

An Examination of Self-Reported Physical Activity and Physical Activity Self-Efficacy Among Children with Obesity: Findings from the Children's Health and Activity Modification Program (C.H.A.M.P.) Pilot Study

Análisis de la actividad física autoreportada y de la autoeficacia para la actividad física en niños con obesidad: resultados del estudio piloto del Programa de modificación de la salud y la actividad infantiles (CHAMP)

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Abstract. The increasing prevalence of childhood obesity is a global public health concern. Numerous experts have noted that comprehensive treatment methods are required to address this complex condition. The Children's Health and Activity Modification Program (C.H.A.M.P.), a 4-week intervention delivered in a unique camp-based format, was developed for children with obesity and their families using a multidisciplinary approach. The purpose of the current study was to investigate the short- (i.e., 1-week post-intervention) and longer-term (i.e., 3-, 6-, and 12-months post-intervention) effects of C.H.A.M.P. on children's self-reported: (a) task and barrier self-efficacy; and (b) home-based physical activity. A secondary purpose was to determine whether task and/or barrier self-efficacy served as predictors of self-reported home-based physical activity at any of these time points. The Physical Activity Questionnaire for Older Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997) was used to assess self-reported home-based physical activity and modified versions of the Self-Efficacy Scale and Barrier Efficacy Scale (McAuley & Mihalko, 1998) were administered to children to assess task and barrier self-efficacy, respectively. Forty participants (36 different children) completed Year 1 ($n = 15$; $M_{\text{age}} = 10.6$; 53% female) and/or Year 2 ($n = 25$; $M_{\text{age}} = 10.6$; 56% female) of the program. Results showed that participation in C.H.A.M.P. was associated with significant increases in task and barrier self-efficacy from pre- to post-intervention, after which mean values remained significantly higher than baseline at the 3- and 6-month follow-up assessments. No significant changes were observed from baseline to any of the post-intervention time points for home-based physical activity. Linear regression analysis revealed that task and barrier self-efficacy explained between 18% and 34% of the variance in self-reported home-based physical activity scores. While task self-efficacy contributed more towards the prediction of home-based activity at baseline, 1-week post-intervention, and 3-months post-intervention, barrier self-efficacy emerged as the predominant predictor at 6- and 12-months post-intervention. These results suggest that efficacious beliefs to be physically active and to overcome physical activity-related barriers may be important in the prediction of self-reported home-based physical activity in children with obesity. Taken together, the current findings also emphasize the importance of targeting self-efficacy as a first step towards increasing physical activity in this young population.

Keywords. childhood obesity; physical activity; self-efficacy; C.H.A.M.P.; community-based intervention.

Resumen. La creciente prevalencia de la obesidad infantil es un problema de salud pública mundial. Numerosos expertos han señalado que se requieren métodos de tratamiento integral para hacer frente a esta condición compleja. El programa de modificación de la salud y la actividad en niños (CHAMP), una intervención de 4 semanas diseñada en un formato único de tipo campamento, fue desarrollado para niños con obesidad y sus familias mediante un enfoque multidisciplinario. El objetivo del presente estudio fue investigar a corto plazo (es decir, 1 semana después de la intervención) y a largo plazo (es decir, 3, 6, y 12 meses después de la intervención) los efectos de CHAMP en la percepción subjetiva de los niños: (a) la autoeficacia en la tarea y en la barrera; y (b) la actividad física en el entorno familiar. Un objetivo secundario fue determinar si la autoeficacia en la tarea y/o barrera sirvió como predictores de la actividad física auto-reportada en el entorno familiar en cualquiera de estos puntos en el tiempo. El cuestionario de actividad física para niños mayores (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997) se utilizó para evaluar la actividad física auto-reportada en el contexto familiar y versiones modificadas de la escala de autoeficacia y la escala de eficacia de la barrera (McAuley & Mihalko, 1998) se administraron a los niños para evaluar la autoeficacia de tarea y relativa a las barreras, respectivamente. Cuarenta participantes (36 niños diferentes) completaron el año 1 ($n = 15$; $M_{\text{edad}} = 10.6$; 53% chicas) y el año 2 ($n = 25$; $M_{\text{edad}} = 10.6$; 56% chicas) del programa. Los resultados mostraron que la participación en C.H.A.M.P. se asoció con aumentos significativos en la autoeficacia de la tarea y la barrera en la pre y post-intervención, después de que los valores medios se mantuvieron significativamente más altos que en la línea base en las evaluaciones de seguimiento a los 3 y 6 meses. No se observaron cambios significativos desde el inicio hasta cualquiera de los puntos en el tiempo posteriores a la intervención para la actividad física en el entorno familiar. El análisis de regresión lineal reveló que la autoeficacia de tarea y de barrera explica entre el 18% y el 34% de la varianza en las puntuaciones de actividad física auto-reportada en el entorno familiar. Mientras la autoeficacia en la tarea contribuyó más a la predicción de la actividad física en el entorno familiar al inicio del estudio, la primera semana después de la intervención, y 3 meses después de la intervención, la autoeficacia en la barrera surgió como el factor de predicción predominante a los 6 y 12 meses después de la intervención. Estos resultados sugieren que las creencias eficaces para ser físicamente activo y para superar las barreras relacionadas con la actividad física son importantes en la predicción de la actividad física auto-reportada en el contexto familiar en niños con obesidad. En conjunto, los hallazgos actuales también hacen hincapié en la importancia de actuar sobre la autoeficacia como un primer paso hacia el aumento de la actividad física en esta población joven.

Palabras clave. Obesidad infantil; actividad física; auto-eficacia; C.H.A.M.P.; intervención basada en la comunidad.

Introduction

Childhood obesity is one of the most serious global health challenges of our time. Over the past 50 years or so, the prevalence of obesity among children and adolescents has risen in developed countries including, but not limited to, Canada (Roberts, Shields, de Groh, Aziz, & Gilbert, 2012), the United States (Ogden & Carroll, 2010; Ogden, Carroll, Kit, & Flegal, 2014), Japan (Matsushita, Yoshiike, Kaneada, Yoshita, & Takimoto, 2004), and Denmark (Bua, Olsen, & Sørensen, 2007). Developing nations have not been immune; data show that rates of obesity have also increased among children in Mexico, Brazil, India, and Argentina (Gupta, Goel, Shah, & Misra, 2012) and among preschoolers in the Dominican Republic, Haiti, Peru, and Zambia (de Onis & Blössner, 2000).

Childhood obesity is associated with a number of health comorbidities including heart disease (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001), Type II diabetes (Daniels, 2006), hypertension (Daniels, 2006; Freedman, Serdula, Srinivasan, & Berenson, 1999), musculoskeletal problems (Daniels, 2006; Wearing, Henning, Bryne, Steele, & Hills, 2006), asthma (Leung & Robson, 1990), poor self-esteem (French, Story, & Perry, 1995; Wang, Wild, Kipp, Kuhle, & Veuglers, 2009), and psychosocial stress (Puhl & Latner, 2007). Furthermore, children with obesity have an increased risk of becoming obese in later life (Guo, Roche, Chumlea, Gardner, & Siervogel, 1994) and many obesity-related ailments persist into adulthood (Celemajer & Ayer, 2006; Reilly & McDowell, 2003).

One of the most well recognized and widely cited health behaviors on the growing list of determinants of pediatric obesity and/or weight gain in children—including increased consumption of sugar-sweetened beverages (e.g., Malik, Pan, Willett, & Hu, 2013), reduced sleep duration (e.g., Chen, Beydoun, & Wang, 2012; Woodward-Lopez, Kao, & Ritchie, 2010), increased time spent in sedentary behaviors (e.g., Patel & Hu, 2008; Rey-Lopez, Vincente-Rodriguez, Biosca, & Moreno,

2008), and not having been breastfed or only having been breastfed for a short time (e.g., Arenz, Ruckerl, Koletzko, & von Kries, 2004; Monasta et al., 2010)—is insufficient levels of *physical activity*. Numerous studies have highlighted the relationship between physical inactivity and increased adiposity in children (cf. Hills, Andersen, & Byrne, 2011). In fact, a 2010 systematic review of 48 studies (the majority of which were cross-sectional) provided “strong evidence” in support of the conclusion that a negative relationship exists between objectively measured physical activity rates and child and adolescent (i.e., 0-18 years) obesity (Jimenez-Pavon, Kelly, & Reilly, 2010, p. 16).

It has long been acknowledged that regular levels of physical activity are essential for normal growth and development during childhood and beyond (e.g., Hills et al., 2011; Sallis, 1994). Given the many health benefits associated with regular physical activity including improved weight management (Marcus et al., 2000; Warburton, Nicol, & Bredin, 2006) and motor skill development (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009), increased self-esteem (Strauss, Rodzilsky, Burack, & Colin, 2001), and improved cognitive performance (Strong et al., 2005), the World Health Organization (2010) recommends that all children between the ages of 5 and 17 years should strive to accumulate 60 minutes of daily moderate-to-vigorous intensity physical activity (MVPA). Unfortunately, children in many Western settings are not meeting these guidelines. For example, in Canada, objective data indicate that only 7% of children (6-17 years of age) are accumulating 60 minutes of daily physical activity (Colley et al., 2011). In Australia and the United States, only 19% and 25% of children (5-17 years of age in Australia, 6-11 years of age in the United States) are achieving 60 minutes of MVPA per day, respectively (Australian Bureau of Statistics, 2013; Troiano et al., 2008).

Insofar as weight status is concerned, research has shown that children with obesity are less physically active than children without overweight or obesity (e.g., Page et al., 2005). Given the evidence that suggests obesity (Freedman et al., 2001), its related co-morbidities (Celermajer & Ayer, 2006), and physical activity patterns (Telama et al., 2005) track across the lifespan, early intervention and the use of theory- and evidence-based treatment protocols are essential (Martin et al., 2009).

Childhood obesity is complex, and as such, requires a comprehensive treatment approach (Oude Luttikhuis et al., 2009). In 2009, Oude Luttikhuis and colleagues published a Cochrane review of the childhood obesity treatment intervention literature (including lifestyle and drug interventions; $n = 64$ randomized controlled trials). The authors concluded that interventions had the most significant and clinical impact with regard to reducing childhood and adolescent (3-21 years of age) overweight when they were designed as family- and lifestyle-based programs geared towards modifying physical activity and nutrition behaviors. Among other recommendations, it was suggested that researchers should consider the examination of psychosocial determinants of behavior change in this young population (Oude Luttikhuis et al., 2009).

More recently, Cliff and colleagues (Cliff, Okely, Morgan, Jones, & Steele, 2010) conducted a systematic review to evaluate the impact of treatment interventions on the physical activity levels of children and adolescents (12-18 years of age) with obesity (Cliff et al., 2010). Of the 20 studies that were included in the review, 15 reported increases in physical activity levels at either the post-intervention or follow-up assessment points. According to the authors, effective interventions included evidence-based multifaceted approaches and were characterized by family involvement and the use of behavior change techniques. Similar to Oude Luttikhuis and colleagues (2009), Cliff et al. (2010) suggested that treatment programs for children and adolescents with obesity should be designed using evidence-based strategies for physical activity promotion, valid measurement tools, and theoretically-based approaches.

One theory that has shown promise for understanding and predicting physical activity among children (e.g., Goran, Reynolds, & Lindquist, 1999; Martin, McCaughy, Flory, Murphy, & Wisdom, 2011; Strauss

et al., 2001) is social cognitive theory (Bandura, 1989; Lewis, Marcus, Pate, & Dunn, 2002). Self-efficacy, which refers to an individual's confidence in his or her ability to perform a particular task (Bandura, 1989; Bandura, 1997), represents a major tenet of social cognitive theory and is arguably one of the most important determinants of human behavior (Bandura, 1989; Bauman et al., 2012; Giles-Corti & Donovan, 2002; McAuley & Blissmer, 2000). Self-efficacy has been divided into various subdomains including *task self-efficacy* (i.e., one's confidence in his or her ability to engage in or carry out a particular task/behavior) and *barrier self-efficacy* (i.e., one's confidence in his or her ability to overcome barriers or to complete a task under undesirable conditions; Maddux, 1995).

In 2008, Foley, Prapavessis, Maddison, Burke, McGowan, and Gillanders found that: (a) task and barrier self-efficacy were strong predictors of self-reported physical activity behavior in school-aged children (aged 11-13); and (b) children with higher levels of task and barrier self-efficacy engaged in significantly greater amounts of objectively measured physical activity than their less efficacious counterparts. More recently, a systematic review conducted by Cataldo and colleagues (2013) provided additional support for the conclusion that physical activity interventions can improve self-efficacy among children and adolescents (5-18 years of age). Researchers have also examined the self-efficacy levels of school-aged children (11.4 ± 0.6 years) with obesity in relation to objectively measured physical activity behaviors; as one might expect, children with obesity reported significantly lower levels of physical activity self-efficacy than their non-obese counterparts (Trost, Kerr, Ward, & Pate, 2001). Given these findings, researchers have suggested that interventionists should target self-efficacy as a means of enhancing physical activity behavior among children with obesity (Cataldo et al., 2013; Guinhouya, 2012; Trost et al., 2001). In fact, Cataldo and colleagues (2013) went so far as to suggest that “self-efficacy may be the transformational ‘missing link’ to innovatively address the growing obesity crisis” (p. 2).

In an effort to target childhood obesity in an urban setting in Ontario, Canada, our multi-disciplinary team of researchers developed and implemented an innovative community-based lifestyle (pilot) intervention for children with obesity and their families (see Martin et al., 2009 for a full description of the program and study protocol). The Children's Health and Activity Modification Program (hereafter referred to as “C.H.A.M.P.”) was a 4-week intervention delivered to children in a unique camp-based format. The overarching goal of C.H.A.M.P. was to increase children's physical activity behaviors in the camp and home environments via the inclusion of several evidence-based group dynamics strategies (e.g., enhancing group cohesion, setting individual and group goals, and increasing feelings of distinctiveness via the use of group names, logos, and songs (Eys, Burke, Dennis, & Evans, 2014; Sallis, 1993; Stucky-Ropp, 1993; Tucker & Irwin, 2006). Secondary objectives included improving psychological outcomes, such as physical activity self-efficacy and health-related quality of life, in children with obesity.

C.H.A.M.P. was designed to address several limitations identified in the literature regarding obesity treatment programs (e.g., Cliff et al., 2010; Oude Luttikhuis et al., 2009) including: (a) the use of a theory-based approach; (b) the use of a valid physical activity measure; (c) the measurement of psychosocial indices related to physical activity (e.g., self-efficacy); (d) the inclusion of parents and caregivers; and (e) a long-term (i.e., 12-months post-intervention) follow-up assessment. Furthermore, in line with Bandura's (1986) assertions regarding the four main sources of information that contribute to self-efficacy, as well as recommendations advanced by Trost and colleagues (2001), program components and the C.H.A.M.P. “philosophy” were created with a goal of enhancing the physical activity-related self-efficacy beliefs of children with obesity. Specifically, children were provided with opportunities to: (a) successfully engage in and experience (i.e., ‘master’) a wide range of group-based physical activities that were enjoyable and developmentally appropriate (i.e., soccer, baseball, dodgeball, and an adapted version of Harry Potter's fictional game “Quidditch” [Rowling, 1997]); (b) observe, support, and be encouraged by influential

others (e.g., parents, peers, counselors, professional athletes) who were also modeling physical activity behaviors; (c) receive praise, encouragement, and acknowledgement for participating in physical activity on a regular basis (i.e., from the important others noted above); and (d) engage in a range of activities in a supportive and wellness-enhancing environment, free from potentially anxiety-producing situations (i.e., competition, 'singling out' children, etc.).

Purpose

Our previous work has shown that participation in C.H.A.M.P. was associated with positive outcomes for children, including: improvements in cardiovascular indices (i.e., pulse pressure and brachial artery compliance; Jackman et al., 2009); trends towards improvements in glucose metabolism and blood lipid levels (Jackman et al., 2009); significant improvements in body composition (i.e., reduced standardized body mass index, increased muscle mass, and decreased body fat percentage (Burke et al., under review); and significant short- and long-term improvements in child- and parent-proxy reported quality of life (Burke et al., under review). In addition, the program was viewed and received positively by parents (Pearson, Irwin, Burke, & Shapiro, 2013) and children (Pearson, Irwin, & Burke, 2012). The purpose of the current study was to investigate the short- (i.e., 1-week post-intervention) and longer-term (i.e., 3-, 6-, and 12-months post-intervention) effects of C.H.A.M.P. on children's self-reported: (a) task and barrier self-efficacy related to physical activity; and (b) home-based physical activity. A secondary purpose was to determine whether task and/or barrier self-efficacy served as predictors of self-reported home-based physical activity at baseline, 1-week post-intervention, and at 3-, 6-, and 12-month follow-up time points for children with obesity. It was hypothesized that children would report significantly higher levels of task self-efficacy, barrier self-efficacy, and home-based physical activity immediately following the formal intervention (i.e., 1-week post-intervention), after which levels would remain stable and/or decrease slightly up to 12-months post-intervention. It was also hypothesized that both task and barrier self-efficacy would serve as predictors of self-reported home-based physical activity. Specifically, given both the nature and duration of C.H.A.M.P., as well as the findings from previous research (e.g., McGowan et al., 2012; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002), we anticipated that task self-efficacy would contribute more towards the prediction of home-based activity in the short-term (i.e., during the initiation of and immediately following the intervention), after which barrier efficacy would serve as the strongest predictor (i.e., in the maintenance of the behavior after participation in the 4-week program).

Method

As noted above, detailed accounts of the study development and methodology have been provided elsewhere (Burke et al., under review; Martin et al., 2009). Briefly, C.H.A.M.P. consisted of a 4-week lifestyle intervention that was delivered to two cohorts over the course of two years, and post-intervention support for one year following the program. Participants in the city of London, Canada were recruited through various means including media (i.e., newspaper and radio) advertisements, posters, and physician referrals. Families were eligible to participate if they had a child who: (a) was between the ages of 8 and 14 years; and (b) had a BMI-z greater than or equal to the 95th percentile for his/her age and sex. A total of 41 participants (54% female, mean age = 10.6 years) commenced the program over the course of two years (Year 1 $n = 16$; Year 2 $n = 25$). The primary caregiver in the participating families identified as Caucasian (82.0%) and employed (93.2%), and reported a median household income between \$60,000 and \$80,000 CAD.

One child/family was removed from the program for behavioral reasons mid-program, three children/families dropped out at the 6-month follow-up, and five children/families dropped out at the 12-

month follow-up. Five children/families participated in both years of the program.

Procedure

Children attended the program on weekdays (i.e., Monday to Friday) from 9am-4pm for four consecutive weeks during the month of August, and parents and/or guardians attended weekly group-based educational sessions on four consecutive Saturdays from 10am-2pm. C.H.A.M.P. consisted of several group-based intervention components for the children that were integrated into the daily curriculum including: (a) sport, fitness, strengthening, and games-based physical activity sessions; (b) behavior modification counselling; and (c) dietary counselling. Weekly educational sessions for parents and caregivers that targeted behavior modification strategies, physical activity, and nutrition in the home environment were also included. Post-intervention group support was offered to both children and caregivers (combined) in the form of "booster sessions" held once every two months for one year following the formal intervention.

A total of 32 program counselors and assistants (i.e., volunteers) were involved in the implementation of the child-based portion of the intervention over the course of two years. In addition, a number of guest speakers (e.g., certified professional life coach, exercise physiologist, registered dietitian, psychotherapist, anti-bullying representatives) led program sessions and assisted with the facilitation of the family-based meetings. Each family paid a fee of \$200.00 (CAD) for participation in the program. Ethical approval was obtained from the appropriate ethics board at Western University in London, Ontario, Canada.

Measures

Children and family members completed research assessments at baseline, mid- and/or post-program, and at 3-, 6-, and 12-month follow-up time points (Martin et al., 2009). For the purpose of the present study, only measures (and resulting data) related to physical activity self-efficacy and self-reported physical activity are presented. Trained research assistants administered all questionnaires in a lab or classroom setting.

Physical activity-related task and barrier self-efficacy

To assess task self-efficacy, an adapted version of the Self-Efficacy Scale (McAuley & Mihalko, 1998) was administered to children at five separate time points: baseline, 1-week post-intervention (i.e., 5 weeks), and at 3-, 6-, and 12-months post-intervention. Children were asked to identify how confident they were in their ability to complete regular physical activity for increasing amounts of time (10, 30, and 60 minutes) at three intensities (light, moderate, and hard). A color-coded scale with response options ranging from 0% (*no confidence at all*) to 100% (*completely confident*) was used, and verbal, written, and pictorial examples of mild, moderate, and hard physical activities were provided. The responses for each item were summed and divided by the total number of items to compute an overall task self-efficacy score; higher scores reflected greater efficacy to engage in physical activity for increasing durations and intensities. The task self-efficacy scale demonstrated a high level of internal consistency across all time points (Cronbach's alpha [α] = .89 - .95). Barrier self-efficacy was assessed using a modified version of the Barrier Efficacy Scale (McAuley & Mihalko, 1998). Again, using a color-coded scale ranging from 0% (*no confidence at all*) to 100% (*completely confident*), children were asked to rank their confidence in their ability to perform physical activity, for 60 minutes per day on most days, in the presence of six common barriers (e.g., "If I have a lot of activities to do with my friends and/or family", "If I am tired") presented verbally, in text, and pictorially. Scores were summed and divided by the number of items to produce an overall barrier self-efficacy score. Higher scores indicated greater levels of efficacy to engage in regular physical activity in the presence of barriers that have been deemed salient by school-aged children (Foley et al., 2008). Internal consistency was acceptable at all time points ($\alpha = .85 - .92$).

Home-based physical activity

Self-reported physical activity was assessed at five time points (i.e., baseline, 1-week post-intervention, 3-, 6-, and 12-months post-intervention) using the Physical Activity Questionnaire for Older Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997). The PAQ-C is a commonly used, self-administered, 7-day recall tool. Adequate test-retest reliability ($r = 0.75 - 0.82$ across a one week period), internal consistency ($\alpha = 0.79 - 0.89$), and convergent validity ($r = 0.39$ with the Caltrac motion sensor) have been demonstrated with children aged 8-14 years (Crocker et al., 1997; Kowalski, Crocker, & Faulkner, 1997). The PAQ-C is comprised of nine items which assess the frequency and intensity of spare time exercise, school-based exercise, and participation in sports after school, in the evenings, and on weekends, as well as perceived general activity level. Each item is scored on a 5-point Likert-type scale (i.e., 1 = no activity and 5 = the highest level of activity); as such, higher values are reflective of greater levels of physical activity. A final PAQ-C activity summary score is typically calculated by summing all nine items and dividing by the total number of items. Because the PAQ-C is intended to be used during the school year and the present study included two assessments that took place during summer holidays (i.e., baseline and 12-months post-intervention), only the four items which referred to *home-based physical activity* were used in the present study. Specifically, items associated with frequency of physical activities engaged in: (1) for specific physical activities (e.g., bicycling, dancing, soccer) over the past 7 days; (2) on the last weekend; (3) during one's "free time" over the past 7 days; and (4) for each day of the previous week, were included in the analyses. Internal consistency for the four items related to home-based physical activity ranged from poor ($\alpha = .46$ at 12-months post-intervention) to adequate ($\alpha = .72 - .82$ at remaining time points).

Data Analysis

All analyses were conducted using IBM SPSS Statistics Version 19. For children who participated in both years ($n = 5$), Year 1 12-month follow-up scores were replaced with the series mean to avoid duplication between these scores and Year 2 baseline scores. As recommended by Meyers and colleagues (Meyers, Gamst, & Guarino, 2006), histograms and normal probability plots were used to check that the data were normally distributed. Following confirmation of normal distribution, separate one-way repeated-measures ANOVAs were conducted for task self-efficacy, barrier self-efficacy, and self-reported home-based physical activity to examine potential time effects. Statistically significant effects were then followed by Bonferroni post-hoc analyses. Effect sizes (i.e., Cohen's d) were also calculated for the variables across time. According to Cohen (1969, 1992), effect size (d) values of .20, .50, and .80 can be interpreted as small, medium, and large, respectively.

Pearson correlations were used to examine the relationships between

Table 1
Descriptive statistics and repeated-measures ANOVA results for task self-efficacy, barrier self-efficacy, and home-based physical activity ($n = 41$)

Measure	Assessment Time Point					Repeated-measures ANOVA results		
	Baseline	1-week post-intervention	3-months post-intervention	6-months post-intervention	12-months post-intervention	F(4, 37)	p	?2
	Mean (SD) 95% CI	Mean (SD) 95% CI	Mean (SD) 95% CI	Mean (SD) 95% CI	Mean (SD) 95% CI			
Task self-efficacy	69.70 _a (20.16) 63.34-76.07	82.68 _b (16.63) 77.44-87.93	85.90 _b (14.49) 81.32-90.47	82.54 _b (15.96) 77.50-87.57	80.83 _b (17.34) 75.35-86.31	13.75	.000	.60
Barrier self-efficacy	59.84 _a (23.53) 52.41-67.27	69.05 _b (19.06) 63.04-75.07	71.50 _b (23.03) 64.23-78.78	69.80 _b (17.84) 64.23-75.43	67.90 _b (19.95) 61.60-74.19	3.00	.031	.25
PAQ-C home-based PA ¹	2.94 _{abc} (0.71) 2.72-3.17	2.94 _{abc} (0.75) 2.70-3.17	3.05 _b (0.60) 2.86-3.24	2.70 _c (0.63) 2.50-2.89	2.87 _{abc} (0.49) 2.72-3.03	2.92	.034	.24

Note. CI = Confidence Interval; PAQ-C = Physical Activity Questionnaire for Older Children; PA = physical activity; SD = Standard deviation; Mean scores which do not share a common subscript are significantly different from one another ($p < .05$).
¹PAQ-C home-based PA items = Q1, Q7, Q8, & Q9 only (Q5 & Q6 excluded based on references to after school hours).

variables (Table 2) and tolerance and Variance Inflation Factor (VIF) were used to check for possible multicollinearity between task self-efficacy, barrier self-efficacy, and home-based physical activity at each time point. Tolerance ($\geq .30$) and VIF (≤ 3.32) values were all acceptable, indicating that multicollinearity did not exist (Meyers et al., 2006). Linear regression was then used to evaluate the relationship between task and barrier self-efficacy and physical activity at each time point. Physical activity served as the dependent variable and task and barrier self-efficacy were entered together as predictor variables.

Results

Changes Across Time

Task self-efficacy, barrier self-efficacy, and self-reported home-based physical activity scores are summarized in Table 1. Significant overall time effects emerged for all three variables ($p < .05$). Bonferroni-adjusted post-hoc analyses demonstrated that task self-efficacy scores increased significantly from baseline to 1-week post-intervention ($p = .000, d = .70$) and remained significantly higher than baseline values at 3- and 6-months post-intervention ($p = .000$ and $.000$ respectively, $d = .92$ and $.70$ respectively). All increases were associated with medium to large effect sizes. Although mean task self-efficacy scores were still greater than baseline levels at 12-months post-intervention (see Table 1), the difference was no longer statistically significant ($p = .09$), although the effect size remained moderate ($d = .60$). Similarly, significant increases in mean barrier self-efficacy scores were observed from baseline to 1-week post-intervention ($p = .000, d = .42$) and remained significantly above baseline values at 3- and 6-months post-intervention ($p = .006$ and $.004$ respectively, $d = .50$ and $.48$, respectively). Again, while mean barrier self-efficacy scores were still greater than baseline values at 12-months post-intervention, the difference was not statistically significant ($p = .044, d = .37$).

For home-based physical activity, post-hoc analyses revealed that there were no significant changes in mean scores from baseline to any of

Table 2
Correlations between task self-efficacy, barrier self-efficacy and self-reported home-based physical activity

Variable	Assessment Time Point														
	Baseline			1-week post-intervention			3-months post-intervention			6-months post-intervention			12-months post-intervention		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Baseline															
1. Task self-efficacy	-														
2. Barrier self-efficacy	.71**	-													
3. Home-based PA	.54**	.50**	-												
1-week post-intervention															
4. Task self-efficacy	.60**	.55**	.45**	-											
5. Barrier self-efficacy	.55**	.64**	.53**	.84**	-										
6. Home-based PA	.43**	.37*	.36*	.60**	.56**	-									
3-months post-intervention															
7. Task self-efficacy	.68**	.59**	.51**	.74**	.66**	.48**	-								
8. Barrier self-efficacy	.29	.40**	.40**	.38*	.45**	.29	.58**	-							
9. Home-based PA	.43**	.29*	.41**	.59**	.40**	.54**	.51**	.20	-						
6-months post-intervention															
10. Task self-efficacy	.53**	.68**	.39**	.69**	.74**	.51**	.81**	.57**	.47**	-					
11. Barrier self-efficacy	.26	.53**	.26	.41**	.57**	.28	.49**	.61**	.38*	.70**	-				
12. Home-based PA	.35*	.30*	.31	.30*	.39*	.49**	.33*	.30*	.38**	.46**	.54**	-			
12-months post-intervention															
13. Task self-efficacy	.05	.25	.06	.04	.13	.13	.23	.63**	-.06	.29	.34*	.26	-		
14. Barrier self-efficacy	.02	.32*	.14	.13	.28	.32*	.16	.47**	.15	.37*	.46**	.35*	.81**	-	
15. Home-based PA	.31*	.35*	.13	.46**	.39*	.58**	.33*	.00	.49**	.40**	.22	.24**	.03	.31	-

Note. PA = physical activity (i.e., self-reported home-based component as measured by the Physical Activity Questionnaire for Older Children)

Table 3
Regression analysis for self-reported home-based physical activity (as measured by the PAQ-C) at each assessment time point

Variable	R ²	Adjusted R ²	F(2,38)	p	beta	p
DV: Baseline home-based physical activity						
Baseline	.32	.28	8.85	.001		
1. Task self-efficacy					.37	.059
2. Barrier self-efficacy					.24	.220
DV: 1-week post-intervention home-based physical activity						
1-week post-intervention	.37	.34	11.19	.000		
1. Task self-efficacy					.45	.063
2. Barrier self-efficacy					.18	.443
DV: 3-months post-intervention home-based physical activity						
3-months post-intervention	.27	.23	7.02	.003		
1. Task self-efficacy					.59	.001
2. Barrier self-efficacy					.14	.412
DV: 6-months post-intervention home-based physical activity						
6-months post-intervention	.31	.27	8.33	.001		
1. Task self-efficacy					.15	.431
2. Barrier self-efficacy					.44	.027
DV: 12-months post-intervention home-based physical activity						
12-months post-intervention	.22	.18	5.49	.008		
1. Task self-efficacy					.62	.015
2. Barrier self-efficacy					.80	.002

Note. DV = dependent variable; PAQ-C = Physical Activity Questionnaire for Older Children

the post-intervention time points. The only significant difference was a decrease in children's self-reported home-based activity from 3- to 6-months post-intervention ($p = 0.008$, $d = 0.48$).

Predicting Home-Based Physical Activity

Linear regression analysis showed that task and barrier self-efficacy explained between 18% (12-months post-intervention) and 34% (1-week post-intervention) of the variance in children's self-reported home-based physical activity scores (p s = .000 to .008; see Table 3). An examination of individual beta weights revealed that at baseline, 1-week post-intervention, and 3-months post-intervention, task self-efficacy contributed more towards the predictive utility of the model than barrier self-efficacy. However, barrier self-efficacy emerged as the predominant predictor of physical activity at 6- and 12-months post-intervention.

Discussion

The purpose of the study was to investigate the short- and longer-term effects of a 4-week theory-based lifestyle intervention on the self-reported task self-efficacy, barrier self-efficacy, and home-based physical activity of children with obesity. A secondary objective was to determine whether task and/or barrier self-efficacy served as predictors of self-reported home-based physical activity at various time points up to 12-months post-intervention. Overall, the findings provide preliminary support for the effectiveness of C.H.A.M.P. with regard to increasing task and barrier self-efficacy, and offer insights into the potential contributions of these psychosocial constructs towards our understanding of home-based physical activity among children with obesity. Beyond these general conclusions, several issues warrant further discussion.

With regard to self-efficacy, as noted above, participation in C.H.A.M.P. was associated with significant increases in both task and barrier self-efficacy among the children in our study. Mean task and barrier self-efficacy values increased significantly from baseline to post-intervention, after which they remained significantly higher than baseline at the 3- and 6-month follow-up assessments. At 12-months, mean task and barrier self-efficacy scores were still higher than baseline values, although the differences were no longer significant. These findings are consistent with our hypothesis and are promising given evidence showing: (a) a positive relationship between self-efficacy and physical activity among children with obesity (McAuley & Blissmer, 2000; McAuley et al., 2001); and (b) significantly lower levels of physical activity self-efficacy among children with obesity versus non-obese children (Trost et al., 2001). With regard to the latter point, our results showed that the mean baseline scores for both task and barrier self-efficacy—although they could be interpreted as 'moderate' (approximately 70% and 60%, respectively)—were indeed lower than the baseline values reported previously for a sample of non-obese primary school children in Canada (approximately 86% and 75%,

respectively; Foley et al., 2008). Taken together, these results emphasize further the importance of targeting this psychosocial construct in childhood obesity treatment interventions (cf. Cataldo et al., 2013; Guinhouya, 2012; Trost et al., 2001).

Interestingly, a comparison of the mean scores of these two variables at all time points revealed that the children with obesity were more efficacious in regards to their ability to complete regular physical activity for increasing time periods (i.e., task self-efficacy) than they were in their ability to successfully overcome physical activity-related obstacles (i.e., barrier self-efficacy). Given the nature of the intervention as well as previous research with school-aged children (e.g., Foley et al., 2008), this finding was not surprising. For example, while barrier self-efficacy was targeted via discussions and worksheets pertaining to the challenges associated with engaging in physical activity at home or school, the day-camp nature of the program provided children with ample (daily) opportunities to learn new skills (i.e., mastery experiences), observe similar others successfully engaging in a wide range of physical activities (i.e., vicarious experiences), receive and provide encouragement and support (i.e., verbal persuasion), and experience 'normal' physiological responses associated with exercise (i.e., physiological state) (Bandura, 1986; Trost et al., 2001). Furthermore, all activities were performed in a supervised, comfortable environment free from many physical activity-related barriers. To reiterate, mean barrier self-efficacy scores *did* in fact increase significantly over time, providing support for the effectiveness of the strategies used in C.H.A.M.P. to increase children's confidence to overcome challenges related to engaging in physical activity outside of the program.

Contrary to our hypothesis, C.H.A.M.P. was not associated with an increase in children's self-reported home-based physical activity. Despite this finding, one might argue that the program played a role in stabilizing physical activity levels in the short-term and/or preventing longer-term decreases. In fact, the small (albeit non-significant) increase in home-based physical activity over the first 3 months post-intervention, coupled with the absence of a significant decrease from baseline to 12-months post-intervention, may be viewed as encouraging given the physical activity guidelines for Canadian children and youth which emphasize that more activity leads to greater health benefits (Canadian Society of Exercise Physiology, 2012a; Canadian Society of Exercise Physiology, 2012b). Therefore, any improvement in children's physical activity levels—particularly those that take place on one's own, outside of the school environment or a supervised intervention program—should be viewed positively. In addition, the significant decrease in children's self-reported activity from 3- to 6-months post-intervention mirrors the timing of the (non-significant) declines in self-reported task and barrier self-efficacy. These decreases may be explained, at least in part, to the fact that this three month period spanned from November to February; winter months that are typically very cold in Canada. A 2010 review conducted by Carson and Spence provides support for this possibility, as studies from the United States and Canada have shown that the physical activity levels of children and adolescents tend to be lowest in the fall/winter months. Notably, while researchers have suggested that summer day camps hold potential as a means of increasing children's physical activity levels (e.g., Jago & Baranoski, 2004), additional research is warranted to identify and examine strategies that can be used to translate physical activity behaviors from the camp environment to the home environment.

Another important finding was that together, at different time points, task and barrier self-efficacy explained between 18% and 34% of the variance in self-reported home-based physical activity. This is in line with previous research using the same measures (with the exception of use of the full PAQ-C rather than home-based items only) with a sample of school-aged children (Foley et al., 2008). These findings are also unique in that they highlight specifically the value of targeting self-efficacy as a first step towards increasing the physical activity behaviors of children with obesity.

Lastly, in support of our hypotheses, the results showed that from baseline through to 3-months post-intervention, task self-efficacy

contributed more towards the prediction of self-reported home-based physical activity than did barrier self-efficacy. Subsequently, barrier self-efficacy played a greater role in the prediction of home-based physical activity at 6- and 12-months post-intervention. These results are consistent with previous research and support the idea that task self-efficacy may be more important during the initiation of physical activity while barrier self-efficacy may be more important for maintenance of the behavior (McGowan et al., 2012; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002). This pattern is also reflective of the nature and type of education and activities offered to children who participated in C.H.A.M.P. Specifically, many children reported (anecdotally) limited experiences with participation in sports, exercise (fitness-based, weight-bearing, etc.) or physical education classes. As such, the activities in which children engaged early in the program were primarily skills- and task-based; as the program progressed and children's competencies increased, greater discussions occurred around overcoming obstacles to participation in physical activity outside of the program.

The present study is not without its limitations. While the 12-month follow-up period represents a strength of the study (e.g., Cliff et al., 2010), it also prohibited us from being able to report the results of the full PAQ-C instrument, as two out of the five measurement periods coincided with the children's summer break (and thus, school-based physical activity was not measured at all time points). Given the fact that C.H.A.M.P. was purposefully developed as a summer camp, we did not aim to assess school-based activity; however, the use of only four items of the PAQ-C was not ideal as evidenced by the poor reliability at 12-months post-intervention. In addition, the self-reported nature of the PAQ-C is an important limitation of the current study, along with the small sample size and lack of comparison group. A final limitation is that our repeated measures ANOVA did not control for correlated residuals which may have resulted from having multiple time-points from each participant.

Generally speaking, our team's previous research has shown that C.H.A.M.P. is a novel and promising pediatric obesity intervention (e.g., Burke et al., under review). The current study provides additional (preliminary) support for the effectiveness of the program with regard to increasing the physical activity-related task and barrier self-efficacy of children with obesity. Furthermore, with regard to actual behavior, the results suggest that efficacious beliefs to perform activities and overcome physical activity-related barriers are important in the prediction of self-reported home-based physical activity among children with obesity. Thus, the present study adds to the existing literature suggesting that self-efficacy represents an essential starting point in the establishment of regular physical activity behavior among children with obesity (Guinhouya, 2012). On the basis of these conclusions, considered within the context of previous research, future pediatric obesity interventions should be developed with a focus on improving children's self-efficacy for performing specific activities and for overcoming obstacles related to regular participation in physical activity.

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