

Idiosyncratic food preferences of children with autism spectrum disorder in England

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Objectives: To obtain a better understanding of feeding difficulties experienced by children with autism spectrum disorder (ASD).

Methodology: Parents/caregivers ($n = 325$) of children (3–16 years) diagnosed with ASD living in England participated in an online questionnaire investigating early feeding history, food preferences and mealtime environment.

Results: The most common feeding problem was the transition from weaning foods to textured food. Food appearance mainly determined food acceptance with over half the children ($n = 152$) being specific about the colour of their food. Nearly 65% ($n = 191$) were particular about food presentation, including specific brands and food packaging. Sensory attributes and texture of food affected food acceptance. There were clear preferences for crunchy or dry foods, followed by food with a smooth consistency. Nearly 80% ($n = 223$) repeatedly chose the same foods from a limited range. For specific food groups, the clear favourite among the study population was refined carbohydrates (64.4%, $n = 186$). A large proportion of children had tactile sensitivity, where 60% ($n = 176$) disliked having their hands/face dirty. Over 70% ($n = 205$) of children disliked strong odours, indicating the importance of the sensory attributes to food and the mealtime environment. Less than 40% ($n = 108$) of children were seen by a dietitian and the most common concern was the limited variety of foods and dietary intake.

Conclusion: The study highlighted the need for nutritional monitoring and intervention where long-term idiosyncratic feeding behaviour may contribute to nutritional deficiencies.

Keywords: autism spectrum disorder, dietary intake, food preferences, idiosyncratic, sensory attributes

Introduction

Autism spectrum disorder (ASD) affects more than 1 in 100 people in the United Kingdom. ASD is a neurodevelopmental disorder causing impairment in social interactions, and in verbal and non-verbal communication, as well as restricted or repetitive behaviour.

These impairments can have a detrimental effect on food intake and mealtime behaviour.¹ Feeding problems in children with ASD may be due to a range of factors including early feeding experiences, sensory problems, neophobia, anxiety, inability to deal with change within the mealtime environment, specificity of food appearance, and other presenting health complaints that may affect food intake. In addition to the complexities that ASD can have on everyday family life, selective eating and disruptive mealtime behaviour has been identified as a major cause of parental anxiety and co-parenting strain.^{2,3}

It is of concern that children with ASD are more likely to have a low body mass index (BMI below the 5th centile), compared with children of neurotypical development.⁴ It is therefore not surprising that many parents often seek professional advice. In the UK, referrals for children with ASD can make up an unrepresentatively large proportion of a paediatric dietitian's workload — particularly in community settings.⁵

The problem has been well documented and was even addressed by the World Health Organization (WHO) in 2004 to reiterate the need to address feeding problems in ASD.⁵ In order for dietitians to address the nutritional status by recommending ways to improve dietary intake, a better understanding

of ASD and related factors influencing food selectivity is needed. This study sought to understand the extent of the feeding problem as experienced by parents/caregivers of children with ASD residing in England. This in turn will help dietitians improve clinical practice in this complex area of work and consequently lead to greater support of patients and families affected by ASD.

Methods

The study had a descriptive, cross-sectional study design with a qualitative component. Parents/caregivers of children with ASD were recruited using the website of the National Autistic Society of the United Kingdom (NAS) as a platform to participate in our questionnaire-based study. Informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Questionnaire

The researchers compiled a questionnaire using existing literature that consisted of 33 questions covering the following domains: demographic information, early feeding experiences, food preferences based on characteristics of food, dietary interventions and supplements as well as dietetic support.

Procedure

Ethical approval documentation obtained from the Health Research Ethics Committee of Stellenbosch University (N10/05/

153) and the study protocol was shared with the NAS in order to gain approval to recruit participants through their organisation. Participants could access the web-based questionnaire by navigating to the website address: <http://www.autism.org.uk>. A two-stage pilot study was conducted between October and November 2010 and recruited 10 participants. The first stage (four weeks) aimed to improve the quality of the questionnaire. Thereafter the pilot study was repeated to determine the reliability of the questionnaire. The questionnaire was then refined, finalised and hosted online on the NAS's website where the final study was featured for seven months (January 10, 2011 until August 7, 2011). Parents/caregivers of children of both genders, formally diagnosed with ASD, aged between 3–16 years and residing in England were included. Participation in the study was voluntary and responses were anonymous, ensuring confidentiality.

Data analysis

Data were analysed by the collation of responses from the Survey Monkey online programme. Summary statistics was used to describe the variables. The relationship between two nominal variables was investigated with contingency tables and likelihood ratio chi-square tests. A p -value of $p < 0.05$ represented statistical significance in hypothesis testing and 95% confidence intervals were used to describe the estimation of unknown parameters.

Sample size

At the time of the study, the NAS had 12 017 members in England. In the absence of robust studies on response rates for online surveys, a power analysis indicated that a response rate of 2.06% was required for viable study results. The total study population consisted of 325 participants with a response rate of 2.7%; therefore the sample population obtained was statistically significant. Sample sizes for specific non-compulsory sections of the questionnaire varied according to the completion of the questionnaire by participants.

Results

Demographic information

A total of 325 questionnaires were completed online. The age range of the study population was 3 to 16 years as per inclusion criteria, and the mean age of the children was 9.5 years (Figure 1). Some 85% of children were male ($n = 273$) and only 15% were female ($n = 49$), representing a male to female ratio of nearly 7:1. (Figure 1). The majority of children (59%, $n = 190$) had a diagnosis of autism spectrum disorder (ASD), 22.4% ($n = 72$)

had Asperger syndrome (AS), 12.4% ($n = 40$) had classical autism (CA), 3.4% ($n = 11$) had pervasive developmental disorder not otherwise specified (PDD-NOS), and 2.8% ($n = 9$) stated 'other' as a diagnosis without specifying. All participants resided in England. There was variation in the number of respondents from each county in England. Of the 48 geographical counties in England, Greater London had the highest response rate (13%, $n = 42$).

Early feeding history

The majority of parents (76%, $n = 246$) reported that their children were initially exclusively breastfed (only breast milk offered, no formula or solids given at the time). Of these, only 19.1% ($n = 47$) of infants were breastfed exclusively for six months or longer. The mean age for introducing complementary foods was five months. Early weaning (before the age of six months) was reported by 60.9% ($n = 184$) of parents/caregivers. More than one-third (38.8%, $n = 118$) of children struggled to take smooth puréed food from a spoon (Stage 1). The progression from smooth puréed foods to food with a mixed texture (Stage 2) appeared to be more problematic and nearly half the children (48.7%, $n = 148$) struggled to accept foods with soft lumps. Stage 3 weaning foods have textured lumps and chunks and more than half of the children (55.6%, $n = 169$) struggled with this food texture. Furthermore, nearly half of the children did not accept finger foods well (38.8%, $n = 118$).

Food acceptance

The level of food acceptance varied in response to different food attributes such as food colour, presentation, temperature and texture. Half of the children (51.0%, $n = 152$) were particular about the colour of their food. The majority of children (64.7%, $n = 191$) were also influenced by food presentation, including specific brands of food and food packaging. Parents/caregivers further commented that food would be refused if it looked slightly different from what they were used to or if the preferred brand was not available. Specifics regarding presentation of food included a preference for having bread cut into squares, whole foods rather than cut food, or that certain food items need to be served in bowls of a specific colour.

Another common theme was that children did not like different food items to touch after plating, irrespective of different food textures. One specific child preferred food arranged in individual groups on the plate and if any of these touched (such as a carrot that slightly touched gravy), then he/she would refuse all the food.

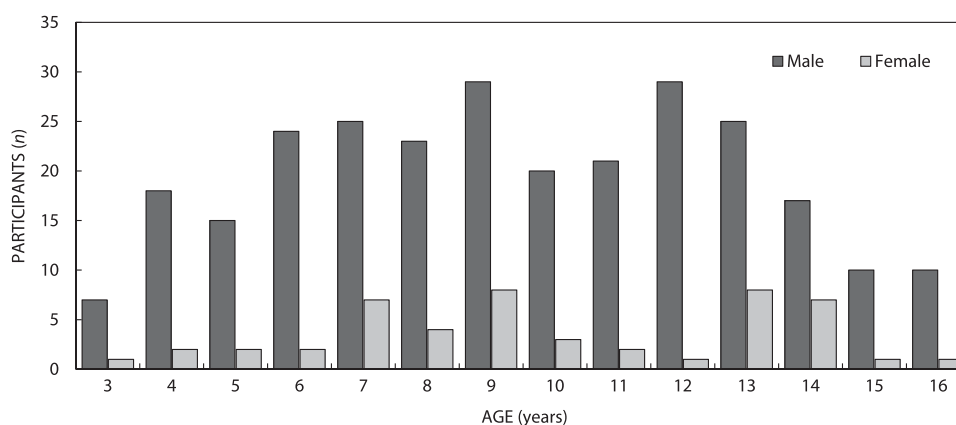


Figure 1: Age and gender of study participants ($n = 325$).

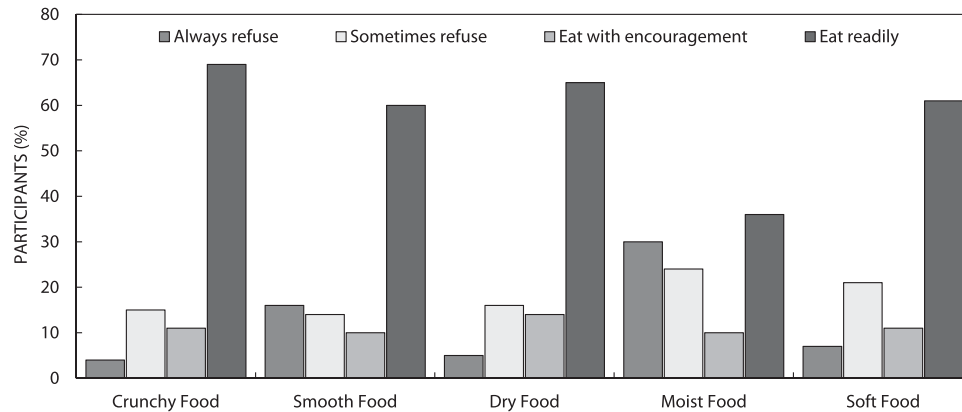


Figure 2: The influence of texture on food acceptance in children with ASD ($n = 295$).

The following food attributes were used to assess preferences for different textures: (1) 'Crunchy' food such as apples, cornflakes and toast; (2) 'Smooth' food such as puréed food, yoghurt and custard; (3) 'Dry food' such as cooked food without any sauce, dry crackers and bread without spread; (4) 'Moist' food such as cooked food with sauce or food with high water content such as fruit; and (5) 'Soft' food where food is described as having an easily chewable texture. Figure 2 illustrates that 60–69% of the study population would readily eat crunchy, smooth, dry, moist and soft food while 4–30% of the children would always refuse these textures (Figure 2).

To assess the children's reaction to food temperatures, example scenarios were provided such as 'How does your child react if you offer warm food or drinks?' Examples of cold foods were yoghurt, cheese and cold cooked food. Examples of hot food or drinks were tea or hot chocolate. Warm and lukewarm food was most popular (77.3%, $n = 228$), followed by cold food (75.6%, $n = 223$).

Preferred food items

It is disconcerting that parents/caregivers reported that the majority of children (75.6%, $n = 223$) would repeatedly choose the same foods from a limited range during meals. Parents/caregivers were asked to answer questions about their child's acceptance of different food groups using a four-point Likert type scale (will always eat, will eat with encouragement, sometimes refuse, and always refuse). The results obtained indicating children's food preferences according to specific food groups are summarised in Table 1.

Significant differences in food preferences ($p < 0.05$) were found for all foods apart from unrefined carbohydrates ($p = 0.021$) and vegetables ($p = 0.855$). These results indicate that there were clear differences in food acceptance of all the other food groups. In particular, refined carbohydrates formed the most popular food group (examples of these given in the questionnaire were white bread, cake, biscuits, pastries and refined cereals) where 64.4% ($n = 186$) of children with ASD would readily eat these.

Table 1: Food preferences of children with ASD according to food groups

Food group	Always refuse	Sometimes refuse	Will eat with encouragement	Will eat readily	p -value*
Fruit ($n = 291$)	19.2% ($n = 56$)	21% ($n = 61$)	18.2% ($n = 53$)	41.6% ($n = 121$)	$p < 0.001$
Fruit juice ($n = 293$)	20.5% ($n = 60$)	12.3% ($n = 36$)	21.5% ($n = 63$)	45.7% ($n = 134$)	$p < 0.001$
Vegetables ($n = 294$)	25.5% ($n = 75$)	23.8% ($n = 70$)	23.8% ($n = 70$)	26.9% ($n = 79$)	$p = 0.855$
Starchy vegetables ($n = 291$)	14.4% ($n = 42$)	23% ($n = 67$)	21% ($n = 61$)	41.6% ($n = 121$)	$p < 0.001$
Unrefined carbohydrate ($n = 286$)	27.6% ($n = 79$)	21.7% ($n = 62$)	19.6% ($n = 56$)	31.1% ($n = 89$)	$p = 0.021$
Refined carbohydrate ($n = 289$)	4.8% ($n = 14$)	14.2% ($n = 41$)	16.6% ($n = 48$)	64.4% ($n = 186$)	$p < 0.001$
Eggs ($n = 287$)	44.3% ($n = 127$)	15% ($n = 43$)	17.4% ($n = 50$)	23.3% ($n = 67$)	$p < 0.001$
Unprocessed meat ($n = 287$)	27.5% ($n = 79$)	14.6% ($n = 42$)	22% ($n = 63$)	35.9% ($n = 103$)	$p < 0.001$
Processed meat ($n = 286$)	16.1% ($n = 46$)	14.7% ($n = 42$)	16.8% ($n = 48$)	52.4% ($n = 150$)	$p < 0.001$
Meat alternatives ($n = 282$)	57.1% ($n = 161$)	15.6% ($n = 44$)	16% ($n = 45$)	11.3% ($n = 32$)	$p < 0.001$
Dairy ($n = 290$)	14.8% ($n = 43$)	16.6% ($n = 48$)	17.9% ($n = 52$)	50.7% ($n = 147$)	$p < 0.001$

*Significant difference is indicated by $p < 0.05$ (chi-square test).

Table 2: Advice to assist parents/caregivers in managing selective eating habits of children with ASD

Factor	Advice
Food colour	Child might refuse to eat certain food colours, thus assess and limit the applicable colour and be aware of the nutrients that need to be replaced
Food presentation	Child might prefer specific food brands, food packaging, food shapes and prefer not to have food on a plate. Keep these in mind when preparing meals
Food temperature	Child might prefer warm/lukewarm foods. Make temperature adaptations as necessary
Food texture	Child might prefer some food textures to others (crunchy/smooth/dry/moist or soft), thus make consistency changes as necessary, but be aware of possible loss in fibre
Mealtime environment	Consider the influence of the meal location, meal routine, other people present and, if necessary, provide suitable distractions, e.g. reading a book, watching television etc.
Sensory processing problems	Avoid strong food smells while cooking or before serving food (open windows or keep the child away from the kitchen) Assess whether the child likes finger foods and whether he/she can tolerate when his/her face/hands get dirty
Food choices	Some children might repeatedly eat the same foods. Keep favourite healthy foods in mind when planning a meal

Mealtime environment

A quarter (24.4%, $n = 72$) of children with ASD had a clear preference for meal location, for example, a specific area in the house. Parents/caregivers commented that their children preferred to eat alone or with only the main caregiver or a specific person present. They disliked eating with other people and in public places or insisted on using only a specific chair when eating. Other comments from parents included that their child would not sit still during mealtimes or would eat only when a set routine was adhered to, such as having fixed mealtimes. Some children disliked hearing other people chewing, while others preferred having certain distractions while eating such as reading books, listening to music or watching specific television programmes.

Sensory presentation

The majority (59.9%, $n = 176$) of the children generally disliked getting their hands and face dirty. Nearly three quarters of the children (71.7%, $n = 205$) would normally dislike strong smells, including food odours, indicating that the majority of the study population were over-sensitive to environmental odours.⁶ It is interesting that despite this hyper- or hyposensitivity to mealtime stimuli, the majority of children in this study (71.3%, $n = 191$) were not particular about using specific eating utensils and cutlery.

Dietetic referrals

Children with ASD are often referred to dietitians to address concerns relating to their dietary intake and consequent nutritional status.^{7,8} In our study, over a third (37.6%, $n = 108$) of parents indicated that their child was seen by a dietitian. The main reasons for consulting a dietitian were: concerns regarding the provision of a balanced diet/not eating a varied diet (15.3%), advice on exclusion diets/dietary interventions for ASD (7.6%), general dietary assessment (6.6%), constipation/gut-related problems (6.3%), refusal or difficulty accepting new foods (4.9%), being underweight (4.5%) or overweight (4.2%), unacceptable behaviour during mealtimes (2.1%), iron deficiency anaemia (1%) and dietary supplementation (0.7%).

Discussion

Our study encompassed an investigation into a wide range of factors to try and gain a further understanding of variations in dietary intake for children with ASD.

Early feeding history

Early feeding history of children with ASD in this study indicated that three-quarters of mothers initially breastfed their infants,

which is similar to the incidence of breastfeeding in the general UK population where 81% of mothers breastfed their infants according to the Infant Feeding Survey in 2010.⁹ The results on breastfeeding rates in the study population are encouraging as the World Health Organization (2001) recommends that all infants should be exclusively breastfed until the age of six months.¹⁰ The benefits of breast milk for the general population are well documented. Recent studies suggesting that breastfeeding may be a protective factor against the development of ASD, so may be an important area for future research.^{11,12}

In our study, early weaning (before four months) was much lower than in the general UK population.⁹ The current guidelines for introducing complementary foods to infants, as reviewed by the WHO, is six months of age.¹⁰ The British Dietetic Association (BDA) supports this recommendation but reiterates that, if weaning should commence earlier, complementary foods should not be introduced to infants before the age of 17 weeks.¹³ The majority of children in our study were offered complementary foods between the ages of 4–6 months, and delayed introduction of solids (> 7 months age) was present in only 1 out of 5 children. These results are encouraging because the timing of the introduction of complementary foods is thought to be important, as doing so too early can have health risks and too late can lead to suboptimal nutrition and oral motor delays such as poor speech development.^{13,14}

Food and mealtime environment preference

Isherwood and Thomas (2008) termed it well in their study by saying 'a meal is a complex sensory experience'.¹⁵ To add to this, Nicklaus (2011) described that sensory properties of foods are important determinants of food acceptance by infants, regardless of having ASD.¹⁶ In our study of children with ASD, food texture played a major role in food preference as the majority of participants readily ate crunchy and dry, as well as smooth puréed food while only a few of the children would always refuse these textures. It seems therefore as if uniform textures may be preferable and meals with mixed textures may cause some resistance. The study showed that both cold and warm foods were equally popular choices and may play a role in food acceptance; however, food texture remains a key theme. Food selectivity can be purely due to oral defensiveness causing an overreaction to the feel of certain foods in the mouth.^{17,18} Our study population would eat only in a specific environment or place in the house. However, other factors such as eating in a specific chair, with music playing, or even with the same person present during meals, did not play a

large role. This relates to the findings of the study by Williams *et al.* (2000) that reported any change to routine may cause anxiety and undesired behaviour, especially when meals are taken outside the normal environment, such as in restaurants or other similar social settings.¹⁷

Food presentation played a major role in our study with more than half of the children being particular about the appearance of their food, including specific brands of food and food packaging. This is supported by other studies where rituals surrounding eating and problems adapting to change were present.¹⁷ The information gathered from our study is invaluable for menu planning and food preparation (including making necessary consistency and temperature adaptations). A consistent mealtime environment to encourage the consumption of essential nutrients, for instance protein sources, is also highlighted.

Environmental hyper- and hyposensitivity

Individuals with ASD may be hypo- or hypersensitive to certain tastes, smells and textures.⁶ Literature on the topic suggests a correlation between environmental stimuli and eating behaviour.¹⁹

It is therefore understandable that children with ASD would experience sensory attributes to food and the mealtime environment in a heightened way that may affect their food intake positively or negatively. This study found that more than half of the children disliked getting their hands or face dirty. Mealtimes can be a messy exercise for children, especially when complementary food is introduced, and is an important part of sensory development. Children with ASD may choose not to have specific foods and finger foods, not because they do not like the way it looks or tastes, but possibly due to how it feels and the effect it has on their hands afterwards, thus limiting the dietary diversity and resultant nutrient intake.

Food choices

Specific food preferences in this study were investigated and a considerable number of children would repeatedly choose the same foods during mealtimes. Sharp *et al.* (2011) also reported that children with ASD generally consume a smaller range and quantity of food, and would also present with disruptive behaviour when non-preferred foods are offered.²⁰

In our study, significant differences were indicated for food selectivity according to food groups in all categories, apart from vegetables and unrefined carbohydrates. Fruit seemed to be more popular, with almost half of the children readily eating fruit and consuming fruit juice. This was more encouraging than expected compared with lower fruit intakes in ASD groups presented in the literature.²¹ Half of the children would not eat vegetables, implying that they miss the opportunity to consume a range of important micronutrients and fibre. However, this is also true for children of neurotypical development as found by Williams *et al.* (2005).²² Refined carbohydrates were accepted by more than half of the children in this study and these findings correspond with current literature.²⁰ High intakes of refined carbohydrates in children may be detrimental due to the lack of nutritional value of these foods that replace other nutrient-dense food. Refined carbohydrates, typically low in fibre and high in fats, could cause constipation and further impair appetite and dietary intake.²³ An increased intake of refined carbohydrates combined with a low protein and fibre intake, can also lead to fluctuations in blood glucose levels that may affect children's mood and concentration levels.²⁴

All forms of eggs and meat alternatives were refused by most children in this study and they preferred processed meat to unprocessed meat. This may play a role in the high prevalence of iron deficiency (low serum ferritin levels) commonly found in children with ASD as red meat is the best source of haem iron.²⁵ Frequent consumption of processed meats was common, which is of grave concern due to a high fat and sodium content and as well as the use of food additives and preservatives. Another positive finding was that the majority of children would always consume dairy products and alternatives. Dairy products provide essential nutrients, e.g. protein, calcium and vitamin D, for growth and development. Dietetic assessments can be valuable in establishing the daily number of dairy products to be consumed in order to meet calcium and vitamin D requirements for age, and identifying over-consumption. Excessive intake of cow's milk protein-based products may lead to a false sense of satiety at the expense of other nutrient-dense foods. It may also lead to constipation which can cause a vicious cycle of poor appetite and low dietary intake yet again.²⁶

Our study reiterates that children with ASD often have selective eating habits that go beyond the usual 'fussy eating' behaviour seen in children throughout specific developmental ages.¹⁵

Limitations of the study

We acknowledge several limitations with our study. The findings were based on parents/caregivers' perceptions of feeding problems and relied on memory for early feeding history. In the absence of a control group, it was difficult to identify how the prevalence of feeding problems differs from neurotypical children. The wide age range (3–16 years) of the study population is a weakness, as Nadon (2011) concluded that, in both ASD and neurotypical children, eating problems were more prevalent in younger children.²⁷ Future studies with stronger subgroup data specific to age would be useful.

Implications for practice

Our study highlighted that nearly 40% of children with ASD were referred to a dietitian. However, current literature indicates that up to 90% of children with ASD may present with selective eating habits affecting total dietary intake.²⁸ A limited dietary intake in relation to quantity and variety could have an impact on nutritional adequacy during important stages of growth and development where optimum nutrition is needed. Our study data provide insightful information to support the medical professions regarding the nature of the dietetic assessment involving a child with ASD, and the importance of identifying patients in need of dietary intervention. The complexity of assessing children with ASD in clinical practice is emphasised and demonstrates the need for in-depth interviews that are needed with the parent/caregiver and the patient. Taking anthropometric measurements habitually and providing nutritional advice accordingly is also important. By incorporating results from previous studies on parental and co-parental stress during mealtimes of children with ASD, it may be concluded that a family approach is needed during dietetic consultations. This may include an assessment of the family dynamics during mealtimes or creating opportunities for both parents (where relevant) to attend dietetic consultations, ensuring a uniform approach to managing the child's eating problems. Dietitians should also collaborate with other healthcare professionals and ensure that where problems are identified which fall outside the field of dietetics, patients are referred for further clinical support or behavioural intervention. It is of utmost importance to look for patterns of food textures when

Table 3: Summary of study's key findings

Study population: children with ASD in England (n = 325)
<ul style="list-style-type: none"> • 76% of children with ASD were initially breastfed (19.1% exclusively breastfed for ≥ 6 months) • The mean age for introducing complementary foods was 5 months • As textures progressed during weaning, there was increased likelihood of food rejection • Over half the children were particular about the colour of their food, and nearly 65% were particular about food presentation (including brand/ packaging) • Preferred textures: <ul style="list-style-type: none"> ◦ Crunchy (e.g. apples, cornflakes and toast) ◦ Dry (e.g. cooked food without any sauce, dry crackers and bread without spread) ◦ Soft (easy to chew foods) • Nearly 80% repeatedly chose the same foods from a limited range • Refined carbohydrates formed the most popular food group (64.4%) • A large proportion were hypersensitive: 60% disliked having hands/face dirty, and > 70% disliked strong odours • Nearly 40% were seen by a dietitian and the most common concern was the limited variety of foods and dietary intake

taking a diet history for a child with ASD. Other foods with similar sensory properties not already featuring in the diet may then be recommended as a means of expanding intake and variety. In order to encourage varied dietary intake from all food groups to optimise nutritional well-being, a summary of findings from this research is provided (Table 3).

Conclusion

The study investigated various aspects of food selectivity in children with ASD. Factors that may influence dietary intake and identified foods that may be more favourable in this study population were highlighted. Feeding problems can already start during weaning and become more prominent when progressing to more complex textures. The children can show idiosyncratic food preferences by texture, colour, smell, presentation and the temperature of the food. Sensory sensitivity, which causes negative reactions to food on the face or hands, can also negatively impact on food intake. Consciousness about the sensory world of autism may hold the key to assisting these patients in improving their dietary intake in order to prevent nutritional deficiencies and possible poor growth, while improving the enjoyment of the meal experience for the patients and their families. These results broaden our current knowledge of dietary behaviours in ASD and may be beneficial to caregivers and healthcare professionals in understanding and managing these children's food preferences and needs.

Funding statement – This study did not receive any external funding.

Disclosure statement – No potential conflict of interest was reported by the authors.

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Received: 28-06-2019 Accepted: 20-11-2019