Health Promotion Intervention in Low Socioeconomic Kindergarten Children

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Objective To prospectively examine the effects of a randomized school-based intervention on nutrition and physical activity knowledge and preferences, anthropometric measures, and fitness in low socioeconomic kindergarten children.

Study design A total of 376 children completed a school-year combined dietary–behavioral–physical activity intervention and were compared with 349 control subjects (age 3.8–6.8 years).

Results The prevalence of overweight and obesity among the kindergarten children was 27.7%. Even though the intervention was not associated with between group differences in body mass index changes, it was associated with significantly \((P < .05)\) greater increase in nutrition knowledge and preferences, physical activity knowledge and preferences, and improvement in fitness. There was a greater \((P < .05)\) decrease in the number of overweight children in the intervention group \((-31.9\%)\) compared with the controls \((-17.5\%)\).

Conclusions A kindergarten dietary–physical activity intervention applied by the kindergarten teachers, had no effect on body mass index changes between the groups, but improved nutrition and physical activity and preferences, improved fitness, and decreased the percent of overweight children. This intervention may play an important role in health promotion, prevention and treatment of childhood obesity. (J Pediatr 2011; 118: 232–238).

The prevalence of pediatric obesity is increasing worldwide and has reached epidemic proportions in westernized societies despite major efforts to promote weight reduction. Childhood obesity in Israel is among the highest compared with European countries and the United States. The underlying mechanisms for the increasing prevalence of childhood obesity are not completely understood, but it is clear that alterations in food consumption and physical activity habits are associated with an obesogenic environment and interact with the individual’s genetic predisposition, leading to obesity.

Relatively few studies have examined the prevalence of childhood obesity in preschool years and, in particular, in low socioeconomic communities. In the United States, obesity prevalence among low-income, preschool-aged children increased steadily from 12.4% in 1998 to 14.5% in 2003 and remained essentially the same, with a 14.6% prevalence in 2008. However, studies in the New York city public elementary schools reported a much higher overall overweight (body mass index [BMI] 85%–95%) prevalence rate of 48%, with a 23% prevalence rate of obesity (BMI >95%) in kindergartners, with a significantly higher prevalence among Hispanic compared with black and white children. High prevalence of overweight and obesity in preschool aged children was also reported in Canada (21.5%), as well as several central and eastern European, Mediterranean (Greece, 31.9%), Middle Eastern (Egypt, 25.7%), and Latin American countries (Peru, 28%).

We previously reported a prevalence of 22% overweight and obesity among Israeli preschool children of middle-upper socioeconomic status. This increase in the prevalence of preschool childhood obesity and the tendency of these children to become obese adults suggest that health education and preventive and therapeutic interventions should start early.

Organizational complexities and high costs make structured multidisciplinary interventions feasible only for a fraction of obese children. A more effective, preventive and therapeutic approach should include the development of generalizable school-based interventions. Surprisingly, few school-based programs for the prevention and treatment of childhood obesity have been reported. Some of these programs have been shown to decrease overweight, reduce sedentary behaviors, and improve dietary intake in overweight and obese children. A review study of school-based intervention programs found that the mean reduction in percentage of overweight children was 10%. Relatively few school-based interventions have been reported for preschool and kindergarten children, and a recent Cochrane review pointed out the lack of interventions for preschool-aged children for the prevention and treatment of childhood obesity.

We previously reported the favorable effect of a combined nutritional–physical activity intervention on body weight, BMI percentiles, adiposity, and fitness in Israeli kindergarten children from middle to upper socioeconomic communities. We hypothesized that the intervention would lead to improved nutrition and physical activity knowledge and preferences, a decrease in BMI percentile and improvement in fitness in preschool children of lower socioeconomic status.

| BMI | Body mass index |
Methods

Seven hundred ninety-five healthy kindergarten children (age range 3.8-6.8 years; 378 control subjects and 417 subjects undergoing intervention) participated in the study. The study was approved by the institutional review board of the Meir Medical Center, and the Israeli Ministry of Education. Children were included after parental consent.

The study included 30 kindergartens from low socioeconomic status communities in the Sharon area, Israel. Socioeconomic status was determined with criteria set by the Israeli Central Bureau of Statistics. Briefly, a scale of 1 to 10 refers to the socioeconomic status, whereas low socioeconomic status is defined by a score of 1 to 4. The score is comprised of the level of education, employment/unemployment status, income level, number of children per family, number of people per household, and additional standard of living characteristics (eg, brand and model of cars).

In Israel, kindergartens are separated from the school system, and each includes only one class. Kindergarten classes were randomly assigned by computerized program to participate in a year-round, in-school, combined, nutritional and physical activity intervention or to serve as control subjects (15 kindergarten classes in each group). Seventy children did not complete the study (8.8%), because they were absent on the days of follow-up measurements (29/378 control, 41/417 intervention) and therefore were excluded from the study. Seven hundred twenty-five participants completed the study (349 control subjects, 376 subjects treated with intervention). Measurements were performed in both groups at the beginning and at the end of the program, by the same group of trained technicians who were blinded to the assignment of the kindergarten to either the intervention or control group.

Intervention Design

The intervention protocol was designed by pediatricians, registered dietitians, an exercise physiologist, youth exercise coaches, and the preschool staff. A major challenge was to ensure the transferability of the intervention, so that if successful, it will be possible to apply it in a larger number of preschools nationwide.

After randomization, the intervention group preschool teachers attended an all-day seminar in which they were acquainted with the program and were trained by the study team so that preschool staff (ie, teacher and assistant teacher) could perform all the nutritional aspects of the intervention and most exercise classes. Teachers were given lectures, hands-on sessions (on nutrition and physical activity), and written material to familiarize them with the program and enable them to perform it in their classes. During the intervention, kindergarten teachers were invited to two additional training days; the goal of these meetings was to collect feedback on the program and to introduce new materials to the teachers. Adherence to the program was followed weekly by the study coordinator and by the professional youth coach. Participants in the control group were informed that measurements are part of a survey on physical activity and nutrition in kindergarten children, and they continued their regular kindergarten schedule.

Parents and children of the intervention groups only were invited for two “Healthy Day Festivals” that focused on the major themes of the program (introduction of healthy nutrition, prevention of childhood obesity, and beneficial effects of exercise in children). The first festival was performed during the second month of the program, and the second festival was performed toward the middle of the program. The festivals included lectures given by the study team and games for both children and parents. At the end of school year, intervention group teachers were invited to a summary meeting in which they were given an update on the study results.

Nutritional Intervention

The nutritional intervention was designed mainly to improve nutritional knowledge and was based on the nutritional program “It Fits Me” (“Tafur Alay”) of the Israeli Ministry of Education (www.tafuralay.co.il). Briefly, the intervention consisted of teaching topics such as food groups, vitamins, healthy food choices, food preparation and cooking methods, and information on fast-food versus home cooking. The topics were taught through short lectures/talks, games, and story reading.

Topics included the following: what do popular Israeli foods contain, fruits and vegetables, what is calcium and why is it important, special dietary consideration during holidays, and how to deal with food excess during celebrations, vacations, and restaurant meals. All topics were delivered by the preschool teachers and made appropriate to the cognitive and social development levels of kindergarten children. In addition, monthly flyers detailing nutritional information were sent home via the children. Children were asked to present the nutritional information to their parents, and parents were asked to discuss the information with their children.

Physical Activity Program

All intervention children participated in 45 minutes (divided to three 15-minute sessions) per day of exercise training (6 days a week). Once a week, the training was directed by a professional youth coach. During the rest of the week similar physical activity sessions were coordinated by the preschool teacher or assistant, as instructed during the seminars. The physical activity sessions were performed indoors or outdoors. The activities varied in duration and intensity and were designed primarily as games to encourage enthusiasm and participation of the children. Endurance type activities accounted for most of the time spent in training (about 20% team sports [soccer, dodge ball] and 80% running games [tag, hide-and-seek, relays, etc]), with attention also given to coordination and flexibility skills. Children were encouraged by the study staff to increase their habitual after-school physical activity and to reduce sedentary activities (eg, television viewing, video games). Preschool teachers also were given a CD collection of children’s songs, written
by a famous Israeli children’s song writer. All the songs were related to the topic of nutrition and exercise.

Anthropometric Measurements
Standard, calibrated scales and stadiometers (Seca 769, Hamburg, Germany) were used to determine height, weight, and BMI (kg/m²). Participants were asked to void and remove shoes and heavy clothing before measurement. Children were measured twice, and the average was recorded for analysis. A third measurement was performed when a difference of >0.1 kg or 0.5 cm was detected, and the two closest measurements were averaged. Measurements were performed by experienced technicians who were blinded to the group assignment. Because BMI changes with age and as a result of the length of the intervention (1 school year), BMI-for-age percentile was calculated according to the growth charts from the Centers for Disease Control and Prevention.17

Nutritional and Physical Activity Knowledge and Preferences Evaluation
Nutritional and physical activity knowledge and preferences were evaluated by a photo-pair food and exercise-pairing questionnaire based on a questionnaire developed by Calfas et al.18 The questionnaires were completed individually, and the assessors were blinded to the assignment of the children. The same assessor performed the pre-evaluations and post-evaluations in each kindergarten.

At the beginning of the test, each child was asked if he/she knew what healthy means and was provided with an age-appropriate explanation, such as, “Being healthy means that you can play outside, you do not get sick, and you feel good.” To determine knowledge, children were asked to choose a doll that they were supposed to help stay healthy and take care of. The doll was used so that the child would assume a more caretaking approach and to make it less likely that they make choices purely on the basis of personal preferences. Then children were presented with 15 photo-pairs pictures. In each set of pictures, presented on a laptop computer, one picture signified the healthy choice and the other the unhealthy one. Children were asked to identify which food/activity of the pair would “make the doll healthy and grow big and strong.”

To determine preferences children were presented with the same 15 pairs of pictures and were asked to point to the food/activity they best like. This type of visual instrument was previously found to be appropriate for this age group and was validated on a similar group of children in the United States.18 The order of knowledge or preference testing was randomly assigned with a computerized program. A score (0%-100%) for nutrition and physical activity knowledge and preferences was calculated and used for statistical analysis.

Fitness Assessment
Fitness was assessed by use of the shuttle run test. The test usually consists of shuttle running at increasing speeds between two markers placed 20 m apart, and a portable compact disc (Sony CFD-V7; Sony, Tokyo, Japan) dictates the pace of the test by emitting tones at appropriate intervals. Because of the young age of the participants, and because we were not allowed to test the children outside the kindergarten, we modified the test and used the same pacer but reduced the running distance to 10 m. Each participant was required to be at one of the ends of the 10-m course at the signal. A start speed of 8.5 km/h was maintained for 1 minute, and thereafter the speed was increased 0.5 km/h every minute. The test score achieved was the number of laps completed before the subject either withdrew voluntarily from the test or failed to arrive within 2 m of the end line on two consecutive tones. All children were encouraged throughout the test by the staff to achieve their best performance.

Statistical Analysis
Two-sample t test was used to determine baseline differences between the control and intervention groups. A two-way repeated measures analysis of variance was used to compare effects of the intervention on body weight, height, BMI, BMI percentiles, nutrition and physical activity knowledge and preferences and fitness between the intervention participants and the control participants with time serving as the within group, and intervention as the between group factor. When differences between the two groups were identified, a mixed model analysis was performed, to ensure no class effect.

The χ² test was used to determine the difference in the number of participants at each group that decreased their BMI percentile from overweight (85%-95%) to normal weight (<85%). Statistical significance was taken at P < .05. Data are presented as mean ± standard error of the mean.

Results
Baseline characteristics of the participants are summarized in Table 1. The overall prevalence of overweight and obesity (BMI > 85%) was 27.8%.

The effect of intervention on nutrition and physical activity knowledge and preferences is shown in Figures 1 and 2.

Table 1. Baseline characteristics of the study participants (n = 725)

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 349)</th>
<th>Intervention (n = 376)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>5.24 ± 0.03</td>
<td>5.20 ± 0.02</td>
</tr>
<tr>
<td>Sex (M/F, %)</td>
<td>56/44</td>
<td>54/46</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>19.4 ± 0.2</td>
<td>19.1 ± 0.2</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>109.0 ± 0.3</td>
<td>108.4 ± 0.3</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>16.2 ± 0.1</td>
<td>16.2 ± 0.1</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>62.6 ± 1.5</td>
<td>62.6 ± 1.4</td>
</tr>
<tr>
<td>Overweight</td>
<td>63/349</td>
<td>72/376</td>
</tr>
<tr>
<td>BMI percentile 85-95</td>
<td>18.1%</td>
<td>19.1%</td>
</tr>
<tr>
<td>Obese</td>
<td>34/349</td>
<td>33/376</td>
</tr>
<tr>
<td>BMI percentile &gt; 95</td>
<td>9.7%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Overweight and obese</td>
<td>97/349</td>
<td>105/376</td>
</tr>
<tr>
<td>BMI percentile &gt; 85</td>
<td>27.8%</td>
<td>27.9%</td>
</tr>
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</table>
There was a significant increase in nutrition knowledge and preference, and in physical activity knowledge and preference in the intervention group compared with controls. These findings were consistent through both sexes.

The effects of the intervention on body weight, height, BMI, and BMI percentiles, are summarized in Tables II and III (available at www.jpeds.com). After the intervention there was a significant increase in height and weight, no change in BMI, and a significant decrease in BMI percentile in both groups. The only significant difference between the groups following the intervention was a greater increase in height in the intervention group. These findings were consistent through both sexes and through all weight groups (normal weight, overweight, and obese). At the end of follow-up, the overall number of overweight children (85-95 BMI percentile) decreased significantly \(P < .05\) from 72 to 49 (a 31.9% reduction) in the intervention group and from 63 to 54 in the control group (a 17.5% reduction). Among children classified at baseline as obese (>95%ile), three children from the control and two from the intervention groups were reclassified as overweight.

The effect of the intervention of fitness is shown in Figure 3. The intervention led to a significant greater improvement in the fitness in both male and female participants. The improvement in fitness was observed also in overweight and obese children.

Discussion

This study demonstrates an overall 27.8% prevalence rate of overweight, with about 9.5% of obesity in Israeli kindergarten children. This suggests that childhood obesity is a major public health issue from the very early stages of life, and therefore preventive and therapeutic interventions must start at least as early as the preschool and kindergarten years.

Although we did not find significant between-group differences in BMI percentiles, we were encouraged by the significant improvement in nutrition and physical activity knowledge and preference scores and the significant improvement in physical fitness in the intervention participants compared with the controls. In addition, 32% of the intervention group children who started the program as overweight were reclassified as normal weight at the end of the program, compared with a decrease of 17.5% in the control group. Moreover, the low dropout rates from the intervention (8.8%, mainly because of absence in the final data collection day) emphasizes that school-based health education programs may indeed be an important platform in our efforts to prevent and treat childhood obesity.

One of the most significant findings of this study was the marked intervention-induced improvement in nutrition and physical activity knowledge and preferences. Interestingly, the baseline nutrition and physical activity knowledge

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**Figure 1.** The effect of intervention on nutrition knowledge and preferences.

**Figure 2.** The effect of intervention on physical activity knowledge and preferences.
score of the kindergarten children in this study was markedly lower compared with our previously reported scores of kindergarten children from middle-high socioeconomic communities in the same region. This suggests that a large gap in health-related knowledge (eg, nutrition and physical activity) exists between children in low and high socioeconomic status as early as in the kindergarten age, probably indicating the large environmental contribution to the general knowledge of children in this age. The low knowledge scores of the low socioeconomic children in this study indicates that one of the first steps in any preventive and therapeutic interventions for childhood obesity in this population must be to increase the nutritional and physical activity knowledge. Better knowledge may lead to improved nutritional and physical activity preferences, healthier nutritional life-style and increased physical activity. The longer-term effects of improved knowledge and preferences on health behaviors and obesity are not yet established.

Today’s children’s sedentary lifestyle and the increased inactivity in western societies are major contributors to the increased prevalence of childhood obesity. Therefore physical activity was a major focus of our intervention. The intervention resulted in a significant increase in physical fitness. These results are consistent with our previous findings of improved fitness after a similar intervention in kindergarten children from moderately-high socioeconomic communities. Physical activity levels were not determined in this study. However, we previously demonstrated that a similar intervention was associated with a significant increase in physical activity levels during both school and after-school hours suggesting, encouragingly, that the children assimilated the importance of habitual physical activity. Our results are consistent with the recommendations of Datar et al that expanding the physical education instruction time in kindergarten children to at least 5 hours of physical activity per week (close to the recommended levels, and to the amount of physical activity performed in this study) could markedly reduce the prevalence of childhood overweight and obesity. Improved physical fitness not only may be a very important contributor to weight reduction but also may have other health-related effects, such as improved insulin sensitivity, improved lipid profile, decreased blood pressure, and reduced risk of coronary heart disease later in life, as well as beneficial psychosocial effects.

Our intervention did not result in an overall greater decrease in age-adjusted BMI percentiles. This finding is similar to the recently reported HEALTHY study (in middle school children). Although a significant beneficial effect on age-adjusted BMI percentiles was observed in the intervention group, an almost similar reduction in BMI percentiles also was observed in the control group kindergarten children. A possible explanation to this decrease is that merely participation in a research study encouraged children from the control group to improve their nutritional habits and, as a result, to reduce BMI percentiles. The question still remains why we did not observe an additional beneficial effect on BMI percentiles in the intervention group. The data indicate that there is still a large gap between increased nutrition knowledge and preferences and their actual implementation as healthier dietary lifestyle and reduced caloric intake. Moreover, environmental, social, economic (ie, accessibility to food) and other barriers also may play a role. Another possibility, not studied in this study, is a favorable change in body composition (an increase in lean body mass, with a reduction in fat), that was not reflected in weight change. Nevertheless, the intervention was associated with a significant reclassification (almost double) in the number and percentage of overweight (but not obese) children who ended the study at normal weight, suggesting an important and specific beneficial effect for this unique subgroup. Interestingly, in a large cohort of middle school children from the United States, a greater beneficial effect was seen in the more obese children, suggesting that age, maturity, and ethnic background probably affect the outcomes.

One of the most interesting findings of this study was the greater increase in linear growth in the intervention participants. The greater increase in linear growth occurred in the whole group, in the males and females, and in the normal weight, overweight, and obese subgroups (ranged 0.6 to 1.1 cm between the different subgroups). It is now well established that although there is a decrease in anabolic components of the growth hormone insulin-like growth factor-I during initial stages of exercise training, longer periods of training are associated with a significant increase in these
anabolic mediators. It is believed that this increase mainly mediates exercise-induced muscle hypertrophy. We can only speculate that an increase in these anabolic hormones may affect linear growth as well. Moreover, the clinical implication of the greater height gain and whether this will affect final height is yet to be determined. Indeed, we previously reported that active high school girls were taller than their sedentary peers.

Finally, the positive effects of our school-based combined nutritional-physical activity intervention on nutrition and physical activity knowledge and preferences, fitness, and overweight in children in low socioeconomic status are especially encouraging because the program was incorporated into the existing preschool core curriculum and delivered mainly by the preschool staff and not by external professional personnel. Therefore the program did not require major investment of time or financial expenses. This program may serve as an effective model and preventive strategy for the nationwide campaign against sedentary lifestyle, inactivity, and overweight in kindergarten and preschools, particularly in low socioeconomic communities. Future studies are needed to objectively determine the effects of the intervention on actual caloric intake and energy expenditure. The long-term effects of this intervention are yet to be determined.

We thank Ms. T. Eylon, Ms. R. Menkin, and Ms. I. Livne from the Israeli Ministry of Education. We also thank the kindergarten staff, the children, and their parents for their cooperation.

References

Table II. Changes in anthropometric measures from baseline to post test of the study participants, data are presented as changes from baseline (mean ± SEM)

<table>
<thead>
<tr>
<th></th>
<th>Control Total (n = 349)</th>
<th>Control Male (n = 192)</th>
<th>Control Female (n = 157)</th>
<th>Intervention Total (n = 376)</th>
<th>Intervention Male (n = 201)</th>
<th>Intervention Female (n = 175)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>1.3 ± 0.1</td>
<td>1.3 ± 0.1</td>
<td>1.3 ± 0.3</td>
<td>1.5 ± 0.1</td>
<td>1.4 ± 0.1</td>
<td>1.5 ± 0.1</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>4.2 ± 0.2</td>
<td>4.3 ± 0.1</td>
<td>4.0 ± 0.1</td>
<td>5.0 ± 0.1*</td>
<td>5.0 ± 0.1*</td>
<td>4.9 ± 0.1*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>-0.18 ± 0.04</td>
<td>-0.24 ± 0.06</td>
<td>-0.13 ± 0.05</td>
<td>-0.25 ± 0.04</td>
<td>-0.32 ± 0.05</td>
<td>-0.17 ± 0.06</td>
</tr>
<tr>
<td>BMI%</td>
<td>-5.9 ± 0.8</td>
<td>-6.3 ± 1.2</td>
<td>-5.5 ± 0.9</td>
<td>-6.4 ± 0.8</td>
<td>-8.0 ± 0.5</td>
<td>-4.6 ± 1.0</td>
</tr>
</tbody>
</table>

BMI%, BMI percentiles.

*P < .05 for between group difference.

Table III. Changes in anthropometric measures from baseline to post test in the overweight (BMI% between 85-95) and obese (BMI% > 95) participants, data are presented as changes from baseline (mean ± SEM)

<table>
<thead>
<tr>
<th></th>
<th>Control Overweight (n = 63)</th>
<th>Control Obese (n = 34)</th>
<th>Intervention Overweight (n = 72)</th>
<th>Intervention Obese (n = 33)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>1.4 ± 0.1</td>
<td>2.2 ± 0.2</td>
<td>1.7 ± 0.1</td>
<td>2.1 ± 0.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>4.4 ± 0.2</td>
<td>4.2 ± 0.3</td>
<td>5.0 ± 0.3*</td>
<td>5.3 ± 0.4*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>-0.25 ± 0.08</td>
<td>0.19 ± 0.31</td>
<td>-0.25 ± 0.1</td>
<td>-0.20 ± 0.20</td>
</tr>
<tr>
<td>BMI%</td>
<td>-5.4 ± 1.0</td>
<td>-1.3 ± 0.5</td>
<td>-6.1 ± 1.1</td>
<td>-4.5 ± 2.0</td>
</tr>
</tbody>
</table>

BMI%, BMI percentiles.

*P < .05 between-group difference.