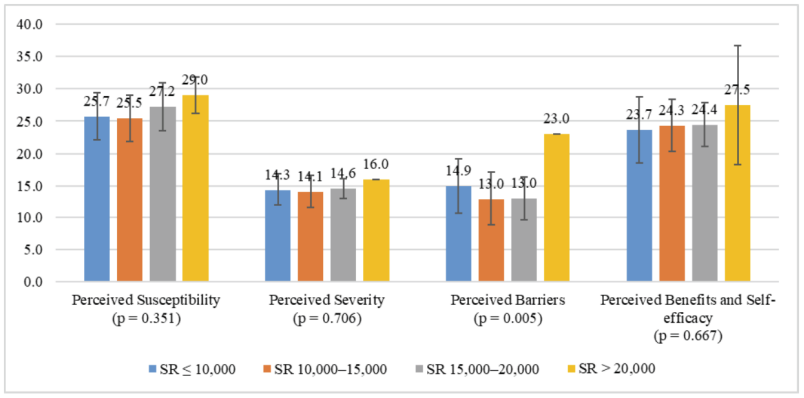
(**a**)



(b)



(**c**)



(**d**)

Figure 1: (**a**) Distribution of Health Belief Model perception scores across maternal education levels (mean ± SD); (**b**) distribution of Health Belief Model perception scores across maternal sources of information (mean ± SD); (**c**) distribution of Health Belief Model.

Overall, the mothers showed a fair level of awareness about health risks and a moderate degree of concern about their potential impact. Although their confidence in nutritional knowledge was limited and participation in formal support resources was low, they expressed strong beliefs in the value of dietary changes and a high readiness to adopt them. Structural barriers were not widely reported overall; however, a clinically significant minority of mothers indicated difficulty affording fresh produce or lacking transportation. Taken together, these findings indicate that while mothers appreciate the importance of healthy eating and are motivated to make changes, there remain notable gaps in nutritional knowledge and access to professional guidance.

3.4. Associations between Maternal Perceptions and Child and Maternal Characteristics

HBM perception scores were summarized as means ± standard deviations and stratified by children's gender and BMI categories. No statistically significant differences were observed across gender or BMI for any HBM component (all $p > 0.05$). Mean scores for perceived susceptibility, severity, barriers, and benefits/self-efficacy were comparable between male and female children and across BMI categories.

HBM perception scores are shown in Figure **1**, summarized as means ± standard deviations and stratified by maternal education level, source of information, employment status, and household income. Perceived susceptibility ($p = 0.538$), severity ($p = 0.837$), and benefits and self-efficacy ($p = 0.342$) scores did not differ significantly across maternal education categories; however, perceived barrier scores differed significantly by education level ($p = 0.033$). Specifically, mothers with a PhD reported significantly more perceived barriers than those with a bachelor's degree ($p = 0.017$), as did mothers with a primary-level education ($p = 0.043$).

Perceived susceptibility ($p = 0.435$), barriers ($p = 0.328$), and benefits and self-efficacy ($p = 0.419$) scores did not differ significantly across maternal information sources; however, perceived severity scores varied significantly by source of information ($p = 0.010$), with mothers who relied on books and journals had higher severity score than those relying physicians ($p = 0.008$), as well as between mothers relying on dietitians (p-value = 0.047).

Additionally, no significant difference was observed in any HBM component across maternal employment status categories ($p > 0.05$).

Perceived susceptibility ($p = 0.351$), severity ($p = 0.706$), and benefits/self-efficacy ($p = 0.667$) scores were comparable across household income levels. In contrast, perceived barrier scores exhibited significant overall differences by income level ($p = 0.005$), specifically those who had an income of more than SR 20,000 had higher barrier score than those who had an income of less than SR 10,000 ($p = 0.042$), an income of SR 10,000–15,000 ($p = 0.006$), or an income of SR 15,000–20,000 ($p = 0.013$).

4. DISCUSSION

To our knowledge, this is among the first studies in Hail, Saudi Arabia, to apply the Health Belief Model to examine maternal perceptions related to dietary practices in children with ASD. Overall, the mothers demonstrated significant concern regarding their children's future health and expressed interest in improving their nutrition-related knowledge. However, variations were observed across perception domains, with perceived susceptibility receiving the highest score (25.8; 32.9%), followed by perceived benefits and self-efficacy (24.2; 30.9%), severity (14.3; 18.3%), and barriers (13.9; 17.8%). Certain maternal characteristics, particularly mothers' sources of nutritional information, educational status, and household income, were associated with differences in perception scores.

The mothers generally expressed concern about the possibility of future health complications in their children, regardless of the children's or mothers' characteristics, reflecting an awareness of potential long-term health risks associated with ASD. Nevertheless, uncertainty was evident in some susceptibility-related items, particularly regarding the likelihood of developing complications in adulthood, with more than one-third of the mothers concerned. These findings align with those of other research; for example, a prior study found that more than 90% of parents were concerned about their child's development, while 7% were not [17]. Additionally, a study conducted in Saudi Arabia by Al Aotaibi *et al*. reported that less than one-third (30.5%) of mothers expressed confidence in their nutritional knowledge when preparing meals for their children with ASD [18]. The results of the present study are consistent with this, with only 18.8% of mothers reporting such confidence. In line with these data, almost all mothers

in the present study expressed a desire to obtain additional nutrition-related information. Similar trends have been reported by Al Aotaibi *et al*., in Saudi Arabia, where most respondents (79.5%) indicated willingness to seek further nutritional guidance, although a smaller proportion remained uncertain or unwilling [18].

Comparable evidence from a Malaysian study conducted in 2020 further suggests that parents of children with ASD commonly exhibit limited awareness and understanding of nutrition-related issues affecting their children [19]. Parental nutrition knowledge plays a key role in shaping children's nutrition knowledge, suggesting that enhancing parents' understanding could improve children's dietary behaviors. In the present study, 33.8% of mothers had visited a dietitian for their child, while 57.5% had not; these results contrasted with another study conducted in Riyadh, Saudi Arabia, in which 44% of mothers had consulted a dietitian, while 25.5% had not. Although comparisons with studies conducted in Riyadh provide a useful context, these findings should be interpreted cautiously due to potential regional differences in healthcare access, referral pathways, and availability of specialized nutrition services. Although the proportions differ between the two studies, both findings highlight variability in the use of professional nutritional guidance among mothers of children with ASD. These mixed perceptions may reflect limited access to clear, evidence-based information regarding long-term nutritional and health outcomes in children with ASD. Consistent with this, health professionals have identified a lack of nutritional knowledge among parents as a key challenge contributing to poor diet quality and suboptimal feeding practices among children with ASD [11].

Perceived severity scores reflected mothers' recognition of the importance of nutrition for their children's health; however, these perceptions varied by source of nutritional information. Mothers who relied on professional literature reported higher perceived severity scores than those who used informal sources, emphasizing the role of credible information in shaping healthy dietary practices. In Al Aotaibi *et al.'s* study, most mothers (58%) perceived their children's nutrition as adequate, whereas a notable proportion (22%) considered it inadequate, and 20% expressed neutral perceptions [18]; similar trends were observed in the present study. Although 45% of mothers believed their children were well-nourished, many perceived their children as underweight and expressed concerns about nutritional adequacy, with more than half (52.6%) reporting insufficient intake of vitamins and minerals. Similarly, Al Aotaibi *et al*. reported that fewer than half of parents of children with ASD (48%) believed their children received adequate amounts of vitamins and minerals, while over one-third perceived their children's intake as insufficient [18].

Previous research has further linked food selectivity among autistic children to an increased likelihood of inadequate intake of several essential nutrients, including dietary fiber, vitamins A, C, D, and E, calcium, zinc, and folate [11]. In the current study, only 35% of mothers believed that their children were receiving enough to eat, while 60.1% and 3.8% believed that their children were underweight and overweight, respectively; a notably lower proportion (20.5%) perceived their children as being underweight in the study by Al Aotaibi *et al*. [18]. Objective assessments supported these concerns; the present study revealed that 3.8% of the children were underweight, while 28.8% were classified as overweight or obese. Notably, the combined prevalence of underweight, excess weight, and gastrointestinal concerns among children with ASD appears higher than that observed in typically developing peers, a pattern frequently attributed to food-selectivity behaviors [9, 11]. Similar trends have also been documented among Malaysian children with ASD, where 7.3% were underweight, 11.3% overweight, and 21.9% obese [8]. The discrepancy between maternal perceptions of underweight and objectively measured BMI reflects a mismatch between perceived and actual weight status, consistent with evidence that many parents fail to recognize overweight in their children [20]. Parental underestimation of weight has been linked to less engagement with healthy dietary habits and may reduce recognition of obesity-related risks, potentially delaying appropriate nutrition guidance [21, 22]. Cultural and sociodemographic factors, such as parental education and beliefs about body size, also shape these perceptions [23].

In children with ASD, where feeding behaviors, sensory sensitivities, and concern about dietary adequacy are common, these perceptual and cultural influences may be particularly significant, and ASD-specific approaches may be needed to support accurate weight perception and healthy behaviors [11]. Addressing these perceptual gaps requires strategies that go beyond information provision to actively support caregivers in accurately interpreting their child's health status, while further research should clarify how such misperceptions shape health behaviors and outcomes in this population.

Prior research has shown that financial and practical constraints can limit access to nutritious foods and healthcare services for children with ASD [11]. In this study, although cost, time, and food preparation were not perceived as major barriers in this sample, mothers' education level and household income were significantly associated with overall perceived barrier scores, highlighting that socioeconomic factors can still influence caregivers' capacity to implement healthy dietary practices. Furthermore, evidence suggests that the financial burden associated with ASD-related education and treatment significantly increases parental stress, with low-income families being particularly affected [24]. While there is no specific information on the economic burden of ASD in Saudi Arabia, families of children with this condition frequently face substantial extra costs, reduced income, and greater caregiving responsibilities due to their children's special needs [5]. Supporting this, 18.8% of the mothers in this study reported being unable to afford fresh produce, and 21.3% reported lacking transportation to access food or essential services. Only a small proportion of participants reported that their children with ASD were unable to engage in physical activity, whereas the majority disagreed. Studies have reported that physical activity is often underemphasized for children with autism and other developmental disabilities, largely due to limited awareness and a lack of inclusive opportunities, contributing to higher levels of inactivity [11]. However, our findings did not fully reflect this pattern, suggesting that caregivers underreport physical activity limitations, potentially due to misperceptions, limited opportunities for participation, or lowered expectations regarding physical activity among children with ASD. These findings underscore the need for tailored educational initiatives aimed at enhancing parents' awareness and understanding of ASD [25].

Most mothers acknowledged the benefits of healthy eating and expressed a willingness to adopt dietary changes when appropriate. However, self-efficacy related to accessing professional nutrition support and participating in structured nutrition programs appeared limited. This may reflect gaps in service availability or awareness of specialized nutrition support for families of children with ASD. Findings from the current study showed that 65% of mothers had no knowledge about special diets; however, 75% were interested in trying such diets, including gluten-free and casein-free regimes. These data align with research by Blaine *et al.,* in which parents expressed interest in learning more about autism-specific dietary guidance, food selectivity management, nutritional supplements, and specialized diets (including gluten-free and casein-free), despite limited evidence supporting some of these approaches. Although these diets may benefit some children with gastrointestinal comorbidities, evidence for their routine use in ASD remains limited [11, 26].

In the present study, family and friends were the most frequently reported sources of nutrition information, followed by media platforms, with relatively few mothers relying on dietitians, physicians, or books and journals. One possible explanation for this finding is that mothers who rely primarily on family and friends may receive advice based on personal experiences that may not be fully appropriate for their child's specific condition. In contrast, physicians are more likely to provide evidence-based, practical, and comprehensible guidance, which may contribute to improved health outcomes among children with ASD. This reliance on informal and non-specialist sources may increase the risk of adopting restrictive dietary practices, such as gluten-free and casein-free diets, without appropriate professional guidance, which potentially leads to nutritional inadequacies or deficiencies [7]. This pattern is consistent with previous research conducted in Saudi Arabia, which similarly identifies family and friends as the primary sources of nutrition knowledge, followed by media platforms. For example, Al Aotaibi *et al*. reported that nearly half of respondents obtained nutrition information from family and friends [18], while Alhuzimi *et al*. found that social media was the predominant information source among parents, exceeding their reliance on formal education or healthcare professionals [27]. This reliance on informal sources may reflect limited access to specialized nutrition services or low awareness of professional support, particularly in settings where structured dietary counseling is not routinely integrated into ASD care. When asked, more than half of the interviewed mothers in this study generally shared a common basic understanding of healthy eating. Caregivers require structured guidance on balanced nutrition, portion control, meal planning, and practical food-preparation strategies, as well as support in managing mealtime behaviors and reducing feeding-related stress [7]. Previous research has demonstrated that parental nutrition knowledge is a key determinant of children's dietary quality, highlighting the need for structured educational support to improve nutritional outcomes [19]. Only 21.3% of mothers in this study

reported obtaining nutrition-related information through support groups. In general, research has identified parent support networks as important channels for sharing nutrition guidance and evidence-based practices, particularly when professional services are not readily accessible [11].

This study has notable strengths, including the use of a validated questionnaire and a theory-based approach to explore maternal perceptions of nutrition in an under-researched population. However, the study also has some limitations. The use of convenience sampling from two autism centers, combined with the relatively small sample size (n = 80) and an exploratory study design, limits the representativeness and generalizability of the findings. In addition, no formal adjustments for multiple comparisons were applied; therefore, the results should be interpreted with caution, given the increased risk of Type I error associated with multiple bivariate analyses. While this study provides valuable preliminary data, several methodological constraints should be noted. The analytical approach is primarily descriptive and exploratory, focusing on bivariate associations to establish a foundational understanding of maternal perceptions in the Hail region. The current sample size, while calculated for regional representation, may lack the statistical power required for stable multivariable regression modeling without risking overfitting. Therefore, the findings should be interpreted as identifying potential factors rather than confirming definitive predictors of maternal health beliefs. Another limitation is that the data were self-reported, which may introduce recall and social desirability bias. Some eligible mothers declined participation due to privacy concerns and fear of social stigma related to their child's ASD diagnosis, which may also influence caregivers' willingness to seek health and support services [28]. Additionally, only mothers were included, as they were the accompanying parents during data collection in the participating centers. Although mothers are often primary caregivers, children's dietary behaviors and health-related decisions may also be significantly influenced by fathers and other caregivers. The findings reflect maternal perceptions and may not be generalizable to these two groups. Future research should explore these factors. In addition, children's actual dietary intake was not directly assessed. Future research employing longitudinal designs and larger, more diverse samples drawn from multiple settings is warranted to strengthen the evidence base and enhance the generalizability of the findings. The use of objective measures, such as direct dietary assessments or clinical records, would further improve data accuracy and reduce potential reporting bias. Additionally, including fathers and other caregivers in future studies would provide a more comprehensive understanding of family influences on children's dietary behaviors.

5. CONCLUSIONS

This study offers insights into mothers' perceptions of the healthy dietary practices of children with ASD in Hail, Saudi Arabia. While the mothers demonstrated moderate concern for their children's future health and recognized the importance of proper nutrition, barriers related to socioeconomic factors and food preparation were observed among one-third of the participating mothers. Variations in mothers' perceived severity of their children's health conditions and perceived barriers, assessed by mothers' education level, household income, and sources of nutrition information, underscore the influence of social determinants on dietary management among families attending the two autism centers. These findings highlight the importance of delivering structured, evidence-based nutrition education and improving access to professional dietary support within autism centers. Integrating caregiver-focused educational programs into routine services tailored according to caregivers' socioeconomic background may help address perceived barriers and promote healthier dietary practices. Future research should include broader family perspectives and explore how family dynamics and caregiver involvement further influence nutritional outcomes among children with ASD. Additionally, future research should build upon these descriptive findings by utilizing larger, multicenter longitudinal cohorts that allow for more sophisticated statistical frameworks. Robust multivariate regression analysis is recommended to identify significant independent predictors of maternal perceptions across all domains of the Health Belief Model, including ASD symptom severity, number of siblings, and maternal stress level. This analytical approach will explain the complex relationships among socioeconomic status, educational background, and professional health advice, thus offering reliable evidence to guide targeted nutritional interventions for the ASD population in Saudi Arabia.

FUNDING

Research funded by the Scientific Research Deanship at the University of Ha'il, Saudi Arabia (RG-21 132).

ABBREVIATIONS

ASD = Autism Spectrum Disorder

ADDM = Autism and Developmental Disabilities Monitoring

HBM = Health Belief Model

BMI = Body mass index

Kg = kilograms

Cm = Centimeters

SD = Standard Deviation

N = Frequency

% = Percentage

SR = Saudi Riyal

ETHICS APPROVAL

This study was approved by the Ethical Committee at the University of Ha'il (dated 7/3/2022, No. of Research H-2022-054).

CONSENT TO PARTICIPATE

Written and oral informed consent was obtained from the parents identified in this study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest concerning the research, authorship, and/or publication of this article.

ACKNOWLEDGEMENTS

The authors extend their appreciation to the Scientific Research Deanship researcher supporting project number (RG-21 132), University of Ha'il, Hail, Saudi Arabia. They would also like to express sincere gratitude to all the contributors, healthcare assistants, and doctors who played an essential role in collecting the data for this study. Their dedication, hard work, and commitment were invaluable to the success of this research.

REFERENCES

[1] Autism and Developmental Disabilities Monitoring Network Surveillance Year 2000 Principal Investigators; Centers for Disease Control and Prevention (CDC). Prevalence of autism spectrum disorders-Autism and Developmental Disabilities Monitoring Network, six sites, United States, 2000. MMWR Surveill Summ 2007; 56(SS-1): 1-11.

[2] Maenner MJ, Warren Z, Williams AR, Amoakohene E, Bakian AV, Bilder DA, *et al.* Prevalence and characteristics of autism spectrum disorder among children aged 8 years - Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2020. MMWR Surveill Summ 2023; 72(2): 1-14. https://doi.org/10.15585/mmwr.ss7202a1

[3] Loomes R, Hull L, Mandy WP. What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. J Am Acad Child Adolesc Psychiatry 2017; 56(6): 466-74. https://doi.org/10.1016/j.jaac.2017.03.013

[4] Shulman C, Nir Z, Bitton D. Gender differences in autism presentation at initial clinical referral: Diagnostic measures, empathy, and adaptive functioning. Med Res Arch 2025; 14(1). https://doi.org/10.18103/mra.v14i1.7164

[5] Sauer AK, Stanton JE, Grabrucker AM, Hans S. Chapter 1. In: Autism spectrum disorders: Etiology and pathology [Internet]. Brisbane (AU): Exon Publications; 2021 [cited 2021 Aug 20]. https://doi.org/10.36255/exonpublications.autismspectrumdisorders.2021.etiology

[6] Al Awaji N, Al-Taleb S, Albagawi T, Alshammari M, Sharar F, Mortada E. Evaluating parents' concerns, needs, and levels of satisfaction with the services provided for ASD children in Saudi Arabia. J Multidiscip Healthc 2024; 17: 123-46. https://doi.org/10.2147/JMDH.S447151

[7] Al-Beltagi M. Nutritional management and autism spectrum disorder: A systematic review. World J Clin Pediatr 2024; 13(4). https://doi.org/10.5409/wjcp.v13.i4.99649

[8] Kamal Nor N, Ghozali AH, Ismail J. Prevalence of overweight and obesity among children and adolescents with autism spectrum disorder and associated risk factors. Front Pediatr 2019; 7: 38. https://doi.org/10.3389/fped.2019.00038

[9] Tan WY, Hamzaid NH, Ibrahim N. Parental perceptions on the importance of nutrients for children with autism spectrum disorder (ASD) and the coping strategies: A qualitative study. Nutrients 2023; 15(7): 1608. https://doi.org/10.3390/nu15071608

[10] Narayanan S. Parents' attitudes and beliefs towards dietary behaviors of children with autism aged 5-13 years [Internet] 2021 [cited 2026 May 12]. Available from: https://digitalcommons.unf.edu/etd/1082

[11] Blaine RE, Blaine KP, Cheng K, Banuelos C, Leal A. Priorities, barriers, and facilitators for nutrition-related care for autistic children: A qualitative study comparing interdisciplinary health professional and parent perspectives. Front Pediatr 2023; 11. https://doi.org/10.3389/fped.2023.1198177

[12] Alyafei A, Easton-Carr R. The Health Belief Model of Behavior Change. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 [updated 2024 May 19]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK606120/

[13] Abualhommos AK, Aldoukhi AH, Alyaseen AA, AlQanbar FA, Alshawarib N, Almuhanna ZA. Community knowledge about autism spectrum disorder in the Kingdom of Saudi Arabia. Int J Environ Res Public Health 2022; 19(6): 3438. https://doi.org/10.3389/fped.2023.1198177

[14] Sabbagh HJ, Al-Jabri BA, Alsulami MA, Hashem LA, Aljubour AA, Alamoudi RA. Prevalence and characteristics of autistic children attending autism centres in 2 major cities in Saudi Arabia. Saudi Med J 2021; 42(4): 419-27. https://doi.org/10.15537/smj.2021.42.4.20200630

[15] Holt RC. Parental perceptions of nutritional status of children with autism [Internet]. [cited 2026 May 12]. Available from: https://uknowledge.uky.edu/gradschool_theses/542

[16] El Mouzan MI, Al Salloum AA, Al Herbish AS, Foster PJ, Qurashi MM, Al Omar AA. The 2005 growth charts for Saudi children and adolescents. Riyadh (KSA): King Abdulaziz City for Science and Technology; 2009. Report No.: AR-20-63. Available from: https://www.moh.gov.sa/HealthAwareness/EducationalContent/BabyHealth/Documents/Intermediate%201%20Compatibility%20Mode.pdf

[17] Richards M, Mossey J, Robins DL. Parents' concerns as they relate to their child's development and later diagnosis of autism spectrum disorder. J Dev Behav Pediatr 2016; 37(7): 532-40. https://doi.org/10.1097/DBP.0000000000000339

[18] Alotaibi F, Alharbi M. Mothers' perspectives of nutritional status of children with autism spectrum disorders (ASD) in Saudi Arabia. J Health Med Nurs 2017; 39: 40. Available from: https://iiste.org/Journals/index.php/JHMN/article/view/37507/38587

[19] Ismail NA, Ramli NS, Hamzaid NH, Hassan NI. Exploring eating and nutritional challenges for children with autism spectrum disorder: Parents' and special educators' perceptions. Nutrients 2020; 12(9): 2530. https://doi.org/10.3390/nu12092530

[20] Rietmeijer-Mentink M, Paulis WD, van Middelkoop M, Bindels PJE, van der Wouden JC. Difference between parental perception and actual weight status of children: A systematic review. Matern Child Nutr 2012; 9(1): 3-22. https://doi.org/10.1111/j.1740-8709.2012.00462.x

[21] García-Blanco L, Berasaluce A, Romanos-Nanclares A, Martínez-González MÁ, Moreno-Galarraga L, Martín-Calvo N. Parental perception of child's weight, their attitudes towards child's dietary habits and the risk of obesity. World J Pediatr 2022; 18(7): 482-9. https://doi.org/10.1007/s12519-022-00540-6

[22] Gketsios I, Foscolou A, Vassilakou T, Panagiotakos D, Kosti R. Parental misperceptions of their offspring's weight and their strategies for child's eating behavior: A narrative review of the recent evidence. Children (Basel) 2022; 9(10): 1565. https://doi.org/10.3390/children9101565

[23] Remmers T, van Grieken A, Renders CM, Hirasing RA, Broeren SM, Raat H. Correlates of parental misperception of their child's weight status: The 'be active, eat right' study. PLoS One 2014; 9(2): e88931. https://doi.org/10.1371/journal.pone.0088931

[24] Papadopoulos D. Mothers' experiences and challenges raising a child with autism spectrum disorder: A qualitative study. Brain Sci 2021; 11(3): 309. https://doi.org/10.3390/brainsci11030309

[25] ALRuwaili BF, Alrashdi BA, Mallick A, Alruwaili TA, Alanazi MF, Alruwaili HF, *et al.* Knowledge, attitude, and perception towards autism spectrum disorders among parents in Sakaka, Al-Jouf region, Saudi Arabia: A cross-sectional study. Healthcare (Basel) 2024; 12(16): 1596. https://doi.org/10.3390/brainsci11030309

[26] Alamri ES. Efficacy of gluten- and casein-free diets on autism spectrum disorders in children. Saudi Med J 2020; 41(10): 1041-6. https://doi.org/10.15537/smj.2020.10.25308

[27] Alhuzimi TE, Alharbi MH. Perceptions of parents on management of food allergy in children with autism spectrum disorder (ASD) in Saudi Arabia. Children (Basel) 2022; 10(1): 48. https://doi.org/10.3390/children10010048

[28] Ismail NA, Ramli NS, Hamzaid NH, Hassan NI. Exploring eating and nutritional challenges for children with autism spectrum disorder: Parents' and special educators' perceptions. Nutrients 2020; 12(9): 2530. https://doi.org/10.3390/nu12092530