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A controlled trial of a school-based environmental intervention to improve physical activity in Dutch children: JUMP-in, kids in motion

MERLIN E. JURG[1], STEF P.J. KREMERS[2], MATH J.J.M. CANDEL[3], MARCEL F. VAN DER WAL[1] and JUDITH S.B. DE MEIJ[1]

[1]Department of Epidemiology, Documentation and Health Promotion, Municipal Health Service Amsterdam, Amsterdam, [2]Department of Health Education and Promotion and [3]Department of Methodology and Statistics, Maastricht University, Maastricht, The Netherlands

SUMMARY

Interventions to promote physical activity are important in preventing children from becoming overweight. Many projects have been developed but only a few showed (moderate) effects. JUMP-in is a systematically developed primary-school-based intervention that focuses on the use of theory, environmental changes, parental influences and cooperation with multi-level parties in intervention development. The effects of JUMP-in were evaluated with a quasi-experimental pre-test/post-test research design. In total, 510 children from Grades 4, 5 and 6 of four intervention schools and two control schools in Amsterdam were followed for an intervention period of one school year. Changes in physical activity as well as in the social cognitive determinants were assessed using self-reports. In addition, a process evaluation has been executed. The results show that JUMP-in was effective in influencing physical activity, especially among children from Grade 6. Children in the control group decreased their level of physical activity considerably, while activity levels in intervention children from Grade 6 remained stable. The intervention effects could not be explained by changes in the measured social cognitive determinants. In contrast, process information illuminated differences in intervention effects between the participating schools. The results from the JUMP-in study show the importance of intervention designs that focus on a theory-based mix of relevant environmental and social cognitive factors.

Key words: controlled trial; children; JUMP-in; physical activity

INTRODUCTION

The prevalence of overweight and obesity among children in western countries has risen dramatically in recent years (Hirasing *et al*., 2001; Magarey *et al*., 2001, Gregg *et al*., 2005). Insufficient physical activity is an important factor in the development of overweight. Although there are no accurate data on temporal trends in physical activity participation, it is clear that opportunities for children to be sedentary in their leisure time have increased through greater access to 'pay' television, electronic games, computers and the internet (Salmon *et al*., 2005). Data from surveys in the United States and Canada as well as from the Netherlands suggest a downward trend in the prevalence of participation in physical activity as children grow older (Kohl III and Hobbs, 1998; van Mechelen *et al*., 2000). Various interventions have aimed at promoting physical activity among children (Sallis *et al*., 1993; Davis *et al*., 1995; Donnelly *et al*., 1996; Harrell *et al*., 1996; Pate *et al*., 1997; Gortmaker *et al*., 1999; Nader *et al*., 1999;

Müller *et al*., 2001; Sahota *et al*., 2001*a*, *b*; Going *et al*., 2003; Pangrazie *et al*., 2003; Robinson *et al*., 2003; Veugeleurs *et al*., 2005). Only a few showed (moderate) effects (Davis *et al*., 1995; Harrell *et al*., 1996; Nader *et al*., 1999; Müller *et al*., 2001; Pangrazie *et al*., 2003). The lack of effect on physical activity may be attributable to limitations in the measurement of physical activity among youth, but may also have been due to an insufficient intervention design (Campbell *et al*., 2005; Brug *et al*., 2005). Some interventions did not pay attention to environmental changes (Gortmaker *et al*., 1999; Müller *et al*., 2001; Going *et al*., 2003; Pangrazie *et al*., 2003; Robinson *et al*., 2003), did not involve parents (Sallis *et al*., 1993; Harell *et al*., 1996; Donnelly *et al*., 1996; Going *et al*., 2003; Pangrazie *et al*., 2003; Robinson *et al*., 1999) or were only short term projects (Davis *et al*., 1995, Robinson *et al*. 1999; Pangrazie *et al*., 2003). In addition, some interventions were not theory-based (Donnelly *et al*., 1996; Going *et al*., 2003; Pangranzie *et al*., 2003). Furthermore, most programmes have not taken into account individual preferences and lack the possibility of choice. Offering different behavioural alternatives may positively effect compliance and long-term success.

JUMP-in is a systematically developed primary-school-based intervention that focuses on the use of theory, environmental changes, parental influences and cooperation with multilevel parties in intervention development. This article presents the effectiveness of a 1-year JUMP-in intervention on physical activity as well as its social cognitive determinants in a population of primary school children. Process evaluation has been used in order to illuminate the effect evaluation results.

METHODS

In 2002 a primary-school-based intervention programme called 'JUMP-in', was started in Amsterdam. JUMP-in aims to promote physical activity among primary school children. The intervention is a systematically developed, joint project involving municipal authorities, local sport services, primary schools and local sport clubs. It focuses on action points at personal level as well as on the physical and (social) environments. The term environment refers to on objective notion of all the factors that can affect a person's behaviour but that are physically external to that person. Examples of a social environment include family members, friends and peers in the classroom. The physical environment might include the availability of physical activities and sport and policies (Glanz *et al*., 1997). JUMP-in consisted of six programme components: (1) school sports activities, (2) a pupil follow-up system, (3) The Class Moves!®, in-class exercises, (4) Choose your Card! lessons aimed at increasing awareness, (5) parental information services and (6) an Activity-week. In addition, special attention was paid to pleasure and to ethnic minorities. In Frame 1, a brief description of various distinct JUMP-in programme components are given. With the exception of 'parental information service' and 'Activity-week', all programme components were designed for permanent use during a school year. JUMP-in was developed based on scientific theories and methods. The intervention mapping protocol (Bartholomew *et al*., 2001) was applied in order to systematically design the intervention, using theoretical input from the Theory of Planned Behaviour (Ajzen, 1988), a model of physical exercise and habit formation (Aarts *et al*., 1997), the Precaution Adoption Process model (Weinstein and Sandman, 1992), a social ecological model of physical activity (Pikora *et al*., 2003) and the Service Quality Model (Parasuraman *et al*., 1985). Also empirical studies (mentioned in the introduction) were used in planning the JUMP-in intervention. Factors that positively or negatively influenced these interventions were taken into account.

Design, recruitment and participants

A pre-test/post-test control group design was used to study the differences between the intervention and control schools on physical activity and its determinants. Intervention schools were selected by asking them to participate in the intervention and research. Control schools were selected by asking them to participate in a research. The inclusion criteria for participation were that schools needed to have (1) a trained physical education teacher, (2) pupils with low socio-economic status and (3) a location where school sport activities could be organized in the school or in the vicinity. To avoid contamination the two recruited control schools were located in a different city

Frame 1: Description of the components of the JUMP-in programme

School sports activities
Easy accessible school exercise activities are offered in or near to the school premises. During school hours children get acquainted with a variety of sports, each sport a number of times in several weeks. Subsequently they can join the club out of school hours. School sport activities are characterized by continuity. As far as possible, use will be made of the normal local range of physical activities and existing sports activities in the area, and the school child care centres in the school. 'School sports activities' is designed to be adopted in the regular school policy, in order that school sport activities will be available all school year long.

Pupil follow-up system.
The physical education (PE) teacher monitors the pupils once a year, in order to stimulate pupils in a structured way in their development in the areas of sport and physical activity and in attaining the physical activity recommendation for youth (i.e. at least 60 min of moderate-intensity physical activity on most, preferably all days of the week, including twice weekly activities that aim at increasing or maintaining physical fitness (Kemper *et al*., 1999). In cases where support or care is required, use is made of the existing school network channels.

The Class Moves! ® (De klas beweegt!®)
This programme offers during normal lessons regular breaks for physical activity, relaxation and posture exercises. The aim is to make physical activity a daily habit, to give the children pleasure, awareness and more self-esteem, and to contribute to a healthy sensor-motor development. The Class Moves consists of calendars, each grade had its own calendar. The calendars contain exercises separated on 10 themes, each for every school month. Teachers need to be trained to use 'the Class Moves!®'

Choose your Card!
This is a newly developed card game approach that works with assignments to be done in the class and at home. The method is especially aimed at raising awareness on the importance of physical activity for health and one's own physical activity behaviour, self-efficacy, social support, planning skills, of both the children and their parents. The cards can also be used to prepare an Activity-week and an exhibition. The development of 'Choose Your Card' was supported by a group of experts on the terrain of physical activity determinants and the implementation of health promotion in schools, and the Dutch Heart Foundation. The cards are used to prepare for an Activity-week and are linked to an exhibition.

Parental information service
A service in which the importance of physical activity and sports for children and the role played by parents in supporting and stimulating such activity among their children is emphasized. The information can be given in the parents' own language by specially trained information officers. 'Parental information service' will take place at least once a year.

Activity-week
In the Activity-week some components of JUMP-in are brought together. Parents play an important role in this week. Some examples of activities in this week are: a sport and activity exhibition where products of 'Choose your Card' are presented, sports activities and during the week, a warming-up session for parents and children and a sport market where parents and children meet local sport clubs. In this week parental information services will be carried out. 'The Activity-week' will take place once a year.

district than the four selected intervention schools (two schools in district A and two in district B). The baseline measurement was conducted in August and September 2002 (T0; at the beginning of the school year) and the post-test in May and June 2003 (T1; at the end of the school year). While the JUMP-in intervention was developed for pupils in primary school from Grades 1 to 6 (4–12-years-old), the effect evaluation population only consisted of pupils from Grades 4, 5 and 6 (9–12-years-old) because younger children are less able to complete questionnaires (Sallis *et al*., 1999). A passive consent procedure (Gortmaker *et al*., 1999) was applied: a letter was sent to all parents describing the study, with the option to sign and return the form if they did not want their child to participate. Nobody raised objections.

Measures

Data on physical activity and its determinants were gathered by questionnaires completed at school. The pupils received a verbal introduction from the researcher. During completion of the questionnaires pupils were allowed to ask questions. Most of the non-participation was due to absence from school (e.g. illness) on the day of the study. For the process evaluation several instruments were used: semi-structured-interviews, questionnaires, observations and document analysis. The process evaluation was used to gain insight into the extent to which (1) children had participated in school exercise, (2) the different programme components were used and (3) the parental information service was visited.

Physical activity behaviour

Physical activity was assessed with a newly developed questionnaire that allowed a physical activity score to be calculated in minutes. The questionnaire was developed based on relevant literature (Sallis, 1991; Welk *et al*., 2000; Tremblay *et al*., 2001), existing questionnaires (Sallis *et al*., 1996) and consulting experts on this subject. This questionnaire was pre-tested among 10-year-old children. In the questionnaire pupils were asked what activities they commonly engage in during a usual school day. The school day was separated into different segments, because children remember their physical behaviour more precisely that way (Tremblay *et al*., 2001) (e.g. 'What do you do usually after dinner and before going to bed?'). This questionnaire allowed a physical activity score to be calculated in moderately active minutes per day. All minutes of activities with a MET-score of ≥ 5 were counted, acknowledging the Dutch guidelines for moderate physical activity (Kemper *et al*., 2000), using The Compendium of Physical Activities (Ainsworth *et al*., 1993). This resulted in a 'daily activity score'. Additional questions were asked about membership of a sports club and the frequencies of practice and competitions as well as the duration of a session. Frequency and duration of attendance at sports clubs were multiplied, giving a score for the total amount of minutes per day spent on organized sports ('sports score'). Finally the 'daily activity score' and 'sports score' were added into a total score: 'minutes per day (at least) moderately active'.

Determinants of physical activity

The measured determinants of physical activity were awareness, attitude, encouragement, descriptive norm (social modelling), self-efficacy, intention and habit. The items were based on a literature study (Dijkman, 2002) and different theories: Theory of Planned Behaviour (Ajzen, 1988), the model of physical exercise and habit formation (Aarts *et al*., 1997) and the first phase of the Precaution Adoption Process model (Weinstein and Sandman, 1992). The questions were also developed using existing validated questionnaires (Saunders *et al*., 1997; Motl *et al*., 2000; Sallis *et al*., 2002) and were pre-tested.

Awareness

Similar to a previous study on this subject by Ronda *et al*. (2001), two questions were used to assess awareness. First, children were asked to rate their own physical activity level as much more (5), more (4), equal (3), less (2) or much less (1) physically active than other children of the same age. Based on this subjective score, the respondents were allocated to three categories ['low' (1 or 2), 'middle' (3) and 'high' (4 or 5)]. This subjective score was compared with the score obtained from the physical activity questionnaire. Here, tertiles were used to divide the respondents into three groups (low, middle and high). Finally, respondents were allocated to 'realistic' if the subjective estimate corresponded with the behavioural category derived from the physical activity questionnaire and to 'non-realistic' if the two scores did not correspond.

Perceived advantages and disadvantages

Perceived advantages of physical activity were assessed by seven items and perceived disadvantages were assessed by measuring responses to five potential disadvantages using a 5-point scale: completely disagree (–2) or agree (+2) [e.g. advantage: 'if I exercise, I stay healthy' (Cronbach's $\alpha = 0.60$); e.g. disadvantage: 'if I exercise, I get bored' (Cronbach's $\alpha = 0.67$)].

Encouragement

Encouragement was assessed with five items by asking the children 'How often are you encouraged to exercise by your [father, mother, brother(s), sister(s), friend(s)]?'. Answering categories were 'very often' (4), 'often' (3), 'now and then' (2), 'almost never' (1), 'never' (0) (Cronbach's $\alpha = 0.76$).

Descriptive norms

To assess descriptive norms (social modelling), children were asked to report how often they thought their father, mother, brother(s), sister(s) and friend(s) exercise (e.g. 'how often does your mother exercise?'). Answering possibilities were '(almost) never' (0), 'once a week' (1), 'a few times a week' (2), 'every day' (3), 'I don't know' (0), 'I don't have (e.g. a mother)' (0). The different items of descriptive norm were not combined to one scale but analysed separately because of their low internal consistency (Cronbach's $\alpha = 0.39$).

Self efficacy

Self-efficacy toward physical activity was assessed with twelve items on a 5-point scale by asking respondents how confident they were about their ability to exercise under difficult circumstances like bad weather and when feeling tired. [e.g. 'I am absolutely able' (+2) to 'I am absolutely unable' (–2); Cronbach's $\alpha = 0.77$].

Intention

The intention for physical activity was assessed by a single item, asking children whether they intended to exercise more often in the year to come; on a 7-point scale ['certainly yes' (+3) to 'certainly not' (–3)].

Habit

To assess habit strength, the Self-Report Habit Index (SRHI; Verplanken and Orbell, 2003) was used. This index consists of 12 items based on three postulated features of habits, i.e. a history of repetition, automatic in nature and expressing identity. On a 5-point scale, children were asked to what extent they agreed (+2) or disagreed (–2) with different statements (e.g. 'exercise is something that is a part of my daily routine'; Cronbach's $\alpha = 0.77$).

Furthermore, data were collected on grade, gender and ethnicity. If the child or one or both parents was born outside the Netherlands, the child was classified as being of foreign origin.

Process measures

The extent to which children participated in school exercise became clear by analysing participation lists. Sport trainers noted which children showed up. The teachers' questionnaires gave, among other things, insight in the level of use of the different programme components. An example of such a question was: 'I taught the exercises from the calendar:. . .'. The seven response categories ranged from 'never' to 'more times each day'. The questionnaires were distributed among all school teachers by the PE teacher. The reach of the programme components was also measured by structured in-depth interviews among PE teachers. Finally, observations during the parental information services informed us about the attendance of the parents.

Statistical analysis

Descriptive statistics (frequencies and means) were used to describe demographic characteristics (ethnicity, gender, age) and physical activity minutes at T0 and T1. Chi-squared analyses were used to identify baseline differences in demographic characteristics between the intervention and control groups. To identify differences between intervention and control schools multilevel analyses were done (Snijders and Bosker, 1999). Random effects were incorporated for the schools and the classes involved in the study, in this way taking care of the dependencies in the data due to the hierarchical nature of the sampling design. To examine differences between intervention and control schools in the physical activity at T1, a linear multilevel analysis was done, controlling for the physical activity at baseline, gender, grade, ethnicity as well as the baseline scores on each of the social cognitive determinants. Respondents with missing values on key variables were excluded [$n = 63$ (12%)]. In a similar way a logistic multilevel analysis was done to study the effect of the intervention on meeting the Dutch recommendation for daily exercise [i.e. at least 60 min of moderate-intensity physical activity on all days of the week, including activities twice a week that aim at increasing or maintaining physical fitness (Kemper *et al*., 2000)].

To examine differences in behavioural determinants at T1 between intervention and control schools, also linear multilevel analyses were performed. Adjustments were made for grade, gender, ethnicity and the particular determinant score at baseline.

For each multilevel analysis top–down testing was employed to obtain a final model in which the effect of the intervention was examined. In top–down testing, first the non-significant random effects of the model were removed sequentially,

Table 1: Demographic characteristics and physical activity level at T0 and T1 in the intervention groups (I) and control groups (C)

Variable	T0			T1		
	I (%)	C (%)	*P*-value	I (%)	C (%)	*P*-value
Total *n*	363	139		369	141	
Gender (male)	178 (49)	67 (48)	n.s.	182 (49)	64 (45)	n.s.
Ethnicity (foreign origin)	256 (71)	130 (94)	$P < 0.01$	267 (72)	131 (93)	$P < 0.01$
Pupils grade 4	121 (33)	46 (33)	n.s.	122 (33)	50 (36)	n.s.
Pupils grade 5	112 (31)	45 (32)	n.s.	118 (32)	42 (30)	n.s.
Pupils grade 6	130 (36)	48 (35)	n.s.	129 (35)	49 (35)	n.s.

n.s. = not-significant.

Table 2: Extent to which children participated in facultative programme components

Programme component	City district A		City district B	
	School 1	School 2	School 3	School 4
School sport activities participation (%)	80 (57)	54 (45)	98 (82)	72 (30)
Duration of use (months)	3	6	10	7
Parental information service: attendance (*n*)	31	29	—	—
The Class Moves!: duration of use (months)	—	6	—	9
Level of use (≥ once a week) (%)		20		40
Choose your Card!: duration of use (months)	2	2	—	—
Level of use (≥ once a week) (%)	43	29		
Pupil follow-up system: duration of use (months)	1	1	1	—
Activity-week (in weeks)	1	1	—	—

such that first the least significant effects are removed. In a similar way the non-significant fixed effects of the model were removed (except for the intervention effect). For the final model, in which there are only significant effects, the effect of the intervention is examined and reported upon. To make the regression coefficients mutually comparable, standardized regression coefficients are reported for the linear multilevel analyses. For the logistic multilevel analyses, odds ratios and corresponding confidence intervals are given. All multilevel analyses were done within the MlwiN (2005) package.

RESULTS

Baseline characteristics of the respondents

In total, 510 children participated in this study; 369 children in the intervention group and 141 in the control group. Table 1 shows demographic characteristics of the respondents at baseline and at the post-test. The control groups and intervention groups differed significantly regarding ethnicity. The control group included significantly fewer native children than the intervention group. With regard to gender and grade, no differences were found.

Participation and implementation of the programme

Table 2 provides an overview of the results of the process evaluation: the extent to which children participated in school exercise, the attendance of the parents at the parental information services and the duration of use of the different programme components. The questionnaire distributed among school teachers had a response rate of 43% (n = 20/46). The school sports activities and the parental information services were facultative, which meant that children and parents were not bound to participate. As Table 2 shows, the schools in city district A had implemented more programme components than city district B.

Physical activity

At T1, children from the control schools were less physically active than they were at baseline.

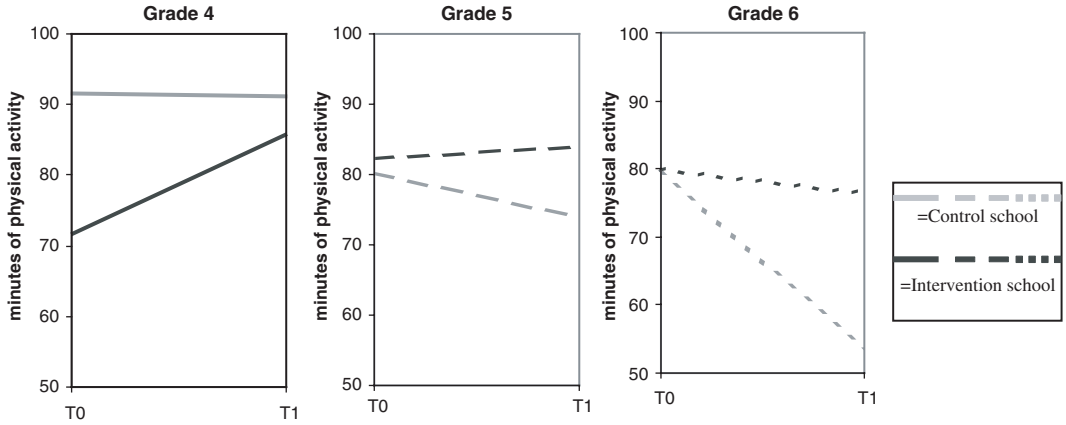

Fig. 1: Physical activity minutes for the intervention and control groups

Table 3: Results of multilevel regression analyses regarding the main effects of the intervention JUMP-in on the physical activity minutes (overall and stratified by grade)

Groups	N	Physical activity minutes Standardized beta	N	Physical activity recommendation OR (95% CI)
Corrected overall model	447	0.11* [a]	447	1.63 (1.02–2.61)* [c]
Stratified grade 4	150	0.05 n.s. [b]	150	0.84 (0.34–2.09) [d]
Stratified grade 5	137	0.07 n.s. [b]	137	1.16 (0.48–2.79) [d]
Stratified grade 6	160	0.22*** [b]	160	4.33 (1.82–10.32)*** [d]

*= $P < 0.05$; **= $P < 0.01$; ***= $P < 0.001$; n.s. = non-significant
Note: Standardized beta's are shown.
[a]adjusted for group, physical activity at baseline and habits at baseline;
[b]adjusted for physical activity at baseline and habits at baseline;
[c]adjusted for group, physical activity at baseline, descriptive norm friends at baseline, perceived disadvantage at baseline and habits at baseline;
[d]adjusted for physical activity at baseline, descriptive norm friends at baseline, perceived disadvantage at baseline and habits at baseline.

As shown in Figure 1, the number of minutes that control group children were physically active decreased, although the decrease in Grades 4 and 5 was not significant (n.s.). On the other hand, intervention group children in Grades 4 and 5 increased their time spent in physical activity (n.s.). Despite a slight decrease in physical activity among Grade 6 children in the intervention group, the largest intervention effect was measured in this grade. The control group of school children from Grade 6 were less active at T1 than at T0 ($P < 0.01$) by 26.49 min/day, while the intervention group decreased by 3.52 min/day (n.s.). Multilevel analyses showed that the JUMP-in intervention had a significant overall effect (Table 3). The prevention of a decrease in physical activity of pupils in Grade 6 (standardized $\beta = 0.22$; $P < 0.001$) made a particular contribution to the size of this effect.

The analysis of recommendation for exercise showed similar results (Table 3). The overall effect on meeting the recommendation (OR = 1.63; $P < 0.05$). No differences were found between the intervention and control schools for Grades 4 and 5 while a large effect was found in Grade 6. Children in the intervention group were more than four times more likely to meet recommended guidelines than control group children.

Psychosocial determinants

Table 4 describes the effects of JUMP-in on behavioural determinants. Overall, few effects on determinants of physical activity were found.

Table 4: Results of multilevel analyses regarding the main effects of the intervention JUMP-in on the determinants of physical activity after one year of intervention (T1) (overall and stratified by grade)

Outcome measure	Overall model		Stratified Grade 4		Stratified Grade 5		Stratified Grade 6	
	N	St. ß	N	St. ß	N	St. ß	N	St. ß
Perceived advantage	451	0.06	150	0.16*	138	–0.06; n.s	163	0.03; n.s.
Perceived disadvantage	451	–0.01; n.s.	150	–0.19; n.s.	138	–0.05; n.s.	163	0.02; n.s.
Encouragement mother	451	–0.01; n.s.	150	0.06; n.s.	138	–0.04; n.s.	163	–0.09; n.s
Encouragement father	451	0.00; n.s.	150	0.04; n.s.	138	0.03; n.s.	163	–0.08; n.s.
Self efficacy	451	–0.02; n.s.	150	–0.06; n.s.	138	0.05; n.s.	163	–0.07; n.s.
Intention	451	0.03; n.s.	150	0.12; n.s.	138	0.02; n.s.	163	–0.03; n.s.
Habit	451	0.08; n.s.	150	0.16*	138	0.06; n.s.	163	–0.01; n.s.
Awareness (OR)	451	0.98; n.s.	150	0.70; n.s.	138	1.30; n.s.	163	1.14; n.s.

All determinants were adjusted for baseline differences in demographics as well as for the determinant value at baseline. Analyses for the overall population were additionally adjusted for grade. For 'awareness', logistic regression analyses were executed. Intervention group was used as reference category.
*$P < 0.05$; *n.s.*= non-significant; St. ß = Standerdized beta.

After 1 year of JUMP-in, significantly more perceived advantage of physical activity was found in Grade 4 children of the intervention group, when compared with the control group. Additionally, habit strength of physical activity was found to be higher in Grade 4 children in the intervention group compared to Grade 4 children in the control group.

DISCUSSION

JUMP-in succeeded in promoting physical activity among primary school children. The results indicated that the project was effective in influencing physical activity, among children from Grade 6. The control school children from Grade 6 decreased their level of physical activity considerably, while the intervention school children from Grade 6 were only marginally less active. Empirical evidence has shown that children become less physically active as they get older (Taylor and Sallis, 1997; Kohl III and Hobbs, 1998; Van Mechelen *et al*., 2000). Apparently, JUMP-in has succeeded in preventing Grade 6 children from becoming less active. No significant intervention effect was found among the children from Grades 4 and 5. This could be caused by increasing measurement error as a result of conducting questionnaires among younger children. The cognitive requirements for completion of a questionnaire about physical activity are high for young children. Reliability and validity increase as children become older (Sallis *et al*., 1999).

The intervention effects on physical activity behaviour could not be explained by changes in the measured determinants. Despite the use of extensive theory-based instruments, only in Grade 4 were some effects on potential determinants identified (pros and habit strength). Previous studies have also shown that, in contrast to hypotheses derived from various social cognitive theories (Ajzen, 1988; De Vries and Mudde, 1998), changes in behaviour can be realized without first changing the cognitive determinants of that behaviour (Eriksen *et al*., 2003; Perry *et al*., 2004; Brug *et al*., 2005; Wind *et al*., 2005). Offering easily accessible opportunities to accomplish the 'healthy behaviour' (like availability of sports at school) may suffice for children (Welk *et al*., 2000). Recently, social-ecological theories, which highlight the importance of environmental influences, have gained more attention in the study of physical activity (Spence and Lee, 2003; Brug *et al*., 2005). Ecological models are distinct from most social cognitive theories in that the ecological framework hypothesizes a direct influence of environment on behaviour, i.e. unmediated by cognitive factors (Sallis and Owen, 2002; Spence and Lee, 2003; Kremers *et al*., 2006). The results from the present study appear to underline the claim for this direct causal relationship. Environmental changes (e.g. in-class exercises and organization of school sport activities) appear to have led to behavioural changes, without influencing the physical activity-related cognitions. It has been argued that reductions in levels of obesity and sedentary behaviour seem unlikely until the environments that facilitate its

development are modified (Egger and Swinburn, 1997). The creation of school sport clubs as organized within JUMP-in may be a good example of an effective environmental change.

Nevertheless, changing the cognitive determinants of physical activity must still be a primary goal in health promotion activities. Cognitions like attitude, subjective norm and self-efficacy are important in the process of habit-formation (Aarts *et al*., 1997; Meertens *et al*., 2000). This seems especially important when the easily accessible opportunities are no longer available. Probably, an optimal intervention design is created when a focus on social cognitive factors is combined with environmental change that facilitates good intentions being turned into action (Kremers *et al*., 2005).

Finally, the possibility of inaccurate survey data and/or measures cannot be neglected, and therefore it is important to note some limitations of the present study. First, physical activity was based on self-reports. This method could bring along problems like memory bias, concentration problems and problems with comprehensibility. Second, weekend activities were not measured because of the length of the questionnaire. Since JUMP-in activities concentrated on the school days, measuring weekend activities were not a primary goal. Third, because schools were not randomized to intervention and control conditions there is a possibility that the intervention and control schools differed in ways that may or may not be measurable. Baseline data indicated only differences in ethnicity, for which we have adjusted in our analyses. Finally, the questionnaires used in the present study were not tested intensively for reliability and validity. The measures of behavioural determinants may have been too insensitive to detect changes. For example, our measure of intention did not distinguish between those who were sedentary and those who were already highly active, which may have resulted in an underestimation of intervention effects on intention.

Inducing behavioural change in general and among children in particular is not easy. During the intervention year, the JUMP-in programme developed continuously. For example, people had to grow in their new roles, programme components were improved, a social basis was created and networks were built. These factors do not contribute to a stable environment in which to perform a thorough evaluation study. They make it more difficult to illuminate the most effective elements within the mix of interventions. Despite this, JUMP-in was successful in influencing physical activity behaviour, which provides a firm base for the near future in which JUMP-in will be disseminated across a larger area in the Amsterdam region, accompanied by a continuous effect- and process-evaluation.

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Address for correspondence:
Merlin Jurg
Department of Epidemiology, Documentation and Health Promotion
Municipal Health Service
Amsterdam
P.O. Box 2200
1000 CE Amsterdam
The Netherlands
E-mail: mjurg@ggd.amsterdam.nl

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