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Body Mass Effects of a Physical Activity and Healthy Food Intervention in Middle Schools

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Abstract

HAERENS, LEEN, BENEDICTE DEFORCHE, LEA MAES, VEERLE STEVENS, GREET CARDON, AND ILSE DE BOURDEAUDHUIJ. Body mass effects of a physical activity and healthy food intervention in middle schools. *Obesity.* 2006;14:847–854.

Objective: To evaluate the effects of a 2-year middle school physical activity and healthy food intervention, including an environmental and computer-tailored component on BMI and BMI *z*-score in boys and girls.

Research Methods and Procedures: A random sample of 15 schools with seventh and eighth graders was randomly assigned to three conditions: an intervention with parental support group, an intervention-alone group, and a control group. Weight and height were measured at the beginning and end of each school year to assess BMI and BMI *z*-score. A physical activity and healthy food program was implemented over 2 school years.

Results: In girls, BMI and BMI *z*-score increased significantly less in the intervention with parental support group compared with the control group ($p < 0.05$) or the intervention-alone group ($p = 0.05$). In boys, no significant positive intervention effects were found.

Discussion: This was the first study evaluating the effectiveness of an intervention combining environmental changes with personal computer-tailored feedback on BMI and BMI *z*-score in middle school children. After 2 school years, BMI and BMI *z*-score changed in a more positive direction in girls as a result of the intervention with parental support.

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Key words: overweight, tailored advice, environment, children, prevention

Introduction

Because childhood overweight and obesity has become a serious health problem among children and adolescents (1,2), there is an urgent need for effective primary prevention interventions aimed at increasing physical activity and promoting healthy foods in youth. The school environment is recognized as having a powerful influence on students' eating (3,4) and physical activity (3,5) behaviors, and through schools, parents can be involved in interventions. Results from previous school-based primary prevention interventions that included at least a dietary and a physical activity component revealed that some studies in elementary schools were effective in changing physical activity or food behavior (6–8). However, few of these studies were effective in changing body weight and adiposity in children (8,9). In addition, few school-based intervention studies were conducted in middle school children. The Planet Health study (10), a 2-year intervention study aimed at promoting a healthy lifestyle within a classroom curriculum, was effective in reducing the prevalence of overweight in girls, but not in boys. M-span (11), a 2-year environmental intervention focused on healthy eating, physical activity, and parental involvement, was effective in reducing BMI in boys, but not in girls. Most of the previous school-based intervention studies used a classroom curriculum. Other studies used multicomponent interventions by combining a classroom curriculum with some environmental changes (8–10). However, it could be argued that greater effects could be achieved if these generic classroom interventions were supported by personalized interventions. However, reaching every child at an individual level is very expensive and time consuming. Hence, the use of computer-tailored interventions can be a promising intervention strategy (12). By using a CD or the Internet, it is possible to bring a personal intervention program into the classroom (13). Adolescents' physical activity behaviors (14) and especially adolescents'

Table 1. Mean values at baseline in the total group and the three conditions

	Total group (n = 2840) (mean ± SD)	I + P (n = 1226) (mean ± SD)	I (n = 1006) (mean ± SD)	C (n = 759) (mean ± SD)
Age (years)	13.06 ± 0.81	13.04 ± 0.79	13.24 ± 0.87	12.85 ± 0.71
Girls (%)	36.6	40.1	15.6	58.8
Lower SES (%)	67.5	68.0	78.9	52.4
BMI (kg/m^2)	19.44 ± 3.60	19.68 ± 3.83	19.52 ± 3.50	18.96 ± 3.28
BMI z-score	0.09 ± 1.06	0.14 ± 1.10	0.13 ± 1.03	−0.03 ± 1.03

I + P, intervention with parents; I, intervention without parents; C, control group; SD, standard deviation; SES, socioeconomic status.

eating behaviors (15,16) are influenced by the family environment. Therefore, it is assumed that parental involvement will increase intervention effects. However, in previous studies targeting adolescents, no comparisons were made between interventions, with and without parental support (8).

Therefore, the purpose of the present study was to evaluate the effectiveness of a 2-year middle school physical activity and healthy food intervention, including an environmental and a computer-tailored component. It was hypothesized that BMI and BMI z-score would decrease or increase less in the intervention groups when compared with the control group, and involvement of the parents would increase the effectiveness of the intervention.

Research Methods and Procedures

Subjects

The present study is a clustered randomized controlled trial. Because of the higher prevalence of overweight and obesity in schools offering technical or vocational training, a random sample of 15 schools of the 65 schools with technical and vocational education in West-Flanders (Belgium) was selected to participate in this study. The 15 schools were randomly assigned to the intervention or control conditions: intervention with parental support (n = 5; 1226 pupils), intervention alone (n = 5; 1006 pupils), and a control condition (n = 5; 759 pupils). The randomization at school level caused variability in size of the groups.

A priori power analyses were conducted to create a strong study design. The analyses showed that an n = 300 in each group was sufficient to power the study at 0.8 and to detect a difference of 0.3 in BMI, given the 0.05 level of significance (α-error). To account for possible drop out and to make afterwards analyses within subgroups possible, larger samples were provided.

The parents of all pupils in seventh and eighth grades received an informed consent form in which authorization was requested for their child's weight and height to be measured. The parents of 151 (5%) children did not give permission for their child to participate in this study. This resulted in a sample of 2840 11- to 15-year-old boys and girls within 15 schools. Table 1 presents the baseline data of the sample according to condition. The study protocol was approved by the Ethical Committee of the University Hospital of Ghent University.

Measurements

Primary Outcome Measures. Measures were performed at the beginning (September 2003) and at the end of the school year 2003 to 2004 (May/June 2004) and were repeated at the end of the school year in 2004 to 2005 (May/June 2005). Weight and height were registered in light clothing and bare feet. Weight was assessed to the nearest 0.1 kg (maximum 200 kg; seca, Hanover, MD). Height to the nearest millimeter was measured using a wall-mounted stadiometer. Children were asked to stand straight, with their heels against the wall. BMI was calculated by dividing the weight (kilograms) by the height (meters) squared. Two pupils were absent on the days of measurements in September 2003. At the end of the 1st and 2nd school years, respectively, 150 and 336 pupils were absent or had changed schools. BMI z-scores were calculated on the basis of the Flemish reference data (17) using the LMS method (18,19). BMI z-scores provide a relative measure of adiposity adjusted for age and time between baseline and follow-up. A z-score is the number of standard deviation units that a person's BMI has deviated from a mean or reference value. Therefore, a positive change in z-score indicates an increase in relative BMI, and a negative change indicates a decrease in relative BMI.

Demographic factors like birth date, gender, and occupation of father and mother were assessed using a self-administered questionnaire that was filled out at school under supervision of a teacher. An estimate of social economical status of the family was obtained by classifying occupation of the father and mother into white or blue collar.

Process Evaluation Measures. At the end of the 2-year intervention period, one workgroup member from each intervention school completed a self-administered implementation questionnaire. The questionnaire was aimed at gathering information about the level of implementation of the intervention. Teachers were asked to rate, on a five-point scale, how much effort was made for each of the intervention issues (from nothing has been done to very much has been done). Based on these ratings, a mean total implementation score per school was calculated. Three schools were categorized as schools with low levels of implementation (score ≤ 3), four schools with medium levels of implementation ($3.0 >$ score ≤ 3.5), and three schools had high levels of implementation (scores > 3.5).

The Intervention

A school-based intervention program to promote healthy food and physical activity was developed to prevent the increasing prevalence of overweight in children. In five of the 10 intervention schools, additional efforts were made to involve and inform parents. The intervention was implemented over 2 school years, beginning in October 2003 and ending in June 2005. Because obesity has a multifactorial etiology (20), the program included environmental modifications (3) and interventions on personal and social levels related to food choices and physical activity behavior. The aim of the intervention was to help children to create a physically active lifestyle, together with a healthy diet.

Workgroup

In each of the intervention schools, a workgroup was created. The members of the workgroup received background information and guidelines on how to address the intervention topics from the intervention staff. They received an intervention manual and educational material. Over the 2 school years, a total of 8 contact hours between workgroup and research staff were achieved, starting with one meeting at the beginning of each school year and then one meeting every 3 months. In those meetings, further actions were planned, and prior implementation was evaluated.

Physical Activity

The physical activity environmental intervention focused on increasing levels of moderate to vigorous physical activity to at least 60 min/d (21). Schools were encouraged to create more opportunities to be physically active during breaks, at noon, or after school hours. This resulted in a weekly organization of an average 4.7 (± 2.66) hours of extra physical activities.

Schools were encouraged to vary the content of the physical activities offered to reach all pupils. The organization of non-competitive activities was encouraged to increase the engagement of less skilled children. On average, 56% (18% to 100%) of all children participated in these activities.

Additionally, extra sports materials were made available. Every school received an intervention box with sports materials such as ropes, Frisbees, balls, beach ball sets, etc. Sports materials were made available during breaks (1 of 10 schools), at noon (6 of 10 schools), and during after school hours (3 of 10 schools). Schools were also asked to encourage active participation.

Over the 2 school years, a total of 4 class hours was spent on the promotion of physical activity at the personal level. Children received a physical fitness test and a computer-tailored intervention for physical activity (22). During classes, all children had to cycle for 10 minutes on a computerized cycle ergometer. By means of a folder, information was given on their own physical fitness level and possible ways to improve it. The computer-tailored intervention for physical activity was completed once each school year, during 1 class hour. First, children had to fill out questions on the computer screen. The first part of the survey concerned demographic factors. The second part consisted of a school-based adaptation of the International Physical Activity Questionnaire (22) and was used to measure physical activity. The final questions concerned psychosocial determinants of physical activity behavior. After completing all questions, tailored feedback was displayed immediately on the screen. First, a general introduction and normative feedback were presented. The normative feedback related the children's activity levels to the current physical activity recommendations (21). Based on the theory of planned behavior (23), children got tailored feedback about their intentions, attitudes, self-efficacy, social support, knowledge, benefits, and barriers related to physical activity. For example, information was given on how to join a sports club, how to increase self-efficacy, and how to overcome their personal barriers associated with physical activity. The Transtheoretical Model (24) was used to match content and approach of this feedback to the stages of changes. Pre-contemplators and contemplators received general information. Children in the preparation stage received more specific information on physical activity and health and were motivated to become more active. In the action stage, children were motivated to stay active, and in the maintenance stage, children were told that they were doing fine and should carry on with their healthy behavior. Overall, an active lifestyle and participation in sports activities were promoted in an advice sheet of approximately five to six pages. Children could either save the advice on the computer or, in some cases, immediately print the feedback. Afterwards, they had to complete a task with questions concerning the advice. During the implementation of the physical activity intervention, schools were en-

couraged to organize extra supportive activities beyond those planned in the intervention manual.

Food

The food intervention focused on three behavioral changes that were supported by environmental changes: increasing fruit consumption to at least two pieces a day, reducing soft drink consumption and increasing water consumption to 1.5 L/d, and reducing fat intake. To facilitate fruit consumption, schools were asked to sell fruit at school at very low prices or for free at least once a week. On average, 69% (11% to 100%) of the pupils subscribed to the school fruit program. It was also suggested to offer fruit as a dessert during lunch break. Schools tried to promote drinking water by offering it for free or at a lower price than soft drinks. All children received a free water can to make it possible to bring water to school. Children received additional information through folders and posters about the improved health consequences of eating fruit as opposed to snacks and drinking water rather than soft drinks.

Over the 2 school years, a total of 2 class hours was spent on the promotion of healthy eating at the personal level. Every school year, children got the computer-tailored intervention for fat intake and fruit intake during 1 class hour (25). Questionnaires concerning demographics, fat intake (26), fruit intake (27), and psychosocial determinants of food choices lead to tailored fat and fruit advice. After completing the questionnaire, tailored feedback was displayed immediately on the screen. Both the fat and the fruit advice started with a general introduction, followed by normative feedback, which related their intakes to the recommended intakes. The fat advice indicated the sources of fat in the diet and tips were given on how to replace fatty foods. In the same way as in the physical activity advice, feedback was based on the Theory of Planned Behavior (23) and the Transtheoretical Model (24). Teachers were encouraged to organize extra supportive activities like healthy breakfasts, an educational game concerning the food pyramid, and a poster design competition as suggested in the intervention manual.

Parent Involvement

The goal of the parent involvement was to create a supportive environment for healthy behaviors outside school. Schools were asked to set up an interactive meeting on healthy food, physical activity, and the relationship with overweight and health. Three times a year, information on healthy food and physical activity was published in the school paper and newsletters for the parents. In addition, all parents received a free CD-ROM with the adult computer-tailored intervention for fat intake and physical activity (22,25) to complete at home. Through an information folder, parents were informed that their child accomplished the same computer-tailored program at school. They were asked to discuss the results together and to give their child support to create a healthier lifestyle, if necessary.

Statistical Analyses

Data were analyzed using the SPSS/PC statistical program (version 12.0 for Windows; SPSS, Inc., Chicago, IL). Preliminary analyses consisted of descriptive statistics of sample characteristics. χ^2 analyses were used to assess the differences in levels of implementation according to the percentage of boys and girls in the schools. Linear mixed models on 1- and 2-year post-intervention values of weight, height, BMI, and BMI z-score, with condition and gender entered as factors, were used to evaluate the intervention effects. School was nested within condition to take into account school variance. Linear mixed models were also used to assess difference in increase in BMI z-score according to the levels of implementation in the 10 intervention schools. All analyses were adjusted for baseline values, age, and social economical status. Post hoc tests analyses were conducted to determine differences in BMI (z-score) changes between the conditions. $p \leq 0.05$ was considered as statistically significant.

Results

Primary Outcome Measures

For all analyses, variance at the school level was not significant (all $z < 1.59$). For the 1-year pre- to post-differences in BMI ($F = 3.75$, $p < 0.05$), the 2-year pre- to post-differences in BMI ($F = 6.39$, $p < 0.01$), and BMI z-score ($F = 5.70$, $p < 0.01$), a significant gender-by-condition interaction was found. Therefore, results are presented separately in Table 2 for boys and in Table 3 for girls. In boys, no significant positive intervention effects were found. In girls, after 1 year of intervention, there was a trend for a significant lower increase in BMI in the intervention with parental support group when compared with the control group ($F = 3.04$, $p < 0.08$). After 2 years of intervention, there was a significant lower increase in BMI ($F = 12.52$, $p < 0.05$) and BMI z-score ($F = 8.61$, $p < 0.05$) in the intervention with parental support group when compared with the control group. In addition, there was a significantly lower increase in BMI z-score ($F = 2.68$, $p = 0.05$) and a trend for a significantly lower increase in BMI ($F = 3.42$, $p = 0.08$) in the intervention with parental support group when compared with the intervention-alone group.

Process Measures

BMI z-score increased significantly more in schools with low levels of implementation, when compared with schools with medium ($F = 5.03$, $p < 0.05$) and high ($F = 2.80$, $p < 0.05$) levels of implementation. After 2 years of intervention, BMI z-score increased with 0.12 units in the schools

Table 2. Effects of the physical activity and healthy food interventions on anthropometrics in boys

Boys	*n*	Pre- (mean ± SD)	1 year post- (mean ± SD)	1-year effects ($F_{condition}$)	*n*	Pre- (mean ± SD)	2-year post-	2-year effects ($F_{condition}$)
Weight (kg)								
I + P	665	48.50 ± 12.16	52.58 ± 12.95	NS	590	48.23 ± 12.02	58.54 ± 13.28	NS
I	708	49.79 ± 12.23	54.15 ± 12.74		611	49.85 ± 12.36	60.17 ± 13.06	
C	278	47.28 ± 11.22	51.03 ± 11.84		239	46.58 ± 11.04	56.63 ± 11.95	
Height (cm)								
I + P	665	157.98 ± 9.39	162.20 ± 9.90	NS	590	157.76 ± 9.32	168.31 ± 9.34	NS
I	708	159.68 ± 9.83	163.83 ± 10.11		611	159.53 ± 9.72	169.29 ± 9.26	
C	278	158.82 ± 9.61	163.04 ± 9.98		239	157.98 ± 9.09	168.95 ± 8.61	
BMI (kg/m^2)								
I + P	665	19.24 ± 3.62	19.79 ± 3.64	NS	590	19.21 ± 3.61	20.52 ± 3.68	NS
I	708	19.32 ± 3.35	19.98 ± 3.35		611	19.38 ± 3.41	20.86 ± 3.51	
C	278	18.58 ± 2.91	18.99 ± 2.82		239	18.45 ± 2.88	19.67 ± 2.89	
BMI *z*-score								
I + P	665	0.07 ± 1.09	0.17 ± 1.03	NS	590	0.08 ± 1.09	0.16 ± 1.04	NS
I	708	0.10 ± 1.02	0.22 ± 0.97		611	0.11 ± 1.03	0.25 ± 0.98	
C	278	−0.07 ± 0.98	−0.02 ± 0.92		239	−0.11 ± 0.99	−0.04 ± 0.94	

SD, standard deviation; I + P, Intervention with parents; I, intervention without parents; C, control group; NS, not significant.

with low levels of implementation and with 0.06 and 0.09 units, respectively, in schools with medium and high levels of implementation. In schools with low levels of implementation, 91.1% of the pupils were boys, and in schools with medium and high levels of implementation, percentages were 62.9% and 55.5%, respectively ($\chi^2 = 234.94$, $p < 0.001$).

Discussion

The main purpose of this study was to evaluate the effects of an intervention promoting physical activity and healthy food on BMI and BMI *z*-score in middle school children. The intervention was unique in combining environmental changes with personalized computer-tailored feedback for fat and fruit intake and physical activity. In five of the 10 intervention schools, efforts were made to involve the parents. In line with our hypothesis, we found that as a result of the intervention with parental support, BMI and BMI *z*-score increased significantly less, but only in girls. Already after 1 school year, there was a trend for a lower increase in BMI ($d = 0.22$) and BMI *z*-score ($d = 0.07$) in girls. These differences in BMI ($d = 0.55$) and BMI *z*-score ($d = 0.17$) found in girls became even more clear after 2 years of intervention. Therefore, it is assumed that the intervention with parental support could be effective in preventing overweight or obesity when implemented over a longer period. Most previous school-based interventions were not effective in preventing increases in BMI and BMI *z*-score (6,8). In the Planet Health study (10) the intervention was effective in reducing the prevalence of overweight in 11- to 14-year-old girls after 2 years. The prevalence of overweight was significantly reduced in girls in the intervention schools (−3.3%) compared with girls in the control schools (+2.2%). In the same line, in the present study, BMI and BMI *z*-score increased less in girls in the intervention with parental support group. A longer intervention period may even result in stronger intervention effects because differences became clearer after 2 years of intervention. Only one previous study conducted in middle schools focused on changing the school environment (11). The study was effective in reducing the increase in BMI ($d = 0.64$) in boys, but not in girls, which is in contrast to the present study. The reasons for the sex differences are difficult to explain. It is possible that boys did not change their physical activity pattern as much as girls because it is known that boys in this population are commonly more active than girls (27). Alternatively, girls could be more attuned to issues of diet and activity (27,28) and, thus, more responsive to the messages given by the tailored intervention. In addition, previous research revealed that adult women were more positive

Table 3. Effects of the physical activity and healthy food interventions on anthropometrics in girls

Girls	*n*	Pre- (mean ± SD)	1 year post- (mean ± SD)	1-year effects		*n*	Pre- (mean ± SD)	2-year post- (mean + SD)	2-year effects	
				$F_{condition}$	Post hoc				$F_{condition}$	Post hoc
Weight (kg)										
I + P	451	50.97 ± 12.05	53.82 ± 11.89	NS		381	50.71 ± 11.84	57.02 ± 11.17	7.14*	I+P≠I
I	130	51.17 ± 11.70	54.11 ± 11.70			118	51.13 ± 11.58	57.67 ± 11.71		I≠C
C	393	48.49 ± 11.20	51.93 ± 11.31			352	47.44 ± 11.06	56.30 ± 11.11		
Height (cm)										
I + P	451	158.08 ± 7.44	160.64 ± 7.09	NS		381	157.83 ± 7.38	163.33 ± 6.40	NS	
I	130	158.39 ± 8.09	160.22 ± 7.89			118	158.32 ± 7.98	162.83 ± 6.72		
C	393	158.20 ± 8.34	160.96 ± 7.84			352	157.91 ± 8.49	164.02 ± 6.89		
BMI (kg/m^2)										
I + P	451	20.26 ± 3.95	20.75 ± 3.90	2.59‡	I+P>C	381	20.23 ± 3.95	21.34 ± 3.83	7.59†	I+P>I
I	130	20.23 ± 3.60	20.94 ± 3.54			118	20.24 ± 3.54	21.66 ± 3.68		I+P>C
C	393	19.23 ± 3.52	19.94 ± 3.65			352	19.12 ± 3.50	20.78 ± 3.66		
BMI *z*-score										
I + P	451	0.23 ± 1.12	0.28 ± 1.08	NS		381	0.24 ± 1.11	0.24 ± 1.06	6.19†	I+P>I
I	130	0.27 ± 0.96	0.39 ± 0.90			118	0.28 ± 0.97	0.35 ± 0.96		I+P>C
C	393	−0.01 ± 1.06	0.11 ± 1.03			352	−0.03 ± 1.05	0.14 ± 1.00		

SD, standard deviation; I + P, Intervention with parents; I, intervention without parents; C, control group; NS, not significant.
* $p < 0.001$.
† $p \leq 0.05$.
‡ $p \leq 0.08$.

toward the interactive computer-tailored fat intake intervention compared with men (25). The differences between sexes suggest that different causal factors may operate among boys and girls. Additionally, data on process measures revealed that BMI *z*-score increased significantly less in schools with medium and high levels of implementation. In schools with medium to high levels of implementation, the percentage of boys was significantly lower than in schools with lower levels of implementation. Therefore, the moderating effect of sex may be a result of differences in levels of implementation in typical boy- and girl-oriented schools. The intervention topics could, indeed, be more closely related to the curriculum in typical girl-oriented schools (offering education in nursing, cooking, etc.) than in typical boy-oriented schools (offering education in mechanics, engineering, etc.).

Parents are supposed to be important role models for health behaviors (14–16). However, in previous studies targeting adolescents, no comparisons were made between interventions with and without parental support (8). It is known that parental involvement declines substantially as children move from elementary schools through middle and high schools (29), and it is often difficult to get parents to participate in meetings at school. In the present study, parents were involved at home through articles in school papers and newsletters. Moreover, every parent received a free CD-ROM with the adult computer-tailored intervention for physical activity and fat intake to complete at home. Results of the present study suggest that the involvement of the parents was necessary for the effectiveness of the intervention on adiposity indices in girls.

The present study is a clustered randomized controlled trial, with a high participation rate (95%), that followed children for 2 school years. In this study, an objective weight-related outcome measure was included. To our knowledge, this is the first study aimed at changing food and physical activity behavior by changing the school environment combined with the use of a computerized tailored intervention that was effective in reducing the increase in BMI and BMI *z*-score in girls. Based on the results of this study, we can conclude that environmental and personal interventions to promote healthy food and physical activity in middle schools had a positive effect on adiposity indices in girls, but not in boys. There was already a trend for significant intervention effects after 1 school year, and these positive effects became significant after 2 school years. Involvement and support of the parents was necessary to see effects in girls. Further studies are necessary to determine which components of the intervention are crucial in yielding significant effects, although it is hypothesized that it is the multicomponent nature of the intervention that caused its effectiveness. Designing interventions that are effective in boys is a challenge for the future.

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References

1. **Reilly JJ, Dorotsy AR.** Epidemic of obesity in UK children. *Lancet.* 1999;354:1874–75.
2. **Strauss RS, Pollack HA.** Epidemic increase in childhood overweight, 1986–1998. *JAMA.* 2001;286:2845–8.
3. **Wechsler H, Devereaux RS, Davis M, Collins J.** Using the school environment to promote physical activity and healthy eating. *Prev Med.* 2000;31:S121–37.
4. **Kubik MY, Lytle LA, Hannan PJ, Perry CL, Story M.** The association of the school food environment with dietary behaviors of young adolescents. *Am J Public Health.* 2003;93: 1168–73.
5. **Sallis JF, Conway TL, Prochaska JJ, McKenzie TL, Marshall SJ, Brown M.** The association of school environments with youth physical activity. *Am J Public Health.* 2001;91: 618–20.
6. **Fulton JE, McGuire MT, Caspersen CJ, Dietz WH.** Interventions for weight loss and weight gain prevention among youth. *Sports Med.* 2001;31:153–65.
7. **Kahn EB, Ramsey LT, Brownson RC, et al.** The effectiveness of interventions to increase physical activity. *Am J Prev Med.* 2002;22:73–107.
8. **Bautista-Castano I, Doreste J, Serra-Majm l.** Effectiveness of intervention in the prevention of childhood obesity. *Eur J Epidemiol.* 2004;19:617–22.
9. **The International Association for the Study of Obesity.** Comparison of controlled trials undertaken to prevent obesity among children and adolescents. *Obes Rev.* 2004;5(Suppl 1):98–104.
10. **Gortmaker SL, Peterson K, Wiecha J.** Reducing obesity via a school-based interdisciplinary intervention among youth. *Arch Pediatr Adolesc Med.* 1999;153:409–18.
11. **Sallis JF, McKenzie TL, Conway TL, et al.** Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. *Am J Prev Med.* 2003;24: 209–17.
12. **De Vries H, Brug J.** Computer-tailored interventions motivating people to adopt health promoting behaviors: introduction to a new approach. *Patient Educ Couns.* 1999;36:99–105.
13. **White MA, Martin PD, Newton RL.** Mediators of weight loss in a family-based intervention presented over the internet. *Obes Res.* 2004;12:1050–9.
14. **Sallis JF, Porchaska JJ, Taylor WC.** A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc.* 2000;32:963–75.
15. **Hanson NI, Neumark-Sztainer D, Eisenberg ME, Story M, Wall M.** Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. *Public Health Nutr.* 2005;8:77–85.

16. **De Bourdeaudhuij I.** Perceived family members' influence on introducing healthy food into the family. *Health Educ Res.* 1997;12:77–90.
17. **Roelants M, Hauspie R.** *Growth Charts 2–20 Years, Flanders 2004*. http://www.vub.ac.be/groeicurven (Accessed July 5, 2004).
18. **Cole TJ.** The LMS method for constructing normalized growth standards. *Eur J Clin Nutr.* 1990;44:45–60.
19. **Cole TJ, Green PJ.** Smoothing reference centile curves: the LMS method and penalized likelihood. *Stat Med.* 1992;11: 1305–19.
20. **Baranowski T, Mendlein J, Resnicow K.** Physical activity and nutrition in children and youth: an overview of obesity prevention. *Prev Med.* 2000;31:S1–10.
21. **Cavill NA, Biddle S, Sallis JF.** Health enhancing physical activity for young people: statement of the United Kingdom Expert Consensus Conference. *Pediatr Exerc Sci.* 2001;13: 12–25.
22. **Vandelanotte C, De Bourdeaudhuij I.** Acceptability and feasibility of a computer-tailored physical activity intervention using stages of change: project FAITH. *Health Educ Res.* 2003;18:304–17.
23. **Ajzen I.** From intentions to actions: a theory of planned behavior. In: Kuhl J, Beckman J, ed. *Action-Control: From Cognition to Behaviour.* Heidelberg, Germany: Springer; 1985, p. 11–39.
24. **Prochaska JO, DiClimente CC, Norcross JC.** In search how people change: applications to addictive behaviours. *Am Psychol.* 1992;47:1102–14.
25. **Vandelanotte C, De Bourdeaudhuij I, Brug J.** Acceptability and feasibility of an interactive computer-tailored fat intake intervention in Belgium. *Health Promot Int.* 2004;19:463–70.
26. **Vandelanotte C, Matthys C, De Bourdeaudhuij I.** Reliability and validity of a computerized questionnaire to measure fat intake in Belgium. *Nutr Res.* 2004;24:621–31.
27. **World Health Organization.** Young people's health in context. Health Behavior in School-Aged Children (HBSC) study: international report from 2001/2002 survey. *Health Policy Child Adolesc.* 2004;4.
28. **McVey G, Tweed S, Blackmore E.** Correlates of weight loss and muscle-gaining behaviour in 10- to 14-year old males and females. *Prev Med.* 2005;40:1–9.
29. **Eccles JS, Harold RD.** Parent-School Involvement during the early adolescent years. *Teach Coll Rec.* 1993;94:568–87.