

# THE EFFECTIVENESS OF EXERCISE AND NUTRITION INTERVENTION PROGRAMMES TO PREVENT AND MANAGE OBESITY AMONG YOUNG POPULATION

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## Abstract

**Background:** Childhood obesity has become a central chronic disease in this modern era. Early prevention and effective treatment of obese children and adolescents is mandatory. Surprisingly, there are limited short- and long-term studies determining targeted interventions particularly physical activity and dietary intervention in preventing and treating obesity among the young population. Further, the efficacy of physical activity and nutritional strategies to prevent and treat pediatric obesity remains unclear.

**Objective:** This review aims to evaluate the effect of physical activity and dietary interventions in preventing and treating obese children and adolescents.

**Results:** There are five main studies involved in this review. Most of the reviewed studies found significant reductions on body weight, body mass index and body fat, and improvement on aerobic fitness and endurance time.

**Conclusion:** The data shows the short- and long-term beneficial effects of physical activity alone and in combined intervention with dietary-behavioural approaches to treat obesity among young population. However, some studies have flawed study design such as small sample size and unmatched participants in control group. Additional research considering behavioural, dietary and physical intervention, and cost-effective approach for primary and community care are required.

## Introduction

The number of obese children has increased dramatically world-wide<sup>1</sup>. World Health Organization states that more than one billion adults throughout the world are overweight, of whom around 300 million are obese<sup>2</sup>. Changes in lifestyles including increased caloric intake and sedentary activity are assumed to be related with this health problem<sup>3</sup>.

Obesity is usually defined as excess weight after adjusting for height resulting from energy intake greater than energy expenditure<sup>4</sup>. Children with body mass index (BMI) 85<sup>th</sup> to less than 95<sup>th</sup> percentile are considered overweight, and children with BMI equal to or greater than 95<sup>th</sup> percentile are categorized as obese<sup>5</sup>.

Obesity is caused by the interaction of contributing components. Factors such as genetics, physiological factors, behavioral influences (e.g. food choices and physical

activity), psychosocial consequences (e.g. externality, restraint and stress), and socioeconomic status, are considered to influence childhood obesity<sup>4,6</sup>.

Childhood obesity is associated with several health risks during childhood including pre-diabetes, diabetes, cardiovascular, pulmonary, orthopaedic, and gastrointestinal diseases<sup>7</sup>. Another consequence of obesity in young children is psychosocial problems. Obese children may get early and systemic discrimination. For instance, boys and girls aged 10 to 11 years prefer thinner friends rather than overweight or obese peers. Also, obese adolescents may develop low self-image or self-esteem that appears to persist into adulthood<sup>8</sup>. Obesity-related health problems seem to persist into adulthood<sup>9</sup>.

Paediatric obesity is also associated with many adverse health outcomes in adulthood, such as hyperlipidemia, hypertension,

abnormal glucose tolerance, insulin resistance, and diabetes mellitus<sup>10</sup>. In addition, there are consistent reports that overweight and obese youth have an increased risk to become overweight adults<sup>11,12</sup>. Based on current studies in adults, it has been suggested that lifestyle alteration and weight control in childhood could reduce the risk of insulin resistance, type 2 diabetes, and cardiovascular diseases<sup>13</sup>.

Early prevention and effective treatment of childhood obesity are essential and must start during childhood<sup>3</sup>. However, changing behaviour is difficult, particularly behaviours that are required for daily life. Thus, behavioural modification and weight management are mandated in the face of continuing obstacles<sup>4</sup>. This essay aims to review the effect of exercise and nutritional intervention programs to prevent and treat childhood obesity. This review will focus mainly on studies of the exercise intervention to treat obesity among children and adolescents.

### **Obesity prevention in young population**

The increased prevalence of obesity in youth and its parallel health risks justify extensive efforts toward prevention<sup>14</sup>. Parental assistance significantly affect children's food attitude and practices particularly during early and middle childhood<sup>15</sup>. Based on several studies, it has been suggested that food should not be presented as a reward to young children since this practice will influence preference of that food<sup>16</sup>.

One useful strategy is promoting portion control. This can be performed by modifying nutrition labels on marketplace products, and

supporting single-serving packaging in order to reduce caloric intake. Published data suggests that increased portion size contributes to global obesity epidemic<sup>17</sup>.

Reducing mass marketing of unhealthy food to young population is another approach to prevent childhood obesity. Around 50% of the television advertising is for food, of which, about 91% are high in sugar, salt and fat<sup>16</sup>.

Dietz and Gortmaker (2001) notes that reducing television viewing is an essential preventive strategy since it influences both energy intake and energy expenditure, and therefore indicates a reasonable target for interventions. Current evidence indicates the importance of physical activity in obesity prevention of young population. However, the optimum intensities, levels and modality of physical activity in young population are uncertain<sup>14</sup>.

The WHO recommends environmental changes supporting physical activity, such as walking and biking, rather than stimulating some vigorous activities<sup>18</sup>. Likewise, the Centers for Disease Control addresses several levels of physical activity promotion for youth integrating policy, health and physical education, environment, parental participation, extracurricular programs, personal training, community approaches and evaluation<sup>19</sup>.

### **The efficacy of dietary, behavioural and physical interventions for the treatment of childhood and adolescent obesity**

Robinson (1999) carried out a randomized controlled trial among elementary school children in San Jose, Calif. The study determined the effect of reduced sedentary activity by reducing television watching, video

tape and video games on changes adiposity, physical activity and dietary intake with body mass index as the main outcome of measurement.

The researcher involved two public elementary schools in the same district. One school was randomly assigned to fulfil a program to reduce television, videotape and video game use. The other school was assigned as control. They measured BMI, self-reported media consumption, physical activity, dietary behaviour and reports from parents about child and family behaviour at baseline and after the completion of intervention<sup>19</sup>.

The findings indicated that children in the intervention group had a statistically significant reduction in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio compared with controls. In addition, participants in the intervention group had significantly reduced the number of meals while watching TV compared with controls. Reducing television viewing, videotape, and video games can be a promising approach on population-based strategy to prevent and treat childhood obesity<sup>19</sup>.

This study observed the effect of media use alone in adiposity, factors such as dietary intake and physical activity which might also influence the results, have not been taken into account. This might lead bias in interpreting intervention effects .

This interventions seem require a small budget, would be easily to do in large-scale samples and needs a few trained workers. It seems that reducing media use such as television, video games and videotape among young population can be an alternative strategy to prevent and treat

pediatric obesity. However, I think a cost-effective program integrating the reduction in media use, increasing physical activity and controlling dietary intake (such as increased consumption of fruits and vegetables and decreased intake of energy-dense foods) might result in more weight loss.

Since this experiment only involved two public elementary schools, socio-demographical diversity of participants was not adequate to generalize the findings. Thus, further randomized studies involving larger and more socio-demographically varied samples integrating physical activity and diet interventions are required.

In the same year, Gortmaker *et al.* (1999) carried out a study called Planet Health on obese girls and boys in grade 6 to 8. This randomized controlled field trial involved five schools in intervention and control groups. This 2-year school-based approach delivered health sessions focused on decreasing of TV viewing and high-fat food intake, increasing consumption of fruit and vegetables, and increasing moderate to vigorous physical activity<sup>20</sup>.

Planet Health was developed to reduce obesity by improving energy expenditure and promoting key dietary recommendation to take fruits and vegetables 5 a day or more. The findings showed that the prevalence of obesity among intervention girls reduced significantly compared with control group, but not in the intervention boys. Among boys, the obesity was reduced in both intervention and control group and there was no significant different was found. Author assumes that the different outcomes may be due to different causal factors between girls and boys, however there is limited scientific

evidence supporting this hypothesis. Alternatively, girls may be more responsive and adjusted to the diet and activity interventions.

I appraise that this study has some strengths. It used the school system to implement the interventions, in which there are still limited studies in this area. The participating schools should implement physical education (PE) curriculum in the classroom. Also, students spend a lot of time at school, because of that it is valuable to develop school-based interventions to reduce the increasing prevalence of childhood obesity. Moreover, this program involves a large-scale and multi-ethnic study population.

However, since this approach involve many components (e.g schools, teachers, students, trainers and other professional workers), this requires adequate funds to run the program. A good partnership among related institutions is also needed. But, this program could be implemented if there is goodwill from policy makers, advantageous partnership from all related sectors and sufficient funds to operate this approach.

Epstein et al. (2000) performed a randomized controlled outcome study in a clinical setting comparing the effect of reduction in sedentary behaviour versus increased physical activity in the comprehensive treatment of obesity. The study involved ninety obese children aged 8 to 12 years old and their family. The participants were randomly assigned into increase activity (n=45) or decrease sedentary (n=45) groups and treatment dose (low vs high) <sup>21</sup>.

Researchers recruited the participants from physician recommendations, television,

posters and newspaper advertisement. This recruitment method could lead to recruitment's bias since the participating sample may be people who were highly motivated and liked to read newspaper and watch television.

Families received weight control education, self-monitoring introduction, specific activity program, behavioural change strategy and how to maintain the behavioural changes. Participants in the physical activity group were encouraged to increase their physical activities both at school and home while the sedentary activity group was assisted to reduce their targeted sedentary activities (e.g TV viewing, videotape and video games use, and talking on the telephone). They were followed up at 1 and 2 years<sup>21</sup>.

The main finding indicated that the targeted interventions, either decreased sedentary behaviour and increased physical activity, significantly decreased the percentage of overweight and body fat and increases aerobic fitness.

The strategies to increase physical activity and reduce sedentary activity might work in communities since this approach looks cost-effective and easy to implement. These factors makes this program likely to be successful compared with combined program involving many interventions which requires substantial amount of funding, involvement of several professional workers and high compliance of targeted population.

However, dietary intake was not measured in this study. I think it is important to include participants' dietary intake in the measurement. Whether the interventions might change their diet behaviour (reduced

or increased caloric intake). Furthermore, since not all sedentary activities and/or physical activities were targeted, it is interesting to determine which particular activity contribute to the most reduction of body fat and improve aerobic fitness. For example, it might be possible to determine which physical activities were most preferred and most motivating.

In 2005, Nemet et al. performed a study determining the effect of the combined approaches of diet, behaviour and physical intervention in a short- and long-term period. By this study, researchers assessed dietary intake, body composition, anthropometric measurement, leisure time habits, fitness, and lipid profile within obese Israeli young population.

This randomized prospective study involved 24 obese children in the intervention group and 22 obese participants matching in age and gender in the control group. Researchers followed up the study in 3-month and 1 year period.

In this multidisciplinary intervention studies, researchers engaged a 3-month intervention programme for participants and parents. Both parents and subjects had 4 evening classes on childhood obesity, general nutrition, therapeutic nutritional intervention for an obese child, and the effect of exercise on childhood obesity. Physicians and dieticians were involved during the programme.

In the dietary intervention, parents and/or subjects had 6 meeting times with the dietician during the 3-month program. Participants had a balanced hypocaloric diet contains around 5021 to 8368 kJ which depend on children's age and weight, a

caloric reduction of ~30% from reported intake, or intake 15% less than the estimated daily required intake.

This study is interesting and valuable since it applied a programme giving a comprehensive intervention, both dietary approach and exercise program, with a wide-range of assessments, such as anthropometric and nutritional measurement, habitual activity, fitness and serum lipid analysis and all factors which may influence child obesity.

However, since this 3-month project only involved 24 obese children and 22 obese participants matched in age and gender in the intervention and control group respectively, it seems that the sample was too small and the time duration was too short for the general judgement of the result in a community setting. I appraise that researchers need a larger sample size, longer duration, and to determine costs and effects.

Meanwhile, many children are becoming obese or overweight, and childhood obesity has achieved an epidemic proportion globally, any programmes to overcome this public health problem should be cost effective, easy to do, and can be widely applied in young population. This program seems too difficult to do in large-scale samples since it requires many professional workers, such as physicians, dieticians, and professional coaches for sport training sessions. Also, this program involves several interventions which require a high compliance of participants to complete it.

In addition, this program was costly since it required substantial funds for dietary and exercise interventions, professional workers

and all measurements (nutritional assessment, anthropometric, habitual activity, fitness and serum lipid measurements). All those factors made this program less cost effective.

Further, the project only involved 46 participants for both intervention and control group. Hence, the authors could easily control and monitor samples. However, it seems that this setting approach might not easily be applied in a larger group or population as several factors such as funding, human resources, policy and variable measurements may challenge this approach.

Eliakim et al. (2002) investigated the effect of a weight management program on BMI, body weight and fitness among obese children and adolescents. This combined dietary- exercise study involved 177 children completing the 3 month intervention, of whom 65 participants completed the 6 month program. 25 children who were unable to join this program due to some difficulties served as controls .

For the dietary intervention, participants received some sessions with a dietician, nutritional education and a balanced hypocaloric diet. Moreover, they had 1 hour training sessions twice a week instructed by professional coaches. All variables were measured at baseline, 3 months and 6 months. Researchers found that there was a significant reduction on BMI and body weight, and a significant increase in endurance following the 3 month program<sup>22</sup>.

This study is quite similar with study carried out by Nemet et al. (2005). However, one of the differences was this experiment

was larger sample size compared with the study by Nemet et al. (2005) which may contribute to the strength of the study. Conversely, it appears that the number of sample in the intervention group and controls were not balance since only a small number of participants were involved as controls. This might lead to selection bias.

Furthermore, researchers identified some limitations on their study. This experiment indicated only the short-term effects of combined dietary-behavioural-exercise intervention while the long-term effects were not measured. Researchers noted that they were unable to provide substantially matched control group. They reasoned that most participants were interested to participate the combined intervention. However, I think there was no excuse for the willingness of participants and researcher could distribute them into intervention and control groups properly. In a robust study design, researchers have to completely control their research and do not allow everyone else, including samples, to interfere their study.

Other aspect that needs to be considered for the implementation of this combined dietary-behavioural-exercise approach in large-scale participants is the cost. It seems that this intervention requires a lot of money in providing professional workers, such as dieticians, nutritionists, professional coaches and transportation cost of participants. Similarly, this program requires a high compliance of participants since they have to consume a balanced hypocaloric diet, take an hour sport session for twice a week and visit the dietician once a month during the program.

**Table. Summary of all reviewed studies**

Source	Type of Study	Participants	Interventions	Main findings	+/-
Robinson (1999)	Randomized control trial	192 third- and fourth students in two public elementary schools	↓ TV viewing and the use of videotape and video games	Children in intervention group had statistically significant reduction	(+) • Evaluate the single effect of media use in adiposity • Seems cost-effective & easily implemented in large-scale • Need few professional workers (-) • Did not measure PA and dietary intake → may lead to bias in overestimating intervention effects • Include 2 primary schools → the diversity of samples was not enough to generalize the results
Gortmaker <i>et al.</i> (1999)	Randomized controlled field trial	1295 students in gr-6 to -8 in the 10 elementary schools	• ↓ TV viewing & high-fat food intake • ↑ PA & fruit, vegetables intake	• Significant ↓ of obesity in intervention girls • No difference among boys were found	(+) • Large sample size • Comprehensive interventions • Involving school system and curriculum in the intervention (-) • Seems not cost-effective • Not easy to do without strong policy and a good partnership among all related sectors
Epstein <i>et al.</i> (2000)	Randomized control outcome study	90 obese children aged 8-12 years and their families	↓ sedentary activity and ↑ PA	participants in both ↓ sedentary and ↑ PA group significantly decrease in the % of obesity and body fat, and ↑ aerobic fitness	(+) • Seems cost-effective & easily implemented in community (-) • Recruitment method via newspaper, posters and TV → may lead to recruitment bias • Did not assess dietary intake → researchers should consider that interventions might change participant dietary intake
Nemet <i>et al.</i> (2005)	Randomized prospective study	24 and 22- obese children in intervention and control respectively	Short and long-term effects of combined dietary, behavioural and PA	Beneficial short- and long- term effects of the combined intervention on changes body weight and fat percentage	(+) • A complete intervention study (-) • Seems sample was too small for generalizable results • Too costly and difficult to do it in a large sample size • Requires high compliance of participants

**Table. Summary of all reviewed studies(continuation from page 53)**

Source	Type of Study	Participants	Interventions	Main findings	+/-
Eliakim et al. (2002)	Clinical experimental	177 children	Short-term intervention of combined dietary and		(+) • A complete intervention study (-) • Un-balanced sample numbers between intervention and control may lead to selection bias • Too costly and difficult to do it in a large sample size • Requires high compliance of participants

### Conclusion

In conclusion, the data in this reviewed study shows the short- and long-term beneficial effects of physical activity alone and in combined intervention with dietary-behavioural approaches to treat obesity among young population. However, some studies have flawed study design such as small sample size and unmatched participants in control group. Also, some other studies seemed require a lot of funding to accomplish.

There are also several studies that seem very ideal but honestly quite difficult for implementation of those studies in a community setting due to some circumstances such as too costly, required a very high motivation and compliance of the participants, and need a lot of professional workers (Eliakim *et al.*, 2002; Nemet *et al.*, 2005). Not all studies that seem comprehensive and ideal are applicable and effective to treat obese children in a large sample size.

However, some other studies that look simple, but effective in reducing body weight by reducing media use and sedentary activity

alone and/or in combination with increased physical activity and some dietary intervention such as reduced high-fat food intake and increased consumption of fruit and vegetables result in similar outcomes. In general, this program might easier in its implementation. Also, all the studies have not determined the very long-term results (5 years or 10 year)

Additional researches considering behavioural, dietary and physical intervention, and cost-effective approach for primary and community care are required.

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