

An Innovative Technology-based Intervention to Address Childhood Obesity

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Statement of originality

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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Thesis by publication

I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written declaration from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers.

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Author's notes

People's first language for Obesity

Person-first language is the standard for respectfully addressing people with chronic conditions. Person-first language is used throughout the thesis when discussing individuals with overweight or obesity. For example, person-first language requires that the young people discussed herein are never described as “overweight children” or “obese children”, but rather “children with overweight” or “children with obesity”.

Thesis navigation using cross-references

To facilitate navigation of this thesis, cross-referencing feature was applied when referring to chapters, sections, tables, figures and appendices throughout the thesis. Keyboard controls listed below can be used to navigate to cross-referenced content and return to previously viewed position within the PDF document.

Functions	Keyboard controls
Go to a cross-referenced content	Left click (mouse)
Return to previously viewed position	Hold down Alt + Left arrow

Publications arising from this thesis

My thesis is presented with the inclusion of 6 peer-reviewed manuscripts and 1 policy brief report. My thesis comprises of five of these manuscripts (Chapters 2 to 6) and the remaining one manuscript (protocol paper) is included in the Appendices. I am the lead author on all manuscripts and the report.

Manuscripts in peer-reviewed journals: Published

Chai LK, Burrows T, May C, Brain K, Wong See D, Collins C. Effectiveness of family-based weight management interventions in childhood obesity: an umbrella review protocol. *JBIR Database System Rev Implement Rep*. 2016;14(9):32-9.

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Chai LK, Collins CE, May C, Brown LJ, Ashman A, Burrows TL. Fidelity and acceptability of a family-focused technology-based telehealth nutrition intervention for child weight management. *J Telemed Telecare*. 2019 Aug 7:1357633X19864819. doi: 10.1177/1357633X19864819

Chai LK, Collins CE, May C, Holder C, Burrows TL. Accuracy of parent-reported child height and weight and calculated body mass index compared to objectively measured anthropometrics. *J Med Internet Res*. 2019 Sep 16;21(9):e12532. doi: 10.2196/12532.

Presentations arising from this thesis

During my candidature, I presented results arising from my thesis at 2 national and 4 international conferences. This resulted in 3 oral and 3 poster presentations.

Conference abstracts: Published in conference proceedings

1. **Chai LK**, Collins C, May C, Holder C, Burrows T. Are parents accurate reporters of their child's height, weight, and calculated Body Mass Index? And does their accuracy change between pre- and post-intervention? *International Society of Behavioral Nutrition and Physical Activity Conference, Prague, Czech Republic, 4-7 June 2019*. [Poster presentation]
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6. **Chai LK**, Burrows T, May C, Brain K, Wong See D, Collins C. Effectiveness of Family-based Childhood Obesity Interventions with Parental Involvement: An Umbrella Review. *International Society of Behavioral Nutrition and Physical Activity Conference, Victoria, Canada, 7-10 June 2017*. [Poster presentation]

Additional publications co-authored during candidature

During my candidature, I worked as a Research Assistant at the University of Newcastle and contributed to 4 additional publications. The publications are consistent with my research focus, however they sit aside from the research included within this thesis and were therefore not included. Details of the additional publications to which I contributed are listed below.

Additional manuscripts in peer-reviewed journals: Published

1. Burrows T, Hutchesson M, **Chai LK**, Rollo M, Skinner G, Collins C. Nutrition Interventions for Prevention and Management of Childhood Obesity: What Do Parents Want from an eHealth Program? *Nutrients* 2015, 7(12):10469-10479. doi:10.3390/nu7125546.
2. Yoong SL, **Chai LK**, Williams CM, Finch M, Wiggers J, Wolfenden L. A systematic review of the impact of interventions involving a sleep component on child body mass index, diet and physical activity. *Obesity* 2016, 24(5):1140-7. doi: 10.1002/oby.21459.
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Awards

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Priority Research Centre in Physical Activity & Nutrition Best Paper Award 2019 - *Accuracy of parent-reported child height and weight and calculated body mass index compared to objectively measured anthropometrics*

Glossary of terms and abbreviations

ABS	Australian Bureau of Statistics
ADG	Australian Dietary Guidelines
AES	Australia Eating Survey
APD	Accredited Practising Dietitian
B2BF	Back2basics Family
BCW	Behaviour Change Wheel
BMI	Body mass index
CCC	Concordance correlation coefficient
CDC	Centers for Disease Control and Prevention
COM-B	Capability, opportunity, motivation for behaviour
EDNP	Energy-dense nutrient-poor
FFQ	Food frequency questionnaire
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
IOTF	International Obesity Task Force
IVR	Interactive voice response
MM	Modified Monash
NSW	New South Wales
PAL	Physical activity level
QOE	GRADE quality of evidence
RCT	Randomised controlled trials
SES	Socioeconomic status
SMS	Short message service (mobile text messaging)
SR	Systematic review
T2DM	Type 2 diabetes mellitus
TDF	Theoretical Domains Framework
WHO	World Health Organization
zBMI	Body mass index z-scores

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Abstract

Childhood overweight and obesity currently impacts one in four children aged 5-17 years in Australia. Compared to peers with a healthy weight, children with overweight and obesity commonly experience bullying or teasing at school, have poorer mental health, including depression, anxiety, and in some cases disordered eating, exacerbated by weight bias and stigma. These children also have greater risk of having myocardial infarction and stroke in adulthood, and are at elevated risk for developing type 2 diabetes mellitus (T2DM). Given 90% of cases of T2DM are preventable through healthy lifestyle interventions that incorporate improvements in dietary patterns and physical activity levels, accessible programs are needed.

Current Australian public health services for personalised child overweight and obesity treatment have limited geographical reach. Given the prevalence of childhood obesity, Australian public health services need more timely and cost-effective methods to efficiently address high levels of demand for personalised child weight management consultation, advice and support. This is particularly crucial to those who have difficulty accessing currently available services. One of the challenges in the field is translating research findings into evidence-based public health and clinical practice in partnership with health services in order to actively disseminate them and with wide uptake. My thesis presents a series of research studies that aimed to develop and evaluate the feasibility and acceptability of a novel technology-based intervention that was developed alongside current services in New South Wales (NSW) and that has the potential to be translated into health services widely in Australia to support families in improving child weight status and dietary outcomes.

Firstly, an umbrella review was conducted in order to synthesise the existing evidence from systematic reviews and meta-analyses of experimental studies on the effectiveness of family-based behavioural weight management interventions for children with overweight or obesity. The umbrella review included 14 systematic reviews, consisting of 47 independent trials which were rated as being of low to moderate methodological quality. The review highlights that family-based interventions targeting parents, alone or with their child, are effective for child weight management. Five reviews highlighted that parent-only interventions have similar ($n=4$) or greater ($n=1$) effectiveness compared to parent-child interventions. However, there was a lack of high quality evidence, especially in the emerging parent-only interventions area. Effective interventions employed parent-targeted strategies, including nutrition and physical activity education sessions, positive parenting skills, role modelling, and child behaviour management to encourage positive healthy eating/exercise behaviours in children and/or whole family.

The second study presented in my thesis reports the development of a set of evidence-based text messages, targeted to mothers and fathers, which is complementary to a family-focused nutrition intervention and guided by the Theoretical Domain Framework and COM-B model of behaviour change. The study fills a gap to address the lack of reporting in existing research as to how text message interventions were developed and whether the text messages content was endorsed by the intended recipients. The study used a systematic process in developing text messages which were grounded in behaviour change theory and research evidence concerning the importance of the relationship that parents share in raising children, the parenting partnership. The study used a co-design approach to develop the text messages by involving key stakeholders and end-users (i.e. parents, dietitians, researchers) who reviewed and provided feedback on the clarity, usefulness, and relevance of a total of 97 messages from the initial draft. A final set of 48 messages (36 messages targeting both parents, six messages targeting fathers and six messages targeting mothers) were selected for use within a lifestyle intervention to support parents in improving the dietary behaviours of their children. The set contained a combination of messages which can be implemented in combination with additional behavioural interventions to prompt parents on healthy eating within the family while simultaneously leveraging the influence of parenting partnerships to support lifestyle change.

The third study applied findings from the umbrella review and the text message development study into an innovative family-focused online telehealth nutrition intervention. The study aimed to test the feasibility and acceptability of the novel intervention in improving child weight status and dietary intake, and the impact of the addition of evidence-based text messages targeted to mothers and fathers. Findings from the 12-week pilot study demonstrated that a tailored family-focused online telehealth nutrition intervention was highly feasible and acceptable among families with children aged four to 11 years. Children in the intervention groups had significantly improved dietary intakes at week 12 (reduced energy intake from energy-dense nutrient-poor foods, and increased energy intake from healthy core foods) compared to control group. However, change in weight outcomes were not significantly different within or between groups. The study being a feasibility and pilot trial, which was underpowered, had insufficient sensitivity to detect statistically significant between-group differences in child weight outcomes. A sample size of 104 children per group was recommended to be able to detect two unit of difference in BMI at 80% power based on post hoc sample size calculation.

A process evaluation of the pilot study was conducted to evaluate intervention fidelity in accordance with the National Institutes of Health Treatment Fidelity Framework. Results demonstrated that an online telehealth intervention delivered by trained Accredited Practising Dietitians (APDs) had good adherence with $\geq 83\%$ of planned content delivered as intended.

Results also indicated that parents who completed the program found the telehealth intervention convenient and easy to use and would recommend telehealth to other parents. Overall, a technology-based child nutrition and weight management intervention using telehealth, website, Facebook and SMS can be delivered by trained APDs with good fidelity and attain high acceptability and satisfaction among families with children aged four to 11 years in NSW, Australia.

The final study was a secondary analysis of data to assess the level of agreement between parent-reported child height, weight, and researcher-calculated BMI compared to the same data objectively measured by trained researchers. The study used Lin's concordance correlation coefficient, which is superior to Pearson's correlation coefficients which only measures the correlation between two data variables, but not how close or far the data fall from the line representing perfect agreement. This is a unique component of my thesis because for researchers and clinicians to have confidence in the integrity of eHealth interventions, knowing whether parent-reported measures online are valid is critical to interpreting data on health measures collected via online means. It is also essential to understand the nature of bias within parent-reported data to allow for adjustment in eHealth research ahead of translation to practice settings. Results demonstrated that parents under-reported child height and weight among a group of children aged four to 11 years, and were generally more accurate in reporting child weight compared to height. The under-reporting of child height and weight in the study resulted in poor agreement between the BMI calculated by researcher using parent-reported and researcher-measured data. However, the weight category (i.e. underweight, healthy weight, overweight, obesity) derived from parent-reported data of the majority of children were in agreement with researcher-measured data. Therefore, online parent-reported child height and weight may be a valid method of collecting child weight category information ahead of participation in a web-based program.

The results presented in my thesis demonstrate that personalised technology-based child weight management intervention has high feasibility and acceptability among families with children aged four to 11 years. This novel intervention, underpinned by findings from an umbrella review and a text message development study, has the potential to be translated more broadly to other health services and scaled up to complement existing weight management services in Australia. The results, in addition to findings reported in manuscripts, were collated into a policy brief to communicate the major findings from this trial to key stakeholders and policy developers and to highlight key implications to the wider health services in Australia. This policy document was written in collaboration with representatives from the NSW Office Preventive Health and Children's Health Queensland Hospital and Health Service. The innovative eHealth approach was complemented by promising results showing

that online parent-reported child height and weight were relatively reliable for deriving the weight category of the child. Health practitioners can work with parents as the agents of change and focus on fostering positive parenting skills, such as monitoring, reinforcement, role modelling, and providing a nurturing environment, in order to support health behaviours in their children. Given children with obesity may experience a range of health complications and co-morbidities that reduce their quality of life and adversely impact their health and wellbeing, the results presented in my thesis provide both clinical practice and research recommendations for child weight management using technology-based nutrition interventions, and have implications for parents, clinicians, health research and policy.