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Research Article

Effect of Nutritional Education on Nutrition Knowledge and Dietary Behavior in Overweight and Obese Children

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Abstract: The aim of the present study was to explore the effect of nutrition and health education combined with exercise intervention on nutrition knowledge and dietary intake attitudes in overweight and obesity children. A self-controlled experimental design was adopted in this study and 78 overweight and obese children come from two primary schools were voluntarily participated in this study and their parents gave written agreement. The results indicated that (1) Nutrition education programs and exercise intervention can significantly reduce the body weight, BMI and waist circumference and help the body height growth in the overweight and obese children, however this change required a long-term process; (2) Nutrition education improve the nutrition knowledge of overweight obese children and deepen understanding of food nutrients; and (3) Nutrition education intervention can also change the dietary intake attitude and behavior in overweight and obese children, therefore to control body weight and achieve the target of weight reduction. The findings revealed that the nutrition and health education combined with exercise intervention on the regulation of body weight and morphology in obese children have a positive effect, increase the nutrition knowledge, improve eating behaviors and beneficial to develop good exercise habits.

Keywords: Dietary behavior, exercise therapy, nutrition knowledge, obese children

INTRODUCTION

Childhood obesity has become a global public health issue which became more severe in recent 10 years. WHO (World Health Organization) (year) estimated that there were about 200 million overweight children under 5 years old in 2005 and this figure increased to 220 million in 2007 and is expected to reach 300 million in 2015 (Gidding *et al*., 2004). Obesity has great influence on children's development and childhood obesity can directly affect their growth and psychosocial development and even will cause hyperlipidemia, hypertension, diabetes and arteriosclerosis, etc. in adulthood and increase the morbidity and mortality rate of relevant chronic diseases after adulthood (Zhao *et al*., 2009; Xu, 2009). Chu (2001) and other studies show that, the obese group (adult or child) have higher blood pressure, blood glucose and blood triglyceride and lower high density lipoprotein cholesterol compared with the group with normal weight, thus, the prevention and treatment of obesity should be implemented from early childhood. Hedley *et al*. (2004) and other studies show that: the prevalence of overweight schoolchildren of 6-19 years old in America is 16%, while the prevalence of overweight schoolchildren of 4-18 years old and the obese group in England are about 15.4 and 4.0% respectively. Baur (2002) study shows that: one in five children and adolescents are suffering from overweight or obesity. The data of the (Chinese Center for Disease Control and Prevention, year) indicated that: the obesity group under 18 years old in China reached 120 million, of which 12% is overweight children and the percentage of adolescent with diabetes in China is equivalent to four times of that in America.

It is reported in related documents (Qiu *et al*., 2009; Zhou *et al*., 2009) that: the children in China have a poor dietary habit, they absorb high calorie, protein, grease and saccharides but insufficient dietary fiber, calcium and iron supplements and the poor dietary habits include dietary bias, dining out, eating snacks and sweets and drinking sugared beverages. Many studies (Liu *et al*., 2008; Yang *et al*., 2009) show that: people's lifestyle, dietary and exercise habits are gradually formed during childhood and basically fixed during adulthood. The poor habit is hard to change even though it is detrimental to one's health, it is thus suggested to form nutrition education and exercise habit as early as possible, so as to establish good dietary and exercise habit and avoid chronic disease. However, the

physical activities of adolescents in most countries so far has reduced gradually and there may be less than one third of the adolescents in the world having enough physical activities (Jebb *et al*., 2004). Thus, the Study will discuss the effect of nutrition education and sports courses' short-term weight control and long-term maintenance for overweight and obese children as well as the influence of nutrition education on nutrition knowledge and dietary attitude.

MATERIALS AND METHODS

Materials:

Subjects: 78 overweight and obese children (Grade 3, Grade 4 and Grade 5 of Chaoyang Primary School and Elementary School Attached Southwest University at Beibei Chongqing) who are voluntary and with the written consent of their parents joined this study in September 2013.

Questionnaire method:

- The study design of pre-test and post-test accompanied by nutrition education and physical fitness activities are adopted and the questionnaire about nutrition knowledge and dietary behavior attitude will be carried out before the first nutrition education course.
- According to the requirements of the Study, the questionnaire items are prepared based on the studies of several scholars and in combination of corresponding teaching materials and relevant reference materials. 10 questions are respectively set for nutrition knowledge and dietary attitude, of which the questions about nutrition knowledge and dietary attitude are set with "Right/Wrong" and "Agree/Disagree" as the answer options respectively. The higher score the children get, the better nutrition knowledge and dietary attitude they have.
- After the questionnaire was designed, 5 schoolchildren in Grade 5 of primary school modified the questionnaire from the aspect of applicableness of the title and the readability of the text and 6 sport nutrition experts were invited to evaluate the content and face validity of the questionnaire.
- The nutrition education and exercise intervention were from October 2013 to December 2013 (12 weeks in total). In addition to the 4 class/week of physical education regulated by the school, another 1 h of interesting sport directed by the fitness instructor was arranged and 1 time/week of nutrition education course (1 h) is set for nutrition education intervention and the outline of this course was based primarily on the National Student Physical Health Standard published by the Ministry of Education.
- After the end of the 12-week nutrition education course, the questionnaire about nutrition knowledge and dietary attitude was carried out again. Then the follow-up study was implemented for this group of objects every 10 weeks, i.e., the subjects were required to fill the following contents in the healthy life self-management table from the 13^{th}-23^{rd} week: Having breakfast, drinking sugared beverages, eating snacks, eating five fruits and vegetables every day, exercising for more than 30 min, watching TV, playing computer, eating curry rice or beef noodles, etc. and the table would be signed by their parents. If the complete healthy life self-management table was submitted in the end of the 23^{rd} week, then the children would be rewarded. The weight, waist circumference and height of the subjects were measured respectively in the 1^{st}, 12^{th} and 23^{rd} week of the nutrition education course.

Data processing: All data collected from this study were analyzed with SPSS 16.0 for Windows. All significant level was set at $p<0.05$ level.

RESULTS AND DISCUSSION

Results: Analysis of BMI of the subjects before and after the nutrition education and at the end of the follow-up: Table 1 shows that:

- Before the intervention and after 12 weeks of the intervention, there was no difference in the height of the subjects (147.25±2.48 cm vs.148.04±3.15 cm, $p>0.05$), but after the 10-week follow-up, the height increased markedly (increased to 153.14±3.58 cm, Pac*; Pbc*).
- After 10 weeks of the course intervention, the weight of the subjects reduced from 61.44±5.14 to 60.87±3.89 kg, but there was no significant difference ($p>0.05$); after the 10-week follow-up, the weight declined significantly, i.e., the weight fell to 57.56±5.14 kg (Pac*; Pbc*).
- After 12 weeks of the course intervention, there was no significant difference in the Body Mass Index (BMI) of the subjects (28.11±5.1 kg/m^2 vs. 27.78±4.06 kg/m^2, $p>0.05$); but after the 10-week follow-up, the BMI declined to 24.66±3.711 kg/m^2 sharply (Pac*; Pbc*).
- After 12 weeks of the course intervention, the waist circumference of the subjects declined sharply (81.77±5.24 cm vs.75.55±4.13 cm, $p<0.05$), after the 10-week follow-up, the waist circumference continued to decline (to 71.66±5.14 cm; Pab*; Pac*; Pbc*).

Table 1: Difference analysis of physical fitness index among pre-, after-intervention and tracking end

Index	Before (a)	After (b)	Tracking (c)	LSD comparison
Body height (cm)	147.25±2.48	148.04±3.15	153.14±3.58	P_{ab}; P_{ac}^{*}; P_{bc}^{*}
Body weight (kg)	61.44±5.14	60.87±3.89	57.56±5.14	P_{ab}; P_{ac}^{*}; P_{bc}^{*}
BMI (kg/m^2)	28.11±5.19	27.78±4.06	24.66±3.71	P_{ab}; P_{ac}^{*}; P_{bc}^{*}
Waist circumference (cm)	81.77±5.24	75.55±4.13	71.66±5.14	P_{ab}^{*}; P_{ac}^{*}; P_{bc}^{*}

Table 2: Analysis table of nutrition knowledge and dietary attitude

Item	Pre	After	Test
Nutrition knowledge	Correct (%)	Correct (%)	X^2 ; P
1. Missing breakfast occasionally will not influence health.	91.6% (71/78)	98.9% (77/78)	4.74; P = 0.029*
2. One cup of 240cc juice and one bowel of cut fresh fruits contain the same amount of calorie.	65.5% (51/78)	91.6% (71/78)	15.78; P = 0.00*
3. Five fruits and vegetables a day means 2 kinds of fruits and 3 kinds of vegetables shall be taken every day.	85.5% (67/78)	97.5% (76/78)	8.89; P = 0.003*
4. High-calorie sugared beverages are beneficial to growth.	30.7% (24/78)	91.6% (71/78)	11.81; P = 0.000
5. Both milk and soybean milk contain rich protein; therefore they are the same kind of food.	78.8% (61/78)	91.6% (71/78)	4.92; P = 0.026*
6. Balanced diet means that 6 kinds of foods shall be taken every day.	81.1% (63/78)	96.7% (75/78)	10.97; P = 0.001*
7. Exercises are beneficial to body weight control.	98.9% (77/78)	100.0% (78/78)	1.01; P = 0.322
8. One or two meals a day is the most efficient way to lose weight.	97.5% (76/78)	98.9% (77/78)	0.34; P = 0.56
9. Five cereals, root vegetables and carbohydrates are the main food sources.	47.9% (37/78)	75.4% (59/78)	13.12; P = 0.00*
10. Both vegetable and fruit contain rich vitamins and mineral substances, therefore they belong to one kind of food.	15.6% (12/78)	85.8% (67/78)	77.57; P = 0.00*
Dietary attitude			
1. Breakfast can be missed if you get up late for school.	81.6% (64/78)	92.3% (72/78)	3.67; P = 0.055
2. It is not necessary for kids to control weight through diet for obesity at young age will not influence health.	83.8% (65/78)	96.7% (75/78)	6.96; P = 0.008*
3. You can read or watch TV as eating to save time and it is healthy.	91.6% (71/78)	92.2% (72/78)	0.084; P = 0.772
4. Instead of having meal, you can eat whatever you want when you are hungry to prevent getting fat.	81.6% (64/78)	96.7% (75/78)	7.98; P = 0.005*
5. Developing good eating habit since kid helps to keep in shape.	83.8% (65/78)	92.3% (72/78)	2.94; P = 0.087
6. Chewing food more can help you controlling weight.	81.6% (64/78)	96.7% (75/78)	7.98,P = 0.005*
7. To quench thirst, plain boiled water is better than sugared beverages.	72.7% (57/78)	97.5% (76/77)	18.41; P = 0.00*
8. Dinner is the most important meal of the day; therefore, it must be bounteous.	67.8% (53/78)	83.2% (65/78)	5.01; P = 0.025*
9. Eating high salinity, fat and calorie foods often is harmful to health.	93.6% (73/78)	95.6% (74/78)	0.12; P = 0.73
10. Balanced nutrition can also be obtained from snacks.	83.8% (65/78)	93.6% (73/78)	4.02; P = 0.045*

Analysis of difference in changes of nutrition knowledge and dietary attitude of subjects after nutrition education:

Difference comparison of nutrition knowledge: Table 2 shows that: After 12 weeks of nutrition education, there were great changes in the nutrition knowledge of the subjects. Among the 10 questions, the correct rate of 7 questions in post-test was significantly greater than that in the pre-test and the increased rates are listed as follows from high to low: “Both vegetable and fruit contain rich vitamins and mineral substances, therefore they belong to one kind of food”, the correct rate increased from 15.6 to 85.8% (X^2 = 77.57, p = 0.000); “High-calorie sugared beverages are beneficial to growth”, the correct rate increased from 30.7 to 91.6% (X^2 = 11.81, p = 0.000); “Five cereals, root vegetables and carbohydrates are the main food sources”, the correct rate increased from 47.9 to 75.4% (X^2 = 13.12, p = 0.000);“One cup of 240cc juice and one bowel of cut fresh fruits contain the same amount of calorie”, the correct rate increased from 65.5 to 91.6% (X^2 = 15.78, p = 0.000); “Five fruits and vegetables a day means 2 kinds of fruits and 3 kinds of vegetables shall be eaten every day”, the correct rate increased from 85.5 to 97.5% (X^2 = 8.89, p = 0.003); “Balanced diet means that 6 kind of foods shall be taken every day, the correct rate increased from 81.1 to 96.7% (X^2 = 10.97, p = 0.001); “Both milk and soybean milk contain rich protein, therefore they are the same kind of food”, the correct rate increased from 78.8 to 91.6% (X^2 = 4.92, p = 0.026).

Difference comparison of dietary attitudes: There are 10 questions in the test of differences in diet and the correct rate of 6 of which are obviously higher than that of the pre-test and the increased rates are listed as follows from high to low: the correct rate of answering "To quench thirst, plain boiled water is better than sugared beverages. "Increased from 72.7% to 92.5% (X^2 = 18.41, p = 0.000); the correct rate of answering "Chewing food more can help you controlling weight." increased from 81.6 to 96.7% (X^2 = 7.98, p = 0.005); the correct rate of answering "Instead of having meal, you can eat whatever you want when you are hungry to prevent getting fat." increased from 81.6 to 96.7% (X^2 = 7.98, p = 0.005); the correct rate of answering "It is not necessary for kids to control weight through diet for obesity at young age will not influence health." increased from 83.8 to 96.7% (X^2 = 6.96, p = 0.008); the correct rate of answering "Dinner is the most

important meal of the day, therefore, it must be bounteous." increased from 67.8 to 83.2% ($X^2 = 5.05$, $p = 0.025$); the correct rate of answering "Balanced nutrition can also be obtained from snacks." Increased from 83.8 to 93.6% ($X^2 = 4.02$, $p = 0.045$).

DISCUSSION

The health of adolescents are the most important aspect of the country and health is the basis for everyone to grow healthily and live a happy life, therefore, health is the key and hot topic among Chinese people. Implementation plan for body control taking diet control and exercises as the main measures is given in the Service Plan for Body Weight Control of Teenagers issued by Ministry of Education in 2012. Small tools such as skipping rope and pedometer are provided in the exercise intervention in this Research to encourage the subjects to develop a habit of 1 h exercise each day and nutrition education interventions such as interesting and easily understood demonstration exercises, summer drink making by subjects, prize game, game, video appreciation and interaction after appreciation are organized to let the subjects know that some of their diet habits are not right and help them learn nutrition knowledge in daily life and enhance their cognition in healthy diet and to help them change their diet behavioral motives.

After the nutrition education of this Research, it is found that the nutrition knowledge and dietary altitudes of the subjects changed qualitatively. According to relevant published literatures (Thompson *et al*., 2013; Bassett *et al*., 2013; Cunningham *et al*., 2014), children in China drink a lot of sugared beverages in daily life and 7-11 year-old children drinking sugared beverages once a week account for 78.5%. The more sugared beverages they drink, the faster children's weights and waists grow, therefore, it is highlighted in Dietary Guidelines for Chinese Residents that children shall drink sugared beverages as little as possible to prevent diseases. Before the intervention, the correct rate of answering "High-calorie sugared beverages are beneficial to growth" by subjects is only 30.7, that is, 69.3% of the students think it is right. After the 12-week nutrition education, such correct rate rapidly increased to 91.6%. It is found from the Table of Self-management for Healthy Life filled by the subjects every day that: the rate of subjects drinking sugared beverage once a week drops to 26.7% from 77.9% (before the intervention). Another obvious change is that the proportion of subjects eating breakfast everyday has increased from 87.1 to 100%; proportion of subjects eating snacks at least once a week averagely drops to 26.6% (proportion before the intervention is 91.8%); subjects eating five vegetables and fruits every day per week account for 68.1% (proportion before intervention is 15.5%); subjects doing exercises 1 h a day per week take up 79.8% (proportion before intervention is 45.1%); the rate of subjects watching TV for over 2 h at least once a week averagely drops to 38.6% (before intervention, the rate is 61.4%); the proportion of subjects eating high-calorie food at least once a week averagely drops to 42.6% (proportion before intervention is 71.8%).

Despite obvious shrinking of waist circumference, the subjects have no obvious change in body weight, height and BMI after the 12-week nutrition education and outdoor exercises ($p>0.05$). However, there are significant decreases in the height, weight, BMI and waist circumference after the 10-week follow-up, the reason is that weight loss is a long process needing persistence and persisting exercises and diet control. The reason for obvious weight loss after follow-up period is that the guidance from nutritionist and fitness coach are learnt by the subjects after the 12-week courses and the subjects selected healthier diet and insisted on regular exercises which make them grow healthier and help them control and loss weight.

It is well-known that the children have great potential and if the subjects in this Research (overweight and obesity ones) can develop good diet habits, they will get and keep in shape. Despite that some of the BMI of subjects are improved in short period and obvious achievements are gained after the intervention, the objective of this Research is to help subjects to learn correct nutrient knowledge, develop good diet altitude and keep regular exercises and did not strictly restrict the diet of the subjects. However, as the subjects of this Research receiving nutrition education and exercises intervention, the roles of their parents are not considered. As to the living space of the subjects, foods are mostly prepared by their parents and different views of parents on diet may influence the diet plan of the subjects. Hence, the subjects are likely to be influenced by the family environment and parents rearing during weight control. Therefore, during the nutrition education, health education and exercises intervention, the leading and guidance from parents toward correct diet altitude are critically necessary and are the important factor needed to be considered in the further research.

CONCLUSION

- After the 12-week nutrition courses and exercise intervention, the height, weight and BMI of overweight and obese children didn't decline obviously ($p>0.05$), but the waist circumference shrank obviously ($p<0.05$); in the subsequent 10-week follow-up period, the weight, BMI and waist circumference drop and shrank significantly and height increased obviously ($p<0.05$).
- After 12 weeks of nutrition education, the nutrition knowledge of overweight and obese children changed a lot. The correct rate of answering 7 out

of the 10 nutrition-related questions is obviously higher than the pre-test, which shows that the knowledge of subjects in food nutrients, caloric content, mineral substances, beverage ingredients, cereals, fresh fruits, balanced diet and protein functions etc. are greatly enhanced.

- After 12 weeks of nutrition education, overweight and obese children's dietary altitudes changed a lot. The correct rate of answering 6 out of the 10 dietary altitude-related questions is obviously higher than the pre-test, which shows that the altitudes of subjects toward dehydrating, eating, diet plan, appetite and food selection etc. changed a lot in a good way.

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