Effectiveness of Nutrition and Exercise Counseling Combination on Desirable Dietary Pattern and Weight Loss

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Abstract The prevalence of overweight and obese among teenagers in Jakarta City was recorded at 9.4% and 5.7%, respectively. Overweight and obesity are known conditions that have consequences on the physical, psychological and emotional as well as the risks related to non-communicable diseases. In order to address the problems on overweight and obesity, the study was designed to assess the effect of nutrition education (NE), nutrition counseling (NC), nutrition counseling and exercise (NCE) in changing the desirable dietary pattern (DDP) and weight of overweight and obese teenagers in Jakarta.

Methods: The subjects were 120 students in High School 80 Jakarta who met the criteria of inclusion (with z-score BMI for Age score above 1) and exclusion. The study design was employed a Randomize Control Trial having three intervention groups (NE, NC and NCE) and one control group, each with 30 subjects. Interventions were implemented for two months. Baseline and endline data were obtained through interviews, self-administered questionnaires, anthropometric measurements (weight and height) and 24-hour food recall. Results: Wilcoxon test (α=0.05) showed significant changing in DDP score in NE (pNE=0.012) and NC (pNC=0.000); and weight loss in all three intervention groups (pNE=0.018; pNC=0.003; pNCE=0.004). Compared to Control Group (Mann-Whitney test, α=0.05), NC intervention was the most effective in changing DDP scores (p=0.000) and weight loss (p=0.000).

Conclusion: Nutrition counseling was found the most effective intervention in improving the DDP and in decreasing the weights of overweight and obese subjects. It can be continued through peer counseling model among high school students to prevent obesity in teenagers.

Keywords: teenager, overweight, obese, nutrition counseling, nutrition education


1. Introduction

Adolescence is a period of rapid change in physical, cognitive, and psychosocial growth. This period is a transition from children to adolescents which is marked by many changes, including the increase in muscle mass, body fat tissue, and hormonal changes [1]. Teenagers are adolescents who aged 13 – 19 years. Psychosocial development in adolescents has a direct influence on the type of food and drinks to be consumed. Selection of adolescent food is usually based on taste, price, and habits of surrounding friends without considering its effects on health [1].

Nutritional status is the health condition of a person’s body or group of people caused by consumption (absorption), and use of food nutrients in the body. Imbalance in food supply causes problems in fulfilling nutrition, namely the problem of undernutrition and the problem of overnutrition [2]. In 2016, World Health Organization reported that prevalence of overweight and obesity among children and teenagers aged 5 – 19 was 18% [3]. World Obesity Federation reported prevalence of overweight and obese children and teenagers in various countries, namely: 39.3% among 11-15 years old in England (2019); 38.4% among 12-19 years old in Mexico (2018); 11.5% for 11-14 years old in Vietnam (2018); and 9.1% for 11-19 years old in the Philippines (2015) [4]. In Indonesia, the prevalence of obese teenagers (13 – 18 years old) was 18.1% in 2013 [5] and increased in 2018 to 29.5% [6].

Teenage obesity can increase the risk of non-communicable diseases such as type 2 diabetes mellitus, hypertension, cardiovascular disease, digestive disorders, and respiratory disorders [7,8,9]. Untreated teenage obesity can have long term effects during adulthood in terms of its impact on difficulty in walking, performing activities and severe orthopedic complications [7,8]. Psychologically, obesity can cause depression, anxiety disorders, eating disorders, and social isolation [7,9].
Nutritional problems are caused more by energy input than energy release. Previous studies mentioned several factors of teenage obesity include in terms of diet such as excessive food intake [10], frequent consumption of high calorie density food and/or drink [7,11], increased consumption of sugar sweetened beverages, fast food, and junk food [9,12]. Study in Saudi Arabia showed that overweight and obesity status was significantly associated with consumption of sugar-sweetened drink on 3 – 4 days per week [13]. Lifestyle factors that can cause obesity include lack of physical activity [9,10] and sedentary behavior or activities that do not require a lot of movement such as watching TV, using computers, playing video games [7,9,11]. Obesity can also occurred because of psychological aspect which is eating disorders [9].

Teenage obesity treatment needs a multi-disciplinary approach. From the dietary aspect, it is recommended for obese teenagers to modify their diet, avoid consumption of calorie-dense and nutrient-poor foods, and increase the consumption of fruit and vegetable [7,9,14]. From physical activities aspect, obese teenagers encouraged to do 20 – 50 minutes of physical activities each day for at least 5 days per week [9] and reduce screen time or sedentary behavior [7,14]. Sientia's study (2012) showed that there was a significant difference between the effect of physical activity on changes in participant's body weight before and after participating in physical activity (aerobic exercise) for 12 weeks [15].

Overcoming the problem of being overweight is to balance energy input and output through reducing food and adding physical exercise or sports and avoiding life stress [16]. One of the things that can be done to change a person’s behavior is through nutritional counseling [17]. Counseling is a form of approach used in nutrition care to help individuals and families gain a better understanding of themselves and the problems they face. After counseling, it is hoped that individuals and families will be able to take steps to overcome nutritional problems including changes in diet and solving nutrition-related problems towards healthy living habits [18]. A study in Korea showed that there was a tendency of decrease in weight, body fat percentage, BMI, and energy intake after 10-week nutrition counseling program [19]. A study in Indonesia showed a significant change in average energy, fiber, and fat intake after being given counseling using leaflet and booklet [12]. Counseling and magazine distribution to teenagers in Brazil for 6 months got results significantly improved breakfast habits and consumption of fruit and vegetables [20] while the effect of nutrition education intervention models on obese and physical exercise for 6 months obtained results to significantly improve academic performance, body mass index and breakfast habits [20]. This study aimed to assess the effects of nutrition education; nutritional counseling; and nutrition counseling with nutrition in changing the Desirable Dietary Pattern (DDP) and body weight in teenagers in Jakarta.

2. Material and Methods

The study was conducted in one high school in Jakarta before the pandemic using a Randomize Control Trial (RCT) design with three (3) treatment groups and one (1) control group. Each group consisted of 30 randomly selected overweight teenagers. Inclusion criteria for the subjects were aged 14-18 years; Body Mass Index by Age Z-Score greater than one; not diagnosed as having poor mental or emotional status; and willingness to participate in the study. The study excluded students who were currently in a special diet program; sick during intervention; having abnormal bone structure, and who refused to participate during data collection. Considering fasting holidays, Eid holidays and semestral breaks, the intervention (treatment) was carried out for a total of 4 months from April to May and July to August 2018. The interventions provided were: 1) nutrition education (NE), 2) nutrition counseling (NC), and 3) nutrition counseling and exercise (NCE), and control group (see Figure 1).

Instruments and tools used were interview questionnaire, 24-hour food recall questionnaire, digital weighing scales with a capacity of 150 kg and an accuracy of 0.1 kg, and a height measuring instrument (microtoise) with a capacity of 200 cm and an accuracy of 0.1 kg. All tools were validated and calibrated before use. Data collected include respondent characteristics (age and gender), anthropometric (body weight and height), and 24-hours-food intakes for 2 consecutive days. All data were collected before and after the intervention. Nutrition status was determined by processing anthropometric, age and gender data using the WHO 2007 standard [21]. Food Recall data was processed using Nutrisurvey. DDP Score calculation was based on the references of food security agency 2016 [22]. Data analysis was performed descriptively and statistically using Wilcoxon, Kruskal Wallis, and Mann-Whitney tests.

3. Results

3.1. Characteristic of Teenagers

A total of 120 overweight and obese teenagers (13-18 years old) were involved in this study. The subjects had an average height of 159.90 ± 8.25 cm (min 144.0 – max 177.9); weight of 72.88 ± 14.45 kg (min 52.4 – max

![Figure 1. Sampling Profile](Image)

Population
BMI by age Screening
z-score > 1
Inclusion & exclusion criteria
Referred to be the subject of research
8 students
SR
G1:NE 30
G2:NC 30
G3:NCS 30
G4:CG 30
Eligible: 120 students
G1:NE 30
G2:NC 30
G3:NCS 30
G4:CG 30
536 students
369 students
128 students

G2:NC
G3:NCS
G4:CG
8 students

G3:NCS
G4:CG
30

3.2. Energy and Macronutrient Intake

The average energy and macronutrient intake of teenagers before and after interventions is shown in Table 1. A decrease in energy, protein, fat, and carbohydrate intake of overweight and obese teenagers after the interventions ranged from 4.4% to 31.9%. Overweight and obese teenagers following the nutrition counseling and exercise (NCE) intervention, had the highest percent change in fat (31.9%), protein (30.5%), and energy (17.1%) intake. Those who received nutrition counseling recorded the highest percent change of 15.4% in carbohydrate intake. On the other hand, the subjects with no intervention had an increase in energy by 11.7%, protein by 4.2% and carbohydrate by 16.8%. For the control group, fat intake decreased by 1.6%.

3.3. Desirable Dietary Pattern (DDP)

Based on the Wilcoxon test, there was a significant difference between DDP scores before and after intervention for NC, NE, and CG ($p<0.05$). The DDP scores of all the study groups before intervention were below the total standard DDP score of 100. After intervention, the NC and NE groups increased DDP scores above the standard (NC = 109.57, NE = 100.85). The results showed that the NC group had a higher food consumption quality compared to the other groups as indicated by the highest DDP score (109.57) in Figure 2.

Based on the DDP score in the Food Material Group (Figure 3), the animal product and the fat and oil food groups exceeded the standard DDP scores in all study groups before and after intervention. Cereal was still at normal limits, while the nuts & oil seeds, pulses, beans & soy beans, and fruits and vegetables food group were far below the standards. Nevertheless, results showed that DDP scores for cereals and fruits and vegetables of NC and NCE group increased after intervention.

<table>
<thead>
<tr>
<th>Group</th>
<th>Energy and Macronutrients</th>
<th>Before Intervention</th>
<th>After Intervention</th>
<th>Percentage change in intake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. Energy (kkal)</td>
<td>1469 ± 656</td>
<td>1278 ± 304</td>
<td>13.0</td>
</tr>
<tr>
<td>NE</td>
<td>b. Protein (gr)</td>
<td>45 ± 32</td>
<td>41 ± 11</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td>c. Fat (gr)</td>
<td>56 ± 42</td>
<td>46 ± 16</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>d. Carbohydrate (gr)</td>
<td>183 ± 75</td>
<td>364 ± 166</td>
<td>4.4</td>
</tr>
<tr>
<td>NC</td>
<td>a. Energy (kkal)</td>
<td>1586 ± 629</td>
<td>1332 ± 275</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td>b. Protein (gr)</td>
<td>49 ± 23</td>
<td>46 ± 14</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>c. Fat (gr)</td>
<td>58 ± 31</td>
<td>50 ± 22</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>d. Carbohydrate (gr)</td>
<td>208 ± 91</td>
<td>176 ± 34</td>
<td>15.4</td>
</tr>
<tr>
<td>NCE</td>
<td>a. Energy (kkal)</td>
<td>1646 ± 657</td>
<td>1364 ± 247</td>
<td>17.1</td>
</tr>
<tr>
<td></td>
<td>b. Protein (gr)</td>
<td>59 ± 42</td>
<td>41 ± 12</td>
<td>30.5</td>
</tr>
<tr>
<td></td>
<td>c. Fat (gr)</td>
<td>69 ± 33</td>
<td>47 ± 16</td>
<td>31.9</td>
</tr>
<tr>
<td></td>
<td>d. Carbohydrate (gr)</td>
<td>204 ± 81</td>
<td>195 ± 42</td>
<td>4.4</td>
</tr>
<tr>
<td>CG</td>
<td>a. Energy (kkal)</td>
<td>1550 ± 600</td>
<td>1732 ± 411</td>
<td>-11.7</td>
</tr>
<tr>
<td></td>
<td>b. Protein (gr)</td>
<td>48 ± 27</td>
<td>50 ± 12</td>
<td>-4.2</td>
</tr>
<tr>
<td></td>
<td>c. Fat (gr)</td>
<td>63 ± 35</td>
<td>62 ± 21</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>d. Carbohydrate (gr)</td>
<td>196 ± 82</td>
<td>229 ± 56</td>
<td>-16.8</td>
</tr>
</tbody>
</table>

Figure 2. Mean of Desirable Dietary Pattern (DDP*)

Table 1. Average energy intake and macronutrients before and after intervention.
Figure 3. DDP Scores of Teenagers Food Consumption; (A) Cereals; (B) Roots and tubers; (C) Sweetener; (D) Animal product; (E) Added fats and oil; (F) Nuts and oilseeds; (G) Pulses, beans, and soybeans; (H) Fruit and vegetable
Table 2. Changes in the desirable dietary pattern score* and body weights of the subjects per intervention.

<table>
<thead>
<tr>
<th>Group intervention</th>
<th>n</th>
<th>Mean Rank</th>
<th>df</th>
<th>Chi-Square</th>
<th>P value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDP Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. NE</td>
<td>30</td>
<td>70.42</td>
<td>3</td>
<td>16.24</td>
<td>0.001</td>
</tr>
<tr>
<td>2. NC</td>
<td>30</td>
<td>74.92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. NCE</td>
<td>30</td>
<td>53.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CG</td>
<td>30</td>
<td>43.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. NE</td>
<td>30</td>
<td>65.18</td>
<td>3</td>
<td>21.90</td>
<td>0.000</td>
</tr>
<tr>
<td>2. NC</td>
<td>30</td>
<td>66.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. NCE</td>
<td>30</td>
<td>74.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CG</td>
<td>30</td>
<td>35.57</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indonesian DDP (BKP, 2013)
**Kruskal–Wallis test, α = 0.05.

Table 3. Comparison of the changes in DDP scores between intervention groups and control group

<table>
<thead>
<tr>
<th>Intervention Groups</th>
<th>Z value</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDP Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NE – CG</td>
<td>-2.84</td>
<td>0.005</td>
</tr>
<tr>
<td>NC – CG</td>
<td>-3.35</td>
<td>0.000</td>
</tr>
<tr>
<td>NCE – CG</td>
<td>-1.29</td>
<td>0.200</td>
</tr>
<tr>
<td>Body Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NE – CG</td>
<td>-3.39</td>
<td>0.001</td>
</tr>
<tr>
<td>NC – CG</td>
<td>-3.65</td>
<td>0.000</td>
</tr>
<tr>
<td>NCE – CG</td>
<td>-4.01</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Mann-Whitney test, α=0.05.

Statistically, there was a significant difference between the mean rank of DDP scores between different interventions as determined by Kruskal-Wallis test (p=0.001). The mean rank was highest in the NC group (M=74.92) (Table 2). There was also a statistically significant difference between the average DDP of NC group (p<0.001) and NE group (p=0.005) compared to those without intervention as determined by Mann-Whitney test. The results indicated that NC was the most effective intervention that had significant effect in changing DDP scores (Table 3).

3.4. Changes in Body Weight

The result of Wilcoxon test in Figure 4 showed that there is a significant decrease from the subjects’ average baseline body weight to average end line body weight following the NC (p = 0.003), NE (p=0.018) and NCE (p = 0.004) interventions. The mean weight of the subjects decreased after the interventions by 1.72 kg for NC, 1.71 kg for NE and 1.65 kg for NCE. Figure 3 also shows that changes in body weight of teenagers decreased for the NC, NE and NCE groups from baseline to endline weights. For the CG, an increased in weight was noted from 73.9 kg at baseline to 75.4 kg at endline. There was also a significant difference between the mean rank of weight change between different interventions as determined by Kruskal-Wallis test (p=0.001). The mean rank was highest in the NCE group (M=65.18), followed by NC group (M=66.47) then NE (M=74.78). Based on the result of Mann-Whitney test, there was a significant difference between the average body weight of overweight and obese teenagers in NC, NCE, and NE groups compared to the group without intervention (p<0.001).

![Figure 4. Graph of Changes in Body Weight](image)
4. Discussion

The intake of energy and macronutrients in teenagers is still in compliance with the Indonesian Recommended Dietary Allowance. However, the composition of the nutrients to the total energy is not in accordance with the principles of balanced nutrition, especially in fat consumption. There was a decrease in the percentage of fat intake to the total energy in four groups. However, it does not fulfill the principle of balances nutrition which should range from 20-15%, while the finding is still above 30%. High intake of fat in teenagers can increase the risk of obesity [23,24].

The findings on DDP score by food material group (Figure 3D and 3E) were consistent with the previous studies in Indonesia [23,24,25] where in obese teenagers have excess protein and fat intake. Moreover, the limited intake of fruits and vegetable among the subjects before the interventions were similar to the findings of Hermina and Prihatini S. (2014), Wuriyaningrum (2020), and Ochola et al. as stated by Isabirye (2020) which stated that fruits and vegetables are the least consumed food group by teenagers in Indonesia, particularly in rural areas [26,27,28]. An increase in the DDP score of NC and NCE group and an increase in fruits and vegetable intakes after intervention indicated improved quality of diets among teenagers.

Giving counseling interventions alone or in combination with exercise provided better results in teenager weight loss (Figure 4). In the study of Neumark-Sztainer (2008), important components of a dietary intervention for healthy weight management among teenagers include group education, personal and individual sessions, availability of healthy options, and family involvement [29]. Similar results on the importance of education and individual session through nutrition counseling are found in this study as evidenced by higher mean weight change among NC and NCE group before and after intervention, higher mean rank between different interventions, and a significant difference in average body weight of NC and NCE group compared to the control group.

Study in Indonesia showed a similar result, there was a decrease of body weight in group that received nutrition education and physical activities treatment (56.95±6.38 kg to 56.24±6.38 kg) [30]. Kim, et., al. also showed a body weight decrease of 0.7 kg in men and 2.6 kg in women after a weekly nutritional counseling for 10 weeks [19].

5. Conclusion

Nutrition counseling was found the most effective intervention in changing desirable dietary pattern of overweight and obese teenagers in Jakarta. Effective interventions in reducing weight of overweight and obese teenagers were nutrition counseling (NC) and nutrition counseling with exercise (NCE). Research needs to be carried out targeting younger age groups (junior high school students) and with a duration of at least 6 months.

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