School-based systems change for obesity prevention in adolescents: outcomes of the Australian Capital Territory 'It's Your Move!'

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Abstract

Objective: The Australian Capital Territory 'It's Your Move!' (ACT-IYM) was a three-year (2012-2014) systems intervention to prevent obesity among adolescents.

Methods: The ACT-IYM project involved three intervention schools and three comparison schools and targeted secondary students aged 12-16 years. The intervention consisted of multiple initiatives at individual, community, and school policy level to support healthier nutrition and physical activity. Intervention school-specific objectives related to increasing active transport, increasing time spent physically active at school, and supporting mental wellbeing. Data were collected in 2012 and 2014 from 656 students. Anthropometric data were objectively measured and behavioural data self-reported.

Results: Proportions of overweight or obesity were similar over time within the intervention (24.5% baseline and 22.8% follow-up) and comparison groups (31.8% baseline and 30.6% follow-up). Within schools, two of three the intervention schools showed a significant decrease in the prevalence of overweight and obesity ($p<0.05$).

Conclusions: There was some evidence of effectiveness of the systems approach to preventing obesity among adolescents.

Implications for public health: The incorporation of systems thinking has been touted as the next stage in obesity prevention and public health more broadly. These findings demonstrate that the use of systems methods can be effective on a small scale.

Key words: Adolescence, systems intervention, obesity, weight status, schools, health promotion

The prevalence of overweight and obesity among children has increased substantially in Australia and around the world.[1,2] In Australia, the prevalence of childhood overweight and obesity almost doubled between 1985 (10.7% for boys and 11.8% for girls aged 7-15 years) and 1995 (20.0% for boys and 21.5% and for girls aged 2-18 years).[2,3] Subsequently, from 1996-2007, it appears that the increases in overweight and obesity prevalence have noticeably slowed or plateaued (23% for boys and 24% for girls aged 2-16 years in 2007)[4,5] though remains consistently high at 23.6% for boys aged 5-17 years and 27.1% for girls of the same age group in 2011/12.[6]

The negative impacts of overweight and obesity on health and psychological wellbeing are significant and well described.[7,8] The evidence suggests that multi-strategy and multi-setting obesity prevention interventions which are long-term, community-based, and collaborative have the greatest potential to impact the current global obesity epidemic.[9-11] In a recent systematic review and meta-analysis of whole-of-community-interventions, seven of the eight included trials had significant effects favouring the intervention on at least one measure of adiposity and meta-analysis of six trials showed a small reduction in BMI z-score among participants in intervention communities.[12] While these interventions are considered promising, questions remain about sustainability of effect and translation to scale. This has been highlighted by work demonstrating obesity and particularly childhood obesity as a complex issue resulting from the relationship of various interacting obesogenic risk factors at individual physiological and behavioural level, family, setting and broader environments.[13]

The Foresight Map provides a well-recognised visualisation of the complexity surrounding obesity.[14] This map contains 108 variables, clustered in seven domains; physiology, individual physical activity, physical activity environment, individual psychology, social psychology, food consumption and food production, with links between them that provide feedback loops and interactions.[14]

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As a response to this complexity, systems thinking has emerged as a possible approach to bring sustainability, scale and engagement with complexity to obesity prevention efforts.[15]

Systems thinking holds the assumption that non-linear relationships exist among a complex set of causes and that feedback loops, time lags and unintended consequences all contribute to an outcome.[16,17] The UK National Institute for Health and Clinical Excellence (NICE) guidelines for obesity prevention recommend a systems approach to include integrated policies with population-wide and target measures, as opposed to individual risk factors or isolated interventions.[18] Despite this recommendation, and the general agreement among researchers that a systems approach is appropriate for obesity prevention, practical applications of systems-based interventions are preliminary and yet to be comprehensively defined.

To test the practical application of a systems approach to obesity prevention, The Australian Capital Territory 'It's Your Move!' (ACT-IYM) project was initiated. The ACT-IYM project was a community-based intervention that extended the design and methodology used in the Victorian 'It's Your Move!' (Victorian-IYM) project to explicitly include a systems approach.[19,20] The Victorian IYM was an adolescent obesity intervention program designed to build the capacity of the school and surrounding community to promote healthy eating and physical activity behaviours to reduce unhealthy weight gain in children aged 12-18 years. Details of the Victorian IYM program design and implementation are described elsewhere.[19,20] Previously reported results indicate that Victorian IYM resulted in significant improvements at all levels of the intervention.[19,21] ACT-IYM was based on the successes of the Victorian IYM but updated to adopt a systems approach. The aim was to prevent obesity among secondary students in three secondary schools in the ACT, during 2012 to 2014 inclusive.

The Australian Capital Territory "It's Your Move!' (ACT IYM) project sought to reduce unhealthy weight gain among adolescents through comprehensive school- and community-based systems changes to facilitate healthier lifestyles. Aligning with the assumptions of the systems approach (adaptive to context), each intervention school also held a specific objective, developed by key informants from within schools during the initial workshop (further described in the methods section). These objectives were to; increase the time adolescents spend in physical activity at school; increase the proportion of adolescents using active transport to and from school who live within 30 minutes walking distance; and to increase mental wellbeing through the promotion of healthy eating and physical activity. To achieve these objectives, schools both leveraged existing health-promoting activities and introduced initiatives informed by the determinants of obesity framework described below. More details regarding intervention development and implementation will be included in the forthcoming process evaluation.

Methods

Intervention design

The Australian Capital Territory (ACT) (population 385,573 in 2014) is a territory in the south-east Australia with one major city, Canberra.[22] The ACT is considered a city state and is a self-governed territory. The city's main industries are public service administration and defence force establishments and typically, Canberra has a lower unemployment rate, higher than average income and a significantly higher level of education attainment than the national average. Canberra is ranked as both the most relatively advantaged and least relative disadvantaged compared to other states and territories.[22]

The study design was a quasi-experimental repeated measures longitudinal study with intervention and comparison groups as defined by specific secondary school communities. The ACT-IYM project involved three intervention schools and three comparison schools and targeted secondary students aged 12-16 years. An expression of interest was circulated by the ACT Education and Training Directorate to all public high schools with information regarding the 'It's Your Move!' program, including the aim of the program, roles and responsibilities of the partners and schools, and incentives for taking part. Based on further discussion with schools, six schools self-selected to participate: three as intervention schools and three as comparison schools. The intervention schools were on the south side of the Canberra city centre and the comparison schools were north of the city centre, to minimise contamination from the intervention activities and to ensure comparability to the intervention group. All participating schools were government schools and intervention schools and comparison schools received $50,000 and $5,000, respectively over the duration of the intervention. Intervention schools used funding to cover costs relating to establishing and maintaining ACT IYM related initiatives. Examples include; redeveloping the school environment to support nutrition and physical activity (e.g. school gymnasium, cafeteria/outdoor dining spaces), sporting/fitness equipment, and costs associated with presentations to intervention schools from community leaders relating to health promotion (e.g. professional sportspeople). Baseline measures were collected in May 2012 and follow-up measures in May 2014. Written consent was obtained from adolescents and their parents or guardians.

Intervention development and objectives

Key personnel (principals, PE teachers, health teachers and students) from each intervention school along with representatives from ACT Health Directorate, ACT Education and Training Directorate, and Nutrition Australia (a non-government, non-profit community organisation) participated in a two-day workshop in March 2012 to develop a multi-component intervention targeting key determinants of obesity and obesogenic environments. The workshop was a modified version of the Analysis Grid for Element Linked to Obesity (ANGELO) workshop.[23] The ANGELO workshop was modified to incorporate the World Health Organization systems building blocks, which include leadership, information, financing/resources, partnerships and workforce development, into the development and implementation of the project.[24] Incorporation of the building blocks define and reorient existing capacity within a system, define priorities and identify gaps. This method provided an efficient and flexible way of identifying and prioritising the key determinants within an environment while taking into account gaps in knowledge, community capacity, culturally specific needs and current health promotions that may already be in place.[23]

The overarching goal of the project was to reduce unhealthy weight gain among adolescents through comprehensive school-

and community-based systems changes to facilitate healthier lifestyles. All intervention schools agreed to implement a common objective and each school identified one additional school-specific objective. The generic objective was to develop, implement and evaluate a comprehensive 'Food at School policy'. This policy encompassed the whole food at school system including canteen food, food at fundraising and sporting events, school catering, etc. The following strategies were used to address this objective: (i) increased collaborations with local food producers and Nutrition Australia to create healthy food policies; (ii) commitment to increasing healthy food consumption among staff and students; (iii) a focus on the relationship between health and food across all areas of the curriculum; (iv) traffic light colour coding of food sold at the school canteen by nutrition content; (v) provision of healthy foods and the reduction of unhealthy foods at school events; (vi) healthy morning teas for staff to encourage positive role modelling; (vii) cooking classes outside school hours for students and their families; (viii) increased access to water fountains within the schoolyard. Each intervention school also had a unique objective that was specific to their identified needs and these were:

- School A: to increase the time adolescents spend in physical activity at school.
- School B: to significantly increase the proportion of adolescents using active transport to and from school who live within 30 minutes walking distance.
- School C: to increase mental wellbeing through the promotion of healthy eating and physical activity.

Measures

Data collection for the project included objectively measured anthropometry and a self-report questionnaire.

Anthropometry

Weight and height were measured in adolescents using standard methods for the collection of anthropometric data by trained researchers.[20] Weight was measured to the nearest 0.05 kg using electronic scales (A&D Personal Precision Scale UC-321) and height was measured to the nearest 0.1 cm using a portable stadiometer (Charder Portable Stadiometer Height Rod HM200P). All measurements were made while the adolescents were wearing light clothing and no shoes. Two measurements were recorded for each parameter with a third measure taken in the case of any discrepancies (>0.1 kg for weight, >0.5 cm for height). The mean of all the measures recorded was used for analysis. Body mass index (BMI; weight(kg)/height(m^2)) and BMI-z score using the WHO Reference 2007[25] were calculated. The WHO Reference 2007 age- and sex-specific BMI-z score cut-offs were used to classify children's weight status as healthy weight, overweight and obese (≤+1 healthy, >+1 overweight, >+2 obese).

Health behaviour data

The Adolescent Behaviours, Attitudes and Knowledge Questionnaire (ABAKQ) was used to measure health behavioural data. A guided Turning Point presentation was used to deliver the ABAKQ.[27] The Turning Point presentation encompassing the questionnaire was administered by a trained researcher and responses collected from students using Keepad Interactive technology.[27] This system uses a creative interactive presentation whereby the administrator reads through each question individually and students are able to use response devices to input answers. The ABAKQ contained self-report questions with subsections: demographics, health behavioural, and mental wellbeing. This questionnaire has been used in previous evaluations of large-scale intervention projects; further details are available elsewhere.[26] The ABAKQ focuses on key behaviours such as: nutrition/dietary practices, physical activity, sedentary behaviours, perceptions of school environment (teachers, canteens, opportunities for physical activity/healthy nutrition), home environment (role of parents/siblings), and neighbourhood environment.

Mental health indicators

The ABAKQ contained a mental wellbeing subsection assessing health related quality of life and depressive symptomatology. The Pediatric Quality of Life Inventory 4.0 (PedsQL, generic module for 13-18 year olds)[28,29] measured physical, emotional, social and school functioning, and provided a global quality of life score (23 items). The recall frame is one month and each item has five response alternatives. Item scores are transformed into a 0-100 point scale with higher scores signalling higher health-related quality of life. Depressive symptomatology was measured using the Short Mood and Feelings Questionnaire – Child Version (SMFQ), which contains 13 self-report items aimed at assessing depressive symptomatology for children and adolescents.[30,31] The SMFQ comprises items relating to mood states, asking participants to indicate how they had been feeling or acting in the past two weeks, resulting in an overall total possible score range of 0-26 (higher scores indicate greater depressive symptoms).

Demographics

Demographic information and parental education level was collected from the completed consent forms. In addition, the Socio-Economic Index for Areas (SEIFA) was used to assess socio-economic status (SES). This index is an area-level indicator based on the 2011 Australian census of population and summarises information about the economic and social resources of people and households within an area that reflect both advantage and disadvantage. There are 21 measures which include: low or high income, internet connection, occupation and education. A low score indicates relatively greater disadvantage and a lack of advantage relative to the ACT. The SEIFA classification is based on geographic postal area of the child's address.[32] As it has recently been demonstrated that SEIFA masks the relative disadvantage of Canberra's socio-economically diverse neighbourhoods and does not reflect the true level of disadvantage being experienced,[33] parental education level was instead used as a proxy marker for socio-economic status.[34]

Analysis

The original design was quasi-experimental with schools assigned to either the intervention or comparison group and the first part of the analysis reflects that design. The second part of the analysis addresses systems changes within individual intervention schools and the corresponding within schools changes in diet and physical activity behaviours and in depressive symptoms.

All analyses used Stata release V.12.0 (StataCorp LP, College Station, Texas, USA). All variables were checked for missing and out-of-range values and cases with outlying (>3 SD from mean) values were removed from relevant analyses (<2% of any given variable). Multivariate outliers were identified

using Hadi's method and also removed from the relevant analyses.[35] Continuous variables were checked for normality using histograms and calculating skew and kurtosis values; no transformations were needed. A *p*-value of less than 0.05 was considered statistically significant. Demographic data were analysed using descriptive statistics, two-tailed independent samples t-tests or, where applicable, Pearson χ^2 tests. The analysis of outcomes (adjusted) used mixed-effects linear regression (continuous variables) or fit population-averaged panel data models by using Generalised Estimating Equations (categorical variables) and taking into account the repeated measures data over time. All adjusted analyses were controlled for gender, age, parent education and school. McNemar's test was used to examine the change in weight status and to examine the outcomes of the three unique school-specific objectives within study conditions and within intervention/comparison schools over time (unadjusted).[36]

Ethics approval was received from the Deakin University Human Research Ethics committee (EC 2012-015) and the ACT Government Education and Training Directorate (Ref. 2012/00545-1).

Results

Participant characteristics

The overall baseline response rate was 56.5% and the follow-up response rate was 74.5%. The response rate for intervention schools was much higher than for comparison schools at both baseline (70.5% and 37.8%, respectively) and follow-up (88.6% and 76.8%, respectively) (Figure 1). Mean BMI-z scores were significantly lower in the intervention group than the comparison group at both baseline ($p<0.05$) and follow-up ($p<0.05$) (Supplementary Table 1). Differences in weight status (2-categories) were observed at baseline ($p<0.05$) where there was a lower proportion of overweight/obese participants in the intervention group compared to the comparison group. There was also a difference in parental educational attainment with the intervention group showing a higher level of educational attainment compared to control. The adolescents who were lost to follow-up did not differ significantly for any of the baseline characteristics compared to those who were followed up.

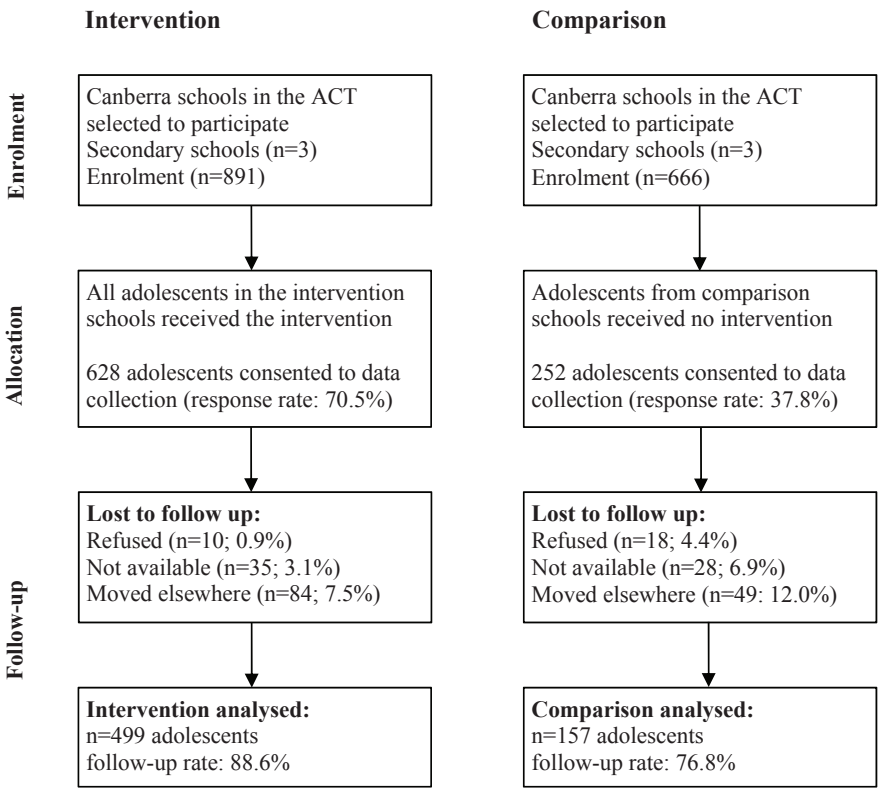
Anthropometric-related outcomes

Unadjusted within-school results show that two of three of the intervention schools showed a significant decrease in the prevalence of overweight/obesity (School A, School C $p<0.05$) and a significant decrease in the prevalence of overweight/obesity within the pooled intervention group ($p<0.05$) but not the pooled comparison group (*NS*) (Figure 2). Models to compare the intervention and comparison groups (i.e. all three intervention schools combined compared to all three comparison schools combined) over time and that were adjusted for age, gender, parent education and school showed no statistically significant interaction effect on weight, height, BMI, BMI-z and proportion of overweight/obesity. Investigation of the main effects showed that BMI-z was significantly lower in the intervention group compared to the comparison group ($p<0.05$) (Supplementary Table 2).

Dietary and physical activity-related outcomes

There were few differences between the intervention and comparison groups for any dietary and physical activity behaviours, body image perceptions or the home or school environment (Supplementary Table 3). We observed no significant changes in consumption of fruit and vegetables, soft-drinks and cordials or snack foods. Transport to and from school and lunch time activity levels were not different between the intervention and comparison groups. There was a significant interaction between study condition and time on recess activity levels ($p<0.05$); the proportion of adolescents participating in activity at recess in the intervention group increased over time while in the comparison group it remained stable. Overall, the proportion of adolescents from the intervention group that met the recommended ≤2 hours of total screen time (TV/DVDs/Videos and video games/electronic games/use the computer combined) decreased over time while the proportion of adolescents from the comparison group that met the recommended ≤2 hours of total screen time increased over time ($p<0.02$). Though there were no observed differences between intervention and comparison regarding most measures of food environment (e.g. healthiness of the school canteen, school encouraging healthy food choices or lunchtime activities, teacher role-modelling), the proportion of adolescents that were aware of healthy eating programs at school significantly increased in the intervention group compared to the

Figure 1: Flow diagram of participants.



comparison group at follow-up ($p<0.05$). There was an increased proportion of adolescents in the comparison group that reported their school encouraged all students to play organised sport often or all the time at follow-up compared to baseline and relative to the intervention group, in which the proportion did not change ($p<0.05$).

Intervention school-specific outcomes

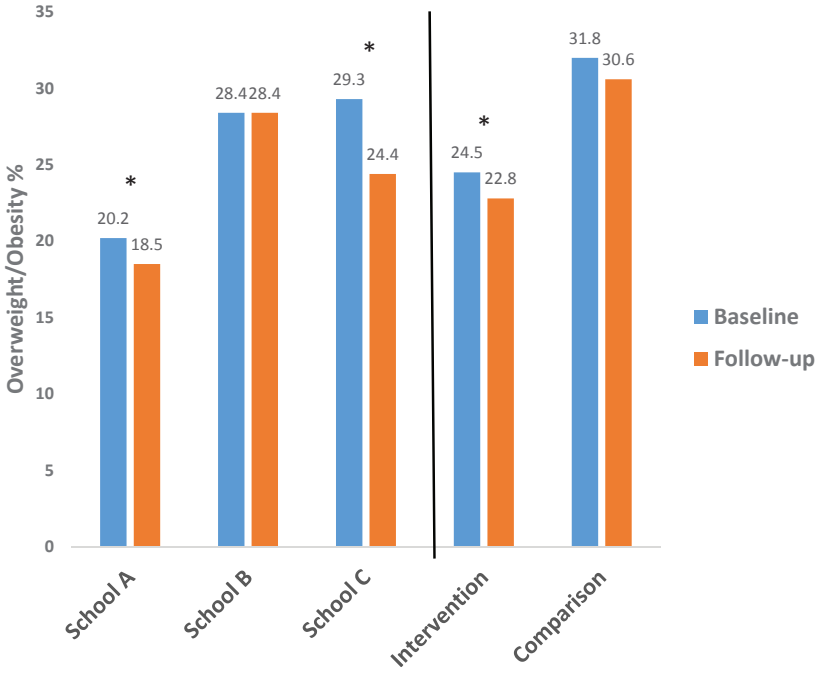
Analyses examining school-specific objectives of increasing time adolescents spend in physical activity at school (School A) and increasing the proportion of adolescents using active transport to and from school (School B) showed that interaction coefficients for these items were non-significant (Table 1). Significant decrease in depressive symptoms in the intervention school aiming to improve mental well-being through the promotion of healthy eating and physical activity were observed (School C). Participants in School C reported a decrease ($p<0.05$) in depressive symptomatology between baseline (25.5%) and (17.4%) follow-up compared with an increase in the other two intervention schools from 16.3% at baseline to 20.2% follow-up.

Discussion

There was some evidence of effectiveness of the ACT IYM project within schools but no interaction effect when comparing results from the intervention and comparison schools over time. Two of the three intervention schools reported significant decreases in the level of overweight and obesity over the study period. Some positive mental wellbeing findings were found with one intervention school reporting a decrease in depressive symptoms relative to the two other intervention schools combined.

There are several possible explanations for the lack of overall intervention effect. The design of this project was quasi-experimental with few intervention and comparison schools. Further, the sample size was pragmatically determined by resources available for intervention and evaluation, rather than being explicitly powered to detect likely intervention effects. Studies of this nature are often limited by the lead time required to establish community-based intervention.[19,37] The systems approach has as one of its initial tenets a requirement to understand time delays within systems[38] and many of the strategies designed by the schools were only being fully implemented towards the end of the intervention period defined by this study. Although the intervention duration was nominally three years, the duration between measurements was actually two years and it is anticipated that the changes may take some time to embed and demonstrate significant results.

Figure 2: McNemar's change in prevalence of overweight/obesity in intervention schools individually and intervention compared to comparison schools combined (* $p<0.05$).



It is difficult to compare this study with others as it is the first community-based intervention that incorporates systems thinking into the project development, implementation and evaluation. The ACT IYM was based on the success of previous community-based obesity prevention interventions for children and adolescents in Australia.[19,39,40] These previous studies shared common features with the ACT IYM in recognising complexity of obesity prevention and the implementation of multi-focused, multi-level interventions that targeted multiple behaviours. All three of the previous interventions demonstrated significant improvements in anthropometric related outcomes in intervention groups. Key methodological differences include; the participation rates for intervention and comparison groups (low comparison group participation rates were reported in ACT IYM) and differences in study groups (intervention

Table 1: Adjusted proportions of measures relating to school specific objectives at baseline and follow-up for intervention schools and adjusted beta coefficients of an interaction between wave and intervention school specific to unique objectives.

Unique objective	Intervention school specific to unique objective		Other intervention schools combined		β Coef.	*P*
	Baseline	Follow-up	Baseline	Follow-up		
(i) to increase the time adolescents spend in physical activity at school (School A)						
Active at school[a] (%)	56.5	58.7	61.7	53.7	0.48	0.06
(ii) to significantly increase the proportion of adolescents using active transport to and from school who live within 30 minutes walking distance (School B)						
Transport to/from/both school (% active)	76.5	55.8	76.2	71.0	-0.71	0.143
(ii) to increase mental well-being through the promotion of healthy eating and physical activity (School C)						
With depressive symptomatology[b] (%)	25.5	17.4	16.3	20.2	-0.81	0.038

a: Based on combined variables of self-reported activity at recess, lunchtime and whether student reported doing dance, sport or playing games on last school day

b: Cut of score of 10 or higher on Short Mood and Feelings Questionnaire

and comparison groups differed in key characteristics in ACT IYM). An important difference between the current and previous projects was the recognised systems science approach that informed the ACT IYM project. Findings in relation to this approach, and how it differs from previous intervention implementations are expected to emerge from process evaluation (forthcoming).

Several interventions focused on younger children reported a significant and favourable effect on weight and BMI-z but there were no associated patterns of behavioural change.[37,39-41] Similarly, the Victorian IYM saw significant reductions in weight and BMI-z.[19] A systematic review of 64 prevention programs for children and adolescents aiming to produce weight gain prevention effects reported success in just 21% of previous studies, demonstrating the difficulties in improving health behaviours and preventing unhealthy weight gain.[42] Importantly, this systematic review found that only two of the 13 prevention programs that were successful were conceptualised as purely obesity prevention programs. The other interventions were designed as general health education, physical activity, nutrition/diet-based interventions and cardiovascular disease prevention programs. This suggests obesity prevention may be best reached through tackling broader health issues and complex interrelationships, which aligns with the systems approach adopted in the ACT IYM. The favourable results from the ACT intervention school that targeted mental health as well as obesity support these findings. In that school, there was a no change compared to an increase in all other intervention and comparison schools in depressive symptomatology and a within school decrease in the levels of overweight and obesity.

Recent evidence indicates that modifiable lifestyle behaviours are linked to mental health outcomes among adolescents,[43-46] however the number of obesity prevention interventions including mental health measures at follow-up is low.[47] Those studies that have included mental health measures demonstrated increased quality of life and decreased anxiety.[48,49] This is the first study to demonstrate the effectiveness of a community-based obesity prevention intervention designed to prevent obesity with a dual specific mental wellbeing objective in improving depressive symptomatology. This finding should support growing awareness of the interconnectedness of nutrition, physical activity and mental health, which is important given the significant proportion of adolescents suffering from mental health symptoms and the need for effective prevention strategies.[50-52]

There are a number of notable limitations of this study. The selected schools were not randomly assigned, leading to potential selection bias. Allocation concealment was not possible as community interventions typically actively market their participation in the initiatives. For the same reasons non-blinding of data collectors was not possible and this may inadvertently introduce artificial differences in measurements between groups, although significant training was provided to try to address this.

There were very different response rates in intervention and comparison schools and this resulted in differences between groups on several important baseline measures. Given the higher level of socio-economic disadvantage apparent in the comparison group, these discrepancies are to be expected and have been observed in a number of Australian[53,54] and international studies.[55-57] These differences may have introduced a bias causing the groups to behave differently over time.

Behavioural data reported by parents, children or others are known to be subject to social desirability bias and recall bias.[58] Importantly, however, there were no key differences in the characteristics of the participants lost to follow-up. In addition, the small sample numbers, particularly in the comparison group, may result in selection bias of the adolescents consenting to participate and affect the generalisability of the results. There were also a range of Territory and Federal Government health improvement initiatives that may have affected comparison schools, particularly the comparison school that showed a within-school decrease in the levels of overweight and obesity.

One of the barriers to the widespread use of a systems approach to obesity prevention is the infancy of evaluation and statistical analysis methods that take into account the design of the intervention.[59] Modelling methods such as Agent Based Modelling, Systems Dynamics and Social Network Analysis have been proposed as tools to help explain the workings of a systems approach in public health,[59] but these have not been applied on a wide scale. The actual development of an intervention that incorporates the variables impacting obesity as well as the ties between them while taking into account feedback loops, lags and unintended consequences requires new methods. A promising recent development has been to use group model build processes to map the causes of obesity from a community perspective.[60] This method results in a local version of the Foresight map from which intervention actions can be formulated. The systems methodology trialled in ACT IYM was an important advancement from the Foresight map as it led to further nutritional and physical activity changes across primary schools in ACT and subsequent development in local government areas across Victoria. This study was limited, however, in that the extent to which it used true components of system science (feedback loops, lags and unintended consequences) was not evaluated.

Conclusions

The incorporation of systems thinking has been touted as the next stage in community-based obesity prevention. We found some effectiveness of this approach with two intervention schools reporting significant within school decreases in overweight/obesity. Future research should further develop evaluation methods to capture the complexity of system changes, as traditional measures may not account for this complexity. Findings support the inclusion of mental wellbeing-related targets in obesity prevention interventions, and future research examining the effects of school-based nutrition and physical activity programs should evaluate both physical and mental health outcomes. Incorporating systems thinking in school health promotion will provide the tools and language to implement interventions at multiple levels across the school community, which uni-dimensional approaches have previously failed to achieve. It is important to allow for sufficient lead in time to establish community-based interventions as systems changes may take time to embed and show meaningful results. While limited, the findings of this study support the application of systems thinking, as the approach may offer novel and multi-dimensional strategies to combat the national and international crisis of obesity.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Table 1: Unadjusted baseline and follow-up characteristics of study participants.

Supplementary Table 2: Study condition and wave interactions on anthropometric measurements.

Supplementary Table 3: Adjusted proportions (95% confidence interval) of behavioural measures at baseline and follow-up and adjusted odds ratios (ORs) of an interaction between wave and condition and *p*-values for behavioural outcomes.