

**Food Acceptance and Food Rejection
in Children with Autism: Behavioural
factors that affect dietary choices**

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ABSTRACT

Aim

To investigate dietary variety and preference of children with autism, and to determine whether food fussiness and dietary choices are behavioural factors of autism.

Introduction

There has been growing interest in the relationship between autism and diet. Parents and even diagnostic sources have assumed that feeding problems have been more severe for children with autism than for those without autism, yet minimal effort has been concentrated towards determining if there is a relationship between autistic behaviours, food fussiness and dietary choice.

Methods

Two groups were included; an autism group (n=73), and a control group (n=40). Food fussiness was measured using; the Child Eating Behaviour and Appetite Scale (CEBAS) and Connors' Rating Scale. The CEBAS allowed for children's favourite foods to be listed so that colour and texture preferences could be counted on their frequency within the list. The Food Frequency Questionnaire measured children's food intake. The groups were compared using t-tests where $p < 0.05$ to indicate any difference between behavioural influences on food intake and overall food intake.

Results

For each aspect of eating behaviour analysed through the CEBAS and the Connors Rating Scale, significant differences were found. There were no significant differences between the groups for each of the main food groups. Autistic children often ate a lesser variety than the control group, and preferred white coloured foods. In regards to texture, the autism group preferred softer textures.

Discussion

Children with autism seemed to exhibit food fussiness more than those without autism. The number of specific foods eaten within each food group supported that children with autism had less food variety in their diet, demonstrating the repetitive tendencies and need for sameness commonly reported in autistic children.

INTRODUCTION

First described by clinicians in the 1940's, autism is a lifelong developmental disorder, belonging to a group of disorders known as Autistic Spectrum Disorders (ASD) (2,13). ASD also encompasses Asperger's Syndrome and Pervasive Developmental Disorder- Not Otherwise Specified (PDD- NOS) (21). Children with autism continue to grow normally until they reach between 18months and 36months of age, where autistic characteristics become apparent (6). Autism is recognised by a 'triad of impairments', affecting all aspects of a person's social understanding-social interaction, social communication, and social imagination (21). Sufferers are affected to differing degrees (21). Furthermore, restrictive and repetitive patterns of behaviour with a variety of routines and rituals are common, and are evident in selective eating habits (21).

Autism is noted as being the most common form of ASD. In Australia, autism affects approximately 1 in 100 people (4). There is a greater prevalence of autism in males than females. The gender ratio is 5:1, males to females (11).

An association between autism and dietary intake was made as early as the mid-1960's (18). Many children with autism have been reported to have atypical feeding behaviour (1). Feeding can be a problem due to numerous reasons (1);

- Sensitivity to taste, texture and smell- autistic children often experience their senses very acutely, some foods may be overpowering leading to the child possibly refusing to eat, or limiting themselves to a very bland diet. Whetely et al studied eating patterns in 100 autistic children via qualitative analysis of parental reports and identified categories of foods which were consumed excessively, which were found to be cereal based foods, dairy produce and strongly flavoured foods (7). Conversely, some sufferers of autism demonstrate an 'immunity' to even the spiciest or most intense smelling foods, resulting in other problems, including; eating inappropriate foods and chronic indigestion. This sensory difficulty or dysfunction appears to be related to the way sensory information is processed in the brain (20). Anecdotal stories have included children who only eat the 'yellow' or 'baby food' diets, or who will only eat when food has been presented in a particular manner (19).
- Fear of trying new things- many autistic children maintain a very restricted diet as it is simply what they know, labeled as fussiness. They may take this to the extreme and limit

themselves to only 1 or 2 types of food, which can cause havoc for nutritional intake (21).

- Difficulties eating with others- eating is a social activity for most people. Social situations can be very unpredictable and stressful for people with autism, possibly causing them to not eat, eat in unusual ways (21), or cause them to engage in behaviours to avoid or limit social contact (1).

Unfortunately, although parents have reported these behaviours and even diagnostic sources have assumed that eating problems have been more serious for children with autism than for typically developing children, very little research has described these feeding issues related to the diagnosis of ASD (17).

In addition, it may be necessary for future research to be directed at the nutritional adequacy of the diets (11). The nutritional needs of children are different from those of adults as they are still growing and developing (15). Due to the feeding behaviours of children with autism they may be failing to meet their nutritional requirements through specific guidelines such as; need sufficient and nutritious foods to grow and develop normally and, enjoy a wide variety of nutritious foods (15). Exclusion diets involve the removal of many protein containing foods, and in particular casein containing foods which also usually contain calcium (9). A study was undertaken to determine the effects of the gluten and casein free diets in autism (9). It was found that protein intakes of those subjects following the diet did not differ from those subjects not following the diet, but the levels of calcium and zinc for 50% of subjects on the diet were lower than the recommended levels (9).

AIMS

- To document parental assessment of children's eating behaviours
- To assess whether children with ASD are meeting the dietary guidelines for children
- To investigate the dietary variety and preference of children with ASD

METHODS

This experimental cohort study is a follow up study to a research project initiated in 2003 by the Royal Prince Alfred Hospital (RPAH) Allergy Clinic.

Subjects

Volunteer subjects were sourced to form two groups, a cohort of 73 children from the ASD Association of NSW, RPAH Allergy Clinic, special schools, the Developmental Assessment Service (DAS) at Kogarah (ASD group), and a cohort of 40 children from the general preschool and school community (Control group). Although children were the subjects for the study, it was the primary caregivers who provided the information on the children's behalf.

Inclusion and Exclusion Criteria

ASD group-inclusion criteria for the experimental group was primary caregivers of children with ASD aged between 3-10 years, male and female, and toilet trained and diagnosed as per DSM IV criteria- American Psychiatric Association (3).

-exclusion criteria for the experimental group was primary caregivers of children without ASD, and with metabolic disease states other than coeliac's disease and asthma. Control group-inclusion criteria for the control group was primary caregivers of children aged between 3-10 years, male and female, and toilet trained.

-exclusion criteria for the control group was primary caregivers of children diagnosed with ASD as per DSM IV criteria- American Psychiatric Association (3), and with metabolic disease states other than coeliac's disease and asthma.

Exclusion criteria for both cohorts was the absence of daily interaction with the child, as accurate perceptions of the child's dietary intake could not be accurately documented otherwise. The minimum age of 3 was selected as this is often the age when autism is diagnosed, and the maximum age of 10 was selected as it was assumed that parents would still have a fairly accurate perception of what the child was eating as they may still be purchasing their foods.

Ethics

An ethics application designed in 2003 was amended for any necessary alterations to the questionnaires. The ethics application was submitted to the Central Sydney Area Health Service (CSAHS) Ethics Committee in July. Results from questionnaires were handled in confidence, and coded to ensure anonymity when entered into the password secured database at RPAH Allergy Clinic.

Study Design

Along with an Expression of Interest, and a Reply Paid envelope, booklet of questionnaires, functioning as a system of data collection on current dietary practices for the child subject from both the experimental and control groups, was mailed via postal service to the primary caregivers of the ASD cohort of 73 children and the primary caregivers of the control cohort of 40 children. The booklets each consisted of an instruction sheet, checklist, description of research, description of objectives and questionnaires (Refer to Appendix). Questionnaires concerning past and present behaviour, health, and eating habits, social communication and language skills were included in the booklet. The questionnaires were returned for analysis to the RPAH Allergy Clinic via postal service.

Materials and Procedures

The assessment of eating behaviours and variety was studied using the Children's Eating Behaviour and Appetite Scale (CEBAS), the Conners' Rating Scale Food Frequency Questionnaire (FFQ). (A copy of these questionnaires can be found in the Appendix).

General eating behaviour and fussy eating behaviours

The Children's Eating Behaviour and Appetite Scale (CEBAS) assessed the actual eating habits and behaviours related to food. It consisted of 50 questions, each with a multiple choice response, where '0' referred to not at all, '1' just a little, '2' pretty much, and '3' very much. Significant differences within and between groups was determined by t-tests, using SPSS (Statistical Package for the Social Sciences) for Windows, version 10 (SPSS, Inc., Chicago, IL, USA) (18) with significant difference at the ($p < 0.05$) level. In addition, the CEBAS also allowed the caregivers to list the five most liked and the five most disliked foods of the child. Microsoft Excel was used determine the relative frequency of the number of participants who consumed each of the foods mentioned. The foods were then each

designated a colour and a texture. Microsoft Excel was used to determine the relative frequency of the number of participants who consumed each of the colours and textures mentioned.

The Conners' Parent Rating Scale (CPRS-48) as per Conners', CK, 1989 (8), composed of 48 questions, was completed by the primary caregivers in both groups, in respect to characterising various behaviour patterns in children aged 3-10 years old. The CPRS was not an exact measure of the child's behaviour but a reflection of parental perception. It contains 48 questions concerning; conduct and learning problems, psychosomatic, impulsive-hyperactive scales, anxiety and hyperactivity index (16). Caregivers were instructed to indicate "how much you think your child has been bothered by this problem in the past month" where '0' referred to not at all, '1' just a little, '2' pretty much, and '3' very much. Only one of the questions (Q40. Problems with eating) was used in this study. Significant difference in factor scores within and between groups was determined by t-tests, using SPSS (Statistical Package for the Social Sciences) for Windows, version 10 (SPSS, Inc., Chicago, IL, USA) (20) with significant difference at the ($p < 0.05$) level.

Types of foods eaten

The FFQ, based on the CSIRO FFQ, was previously modified to make it more applicable to the study population. The format corresponded with other questionnaires in the booklet, the timeframe was 3 months. Foods were updated to reflect currently available foods, the CSIRO version was last updated in 1998 and measurements were used that represented similar household measurements, for example; cups, slices. In addition, 'other-please specify' options at the end of each section. Caregivers had to answer how often each of the foods listed had been consumed, the choices were 'never tried', 'didn't like', 'rarely', or times a month, week or day it is typically consumed. Microsoft Excel was used to determine the relative frequency of the number of participants who consumed the main food groups (cereals, vegetables, fruits, dairy, and meat). Significant differences within and between groups for each of the five food groups was determined by t-tests, using SPSS (Statistical Package for the Social Sciences) for Windows, version 10 (SPSS, Inc., Chicago, IL, USA) (20) with significant difference at the ($p < 0.05$) level. This FFQ data for both cohorts was compared to the DGCAA to determine whether the children were meeting the necessary requirements (A worked example can be found in the Appendix). The number of serves each

participant consumed of each specific food was also added using Microsoft Excel, the group totals and means were calculated.

RESULTS

For the analysis, SPSS and Microsoft Excel were used. As mentioned earlier, the following results involved the comparison of a group of children with autism, ASD group (n=73) and without autism, control group (n=40).

General Eating Behaviour

General differences in the children's eating behaviours were compared using the CEBAS. Schreck et al indicated that caregivers of children with autism describe their children as having significantly greater fussy eating behaviour, and consequently significantly more feeding issues than caregivers of children without autism (19), this was supported in this study. An Independent Samples t-test was carried out to ascertain whether the children with autism varied from those without autism, via Question 5 of the CEBAS concerning fussy eating behaviour. The Levene's Test for Equality of Variances was significant, indicating unequal variances. Consequently, the t-test for unequal variances was reported, $p=0.000$. The autism group (mean=1.78, standard deviation=1.20) scored higher than the control group (mean=0.95, standard deviation=0.96). This difference depicted that children with autism endure more general fussy eating behaviour, although this finding was not indicative of the exact types of fussy eating behaviour that existed.

Types of fussy eating behaviour

Through the CEBAS and the Conners' Rating Scale, more analysis were conducted on the types of fussy eating behaviours children with autism possessed. The groups were compared for responses given for various behaviours presented in Table 1.

Table 1- Types of fussy eating behaviour of children with autism compared to children without autism

Feeding Problem	ASD Group (n=73)			Control Group (n=40)		
	Mean	SD	CV	Mean	SD	CV
Lacks variety in food choices	1.90	1.16	61.05	0.80	0.97	121.25
Repetitive food choices	2.06	1.12	54.37	1.10	1.01	91.82
Only accept food or drink with certain plates or cups	0.77	1.11	144.16	0.20	0.52	260.00
Fussy about food texture	1.46	1.15	78.77	0.50	0.78	156.00
Fussy about food colour	0.81	1.13	139.51	0.30	0.61	203.33
Fear of trying new things	1.87	1.07	57.22	0.85	0.86	101.18
Has trouble chewing food as expected for age	0.80	1.12	140.00	0.05	0.22	440.00
Problems with eating	0.78	1.21	155.13	0.10	0.50	500.00

When viewing the means in Table 1, variation between the two groups can be clearly noted. It is interesting to view the standard deviations (SD) for each of the questions and the size of the standard deviations compared to their respective means. The Coefficient of Variation (CV) reflects this. The greater the CV, the further the standard deviation from the mean, and hence the greater the difference between the subjects in the groups.

The Independent Samples t-test demonstrated that there was a significant difference between the groups for all of the questions (Table 2). The means show that the autism group scored higher on each of the questions reflecting them having greater feeding problems, compared to the control group.

Table 2- Significance (2-tailed) for various types of fussy eating behaviour

Feeding Problem	Significance (2-tailed)
Lacks variety in food choices	0.000
Makes repetitive food choices	0.000
Will only accept food or drink with certain plates or cups	0.000
Is fussy about food texture	0.000
Is fussy about food colour	0.003
Is afraid of trying new things	0.000
Has trouble chewing food as expected for age	0.000
Problems with eating	0.000

Again, the Levene's Test for Equality of Variances was found to be significant for all questions given to caregivers concerning types of feeding behaviours, thus the t-test for unequal variances was reported (Table 2). This indicates that, according to caregiver responses, there was a definite variation in the eating behaviour of children with autism and those without autism. This finding was further supported by the means for each of the groups. As depicted in Table 1, the means for each of the questions asked were greater in the autism group when compared to the control group. In particular, the mean for question 10 was greater than all other means in both groups, but especially higher in the autism group, reflecting the repetitive behaviour that is characteristic of children with autism.

Similar questions relating to eating behaviour- lacks variety in food choices, makes repetitive food choices, is obsessed with sameness of foods, and is afraid of trying new things, all proved consistent as the t-test for unequal variances was reported as 0.000. Perhaps this is indicative that the caregivers' responses to these similar questions were accurate. The question relating to children only accepting food or drink with certain plates or cups is consistent with anecdotal literature and also with parental responses founded in the focus group study by Hart (10).

With fussiness related to food being identified it was necessary to determine the impact of these behaviours on the dietary choices made by children with autism, and to compare

these choices to those of the control group to establish whether there were any differences between those with autism and those who are typically developing children. Also comparisons to the Dietary Guidelines for Children and Adolescents (DGCAA) to determine whether these children were making choices, as a result of their behaviour, that allowed them to meet adequate levels for each food group. Identification of the types of foods being consumed was conducted through the analysis of the Food Frequency Questionnaire. The five food groups (cereals, vegetables, fruit, dairy, and meat including alternatives) for the two groups were compared.

Types of foods eaten

The proportion of each group consuming each food group was determined by counting the frequency within the FFQ. As demonstrated in Figure 1, a greater percentage of participants within the autism group consumed cereals, fruit and dairy, than the control group where more participants tended to consume vegetables and meat.

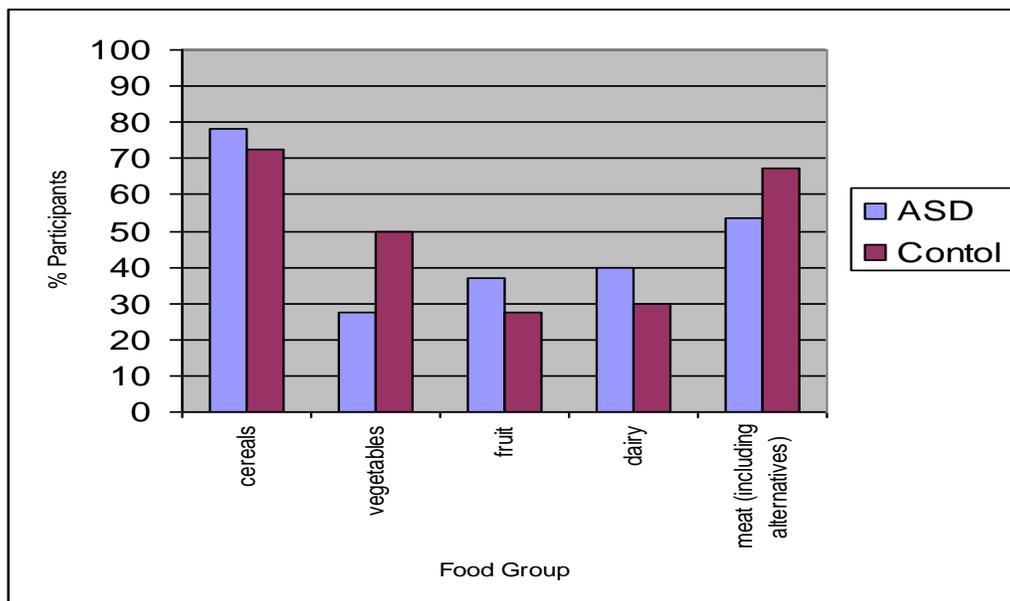


Figure 1- Proportion of ASD children consuming the five main food groups compared with children without autism

Statistical t-tests were undertaken to determine when the children in the autism group differed from the control group on the number of serves for each of the five food groups. When Levene's test for Equality of Variances was significant indicating unequal variances, the t-test for unequal variances was reported. Significant differences in the number of serves

of fruit ($p=0.021$) and dairy ($p=0.000$) were found. Table 3 clarifies this by showing that the mean number of serves consumed by the autism group of fruit and dairy were higher when compared to the control group. Table 3 also shows that compared to the control group, the autism group consumed more serves of meat, but the t-test indicated that there was no significant difference for meat between the two groups.

Table 3- Mean number of serves of the five main food groups consumed by children with autism, compared to children without autism and the DGCAA

Food Types	Recommended Number of Serves (ADG)	ASD Group (n=73)		Control Group (n=40)	
		Mean	SD	Mean	SD
Cereal	5-7 or 6-9	4.67	2.85	5.09	3.17
Vegetable	2-3	2.92	2.37	4.02	2.62
Fruit	1	3.34	3.21	3.04	2.17
Dairy	2	5.95	9.48	4.15	2.71
Meat inc. alternatives	1	6.16	9.12	5.42	2.86

According to Table 3, the autism group failed to meet the dietary guidelines for cereals, where on average they consumed 4.67 serves per day which is lower than what is recommended, 5-7 serves per day for 4-7 year olds 6-9 serves per day for 8-11 year olds (15). The number of serves of vegetables consumed by the autism group was found to be adequate, whilst they consumed over the three times the amount of fruit recommended, and almost three times the necessary amounts of dairy and six times the meat and alternatives. Excessive amounts of dairy consumed by the autistic children was consistent with the findings of Whetely et al (7). The control group consumed adequate amounts of cereal and more than enough of the other four food groups. This indicates that the behaviour of the autistic children is influencing their number of servings of each of the food groups when compared to the control group.

With the CEBAS indicating that the caregivers felt that autistic children were not consuming enough variety of specific foods within each of the food groups, it was interesting to explore this further and to determine if the caregivers beliefs could be supported by the information provided on the FFQ. Figures 2-6 depict the variety of specific foods consumed within each group.

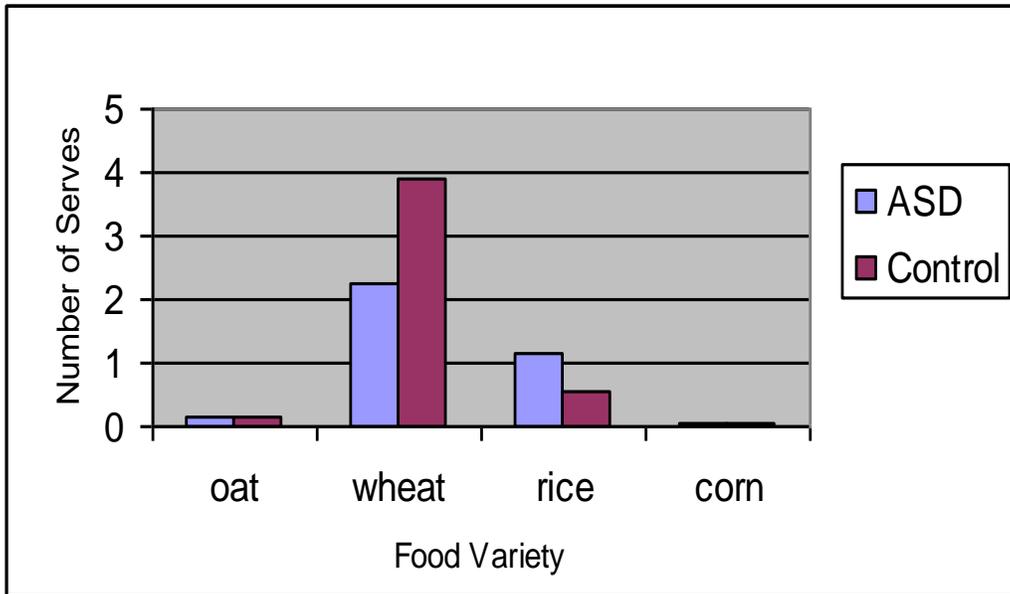


Figure 2- Variety of cereals being consumed by children with autism, compared with children without autism

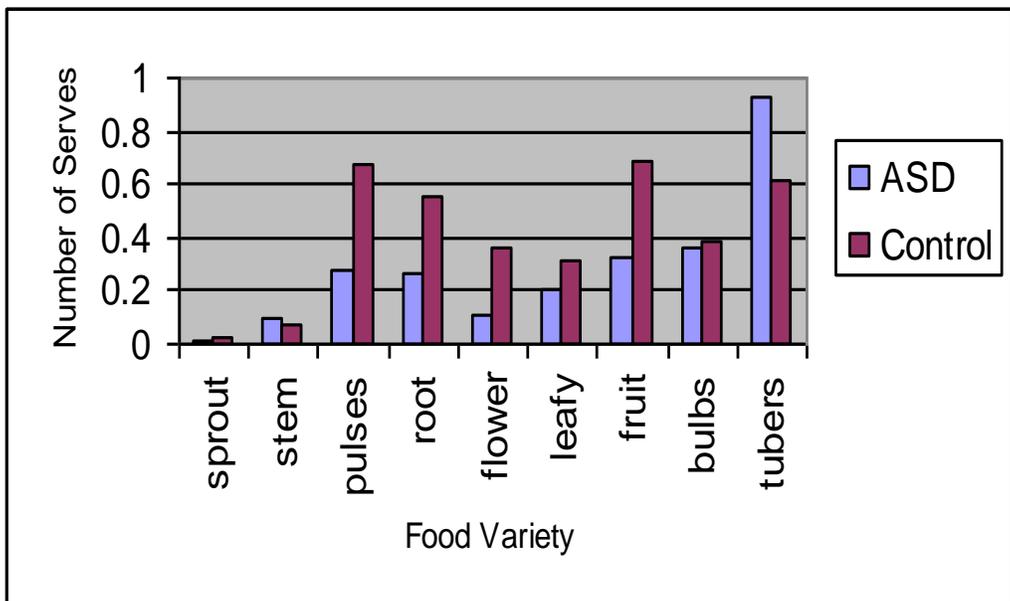


Figure 3- Variety of vegetables being consumed by children with autism, compared with children without autism

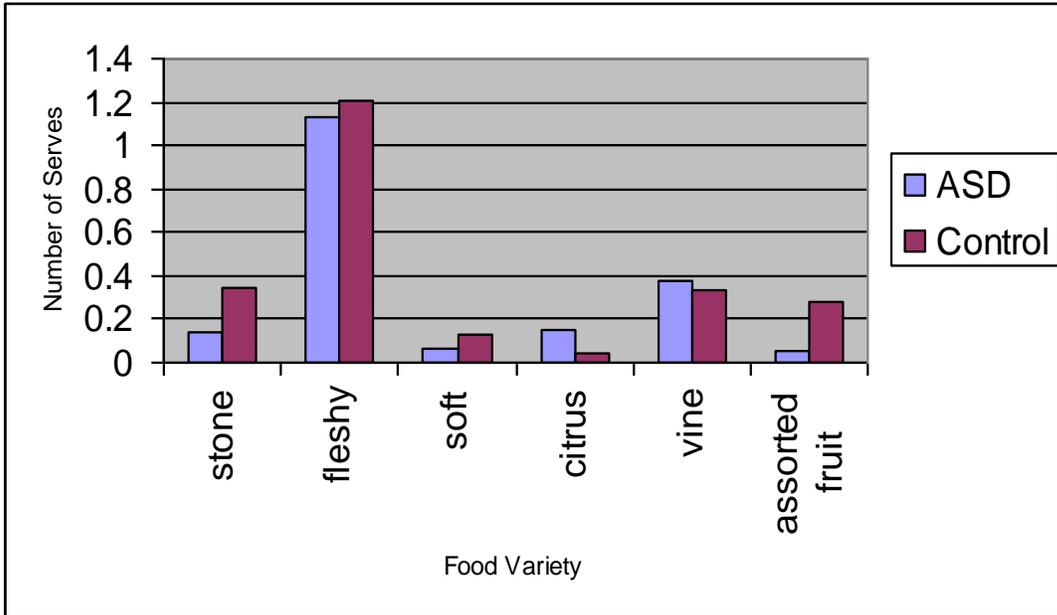


Figure 4- Variety of fruits being consumed by children with autism, compared with children without autism

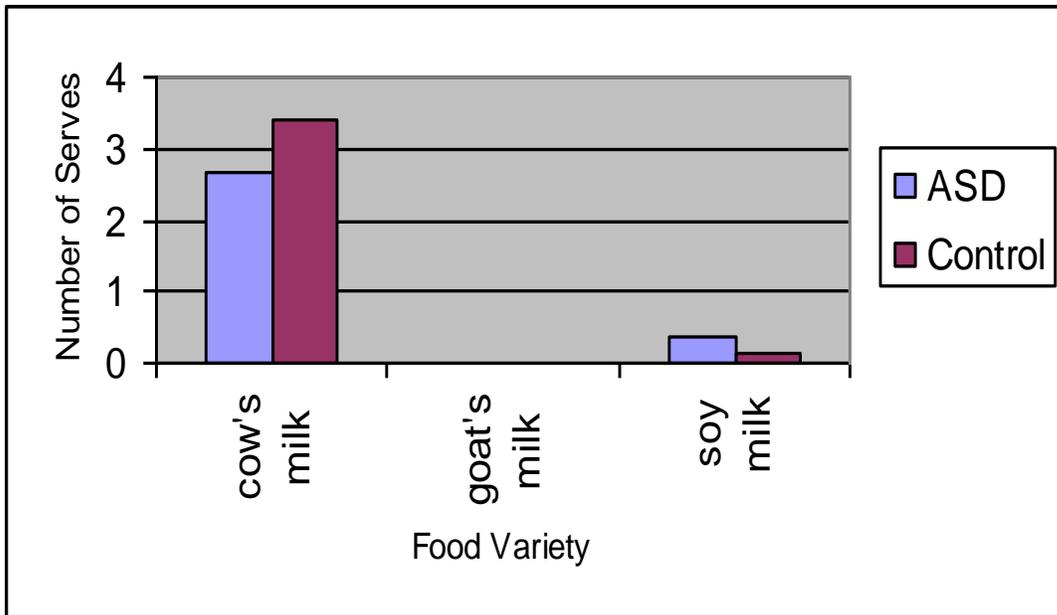


Figure 5- Variety of dairy products being consumed by children with autism, compared with children without autism

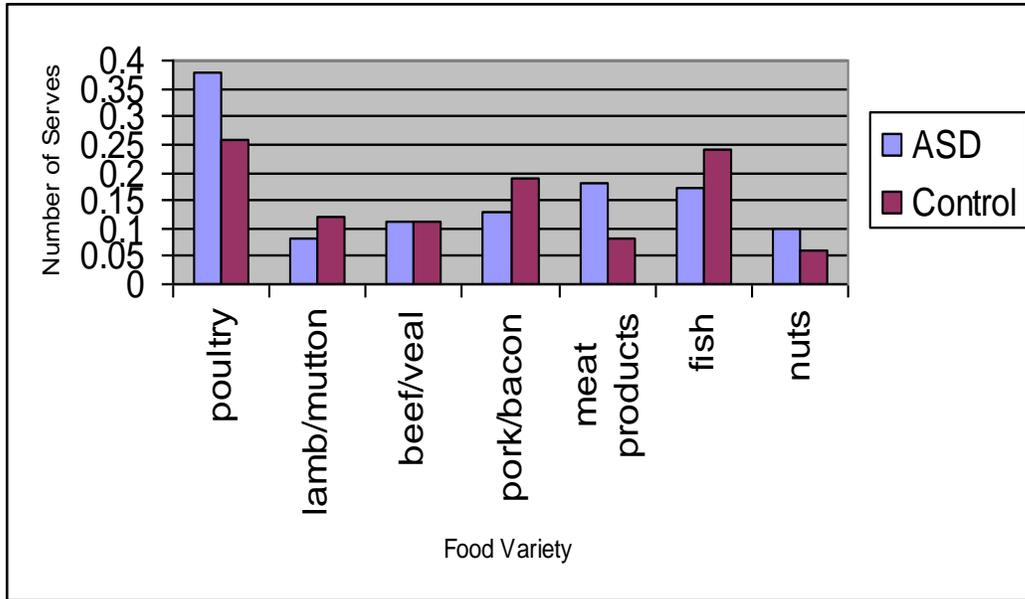


Figure 6- Variety of meat and alternatives being consumed by children with autism, compared with children without autism

As can be seen in Figures 2-6, autistic children often consumed a lesser variety than the control group, which was especially evident with vegetables. Whilst the children with autism appeared to be consuming various types of foods within each of the food groups, the quantities they were consuming were mostly small.

With the range of foods consumed by the autism group being identified compared to the control group, it is interesting to note how their behaviour affected their dietary choices in terms of what foods they prefer and why or what is it about these foods they prefer in terms of colour and texture, when fussiness related to colour and texture presented significant differences between the groups (Table 2).

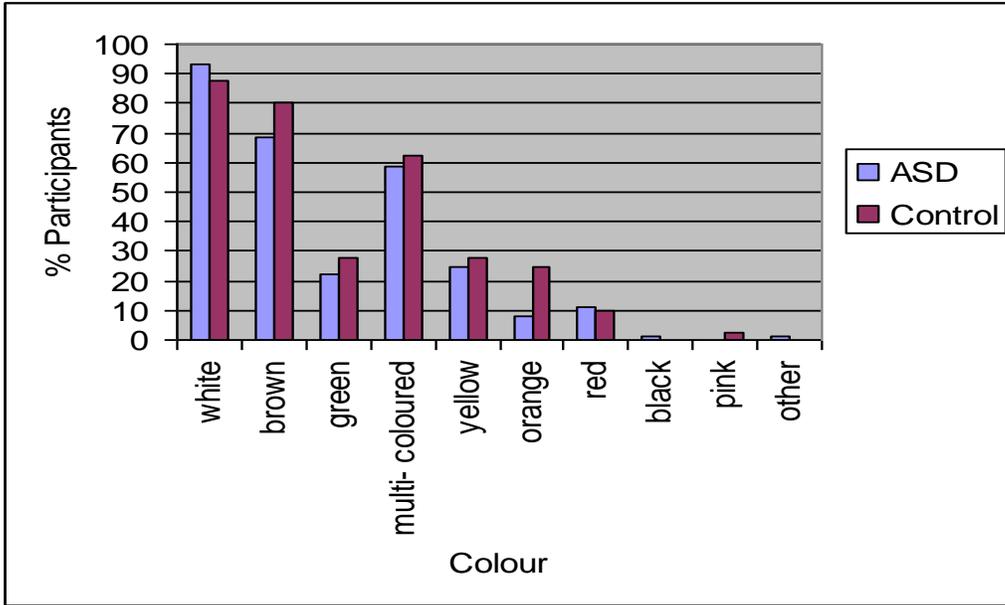


Figure 7- Colour preferences of children with autism compared to children without autism

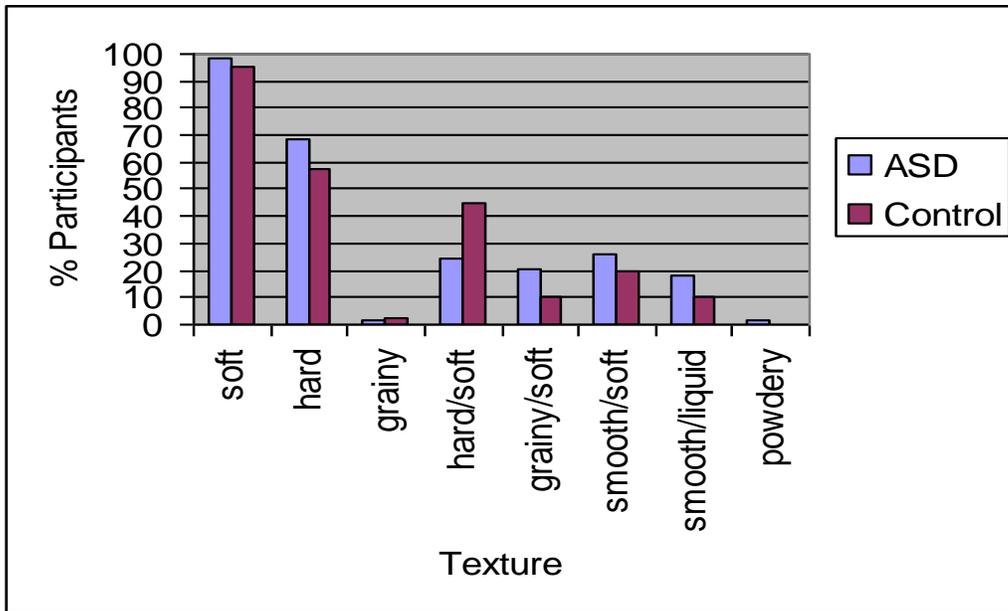


Figure 8- Texture preferences of children with autism compared to children without autism

The results in Figure 7 depict the characteristic behaviour of children with autism to prefer plain foods. The most preferred colour was white, although this was also the case for the control group, raising the question that perhaps more white foods are consumed within the usual diet. Similarly, the most preferred texture in the diet was soft for both groups (Figure 8), hence maybe more soft foods are consumed within the usual diet.

DISCUSSION

The notion that children with autism display more fussy eating behaviours than children without autism (1), was supported in this study. The results of this study were consistent with other previous studies, demonstrating that children with autism have fussy eating behaviour that limits their dietary choices, compared to children without autism (7).

The anecdotal reporting of fussy eating behaviour and limited food intake by the primary caregivers of autistic children from the focus group study (10) and the typical repetitive and restrictive behaviour and need for sameness by autistic children, were confirmed by the CEBAS, and in part by the FFQ. In this study, primary caregivers reported their children with autism exhibited more general feeding problems including; lacks variety in food choices, makes repetitive food choices, is fussy about food texture, colour, and its presentation, and is afraid of trying new things. Many of these problems were also commented upon within the conducted focus groups (10).

The analysis of the number of serves of each food group consumed reflected the restrictive behaviour of the autistic children as they consumed fewer serves per day of cereals and vegetables, compared to the children without autism. Similarly, this behaviour was also apparent when viewing the variety of foods being consumed, where the children with autism consumed fewer specific types of foods within each food group than the children without autism. Whilst the variety displayed by both groups was similar for cereals, dairy and meat. The children with autism consumed fewer vegetables as a whole in terms of food groups, and constantly consumed less serves contributing to them having a lesser variety within their diet, with the exception of tubers. Tubers, primarily potatoes, were more readily consumed by the autistic children than the children who were not autistic, reflecting not only the limited range and need for sameness through fear of trying new things of those with autism but also their

preference for white coloured foods, which in turn was confirmed in the analysis of their colour preferences. In the fruit group it appeared that both groups were consuming similar quantities, with the exception of assorted fruit, where those with autism ate significantly fewer serves compared to those without autism. Again, reflecting the autistic children's preference for plain coloured foods rather than multi-coloured foods, like the assorted fruits.

The preference for colour in the five most liked and disliked foods somewhat validates the need for sameness. Children with ASD like things to be plain and simple rather than too busy and confusing (18), which would indicate why they prefer white foods the most, such as poultry over red meats (Table 6). Although it is possible that this result is not completely suited to only those with autism as there is a possibility that white foods are found in greater quantities within the normal diet. There is a lack of evidence to support that only those with autism prefer white coloured foods, and as can be found in the results of this study, those without autism also had a significantly high preference for white coloured foods. The children without autism preferred brown and multi-coloured foods quite significantly and more than the children with autism, further validating the pattern in the autistic children's preferences for plain coloured foods. A preference for plainer white foods by the children, particularly those children with autism, may be a reflection of them perceiving these foods as being 'safe' or familiar.

As previously stated, autistic children do not like things, including foods to be too busy (18), which could be the reason why they chose softer textures, for example; fleshy fruits (Figure 4) as the most preferred over grainier foods and foods with a combination of very different textures like hard/soft. Results from the CEBAS demonstrated the children with autism are more fussy about texture than the controls.

Although with both groups preferring softer textures it could be because this study is concentrating on fairly young children who would probably be consuming more soft foods than older children and adults. In addition to this, it perhaps is not related to the type of texture these young children were able to tolerate, as according to caregiver responses in the CEBAS, 'has trouble chewing as expected for age' was not a major issue when looking at the means (Table 1) although there was a significant difference between the two groups (Table 2).

Whilst this study is in agreement with much of the previous research already conducted,

there are some problems in the study design which could possibly have impacted upon the results and thus should be improved for greater accuracy to be achieved.

There were a greater number of participants with ASD than the control group, perhaps the accuracy of the results could be improved if equal numbers of participants were present in each group, and if participants were aged matched across the groups. In addition to this, increasing the overall number of study participants would also allow for less variation and consequently more accurate results.

The age range 3-10 years was chosen for a variety of reasons, but it could have possibly limited the results to only this age range, when it has been found that older children do indeed possess fussy eating behaviours also (19). Although this does not mean that the results can not be used and information gained from this study by older children with ASD, as the general behavioural patterns would still be similar.

In terms of the overall reliability of the caregiver responses to the CEBAS, the Connors' Rating Scale, and the FFQ, certain factors need to be considered. Caregivers sometimes failed to completely fill in questionnaires which would have impeded upon the results. Perhaps there needs to be greater explanations provided to each of the caregivers concerning what exactly is required in each questionnaire and make it understood that by only partially completing them the results will not be as accurate or worthwhile.

For the measure of food intake, the results may have been more accurate had the food actually been physically presented to the children rather than relying upon caregiver responses (1). It is possible that caregivers may issue their children with foods they know the child will readily accept and not reject, it is also possible that in the FFQ the amounts and the frequency of foods were not reported correctly, therefore, leading to inaccuracies within the results due to underestimation or even overestimation of foods. Although if the method by Ahearn et al was to be utilised (1), it would not necessarily be the most appropriate of ways to investigate autistic children's eating behaviours when considering their attitudes towards the unfamiliar, so an artificial eating environment may cause the child to eat less or differently to what they would typically consume in a more familiar setting (21).

Whilst few studies have looked at fussy eating behaviours and the impact upon dietary choice between children with and without autism, it is necessary that far more research be conducted to both confirm and expand upon what has already been discovered.

As indicated by the partial failure of autistic children to meet the dietary guidelines, it may be necessary for further study and also medical professionals to address the fussy eating behaviours to ensure children with autism not only consume a decent variety of foods within each food group, but also that they meet their nutritional requirements (11).

CONCLUSION

When comparing children with autism with children without autism, it can be seen that those with autism suffer a greater number of feeding problems due to their characteristic behaviours, as documented by caregivers. These behaviours often impact upon their dietary choice, evident through often lesser serving sizes than typically developing children, and preference for plain foods. Continuation of this study, along with some changes to the study design would allow for the feeding behaviours of autistic children to be further explored. More focus should be concentrated on how the behaviour of children with autism affects their dietary choice, to ensure that the diets of these children still allow them to meet their dietary requirements, despite their repetitive and restrictive behaviours.

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APPENDIX