ARTICLE

ONLINE FIRST

Evaluation of the Web-Based Computer-Tailored FATaintPHAT Intervention to Promote Energy Balance Among Adolescents

Results From a School Cluster Randomized Trial

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Objective: To evaluate the short- and long-term results of FATaintPHAT, a Web-based computer-tailored intervention aiming to increase physical activity, decrease sedentary behavior, and promote healthy eating to contribute to the prevention of excessive weight gain among adolescents.

Design: Cluster randomized trial with an intervention group and a no-intervention control group.

Setting: Twenty schools in the Netherlands.

Participants: A total of 883 students (aged 12-13 years).

Intervention: The FATaintPHAT (VETisnietVET in Dutch) Web-based computer-tailored intervention.

Outcome Measures: Self-reported behaviors (diet, physical activity, sedentary behavior) and pedometer counts were measured at baseline and at 4-month and 2-year follow-up; body mass index (BMI), waist circumference, and fitness were measured at baseline and at 2-year follow-up. Descriptive and multilevel regression analyses were conducted among the total study population and among students not meeting behavioral recommendations at baseline (students at risk).

Results: The complete case analyses showed that FATaintPHAT had no effect on BMI and waist circumference. However, the intervention was associated with lower odds (0.54) of drinking more than 400 mL of sugar-sweetened beverages per day and with lower snack intake ($\beta = -0.81$ snacks/d) and higher vegetable intake ($\beta = 19.3$ g/d) but also with a lower step count ($\beta = -10\,856$ steps/wk) at 4-month follow-up. In addition, among students at risk, FATaintPHAT had a positive effect on fruit consumption ($\beta = 0.39$ g/d) at 4-month follow-up and on step count ($\beta = 14\,228$ steps/wk) at 2-year follow-up but an inverse effect on the odds of sports participation (odds ratio, 0.45) at 4-month follow-up. No effects were found for sedentary behavior.

Conclusion: The FATaintPHAT intervention was associated with positive short-term effects on diet but with no effects or unfavorable effects on physical activity and sedentary behavior.

Trial Registration: Netherlands Trial Registry: ISRCTN15743786.

Arch Pediatr Adolesc Med. 2012;166(3):248-255. Published online November 7, 2011. doi:10.1001/archpediatrics.2011.204

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THE HIGH PREVALENCE OF overweight and obesity among adolescents is a major public health concern because of its association with various chronic diseases.[1] Continuing preventive action is therefore needed. However, the number of effective obesity-prevention interventions for adolescents is limited.[2] Computer tailoring has been recognized as a promising health communication technique to promote energy balance–related behaviors.[3] Computer tailoring is a technique through which individualized feedback on risk behaviors, cognitions, and perceptions relevant to that behavior can be provided to larger numbers of people.[4] Systematic reviews indicate that computer tailoring is likely to be more effective than generic health education for modifying dietary intake[5-7] and possibly physical activity[8] among adults. At present, only a few studies have evaluated the single effects of computer-tailored interventions among adolescents.[9,10] The present evaluation of a stand-alone computer-tailored intervention can add to the evidence on the effectiveness of computer tailoring for adolescents to prevent excessive weight gain and improve dietary behavior, physical activity, and sedentary behavior.

Our study group[11] developed an online school-based, computer-tailored intervention called FATaintPHAT (VETisnietVET in Dutch). The present study aims to evaluate the short- and long-term effects of this intervention among adolescents. The predictions were that in the intervention group vs the control group (1) anthropometric outcomes (body mass index [BMI], percentage overweight, waist circumference) and fitness would be more favorable at 2-year follow-up; and (2) the outcomes on the targeted behaviors (consumption of sugar-sweetened beverages, snacks, fruit, vegetables and fiber, screen time, and physical activity behaviors) would be more favorable at 4-month and 2-year follow-up.

METHODS

STUDY DESIGN

A 2-group cluster randomized trial (n=883; 20 schools) was conducted with assessments at baseline and 4-month (school year 2006-2007) and 2-year follow-up (school year 2008-2009). Schools were randomized into an intervention group or a no-intervention control group after stratification according to educational level (vocational or preuniversity training) using a random-number generator. The study was approved by the medical ethics committee of the Erasmus Medical Center and registered in the Netherlands Trial Registry (ISRCTN15743786). The methods and intervention have been described in detail previously.[11] The study was conducted in collaboration with the Municipal Health Services in the Rotterdam area.

PARTICIPANTS AND RECRUITMENT

Adolescents aged 12 to 13 years were recruited in a 2-step procedure. First, 88 schools for secondary education in the Rotterdam area were invited to participate. Twenty-three schools were eligible and willing to participate (**Figure**). Second, adolescents from 1 to 5 first-year classes in each school (depending on the number of first-year classes in the school, maximum of 5) were invited to participate. Students received information and an informed consent form for themselves and their parents for active consent. The completed consent forms were returned through the schools. Three schools withdrew from the study after randomization and before the baseline measurement because they found the informed consent procedure too burdensome. Of the 1494 students, 1156 returned their forms (77%), and 883 students agreed to participate in the study (59%). Students in the intervention group were more likely to participate (33% vs 26%), even though allocation was concealed until the start of the intervention.

THE INTERVENTION

The objective of the computer-tailored intervention is to help prevent excessive weight gain among adolescents aged 12 to 13 years by improving dietary behaviors (reducing the consumption of sugar-sweetened beverages and high-energy snacks and increasing the intake of fruit, vegetables, and whole-wheat bread), reducing sedentary behavior (reducing screen time), and increasing physical activity (increasing active transport to school, leisure time activities, and sports).

Separate modules (n=8) addressed the issues of weight management and energy balance–related behaviors. Each module consisted of information about the behavior-health link, an assessment of behavior and determinants, individually tailored feedback on behavior and determinants, and an option to formulate an implementation intention to prompt specific goal setting and action planning. The feedback provided included several elements: behavioral feedback (comparing the student's behavior with guidelines for that behavior [normative feedback] and with behavior of peers [comparative feedback]), prompts for intention formation, decisional balance information to change attitudes, prompts for barrier identification, instructions on how to perform and/or change a behavior to improve self-efficacy, and suggestions on how to organize social support. We used a multiple-theory approach, including the Theory of Planned Behavior,[12] the Precaution Adoption Process Model,[13] and implementation intentions,[14] to inform the intervention. The intervention was accessible through the Internet. The teachers were asked to allocate 15 minutes for each of 8 lessons over 10 weeks to work with the program according to a teacher manual.

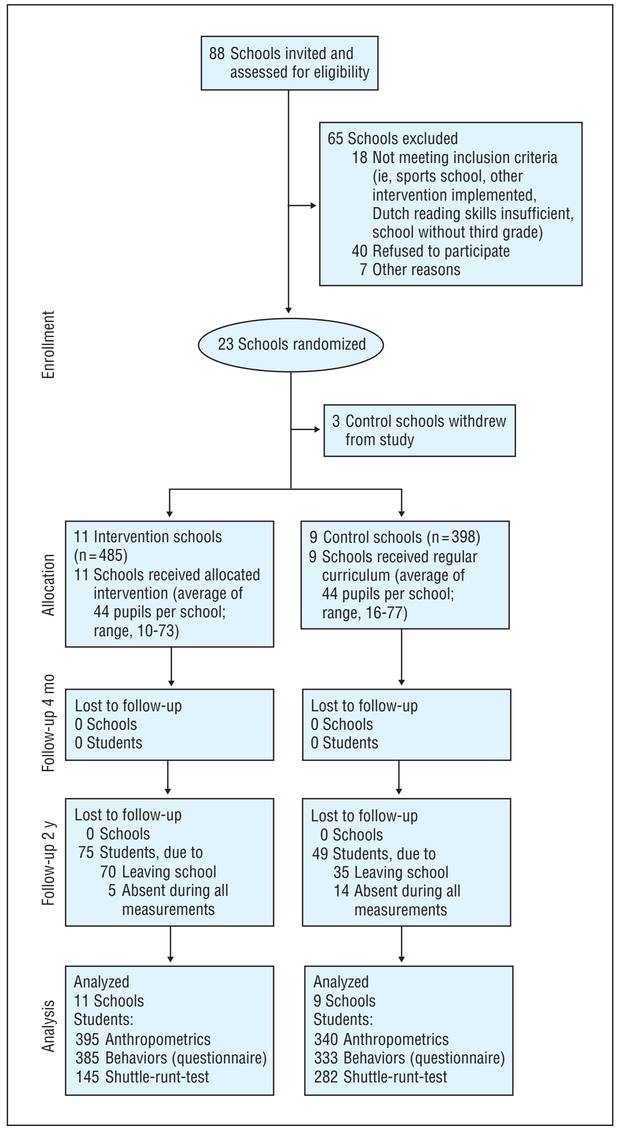

Figure. Cluster and participant flow for the FATaintPHAT[11] study.

PROCEDURE

The outcome measures were anthropometrics and fitness (at 2-year follow-up), and energy balance–related behaviors (at 4-month and 2-year follow-up). Data on the outcome measures were collected through anthropometric measurements, questionnaires, pedometers, and shuttle-run tests. Fitness was measured with a shuttle-run test administered by the physical activity teacher according to a standard protocol.[15] After baseline assessments, the intervention was implemented by the teachers. The control school implemented the regular curriculum.

MEASUREMENTS

Anthropometrics

According to a protocol, a research assistant measured height (average of 2 measurements without shoes using a Seca 225 mobile height rod [Seca, Hanover, Maryland] with an accuracy of 0.1 cm, and the average was calculated) and weight of the students who wore shorts and t-shirt or underwear (using a Seca 888 class III calibrated electronic digital floor scale with an accuracy of 0.2 kg).[11] The BMI was calculated as weight in kilograms divided by height in meters squared. Cutoff points were based on the International Obesity Task Force guidelines.[16] Waist circumference was measured twice. Third and fourth measurements were taken when the difference between the first 2 measurements was more than 1.0 cm. The average of the last 2 measurements was calculated. Circumference was measured at the waist equidistant from the lowest rib and the hip bone at the end of an expiration.[11]

Self-Reported Behaviors

Electronic self-administered questionnaires were used to assess behaviors (eTable; http://www.archpediatrics.com). Questionnaires were completed within 1 school hour under the supervision of a research assistant. Dietary intake was assessed using a food frequency questionnaire assessing the frequency and quantity of sugar-sweetened beverage consumption in the past week and a self-administered 24-hour recall for snacks and fruit and vegetable consumption.[17-19] Physical activity and sedentary behavior were assessed using the Flemish validated questionnaire.[20] This questionnaire assessed sports during leisure time, active transportation to school, television viewing, and computer use during leisure time in the past 7 days by asking about the frequency and duration of the activities. In addition, the number of days spent in moderate or vigorous physical activity for at least 60 minutes was assessed. An additional assessment of physical activity was obtained with pedometers (Digiwalker SW200; YAMAX USA Inc, San Antonio, Texas)[21] that were worn by a random subsample of 5 students per class for 7 consecutive days after the questionnaire assessment.

Demographics

Questions on demographic characteristics included sex, age, educational level, country of birth, and parents' country of birth. Ethnicity was defined according to standard procedures of Statistics Netherlands, the Hague, as either Western (both parents born in Europe, North America, Oceania, Indonesia, or Japan) or non-Western (at least 1 parent born elsewhere).

STATISTICAL ANALYSIS

Logistic regression analyses were used to identify whether there was selective dropout. Dropout (yes/no) was used as the dependent variable, and sex, education, ethnicity, intervention, BMI at baseline, and compliance with recommendations for each behavior were independent variables.

Baseline group differences were tested using the nonparametric Kolmogorov-Smirnov test or the χ^2 test. Multilevel linear and logistic regression analyses were used to establish intervention effects. Each outcome measure was regressed on group, (intervention [1] vs control [0]) and baseline value of the outcome measure. Sex (girls [1] vs boys [0]), education (preuniversity [1] vs vocational [0]), and ethnicity (non-Western [1] vs Western [0]) were included as potential confounders. Intraclass coefficients for the continuous outcomes were calculated as the between-school variance divided by the total variance. Separate analyses were run for the short- and the long-term results. The analyses were conducted for the total study population and then repeated for the students not meeting behavioral recommendations at baseline (at-risk students) because students engaging in risk behavior were expected to benefit more from the intervention. For anthropometric outcomes the risk group included normal, overweight, and obese adolescents because these students received feedback to prevent excessive weight gain.

Complete case analyses and intention-to-treat analyses were performed using baseline observation carried forward (BOCF) and last observation carried forward (LOCF) procedures.[22] Multilevel regression analyses were performed in MLwiN 2.02 (University of Bristol, Bristol, England), other analyses in SPSS 15.0 (IBM Corporation, Armonk, New York). The significance level was set at 0.05, and tests were 2 sided.

LOSS TO FOLLOW-UP

In the intervention group, 15% of the students were lost to follow-up (left school or had incomplete data at baseline and follow-up); in the control group, 12% were lost (Figure). Loss to follow-up did not differ according to study condition, educational level, ethnicity, or sex.

RESULTS

STUDENT CHARACTERISTICS

The intervention group consisted of more vocational schools and vocational-level students, more boys, and more non-Western students than the control group. At baseline, more students in the intervention group were active for less than 60 minutes per day, and more students in the intervention group engaged less than 2 hours in sedentary behavior (**Table 1**).

INTERVENTION EFFECTS

Table 2 lists the mean values for the outcome measures at baseline and 4-month and 2-year follow-up for the intervention and control groups, the total sample, and for the students at risk. The regression analyses (**Table 3**) showed no intervention effects on BMI, waist circumference, or percentage of students being overweight or obese in the total sample and among normal-weight, overweight, and/or obese students.

At 4-month follow-up, the intervention group was less likely to report drinking more than 400 mL of sugar-sweetened beverages per day compared with the control group in the total sample but not in the risk group. Mean self-reported snack consumption was lower in the intervention group than in the control group at 4-month follow-up. The difference at 2-year follow-up was not significant. Among the students at risk, those in the intervention group reported eating more pieces of fruit than those in the control group at 4-month follow-up. For vegetable intake, the intervention groups reported consuming more grams per day at 4-month follow-up than the control groups in both the total sample and among the students at risk. There were no differences in self-reported consumption of whole-wheat bread between intervention and control groups.

Among the students at risk, the intervention group was less likely to report participating in sports at 4-month follow-up than the control group. In the intervention group, fewer steps per week were recorded at 4-month follow-up, but more steps at 2-year follow-up (only in the at-risk group), compared with the control group.

INTENTION-TO-TREAT ANALYSES

Imputation of the 4-month and 2-year follow-up outcomes with BOCF and LOCF procedures resulted in only few differences compared with the complete case analyses. In the at-risk group, imputation led to a significant effect for fruit intake at 2-year follow-up (BOCF β=0.26; 95% confidence interval [CI], 0.01-0.51), while the group differences for step count at 4-month follow-up (BOCF β=−7413; 95% CI, −15272 to 487) and 2-year follow-up (BOCF β=2838; 95% CI, −3563 to 9272) (LOCF β=−5017; 95% CI, −16074 to 6098) were nonsignificant.

COMMENT

MAIN RESULTS

The results indicate that the FATaintPHAT intervention[11] had no effects on anthropometric outcomes. We found favorable effects on self-reported obesity-related dietary behaviors at 4-month follow-up but not at 2-year follow-up. No effects for sedentary behaviors and some unfavorable effects for physical activity behaviors (sports participation and step counts) were found at 4-month follow-up.

INTERPRETATION OF THE RESULTS

Anthropometrics and fitness were only found at 2-year follow-up, while behavioral effects were only found at 4-month follow-up. The intervention thus appears to be not strong enough to have sustained effects, possibly owing to its short duration (8 sessions of 15 minutes each within 10 weeks). Furthermore, the 4-month changes in behavior were not all in the desired direction, making changes in body composition and fitness less likely.

However, it is promising that we found positive effects on dietary behaviors at 4-month follow-up. These findings compare positively with the effects that have been found in previous comparable studies, both in terms of number of effects and the sizes of the effects. Haerens et al[23,24] found a decrease in fat intake at 1-year and 2-year follow-up but not in sugar-sweetened beverage intake or fruit and water consumption. The 1-school-year healthy eating promotion intervention combined environmental changes, computer-tailored feedback, and a parent component. Singh et al[25] did not find effects on snack consumption, but they did find a decrease in sugar-sweetened beverage consumption after 8 and 12 months—about a 250-mL difference between groups. They did not find an effect after 20 months.

Table 1. School and Student Characteristics at Baseline for the Intervention and Control Groups[a]

Characteristic	Intervention	Control	*P* Value[b]
School Characteristics			
Schools, No.	11	9	NA
Educational level			
Vocational	7 (64)	5 (56)	NA
Preuniversity	4 (36)	4 (44)	
Student Characteristics			
Students, No.	485	398	NA
Age, mean (SD), y	12.7 (0.7) (n=482)	12.6 (0.6) (n=398)	.12
Sex			
Boys	284 (58.9)	198 (49.7)	.01
Girls	198 (41.1)	200 (50.3)	
Education			
Vocational	282 (62.3)	192 (50.5)	.001
Preuniversity	171 (37.3)	188 (49.5)	
Ethnicity			
Western	320 (66.0)	314 (78.9)	<.001
Non-Western	165 (34.0)	84 (21.1)	
Weight category[c]			
Underweight	40 (9.1)	34 (9.0)	.22
Normal weight	331 (75.2)	293 (77.9)	
Overweight	53 (12.0)	44 (11.7)	
Obese	16 (3.6)	5 (1.3)	
Risk Groups for the Behaviors			
SSB consumption			
≤400 mL/d	112 (25.6)	81 (21.9)	.22
>400 mL/d	325 (74.4)	289 (78.1)	
Snacks			
≤3 pieces/d	161 (37.3)	127 (35.0)	.55
>3 pieces/d	271 (62.7)	236 (65.0)	
Fruit			
<2 pieces/d	208 (47.1)	178 (47.8)	.88
≥2 pieces/d	234 (52.9)	194 (52.2)	
Vegetables			
<200 g/d	389 (87.8)	332 (87.8)	>.99
≥200 g/d	54 (12.2)	46 (12.2)	
Whole-wheat bread			
Always/mostly	246 (56.6)	210 (57.2)	.91
Sometimes/ seldom/never	189 (43.4)	157 (42.8)	
Physically active			
<60 min/d	229 (52.8)	155 (42.7)	.01
≥60 min/d	205 (47.2)	208 (57.3)	
Sedentary			
≤2 h/d	49 (11.6)	25 (6.9)	.04
>2 h/d	374 (88.4)	336 (93.1)	

Abbreviations: NA, not applicable; SSB, sugar-sweetened beverages.
[a] Unless otherwise indicated, data are reported as number (percentage) of study participants.
[b] *P* value for the test for a significant difference between intervention and control group. Age by S-K test, categorical data by χ^2 test.
[c] Based on the International Obesity Task Force cutoff points.[16]

The 1-school-year intervention to prevent excessive weight gain among adolescents consisted of educational (11 lessons) and environmental components. Martens et al[26] did not find a significant effect for fruit intake or breakfast consumption, but they did find a decrease in snack consumption (0.6 pieces) at 3-month follow-up. The dietary intervention consisted of educational (8 lessons) and parental components. Knai et al[27] found in their review of studies on fruit and vegetable consumption that of the 4 identified studies, 2 found no signifi-

Table 2. Outcome Measures[a] for the Intervention and Control Groups and for the Total Sample and the Students at Risk[b]

Outcome	Baseline	4-Month Follow-up	2-Year Follow-up
Anthropometrics			
BMI			
All students			
Intervention	19.48 (3.45) (n=440)	NA	21.08 (3.93) (n=391)
Control	19.23 (2.96) (n=376)	NA	20.67 (3.15) (n=337)
At-risk group			
Intervention	19.91 (3.33) (n=400)	NA	21.36 (3.78) (n=323)
Control	19.62 (2.81) (n=342)	NA	21.11 (3.06) (n=286)
Overweight or Obese Students,[c] %			
All students			
Intervention	15.7 (n=440)	NA	17.8 (n=393)
Control	13.0 (n=376)	NA	16.2 (n=340)
At-risk group			
Intervention	17.3 (n=400)	NA	18.8 (n=325)
Control	14.3 (n=342)	NA	18.0 (n=289)
Waist Circumference, cm			
All students			
Intervention	67.88 (8.13) (n=442)	NA	74.70 (9.78) (n=393)
Control	66.82 (6.95) (n=376)	NA	73.24 (8.20) (n=339)
At-risk group			
Intervention	68.78 (7.96) (n=400)	NA	75.26 (9.82) (n=325)
Control	67.55 (6.82) (n=342)	NA	73.96 (8.13) (n=288)
Diet			
SSB (usual), % > 400 mL/d (vs ≤400 mL/d)			
All students			
Intervention	74.4 (n=436)	64.3 (n=426)	71.5 (n=364)
Control	78.1 (n=372)	75.8 (n=367)	72.3 (n=325)
At-risk group			
Intervention	100 (n=325)	75.5 (n=286)	78.3 (n=235)
Control	100 (n=289)	82.4 (n=262)	77.6 (n=237)
Snacks, pieces/d (24-h recall)			
All students			
Intervention	5.5 (3.8) (n=432)	4.9 (3.8) (n=412)	5.3 (4.7) (n=359)
Control	5.2 (3.3) (n=363)	5.5 (4.1) (n=360)	5.8 (4.8) (n=318)
At-risk group			
Intervention	7.6 (3.4) (n=271)	5.7 (3.4) (n=232)	6.0 (5.1) (n=196)
Control	6.9 (2.8) (n=236)	6.2 (3.9) (n=216)	6.6 (4.9) (n=193)
Fruit, pieces/d (24-h recall)			
All students			
Intervention	1.67 (1.25) (n=442)	1.74 (1.32) (n=421)	1.48 (1.31) (n=371)
Control	1.63 (1.24) (n=372)	1.58 (1.26) (n=374)	1.46 (1.21) (n=330)
At-risk group			
Intervention	0.60 (0.49) (n=208)	1.33 (1.27) (n=184)	1.25 (1.26) (n=168)
Control	0.61 (0.49) (n=178)	0.96 (1.05) (n=166)	0.95 (0.96) (n=141)
Vegetables, g/d (24-h recall)			
All students			
Intervention	107 (79) (n=443)	118 (81) (n=436)	106 (76) (n=375)
Control	106 (76) (n=378)	99 (72) (n=377)	105 (75) (n=330)
At-risk group			
Intervention	86 (59) (n=389)	109 (79) (n=356)	101 (72) (n=301)
Control	87 (58) (n=332)	94 (68) (n=318)	104 (74) (n=273)
Whole Wheat Bread (usual), % sometimes, seldom, never (vs always, mostly)			
All students			
Intervention	43.4 (n=435)	40.0 (n=425)	40.0 (n=370)
Control	42.8 (n=367)	40.9 (n=369)	37.5 (n=320)
At-risk group			
Intervention	100 (n=189)	68.7 (n=163)	69.6 (n=138)
Control	100 (n=157)	70.7 (n=140)	61.9 (n=126)

(continued)

cant effects after 3 years; 1 found an increase of 0.3 servings per day among girls after 2 years; and 1 found an increase of 0.9 servings per day at interim evaluation but no effect at 2-year follow-up. Muth et al[28] found an increase of 0.9 servings of fruit and vegetables per day directly after the intervention period. It is noteworthy that these other interventions were all high-intensity programs made up of more components than only tailored feedback.

The adverse effects that we found on some physical activity indicators were unexpected. These adverse effects were mainly caused by a larger increase in sports participation and step counts in the control group compared with the intervention group. The observed increase in physical activity in the control group might be owing to seasonal influences over the 4-month period (fall/winter–spring/summer),[29] an increase that we at least would have expected to see in the intervention group as well. The findings may indicate

Table 2. Outcome Measures[a] for the Intervention and Control Groups and for the Total Sample and the Students at Risk[b] (continued)

Outcome	Baseline	4-Month Follow-up	2-Year Follow-up
Physical Activity in Last Week			
Days with 60 min of moderate activity			
All students			
Intervention	2.61 (1.92) (n=453)	2.95 (2.02) (n=444)	2.46 (1.90) (n=383)
Control	2.96 (1.90) (n=380)	3.23 (2.10) (n=379)	2.63 (1.95) (n=332)
At-risk group			
Intervention	2.00 (1.58) (n=229)	2.46 (1.88) (n=212)	2.09 (1.78) (n=184)
Control	2.35 (1.59) (n=155)	2.96 (2.08) (n=149)	2.18 (1.82) (n=136)
Transport to School (min/wk)			
All students			
Intervention	131 (137) (n=452)	135 (133) (n=444)	132 (130) (n=382)
Control	156 (117) (n=380)	160 (114) (n=378)	161 (113) (n=329)
At-risk group			
Intervention	81 (103) (n=229)	105 (118) (n=212)	104 (120) (n=184)
Control	124 (97) (n=155)	134 (98) (n=148)	137 (97) (n=134)
Sport Outside School, % yes (vs no)			
All students			
Intervention	81.8 (n=466)	80.4 (n=414)	76.4 (n=453)
Control	89.3 (n=393)	90.9 (n=374)	82.0 (n=394)
At-risk group			
Intervention	63.8 (n=229)	66.5 (n=209)	70.3 (n=222)
Control	72.9 (n=155)	82.3 (n=147)	71.0 (n=155)
Step count, No of steps/wk			
All students			
Intervention	81 046 (28 987) (n=128)	79 350 (25 623) (n=116)	78 560 (253 489) (n=105)
Control	84 679 (21 697) (n=99)	89 934 (29 796) (n=85)	68 276 (27 862) (n=68)
At-risk group			
Intervention	73 052 (24 049) (n=62)	71 007 (20 943) (n=58)	71 923 (24 021) (n=51)
Control	80 465 (22 335) (n=35)	82 672 (27 369) (n=40)	59 534 (20 879) (n=27)
Fitness			
Shuttle-run test, min			
All students			
Intervention	6.4 (2.3) (n=367)	NA	7.5 (2.5) (n=145)
Control	6.8 (2.3) (n=321)	NA	7.9 (2.4) (n=260)
Sedentary Behavior in Last Week			
Television + computer time, min/d			
All students			
Intervention	299.7 (163.6) (n=423)	287.1 (162.3) (n=404)	313.1 (155.6) (n=355)
Control	312.9 (163.9) (n=361)	295.2 (154.6) (n=358)	331.3 (161.7) (n=316)
At-risk group			
Intervention	326.8 (154.5) (n=374)	296.7 (155.3) (n=316)	320.8 (151.1) (n=277)
Control	330.0 (156.8) (n=336)	299.4 (146.6) (n=307)	341.8 (157.8) (n=263)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); NA, not applicable; SSB, sugar-sweetened beverages.
[a] Unless otherwise indicated, data are mean (SD) values of the specified outcomes.
[b] *At-risk* is defined as normal or overweight or not meeting behavioral recommendations.
[c] Based on the International Obesity Task Force cutoff points.[16]

that the intervention inhibited the adolescents from increasing their levels of physical activity. This inhibition effect might be the result of unexpected reactions to the feedback messages. Currently, there is limited evidence for the way adolescents respond to personalized feedback.[30] More insight in the processing of feedback messages is therefore needed. In addition, we cannot rule out that students might have compensated for their improved dietary behaviors by lowering their physical activity, although additional analyses of our data do not reveal such compensating associations.

Imputation of step count led to nonsignificant effects. As might be expected, BOCF imputation led to smaller effect sizes,[22] while LOCF imputation led to effects that were more comparable with outcomes at second follow-up, since any effects on first follow-up are carried forward. Thus, even though we found negative effects for physical activity outcomes, these effects were not consistent. What we did find consistently was no effect on physical activity. The results of our study are in line with those reported in a review by van Sluijs et al,[31] which showed that education-only school-based interventions to increase physical activity among adolescents did not result in an increase in physical activity, whereas multicomponent interventions (including, eg, family, community, and/or environmental changes) did have a positive effect. Therefore, to promote physical activity in the school setting, computer-tailored programs might need to be accompanied by family, community, and/or environmental interventions.

Effects of computer-tailored interventions for dietary, physical activity, and sedentary behavior among adolescents have not been studied extensively. Haerens et al[9,10] showed that a computer-tailored intervention for increasing physical activity among adolescents was more effective than a no-intervention control group[9] but not more effective than generic information.[10] De Bourdeaudhuij et al[32] concluded, based on a systematic review including multicomponent

Table 3. Intervention Effects Among All Students and Students at Risk[a]

	4-Month Follow-up					2-Year Follow-up				
Outcome	**No.**	**ICC**	**β**	**OR**	**95% CI**	**No.**	**ICC**	**β**	**OR**	**95% CI**
Anthropometry										
BMI										
All students	NA	NA	NA	NA	NA	676	0.000	0.14	NA	−0.17 to 0.45
Risk group	NA	NA	NA	NA	NA	611	0.010	0.11	NA	−0.27 to 0.49
Weight category,[b] overweight/obese, 1; normal/underweight, 0										
All students	NA	NA	NA	NA	NA	676	NA	NA	0.91	0.52 to 1.61
Risk group	NA	NA	NA	NA	NA	611	NA	NA	0.91	0.51 to 1.62
Waist circumference,										
All students	NA	NA	NA	NA	NA	678	0.012	0.60	NA	−0.44 to 1.64
Risk group	NA	NA	NA	NA	NA	611	0.012	0.55	NA	−0.55 to 1.64
Diet										
SSB, mL/d (>400, 1; ≤400, 0)										
All students	729	NA	NA	**0.54**	0.34 to 0.88	633	NA	NA	1.00	0.68 to 1.45
Risk group	548	NA	NA	0.62	0.34 to 1.13	472	NA	NA	0.93	0.46 to 1.90
Snacks, pieces/d										
All students	714	0.000	**−0.81**	NA	−1.33 to −0.29	619	0.000	−0.66	NA	−1.35 to 0.04
Risk group	448	0.004	**−0.97**	NA	−1.70 to −0.24	389	0.000	−0.90	NA	−1.85 to 0.05
Fruit, pieces/d										
All students	742	0.007	0.11	NA	−0.08 to 0.31	649	0.000	0.06	NA	−0.13 to 0.24
Risk group	350	0.009	**0.39**	NA	0.13 to 0.66	309	0.082	0.24	NA	−0.13 to 0.63
Vegetables, g/d										
All students	765	0.007	**19.34**	NA	7.54 to 31.21	659	0.027	−2.42	NA	−18.12 to 13.36
Risk group	674	0.003	**16.72**	NA	5.43 to 28.07	574	0.041	−5.15	NA	−22.75 to 12.55
Whole wheat bread, always, mostly, 1; sometimes, seldom, never, 0										
All students	730	NA	NA	1.08	0.67 to 1.75	642	NA	NA	0.85	0.57 to 1.26
Risk group	303	NA	NA	1.06	0.63 to 1.78	264	NA	NA	0.74	0.41 to 1.29
Physical Activity in Last Week										
Days with 60 min of moderate activity, No.										
All students	780	0.010	−0.21	NA	−0.54 to 0.13	678	0.000	−0.13	NA	−0.41 to 0.16
Risk group	361	0.037	−0.46	NA	−0.98 to 0.08	320	0.000	−0.03	NA	−0.42 to 0.37
Transport to school, min/wk										
All students	779	0.042	−10.7	NA	−28.2 to 6.8	674	0.036	−14.5	NA	−37.2 to 8.2
Risk group	360	0.030	−0.9	NA	−21.5 to 19.8	318	0.032	−9.4	NA	−34.5 to 15.8
Sport outside school, yes, 1; no, 0										
All students	726	NA	NA	0.54	0.30 to 1.00	631	NA	NA	0.81	0.53 to 1.23
Risk group	356	NA	NA	**0.45**	0.24 to 0.85	313	NA	NA	1.18	0.67 to 2.05
Step count, steps/wk										
All students	136	0.125	**−10 856**	NA	−21 556 to −101	80	0.000	8611	NA	−2296 to 19 574
Risk group	65	0.000	**−13 636**	NA	−23 938 to −3281	34	0.000	**14 228**	NA	678 to 27 838
Fitness										
Shuttle-run test, min										
All students	NA	NA	NA	NA	NA	353	0.202	0.03	NA	−0.95 to 1.01
Risk group	NA	NA	NA	NA	NA	312	0.173	−0.19	NA	−1.14 to 0.77
Sedentary Behavior in Last Week										
Television + computer time, min/d										
All students	688	0.000	−5.4	NA	−25.2 to 14.5	602	0.015	−16.6	NA	−43.4 to 10.4
Risk group	623	0.000	−4.1	NA	−25.5 to 17.5	540	0.008	−21.7	NA	−47.8 to 4.6

Abbreviations: β, regression coefficient; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); ICC, intra-class coefficient; IOTF, International Obesity Task Force[16]; OR, odds ratio; SSB, sugar-sweetened beverages.

[a] *At-risk* is defined as normal or overweight or not meeting behavioral recommendations.

[b] Bolded numbers indicate statistical significance. All multilevel linear and logistic regression analyses were adjusted for sex, education, ethnicity, and the baseline value of each outcome. Odds ratios or β values indicate comparison with the control group. All 20 clusters are in the analyses except for fitness (14 clusters all students; 13 clusters at-risk group) and step count (18 clusters 4-mo follow-up at-risk group; 18 clusters 2-y follow-up all students; 14 clusters 2-y follow-up at-risk group).

interventions, that computer-tailored personalized education in the classroom led to better results than a generic classroom curriculum in school-based nutrition and physical activity interventions. Our study indicates adverse effects on physical activity but a favorable impact on dietary behaviors among adolescents compared with a no-intervention control group. This is largely in line with the conclusions of recent reviews that found convincing evidence for the effectiveness of computer-tailored interventions on diet but inconclusive results for physical activity among adults.[5,6,8]

STRENGTHS AND LIMITATIONS

Important strengths of this study are its randomized design, large size, objective measures for anthropometry and physical activity, and the novelty of addressing the effectiveness of a stand-alone computer-tailored intervention. Limitations to the study are the use of self-reported measures, which might have resulted in less reliable outcomes and might have weakened the effects found in this study. In addition, more students from the intervention group were lost to follow-up, possibly owing to the overrepresentation of vocational schools in this group. Vocational school students choose their specialty after 2 years and then often change to a different school location. Since the pedometers were used in a subsample of students and there was some loss to follow-up, the number of adolescents who used the pedometer at the second follow-up was small compared with number at baseline and at first follow-up. Therefore, results should be interpreted with care. Another limitation is that we did not assess pubertal status to allow correction of the anthropometric data.

In conclusion, our study shows that the computer-tailored intervention FATaintPHAT was not effective in modifying anthropometric outcome measures but that it can have a positive effect on dietary behaviors among adolescents at short-term follow-up. Expanding the intervention with additional components or booster sessions might improve the effectiveness in the short and long term. The results of our study seem to be in line with the findings of recent reviews that have indicated that classroom-based educational programs (not only computer tailored) seem to be effective for promoting dietary intake but not for promoting physical activity. Successful promotion of physical activity might require (additional) environmental changes.

Accepted for Publication: August 31, 2011.
Published Online: November 7, 2011. doi:10.1001/archpediatrics.2011.204
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Author Contributions: Dr Ezendam had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses. *Study concept and design:* Ezendam, Brug, and Oenema. *Acquisition of data:* Ezendam. *Analysis and interpretation of data:* Ezendam, Brug, and Oenema. *Drafting of the manuscript:* Ezendam, Brug, and Oenema. *Critical revision of the manuscript for important intellectual content:* Ezendam, Brug, and Oenema. *Statistical analysis:* Ezendam. *Obtained funding:* Brug. *Administrative, technical, and material support:* Ezendam and Oenema. *Study supervision:* Brug and Oenema.
Financial Disclosure: None reported.
Funding/Support: This study was funded by grant 62200020 from ZonMw, the Netherlands Organization for Health Care Research and Development.
Role of the Sponsors: The funding organization was not involved in any aspect of the analyses or in the preparation of the manuscript.
Online-Only Material: The eTable is available at http://www.archpediatrics.com.

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