ORIGINAL ARTICLE

Relationships Between Sensory Processing Disorders With Feeding Behavior Problems Among Children With Autism Spectrum Disorder

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ABSTRACT

Introduction: Self-feeding is an essential skill that is acquired by young children and it demonstrates a child's degree of independence. As feeding behaviours are influenced by multiple sensory processes, children with autism spectrum disorder (ASD) have severe difficulties during feeding in comparison to their peers. Therefore, this study investigated impairments in sensory domains and the factors of problematic feeding behaviours. It also examined the correlation between sociodemographic profiles and sensory domains. **Methods:** 63 parents of children receiving treatment at the National Autism Society of Malaysia (NASOM) were provided with two questionnaires: 1) the short sensory profile (SSP) and 2) the brief autism mealtime behaviour inventory (BAMBI). The data collected from these questionnaires revealed that a majority of respondents noticed a Definite Difference in sensory processing in the under-responsive/seeks sensation domain. **Results:** In the BAMBI questionnaire, the Limited Variety of food subscale was found to result in most of the problematic feeding behaviours. A correlation was noted between tactile sensitivity ($r(61) = -.260$), taste/smell sensitivity ($r(61) = -.515$), auditory filtering ($r(61) = -.340$), and visual/auditory sensitivity ($r(61) = -.319$) factors and the prevalence of problematic feeding behaviours. Other factors; such as gender ($r(61) = -.291$, $p<.05$), weight ($r(61) = -.313$, $p<.05$), and disease status ($r(61) = .293$, $p<.05$) were also found to significantly correlate with problematic feeding behaviours. **Conclusion:** The findings of this study highlight the need for occupational therapists to incorporate sensory components in feeding interventions as using sensory integration or sensory-based approaches to improve the processing of sensory information will enable children with ASD to make adaptive responses during mealtimes.

Keywords: Autism, Feeding behaviour problem, Sensory processing disorder

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INTRODUCTION

Autism spectrum disorders (ASD) are characterised by impairments in social communication and interaction as well as limited stereotypes and interest behaviours (1). Activities of daily living (ADLs); such as self-grooming, self-feeding, and dressing; become more important as a child grows and serve an indicator of their independence and maturity. However, problematic feeding behaviours among children with ASD has become a growing concern among parents (2) as these feeding behaviours negatively impact a child's growth and development (3,4).

In the Diagnostic and Statistical Manual of Mental Disorders (DSM–5), avoidant restrictive food intake disorder (ARFID) is categorised as a "feeding and eating disorder". ARFID was added to the DSM-5 in 2013 under the feeding disorder of infancy or early childhood (FDIEC) category and explains a variety of eating disorders that may contribute to the lack of energy or nutrition intake among children with developmental delays. Inadequate energy or nutrition intake is described as the product of a variety of causes; such as limited appetite, sensory issues, and fear of feeding. Although one's anatomy, metabolism, gastrointestinal tract, motor functions, and sensory functions all play a part in one's feeding ability, it may also be a factor in problematic feeding behaviours (5).

Although between 20% to 40% of children present with some form of problematic feeding behaviours (6),

children with ASD present with more severe problems than their peers (7). Problematic feeding behaviours are found arise at the age of three (27.6%) and decline by the age of six (13.2%) (8). This is because food selectivity and intake become more complex as a child's autonomy increases (9). Numerous studies have reported that food selectivity (10,11), food refusal (12,13), rituals, pica, poor appetite, as well as aggression and tantrums during feeding (14,15) are most prevalent among children with ASD.

Feeding is a multisensory affair as all our senses must work together to influence our perception of a food's flavour and whether we like the taste (16). This is not limited to a sense of taste and smell but also involves colour, texture, shape, mouthfeel, and the sound that a food makes during mastication. This entails multiple sensory processes and past experiences with the food which can impact feeding behaviour. In children with ASD, functional impairments become more pronounced as they grow older. Therefore, sensory processing disorders have become the main problem among children with ASD. Consequently, it is important to first identify prior difficulties and factors that may have contributed to the feeding problem in order to understand the behaviours and needs of each child with ASD as this will assist in treatment planning and future interventions (17). Therefore, this study investigated the impairments to sensory domains and the factors of problematic feeding behaviours as well as the correlation between sociodemographic profiles and sensory domains.

MATERIALS AND METHODS

Study Design

As a cross-sectional study was employed while G*Power was used to estimate the sample size of the population. Power analysis was conducted using G*Power to determine a sufficient sample size with a Cronbach's alpha of .05, a power of .80, a medium effect size (p+0.3), and two tails. The formula suggested that 84 parents of children with ASD should be recruited as a sample size for this study. However, only 63 of the 100 respondents shortlisted for participation from four branches of the National Autism Society of Malaysia (NASOM) were included in the population of this study because the remaining 37 parents did not return the questionnaires. The inclusion criteria were 1) parents of children aged between three to six, 2) parents of children diagnosed with ASD and receiving treatment at a NASOM branch in the Klang Valley, and 3) English-speaking parents. The exclusion criteria included children who stayed with someone other than their parents.

Data Collection

Purposive sampling was used to select the respondents of this study. The respondents were required to answer both the short sensory profile (SSP) and autism mealtime behaviour inventory (BAMBI) questionnaires. The coordinators of the four NASOM branches were provided with copies of both questionnaires. The completed questionnaires were collected two weeks and four weeks later. The coordinator of every NASOM branch was personally briefed on the inclusion and exclusion criteria for respondents. As a result, selected parents were asked if they were willing to provide information and answer the questionnaires. Upon completion, the questionnaires were returned and the collected data was entered into Statistical Package for the Social Sciences (SPSS) version 23.

Instruments

The short sensory profile (SSP) questionnaire is used to determine the sensory processing pattern of children aged between three to ten by evaluating how they process sensory information in everyday scenarios (18). The SSP scores were classified according to three categories: Typical Performance, Probable Difference, and Definite Difference. Over the course of 38 questions, the seven sensory domains assessed were tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsive/seeks sensation, auditory filtering, low energy/weak, and visual/auditory sensitivity. The Likert scale was used to rate the frequency (1 = behaviour that is always observed to 5 = behaviour that is never observed). Validity and correlation between the total SSP score and the sections ranged from .25 to .76 with $p<.001$. The Cronbach's alpha for internal consistency coefficient ranged from .800 to .995. The test-retest reliability of the SSP was found to be highly reliable. These findings proved that the SSP was a valid and reliable measure of sensory processing (19).

The brief autism mealtime behaviour inventory (BAMBI) was developed in 2008 by Lukens and Linscheid to assess the mealtime and feeding behaviours of children with ASD (20). The BAMBI questionnaire is used to compare the eating patterns of children aged three to eleven years old (21). The questionnaire's original 21 items was reduced to 18 items and divided into subscales; such as Limited Variety (8 items), Food Refusal (5 items), and Features of Autism (5 items). The BAMBI questionnaire was scored on a Likert Scale (1 = behaviour that is never observed and 5 = behaviour that is always observed). As such, higher scores indicate more behaviour problems at mealtimes. As suggested by Lukens and Linscheid, there was no cut off score in the BAMBI questionnaire. The data collected in this study was compared to mean and standard deviation data of the BAMBI authors (20). The Cronbach's alpha for internal consistency coefficient was .88. Criterion validity of the scale was significantly high ($r(108=.77, p<.01)$) over the behavioural paediatric feeding assessment scale (BPFAS) (20).

Data Analysis

Descriptive analysis was used to document the demographic profiles of the children and their parents. The result described the mean values and standard

deviations; such as the total scores and subscales of the BAMBI questionnaire; for numerical variables while categorical variables; such as gender, race, educational level, and subdomains of sensory processing; were described in percentages and frequencies.

Ethical Consideration

Ethical approval to conduct the study was obtained from the Institutional Review Board of Universiti Teknologi Mara (UiTM) (Reference Number: REC/146/19) in March 2019.

RESULTS

Demographics

The sample consisted of 63 respondents who had a three- to six-year-old child diagnosed with ASD. Table I depicts the demographic profile of the children and respondents involved in the study. Of the 63 samples, a higher prevalence of ASD was observed in males (84.1% (n=53)) than in females (15.9% (n=10)). One third of the questionnaires (36.5% (n=23)) were answered by fathers. Although mothers are thought to be most involved in meal planning, fathers are also involved in family meals and child feeding as families often eat together. A majority of the respondents were of Malay ethnicity and between the ages of 31 to 40 (77.8% (n=49)).

Table I Demographic data of the children and respondents (Parents) (n=63)

Characteristics		*n* (%)
Child		
Age	3-4	11 (17.5)
	5-6	52 (82.5)
Gender	Boy	53 (84.1)
	Girl	10 (15.9)
Other disease	Yes	6 (9.5)
	No	57 (90.5)
Weight	Below normal weight	5 (7.9)
	Normal	52 (82.5)
	Overweight	4 (6.3)
	Obese	2 (3.2)
Parent		
Gender	Male	23 (36.5)
	Female	40 (63.5)
Age	21-30 years	1 (1.6)
	31-40 years	49 (77.8)
	41-50 years	11 (17.5)
	Above 51 years	2 (3.2)
Race	Malay	49 (77.8)
	Chinese	7 (11.1)
	Indian	5 (7.9)
	Others	2 (3.2)

Impaired SSP Domains Among Children with ASD

Our findings indicate that most of the children (63.5%) fell into the Definite Difference category followed by 19% in the Probable Difference category, and 17.5% in the Typical Performance category (Table II). Many of the children ranked in the Definite Difference category in almost all of the SSP domains but ranked in the Typical Performance category only for the movement sensitivity, low energy/weak, and visual/auditory sensitivity domains. While a Probable Difference describes some sensory processing difficulties, it does not affect the child's routines or performance. A Definite Difference indicates that a child experiences difficulty when processing sensory information.

Table II Score of children assessed by Short Sensory Profile

Sensory domain	Sensory classification n (%)			Mean (SD)
	Typical	Probable difference	Definite difference	
Tactile sensitivity	24 (38.1)	14 (22.2)	25 (39.7)	27.06 (4.98)
Taste/smell sensitivity	17 (27.0)	16 (25.4)	30 (47.6)	10.97 (5.30)
Movement sensitivity	33 (52.4)	12 (19.0)	18 (28.6)	12.22 (2.68)
Underresponsive/seeks sensation	9 (14.3)	14 (22.2)	40 (63.5)	21.16 (5.28)
Auditory filtering	19 (30.2)	11 (17.5)	32 (50.8)	19.46 (5.07)
Low energy/weak	28 (44.4)	9 (14.3)	26 (41.3)	24.48 (5.18)
Visual/auditory sensitivity	32 (50.8)	12 (19.0)	19 (30.2)	18.13 (4.80)
Total score	11 (17.5)	12 (19.0)	40 (63.5)	133.43 (21.17)

Problematic Factors in BAMBI Among Children with ASD

Table III displays the means and standard deviations of the BAMBI questionnaire's Total score, Limited Variety score, Food Refusal score, and Features of Autism score. In the BAMBI questionnaire, the Limited Variety of food subscale yielded the highest problematic behaviour score among parents compared to the other subscales. It also had the highest mean raw score. Higher mean scores indicate more problematic mealtime behaviours.

Relationship Between Sensory Processing Domains and Feeding Behaviour Problem

Table IV shows a significant correlation between some sensory processing domains and problematic feeding behaviours. There was a correlation between tactile sensitivity ($r(61) = -.260$), taste/smell sensitivity ($r(61) = -.515$), auditory filtering ($r(61) = -.340$), and visual/auditory sensitivity ($r(61) = -.319$) in the Limited Variety subscale of the BAMBI questionnaire. There was a

Table III Mean and Standard Deviation (SD) of scores on the BAMBI and comparison with reference data

BAMBI	Mean (SD)	Difference with reference mean value from Luken and Linscheid (2008)	
		ASD	TD
Total score	44.17 (9.19)	49.05 (10.33)	32.50 (8.59)
Limited variety	24.24 (5.48)	27.61 (6.79)	17.83 (5.65)
Food refusal	9.67 (3.94)	10.36 (3.74)	6.93 (2.77)
Features of autism	10.27 (3.13)	11.07 (3.49)	7.75 (1.66)

correlation between tactile sensitivity ($r(61) = -.285$) and movement sensitivity ($r(61) = -.340$) in the Food Refusal subscale. However, there was a negatively medium and two-tailed correlation between tactile sensitivity ($r(61) = -.282$, $p<.05$) and the Features of Autism subscale.

Table IV Relationship between sensory domains and BAMBI subscales

Sensory domain	BAMBI subscales					
	Limited variety		Food refusal		Features of autism	
	r	*p*	*r*	*p*	*r*	*p*
Tactile sensitivity	-.260	.040*	-.285	.023*	-.282	.025*
Taste/smell sensitivity	-.515	.000**	-.240	.058	-.031	.810
Movement sensitivity	-.243	-.055	-.340	.006**	-.155	.226
Underresponsive/seeks sensation	-.192	.132	-.130	.310	.017	.896
Auditory filtering	-.340	.006**	-.207	.104	.092	.473
Low energy/weak	.029	.824	-.226	.705	-.127	.323
Visual/auditory sensitivity	-.319	.011*	-.170	.184	-.017	.895

Note: * *p* value significant at .05 level
** *p* value significant at .01 level

Relationship Between Demographics and Feeding Behaviour Problem

Table V shows that gender had a positive correlation in the Limited Variety subscale ($r(61) = -.291$, $p<.05$). However, this differed from weight which only had a negatively medium correlation in the Food Refusal subscale ($r(61) = -.313$, $p < .05$). Meanwhile, children with comorbidities had a positive correlation in the Food Refusal subscale ($r(61) = .293$, $p<.05$). Interesting, there was no correlation between the characteristics of the parents and the problematic feeding behaviours of their child.

Table V Relationship between demographic profile and BAMBI subscales

Characteristic	BAMBI subscales					
	Limited variety		Food refusal		Features of autism	
	r	p	r	p	r	p
Child						
Age	.158	.217	-.028	.829	-.208	.101
Gender	.291*	.021	-.062	.627	-.206	.837
Number of siblings	-.037	.772	-.039	.763	-.187	.142
History of therapy	-.196	.125	.011	.933	-.177	.166
Weight	-.132	.301	-.313	.012*	-.154	.229
Food allergy	-.021	.870	-.169	.186	-.202	.112
Feeding medication	-.080	.533	.023	.860	-.136	.287
Other disease	.215	.091	.293	.020*	.069	
Parent						
Age	-.187	.143	.029	.822	.049	.073
Race	-.178	.164	-.031	.811	.018	.889
Occupation	-.030	.813	.128	.318	.107	.402
Education	.098	.446	-.174	.172	-.225	.077
Income	.034	.793	.015	.910	-.128	.317

Note: *p level significant at .05

DISCUSSION

This study investigated impaired sensory domains and problematic feeding factors to determine a correlation between sociodemographic profiles and sensory domains in problematic feeding behaviours. The results of this study showed a consistent pattern of sensory processing impairments in children with autism spectrum disorders (ASD). This is contrary to previous studies that found higher scores, and therefore deficits in sensory processing, in the results of their short sensory profile (SSP) questionnaire (22-24). The findings showed that over half of the children with ASD fell under the under-responsive/seeks sensation domain, followed by the auditory filtering, taste/smell sensitivity, and tactile sensitivity domains. The findings of this study are corroborated by multiple previous studies (23,25,26). Higher scores in the auditory filtering domain; which may reflect a social deficit; is very common among children with ASD. This could be related to difficulties that children with ASD have with responding to their own names, making eye contact with others, and other aspects that involve speech. Meanwhile, the under-responsive/seeks sensation domain determines their responses to sensory inputs that affect their level of arousal to their surroundings. It has been discussed that combinations of these two domains may result in a larger sensory response capacity or hypo-responsiveness (26); a lack of response and sensation-seeking which covers

quite a few of functioning domains.

The Limited Variety of food domain in the BAMBI questionnaire had the highest problematic feeding behaviour score. It also had the highest mean raw score. As expected, children with ASD may have poor intake of a variety of food. This is consistent with the findings of a few other studies (15,27) that also report that children with ASD had a limited variety of food intake. This includes behaviours, such as difficulty trying new foods, dislike of certain foods, refusal to eat new or certain foods, and a preference for the same meal at every meal. However, in comparison to the majority of the samples in previous studies, our findings showed lower mean scores in most BAMBI factors and total scores (20). Therefore, we can hypothesise that culture plays a part in the feeding practices which may contribute to problems when feeding. This could be because each culture has their own feeding practices (28-30) which may have different routines, the consumption of certain foods, food preparation methods, preservation techniques, and the types of food consumed. The Features of Autism subscale was ranked third after the Food Refusal subscale. Hallmarks of autistic behaviour; such as restricted and repetitive behaviours, insistence on uniformity, difficulty accepting change, and interest in following routines; may contribute to this particular feeding behaviour (31). Meanwhile, Food Refusal is evident when different types of food are refused due to sensory abnormalities (11).

Tactile sensitivity was found to correlate to all problematic feeding behaviours in the BAMBI subscales. This is corroborated by previous studies that found increased sensitivity to touch, which causes the dislike of the particular texture, may increase the likelihood of disliking certain foods (32). Additionally, other studies also agreed that tactile sensitivity and taste/smell sensitivity were the most prevalent factors limiting the intake of food (5,33,34). Tactile sensitivity may cause some children to refuse food with unfamiliar textures when they touch it to feed themselves. Meanwhile, children with taste/smell sensitivity may gag or vomit when they have the food in their mouths. Higher scores in the tactile and taste/smell sensitivity domains also indicate that children may consume fewer fruits and vegetables and be more hesitant to try different foods (35).

A significant correlation was identified between visual and auditory sensitivity and problematic feeding behaviours in children with ASD. The auditory input from the sound of chewing food or sounds in the feeding environment can have an indirect effect on the child's acceptance of a food. Indeed, mealtime can be a noisy affair, particularly when food is being prepared, utensils are being handled, or a conversation is taking place between family members or outsiders. As such, external noises can be overwhelming and increase stress in children with autism as they have difficulty handling the sensory information received from the environment resulting in overstimulation.

Movement sensitivity was found to significantly correlate with Food Refusal. Children who exhibit over-responsiveness toward movement stimuli are more likely to refuse food during mealtimes. This closely relates to gravitational insecurity, which is defined as over responsiveness toward movement stimulation or having difficulties in the vestibular processing domain. Therefore, positioning is crucial to ensure the child feels comfortable during feeding. However, it is suggested that children be positioned in a manner that supports both legs and that the body remains upright during feeding to ensure that they can successfully eat (36).

There was a significantly positive correlation between gender and the Limited Variety subscale as well as between the child's disease and the Food Refusal subscale in BAMBI. Meanwhile, the reduced weight of a child may be due to an increase in the Food Refusal subscale, in which exists a significantly negative correlation. The correlation that this study found between gender and problematic feeding behaviours is dissimilar to one previous study that found that both males and females did not differ in their problematic feeding behaviours (20,31). However, multiple other studies found that gender did affect feeding behaviours (37,38); such as preferences in food intake and different eating styles that could affect their food consumption pattern (38). Koivisto (1996) found higher food neophobia among males than females. This was corroborated in a previous study that states boys were more picky eaters during their early years while girls became picky eaters during adolescence (37). The weight of a child was negatively correlated to Food Refusal in BAMBI. In our study, the parents perceived their children as being in the normal weight category. However, their misconceptions of their child's body weight should be taken in consideration as the children were not weighed. Our findings also indicated that children with comorbidities were also more prone to refuse food. As such, children with illnesses, especially those with illnesses from infancy, may have a lesser acceptance of food as the illness may have interrupted the developmental process of feeding. This means that these children may not have acquired the necessary self-feeding skills and food preferences at an appropriate developmental age. This may not only delay the introduction of solid food but limits the range of food (39).

A few limitations were identified in this study. Firstly, both questionnaires depended entirely on the responding parent's understanding and their perception. Secondly, the sample size of this study was limited and relied solely on respondents from one organisation (NASOM)

from selected branches in Kuala Lumpur and Selangor.

CONCLUSION

Feeding problems are common in children, particularly infants, toddlers, and pre-schoolers. However, it is evident that some sensory processing domains and characteristics of a child influences the feeding problem. The sensory processing domain plays a role in feeding behaviours as it is linked to the perceptual perspective of the environment in which the feeding takes place. Therefore, identifying the correlation between these factors and a holistic evaluations of a client's demographic profile may help occupational therapists develop strategies that involve specific sensory domains during one-on-one interventions and may help the child begin successfully feeding. The findings of this study may be used to assist occupational therapists plan and guide their intervention plans and goals especially with regard to sensory-based interventions or sensory-integrative approaches to reduce incidents of picky eating among children with the ASD.

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