Effectiveness of a Multidisciplinary Lifestyle Intervention to Reduce Obesity among Children and Adolescents
Md. Rizwanul Ahsan1, Sabrina Makbul2, Probir Kumar Sarkar3

Abstract:

Background: Nowadays unhealthy lifestyle primarily responsible for the dramatic increase in obesity among children and adolescents.

Objective: The purpose of the study is to see the effects of a multidisciplinary lifestyle intervention to reduce obese children and adolescents. The main outcome was cardiometabolic risk based on the waist-to-height ratio (WHTR) measurement. Secondary outcomes were (1) changes in body composition; (2) adherence to a Mediterranean diet; and (3) physical performance.

Methods: The study involved 64 overweight/obese children or adolescents conducted at Dhaka Shishu Hospital from October 2017 to September 2018. The intervention was multidisciplinary including nutrition, exercise, and psychological aspects based on a family-based approach; it was delivered for six months for children and three months for adolescents. Before and after the intervention, several anthropometric measures height, body weight, body mass index (BMI), waist circumference, and body composition, cardiometabolic risk index waist-to-height ratio (WHTR), and dietary habits of the participants and their families were evaluated. In addition, a set of functional motor fitness tests was performed to evaluate physical performance measures.

Results: After the intervention both children and adolescents showed a significant reduction in body weight, BMI, waist circumference, fat mass, and WHTR index and an improvement of fat-free mass, adherence to the Mediterranean diet, and physical fitness performance.

Conclusion: A short term family-based multidisciplinary approach is effective in ameliorating the health status, dietary habits, and physical performance in children and adolescents.

Key words: Lifestyle intervention, obesity, children, adolescents.

Introduction
The lack of physical activity (PA) or low levels of PA and sedentary habits with overeating/unhealthy eating are the most causes of the increase obesity.1-4 More specifically, nutrition education efforts should be directed towards children to establish healthy eating habits that will have beneficial effects in adulthood. Perhaps children and adolescent

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populations are those with the most deteriorated Mediterranean diet profile, and thus are worthy of priority attention. Obesity is a multifactorial disease, the product of the complex interaction of genetic, hormonal, physical, nutritional, social, and environmental factors. Overweight and obesity are growing in childhood and adolescence all over the world. In 2014 the World Health Organization (WHO) estimated more than 41 million overweight children under the age of five. European data show that the prevalence of overweight ranged from 18% to 57% among boys and from 18% to 50% among girls; 6-31% of boys and 5-21% of girls are obese. Childhood obesity is a risk factor for adult noncommunicable diseases (NCDs) and represents a health care cost for society. For these reasons childhood obesity is one of the most serious public health problems in our time and a new challenge. Studies show that sedentary behaviors independent of physical activity levels are associated with increased risk of all-cause mortality and psychological problems. So, the promotion of physical activity among children and adolescents is considered a strategic way to tackle childhood obesity. Physical activity habits is necessary to develop in early life and persisting into adulthood. The prevention and treatment of childhood obesity is complex and requires a multicomponent approach involving the family and addressing individual and social aspects, focusing not only on physical activity but also on nutrition and enhancing motivation toward a healthy lifestyle. As adolescents become more autonomous from their parents they look more to their friends for behavioral and social cues. The family-based approach was defined as the “gold standard” treatment. As suggested by Kitzman et al the use of a family-oriented approach to pediatric treatment of obesity can be defined as the active involvement of parents in the treatment of overweight and obesity in children. Family, in particular parents, has been consistently and strongly linked with children’s physical activity and sports involvement.

Materials and Methods
Total number of 64 children and adolescents subjects with obesity were recruited at Institute of the Dhaka Shishu Hospital, Sher-E-Bangla Nagar, Dhaka from March October 2017 to September 2018. The total sample was divided into two subgroups by age: the children group (n=38, age 3-12 yrs.) and the adolescent group (n=26, age 13-14 yrs.). In the children’s group (57.9% male and 42.1% female) there was a mean age of 9.79 ± 1.8 years (min 5-max 12), with no differences for gender, while in the adolescent group (38.5% male and 61.5% female) there was a mean group age of 13.72 ± 0.41 (min 13-max 14), with no differences for gender. Children were evaluated at the Pediatric Clinic of the local hospital and those who met the inclusion criteria were referred to Dhaka Shishu Hospital, Sher-e-Bangla Nagar, Dhaka. At the first visit patients were assessed for the anthropometric values. Inclusion criteria for the enrollment were BMI over 85 percentile, the absence of contraindications to perform physical exercise, and parents’ informed written consent to the lifestyle intervention. The intervention followed the Centro Universitario Ricerca Interdepartmentale Attivita Motorica (C.U.R.I.A.Mo) lifestyle approach for children and adolescents (approved by the Dhaka Shishu (Children) Hospital), a multidisciplinary structured program including the nutritional intervention, the exercise intervention, and the psychological intervention. All participants followed the three different parts of intervention described later. The 9% of the total sample recruited (4 children) did not start the program because they were still engaged in other sports activities or due to family difficulties in managing the timetable of the activities. Parents’ work difficulties were cited as the main barriers to participation. The sample size was calculated based on WHTR endpoint as a main predictor of cardiometabolic risk. A sample size of 74 achieves 89% power to detect a mean of paired differences of 3% with an estimated standard deviation of differences of 8% and with a significance level (alpha) of 0.05 using a two-sided paired t-test. Descriptive analysis in terms of mean, standard deviation, and percentages were computed for the variables investigated. Student’s t-test for paired sample was used to compare all assessment measures (anthropometry, dietary habits, and physical activity) before and after intervention (T0-T1). Analyses were limited to participants with baseline data on the different measurements and performed using SPSS, version 22.0.
Results
Anthropometric data at the baseline and after the intervention are reported in Table I for the children’s group and in Table II for the adolescent group. In children group after the intervention (T1) data showed a significant decrease in all the measures. BMI (p<0.001), waist circumference (p=0.003), and WHTR index (p<0.001) showed a significant reduction with a small effect size. Regarding body composition (subgroup of 33) data showed a significant decrease with a large effect size of percentage for fat body mass (p <0.001) and a significant increase in percentage of fat-free mass with a medium effect size (p=0.004) (Table I).
In Adolescents group after the three months intervention adolescents showed a significant decrease in waist circumference (p= 0.012). The subgroup (N=23) assessed with BOD POD showed a reduction of fat body mass percentage (p=0.001) with a medium effect size and an increase of fat-free mass (p=0.004) (Table II).

<table>
<thead>
<tr>
<th>Table I</th>
<th>Children’s anthropometric measure at T0-T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropometric data</td>
<td>T0</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.65±2.41</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>90.36±8.46</td>
</tr>
<tr>
<td>WTHR (cm)</td>
<td>0.58 ± 0.03</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>24.01 ± 6.32</td>
</tr>
<tr>
<td>FM (%)</td>
<td>40.98± 7.57</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>35.66 ± 6.23</td>
</tr>
<tr>
<td>FFM (%)</td>
<td>61.45 ± 5.40</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD. Statistical significance was considered at p <0.05; BMI = Body mass index; WC = waist circumference; WHTR = waist to height ratio; FM = fat body mass; FFM = fat-free mass.

<table>
<thead>
<tr>
<th>Table II</th>
<th>Adolescent’s anthropometric measure at T0 and T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropometric data</td>
<td>T0</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>31.93 ±4.31</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>105.85 ± 10.63</td>
</tr>
<tr>
<td>WHTR (cm)</td>
<td>0.65 ± 0.08</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>36.74 ± 10.45</td>
</tr>
<tr>
<td>FM (%)</td>
<td>40.51 ± 6.82</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>51.21 ± 7.17</td>
</tr>
<tr>
<td>FFM (%)</td>
<td>59.45 ± 7.28</td>
</tr>
</tbody>
</table>

Statistical significance was considered at p<0.05; BMI=body mass index; WC=waist circumference; WHTR=waist to height ratio; FM=fat body mass; FFM=fat-free mass.
Children showed a significant improvement in KIDMED scores with a medium effect size (t=-3.33; p=.002) from T0 =6.73 2.27 to T1=7.93±1.74.
Adolescents showed a significant improvement in KIDMED scores with a large effect size (t=-5.94; p <0.001) from T0=5.68±2.76 to T1 8.39±2.42.
As reported in Table III, the mean distance walked within six minutes increased (A=37.03±144.03) after three months of exercise, with no statistical difference between two times of evaluation.

Strength values were raised, as expected, in response to the progressive work load proposed during the exercise period. The data showed a significant increase with a medium effect size in ball throw (p<0.001 and p<0.001). The sprint time of the 30 m test improved significantly, with a large effect size (p<0.001). Finally, flexibility improved only the bending test results from the seating position (p=0.05) with a small effect size.

As shown in Table IV, maximal oxygen consumption (VO₂ max) increased (A=0.48±4.53) after three months of exercise, with no statistical difference between two tests. In strength values there was a significant increase with a large effect size in every exercise at the isotonic machine (except in a leg press test that presented p<0.001), while the flexibility value improved only in bending test from standing position with a small effect size (p=0.025).

### Table III

*Children’s physical activity measurement at T0 and T1*

<table>
<thead>
<tr>
<th>Children’s physical activity measurement</th>
<th>T0</th>
<th>T1</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 MinWT (cm)</td>
<td>678.91 ± 87.5</td>
<td>715.2 ± 154.8</td>
<td>0.105</td>
</tr>
<tr>
<td>Ball TA (cm)</td>
<td>4.61 ± 0.75</td>
<td>5.07 ± 0.87</td>
<td>0.002</td>
</tr>
<tr>
<td>Ball TB (cm)</td>
<td>4.69 ±1.03</td>
<td>5.56 ± 1.32</td>
<td>0.001</td>
</tr>
<tr>
<td>30 m sprint (s)</td>
<td>7.25 ± 0.78</td>
<td>6.36 ± 0.81</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>VB (cm)</td>
<td>-3.12 ± 7.31</td>
<td>-2.21 ±7.81</td>
<td>0.497</td>
</tr>
<tr>
<td>HB (cm)</td>
<td>31.68 ± 8.87</td>
<td>33.21 ± 7.87</td>
<td>0.304</td>
</tr>
<tr>
<td>Sargent (cm)</td>
<td>23.11 ± 5.42</td>
<td>26.58± 7.02</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD. Statistical significance was considered at p<0.05; 6 MinWT = six minutes’ walking test; ball TA = medicine ball throw ahead; ball TB = medicine ball throw behind; 30 m sprint = 30 metres’ speed test; VB = vertical bending value at sit and reach test, HB = horizontal bending values at sit and reach test; Sargent = Sargent Test Value.

### Table IV

*Adolescents physical activity measure of the adolescents (13-14) at T0 and T1 of the intervention*

<table>
<thead>
<tr>
<th>Adolescents physical activity measurement</th>
<th>T0</th>
<th>T1</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO₂ max (ml/kg/min)</td>
<td>31.20± 7.25</td>
<td>31.32 ± 6.9</td>
<td>0.923</td>
</tr>
<tr>
<td>Lat (kg)</td>
<td>35.74 ± 7.85</td>
<td>43.28 ± 8.96</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chest (kg)</td>
<td>31.12 ± 7.63</td>
<td>39.21 ±9.36</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Press (kg)</td>
<td>177.12 ± 51.21</td>
<td>214.91 ± 45.01</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lext (kg)</td>
<td>41.21± 11.02</td>
<td>51.93 ± 10.74</td>
<td>.000</td>
</tr>
<tr>
<td>VB (cm)</td>
<td>-6.81 ± 7.28</td>
<td>-4.17 ± 6.87</td>
<td>0.037</td>
</tr>
<tr>
<td>HB (cm)</td>
<td>30.21 ± 8.87</td>
<td>31.02 ± 9.41</td>
<td>0.617</td>
</tr>
</tbody>
</table>

Data are presented as mean±SD. Statistical significance was considered at p<0.05; VO₂ max=maximum rate of oxygen (O₂) consumption; Lat=Lat machine test value; chest=chest press test value; press=leg press test value; Lext=leg extension test value; VB=vertical bending value at sit and reach test, HB=horizontal bending values at sit and reach test.
Discussion
The aim of the present study was to investigate the effects of a multidisciplinary family-based lifestyle intervention to treat overweight/obese children and adolescents. The first results of our structured intervention demonstrate effectiveness in reducing the cardiometabolic risk through a significant reduction of WHTR and changes in body composition. The structured multidisciplinary intervention shows changes in nutritional habits (greater adherence to Mediterranean diet) and improvements in physical performance. Many studies showed significant positive effects of physical activity in favor of the intervention.

The results of this study seem to be able to show how a multidisciplinary approach based on the family is effective not only in children but also in the adolescent group, where a significant decrease in waist circumference (p<.001), a significant reduction of fat body mass percentage (p<.001), and a significant decrease in waist circumference (p<.001) and in fat body mass percentage (p<.001) were observed as well as improvement of the nutritional habits (p<.001) and strength parameters. PA attitudes are influenced by individual, social, environmental, and community aspects. Participants with higher perceived peer acceptance, friendship quality, and soccer competence were more likely to continue on with the sport. Family, in particular parents, has been consistently and strongly linked with youth's PA and sport involvement.

Family influences and friend support can act in improving physical activity habits. Children and adolescents are more physically active when in the presence of peers and it is likely that these positive feelings increase the enjoyment and youth motivation to engage in physical activity (PA). Decrease of sedentary behavior showed effective in children in the meta analysis presented by Kamath et al, and in adolescents in the study by Biddle et al. Interestingly, similar conclusions have been drawn for lifestyle interventions in children to reduce obesity. In its recommendations WHO indicates that children and young people aged 5-17 years should accumulate at least 60 minutes of physical activity every day. The present results confirm that this strategy is effective in ameliorating, in the short term (3-6 months), the health status, the nutrition habits, and the physical performance of children and adolescents. In particular, the present data demonstrate that after the intervention the participants significantly reduced BMI, WC, WHTR, and fat mass and improved fat-free mass, adherence to the Mediterranean diet, and physical fitness.

At baseline, the participants in the study did not follow this recommendation. As shown previously in Tables 3 and 4 improvements in (1) dynamic strength; (2) cardiorespiratory efficiency; (3) the speed of the children, and (4) flexibility were observed. In addition, to train aerobic capacity and flexibility resistance training was also included in the exercise intervention. In adolescents cardiovascular activity was presented using ergometers and with gradually increasing work intensity (5% every two weeks) from 50% up to 70-80% of heart rate reserve combined with free loads and work at isotonic machines with a gradual increase from 55% up to 70-80% of 1 repetition maximum (RM), according to an adolescent's basal fitness level. After three months of exercise, data showed that strength values increased, as expected, in response to gradually augmented load used during exercise periods. In particular, relevant changes in the dynamic strength of the upper limbs and trunk and lower extremity strength were observed, with a medium and large effect size.

In adolescents, we tested the effects of the intervention on VO\textsubscript{2} max and did not observe significant changes. As regards flexibility, the existing studies confirm a role for genetic influences on the individual differences but estimates vary widely. 18-55% of the variation in flexibility (as measured by the sit and reach test) in children and young adults could be explained by genetic influences.

Conclusion
Multidisciplinary lifestyle intervention based on a family-based approach, demonstrating that such kind of approach allows obtaining positive results in lifestyle habits changing in not only children but also adolescents groups with obesity, after a short period (3 to 6 months).

References


