Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.
Associations between Sensory Issues, Mealtime Behaviours, and Food and Nutrient Intakes in Children with Autism Spectrum Disorder

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Science

in

Human Nutrition and Dietetics

at Massey University, Albany, New Zealand.

Nicole Taylor

2016
Abstract

Background: Sensory issues are defined as dysfunction within the integration of the seven senses within the brain. Dysfunction can lead to issues within higher-level integrative functions such as social participation and planning and praxis, and lead to atypical responses to one’s environment. Sensory issues are highly prevalent in children with Autism Spectrum Disorder (ASD) and have been associated with difficult mealtime behaviours. It is not known if sensory issues are associated with food or nutrient intake in ASD children living in New Zealand (NZ). Nutritional deficits during development could have compounding effects on cognition and behaviour in ASD.

Methods: Analysis of baseline data from an ongoing randomised-controlled trial was undertaken. Using a cross-sectional observational study design we investigated associations of sensory issue severity with frequency of difficult mealtime behaviour and food and nutrient intakes of children aged 2.5–8 years with ASD in NZ. The Sensory Processing Measure (SPM), Behavioural Paediatric Feeding Assessment Scale, Dietary Intake for Child’s Eating (DICE), and four-day food diaries were used to measure sensory issues, difficult mealtime behaviours, food intake, and nutrient intake, respectively.

Results: Of 113 participants, 90.2% of children had sensory issues, and 41.5% of children had clinical difficult mealtime behaviours. An increase in sensory issue severity corresponded to an increase in frequency of difficult mealtime behaviours ($r=.265$, $p=.007$). Social participation issue severity was inversely associated with the total DICE score ($r=-.305$, $p=.003$). More than 50% of the children did not meet Ministry of Health recommendations for servings of fruit, vegetables, breads and cereals, milk and milk products, or nutrient intakes for calcium. Neither sensory issue severity nor frequency of difficult mealtime behaviours appeared to be associated with food and nutrient intakes.

Conclusion: Sensory issues are highly prevalent in ASD children and sensory issue severity is positively associated with frequency of difficult mealtime behaviours. Intervention is required in a number of children with ASD to ensure food and nutrient intake recommendations are met.
Acknowledgements

I am proud to have completed my thesis as part of my Master's Degree in Human Nutrition and Dietetics at Massey University. In aiding its completion I would first like to thank my primary supervisor Dr Pamela von Hurst for her patience, guidance, and expertise.

I would also like to thank my co-supervisor, Dr Cath Conlon for her contributions to my findings, aiding my understanding of the Behavioural Paediatric Feeding Assessment Scale, and providing feedback on my work.

I would also like to acknowledge doctorate student Hajar Mazahery, research manager Owen Mugridge, and Dr Kathryn Beck of Massey University. Hajar and Owen provided me with their help and support and Kathryn contributed to the development of the DICE tool.

Finally, I would like to thank Sean Maloney for your relentless support over the last two years.
# Table of Contents

Abstract ........................................................................................................................................ iii
Acknowledgements ..................................................................................................................... iv
Table of Contents .......................................................................................................................... v
List of Tables ............................................................................................................................... vii
List of Figures ............................................................................................................................ viii
List of Abbreviations ................................................................................................................... ix

1.0 Chapter 1: Introduction ........................................................................................................ 1
   1.1 Sensory Issues ............................................................................................................... 1
   1.2 Difficult Mealtime Behaviours ...................................................................................... 2
   1.3 Food and Nutrient Intakes in ASD ................................................................................ 3
   1.4 Study Purpose ................................................................................................................ 3
   1.5 Study Aim, Objectives, and Hypotheses ....................................................................... 4
   1.6 Thesis Structure ............................................................................................................ 5
   1.7 Researchers Contributions ........................................................................................... 6
   1.8 Reference List ................................................................................................................ 7

2.0 Chapter Two: Literature Review .......................................................................................... 9
   2.1 What is Autism? ................................................................................................................. 9
   2.2 Sensory Issues ................................................................................................................ 10
   2.3 Sensory Issues in ASD .................................................................................................... 11
   2.4 Tools Used To Measure Sensory Issues in ASD ............................................................... 13
   2.5 Difficult Mealtime Behaviours ....................................................................................... 18
   2.6 Tools Used to Measure Difficult Mealtime Behaviour .................................................. 20
   2.7 Potential Impacts of Sensory Issues on Mealtime Behaviours ...................................... 25
   2.8 Studies investigating Sensory Issues and Difficult Mealtime Behaviours ..................... 28
   2.9 The Importance of Nutrition ........................................................................................... 29
   2.10 Food and Nutrient Intakes in ASD ................................................................................. 29
   2.11 Tools used to Measure Food and Nutrient Intakes .......................................................... 30
   2.12 Biochemical Assessment of Nutrient Status in ASD Children ...................................... 31
   2.13 Mealtime Behaviours and their Effects on Food and Nutrient Intakes in ASD ............ 32
   2.14 What is Missing from the Research? .............................................................................. 34
   2.15 Reference List .............................................................................................................. 36

3.0 Chapter 3: Associations between Sensory Issues, Difficult Mealtime Behaviours, and Food and Nutrient Intakes in Children with Autism Spectrum Disorder ................................................................................. 43
   3.1 Introduction ..................................................................................................................... 43
List of Tables

Table 1. *Researchers contributions.* ................................................................. 6
Table 2. *Sensory stimuli and their possible effects on children and young people with ASD.* 12
Table 3. *Tools used to measure sensory processing in children with ASD.* .................. 14
Table 4. *Tools used to measure mealtime behaviours in children with ASD.* ................. 21
Table 5. *Participant characteristics.* ......................................................................... 50
Table 6. *Categorisation of sensory issue severity.* ................................................... 51
Table 7. *Most frequently occurring difficult mealtime behaviours.* .......................... 52
Table 8. *Sensory issue severity associations with frequency of mealtime behaviours.* ... 53
Table 9. *Participants meeting food serving recommendations.* ................................. 54
Table 10. *Colours of fruits and vegetables eaten using DICE.* ................................ 54
Table 11. *Participants meeting acceptable macronutrient distribution ranges.* .......... 55
Table 12. *Participants meeting micronutrient intake recommendations.* .................... 56
Table 13. *Participant biochemical status for iron, serum folate, and serum vitamin B12.* 57
List of Figures

Figure 1. *The senses affecting how we interact with the environment* ............................................. 1
Figure 2. *Classifications of sensory processing disorder* ............................................................. 10
List of Abbreviations

AI  Average Intake
AMDR  Acceptable Macronutrient Distribution Range
APA  American Psychological Association
ASD  Autism Spectrum Disorder
BAMBI  Brief Autism Mealtime Behavior Inventory
BMI  Body Mass Index
BPFAS  Behavioural Paediatric Feeding Assessment Scale
CEBI  Child’s Eating Behaviour Inventory
CFS  Child Frequency Score
CRP  C-Reactive Protein
DICE  Dietary Index for a Child’s Eating
DHB  District Health Board
DNZ  Dietitians New Zealand
DSM-5  Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
EAR  Estimated Average Requirement
EBQ  Eating Behaviour Questionnaire
FFQ  Food Frequency Questionnaire
Hb  Haemoglobin
ID  Intellectual Disabilities
IOM  Institute of Medicine
MoH  Ministry of Health
NHMRC  National Health and Medical Research Council
NRV’s  Nutrient Reference Values for Australia and New Zealand
NZ  New Zealand
PFS  Parent Frequency Score
RDI  Recommended Dietary Intake
RRB  Repetitive and Restrictive Behaviours
SBMD  Sensory-based Motor Disorder
SDD  Sensory Discrimination Disorder
SF  Serum Ferritin
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIPT</td>
<td>Sensory Integration and Praxis Tests</td>
</tr>
<tr>
<td>SIT</td>
<td>Sensory Integration Theory</td>
</tr>
<tr>
<td>SMD</td>
<td>Sensory Modulation Disorder</td>
</tr>
<tr>
<td>SP</td>
<td>Sensory Profile</td>
</tr>
<tr>
<td>SPD</td>
<td>Sensory Processing Disorder</td>
</tr>
<tr>
<td>SPM</td>
<td>Sensory Processing Measure</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>SSP</td>
<td>Short Sensory Profile</td>
</tr>
<tr>
<td>SSRC</td>
<td>Sense and Self-Regulation Checklist</td>
</tr>
<tr>
<td>TFS</td>
<td>Total Frequency Score</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VIDOMA</td>
<td>Vitamin D and Omega-3 in Autism</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>