Original Article

A Home-based Intervention to Increase Physical Activity in Girls: The Fit 'n' Fun Dudes Program

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There is a strong need to increase physical activity levels and healthy dietary behaviors among children due to rising levels of obesity in many countries worldwide. Following on from previous research on dietary change, the current study evaluated the effects of a home-based physical activity intervention with 32 girls (mean age, 10.6 ± 0.7 years) and their parents. During the 8-day intervention, children were introduced to fictional role models (the "Fit 'n' Fun Dudes") and were given daily pedometer step targets to reach in order to receive small rewards. Pedometer measures were taken from children and parents in the experimental and control groups at baseline, during the intervention, and 12-week follow-up. Children in the experimental group were significantly more active than control children during the intervention on weekdays and weekend days (both $p < 0.01$). The effect remained at follow-up on weekend days ($p < 0.05$). Parents also increased their physical activity on weekend days. The intervention thus represents a promising strategy to increase physical activity in preadolescent girls and their parents. [*J Exerc Sci Fit* • Vol 7 • No 1 • 1–8 • 2009]

Keywords: children, health behavior, parents, physical activity, rewards

Introduction

There is now clear evidence that regular physical activity is beneficial to the physical and psychological health of children (Parfitt & Eston 2005; Moore et al. 2003; Rowlands et al. 2002; Boreham & Riddoch 2001; Rowlands et al. 1999). The protective effect of physical activity on the development of excess body fat is particularly important given the increasing prevalence of child obesity in many countries worldwide (Lobstein et al. 2004). Efforts to prevent obesity need to focus on both the physical activity levels and dietary habits of children (Dietz & Gortmaker 2001).

In relation to children's diets, there is substantial evidence that a school-based intervention, known as the *Food Dude Program*, produces large and long-lasting increases in the fruit and vegetable consumption of 4–11-year-old children (Horne et al. 2009b; Horne et al. 2004; Lowe et al. 2004; Horne et al. 1998; Lowe et al. 1998; Horne et al. 1995). The program incorporates the key psychological principles of peer-modeling and rewards, which have been shown to influence children's food choice (for review, see Lowe et al. 2004). The peer-modeling element centers on the "Food Dudes", a group of fictional peers who frequently eat and extol the virtues of fruit and vegetables via a series of video adventures (see Figure 1). Daily rewards, such as Food Dude stickers and pencils, are also awarded to children as incentives for eating fruits and vegetables.

Given its success in modifying food intake, this intervention model has recently been applied to increasing children's physical activity in order to determine whether the behavior change principles (peer-modeling, reinforcement) will be similarly effective in this new context. There is evidence in the literature that children's physical activity increases when its occurrence is rewarded using tangible items (Epstein et al. 1995) or

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Fig. 1 The Food Dudes peer-modeling characters, who are presented to children via a series of video adventures.

access to high-preference activities (Goldfield et al. 2000), these being baseball tickets and television viewing, respectively. Peer-modeling has been less investigated as a variable, but correlational studies indicate that peer support, encouragement and joint physical activity participation are associated with higher activity levels in children and adolescents (Davison & Schmalz 2006; Springer et al. 2006; Sallis et al. 2002). An intervention has thus been devised in which children are introduced, via letters and a song, to fictional physically active peers (the "Fit 'n' Fun Dudes"), who are designed to be role models. Children also wear pedometers and are given personalized step targets which they are instructed to reach over an 8-day period in order to receive Fit 'n' Fun Dude rewards. A recent study conducted in a school setting with 9–11-year-old children indicated substantial increases in daily step counts during the intervention period (> 2500 steps/day), with effects maintained at 12-week follow-up in girls (Horne et al. 2009a).

The aim of the current study was to trial and evaluate the Fit 'n' Fun Dudes intervention when implemented in the home context by the child's parents. Involving parents in child interventions is of importance because previous research suggests that parental support (e.g. verbal encouragement, providing transportation) and modeling variables are important for behavior change (Davison et al. 2003; Sallis et al. 1999; Moore et al. 1991). The study focused on preadolescent girls due to their consistently lower activity levels in comparison to boys, coupled with evidence that girls' physical activity begins to decline as early as elementary school (Trost et al. 2002). In line with previous work, it was predicted that the intervention would significantly increase the daily step counts of the participating girls and that the involvement of parents would support the children in maintaining these increases over time.

Methods

Participants

Participants were 32 girls, with a mean age of 10.6 (±0.7) years, recruited from four primary schools in North Wales, UK. In addition, one parent participated with each child. Mean age of the parents was 41.0 (±4.7) years, 84% were female and 84% were in full- or part-time employment. Parents gave written informed consent both for their own and their child's participation. Ethical approval was granted by the School of Psychology Ethics Committee, Bangor University.

Procedures

In order to minimize cross-contamination, schools were randomly assigned to the treatment conditions. Thus, children ($n = 14$) and parents from two of the schools were the experimental group and children ($n = 18$) and parents from the remaining two schools formed the control group. The study comprised a number of experimental phases, as detailed below.

Baseline

Physical activity of children and parents was measured over 8 consecutive days (6 weekdays and 2 weekend days) by pedometry in both the experimental and control groups. Anthropometric measurements were also taken from children and parents.

Child intervention

Only the experimental children took part in the intervention, which was implemented over 8 consecutive days by the parents (note that the physical activity of experimental parents was not targeted at this point). On Day 1, each child was given a personally-addressed letter from the Fit 'n' Fun Dudes, a group of fictional, physically active peers designed to serve as role models. The letter contained encouragement to be physically active. Each child was also given a pedometer step target and was instructed (by the Fit 'n' Fun Dudes) to reach this each day in order to receive a daily reward. The research team

computed the targets by adding 2000 steps onto each child's mean daily step count measured at baseline. Thus, a child who averaged 8000 steps/day at baseline would be given a target of 10,000 steps/day at the start of the intervention. The four Fit 'n' Fun Dude characters were further introduced via the "Fit 'n' Fun Dudes Song", which was recorded onto compact disc and given to each child on the first day of the intervention. After being worn all day, pedometers were checked by the parent at the child's bedtime. Provided the target had been reached or exceeded, the parent gave the child that day's scheduled reward. There were eight rewards in total, one for each day of the intervention, and these consisted of inexpensive items such as balls and frisbees. Parents were instructed to administer verbal praise when the target was achieved. Children used specially designed Fit 'n' Fun Dude charts to record their step totals at the end of each day. Children's physical activity continued to be measured by pedometry in the experimental group on the 6 weekdays and 2 weekend days of the intervention. Measures were also taken for 8 days simultaneously for children in the control group who did not take part in the intervention.

For parents in both groups, the 8-day pedometer measure introduced at baseline continued throughout the phase.

Maintenance

The aim of the maintenance phase was to support the children in maintaining their increased physical activity over a longer time period. In order to do this, each parent in the experimental group was also given a pedometer step target, which was computed by adding 2000 steps onto his/her mean steps/day as measured during the child intervention phase. Parents and children in the experimental group continued to wear their pedometers throughout maintenance; they recorded their daily pedometer counts in provided Fit 'n' Fun Dudes diaries and were instructed to try to reach their targets on as many days as possible. As an additional incentive at the end of the phase, a mystery prize (family day out to a local zoo) was awarded to the child and parent who, as a pair, reached the targets on the most number of days. Fit 'n' Fun Dude letters were also sent as prompts during Weeks 1, 5, and 10. There were no maintenance procedures in the control group.

Follow-up

For all groups of children and parents, follow-up measures were taken 12 weeks following completion of the child intervention in the experimental group or the equivalent measurement period in the control group. As previously, physical activity of children and parents was measured over 8 days (6 weekdays and 2 weekend days) by pedometry.

Measurements

Physical activity

Pedometers (Yamax SW-200, Tokyo, Japan) were used to measure the physical activity of children and parents over 8 days during each of the baseline, child intervention and follow-up phases. The pedometer represents an objective, low cost and unobtrusive tool for measurement of total physical activity (Rowlands & Eston, 2007). Prior to the baseline and follow-up phases, approximately 25% of the pedometers were randomly selected for validity testing via a 50-step walk test.

During each measurement phase, a total of eight individual pedometers were used to measure the children's physical activity, with one pedometer assigned to each day. On the first day of the phase, the child put on the pedometer labeled "Day 1" while dressing that morning. After being worn all day, the pedometer was removed at bedtime and placed in a provided envelope without being reset. On the second day, she wore the pedometer labeled "Day 2", again placing the unit into the envelope at the end of the day without resetting it. This continued throughout the phase until all pedometers had been worn. The envelope was then collected by the researcher who recorded the accumulated daily step count on each of the eight pedometers that had been worn by the child. This procedure thus avoided relying on parents to record the children's daily step counts.

Parents' physical activity was measured using one pedometer that was worn during waking hours for the duration of each measurement phase. The parents did not reset their pedometers at any point, and thus an 8-day total pedometer count was accumulated. To provide a breakdown for individual days, the parent recorded his/her total pedometer count at bedtime on each day. At the end of each measurement phase, the parent placed his/her pedometer into the envelope along with the child's pedometers for collection by the researcher. On each day, the parent recorded the times that the child/parent put on and took off their pedometers in the morning and evening, respectively, as well as indicating whether the pedometer had been removed during the day (e.g. for swimming) and for how long. Any days of illness or absenteeism from school or work were noted. This recording sheet was also collected by the researcher.

Anthropometric assessment

Body mass (to the nearest 0.1 kg) and height (to the nearest 0.1 cm) were measured without shoes using a Hanson electronic scale and a tape measure attached to a vertical wall, respectively, in the participants' homes.

Statistical analyses

Days were deleted from the analysis when: (1) the child or parent reported illness or absenteeism from school or work; or (2) the pedometer was removed during the day for more than 2 consecutive hours (according to the recording form, see above). To be included in the analyses, children and parents needed to have at least 4 weekdays of pedometer data in each measurement phase, in accordance with previous recommendations (Tudor-Locke et al. 2005; Trost et al. 2000). Final sample sizes following exclusion were: experimental girls, $n = 14$; control girls, $n = 15$; experimental parents, $n = 13$; and control parents, $n = 15$. Baseline descriptive statistics were computed for age and anthropometric variables. For each child and parent, mean steps/day on weekdays was computed during the baseline, child intervention and follow-up phases using the pedometer data from the last 4 weekdays of each phase. A series of 3×2 repeated measures ANOVAs were conducted for children and parents separately where independent variables were *time* (baseline, child intervention, follow-up) and *group* (experimental, control), and the dependent variable was mean steps/day on weekdays. Where significant *time* × *group* interactions occurred, independent groups *t* tests were used to compare experimental and control groups at each time point. Changes over time within each group were examined using one-way repeated measures ANOVAs and simple main effects tests. All *post hoc* tests were adjusted for multiple comparisons using the Bonferroni adjustment. An alpha level of 0.05 was used for all other statistical tests. Assumptions of normality and homogeneity of variance were checked and log 10 or square root transformations were employed on the data where violated. The analysis was then repeated with mean steps/day on weekend days as the dependent variable, including only those children (experimental, $n = 9$; control, $n = 9$) and parents (experimental, $n = 9$; control, $n = 13$) who had data points for 2 weekend days in all three measurement phases.

Results

Baseline characteristics

Baseline characteristics of the children and parents included in the analyses are shown in the Table. For both children and parents, there were no significant differences between experimental and control groups with regard to age, anthropometric variables or the frequency of overweight/obese participants ($p > 0.05$ in all cases).

Children's physical activity

Figures 2 and 3 show the mean physical activity of girls on weekdays and weekend days, respectively, across the three study phases.

The analysis of the weekday data showed a significant interaction between time and group, $F(2, 54) = 7.42$ ($p = 0.001$). *Post hoc* analysis showed no significant group difference at baseline ($t = 1.14$, $p = 0.266$). Experimental children during the intervention were significantly more active than controls over the same time period ($t = -2.96$, $p = 0.006$), and a non-significant trend in this direction remained at follow-up ($t = -1.83$, $p = 0.079$). Within-subject comparisons showed that, in the experimental group, step counts were higher during the intervention compared to baseline ($p < 0.001$) and follow-up ($p = 0.003$), but there was no significant difference between follow-up and baseline ($p = 0.81$). Step counts for the control children were significantly lower at follow-up as compared with the intervention

Table. Baseline characteristics of children and parents included in the analyses*

	Children		Parents	
	Experimental ($n = 14$)	Control ($n = 15$)	Experimental ($n = 13$)	Control ($n = 15$)
Age (yr)	10.5 ± 0.9	10.7 ± 0.7	39.9 ± 5.6	41.3 ± 4.0
Height (cm)	144.9 ± 7.6	143.0 ± 8.8	163.9 ± 6.3	163.1 ± 9.0
Body mass (kg)	41.5 ± 9.6	42.0 ± 12.8	69.6 ± 13.3	73.6 ± 19.4
BMI ($kg \cdot m^{-2}$)	19.5 ± 3.3	20.2 ± 4.0	26.0 ± 5.1	27.7 ± 7.3
Overweight/obese† (% participants)	50	53	54	67

*Data presented as mean ± standard deviation or %; †for children, international age-specific cut-off points were used for overweight/obesity classification (Cole et al. 2000). For parents, BMI > 25 $kg \cdot m^{-2}$ was defined as overweight/obese.

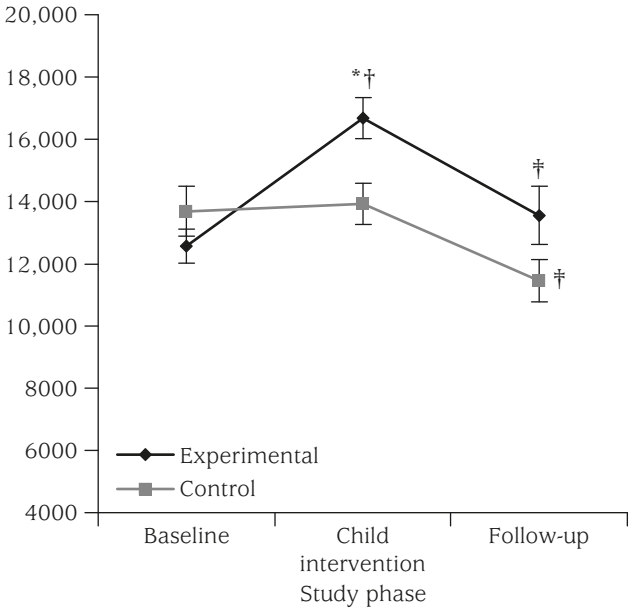

Fig. 2 Mean steps/day for children on weekdays. Bars represent ± 1 standard error of the mean. *Significantly different from control group, $p < 0.01$; †significantly different from baseline within group, $p < 0.001$; ǂsignificantly different from child intervention within group, $p < 0.05$.

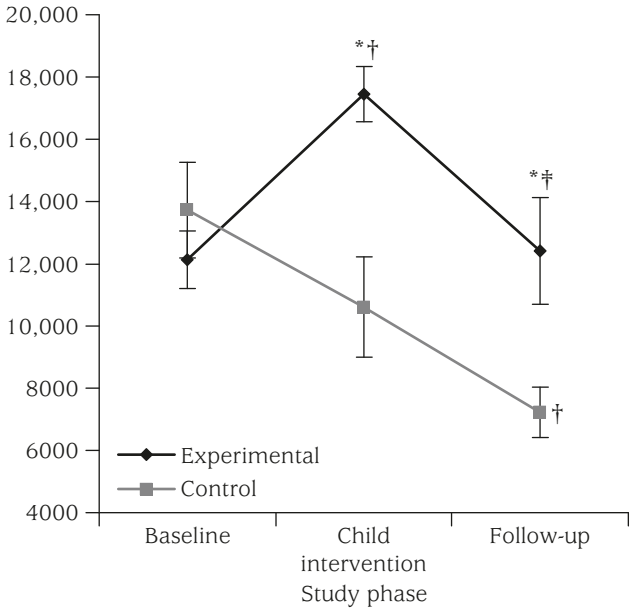

Fig. 3 Mean steps/day for children on weekend days. Bars represent ± 1 standard error of the mean. *Significantly different from control group, $p < 0.05$; †significantly different from baseline within group, $p < 0.01$; ǂsignificantly different from child intervention within group, $p < 0.05$.

period ($p = 0.012$); there was also a non-significant trend for lower step counts at follow-up relative to baseline ($p = 0.086$).

On weekend days, there was also a significant interaction between time and group, $F(2, 32) = 7.89$ ($p = 0.002$). Experimental children were significantly more active than control children during the intervention ($t = -3.57$, $p = 0.003$) and at follow-up ($t = -2.86$, $p = 0.01$), but not at baseline ($t = 0.88$, $p = 0.393$). In the experimental group, steps per day were significantly higher during the intervention compared to baseline ($p < 0.001$) and follow-up ($p = 0.014$), with no difference between baseline and follow-up ($p = 1.0$). In the control group, step counts were significantly lower at follow-up compared to baseline ($p = 0.005$).

Parents' physical activity

Figures 4 and 5 show the mean physical activity of parents on weekdays and weekend days, respectively, across the three study phases.

On weekdays, the analysis showed no significant interaction between time and group, $F(2, 52) = 0.74$ ($p = 0.48$). On weekend days, however, the interaction was significant, $F(2, 40) = 5.44$ ($p = 0.008$). *Post hoc* analysis showed that experimental parents were significantly more active than control parents at follow-up

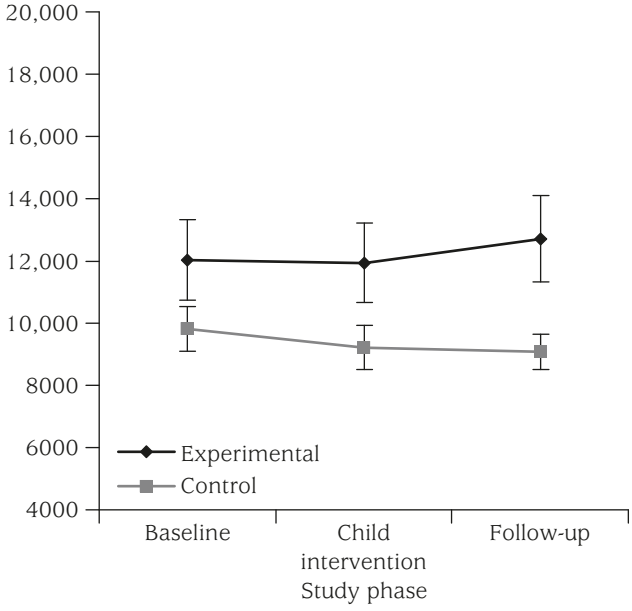

Fig. 4 Mean steps/day for parents on weekdays. Bars represent ± 1 standard error of the mean.

($t = -2.94$, $p = 0.008$), with no group difference at baseline ($t = 0.68$, $p = 0.507$) or during the child intervention ($t = -0.42$, $p = 0.682$). In the experimental group, there was no significant change in steps/day across the three

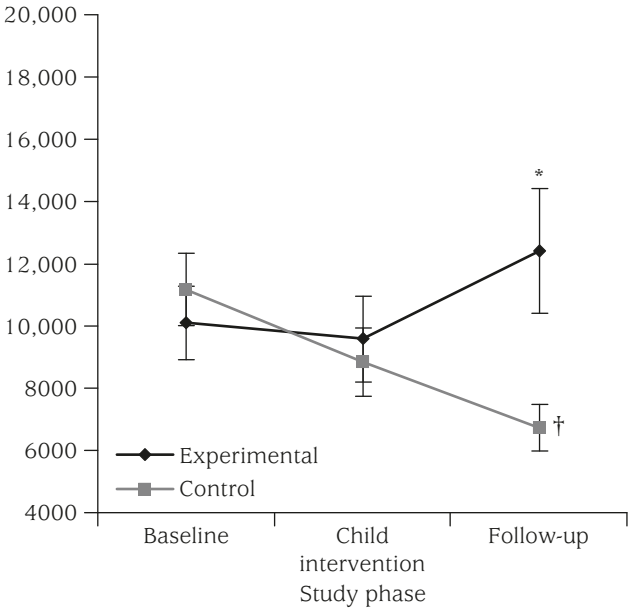

Fig. 5 Mean steps/day for parents on weekend days. Bars represent ± 1 standard error of the mean. *Significantly different from control group, $p < 0.01$; †significantly different from baseline within group, $p < 0.05$.

study phases, $F(2, 16) = 1.88$ ($p = 0.184$). In control parents, steps/day were significantly lower at follow-up compared to baseline ($p = 0.01$).

Discussion

The current results indicate that a parent-delivered intervention, employing peer-modeling, rewards, and pedometer step targets, was effective at increasing the physical activity of preadolescent girls. Children in the experimental group showed a mean increase of 4112 steps/day on weekdays during the intervention. The magnitude of this increase is similar to that obtained by girls in the previous school-based evaluation of the intervention (3822 steps/day; Horne et al. 2009a). The effect on weekend days (+5318 steps/day) appears even greater, a significant finding as the school study did not include weekend physical activity yet previous research indicates that children are less active on these days relative to during the week (Rowlands et al. 1999). Given the well-documented lower activity levels of girls compared to boys (Trost et al. 2002), the intervention's effectiveness in producing such large increases in daily step counts is an important finding. Furthermore, at 12-week follow-up, girls in the experimental group remained significantly more active (12,425 steps/day) at the weekend than control girls, who averaged just 7216 steps/day.

The finding of no statistically significant difference between baseline and follow-up step counts in the experimental group of children needs to be viewed in the context of the decline in physical activity over the study period shown by the control group. This effect is most likely attributable to time-of-year effects because the baseline and child intervention measures were taken in the summer whereas follow-up measures were taken during autumn when shorter daylight hours and weather conditions were less conducive to outdoor physical activity. Previous research indicates that lower temperatures and rainfall are associated with decreased daily steps in adults (Chan et al. 2006). Similarly, Rowlands and Hughes (2006) found that objectively measured physical activity was lower in winter than in summer in children. In the current study, the fact that the experimental group did not show a similar decline from baseline to follow-up suggests that participating in the intervention protected them from these seasonal effects on activity levels. In future research, however, it will be important to identify additional maintenance strategies to ensure that increases in step counts obtained during the intervention are maintained over time.

The parents' data indicated that, by follow-up, the experimental group was significantly more active than the control group on weekend days (12,405 compared to 6720 steps/day, respectively), whereas there had been no significant differences at baseline or during the child intervention, when parental physical activity was not targeted. It thus appears that the step targets set during the maintenance phase were effective at increasing the parents' physical activity over time on weekend days. Parents in the control group, on the other hand, showed a significant decline in weekend physical activity over the study period, which mirrors that shown by the control group of children and most likely reflects seasonal influences. The lack of significant effects at follow-up on weekdays may reflect the constraints of the work environment as the majority of parents were in employment.

The intervention was relatively short in duration and a longer intervention period may have led to better maintenance of the effects. The pedometer targets given during the intervention required children to take an additional 2000 steps per day above their baseline level of activity. Proportionally, this increase was greater for children who were less active compared to those who were more highly active. However, this seems acceptable as it is this low active group of children who

are most in need of intervention and, importantly, all children in the study were able to achieve their targets during the intervention regardless of their initial baseline level of activity. It is currently not possible to determine the relative contribution of each individual component of the intervention (peer-modeling, rewards, pedometer targets). Further research to address this important issue is in progress, though the Food Dudes research showed that the combined peer-modeling and rewards intervention was considerably more effective than when either component was used alone (Lowe et al. 1998).

The current parent-delivered intervention produced comparable increases in girls' weekday physical activity as were found in the school-based evaluation (Horne et al. 2009a). The additional targeting of weekend physical activity and the involvement of parents (and related increases in their weekend physical activity) were key benefits of the home-delivered program. However, among the many advantages of school-based programs is the ability to target large groups of children simultaneously (Goran et al. 1999; Story 1999), which may serve to enhance peer support for physical activity. In order to be of maximum benefit, interventions that are delivered at school should include a substantial home component to ensure that parents and other family members fully engage with the program. Elder et al. (2007) emphasized the importance of broader community-based activity programs as they have the capacity to involve parents and other role models from the community.

In conclusion, the current findings indicate that the Fit 'n' Fun Dudes program may be effectively delivered by parents and produces significant increases in both child and parent physical activity. While further evaluation is needed with larger sample sizes, this study represents an important first step towards the development of a home-based intervention that may be used by parents to promote physical activity in preadolescent girls. In the future, there is great potential to combine this intervention with the existing Food Dudes Program to create an obesity prevention package that brings about improvements in both diet and physical activity.

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