

Reducing obesity in early childhood: results from Romp & Chomp, an Australian community-wide intervention program^{1–3}

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ABSTRACT

Background: There is growing evidence that community-based interventions can reduce childhood obesity in older children.

Objective: We aimed to determine the effectiveness of the Romp & Chomp intervention in reducing obesity and promoting healthy eating and active play in children aged 0–5 y.

Design: Romp & Chomp was a community-wide, multisetting, multistrategy intervention conducted in Australia from 2004 to 2008. The intervention occurred in a large regional city (Geelong) with a target group of 12,000 children and focused on community capacity building and environmental (political, sociocultural, and physical) changes to increase healthy eating and active play in early-childhood care and educational settings. The evaluation was repeat cross-sectional with a quasiexperimental design and comparison sample. Main outcome measures were body mass index (BMI), standardized BMI (zBMI; according to the Centers for Disease Control and Prevention 2000 reference charts), and prevalence of overweight/obesity and obesity-related behaviors in children aged 2 and 3.5 y.

Results: After the intervention there was a significantly lower mean weight, BMI, and zBMI in the 3.5-y-old subsample and a significantly lower prevalence of overweight/obesity in both the 2- and 3.5-y-old subsamples (by 2.5 and 3.4 percentage points, respectively) than in the comparison sample (a difference of 0.7 percentage points; $P < 0.05$) compared with baseline values. Intervention child-behavioral data showed a significantly lower intake of packaged snacks (by 0.23 serving), fruit juice (0.52 serving), and cordial (0.43 serving) than that in the comparison sample (all $P < 0.05$).

Conclusion: A community-wide multisetting, multistrategy intervention in early-childhood settings can reduce childhood obesity and improve young children's diets. This trial was registered with the Australian Clinical Trials Registry at anzctr.org.au as ACTRN12607000374460. *Am J Clin Nutr* 2010;91:831–40.

INTRODUCTION

Unhealthy weight and childhood obesity conditions are known to track into later childhood and adulthood (1, 2), and eating and activity patterns established early in life also persist into later life (3, 4), underpinning the importance of early intervention to develop and maintain health-promoting behaviors and healthy weight throughout life. For these reasons and because, once present, obesity is extremely difficult to overcome, children are

now considered the priority population for interventions to prevent obesity. Children's educational and care settings are being recognized as potentially important points for such intervention activities (5–10).

Current thinking suggests that the interventions most likely to be successful are those that aim to improve environments, such that young children have better access to healthy foods and more opportunities for physical activity (11). Unfortunately, published studies to date have shown minimal effect on children's weight (12–17). Intervention designs are needed that are more comprehensive and which can mimic the complex and multiple influences of today's obesity-promoting environment and reverse its effect. There is growing evidence that community-based multisetting, multistrategy interventions can reduce childhood obesity in older children (18, 19), and there are calls for these types of interventions in younger age groups (20).

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The Romp & Chomp project was established as a demonstration project in Victoria, Australia (21), to test the hypothesis that a community capacity-building, multisetting, multistrategy intervention targeting children aged 0–5 y could prevent the development of childhood obesity and promote healthy eating and active play. This article describes the Romp & Chomp intervention and presents the effect and outcome evaluation.

SUBJECTS AND METHODS

The Romp & Chomp intervention

Romp & Chomp was a community-based and community-wide obesity prevention project conducted in the local government areas of the City of Greater Geelong (CoGG) and the Borough of Queenscliffe (BoQ) in Victoria, Australia, that targeted all children aged 0–5 y ($n \approx 12,000$) and their families. The intervention was conducted from 2004 to 2008 and sought to change policy, sociocultural, and physical aspects of early-childhood environments to favor obesity prevention. Several key organizations in the region designed, planned, and implemented the intervention, particularly Barwon Health (the largest regional health service provider in the Victoria-Dental and Allied Health Units), the CoGG (local government managers of a range of children's care and health services), the Geelong Kindergarten Association (a cluster manager for 33 community-based preschools in the Geelong region), the Leisure Networks Association (regional sporting coordinating body), the Department of Human Services (DHS; the Victoria State health department), Deakin University (Geelong, Australia), Bellarine Community Health (a health service provider), Dental Health Services Victoria (the state's public oral health promotion and dental service provider), and the Department of Education and Early Childhood Development (state government department).

A number of health promotion activities occurred during the Romp & Chomp intervention period. Two such programs were closely aligned to the objectives of Romp & Chomp and were being delivered in early-childhood settings. To increase the reach of each project and to avoid crowding the settings, these programs were subsequently delivered with Romp & Chomp to preschools in the intervention region as an integrated health promotion package. These programs were Smiles 4 Miles and Kids—Go For Your Life. Both projects operated within a health-promoting schools' framework [ie, a holistic, whole-school approach to health promotion that includes a broad health-education curriculum, sociocultural and environmental changes, and policy implementation (22)].

The Smiles 4 Miles program was underway as a pilot program in the CoGG before the Romp & Chomp intervention and was a Dental Health Services Victoria-funded oral health promotion program for preschool-aged children. The program was implemented locally by the Barwon Health Dental Unit; the 5 key messages were as follows: 1) drink well, 2) eat well, 3) clean well, 4) stay well, and 5) play well.

The Kids—Go For Your Life program was a state government-funded initiative, managed by Diabetes Australia Victoria and The Cancer Council Victoria, which encouraged children's healthy eating and physical activity in early-childhood services via the Kids—Go For Your Life award program (23). The first phase of rollout occurred in 2007, and this was limited to 10 local

government areas, one of which was the CoGG. The program's 6 key messages were as follows: 1) limit food; 2) move, play and go; 3) turn off, switch to play; 4) tap into water every day; 5) stride and ride; and 6) plant fruit and vegetables in your lunchbox.

Across the intervention area, Romp & Chomp targeted the entire population of children aged 0–5 y operating primarily through Long Day Care centers (8 large centers), the Family Day Care service (76 home-based care providers), all preschools (45 schools), the Maternal Child Health Service (24 centers), regional immunization services, and community health services. The intervention activities had a strong focus on community capacity building and developing sustainable changes in areas of policy, sociocultural, and physical environments by using a socio-ecologic framework (24, 25). The Romp & Chomp action plan was developed with extensive community consultation and stakeholder engagement (26), and a management committee of stakeholders oversaw its implementation.

The aim of Romp & Chomp was to increase the capacity of the CoGG and the BoQ (the intervention site) to promote healthy eating and active play and to achieve healthy weight in children <5 y of age. This aim was to be achieved through the implementation of 8 project objectives: 1) to increase the capacity of relevant CoGG and BoQ organizations to promote healthy eating and active play; 2) to increase the awareness of the project's key messages in homes and early-childhood settings; 3) to evaluate the process, impact, and outcomes of the project; 4) to significantly decrease consumption of high sugar drinks and promote consumption of water and milk; 5) to significantly decrease consumption of energy-dense snacks and increase consumption of fruit and vegetables; 6) to significantly increase active play at home and decrease television (TV) viewing time; 7) to increase structured active play in kindergarten and child care settings; and 8) to achieve an integrated population growth monitoring program within the department of Maternal and Child Health Service.

The behavioral strategies were communicated to the community via the following 4 key messages: 1) daily active play, 2) daily water and fewer sweet drinks, 3) daily fruit and vegetables, and 4) less screen (TV or DVD) time.

The intervention strategies are summarized in **Table 1**. Evaluation reports are available at www.goforyourlife.vic.gov.au/rompandchomp.

Evaluation design and methods

Romp & Chomp was evaluated by using a repeat cross-sectional quasiexperimental design with measures taken pre- and post-intervention in the intervention community (ie, via intervention sample) and comparison communities drawn from local government areas (LGAs) across the rest of Victoria. The quasiexperimental design has proven to be appropriate and useful for testing the efficacy and feasibility of community-based interventions where it is not possible to use randomization (27). The evaluation was multilevel: outcome measures were anthropometric [body mass index (BMI; in kg/m^2), standardized BMI (zBMI), and weight status] and the effect measures were behavioral (children's nutrition and activity) and environmental (policy, sociocultural, and physical) in early-childhood settings. The CoGG and BoQ were purposely selected as the intervention site through community consultation and established collaborative links between the DHS and Deakin University, which had identified a need to

TABLE 1

Summary of the strategies implemented in Romp & Chomp

Romp & Chomp objectives and activities undertaken
<p>Objective 1: To increase the capacity of relevant Geelong organizations to promote healthy eating and physical activity in children aged <5 y.</p> <ul style="list-style-type: none"> Professional development for early-childhood workers and service staff. Development and enhancement of partnership, strategic alliances, and community organizational networks. Establishment of project management, coordination, budgetary, and governance structures. Identification of funding and resources to support program implementation. <p>Objective 2: To increase awareness of the project's key messages in homes and early-childhood settings.</p> <ul style="list-style-type: none"> Overarching campaign message: children aged <5 y need daily 1) active play and 2) healthy food choices provided. Key messages: daily active play; less screen time; more fruit and vegetables; and more water. Communication plan and social marketing plan. Nutrition and physical activity resources for parents and early-childhood service staff from reputable and compatible sources. Series of posters, postcards, and brochures promoting overarching campaign and key messages (<i>see above</i>). Postcards (>1000) by December 2006 for dissemination to all families presenting to Maternal and Child Health Services, Long Day Care centers, and Family Day Care service. Resource folders (≈1000) to 38 kindergartens by December 2006, with the goal of providing one folder to each family. Resource folders to a total of 46 kindergartens in total by April 2008. Community health professionals distribute folders to kindergartens with suggestions on possible applications. All resource materials made available online for any early-childhood worker to access. Water bottles (1018) to 31 kindergartens in late 2006 (for 2007). Water bottles (2031) to 43 kindergartens in late 2007 (for 2008). Additional water bottles for children attending Long Day Care centers and Family Day Care service in April 2007. Lunch bags (2194) to 38 kindergartens in 2007 and 2826 lunch bags to 47 kindergartens in 2008. Sweet-drink demonstration resource to 76 kindergartens during 2005–2008. Family members (<i>n</i> = 926) attend a kindergarten sweet-drink demonstration in 2008. Energy-dense foods display disseminated to all kindergartens and Long Day Care centers for display. <p>Nutrition objectives</p> <p>Objective 4: To significantly decrease high-sugar drinks and promote the consumption of water and milk.</p> <p>Objective 5: To significantly decrease energy-dense snacks and increase consumption of fruit and vegetables.</p> <ul style="list-style-type: none"> Use of benchmarks to inform policy, including consultation with staff and review of resources from similar projects: Best Start, Start Right Eat Right, Smiles 4 Miles, and the Australian Guide to Healthy Eating for Children. Food safety regulations identified and supported. Production of 3 separate optional policies for kindergartens: 1) fruit and vegetable snack only; 2) fruit, vegetable, and healthy sandwich; and 3) fruit, vegetable, sandwich, and healthy alternative. All were pilot-tested and finalized. Development and adoption of an overarching health and well-being policy for the Geelong Kindergarten Association in 2007/2008. Inclusion of policies into parent handbooks/booklets. Collaboration with Dental Health Services Victoria, which provided resources (lunch boxes, drink bottles, and social marketing material for kindergarten children). Collaboration with Kids—Go For Your Life program from 2007 for healthy eating and drink choices resources. Engagement of dental and primary care staff into the Romp & Chomp project. Early-childhood settings staff trained to reinforce nutrition messages and healthy eating choices for children aged <5 y. Kindergartens given support from allied and dental health professionals to engage with parents on the topic of healthy eating and to provide support for staff to adopt and implement health and well-being/nutrition policies. Community health workers and allied and dental health professionals trained to support kindergartens to undertake the intervention activities. Quarterly inserts into early-childhood newsletters. E-mail, phone, or site visit access to dietitian and other allied health professionals for early-childhood workers as required. Nutrition and drinks media release. Promotional materials (eg, balloons, stickers, posters, postcards) produced and distributed. <p>Activity objectives</p> <p>Objective 6: To increase structured active play in kindergarten and day care.</p> <ul style="list-style-type: none"> Development, pilot testing, and implementation of a physical activity policy for early-childhood care and educational settings. Inclusion of policies into parent booklets. Collaboration with Kids—Go For Your Life program from 2007 for active play resources. Structured Active Play Program developed with input from early-childhood workers. Pilot-tested, produced, and disseminated to all early-childhood settings. Settings staff trained in fundamental movement skills and ways to provide active play opportunities for young children. Professional development for early-childhood staff (active play workshops). Training included how to use the Structured Active Play Program and how to adapt it for each setting. Active play demonstrations at kindergartens in City of Greater Geelong provided by allied health and dental professionals. Active Play newsletter (with information for parents and games for children) produced and distributed. Quarterly inserts placed into early-childhood newsletters. Structured Active Play Program training incorporated into early-childhood workers' vocational training. Presence at school and community festivals, where active-play games were demonstrated and children and parents encouraged to participate.

(Continued)

TABLE 1 (Continued)

Romp & Chomp objectives and activities undertaken
E-mail, phone, or site visit access to occupational therapists for early-childhood workers as required around implementing active-play program.
Active-play media release.
Promotional materials (eg, balloons, stickers, posters, postcards, etc.) produced and distributed.
Objective 7: To significantly increase home/family-based active play and decrease television-viewing time.
Overall needs-assessment evaluation identifying factors found to influence quality and quantity of screen-time viewing.
Literature review, mind-mapping exercise, and focus groups with parents.
Overall summary of recommendations for possible future strategies directed at reducing screen time/exposure in children.
Development and distribution of posters and postcards.
Cross-cutting intervention strategies
Ministerial project launch.
Ongoing media coverage (print and radio).
Awareness-raising activities with parents, health professionals, and early-childhood workers.
Community consultation.
Development and pilot testing of intervention strategies with early-childhood workers.
Development of professional training packages for early-childhood staff and dental and allied health professionals to implement the integrated health promotion package.
Presence at community festivals in the intervention region.
Presentations at community forums and early-childhood and health conferences.
Integration of policies and early-childhood nutrition and active play into local government and health-service strategic and public health plans.

support healthy eating and active play in young children in the region. The presence of a comparison sample greatly strengthened the experimental design because secular trends could also be accounted for. The sample was drawn from nonintervention Victorian LGAs with electronic anthropometric data from the 2- and 3.5-y-old Maternal and Child Health (MCH) Key Age and Stage (KA&S) health checks available at baseline (2004) and follow-up (2007). The follow-up year of 2007 was chosen, as this was the most recent complete year of data available at the time of data collection in 2008. In addition, a short Eating and Physical Activity Questionnaire (EPAQ) was used to collect parent-reported children's eating and activity behaviors when children attended for their 2-y-old or 3.5-y-old KA&S health check, before (intervention sample only) and after (both intervention and comparison samples) the intervention. Details of the data collected for the evaluation reported here are shown in **Figure 1**.

Anthropometric measures

Anthropometric data (height and weight) were collected by trained and experienced MCH nurses as part of routine KA&S health checks. After comprehensive data verification and range checks, the data were used to derive BMI, zBMI [according to the Centers for Disease Control and Prevention (CDC) 2000 growth charts (28)], and weight status [by using the International Obesity Task Force, Cole classification (29, 30)]. The database comprised children who attended their 2-y-old and 3.5-y-old KA&S health checks in 2004 and 2007. The attendance rates in the intervention site for these KA&S health checks are $\approx 60\%$ and 50% , respectively (31).

Behavioral measures

The EPAQ is a validated instrument (32) containing 11 items designed to capture dietary information, activity levels, and demographic characteristics of young children. Dietary measures included intake of fruit juices, cordial (a fruit-flavored sugar syrup diluted with water before drinking), soft drinks, water, plain milk, flavored milk, vegetables, packaged snacks, fruit,

chocolate, candy, cake, and cookies [ie, key foods and beverages with postulated obesity-promoting or obesity-protective roles (33–36)]. Data on children's activity levels, preferences, and time spent watching TV, videos, or DVDs or playing computer games on the previous day were also captured. Parents completed the survey about their child's food and activity behaviors with the aid of a food-servings guide (32). For interpretation of the results, all beverages had a serving size of 250 mL (1 cup), and the food category serving sizes were as follows: 1 serving of fruit = 150 g, vegetables = 75 g, chocolate and candy = 25 g, cake and cookies = 40 g, and packaged snacks = 25 g. The EPAQ took parents/caregivers ≈ 10 min to complete.

The EPAQ was distributed to parents of children through MCH centers across the intervention site when they attended their child's 2- or 3.5-y-old health check. The survey was distributed during the 12 mo from July 2005 to June 2006 (baseline) at the intervention site only and then began in late 2007 in both the intervention and comparison LGAs for a period that varied from 3 to 12 mo (follow-up). The MCH nurses used their discretion about the appropriateness of inviting parents to participate in the study, and surveys were not distributed if the MCH nurse deemed it was inappropriate due to language barriers, maternal mental health concerns, child health concerns, or time pressures during the consultation. The timeframe for data collection in the comparison sample varied for logistical and practical reasons across each LGA (eg, birth rate, staffing levels, number of MCH centers, and perceived burden on MCH nurses). It was not possible to determine an accurate individual-level parent response rate for each LGA due to the survey distribution method used; however, there was good representation across the LGAs, with 18 of 19 LGAs providing data. At baseline, 950 completed EPAQs were collected (intervention only) and in 2007/2008 (follow-up) 375 and 786 completed EPAQs were collected in the intervention and comparison communities, respectively (*see* Figure 1).

Parental awareness

To determine the reach of the program to one of the intended target groups (parents of young children), the awareness of the

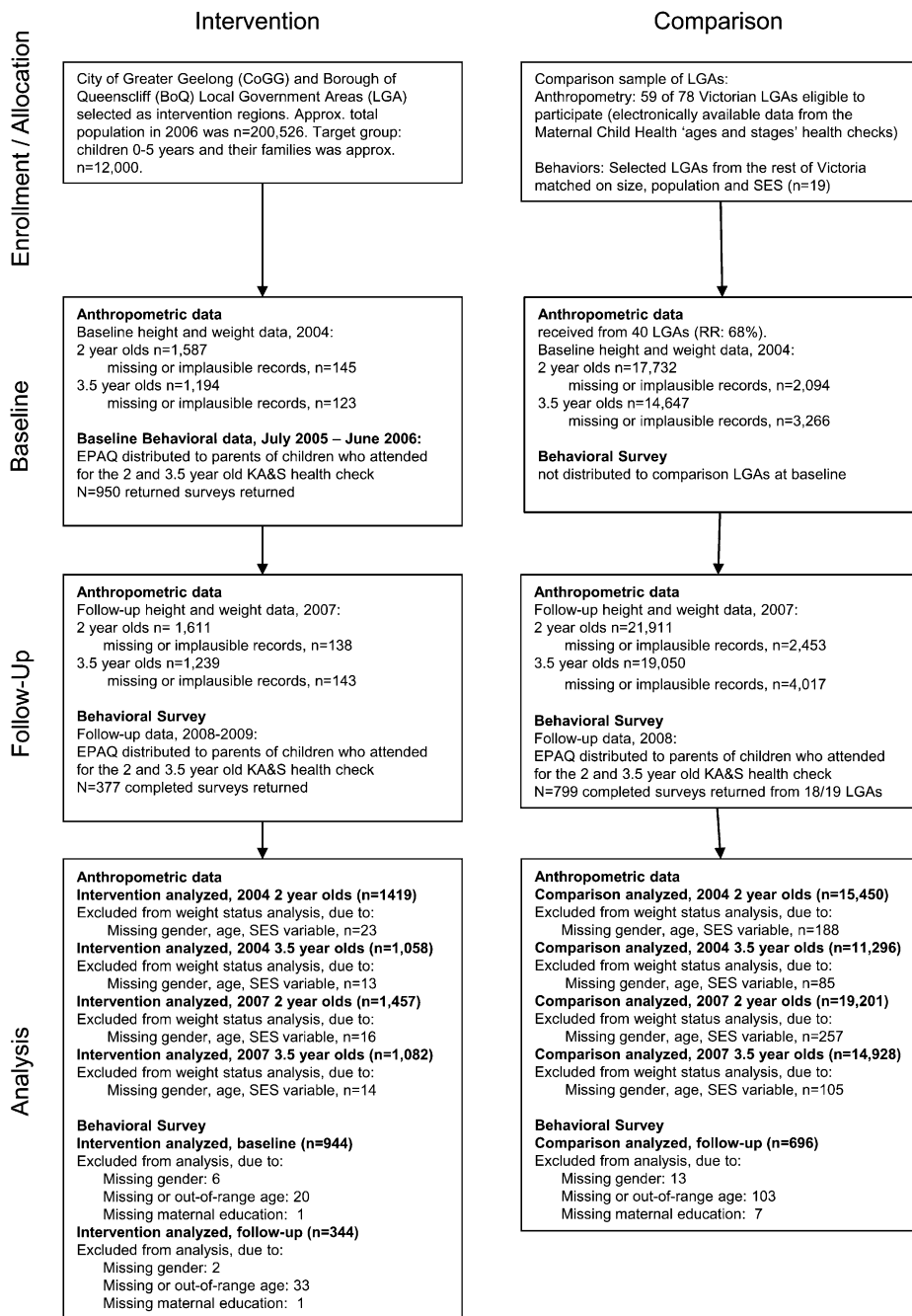


FIGURE 1. Flow diagram detailing anthropometric and behavioral data collection. KA&S, Key Age and Stage; EPAQ, Eating and Physical Activity Questionnaire; RR, response rate; SES, socioeconomic status.

Romp & Chomp project and its key messages was assessed by using short intercept interviews with parents of preschool children attending 2 community festivals in 2006 and 2008 in the intervention area. Interview questions asked about general awareness of the Romp & Chomp project and specific awareness of key messages. The survey took ≈2 min to complete.

Socioeconomic status

Socioeconomic status (SES) was measured in 2 ways: 1) The anthropometric database was used to provide residential postal codes and the 2006 Census data for Australia were used to determine the Socio-Economic Index For Areas (SEIFA) score on

the index of relative socioeconomic disadvantage (37). (This area-level index is based on data collected from the 2006 Australian census of population and housing and incorporates variables such as income, education, occupation, living conditions, access to services, and wealth. A lower score on the index indicates that an area is more disadvantaged.) 2) The EPAQ was used to glean information for the maternal educational level, and this was used as the indicator of SES.

Study approval

All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed

during this research. This study was approved by the Deakin University Human Research Ethics Committee, the Department of Human Services, and the Department of Education and Early Childhood Development.

Statistical tests

Descriptive information (eg, means and frequencies) was used to summarize key variables. BMI, zBMI [calculated according to the 2000 CDC growth reference charts from the United States by using the *zanthro* module in the software STATA (StataCorp, College Station, TX) (38)], and weight status data (healthy weight, overweight, or obese) were calculated (29, 30). Children who were underweight were identified [thinness grades: 2 and 3 (30)] and excluded from subsequent analysis (1.7% of baseline and 2.0% of follow-up samples). Continuous anthropometric data (weight, BMI, and zBMI) were analyzed by using generalized linear modeling (GLM) with child age, sex, height, and SES in the model. Categorical weight status data were analyzed by using GLM with child age, sex, height, and SES in the model by using a Poisson distribution. Behavioral data were also analyzed with GLM by using a Poisson distribution, with measures adjusted for child age, sex, and maternal educational level. Where there were unbalanced sample sizes, analysis was also conducted with bootstrapping to balance the samples, and similar results were obtained. Analyses were conducted using STATA SE (version 10.0), and in all cases $P \leq 0.05$ was considered to be statistically significant.

RESULTS

Demographic characteristics

The demographic characteristics of subjects in the anthropometric data analysis are shown in **Table 2**. The intervention and comparison samples were well matched on age and sex at baseline and follow-up; however, the intervention sample was more socioeconomically disadvantaged than was the comparison sample. The SEIFA data show that the intervention sample was around the 50th percentile of the statewide level, whereas the

comparison sample had a higher mean SEIFA percentile for both age groups. At baseline, the comparison sample had a lower prevalence of overweight and obesity than did the intervention sample.

The EPAQ

In the intervention and comparison samples, respectively, participants in this component of the evaluation were aged 2.9 ± 0.04 y and 2.8 ± 0.03 y, were 51.2% and 49.5% female, and 34.3% and 33.9% had mothers with an educational level of secondary school or less at follow-up. This educational level is similar to data from the 2006 Australian Census for the state of Victoria (33% for adults aged 25–34 y) (39).

Parental awareness of the Romp & Chomp Program

In 2006 ($n = 181$) and 2008 ($n = 123$), awareness of Romp & Chomp was 23% and 47%, respectively. In 2008 the proportion of parents who reported that they were aware of the following key messages was as follows: increase daily consumption of water (98%), increase daily consumption of fruit and vegetables (100%), increase daily physical activity (98%), cut down on TV and DVD viewing time (ie, less screen time; 84%), and clean teeth often (ie, clean well; 84%).

Changes in anthropometric variables

Descriptive data are summarized in Table 2 and **Figure 2** and show that, at follow-up, the prevalence of overweight/obesity in the 2-y-old intervention sample was 2.5 percentage points lower than the baseline intervention sample. In the 3.5-y-old intervention sample at follow-up, the prevalence of overweight/obesity was 3.4 percentage points lower than in the baseline sample. There was a much smaller difference of 0.7 percentage points between baseline and follow-up in the comparison sample (both age groups). Despite the lower prevalence of overweight and obesity in the intervention sample at follow-up, prevalence remained higher than in the comparison sample at follow-up.

TABLE 2

Demographic and anthropometric profile of participants in the 2- and 3.5-y-old (anthropometric) samples¹

	2-y-old sample				3.5-y-old sample			
	Baseline		Follow-up		Baseline		Follow-up	
	Intervention	Comparison	Intervention	Comparison	Intervention	Comparison	Intervention	Comparison
<i>n</i>	1587	17,732	1611	21,911	1191	14,647	1239	19,050
Female (%)	48.0	48.1	47.5	48.7	49.5	48.8	47.7	49.5
Child age (y)	2.07 ± 0.003^2	2.08 ± 0.001	2.06 ± 0.002	2.08 ± 0.001	3.63 ± 0.004	3.65 ± 0.001	3.63 ± 0.004	3.66 ± 0.001
SEIFA percentile	49.2 ± 0.7	57.2 ± 0.2	49.6 ± 0.7	57.1 ± 0.2	50.6 ± 0.8	57.6 ± 0.3	51.4 ± 0.8	57.2 ± 0.2
Weight (kg)	13.25 ± 0.04	13.07 ± 0.01	13.09 ± 0.04	13.04 ± 0.01	17.05 ± 0.07	16.89 ± 0.02	16.76 ± 0.07	16.86 ± 0.02
BMI (kg/m ²)	16.84 ± 0.04	16.60 ± 0.01	16.77 ± 0.04	16.57 ± 0.01	16.35 ± 0.05	16.20 ± 0.01	16.17 ± 0.04	16.17 ± 0.01
zBMI	0.71 ± 0.03	0.54 ± 0.01	0.68 ± 0.03	0.52 ± 0.01	0.67 ± 0.03	0.56 ± 0.01	0.54 ± 0.03	0.54 ± 0.01
Healthy weight (%)	82.9 ± 1.0	86.8 ± 0.27	85.4 ± 0.9	87.5 ± 0.2	81.4 ± 1.2	83.6 ± 0.3	84.8 ± 1.1	84.3 ± 0.3
Overweight (%)	13.8 ± 0.9	11.2 ± 0.3	12.5 ± 0.9	10.8 ± 0.2	14.4 ± 1.1	13.2 ± 0.3	12.7 ± 1.0	12.7 ± 0.3
Obese (%)	3.3 ± 0.5	2.0 ± 0.1	2.1 ± 0.4	1.7 ± 0.1	4.3 ± 0.6	3.2 ± 0.2	2.6 ± 0.4	3.0 ± 0.1
Overweight/obese (%)	17.1 ± 1.0	13.2 ± 0.3	14.6 ± 0.9	12.5 ± 0.2	18.6 ± 1.2	16.4 ± 0.3	15.2 ± 1.1	15.7 ± 0.3

¹ SEIFA, SocioEconomic Index For Areas, from the 2006 Census for Australia [socioeconomic index of relative disadvantage (statewide percentile)]; zBMI, standardized BMI.

² Mean \pm SE (all such values).

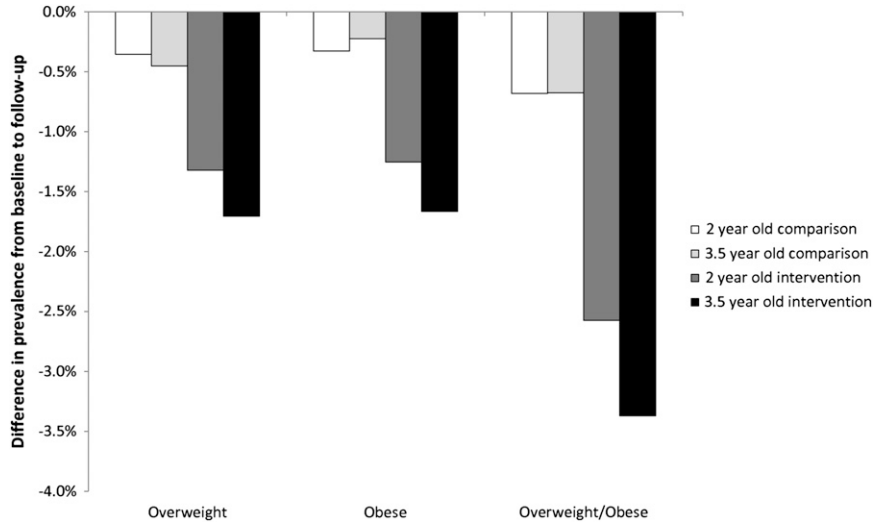


FIGURE 2. Differences in the prevalence of overweight and obesity between the 2- and 3.5-y-old intervention and comparison samples from baseline to follow-up.

In the age-grouped regression analyses, the intervention sample were significantly heavier than the comparison sample for both age groups (eg, for the 2-y-olds this was by 0.18 kg weight, 0.24 BMI units, and 0.17 zBMI units), with adjustment for covariates (child age, sex, and height; $P < 0.05$) (Table 3). Two-year-olds remained significantly heavier than the comparison sample at follow-up ($P < 0.05$), although there were reductions in the size of the differences (ie, the regression coefficients) for weight, BMI, and zBMI, and there was a significantly lower proportion of 2-y-old children who were overweight or obese at follow-up compared with baseline levels ($P < 0.05$). In the 3.5-y-old intervention sample, the regression analysis revealed significant reductions in weight, BMI, and zBMI at follow-up ($P < 0.05$), and the children were no longer significantly heavier than those in the 3.5-y-old comparison sample. In addition, when we explored changes within the intervention samples, there was a significant shift in the distribution of weight status (healthy weight, overweight, obesity) such that at follow-up, a higher proportion of children were in the healthy-weight range in both

age groups (Poisson regression analysis, $P < 0.05$; see Table 2 and Figure 2).

Changes in key obesity-related behaviors

As shown in Table 4, at follow-up there was a significantly lower intake of packaged snacks, fruit juice, and cordial and a significantly higher usual servings of vegetables per day in the intervention sample compared with that in the comparison sample. In addition, the mean number of minutes of TV and DVD viewing time was significantly lower in the intervention sample. From baseline to follow-up in the intervention sample, there was a significant increase in the intake of vegetables, fruit, water, and plain milk and a significant decrease in the intake of fruit juice. The usual servings of vegetables per day also increased from baseline to follow-up. There was no difference in the number of occasions children were taken out for physical activity between the intervention and comparison samples.

TABLE 3

Regression coefficients from analysis of the differences in anthropometric indexes between the intervention group and the comparison group¹

	<i>n</i>	Weight (in kg) (95% CI)	BMI (in kg/m ²) (95% CI)	zBMI (95% CI)	Weight status (95% CI) ²
2-y-old sample					
Baseline	16,426	0.18 (0.12, 0.24) ³	0.24 (0.16, 0.31) ³	0.17 (0.11, 0.22) ³	0.29 (0.17, 0.42) ³
Follow-up	19,983	0.15 (0.09, 0.21) ⁴	0.20 (0.12, 0.27) ³	0.15 (0.1, 0.21) ³	0.16 (0.03, 0.30) ³
3.5-y-old sample					
Baseline	11,898	0.11 (0.01, 0.21) ⁵	0.11 (0.02, 0.20) ⁵	0.08 (0.02, 0.15) ³	0.13 (0.06, 0.07) ⁵
Follow-up	15,451	-0.001 (-0.09, 0.1)	0.004 (-0.09, 0.09)	0.01 (-0.05, 0.07)	-0.03 (-0.17, 0.12)
Intervention sample (baseline vs follow-up)					
2-y-olds	2888	-0.02 (-0.04, 0.01)	-0.02 (-0.06, 0.01)	-0.01 (-0.04, 0.01)	-0.06 (-0.12, -0.01) ⁵
3.5-y-olds	2146	-0.06 (-0.10, -0.02) ⁵	-0.06 (-0.10, -0.01) ⁴	-0.04 (-0.7, -0.01) ⁴	-0.08 (-0.14, -0.12) ⁵

¹ zBMI, standardized BMI. Generalized linear models regression analysis was used. A positive coefficient means a higher outcome, and a negative coefficient indicates a lower outcome in the intervention sample relative to the comparison sample (model includes child age, sex, and height).

² Categorical variable coded as 1-3: 1 = healthy weight and 3 = obese.

³ $P < 0.001$.

⁴ $P < 0.01$.

⁵ $P < 0.05$.

TABLE 4

Regression coefficients from analysis of the differences in key obesity-related behaviors between intervention and comparison samples and between baseline and follow-up in the intervention sample¹

Behavior	Baseline intervention sample (unadjusted)	Difference at follow-up between intervention and comparison			Difference between baseline and follow-up in intervention sample		
		Coefficient ²	95% CI	<i>P</i> value (regression)	Coefficient ³	95% CI	<i>P</i> value (regression)
Servings the previous day							
Vegetables	1.07 ± 0.02 ⁴	0.10	−0.01, 0.20	0.07	0.41	0.30, 0.51	<0.001
Packaged snacks	0.44 ± 0.02	−0.23	−0.44, −0.03	0.03	−0.13	−0.34, 0.07	0.19
Fruit	1.29 ± 0.02	0.07	−0.02, 0.16	0.14	0.52	0.42, 0.61	<0.001
Chocolate/candy	0.45 ± 0.02	−0.06	−0.26, 0.14	0.56	−0.02	−0.21, 0.17	0.80
Cake/muffins/cookies	0.50 ± 0.02	0.02	−0.15, 0.19	0.82	0.16	−0.01, 0.33	0.06
Fruit juice	0.34 ± 0.01	−0.52	−0.79, −0.25	<0.001	−0.49	−0.75, −0.23	<0.001
Cordial (sugar syrup)	0.23 ± 0.01	−0.43	−0.73, −0.13	0.005	−0.23	−0.52, 0.07	0.13
Water	1.62 ± 0.03	0.02	−0.08, 0.11	0.74	0.11	0.02, 0.20	0.02
Plain milk	0.90 ± 0.02	0.01	−0.12, 0.13	0.92	0.18	0.06–0.31	0.004
Flavored milk	0.13 ± 0.01	−0.13	−0.05, 0.23	0.48	−0.05	−0.40, 0.31	0.80
Usual servings of vegetables per day	1.56 ± 0.03	0.13	0.03, 0.23	0.01	0.11	0.01, 0.21	0.03
Fast food consumed ⁵	2.51 ± 0.03	0.03	−0.05, 0.12	0.47	−0.04	−0.13, 0.04	0.27
Child taken to playground, park, pool, etc, in the last week (times/wk)	3.50 ± 0.06	0.05	−0.02, 0.12	0.18	0.01	−0.05, 0.08	0.68
Television/DVD viewing time (min/d)	105.75 ± 2.50	−0.03	−0.04, −0.02	<0.001	0.01	−0.004, 0.02	0.20

¹ Generalized linear models regression analysis (Poisson distribution) was adjusted for child age, sex, and maternal education. A positive coefficient means a higher compliance behavior, and a negative coefficient indicates a lower compliance behavior in the intervention sample relative to the comparison sample (model includes child age, sex, and maternal education).

² *n* varies from 1022 to 993 for these analyses.

³ *n* varies from 1265 to 1257 for these analyses.

⁴ Mean ± SE (all such values).

⁵ Categorical variable coded as 1–7: 1 = less than once/mo, 2 = 1–3 times/mo, 3 = 1 time/wk, 4 = 2–4 times/wk, 5 = 5–6 times/wk, 6 = 1 time/d, 7 = ≥2 times/d.

DISCUSSION

Romp & Chomp was a multisetting, multistrategy, community-based intervention to prevent obesity in early childhood. The intervention has been associated with a reduction in the prevalence of overweight/obesity that is 3 and 5 times more (in the 2-y-olds and 3.5-y-olds, respectively) than in the comparison sample, where the communities were exposed to subtle rather than directed health promotion activities. Children's diets also improved, which has short-term benefits for general (40) and oral health (41–45) and potentially also affects long-term risk of chronic disease, particularly obesity, in later life. These results provide evidence in support of community-wide and environmental approaches in reducing the prevalence of childhood obesity.

In addition to a reduced prevalence of obesity, reductions were also seen in other anthropometric indexes, particularly in the 3.5-y-olds. Importantly, the intervention children were significantly heavier and at greater risk of childhood obesity before the intervention, but in the older age group after the intervention these children were not different from the comparison sample. The younger children remained significantly heavier than the comparison sample even after the intervention, although the magnitude of difference between the 2 samples did decrease. This may be due to a lower exposure to intervention activities in the 2-y-olds, as more activities were focused on the preschool setting, and those attending are predominantly in the 3–5-y-old age group.

To date, to our knowledge, few obesity-prevention intervention studies have been conducted within early childhood and few have had a beneficial effect on obesity-related behaviors or reducing obesity or anthropometric indexes (6, 12, 14–17, 46–49). The most successful intervention has been the US-based Hip-Hop to Health Jr (50), in which the rate of increase in BMI was slowed over time in 3–5-y-olds compared with a control group. The intervention, however, was of high intensity, relatively short duration, and expensive in the long term. To our knowledge, no previous interventions have tested a capacity-building, multi-setting, multistrategy approach—an approach that has been shown to be successful in older children (19, 47). The Romp & Chomp evaluation shows the utility of this type of intervention in early childhood.

The Romp & Chomp intervention aimed to significantly reduce the consumption of high-sugar drinks and energy-dense snacks and to increase consumption of fruit, vegetables, and water. These objectives were achieved, and the diets of children in the intervention area have improved, particularly in relation to lower amounts of sweet drinks and packaged snacks. Specifically, children at follow-up were drinking approximately one-half cup less fruit juice and eating one extra small piece of fruit and approximately one-half serving more vegetables each day than before the intervention. Previous studies have targeted various nutrition risk factors in preschool-aged children. Often samples were small, interventions were of high intensity, and durations were short.

However, some improvements have been described, usually due to increases in fruit and vegetable intakes rather than in reductions in obesity-promoting foods and drinks (12, 17, 48, 50, 51).

We believe that the anthropometric and behavior changes observed in this study are the result of the changes in children's environments across the intervention area. Early-childhood settings in the intervention areas are now places in which fruit, vegetables, and water are promoted and packaged snacks and sweet drinks are restricted or discouraged. Driving these changes has been the implementation and enforcement of effective policy, cultural changes within organizations, and capacity-building with early-childhood teachers and caregivers. The consistency and continued reinforcement of messages across the community was a key factor in the success of the intervention, in addition to the capacity building of a willing and influential group of gatekeepers (early-childhood workers). Utilizing capacity-building and policy-based strategies also increases the potential of the intervention to benefit future cohorts of children.

Limitations and strengths

A considerable limitation of this study was our ability to solely attribute the changes seen to the Romp & Chomp intervention, given the design of both the intervention and evaluation. Other limitations included the inability to accurately determine response rates (although behavioral data were received from all but one of the local government areas sampled) and that anthropometric data were received from only 68% of the eligible LGAs. The method of data collection through the MCH service may have biased the sample toward parents with better language and parenting skills (although the level of education in the overall sample is similar to that in the general population), and more data may have also been collected from centers in which nurses were more motivated to distribute the survey or were in centers that were better staffed. In the anthropometric data set, the comparison sample was of higher SES, which may lead to an underreporting of obesity-related behaviors due to a social desirability bias, indicating a seemingly lower prevalence of overweight/obesity, and therefore an underestimation of the true prevalence in the general population. (However, it should be noted that despite being of higher SES, the difference is consistent from baseline to follow-up, so potentially the degree of bias should not change.)

In addition, the behavioral data were limited to population-level indicators, and sensitive measures of physical activity were not collected; therefore, we cannot make conclusions about the effect of the intervention on the levels of child physical activity. The dietary data were also reported by parents, which may introduce recall and social desirability bias, although we expect that recall bias would be at a similar level across both intervention and comparison samples.

Particular strengths of this study include the large sample size and use of existing child growth-monitoring data, although this concerned only the anthropometric data.

Conclusions

The results from this evaluation show that the Romp & Chomp intervention, working together with other similar health promotion programs, has reduced the prevalence of childhood overweight and obesity. The intervention's effects on obesity-

related behaviors and obesity prevalence suggest that this population group is receptive to environmental changes and that a community-wide multistrategy, multisetting approach to obesity prevention is a worthwhile investment. To our knowledge, Romp & Chomp is the first successful community-wide intervention to reduce obesity in early childhood. This outcome required long-term, committed partnerships and the creation of consistent policy-based changes across the community in a range of children's health, education, and care settings. The application of this approach in other communities should be determined.

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