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Obesity Prevention Programs in Children: Impact on Weight, Shape and Food Concern

Renata L. Cinelli[1] · **Jennifer A. O'Dea**[2]

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Abstract Childhood overweight and obesity have an estimated prevalence of 10 % globally. High body mass index (BMI) is a known major predictor of body dissatisfaction, problem eating, low self-esteem, bullying and poor social and health outcomes for children. Childhood is also a time when lifelong habits are established, and as such is a time where prevention efforts have a high chance of success if implemented appropriately. Obesity prevention in children also has the potential to create weight, shape and food concerns in children and as such programs should focus on the principle *first*, *do no harm*. This paper canvasses existing literature and intervention program data to make the following recommendations for effective childhood obesity prevention: Programs should be educative for both children and their parents, programs should be inclusive of the whole family, there should be a focus on health and growth, not weight, and parents, schools and children should all be involved.

Keywords Childhood obesity · Prevention · Food concerns · Body image · Body dissatisfaction

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✉ Renata L. Cinelli
Renata.cinelli@acu.edu.au

Jennifer A. O'Dea
jennifer.odea@sydney.edu.au

[1] Faculty of Education and Arts, Australian Catholic University, Level 1, 250 Victoria Pde, East Melbourne, VIC 3121, Australia

[2] Faculty of Education and Social Work, The University of Sydney, Sydney, NSW 2006, Australia

Introduction

Childhood obesity has been gaining increasing research and media attention over recent decades, with a calculated global prevalence of combined overweight and obesity of 10 % among 5–19 year olds [1]. The childhood obesity rates vary in different countries and among different age groups according to definitions of childhood obesity. The prevalence of childhood obesity, defined using the 95th percentile of the sex-specific CDC BMI-for-age growth charts, reached 17% in the USA (2–19 year olds) [2•], 12 % in Canada (5–17 year olds) using WHO standards [3] and 6.4 % in Australia (6–18 year olds) [4, 5, 6•] using the IOTF standards. The prevalence of childhood obesity has increased and is increasing in rapidly developing countries such as India, Mexico, Thailand and China [1]. Globally, food availability, rapidly changing dietary practices and an increase in sedentary lifestyles have been attributed to a rise in childhood obesity rates [1].

The aim of this paper is to examine existing literature and intervention program data to assess the need for, and impact of, effective childhood obesity prevention programs. This review summarises factors associated with childhood obesity prevalence, health risks, the impact of prevention programs on weight, shape and food concerns and preliminary findings from our recent Illawarra Health Cohort Intervention Study [4].

Factors Associated With Childhood Obesity Prevalence and Health Risk

Beyond dietary practices and sedentary lifestyle, the development of childhood obesity is determined by a number of factors that can be grouped under genetics (gender, race, genes modulating adiposity) and the environment (geographic

region, family and society) [7]. Other researchers assert that childhood obesity is determined by (high and low) socioeconomic status, unawareness or false beliefs about nutrition, increasing academic stress in childhood, residence in metropolitan cities, marketing by transnational food companies and poor facilities for physical activity [1, 8]. In their systematic review, Gupta and colleagues [1] additionally outlined sociocultural factors, increased caloric intake and school meal programs as potential determinants of childhood obesity in developing countries. In Westernised countries, higher social class appears to be protective against obesity in children, suggesting a positive impact of education, income and other social class indicators [8].

Tabacchi and colleagues [7] elaborate that parents also play a large role in influencing the development of childhood obesity, through factors such as their own obesity, time restraints evolving through working commitments (that lead to less time for cooking, less time for physical activity with the child, more 'bought' meals), poor dietary habits, low level of education, and their own attitudes, beliefs and behaviours. Parents are key players in the promotion of a healthy body weight and lifestyle, as well as in interventions for childhood obesity.

Reilly and colleagues [9] systematically reviewed the literature and concluded that overweight and obesity in childhood and adolescence have adverse consequences on premature mortality and physical morbidity in adulthood. Large studies have found childhood obesity to link with both physical and psychological comorbidities, including attention deficit/hyperactivity disorder (ADHD), depression, learning disabilities, bone/joint/muscle problems, asthma, allergies, dental health issues, headaches, type 2 diabetes mellitus, the early-onset metabolic syndrome, coronary artery diseases and adulthood obesity [9–12]. Further, there is evidence suggesting that the neurobiology ADHD and other mental health disorders substantially overlap with the neurobiology affecting appetite [13], indicating that childhood obesity prevention programs need to holistically account for a broad spectrum of potential comorbidities in order to be most effective.

Beyond the many diagnosable physical and psychological health comorbidities that accompany obesity, childhood obesity and its treatment or prevention can also impact on weight, shape and food concerns among children. Body image and weight concerns have been reported in children as young as 6 years old, and researchers assert that these concerns increase with age [14]. Smolak [15] reported that some normal-weight elementary school-aged children are already worried about their appearance in order to be accepted by their peers, and O'Dea and Abraham [16] reported that overweight prepubescent children considered themselves to be less socially acceptable. Unfortunately, children have also been found to employ techniques such as food restrictions and exercise in order to evoke change in their body weight, shape and size [14, 17]. It has been stated that body mass index (BMI) is a major predictor of body dissatisfaction and problem eating such as fad dieting, extensive starvation, vomiting and laxative abuse among children, and that children of both sexes who had a larger BMI desired a thinner body [16, 17]. Further, girls with a larger BMI are more likely to be plagued by thoughts of dieting or engaged in dieting behaviours. The weight concern, body dissatisfaction and negative body image many young people (in all weight categories) endure have implications for programs aimed at preventing obesity and promoting positive body image and health.

Considering that prevention or treatment of childhood obesity has been on the agenda of health professionals and government bodies for some time, it is important to remember to 'first, do no harm'. More than a decade ago, O'Dea [18] suggested it was necessary to examine the potentially harmful or unhelpful outcomes of obesity prevention efforts, *before* prevention activities begin. This approach was considered necessary because of the potential for well-intentioned and reasonable messages to be misconstrued or misunderstood by health professionals, teachers, parents and the general public, resulting in supposed health-promoting activities having unintended undesirable effects [18]. The media provides an example of how health messages can translate into unhealthy behaviour by depicting narrow appearance ideals that are stereotypical and not representative of the general population [19] thus leaving many young people failing to meet the prescribed 'standards'. This has resulted in many young people developing their own weight control programs, which are often extreme and harmful, such as using laxatives, diuretics and diet pills [20]. Hence, any programs focusing on weight loss and health need to include components of media and health literacy, so program participants are able to be critical and avoid unhealthy weight loss methods.

The abovementioned factors, combined with the fact that obesity is difficult to reverse in older children and adults [21], and that childhood is a time of essential physical growth when lifelong eating and activity patterns are established, mean that young children are a priority population for obesity prevention [21, 22] Considering the 'obesogenic' environment of the twenty-first century [23•], research suggests that for interventions to be successful in reducing childhood obesity, they need to focus on improving environments to allow for increased opportunities to be physically active and to provide better access to healthy foods for children. Batch and Baur [12] suggest that successful prevention requires changes in both the microenvironment (e.g. housing, neighbourhoods, recreational opportunities) and the macro-environment (e.g. food marketing, transport systems, urban planning).

Parents are salient figures in addressing childhood obesity, and initiatives that focus on parental initiative and social support to promote lifestyle changes and maintenance of regular physical activity are considered to be of utmost importance [12, 21, 22, 23•]. Further, family support, taking a

developmentally appropriate approach, dietary change, long-term behaviour modification and decreased sedentary behaviour are all strategies for which there is some evidence of success [12]. A holistic approach that combines all of these elements is likely to have the best chance of lasting success in any childhood obesity prevention program.

The Impact of Prevention Programs on Weight, Shape and Food Concerns

Studies have shown that parents who are concerned about their child's weight, whether this be because of their *perception* of the child's weight status or because of the child's *actual* weight status, are more likely to take steps towards addressing their child's weight than a parent that reports no concern (regardless of their child's weight) [24•, 25•, 26, 27]. These steps include reducing screen time, improving the child's diet and increasing the child's physical activity [23•]. However, published reviews reveal that high proportions of parents misperceive their child's weight, with implications for parental intervention [24•, 25•, 26, 27]. Another study revealed that up to 42 % of parents of obese children and 81 % of parents of overweight children did *not* report concern about their child's weight [27]. Researchers emphasised that appropriate treatment begins with the accurate perception of weight status and as such, all stakeholders (teachers, health professionals, parents) need to be aware of parents' frequent tendency to underestimate their child's weight as well as the likelihood of behaviour modification link with parental concern. Hence, Moore et al. [24•] recommend that treatment and prevention efforts should incorporate education for the parents about child weight via the provision of accurate child weight status and information about health risks associated with childhood obesity. This can prevent parents from pursuing weight loss for children where it is not necessary, and for taking measures, in the right way, when it is.

Parental knowledge, concern and education is important, because while dietary change is a recommended strategy for managing childhood obesity, research [12] suggests that rigid restriction or control of a child's diet can trigger disordered eating. Restriction of foods has also been associated with increased child body weight and non-hunger eating [28, 29]. Birch and Fisher [29] report that while younger children's individual meal intake might be erratic, over a 24-h period, children tend to be quite good at regulating their overall energy intake. Child-feeding practices can alter self-regulation by altering patterns of intake and alter children's responses to internal cues of hunger and satiety. Hence, the imposition of stringent parental controls and dietary restrictions that occur when 'well-intended' and concerned parents believe children need assistance in determining what, when and how much to eat, provides little opportunity for self-control and self-regulation in the child [28, 29], potentially doing more harm than good.

An emphasis on the whole family shifting towards healthier eating patterns has been suggested to be more effective in producing long-term, positive eating habits [12] because children see parents' role modelling the consumption of a healthy diet and are more likely to engage in this behaviour [21, 30•]. The intention should be to provide a program with flexibility to empower the family and the child to make *sustainable* changes in food choices and habits that emphasise energy reduction, lower-fat food choices, increased fruit and vegetable consumption, decreased portion sizes and healthier snacks [12]. There is an emphasis on sustainable changes, as crash dieting and short-term solutions are known to increase weight in the long term [31]. Batch and Baur [12] also report that involvement of the whole family, changes to eating and shopping habits for the whole family, provides support for a child's ability to self-regulate his or her own food intake. Therefore, prevention programs that involve positive changes for the whole family in terms of dietary change and physical activity are the most likely to affect positive and lasting change, with the least potential for development of unhealthy relationships with food and their bodies.

In the same way that prevention programs have the potential to create or reduce food concerns in children, they also have the power to create or reduce weight or shape concerns. There are several factors that impact upon weight and shape concerns among obese children, including perceptions of obese status [24•, 31, 32], actual obese status [32, 33•, 34], weight stigmatisation [35], bullying [36] and self-esteem [37]. Many obese and overweight children underestimate their body size, which has implications for healthy behaviour modification [32]. As explained, the same is true for the parents' perceptions of their children's body size; modification is likely *if* the parent perceives the child to be obese [24•].

Children and adolescents who are obese are already likely to have lower self-esteem than their non-obese peers [38], and pubertal transition is known to be linked with poor body image and body dissatisfaction. Weight stigmatisation is also recognised to be a unique contributor to negative health outcomes as well as promoting behaviours that can exacerbate and foster obesity [35–37]. Peer victimisation, stigmatisation and bullying of obese children have also been shown to predict children's negative evaluations of their physical appearance, poor body esteem, and beliefs about how others view their appearance [34–37]. Hence, prevention programs aiming to promote healthy lifestyles and treat or prevent obesity need to also focus on reducing bullying [39] and weight stigmatisation of obese children [35].

Focusing on a child's weight can also lead a child to link their weight with their self-worth. An American study compared obese and average-weight children and found that dieting behaviours, concerns about their weight, restrained

eating and body dissatisfaction were all significantly more common among the obese children [40]. Hence, research suggests a shift in the focus of prevention efforts from weight loss and weight management for obese or overweight individuals, to supporting and encouraging healthy growth and healthy behaviours across all weight groups [35], is most likely to avoid exacerbating weight, shape and food concerns. This approach recognises the research that weight stigma is a problem experienced by obese and overweight individuals, and programs, if delivered incorrectly, have the potential to reinforce body shame, blame and stigma [18, 35]. Further, interventions that target the entire population, rather than focusing on individuals with obesity, are least likely to encounter ethical concerns [41].

Preliminary Findings of the Illawarra Health Cohort Intervention—2007 to 2012

The Illawarra Cohort Study [4] was conducted annually among a large cohort of schoolchildren over 6 years. Part of the study aimed to monitor the prevalence of obesity, overweight and thinness in the cohort as the students passed through primary and secondary school as well as monitoring body image, physical activity, sleep and other weight-related variables. An age- and gender-matched control group was also included as a comparison in the sixth year of the study as this allowed comparison of students who had participated each year versus those who had no involvement in the intervention program.

The study methodology essentially relied on trained child health staff providing each student with a personalised report about their annual growth in height, as well as reports about their sleeping patterns, physical activity and their nutritional intake. Each student had their height and weight measured, received an individual interview with trained research staff and received a set of handwritten, personalised positive comments about their annual growth as a report note which was taken home to show their parents. In addition, each student was involved with the health educators in a discussion about their current stage of puberty and an estimate of pubertal developments which were likely to occur within the next 12 months (e.g. menarche, breast bud, facial hair, voice breaking, growth of hands and feet and rapid height spurt). The control group participants had their height and weight measured but did not receive the detailed feedback about their growth stage and their normal pubertal development patterns. Control group parents did not receive any feedback or advice about their child's height, weight or pubertal status.

The main findings of this intervention include that:

- There was no difference in the prevalence of obesity, overweight or normal weight between control and intervention groups at time 6 at the end of 2012.
- In control group girls, obesity, overweight and normal weight was 5.8, 17.3 and 77.0 %, and in girls in the intervention group, the prevalence was 6.0, 20.3 and 73.7 % (chi square = 1.22, $P > 0.05$)
- In control group boys, obesity, overweight and normal weight was 6.7, 17.2 and 76.1 %, and in boys in the intervention group, the prevalence was 6.8, 22.8 and 70.4 % (chi square = 5.4, $P > 0.05$)
- Body image perception (Do you think you are too thin, about right or too fat?) was more positive in the intervention group girls in 2012 with frequencies of 3.9, 74.8 and 21.4 %, respectively, and 2.1, 72.0 and 25.9 % in control group girls. While these differences were not statistically different, the direction of the results do suggest a positive intervention effect in girls, with more intervention groups perceiving their weight as 'about right' and fewer perceiving themselves as 'too fat'.
- In control group boys, body image perception (too thin, about right, too fat) was similar in control and intervention students as follows: control boys—8.9, 81.8 and 9.2 % and intervention boys—9.8, 79.9 and 11.2 % (chi square = 1.34, $P > 0.05$).
- When combining all students into one group, the body image perception (too thin, about right, too fat) was more positive among intervention versus controls, as follows, 5.7, 77.1 and 17.2 % versus controls 8.1, 77.8 and 14.1 %. (chi square = 6.52, $P = 0.04$). These statistically significant results suggest that the intervention may have produced a more positive body image among the students who participated in the intervention, as they were less likely to perceive themselves as 'too fat'.
- Dieting behaviours (Do you diet to lose weight (Yes/No); Do you diet to gain weight? (Yes/No)) were no different in control versus intervention group boys—diet to lose weight 13.1 % in control versus 17.3 % in intervention (chi square = 2.69, $P > 0.05$). Dieting to gain weight was also similar in control group boys versus intervention group boys—11.3 versus 11.5 % (chi square = 0.96, $P > 0.05$).
- In girls, students in the intervention group were less likely to report dieting to lose weight in 2012—33.3 % in control girls versus 24.4 % in intervention girls (chi square = 3.99, $P = 0.04$).
- Dieting to gain weight was similar in control group girls versus intervention group girls—3.4 versus 2.2 % (chi square = 0.83, $P > 0.05$).

Further analysis of this new dataset will be undertaken to examine whether any other positive effects were found for any other variables.

A similar pattern of positive results was also found in these preliminary analyses for the Physical Self Perception Score [42] which has been found to be a sound measure of

general self-worth, body image and eating disorder risk in early adolescents. The Physical Self Perception Score is based on a scale which asked early adolescent boys and girls aged 11–14 years to give themselves a score for physical appearance using a scale from zero to ten (ten being 'perfect'). The score measures how you think you look (self score), how other people think you look (other score), how the opposite sex thinks you look (opposite sex score) and how your mother and father think you look (mother and father score). The instrument [42] has been successfully correlated with several scales on the Eating Disorder Inventory, including the Body Dissatisfaction and Drive for Thinness Scales [43] with significant ($P < 0.001$) negative Spearman correlation coefficients of between 0.55 and 0.67. In the current study, the Physical Self Perception Score shows a very good internal reliability consistency with a Cronbach's alpha of 0.75.

The Physical Self Perception Score as illustrated in Fig. 1 below shows consistent gender differences over the 6-year period, with girls scoring significantly lower than boys at each time point; both boys and girls in the intervention group had a greater Physical Self Perception 'Self' Score [41] in 2012 than their age- and gender-matched peers in the control group. Preliminary findings therefore suggest that the positive education about growth, pubertal development and general explanations of the adolescent growth spurt have had a significant intervention effect on the body image of the early-adolescent schoolchildren who participated in the annual health education feedback.

Figures 2 and 3 illustrate the comparison of mean Physical Self Perception Self Scores of control and intervention students in weight categories of obese, overweight and normal weight. Results in Fig. 2 show a comparison of the mean Physical Self Perception Self Scores for boys in control and intervention groups in 2012. The results of ANCOVA, controlling for school year, show no difference in scores among obese or overweight boys but show a significantly higher score among normal-weight boys in the intervention group. Results for girls in Fig. 3, however, show significantly higher scores among girls in the intervention groups of obese, overweight and normal weight. In other words, these preliminary results suggest that the intervention had a far reaching and positive impact on girls in all of the weight categories. The results in boys were more modest, with only the normal-weight boys being positively impacted by the intervention.

These findings are important because they reflect a positive outcome of the intervention being a more positive sense of self which is known to correlate well with other measures of psychological health in adolescents including self-esteem, body dissatisfaction, eating disorders risk and depression. Further analysis of these preliminary findings will investigate whether this intervention affects the students' long-term weight status, participation in physical activity and general nutritional and physical health indices.

The current analyses suggest that there was no intervention effect on weight status at the end of time 6 (2012) in either the control or intervention groups, but further analysis of these data is planned to examine any impact on other variables.

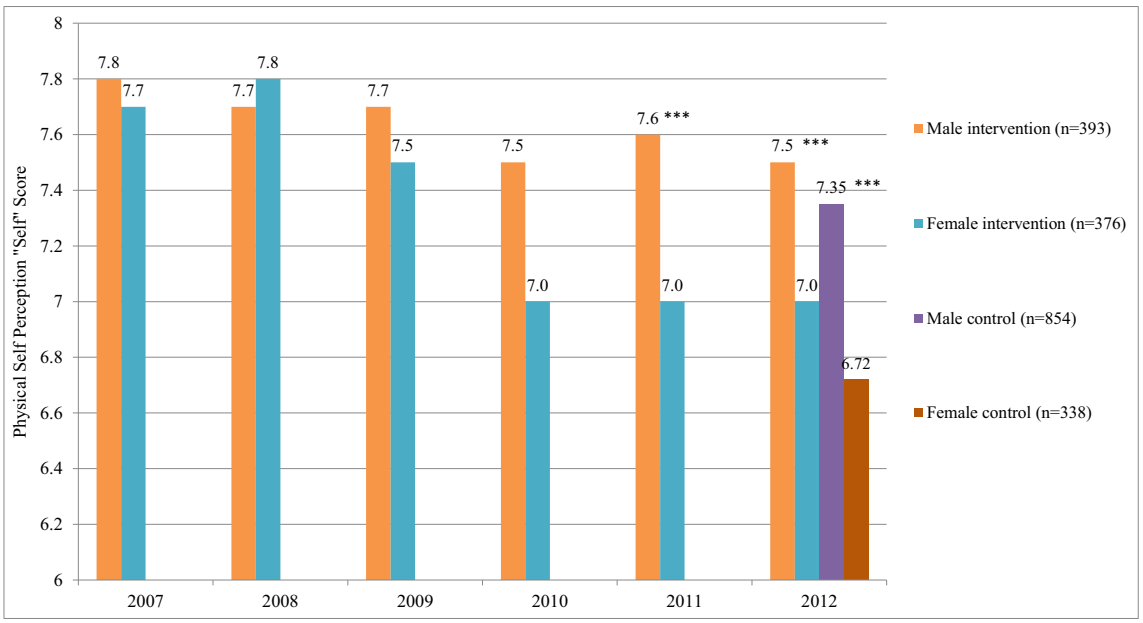

Fig. 1 Mean Physical Self Perception 'Self' Score in a cohort of male and female children and adolescents from 2007 to 2012 and comparison with control group in 2012. Note. Results show gender differences in the Physical Self Perception Self Score using ANCOVA controlling for school year. ANCOVA also shows gender by control/intervention comparison in 2012 (***$P < 0.000$)

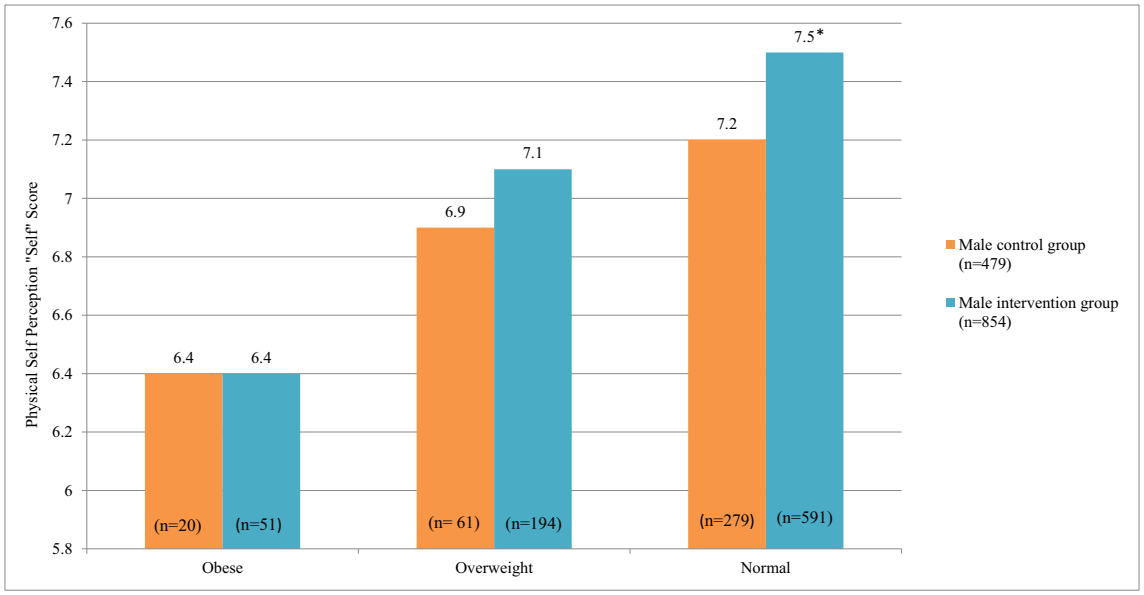

Fig. 2 Mean Physical Self Perception Self Scores of obese, overweight and normal-weight male adolescents in 2012 compared by control and intervention group. Note. Results show findings of ANCOVA controlling for school year (ANCOVA $F = 6.5$, $^*P < 0.05$)

Conclusions

Obesity during childhood and youth is an increasing health concern in the modern world. However, childhood is a stage of development where lifelong habits are formed; there is great potential for prevention and treatment of lifestyle diseases in youth and there is time for preventive programs to be implemented and to have a positive impact. The discussed literature indicates that prevention programs can have undesirable outcomes for youth, such as forming negative relationships with food, low self-worth, poor body image and body dissatisfaction. In turn, these can create dieting, weight cycling, binge eating, eating disorders and engagement in unhealthy behaviours. With the principle of 'first, do no harm' suggested as a starting point for any obesity prevention program, and based on the examined literature and currently reported findings, the following recommendations can be made for programs targeting children and youth in order to minimise risk of promoting weight, shape or food concern:

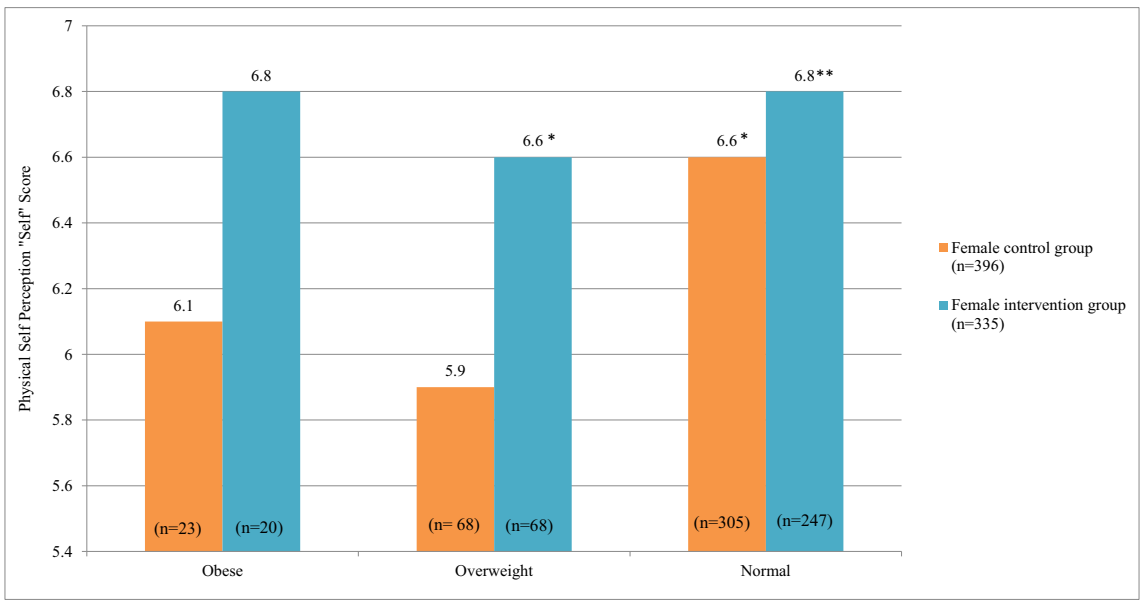

Fig. 3 Mean Physical Self Perception 'Self' Scores of obese, overweight and normal-weight male adolescents in 2012 compared by control and intervention group. Note. ANCOVA controlling for school year: $^*P < 0.05$, $^{**}P < 0.01$, $F = 4.5$; Overweight $F = 3.8$, $P < 0.05$; Normal weight $F = 5.0$, $P < 0.01$

- Programs should be educative for both children and their parents.

  The findings reported from the preliminary analysis of our Illawarra Health Cohort Intervention program suggested an intervention effect at the end of time 6 (2012) with a trend towards a more positive sense of self among males and females who participated in the annual education sessions. The positive self-perception was particularly significant among female students, whose physical self-perceptions were greater than controls in every weight group, including obese, overweight and normal-weight girls. This positive sense of self, independent of actual weight status, is reported to be a 'positive mental health indicator' in adolescents and is likely to be protective against forming negative relationships with food, low self-worth, poor body image and body dissatisfaction. Thus, it appears that the intervention improved body image and physical self-perception in this group and may have further impacted on other related health beliefs, attitudes and behaviours. Further analysis will be required to investigate other potentially positive outcomes. The current preliminary findings, combined with research literature discussing parents' need for accurate knowledge about their child's growth and weight status, suggest that properly planned education will enable parental action and prevent concerned (but ill-informed) parents from causing harm.
- Programs should be inclusive of the whole family.

  Research has shown that rigid control of an individual child's dietary intake can have a negative impact on the child's relationship with food, cause non-hunger eating, disordered eating and other concerns. Focusing on an individual child's weight also promotes low self-esteem, body dissatisfaction and poor body image, as it can cause children to equate their body weight with their self-worth. Therefore, following appropriate education for parents and families, programs that are inclusive of the whole family are more likely to produce lasting, positive change to eating habits, exercise habits, as well as being more likely to make a child feel supported, rather than victimised.
- Programs should focus on health and growth but not weight.

  Programs should focus on empowering individuals to make healthy choices, but not necessarily choices focused on weight loss or weight control. This means providing opportunities for physical activity, educating about and enabling healthy eating and promoting healthy body attitudes through media literacy education. Programs should deemphasize body weight.
- Parents, schools and children should be involved.

  Obesity in adulthood is difficult to change and address, while childhood is considered a time where children and teens can still 'grow into their weight' and develop habits that are 'healthy'. Further, considering the high degree of influence parents and schools have on children's food habits and physical activity opportunities, collectively addressing the promotion of positive health through education, opportunity and role modelling, is likely to encourage the development of positive lifelong habits.

Despite good intentions, obesity prevention programs aimed at children have the potential to cause harm to children during their important developmental years. Positive education and prevention programs that focus on health promotion and education have the potential to create positive lifelong habits, positive sense of self, healthy body image and healthy relationships with food. Our current intervention provided an opportunity to monitor the growth and pubertal development of boys and girls over 6 years as well as providing an opportunity to provide growth, height and weight education and feedback about sleep, nutrition, exercise and pubertal status to the child and their parents. This model of school-based healthy weight promotion has resulted in some positive outcomes in our cohort of students, parents and teachers, and has proven to be a very popular form of health education which has involved several different facets of the school and the community and has successfully utilised the 'first, do no harm' approach.

Compliance with Ethical Standards

Conflict of Interest Renata L. Cinelli and Jennifer A. O'Dea declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent The study was approved annually by the University of Sydney Human Research Ethics Committee—protocol number 7453. Annual signed parental consent was obtained and annual verbal consent was obtained from participants.

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