

# Health Online for Teens (HOT) program for Australian adolescents above a healthy weight: study protocol

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## Abstract

**Background:** Over one quarter of Australian adolescents are overweight or obese, with obesity in adolescents strongly persisting into adulthood. Recent evidence suggests that the mid-teen years present a final window of opportunity to prevent irreversible damage to the cardiovascular system. As lifestyle behaviours may change with increased autonomy during adolescence, this life-stage is an ideal time to intervene and promote healthy diet and activity behaviours, wellbeing and self-esteem. As teenagers are prolific users and innate adopters of online technologies, app-based programs may be suitable for the promotion of healthy lifestyle behaviours and goal setting training.

**Objective:** This study aims to explore the reach, engagement, user experience and satisfaction of the new app- and web-based Health Online for Teens (HOT) program in a sample of Australian adolescents above a healthy weight (i.e. overweight or obese) and their parents.

**Methods:** Health Online for Teens (HOT) is a 14-week program for adolescents and their parents. The program is delivered online via the Moodle app- and website-based online learning environment and aims to promote adolescent lifestyle behaviour change in line with Australian Dietary Guidelines and Australia's Physical Activity and Sedentary Behaviour Guidelines for Young People (13 – 17 years). HOT aims to build parental and peer support during the program to support adolescents with healthy lifestyle behaviour change. This project is currently delivering the intervention to participants and data collection is ongoing.

**Results:** Data collection for this study is ongoing. To-date, 35 adolescents and their parents have participated in one of three groups.

**Conclusions:** Health Online for Teens (HOT) is a new online-only program for Australian adolescents and their parents which aims to reduce cardiovascular disease risk factors. This study protocol paper describes the HOT program in detail, along with the methods to measure reach, outcomes, engagement, user experiences, and program satisfaction. Clinical Trial: This study was prospectively registered in the Australian New Zealand Clinical Trials Registry (ANZCTR, <http://www.anzctr.org.au>) on 29 March 2018 with registration number: ACTRN12618000465257. The first participant was enrolled in to the study on 19 April 2018.

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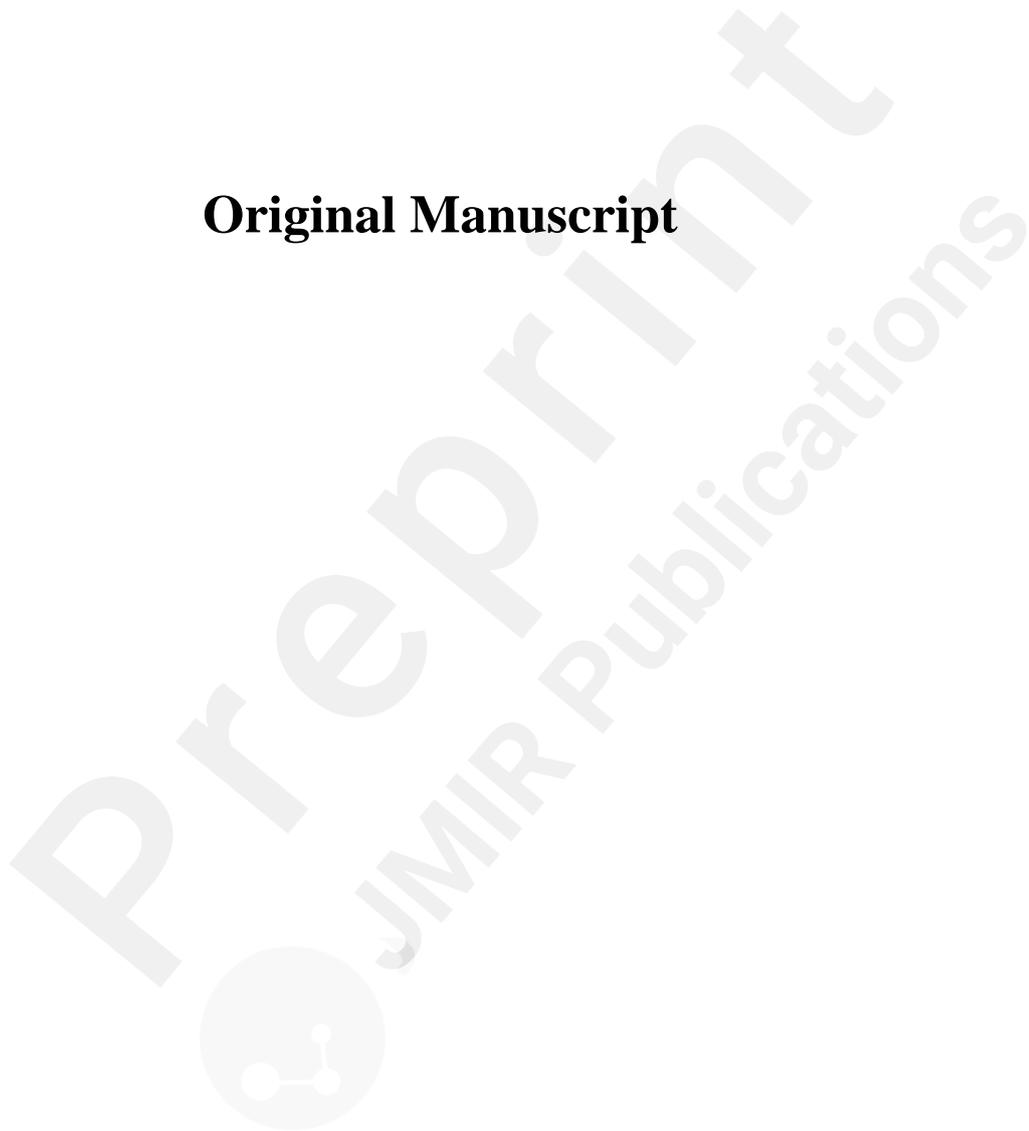
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## Title

Health Online for Teens (HOT) program for Australian adolescents above a healthy weight: study protocol

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**Background:** Over one quarter of Australian adolescents are overweight or obese, with obesity in adolescents strongly persisting into adulthood. Recent evidence suggests that the mid-teen years present a final window of opportunity to prevent irreversible damage to the cardiovascular system. As lifestyle behaviours may change with increased autonomy during adolescence, this life-stage is an ideal time to intervene and promote healthy diet and activity behaviours, wellbeing and self-esteem. As teenagers are prolific users and innate adopters of online technologies, app-based programs may be suitable for the promotion of healthy lifestyle behaviours and goal setting training.

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**Methods:** Health Online for Teens (HOT) is a 14-week program for adolescents and their parents. The program is delivered online via the Moodle app- and website-based online learning environment and aims to promote adolescent lifestyle behaviour change in line with Australian Dietary Guidelines and Australia's Physical Activity and Sedentary Behaviour Guidelines for Young People (13 – 17 years). HOT aims to build parental and peer support during the program to support adolescents with healthy lifestyle behaviour change.

**Results:** Data collection for this study is ongoing. To-date, 35 adolescents and their parents have participated in one of three groups.

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adolescents and their parents which aims to reduce cardiovascular disease risk factors. This study protocol paper describes the HOT program in detail, along with the methods to measure reach, outcomes, engagement, user experiences, and program satisfaction.

**Trial Registration:** This study was prospectively registered in the Australian New Zealand Clinical Trials Registry (ANZCTR, <http://www.anzctr.org.au>) on 29 March 2018 with registration number: ACTRN12618000465257. The first participant was enrolled in to the study on 19 April 2018.

## Keywords

Adolescent

Overweight

Obese

Online

Diet

Physical activity

Psychological wellbeing

Behaviour change

## Introduction

### The issue: Adolescent obesity

Currently, more than a quarter of Australian adolescents aged 14 –to 17 years are overweight or obese, which is significantly higher than 20 years ago [1]. High body mass index (BMI) in adolescence is difficult to reverse and persists into adulthood [2-5]. Previous findings from the

American Bogalusa Heart Study, a longitudinal study with mean follow-up of 17.6 years, showed the prevalence of obesity in adulthood was 86% for men and 90% for women amongst adolescents who had been obese between the ages of 15 and 17 years [4]. Adolescent obesity is associated with considerable short and long-term health consequences, such as increased risk of heart disease and diabetes [6, 7]. These risk factors have also been shown to track into adulthood [2] which, in addition to the risk of being an obese adult, indicate a double burden of adolescent obesity on cardiovascular disease risk.

### **Why target adolescence?**

Adolescence is a period of transition during which autonomy and independence increase. During this life stage, autonomy over food choice [8] and influences from peers can contribute to overweight risk behaviours, including unhealthy diets, insufficient physical activity and excessive sedentary time [9, 10]. Parent behaviours, healthy home food environments [11], peer-support from friends [12], and social norms [13] can each influence adolescent lifestyle behaviours and are important to consider in developing interventions for this population. Typical changes to diet during adolescence include a decrease in breakfast consumption and increased frequency of snacking, fast food consumption and eating outside of the home environment [14-16]. As a result, diet quality declines from childhood to adolescence [17]. Activity changes include a decrease in physical activity (especially in girls) and an increase in sedentary time [14, 18, 19]. As lifestyle behaviours are pliable and behaviours formed during adolescence have been shown to track into adulthood [3, 14] it is important to intervene during this time to promote healthier behaviours. It has been recently suggested that mid-teen years represent a tipping point as the window of opportunity to prevent irreversible damage to the cardiovascular system caused by unhealthy lifestyle factors and excess BMI may close after this time [20].

## **Adolescents and technology-based programs: the evidence gap**

Adolescents are early adopters of technology and generally are innately accepting of innovative methods of communication and learning. In 2015, it was estimated that 65% of Australian teenagers aged 14 to 17 years used a mobile phone to access the internet, 74% used a computer to access the internet, and 80% had a smartphone [21]. Moreover, Australian adolescents between 15 to 17 years of age have the highest proportion of internet users (98%) [22]. Online programs have the capacity to achieve greater reach than face-to-face programs as participants can be included irrespective of geography or means of transport to a physical location [23]. Although online-only programs exist for adult weight management [23] there is a paucity of online-only programs for secondary prevention of obesity in adolescents [24].

### **The HOT program**

A new program, HOT (Health Online for Teens), is the first Australian online-only, expert-supported group intervention involving parental and peer support for obesity prevention in adolescents. HOT is underpinned by theories of behaviour change and self-determination and recognises the importance of engagement in lifestyle choices at a critical, yet pliable, period of transition. Covering the key areas of overcoming peer pressure, maintaining a healthy diet and being physically active as well as emotional well-being, HOT provides opportunities for teens (and their parents) to gain improved lifestyles through goal setting, peer and expert support.

### **Study aims**

The objective of this study is to determine the feasibility of a new online healthy lifestyle program

(HOT) to improve lifestyle-related behaviours in a sample of Australian adolescents above a healthy weight. Specifically, this study aims to 1) obtain feedback from a sample of overweight/obese teens who will be asked to discuss the content, features, and design of HOT; and (2) determine the feasibility of HOT through pilot testing in a sample of up to 45 adolescents and collecting data on recruitment, retention, and engagement over the course of the 14-week program. This publication describes the study methods and rationale to achieve these research aims.

## Methods

### Design and research objectives

This study is a non-randomised intervention feasibility trial [25] which aims to assess the acceptability, demand, implementation and practicality of the HOT program. Accordingly, there is no control or comparator group in this study. The research protocol was prospectively registered with the Australian New Zealand Clinical Trials Registry (ACTRN12618000465257) on 29 March 2018. Ethics approval for this study was granted by the Flinders University Social and Behavioural Research Ethics Committee on 21 March 2018 (Project number 7896; Health Online for Teens: An Australian technology based lifestyle program for overweight adolescents).

This paper reports the protocol of intervention and evaluation of HOT in line with the Standard Protocol Items: Recommendations for Interventional Trials checklist (SPIRIT) [26, 27]. **The findings of the study will be reported according to the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) Statement [28].** The research objectives of this feasibility study are outlined in Table 1.

**Table 1: Research objectives in the HOT Feasibility study**

| Research objectives  |
|--|
| To assess engagement and use of the HOT program and its components, and HOT-BOT by teenage |

|   |
|---|
| participants  |
| To assess engagement and use of HOT and parent resources by parents/caregivers of the participants  |
| To determine the reach of HOT recruitment and representativeness of the target population   |
| To determine the effectiveness of the program to support teenagers to achieve healthy lifestyle goals, and improve weight, diet and activity behaviours, and self-perception (outcome evaluation)                 |
| To determine program satisfaction and process evaluation data from participants   |
| To conduct focus groups and/or interviews to deeply explore the participants' HOT experience, thoughts on the content, appearance and design of the program and its elements, and barriers/enablers to engagement |

## Population

Australian adolescents will be recruited from the community via social media advertising. Adolescent participants express interest to participate in the study via an online survey administered through Qualtrics (Qualtrics, Provo, UT, USA). Qualtrics is an online survey tool which is supported by the researchers' host institution. Adolescents expressing an interest to participate will be screened against several inclusion and exclusion criteria. Eligible adolescents include: girls and boys; aged between 13-17 years at enrolment; who are above a healthy weight for their age and gender; not pregnant or breastfeeding; with access to Wi-Fi at home. Eligible parents or caregivers of included adolescents can be of any age and typically 1 – 2 parents/caregivers are anticipated to be included for each adolescent. Adolescent participants will be identified as above a healthy weight (overweight, obese, and morbidly obese) using self-reported height and weight and weight status from BMI (International Obesity Task Force [IOTF] extended criteria) [29]. Groups are planned to commence when there are a minimum of 10 eligible adolescent and parent dyads who provide their consent to participate. Parents will provide informed consent for themselves and their child to participate and children will provide informed assent to participate in the form of scanned hardcopy consent forms, electronically-signed sheets, or upon commencement of baseline surveys administered online. Copies of Participant Information Sheets and Consent and Assent Forms are provided in the Supporting Information as per the SPIRIT Checklist [26, 27].

## Intervention

The online HOT program aims to support overweight/obese adolescents to improve their lifestyle, through setting goals and making sustainable changes to diet and activity patterns. The HOT program aims to improve knowledge on healthy diet, activity, and emotional wellbeing, and build skills and capacity for teens to plan ahead, set their own goals, reflect and evaluate on their progress. The HOT program encourages participants to seek support from parents and peers to facilitate a home improvement which is supportive of a healthy lifestyle and self-esteem.

The HOT program has a number of principles which inform program targets, and strategies which are promoted in order to achieve the targets (Table 2). These targets are underpinned by national guidelines [30-32] and other evidence-based recommendations [33-36]. The HOT program also aims to build capacity and resilience in teenagers to identify barriers toward a healthy lifestyle, plan ahead and take small steps and sustainable changes to overcome these. The HOT program incorporates a number of behaviour change techniques [37] including: Providing information on consequences of behaviour in general; Providing normative information about others' behaviour; Goal setting (behaviour); Barrier identification/problem solving; Prompting self-monitoring of behaviour; Prompting a focus on past success; Providing information on where and when to perform the behaviour; Providing instruction on how to perform the behaviour; Using of follow-up prompts; Planning social support/social change; and Relapse prevention/coping planning.

Goal setting is a key element of HOT and while HOT participants set their own goals around diet and activity and monitor their progress, HOT aims to address common adverse behaviours for adolescents including skipping breakfast, frequent fast food intake, high levels of sedentary

behaviour, and low levels of physical activity by encouraging individual goal setting in these areas. HOT employs the use of SMART goals [38] which are specific, measurable, achievable, realistic and time-bound. An outline of each week of the program, including the context for individuals to conceptualise their own SMART goals is presented in Error: Reference source not found. In addition to HOT sessions which are accessed through Moodle, a supportive and motivational chat-bot (HOT-BOT) is built in to the HOT program to collect information on teen goals and to prompt them to complete the program tasks for the week, set their goals, and reflect on their progress. HOT-BOT is delivered via Facebook Messenger and operates on the Chatfuel platform [39]. Facebook Messenger was selected for the HOT-BOT as Facebook is widely used and accepted by both adolescents and their parents. The Facebook Messenger platform is also compatible with the chat-bot technology, whereas other social media platforms commonly used by adolescents do not support this technology (e.g. SnapChat, Instagram).

## Program access

Adolescents participating in HOT will be loaned a project iPad mini for the duration of the project. The iPad is configured with the apps required for the project (Moodle and Facebook Messenger) and will be delivered to the adolescents approximately 1.5 weeks before they start the program. Upon safe return of equipment at the end of the program, families will receive a \$50 (AUD) gift card for either Apple iTunes/App Store or Coles Myer in recognition of their contribution to this study. Adolescents will be provided with their HOT login and will be able to log in to Moodle from any other device as they wish. Parents will not be loaned any device during HOT but will be given a login to access HOT for themselves via their own personal devices (smartphone, tablet) or computer (desktop or laptop). Parents and adolescents will have access to the same HOT content, however there will be separate spaces for parents and adolescents to connect with their peers via a discussion

forum. In addition to HOT sessions, parents will have access to specifically-tailored information including: Supporting your teen to meet Health Online for Teens targets; Communicating with your teen; Your teen and body image; Healthy lifestyle guidelines for adults (diet, activity, sleep); and a collection of additional parent resources (web links).

**Table 2: Health Online for Teens (HOT) Lifestyle Behaviour Principles, Targets and Strategies for Adolescents**

| main             | HOT Principles  | HOT Targets   | HOT Strategies  | References  |
|------------------|---|---|---|---|
| et               | Eat a wide range of core foods every day, based on the AGHE   | Aim to eat: <ul style="list-style-type: none"> <li>▪ 2 serves of fruits per day</li> <li>▪ 5 serves of vegetables per day</li> <li>▪ wholegrain and wholemeal cereal-based products (breads, pasta, rice, cereals)</li> <li>▪ low fat dairy and lean meat products</li> </ul> | <ul style="list-style-type: none"> <li>▪ Plan healthy meals and snacks ahead of time</li> <li>▪ Take a packed lunch to school</li> <li>▪ Include fruits and/or vegetables in every meal</li> <li>▪ Get involved in food planning, shopping, preparation and cooking</li> <li>▪ Try healthy recipes</li> <li>▪ Encourage family meals</li> </ul> | ADG [31] and the AGHE [32] Larson <i>et al.</i> , 2007 [40] |
|                  | Limit discretionary foods and choose healthy snacks instead   | <ul style="list-style-type: none"> <li>▪ Aim to limit the number of discretionary foods each week</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Choose fruits and vegetables as snacks; swap discretionary foods (chips, chocolates, muesli and snack bars) for healthy snacks</li> <li>▪ Plan snacks ahead of time and pack healthy snacks for school and other daily activities</li> </ul>   | ADG [31] and the AGHE [32]                                  |
|                  | Replace sweetened soft drinks, sports drinks, energy drinks, flavoured milks and cordial with water | <ul style="list-style-type: none"> <li>▪ Aim to drink 2 litres of water per day and avoid sweetened beverages (cordial, soft drinks)</li> </ul>   | <ul style="list-style-type: none"> <li>▪ Pack a water bottle with you wherever you go</li> <li>▪ Refill at water fountains at school and when on the go</li> <li>▪ On hot days, freeze water overnight for a refreshing drink during the day</li> </ul>   | ADG [31] and the AGHE [32] Healthy Kids (NSW Health) [33]   |
| ysical<br>tivity | Be active every day   | <ul style="list-style-type: none"> <li>▪ Aim to do at least 1 hour of moderate to vigorous intensity physical activity every day</li> </ul>   | <ul style="list-style-type: none"> <li>▪ Incorporate physical activity in everyday life, it is fun and a great way to spend time with people</li> </ul>   | Australia's Physical Activity and Sedentary Behaviour       |

|                     |  |   |   |   |
|---------------------|--|---|---|---|
|                     |  | <ul style="list-style-type: none"> <li>Aim to include strengthening exercises in physical activity at least 3 times per week</li> </ul>   | <ul style="list-style-type: none"> <li>Include activities that build strength for strong muscles and bones, these do not need to be gym-based</li> </ul>  | Guidelines [30]   |
| Sedentary behaviour | Minimise sedentary time and time spent looking at screens (e.g. TV, phone, computer, iPad) | <ul style="list-style-type: none"> <li>Aim for no more than 2 hours in screen-based activities (outside school hours and not including homework)</li> <li>Limit prolonged periods of sitting (&gt;30 minutes)</li> </ul>  | <ul style="list-style-type: none"> <li>Plan specific periods of time for watching TV and using other screen devices</li> <li>Plan for active and outdoor activities with friends over watching tv, playing computer games</li> <li>Choose active travel options where possible</li> <li>Try to get up and move regularly when at home, and when possible at school</li> </ul> |   |
| Sleep               | Get plenty of sleep each night   | <ul style="list-style-type: none"> <li>Aim for 8-10 hours of quality sleep per night</li> </ul>   | <ul style="list-style-type: none"> <li>Avoid using screens in the bedroom and avoid screen use just before bedtime</li> <li>Establish a relaxing bedtime routine</li> </ul>   | National Sleep Foundation (US) [34]<br>Australian Centre for Education in Sleep [36]<br>Better Health Channel (Vic Health) [35] |
| Wellbeing           | Develop and maintain positive relationships with self, family, friends and peers           | <ul style="list-style-type: none"> <li>Treat others with respect in the way you would like to be treated</li> <li>Listen to and respect others' points of view</li> <li>Suggest solutions to problems and be encouraging</li> <li>Avoid toxic relationships – online and in real life</li> <li>Increase self-awareness and learn principles of mindfulness</li> </ul> |   | -   |
|                     | Be a positive influence and encourage healthy behaviours in others                         | <ul style="list-style-type: none"> <li>Encourage and support healthy behaviours</li> <li>Be a role model for others</li> <li>Share enthusiasm and positivity for healthy lifestyles</li> </ul>  |   | -   |

Abbreviations: ADG, Australian Dietary Guidelines; AGHE, Australian Guide to Healthy Eating

Table 3: Health Online for Teens (HOT) Program Outline

| Time        |         |            | Weekly session content   | Weekly activities   |
|-------------|---------|------------|--|---|
| Week        | Days in | Days to go |  |   |
| Pre-program | -7-0    | 99-105     | N/A Evaluation and reflection  | Pre-program evaluation  |
| 1           | 1-7     | 93-98      | <b>Introduction and welcome – live session</b><br>What is HOT<br>How to find your way around HOT<br>Introduction to HOT Targets (Table 2)      | Rules of communicating in HOT – dos and don'ts of participating in forums and chats<br>Introduction to your HOT group (forum)<br><b>To do:</b> Introduction to your HOT group (forum)<br><b>HOT-BOT</b> setup |
| 2           | 8-14    | 85-91      | <b>Nutrition:</b> How your diet impacts health<br>Introduction to the Australian Guide to Healthy Eating and the Australian Dietary Guidelines | <b>To do:</b> Healthy Eating Quiz [41] and forum discussion of results  |
|             |         |            | <b>Activity:</b> What is physical activity and sedentary behaviour   | <b>To do:</b> Keep a physical activity and screen time diary  |
|             |         |            | <b>Wellbeing:</b> Benefits of peer and parental support<br><b>Making changes:</b> Setting SMART goals and changing behaviours                  | <b>HOT-BOT</b> check in   |
| 3           | 15-21   | 78-84      | <b>Nutrition:</b> The 5 core food groups and the other discretionary foods, complete the food group quiz                                       | <b>To do:</b> Keep a diary of what foods you normally eat on a weekend day and weekday  |
|             |         |            | <b>Activity:</b> What are the physical activity and sedentary behaviour guidelines   | <b>To do:</b> Reflect on how much activity you do each day; compare weekday with weekend day  |
|             |         |            | <b>Wellbeing:</b> Finding and giving support, supportive   | <b>To do:</b> Identify barriers to healthy eating and   |

|    |       |       |   |   |
|----|-------|-------|---|---|
|    |       |       | environments  | possible solutions  |
|    |       |       | <b>Making changes:</b> What are barriers and what are enablers  | <b>My goals:</b> set a SMART goal to be more physically active  |
|    |       |       |   | <b>HOT-BOT</b> check in   |
| 4  | 22-28 | 71-77 | <b>Nutrition:</b> Healthy dietary fats  | <b>To do:</b> Reflect on your diet on weekend/non-weekend days: how does it compare   |
|    |       |       | <b>Activity:</b> Benefits of physical activity  |   |
|    |       |       | <b>Wellbeing:</b> What is body image  | <b>My goals:</b> Set a SMART goal to try a new physical activity with a friend or family member   |
|    |       |       | <b>Making changes:</b> Reviewing your goals: are they SMART   | <b>HOT-BOT</b> check in   |
| 5  | 29-35 | 64-70 | <b>Nutrition:</b> Importance of breakfast; healthy breakfast ideas  | <b>To do:</b> Body functionality writing task (modified from [42])  |
|    |       |       | <b>Activity:</b> Barriers to physical activity (busy lives, neighbourhoods, safety) and tips for exercising safely in the neighbourhood | <b>My goals:</b> set a SMART goal to:<br>- eat a healthy breakfast; and<br>- try a physically active alternative to watching TV or playing videogames with a friend |
|    |       |       | <b>Wellbeing:</b> Positive body image   |   |
|    |       |       | <b>Making changes:</b> Being realistic  | <b>HOT-BOT</b> check in   |
| 6  | 36-42 | 57-63 | <b>Nutrition:</b> Healthy lunches and snacks for school   | <b>My goals:</b> Set a SMART goal to:<br>- improve lunches and snacks for school this week; and<br>- try a new strengthening exercise                               |
|    |       |       | <b>Activity:</b> Strength building activities and what makes us strong  |   |
|    |       |       | <b>Wellbeing:</b> Physical activity, health and mental wellbeing  |   |
|    |       |       | <b>Making changes:</b> Goal setting review  | <b>HOT-BOT</b> check in   |
| 7  | 43-49 | 50-56 | <b>Nutrition:</b> Proportion of food groups in balanced dinner meals, Healthy recipe videos   | <b>My goals:</b> Set a SMART goal to:<br>- cook dinner for your family one night this week<br>- reduce screen time this week  |
|    |       |       | <b>Activity:</b> Strategies to reduce (non-homework) screen time  |   |
|    |       |       | <b>Wellbeing:</b> Building resilience   |   |
|    |       |       | <b>Making changes:</b> Building upon your goals   | <b>HOT-BOT</b> check in   |
| 8  | 50-56 | 43-49 | <b>Nutrition:</b> Choosing healthier takeaway foods   | <b>To do:</b> watch the Dove real beauty campaign and think about how the media can control what we see   |
|    |       |       | <b>Activity:</b> Do you spend too much time attached to devices (e.g. checking social media, texting)?                                  | <b>To do:</b> find and appraise a source of nutrition or physical activity advice on social media   |
|    |       |       | <b>Wellbeing:</b> How can media/social media makes us feel and why?   | <b>My goals:</b> Set a SMART goal to:<br>- choose a healthier takeaway meal; and<br>- use social media less this week   |
|    |       |       | <b>Making changes:</b> Review at the halfway point  | <b>HOT-BOT</b> check in   |
| 9  | 57-63 | 36-42 | <b>Nutrition:</b> Choose water over sugary drinks   | <b>To do:</b> Sugar drinks quiz   |
|    |       |       | <b>Activity:</b> Choose active transport over inactive options  | <b>To do:</b> Keep a sleep diary this week  |
|    |       |       | <b>Wellbeing:</b> Being cyber-aware and being safe online   | <b>My goals:</b> Set a SMART goal to:<br>- drink more water/less soft drink; and<br>- take an active transport option   |
|    |       |       | <b>Making changes:</b> How to stay motivated  | <b>HOT-BOT</b> check in   |
| 10 | 64-70 | 29-35 | <b>Nutrition:</b> Label reading and selecting items   | <b>To do:</b> Read labels of some common foods/snacks/drinks at home  |
|    |       |       | <b>Activity:</b> What are the sleep recommendations   |   |
|    |       |       | <b>Wellbeing:</b> Overcoming peer pressure  | <b>My goals:</b> Set a SMART goal to improve your sleep   |
|    |       |       | <b>Making changes:</b> How to cope with relapse   | <b>HOT-BOT</b> check in   |
| 11 | 71-77 | 22-28 | <b>Nutrition:</b> Healthy and easy food swaps at home and away, Recipe modification   | <b>To do:</b> Complete the sleeping habits checklist quiz   |
|    |       |       | <b>Activity:</b> Sleeping habits and sleep hygiene  | <b>My goals:</b> Set a SMART goal to choose a recipe and make it healthier  |
|    |       |       | <b>Wellbeing:</b> Increasing your self-awareness  |   |
|    |       |       | <b>Making changes:</b> How to prevent relapse, healthy eating at parties and celebrations   | <b>HOT-BOT</b> check in   |
| 12 | 78-84 | 15-21 | <b>Nutrition:</b> Why we eat – hunger and satiety, mindful eating   | <b>To do:</b> Reflect on why you eat (Mindless eating reflection task)  |
|    |       |       | <b>Wellbeing:</b> Self-awareness and mindfulness  | <b>To do:</b> Eat a meal mindfully and intuitively  |
|    |       |       | <b>Making changes:</b> sustainability and long term   | <b>My goals:</b> Set a SMART goal to make changes to  |

|              |        |      |   |   |
|--------------|--------|------|---|---|
|              |        |      | changes   | your sleep routine<br><b>HOT-BOT</b> check in   |
| 13           | 85-91  | 8-14 | <b>Nutrition/Activity/Wellbeing:</b><br>- review of HOT targets<br>- lifestyle behaviours can be related to each other<br>- bringing all these behaviours together to have and maintain a healthy lifestyle | <b>To do:</b> Mindful physical activity exercise<br><b>My goals:</b> Set SMART lifestyle (diet, activity etc.) goals you want to maintain after HOT |
|              |        |      |   | <b>To do:</b> Think about how you can maintain goals and HOT target behaviours (identify barriers, enablers)  |
|              |        |      | <b>Making changes:</b> Maintaining healthy lifestyle changes and relationships  | <b>HOT-BOT</b> check in   |
| 14           | 93-98  | 1-7  | <b>Program review - what have we all achieved? - live session</b><br>- How far have we come and where to from here<br>- Where to get help/support after HOT   | <b>To do:</b> Healthy Eating Quiz and reflection on diet changes during HOT   |
|              |        |      |   | <b>To do:</b> review of goals for after HOT   |
|              |        |      |   | <b>HOT-BOT</b> goodbye  |
| Post-program | 99-105 | -7-0 | N/A Evaluation and reflection   | Post-program evaluation   |

## Evaluation

A mixed-methods approach comprising quantitative and qualitative evaluation will be used to evaluate the feasibility of HOT. This project aims to evaluate the feasibility of HOT, including population characteristics (program reach); program outcomes (indication of program effectiveness); processes (program implementation); engagement (program use); and acceptability (program satisfaction) measures. A summary of measures and the time of assessment are described in Supporting Information Table 2. Specific primary outcomes and secondary outcomes of interest are listed in Table 3.

### *Quantitative evaluation: outcomes*

Program outcomes will be determined through pre-post program changes in lifestyle behaviours associated with increased cardiovascular risk and obesity (weight, diet, physical activity, sedentary screen time) as well as changes in adolescent self-perception domains and overall self-esteem. Adolescents will be asked to complete online pre- and post-program semi-quantitative surveys which assess key lifestyle behaviours. Self-reported adolescent height and weight will be used to calculate BMIz [43] and International Obesity Task Force (IOTF) extended weight status categories [29].

Child diet will be measured by the Children's Dietary Questionnaire [44] and estimation of Serves of Core Foods [45] which will be compared to Australian Dietary Guidelines [31] and recommended serves of core and discretionary foods as per the Australian Guide to Healthy Eating [32]. Objective measurement of physical activity and sedentary time will be collected by 7-day 24-hour accelerometry, GENEActiv Original wrist-worn accelerometer [46] on non-dominant hand [47]. Total time spent in sedentary, light, moderate and physical activity will be explored. Additional activity data will be collected using the Adolescent Physical Activity Recall Questionnaire (APARQ) [48] and Adolescent Sedentary Activity Questionnaire (ASAQ) [49]. Activity behaviours pre- and post-program will be compared to Australia's Physical Activity & Sedentary Behaviour Guidelines for Young People (13 – 17 years) [30]. Self-perception and self-esteem will be collected using the Harter self-perception profile for adolescents [50]. This tool explores eight specific self-concept domains: Scholastic Competence, Athletic Competence, Social Competence, Physical Appearance, Behavioral Conduct, Close Friendship, Romantic Appeal, and Job Competence, as well as a ninth subscale which reports Global Self-Worth [51].

### ***Quantitative evaluation: engagement and program satisfaction***

Usage of the program will be measured via metrics together with program satisfaction evaluation will inform adolescent engagement with the program elements and its acceptability. Data on program engagement for both parents and teens will be obtained from the online metrics collected by Moodle and Chatfuel, where applicable. Usage metrics will include: weekly sessions viewed ( $n$ , %); total number of hits ( $n$ ); average number of hits per week ( $n$ , %); number of individual sessions on Moodle ( $n$ ); number of forum posts ( $n$ ); and number of chatbot weekly check-ins completed ( $n$ , %). Parent and adolescent satisfaction with the HOT program will be explored by a purpose-designed questionnaire which is distributed post-program.

**Table 3: Primary and secondary outcomes and their assessment**

|  | Assessment method  | Time point   |
|--|--|--|
| <b>Primary outcomes</b>                                    |  |  |
| User engagement (adolescents and parents) with the program | Access of 14 program sessions, expressed as a proportion of content covered as measured by Moodle metrics  | from the start to the end of the program (14 weeks)  |
| Adolescent self-reported weight status                     | Height and weight used to calculate BMIz [43] and International Obesity Task Force (IOTF) extended weight status [29]  | change from pre-program (enrolment) to post-program (after 14-week intervention)             |
| <b>Secondary outcomes</b>                                  |  |  |
| Adolescent diet behaviour                                  | Children's Dietary Questionnaire [44] and Serves of Core Foods [45]  | change from pre-program (enrolment) to post-program (after 14-week intervention)             |
| Adolescent physical activity behaviour                     | 7-day 24-hour accelerometry, GENEActiv Original wrist-worn accelerometer [46] on non-dominant hand [47] and Adolescent Physical Activity Recall Questionnaire (APARQ) [48] | change from pre-program to post-program (after 14-week intervention)                         |
| Adolescent sedentary behaviour                             | 7 day 24-hour accelerometry, GENEActiv wrist-worn accelerometer [46] on non-dominant hand [47] and Adolescent Sedentary Activity Questionnaire (ASAQ) [49]                 | change from pre-program (enrolment) to post-program (immediately after 14-week intervention) |
| Adolescent self-perception                                 | Harter self-perception profile for adolescents [50]  | change from pre-program (enrolment) to post-program (immediately after 14-week intervention) |
| Parent and adolescent program satisfaction                 | Purpose-designed questionnaire   | post-program (immediately after the 14-week intervention)                                    |
|  | Qualitative interviews   | post-program   |

### *Quantitative evaluation: data management and analysis*

Participants will be allocated unique ID numbers at enrolment and all data collected will be recorded against this ID number, hence evaluation data will be de-identified for research purposes. All questionnaires will be completed online through Qualtrics (Qualtrics, Provo, UT, USA). The collection of evaluation data online has considerable advantages by avoiding manual data entry by research staff, minimising data entry errors and staff time. Direct data entry also enables the research team immediate access to the data via download directly to IBM® SPSS® v23 (IBM Corp. Armonk, New York, USA). As there is no control group for this healthy lifestyle intervention, pre- and post-program changes in lifestyle measures and child anthropometric data will be reported descriptively. Continuous data will be analysed in SPSS (IBM Corp. Armonk, New York, USA) and reported as

means [95% CI LL, UL] or medians (IQR), as appropriate and categorical data reported as  $n$  (%). Repeated measures paired t-tests will be used to analyse changes in outcomes over time for parametric data while the Wilcoxon signed-rank test will be used for paired pre-post non-parametric data. Alpha will be set at 0.05. The proportion of adolescents meeting recommendations for diet, physical activity and sedentary time as per Australian Guidelines [30] pre- and post-program will also be described. Finally, associations between program engagement and a) participant characteristics; and b) program outcomes will be explored.

### ***Qualitative analysis: data collection and analysis***

Upon completion of HOT, parents and adolescents may be invited to participate in an interview or focus group to more deeply explore user experience in HOT. Qualitative semi-structured interviews and/or focus groups will be conducted face-to-face for those living in the Adelaide area or over the phone for rural, remote, and interstate participants. Interview schedules will broadly aim to explore the user experience and usefulness of HOT for both adolescents and their parents. Interview questions will probe experiences for adolescents and their parents and will aim to capture what participants were seeking when they enrolled in to HOT (including perception of lifestyle problems and their severity); what changes they have made to their lifestyle as a result of participating in HOT; what challenges to making behaviour changes were encountered when participating in HOT; what additional content and/or support would have helped to get more out of the HOT program, including to make suggested lifestyle behaviour changes. **A more detailed indicative interview schedule is presented in Table 5.** It is anticipated that these participant interviews will elucidate suggestions for improvement of HOT, including HOT content and program delivery to optimise user experience and satisfaction.

Qualitative semi-structured interviews and/or focus groups will be audio recorded and transcribed

verbatim. Data will be entered and coded in N Vivo v10 qualitative data analysis software (NVivo, QSR International Pty Ltd., Melbourne, Australia) and analysed thematically. All data, including qualitative data, will be de-identified and stored in a secure, password protected drive with access only available to the research team members.

Table 5: Indicative questions for parents and adolescents following participation in HOT

|                                  | Questions for parents   | Questions for adolescents  |
|----------------------------------|---|--|
| <b>Introduction</b>              | <ul style="list-style-type: none"> <li>• Can you tell me a bit about yourself and your family?</li> <li>• How would you describe your relationship with [adolescent name]?</li> <li>• How would you describe your family lifestyle? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> </ul>   | <ul style="list-style-type: none"> <li>• Can you tell me a bit about yourself and your family?</li> <li>• How would you describe your relationship with your parent/s? Siblings?</li> <li>• How would you describe your family lifestyle? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> </ul>  |
| <b>Motivations for enrolment</b> | <ul style="list-style-type: none"> <li>• Can you tell me a little bit about how you became involved in HOT? (prompt: whose idea was it to be involved; how did you feel)</li> <li>• Can you tell me about what you expected HOT to be like?</li> <li>• What was [adolescent name] hoping to get from HOT?</li> <li>• Can you tell me about [adolescent name]'s health?</li> </ul>   | <ul style="list-style-type: none"> <li>• Can you tell me a little bit about how you became involved in HOT?</li> <li>• Can you tell me about what you expected HOT to be like?</li> <li>• What were you hoping to get from HOT?</li> <li>• Can you tell me about your health?</li> </ul>   |
| <b>Lifestyle changes</b>         | <ul style="list-style-type: none"> <li>• How motivated do you think [adolescent name] was to make changes during HOT?</li> <li>• How would you describe [adolescent name]'s lifestyle before HOT? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> <li>• Do you think that there have been changes to [adolescent name]'s lifestyle during HOT? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> <li>• Can you tell me how HOT has impacted your family lifestyle? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> <li>• Follow-up probing questions related to making changes: Were there things which helped you to make these changes? Were there any things which made it harder for you to make the changes you wanted?</li> </ul> | <ul style="list-style-type: none"> <li>• Can you tell me about your motivation to make changes during HOT?</li> <li>• How would you describe your lifestyle before HOT? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> <li>• Can you tell me about your lifestyle now? (prompts for lifestyle behaviours: diet, physical activity, sedentary behaviour, sleep, wellbeing)</li> <li>• Follow-up probing questions related to making changes: Were there things which helped you to make these changes? Were there any things which made it harder for you to make the changes you wanted?</li> </ul> |
| <b>Influences</b>                | <ul style="list-style-type: none"> <li>• Can you tell me who you think [adolescent name] looks to for healthy lifestyle advice?</li> </ul>  | <ul style="list-style-type: none"> <li>• Can you tell me where you go to get healthy lifestyle advice? (prompt: role models)</li> </ul>  |
| <b>Parent role</b>               | <ul style="list-style-type: none"> <li>• What do you think your role was in HOT?</li> <li>• What are some examples of how you helped support [adolescent name] during HOT?</li> <li>• Can you describe to me what you think a parent's role is in their teenagers' health?</li> </ul>   | <ul style="list-style-type: none"> <li>• Can you tell me about the role of your parent in HOT?</li> <li>• Can you describe to me what you think a parent's role is in their teenagers' health?</li> </ul>  |
| <b>Experiences with HOT</b>      | <ul style="list-style-type: none"> <li>• How would you describe your experience with HOT?</li> </ul>  | <ul style="list-style-type: none"> <li>• How would you describe your experience with HOT?</li> </ul>   |

|                          |  |   |
|--------------------------|--|---|
|                          | <ul style="list-style-type: none"> <li>• What are some of the things you liked about HOT? (prompt: and what about for [adolescent name])</li> <li>• What are some of the things you didn't like about HOT? (prompt: and what about for [adolescent name])</li> </ul>   | <ul style="list-style-type: none"> <li>• What are some of the things you liked about HOT?</li> <li>• What are some of the things you didn't like about HOT?</li> </ul>  |
| <b>Time spent on HOT</b> | <ul style="list-style-type: none"> <li>• Can you tell me a bit about how and when you used HOT?</li> <li>• Are there any suggestions for changes to HOT which would have improved the program for you? (prompt: and what about for [adolescent name])</li> <li>• Are there additional supports which would have helped you in HOT? (prompt: and what about for [adolescent name])</li> </ul> | <ul style="list-style-type: none"> <li>• Can you tell me a bit about how and when you used HOT?</li> <li>• Are there any suggestions for changes to HOT which would have improved the program for you?</li> <li>• Are there additional supports which would have helped you in HOT? (prompt: and what about for [adolescent name])</li> </ul> |

## Project governance

The authors of this paper comprise the multidisciplinary Steering Committee for the project which includes an Advanced Accredited Practising Dietitian, Accredited Practising Dietitians, a Registered Nutritionist, a physiotherapist, and health psychology and digital health experts. The project governance will also comprise a four-member Expert Advisory Committee comprising the HOT project manager including three Australian experts in the areas of nutrition and dietetics, physical activity, and eHealth and behaviour change and are external to the administering institution. Any publications arising from this study will be reviewed by all members of the steering committee prior to submission and authorship will be decided according to contribution.

## Results

Data collection for this study is ongoing. To-date, 35 adolescents and their parents have participated in one of three groups.

## Discussion

Multiple health risk behaviours are recognised to emerge and cluster during the adolescent life-stage,

including cigarette smoking, alcohol consumption and drug use [52]. Although there are laws and public health strategies to address these behaviours in Australia, there is a lack of community programs and support for overweight/obese teenagers to make well informed lifestyle decisions. Unlike younger children whom have had greater improvements in health over the past 50 years, teens are a comparatively underserved community group [53]. This project is a pilot feasibility study of a new and innovative, evidence-based approach to address the public health priority of adolescent obesity, which aligns with recommendations from the World Health Organisation Commission on Ending Childhood Obesity to provide family-based, multi-component, lifestyle weight management services for children and young people who are obese as part of universal child health care [54]. It is crucial to intervene and increase healthy lifestyle behaviours during the teenage years to prevent irreversible cardiovascular damage [20] and minimise heart health risks.

Adolescent obesity remains a public health concern in Australia and many other Western nations. This study aims to explore the feasibility of the new online program HOT which promotes lifestyle behaviour change for adolescents who are above a healthy weight. If this program is deemed to be feasible and acceptable for adolescents and their parents, program effectiveness will be explored in a subsequent randomised controlled trial. **It is important to note that while preliminary pre-post outcome measures will be collected in this sample, these data will be used to inform sample size calculations for a larger randomised controlled trial rather than implying intervention effectiveness. Feedback from users will be incorporated in future intervention delivery where possible to improve the experience of future users.**

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MM, AM, JM and CM conceived the study and were awarded competitive funding. All authors were involved in the design of the HOT program and its content. MM is Chief Investigator of the study. CM is Project Manager and has managed program development, ethics, study recruitment, implementation and evaluation. CM wrote the first draft of the paper and all authors provided critical input and revised publication drafts. All authors read and approved the final manuscript.

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## Conflicts of interest

All other authors have no competing interests to declare.

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