A Simple Dietary Intervention in the School Setting Decreased Incidence of Overweight in Children

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Key Words
Randomized controlled trial · Environmental intervention · Educational intervention · Childhood overweight

Summary
Objective: The study analyzed the effect of a combined environmental and educational intervention solely promoting water consumption on the incidence of overweight among school children. Methods: 2,950 second and third graders of 32 elementary schools in socially deprived neighborhoods of two German cities participated in a randomized controlled intervention trial (August 2006–June 2007). In intervention schools (N = 17), water fountains were installed, each child received a water bottle, and teachers performed classroom lessons to promote water consumption. Control schools (N = 15) did not receive any intervention. Body heights and weights were measured at baseline and follow-up to assess the incidence and remission of overweight and obesity during follow-up. The water flow of the fountains was measured regularly during follow-up. Children’s beverage consumption was self-reported in 24-hour recall questionnaires before and after intervention. Results: After the intervention, the incidence of overweight was significantly lower in the intervention group (3.8%) than in the control group (6.0%, p = 0.018). Remission of overweight and obesity did not differ between the groups. Measured water flow of the fountains indicated a sustained use. Conclusion: A simple dietary intervention with the sole focus on the promotion of drinking water effectively reduced the incidence of overweight among school children.

Introduction
The prevention of overweight and obesity in children is one of the major challenges for medicine and public health today [1]. A recent Cochrane Review [2] was not able to identify one particular intervention that prevents obesity in children but designated programs as more promising that consider environmental modifications in addition to individual behavior changes. Prompted by the beneficial effect on weight status demonstrated in two recent smaller intervention trials focusing on decreasing calorific soft drink consumption [3, 4], we evolved an intervention program for school children with the sole focus on the promotion of water consumption. Additionally to an educational intervention, environmental modifications were implemented in the school setting for facilitating the access to drinking water and increasing the attractiveness of water consumption. We conducted a large randomized controlled trial with elementary school children in deprived urban neighborhoods and found a reduced risk for the prevalence of overweight after the intervention [5]. In the present secondary analysis, we tested whether the incidence and remission of overweight and obesity was lower in the intervention group (IG) than in the control group (CG) as a consequence of the promotion of drinking water.

Participants and Methods
Methods and design of the randomized controlled cluster trial have been described in detail elsewhere [5]. The study population comprised children attending the second and third grades of elementary schools in socially deprived neighborhoods of two cities in Germany, Dortmund and Essen. The neighborhoods were defined by socio-demographic criteria as provided by the local public authorities for the city districts [6]. Randomization of the intervention was performed at city level with Dortmund as IG and Essen as CG. Of 81 eligible schools in the defined districts, 40
Table 1. Baseline characteristics of participants and schools of the intervention group (IG) and control group (CG)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>T0 IG (N = 1,641)</th>
<th>p valuea</th>
<th>T0 CG (N = 1,309)</th>
<th>p valuea</th>
<th>T1 IG (N = 1,641)</th>
<th>p valuea</th>
<th>T1 CG (N = 1,309)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, years</td>
<td>8.26 ± 0.73</td>
<td>0.009</td>
<td>8.34 ± 0.76</td>
<td>0.009</td>
<td>8.94 ± 0.73</td>
<td>0.003</td>
<td>9.03 ± 0.76</td>
</tr>
<tr>
<td>BMI, mean ± SD, kg/m²</td>
<td>17.11 ± 2.78</td>
<td>0.050</td>
<td>17.39 ± 3.10</td>
<td>0.050</td>
<td>17.50 ± 2.97</td>
<td>0.037</td>
<td>17.80 ± 3.26</td>
</tr>
<tr>
<td>BMI-SDS, mean ± SD</td>
<td>0.23 ± 1.06</td>
<td>0.108</td>
<td>0.30 ± 1.13</td>
<td>0.108</td>
<td>0.23 ± 1.07</td>
<td>0.087</td>
<td>0.31 ± 1.13</td>
</tr>
<tr>
<td>Body weight statusb</td>
<td>0.138</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese, % (n)</td>
<td>6.2 (102)</td>
<td>0.61 (100)</td>
<td>6.1 (100)</td>
<td>0.0 (10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight, % (n)</td>
<td>17.2 (282)</td>
<td>17.4 (285)</td>
<td>17.4 (285)</td>
<td>19.8 (259)</td>
<td></td>
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<tr>
<td>Normal weight, % (n)</td>
<td>68.7 (1,128)</td>
<td>69.8 (1,145)</td>
<td>69.8 (1,145)</td>
<td>65.8 (861)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight, % (n)</td>
<td>7.9 (129)</td>
<td>6.8 (111)</td>
<td>6.8 (111)</td>
<td>6.4 (84)</td>
<td></td>
<td></td>
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</tbody>
</table>

*p value obtained using chi-square test or Wilcoxon rank sum test for group differences.

According to the International Obesity Taskforce [9] and Cole et al. [10].

Results

In total, 1,641 participants in the IG and 1,309 participants in the CG with anthropometrical data at both baseline and follow-up were analyzed. Participants had a mean age of 8.3 years, and 50.2% were male. Body weight status and characteristics are presented in table 1. Baseline characteristics did not differ between IG and CG regarding sex (p = 0.977), BMI, BMI-SDS, and body weight status whereas children in the IG were slightly older at baseline and follow-up measurements than in the CG (table 1).

The incidence rate of overweight during the follow-up period of 250 days was significantly lower in the IG (3.8%) than in the CG (6.0%) (table 2). In contrast, the remission rate of overweight and obesity among the subgroup of overweight children did not differ significantly between IG and CG (table 2).

Cumulated water flow of the fountains in the intervention schools showed a positive linear time trend over the whole intervention period, indicating a constant consumption level (correlation coefficient r = 0.99, p < 0.001).

Mean self-reported water consumption increased from baseline to follow-up by 1.2 glasses/day in the IG (p < 0.001) whereas mean consumption of soft drinks/juices decreased by 0.2 glasses/day (p = 0.019). In contrast, neither water consumption nor consumption of soft drinks/juices changed sig-
Significantly from baseline to follow-up in the CG, indicated by a difference of 0.0 glasses/day in both beverage categories (p = 0.576 and p = 0.670, respectively).

Discussion

In the present analysis of a randomized controlled cluster trial, we could demonstrate that a school-based intervention solely focusing on the promotion of water consumption was effective for decreasing the incidence of overweight. Behavioral modifications by this dietary intervention for primary prevention of overweight were indicated by an improvement in the beverage consumption of the school children.

Although the number of published trials on the prevention of obesity in children has increased in recent years, there is still not enough evidence for one particular program to be effective [2, 12]. However, the review of interventions showed that the targeting of the drinking habits seems to be a promising approach in the prevention of childhood overweight [13, 14]. Recently, 2 randomized controlled trials with interventions to reduce the consumption of soft drinks had at least partly a beneficial effect on the body weight status of children [4] and adolescents [3]. However, the trial that focused on educational measures failed to be effective in the long term [15]. The other trial applied environmental and educational interventions that were highly intensive [3] and therefore hardly feasible for primary prevention in a deprived population.

Our dietary intervention reduced the overall risk for overweight [5] and, as demonstrated here, was effective in reducing the incidence of overweight but did not affect remission of overweight or obesity. This primary prevention approach was directed to the entire population independent of body weight status. Thus, it was not expected to have a therapeutic effect in already obese or overweight children. This result supports the primary aim of the intervention to counteract the increase in prevalence of overweight in the public health context. For this purpose, the feasibility of the intervention in the school setting is of special importance. Results of the process evaluation of the intervention trial, indicating a good compliance of the teachers [5], point to a sustainable integration of the intervention in schools.

Elementary schools are an ideal setting for primary prevention since the development of health-related behaviors is determined in these age groups [14]. Furthermore, this age period is significant in the development of overweight as prevalence rates increase from 9% in preschool children to 19% in secondary school children aged 11–13 years in Germany [16], underlining the relevance of prevention in this age group. Our intervention reduced the incidence of overweight in this age group and may therefore serve as one effective measure for the prevention of overweight. In contrast, the missing effect on the remission of overweight showed that the intervention could not be used for the treatment of overweight.

As a methodological limitation, the randomization at city level has to be mentioned. Intervention and control schools were located in different cities to minimize treatment contamination but that might have resulted in regional differences between the groups. However, schools were located in districts selected by the same socio-demographic criteria resulting in similar baseline characteristics of the participants in the IG and CG.

From a public health perspective, it is of particular importance that this preventive intervention was effective among children from socially deprived neighborhoods implying a lower socio-economic background. This population group has an increased risk of overweight and obesity [16, 17] and, furthermore, a low socio-economic status seems to serve as a barrier to traditional, behavioral interventions [18, 19]. A reason for the success of our intervention even in this population group might be the environmental intervention approach that was independent from external support, e.g. of parents or study staff. Experts' suggestion that prevention programs should consider the environmental intervention approach in addition to individual behavioral changes [2, 14] is supported by our results.

Disclosure

The authors declared no conflict of interest.

Table 2. Incidence and remission rates of overweight and obesity during the follow-up period in the intervention group (IG) and control group (CG)

<table>
<thead>
<tr>
<th></th>
<th>IG</th>
<th>CG</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td><strong>Incidence rate, % (n)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>3.8 (48)</td>
<td>6.0 (58)</td>
<td>0.018</td>
</tr>
<tr>
<td>Obesity</td>
<td>7.1 (20)</td>
<td>5.2 (12)</td>
<td>0.390</td>
</tr>
<tr>
<td><strong>Remission rate, % (n)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>16.7 (47)</td>
<td>14.4 (33)</td>
<td>0.485</td>
</tr>
<tr>
<td>Obesity</td>
<td>21.6 (22)</td>
<td>15.5 (17)</td>
<td>0.251</td>
</tr>
</tbody>
</table>

According to the International Obesity Taskforce [9]. p values obtained using chi-square test for group differences.
References


