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Physical Activity Promotion and Obesity Prevention in Girl Scouts: SNAP+

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Abstract

Background: A previous version of Scouting Nutrition and Activity Program (SNAP) resulted in greater physical activity (PA) during troop meetings, but no impact on girls' body mass index (BMI) or overall PA. The purpose of this study was to evaluate the effects of a six-month intervention that coupled the evidence-based program SNAP with a channel of communication to parents using health report cards (HRCs).

Methods: Thirty-two Girl Scouts (mean age = 9.5, SD = 1.4 years) received the SNAP+ intervention. Girls were measured before and after the intervention on body composition, BMI, and 7-day step counts. Troop leaders were trained to implement an interactive obesity-prevention curriculum. Parents received health report cards designed to provide personalized information about their daughters' PA and weight status.

Results: The full sample of participants took more steps per day after the intervention (mean difference = 1,741, $p = 0.007$). Results showed that lower values for body fat percentage ($p = 0.620$), BMI percentile ($p = 0.100$) and BMI z-scores ($p = 0.055$) at intervention end were not statistically significant. In the subsample of girls at risk for overweight and obesity, there were lower values for BMI z-score ($p = 0.010$), BMI percentile ($p = 0.027$), and body fat percentage ($p = 0.053$).

Conclusions: From this preliminary study, the SNAP+ intervention appears to be effective for Scout-based promotion of PA, and for the prevention of overweight and obesity in at-risk Girl Scouts, but further evaluation through a fully powered randomized controlled trial is warranted.

Key words: physical activity, obesity prevention, health promotion, Girl Scouts, intervention.

The prevalence of childhood overweight and obesity has risen steadily over the past three decades[1] and is considered a major global issue[2]. This rising prevalence poses a serious public health concern due to negative health complications associated with excess adiposity. Some complications commonly associated with overweight and obesity in children and adolescents include an increased risk of cardiovascular problems[3-5]; dysfunction of the lungs or airways[6, 7] including asthma[8]; metabolic diseases such as Type 2 diabetes[9]; gastroenterological conditions such as non-alcoholic fatty liver[10]; orthopaedic problems[6]; and an array of psychosocial issues[11, 12].

It is estimated that at least ten percent of school-aged children are classified as overweight or obese worldwide[13]. Some of the highest overweight and obesity prevalence rates are found in American children and adolescents. In the United States, 31.7% of children and adolescents aged 2 to 19 are overweight or obese (body mass index [BMI] for age $\geq 85^{th}$ percentile) and, 16.9% are classified as obese (BMI for age $\geq 95^{th}$ percentile)[14].

Parents can be regarded as gatekeepers and key role models for children's health behaviors[15]. Since children's health-related behaviors are largely influenced by their parents, childhood overweight and obesity cannot be effectively addressed without their parents' awareness and understanding of the risks and consequences involved with being overweight and obese[16]. There appears to be a worrying disconnect between parental perceptions of their child's weight status and their child's actual weight status[17]. A recent systematic review found that in 19 out of 23 studies examined, less than half of the parents of an overweight child perceived their child as being overweight[18]. Similarly, one study found most children who were identified as overweight by their parent, were actually obese[19]. This misclassification is especially pronounced if parents are overweight or obese themselves[17]. Parents who do not perceive their

child as being overweight or obese are less likely to make changes to improve their child's lifestyle and to prevent overweight and obesity[17, 19]. Therefore, making parents aware of their child's weight status may be an important component for promoting a healthy lifestyle and healthy body weight among children[16].

One method of communicating a child's weight status to parents is through the use of health report cards (HRCs) reporting BMI. State-legislated BMI measurement programs are currently being implemented in schools in 13 states in the U.S. and internationally in Sweden, Scotland, Ireland, and the U.K.[20]. Although there are some criticisms with the use of BMI measurement programs in schools, evidence suggests that most parents are supportive and respond positively to these programs[21]. Commonly, the use of HRCs is criticized because of weight-based teasing a child may encounter while being weighed at school. However, one study found 96% of students did not mind being weighed at school[22]. The use of HRCs may lead to increased parental awareness of children's weight status, and can be an informative and motivational tool for parents to assist in preventing overweight and obesity[23]. HRCs may also be a valuable tool for the promotion of physical activity (PA) or other health behaviors.

Evidence suggests PA can be an effective approach to treat and prevent overweight and obesity in children[24-26]. It is recommended that children accumulate 60 minutes of moderate-to-vigorous PA (MVPA) daily[27], which can be achieved in bouts of MVPA throughout the day[28]. Step counts can also be used as a benchmark for accumulating appropriate levels of PA. The recommendation for girls is approximately 11,000-12,000 steps/day, 5 days a week (higher for boys) for a standard healthy base[29]. However, many children are insufficiently physically active and PA levels tend to decline with age[30, 31]. This is particularly evident for girls in adolescence where sharper declines of PA are observed[32]. Therefore, environments tailored to girls that have

the capability to provide regular opportunities to contribute and increase MVPA and that are enjoyable, may be beneficial in preventing overweight and obesity. Girl Scouts may provide an ideal environment for girls to be physically active and assist in obesity prevention.

The Girl Scouts of the USA is a not-for-profit national organization that is part of the World Association of Girl Guides and Girls Scouts (WAGGGS). Globally, WAGGGS boasts membership of 10 million girls and adults in 145 countries[33]. Several studies have worked in cooperation with Girl Scouts to promote health behaviors[34-37]. But, few studies have attempted to promote PA to prevent obesity among girls who attend Girl Scouts. One study examined PA levels and sedentary behavior of girls attending Girl Scouts troop meetings, and found that girls were only achieving two minutes of MVPA and were sedentary for 90 minutes of their troop meetings[35]. Furthermore, PA was found to be frequently discouraged by troop leaders at troop meetings[35].

Previous interventions have not been successful in preventing obesity or promoting PA, but this may be due to a lack of communication or connection with parents. In particular, SNAP[34] was successful in promoting PA within troop meetings, but had no demonstrable impact on weight status or PA outside meetings. Therefore, the purpose of this study was to couple an effective PA promotion program with a channel of communication (HRCs) to parents and evaluate the effects of a six-month intervention.

Methods

Participants and setting

Three Girl Scouts troop leaders and their troops were invited and agreed to participate in the intervention study, and parental informed consents were obtained for all attending children (n = 32, 100% female). Participant characteristics are listed in Table 1. One parent of each Girl

Scout was asked to participate in the study, and most agreed by completing informed consent, a short demographics questionnaire, and by taking part in the PA assessment (n = 26, 92% female) and body composition assessment (n = 22, 91% female). Troops held meetings weekly, typically 90 minutes in duration. Meetings were held at a church, or at the Girl Scouts organization's property. Facilities were equipped with kitchens for food preparation, and ample useable space for physical activities inside and outside of buildings.

At study commencement, the mean age of participating girls was 9.5 (SD = 1.4) years and participating parents were 37.1 (SD = 5.4) years. More than half of the parents reported being college graduates, and four participating girls were of lower socio-economic status (i.e., eligible for government-subsidized school lunches). The sample was primarily non-Hispanic Caucasians; only two children were of minority race or ethnicity. For taking part in the study, troops earned $10 per girl, and individual families earned $10.

Evaluation procedures

For the baseline (October 2008) and end of intervention (April 2009) assessments, a research assistant travelled to two consecutive troop meetings, seven days apart, to measure girls and their participating parents. At the first troop meeting of both the October and April evaluation periods, girls were individually taken to a semi-private measurement station to be assessed on height, weight, and waist circumference. After anthropometric measurements, girls had a PA monitor placed on their right ankle (described below) and were instructed to wear this device for the next seven days. After the meeting, when parents arrived to retrieve their daughters, parents were given a pedometer (described below) and logbook, and were asked to wear the pedometer during all waking hours, except for water-based activities. Parents were also asked to record in the logbook their daily step counts, and also the times that they did not wear

the monitor. At the second troop meeting both before and after the intervention, girls and parents returned the PA monitors and logbook to a research assistant, and underwent body composition assessment (described below).

Anthropometric measurements

Prior to measurement, girls were asked to remove shoes and any heavy clothing. Using a portable stadiometer (Seca Corp, Model #214 Road Rod, Hanover, MD), research assistants measured standing height to the nearest 0.1 cm, and they measured weight to the nearest 0.1 kg with a high-precision electronic scale (Seca Corp, Model #770, Hanover, MD). For waist circumference, girls were instructed to breathe normally, relax and stand with feet shoulder-width apart, arms crossed in front of body, with hands on shoulders. Using a non-elastic tape measure, research assistants measured waist circumference by locating the midpoint between the bottom of the ribcage and top of the ileum on the right side of the body, wrapping tape measure snugly and horizontally around the waist, taking measurement at the end of a normal exhalation. For all assessments, duplicate measurements were made. If the first two measurements differed by more than 0.5cm or 0.5kg, a third measurement was taken.

Body mass index (BMI) was derived by dividing body weight in kilograms by height in meters squared. By using the age- and sex-specific LMS parameters from the CDC growth charts, BMI scores were converted into percentiles and z-scores[38]. Participants were then classified as underweight if their BMI fell below the age- and sex-specific 5th percentile (z-score of -1.645). Conversely, participants were classified as overweight if their BMI exceeded the 85th percentile (z-score of 1.036) or classified obese if their BMI exceeded the 95th percentile (z-score of 1.645). Participants at the 5th to 84th percentile (z-scores of -1.644 to 1.035) were classified as being normal weight.

Bioelectrical impedance measurements

Body composition was assessed using Quantum II tetra-polar bioelectrical impedance analyzer with accompanying BC Body Composition Software version 2.1 (RJL Systems, Clinton Township, MI, USA). Participating children and parents came to troop meetings in a four-hour fasted state, without recently having been vigorously active, sweating, or consuming large quantities of fluids. Prior to assessment, participants removed shoes and any metal jewelry, then rested with arms and feet apart on a fully reclining lounge chair, as research assistants cleaned placement sites and attached electrodes. Participants' reactance and resistance were then obtained and entered into the software program, along with height, weight, body frame size, age, gender, and daily activity level using the NHANES III general population (adults) or pediatric equations. These equations have been validated as body composition measures in both young girls[39] and adults[40]. From software output based on these equations, we obtained estimates of body fat percentage, fat mass, fat-free mass, and total body water.

Physical activity measurements

For girls, objective assessment of PA was obtained using the Actical accelerometer-based monitor (Mini Mitter, Bend, OR, USA). Using a locking nylon band, a research assistant snugly placed the device on each girl's right ankle, just proximal to the lateral malleolus. Acticals were initialized to record count and step data with a 15-sec epoch. Ankle-placement of the Actical accelerometer has been shown to be a valid method of measuring levels of PA and steps in children[41, 42]. The research assistant recorded the starting time and the identification number of the accelerometer worn by each girl. Scouts wore the accelerometer for one full week, after which they met with a research assistant to cut off the locked band, and thereby return the

monitor for downloading and data storage. Data from the first and last partial days of wear were discarded, and average daily step counts were calculated from six full days of wear.

For adults, objective PA assessment was accomplished using the NL-2000 piezoelectric pedometer (New Lifestyles, Lees Summit, MO, USA). With an internal clock and seven-day memory, this pedometer records and sums steps for each 24-hour period of wear over a full week. Previous studies have shown this device to provide valid estimates of ambulatory PA in adults, including overweight and obese adults. Based on pedometer logs, any days without 10 hours or more of wear time were excluded from daily averages, and all participants had valid data from at least four days of wear.

Intervention

The Healthier Troops in a SNAP Study[34] described an earlier version of the SNAP intervention program in Girl Scouts. Briefly that intervention included three main components: 1) An interactive obesity-prevention educational curriculum delivered by troop leaders; 2) Healthy eating and PA troop meeting policies implemented by and modeled by troop leaders; and 3) Health-promotion-oriented badge assignments to be completed at home by Girl Scouts, with the help of a parent.

For the current study's intervention, SNAP+, we modified the previous intervention in the following ways: 1) Providing a personalized HRC to parents, based on their child's PA and BMI baseline data. This HRC indicated the child's weight status and PA status, in relation to national standards. Parents were instructed to contact the primary investigator or to consult with their pediatrician or family physician for further information; 2) Using pedometers in troop meetings for troop leaders to self-monitor compliance with the policy for including 1500 steps per PA session and 2000 steps per meeting; and 3) Making minor modifications to educational

curricular activities to enhance their salience and effectiveness, based on feedback from troop leaders who participated in the original study.

Target behaviors of the intervention were expressed in three main messages: 1) "Take steps for fun and health" to promote PA for both girls and parents, particularly PA done together; 2) "Water is a wonderful choice" to promote adequate water consumption and decrease sugary beverage intake; and 3) "Make family connections through mealtime" to promote family meals, turning off the TV when eating, and including fruits and vegetables in meals. All the updated curriculum and troop leader training materials are available for free online at http://kinesiologyksu.weebly.com/healthier-troops-in-a-snap--girl-scouts.html.

Statistical analysis

PASW 18.0 (Chicago, IL, USA) statistical software was used for both descriptive and inferential statistics. Descriptive statistics included frequencies, means, and standard deviations. Inferential statistics included paired samples t-tests, and these were used to determine whether differences existed in outcome variables between baseline and end of intervention time periods. Paired samples t-tests were performed for the full sample (n = 32), and also in a subsample of those at risk of overweight and obesity (n = 17), girls above the 75th percentile for BMI. For all statistical analyses, alpha was set to 0.05.

Results

In total, 32 girls were recruited from 3 Girl Scouts troops. Table 1 displays participant characteristics at baseline. Approximately 31% of participants were either overweight (4/32 participants) or obese (6/32 participants), with an average BMI of 19.0 ± 3.8.

Table 2 presents the main outcomes of the SNAP+ intervention. All participants completed baseline measurement and the end of intervention measurement (n = 32, 100%).

Overall, the full sample of participants took significantly more steps after the intervention (baseline [BL] = 12,764 ± 2,946; intervention end [IE] = 14,505 ± 3,826; t = -2.91; P = 0.007). Slightly lower mean differences were found for body fat percentage (BL = 23.7 ± 9.4; IE = 23.5 ± 8.9; t = 0.50; P = 0.620), BMI percentile (BL = 66.8 ± 28.5; IE = 64.9 ± 28.3; t = 1.70; P = 0.100), and BMI z-scores (BL = 0.57 ± 1.00; IE = 0.49 ± 0.99; t = 1.99; P = 0.055), however, these differences were not statistically significant. Also, results showed non-significant increases in BMI (BL = 19.0 ± 3.8; IE = 19.1 ± 3.9; t = -1.15; P = 0.261).

Given the obesity-prevention focus of our intervention, subsample analysis was conducted for participants at greater risk for overweight or obesity, girls above the 75th percentile for BMI. All subsample participants completed baseline measurement and the second measurement (n = 17, 100%). The subsample analysis showed a non-significant difference in mean steps after the program (BL = 12,426 ± 3,115; IE = 13,566 ± 2,795; t = -1.56; P = 0.139). Girls had a non-significant decrease in body fat percentage (BL = 29.5 ± 8.2; IE = 28.4 ± 8.2; t = 2.09; P = 0.053), and a significantly lower BMI z-score (BL = 1.27 ± 0.52; IE = 1.15 ±; t = 2.94; P = 0.01) and BMI percentile (BL = 87.2 ± 8.4; IE = 83.9 ± 12.2; t = 2.44; P = 0.027). For this subsample, BMI remained unchanged from baseline (BL = 21.2 ± 3.9; IE = 21.2 ± 4.0; t = -0.031; P = 0.975).

One parent of each Girl Scout was asked to participate and most parents agreed (n = 26, 81%), only parents of six Girl Scouts declined. Parents took slightly more steps after the intervention than at baseline, though means did not differ significantly (BL = 8,086 ± 2,945; IE = 8,970 ± 3,740; t = -1.44; P = 0.162). No significant differences were observed for parent's body fat percentage at intervention end (BL = 34.1 ± 8.0; IE = 34.8 ± 8.2; t = -1.06; P = 0.303).

Discussion

SNAP+ was a six-month intervention aimed to couple an evidence-based PA promotion program with parent-directed health report cards. This intervention program was implemented with good fidelity, and was well received by troop leaders, girls, and their parents. Results showed that the girls were more physically active after the intervention, and that there were favourable shifts in body composition for the subsample of girls at risk for overweight and obesity. Although health report cards that communicate BMI and weight status have been criticized due to potential stigmatization[21], we received no complaints and observed no adverse reactions on any aspect of the intervention from children, parents, or troop leaders in the present study. The SNAP+ intervention program resulted in: 1) a channel of communication whereby parents became aware of the weight status and PA levels of their child; 2) opportunities for PA in the troop meeting environment that may otherwise be spent inactive; 3) bolstered PA levels of girls outside of troop meetings; 4) improved weight status among Girl Scouts who were at risk of overweight and obesity. These results demonstrate the feasibility of the SNAP+ intervention and its potential ability to increase Girl Scouts PA levels and improve weight status, particularly among those participants at risk for overweight and obesity.

Previously published interventions have generally not been successful in promoting PA in Scouts. Ievers-Landis et al.[36] sought to increase weight bearing PA and calcium intake in Girl Scouts, aiming primarily to prevent osteoporosis. This study found no significant differences in PA among two intervention groups and a control. Also, Jago et al.[43] conducted an internet-based intervention program and assessed immediate and longer-term (6 month) effects of a physical activity intervention with Boy Scouts. The results indicated a small decrease in sedentary behavior and increased light intensity physical activity in Spring participants only, and no effect on moderate to vigorous PA.

Our previous version of SNAP was evaluated in a cluster-randomized trial and shown to be successful at increasing PA amongst Girl Scouts during troop meetings, but had no apparent impact on self-reported habitual PA outside troop meetings[34]. Building upon SNAP's successful promotion of PA during meetings in the present study of SNAP+, we found significantly higher step counts at intervention end in the full sample, and a non-significant increase in step counts in the subsample of participants at risk for overweight and obesity, compared to baseline. Though not significant, the latter difference was more than 1,000 steps/day, and potentially capable of producing clinically meaningful health improvements for girls at risk of overweight and obesity. We observed a similar finding in parents, such that they achieved approximately 900 additional steps/day at intervention end, compared to baseline, but this was not statistically significant. Traditionally finding ways to reach and impact parents has proven difficult in many child intervention studies[44]. Therefore, our findings suggest a cautious optimism for physical activity promotion in girls and parents.

Improving weight status among Girl Scouts has also been an elusive task in previous research. The previous version of SNAP found no demonstrable impact on weight status[34]. After the SNAP+ intervention, there were non-significant differences in body fat percentage, BMI z-score, and BMI percentile for the full sample of girls. In the subsample of participants at risk for overweight and obesity, however, we observed significantly lower BMI z-score and BMI percentile, and a non-significant drop in body fat percentage, compared to baseline values. For participating parents, we found slightly higher body fat percentages at intervention end, even though parents were more slightly more physically active, compared to baseline.

There are key limitations that should be considered with the present study. First, we used a quasi-experimental pretest-posttest design without a concurrent control group. Also, as a pilot

study with very limited funding, our sample size was small and not fully powered. Despite the lack of a concurrent control group, the original SNAP study may serve to provide historical control data, as there was no evidence for such a favourable shift in PA or weight status in the original cohort's full sample, or in the at-risk subsample, for either intervention or control conditions[34]. Although seasonal shifts present one potential confounder, we saw no evidence for difference between October and April PA levels in our previous study, and seasonality is unlikely to explain the body composition findings.

Counterbalancing the above limitations, the present incarnation of the SNAP+ intervention was implemented with good fidelity and the evaluation included much more rigorous and objective measures of PA and weight status than were used in the original SNAP study[34]. The present study was novel in demonstrating the potential of combining an evidence-based curriculum with a direct method of communicating child PA and weight status to parents. Our ability to generalize the current findings, however, is limited to Girl Scouts and parents of similar demographic characteristics. Further research is needed to address the aforementioned limitations and to determine whether such an intervention program may be effective on a larger scale.

In summary, the SNAP+ intervention appears to be promising as an effective intervention for Scout-based promotion of PA, and for the prevention of overweight and obesity in at-risk Girl Scouts, but further evaluation through a fully powered randomized controlled trial is warranted.

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Table 1. Baseline Sample Characteristics

	Number
Participating children (100% female)	32/32
Non-Hispanic Caucasian Ethnicity	30/32
Low income family	4/30*
Parents are college educated	17/30*
†Normal weight	22/32
†Overweight	4/32
†Obese	6/32
	Mean ± SD
Waist circumference (cm)	66.5 ± 10.7
BMI (kg/m2)	19.0 ± 3.8
Height (cm)	138.2 ± 9.2
Weight (kg)	36.9 ± 10.8
#Fat-free mass (kg)	27.3 ± 4.7
#Fat mass (kg)	9.6 ± 6.6
#Total body water (L)	20.4 ± 3.7
Age (years)	9.5 ± 1.4
Parent's age	37.1 ± 5.4

Notes: *not reported by two participants; †derived from sex- and age-specific BMI growth charts[38]; #derived from bioelectrical impedance pediatric equation[39].

Table 2. Main outcomes associated with SNAP+ intervention

Characteristics	Sample size	Baseline Mean ± SD	Intervention End Mean ± SD	*t* value	*p* value
Full Sample– Children					
BMI (kg/m2)	n = 32	19.0 ± 3.8	19.1 ± 3.9	-1.15	0.261
†BMI z-score	n = 32	0.57 ± 1.00	0.49 ± 0.99	1.99	0.055
†BMI percentile	n = 32	66.8 ± 28.5	64.9 ± 28.3	1.70	0.100
Daily step count (steps)	n = 32	12,763 ± 2,946	14,504 ± 3,826	-2.91	0.007
#Body fat percentage	n = 32	23.7 ± 9.4	23.5 ± 8.9	0.50	0.620
Full sample– Participating parents					
‡Parent body fat percentage	n = 22	34.1 ± 8.0	34.8 ± 8.2	-1.06	0.303
Parent daily step count (steps)	n = 26	8,086 ± 2,945	8,970 ± 3,740	-1.44	0.162
Subsample– Children above the 75th percentile for BMI					
BMI (kg/m2)	n = 17	21.2 ± 3.9	21.2 ± 4.0	-0.03	0.975
†BMI z-score	n = 17	1.27 ± 0.52	1.15 ± 0.59	2.94	0.010
†BMI percentile	n = 17	87.2 ± 8.4	83.9 ± 12.2	2.44	0.027
Daily step count (steps)	n = 17	12,426 ± 3,115	13,566 ± 2,795	-1.56	0.139
#Body fat percentage	n = 17	29.5 ± 8.2	28.4 ± 8.2	2.09	0.053

Notes: †derived from sex- and age-specific BMI growth charts[38]; #derived from bioelectrical impedance pediatric equation[39]; ‡derived from bioelectrical impedance NHANES III equation[40].