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DUANGCHAN, Patcharee, YOELAO, Dusadee, MACASKILL, Ann <http://orcid.org/0000-0001-9972-8699>, INTARAKAMHANG, Ungsinun and SUPRASONSIN, Chittiwat

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Interventions for Healthy Eating and Physical Activity among Obese Elementary Schoolchildren: Observing Changes of the Combined Effects of Behavioral Models

Patcharee Duangchan[1], Dusadee Yoelao[2], Ann Macaskill[3], Ungsinun Intarakamhang[4], and Chittiwat Suprasonsin[5]

The aim of this experimental research was to examine the effectiveness of the SSII-Healthy Eating Intervention and Physical Activity intervention programs at the end of intervention implementation in term of combined effects. The sample of this study was 21 students in Sawadeewittaya School, aged 9-11 years, who met the inclusion criteria and consented to participate in the study. The dependent variables included knowledge about obesity-related Type 2 diabetes, healthy eating behavior, healthy eating self-efficacy, healthy eating self-control, and BMI. The study interventions were the SSII-Healthy Eating Intervention Program, and the SSII-Physical Activity Intervention Program. Each of the two interventions was created using the self-efficacy, self-control, and implementation intention principles. The sample was first implemented with the SSII-Healthy Eating Intervention Program, followed by the SSII-Physical Activity Intervention. Data analysis was performed using SPSS for Windows. The statistical tests were descriptive statistics and One-way repeated measures ANOVA. Results showed that: 1) after the individual SSII-Healthy Eating Intervention Program; mean scores of knowledge about obesity-related Type 2 diabetes, healthy eating self-efficacy, healthy eating self-control, and healthy eating behavior significantly increased from the baseline and BMI significantly decreased. 2) The combined effect of the SSII-Healthy Eating and Physical Activity Intervention Programs on healthy eating behavior was greater than that of the individual SSII-Healthy Eating Intervention, but not for BMI.

***Keywords**:* healthy eating behavior, combined effects, BMI

Childhood obesity is an epidemic in both developed and developing countries. Some countries in Asia showed an increase in obesity rate among children; for example, China 11.3%, Malaysia 8.4%, Japan, 21.7% in boys and 17.4% in girls, and Singapore 19.4% in boys and 14.6% in girls (Sinawat, 2008). In Thailand, results from a nation-wide survey of 47,389 grade 6 students from 268 primary schools in the urban settings in 2005 found that 16.7% of students are overweight and obese (Mo-suwan, 2008). Obesity is the

[1] Ph.D. Candidate in Applied Behavioral Science Research, Behavioral Science Research Institute, Srinakharinwirot University, Bangkok, Thailand
[2] Associate Professor, Behavioral Science Research Institute, Srinakharinwirot University, Bangkok, Thailand
[3] Professor of Health Psychology, Sheffield Hallam University, United Kingdom
[4] Assistant Professor, Behavioral Science Research Institute, Srinakharinwirot University, Bangkok, Thailand
[5] Associate Professor, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

most important risk factor for the development of Type 2 diabetes in children which is now a major health problem globally. The increasing prevalence of overweight or obesity parallels the prevalence of Type 2 diabetes (Hannon, Rao, & Arslanian, 2005).

An increase in the number of children and youths with Type 2 diabetes has been observed in many parts of the world, including America, Asian-pacific region, Europe, and Middle East (Pinhas-Hamiel & Zeitler, 2005; Botero & Wolfsdorf, 2005). In Thailand, the prevalence of Type 2 diabetes has also increased (Mahachoklertwattana, 2006).

Increasing rates of obesity and Type 2 diabetes among children and adolescents will have considerable long-term implications for the affected individuals. If the prevalence of childhood obesity is continuously increasing, Type 2 diabetes and its associated complications will emerge at an earlier age. Therefore, prevention of childhood obesity and Type 2 diabetes is essential because earlier prevention leads to earlier reduction of related mortality and morbidity of the Thai population in the future.

Factors known to be associated with the high prevalence of Type 2 diabetes include diets high in fat and low in dietary fiber intake, low level of physical activity, genetic predisposition, and obesity (Saksvig, Gittelsohn, Harris, Hanley, Valente, & Zinman, 2005). It has been suggested, therefore, that prevention of childhood obesity and Type 2 diabetes should include diet, physical activity, and behavioral approaches which are more likely to be effective if parent or family members are included (Grey et al., 2004; Epstein, Paluch, Roemmich, & Beecher, 2007). A research was done (Duangchan, 2007) using the Theory of Planned Behavior (TPB) (Ajzen, 1991, 2002) to determine the factors that may predict engagement with physical activity and healthy eating and obesity in fourth grade schoolchildren, aged 9-11 years, in four demonstration schools, Bangkok. Results demonstrated that intention and perceived behavioral control (PBC) together accounted for 22.3% and 23.4% of variance in physical activity and healthy eating respectively where, however, only PBC was a significant predictor of both physical activity and healthy eating. It is likely that for the reduction of obesity among schoolchildren, there is a need for an appropriate intervention program, particularly to enhance PBC and thereby help to prevent chronic disease in the future. As Ajzen (2002) suggested, there were two components of PBC namely self-efficacy and controllability. Thus, to verify the predictability of PBC in actual behavioral change, it is logical that any intervention program aiming to enhance PBC will also enhance self-efficacy and controllability related to the targeted behaviors.

The above study also showed that the TPB constructs can only partly explain variability in physical activity and healthy eating behavior. Previous literature suggested that implementation intention may be beneficial for increasing physical activity and healthy eating behavior among schoolchildren given the weak intention-behavior relationships (Gollwitzer, 1993, 1999; Webb & Sheeran, 2003; Latimer, Martin Ginis, & Arbour, 2006: 274; Milne, Orbell, & Sheeran, 2002; Prestwich, Lawton, & Conner, 2003).

In Thailand, there has been a behavioral program developed for adolescents aged 12-16 years attending a diabetic clinic (Chotik-Anuchid, 2005). For schoolchildren, a 7-class behavioral intervention program applying self-control and self-efficacy were implemented in 40 students, grade 4 and 5, Ramkhamhaeng University Demonstration School. The program integrated healthy eating intervention and physical activity intervention. The result showed that there were significant differences in knowledge about obesity-related Type 2 diabetes and healthy eating behavior between the intervention and the control group. However, it was found that implementing the two interventions at the same time yielded only maintenance in healthy eating behavior, but not an increase. There has yet to be a program specifically for schoolchildren using self-efficacy, self-control, and implementation intention. Additionally, investigating the combined effect of the two interventions implemented in different time may be useful for further implementation of the interventions. The aim of this study was to examine the effectiveness of the individual Self-control, Self-efficacy, and Implementation Intention (SSII) Healthy Eating Intervention Program in developing self-efficacy, self-control, healthy eating behavior and thereby combating obesity-related Type 2 diabetes. The combined effects of the SSII-Healthy Eating followed by the SSII-Physical Activity Intervention Program on behavior were also evaluated.

Hypotheses of the study were 1) after the SSII-Healthy Eating Intervention Program; Knowledge, self-efficacy, self-control, and healthy eating of the sample would increase, but BMI of the sample would decrease and 2) the combined effects of the SSII-Healthy Eating and Physical Activity Intervention Program on behavior would be greater than that of the individual programs. This would be measured by increase in healthy eating behavior and reduction in BMI after the combined interventions.

Methods

Participants

The participants for this study were obtained from Sawadeewittaya School, Bangkok. Schoolchildren, who aged between 9-11 years and were defined as overweight or obese by a BMI-for-age ≥ 85th percentile (CDC, 2006), were randomly invited to participate in the study by sending their parents consent forms. The 26 written informed consents were obtained from the parents. This represented 86.7% of children who were eligible to take part. Further 5 boys were excluded from the analysis due to their having an insufficient number of class attendances during the intervention phases and dropouts, thereby providing 21 participants for final analysis. Missing data were due to school absence, children leaving the school (1 boy), school extracurricular activities such as sport and a music tournament, and taking extra tutorial class on the intervention day. Graduate School, Srinakharinwirot University approved the study. The participating sample came from different classes (Grade 4 and grade 5) and different rooms (Room 4/1, room 4/2, room 4/3, room 5/1, room 5/2, and room 5/3). Overall, boys and girls were 10.5 ± 0.5 years of age; with boys being overrepresented (85.7%) in the study sample.

Dependent variables

Dependent variables of this study were; (1) knowledge about obesity-related Type 2 diabetes, (2) healthy eating behavior, (3) healthy eating self-efficacy, (4) healthy eating self-control, and (5) Body mass index (BMI).

Measures

Anthropometric measure

BMI. BMI was calculated based on measured weight (kilograms) and height (meters) using the following formula: BMI = weight divided by height squared. BMI percentile for age and sex was derived using the Center for Disease Control growth charts (CDC, 2006).

Psychosocial and behavioral measures

Knowledge about obesity-related Type 2 diabetes. Knowledge about obesity-related Type 2 diabetes was assessed via a true-false type test containing 15 questions which measured students' capabilities to recognize and understand information about risk factors, symptoms, prevention and treatment, and health consequences of obesity–related Type 2 diabetes.

Healthy eating behavior. Healthy eating behavior was defined as 1) eating fruit and vegetables; 2) eating whole grain/cereal products; 3) avoiding fast foods, fatty foods, and snacks, 4) avoiding sugary foods and sugar-sweetened drinks; 5) eating well-balanced diet according to the 5 food groups. An 11- food item questionnaire was used to measure healthy eating behavior. The participants were asked, "Over the past week, how often did you eat...?" Each food was rated on the frequency it was eaten (everyday = 1; sometimes = 2, never = 3).

Healthy eating self-efficacy. Healthy eating self-efficacy was assessed using an 11-item questionnaire asking the participants to rate how confident/sure they were that they could eat fruit and vegetables, avoid fast food, fatty food and snacks, and avoid sugary foods and sugar-sweetened soft drinks on a 5-point Likert-type scale ranging from 'very sure I could not. do it' (score = 1) to 'sure I could do it' (score = 5).

Healthy eating self-control. Healthy eating self-control was assessed using a 14-item questionnaire which measured participants' beliefs about their control over the specific behaviors corresponding to the definition of healthy eating behavior, and their ability to change their unhealthy eating behavior to healthy eating behavior. The participants were asked to rate 1) how much they believe that they can control themselves to eat fruit and vegetables, avoid fast food, fatty food and snacks, and avoid sugary foods and sugar-sweetened soft drinks, and 2) how much each of specific eating behaviors reflects their current behavior. Reponses were made on a 5-point Likert-type scale from 'very sure I could not do it' (score = 1) to 'sure I could do it' (score = 5).

To obtain content validity, the measures were scrutinized by three experts. Two of the experts were psychologists and the third was a behavioral scientist. The experts all

confirmed that the items used were consistent with the variable definitions. A pilot test was then undertaken with 32 schoolchildren from the same population to ensure clarity and ease of comprehension and also determine the reliability of the instrument. The results indicated that the reliability of some items was unacceptable and slight changes in wordings and addition of some items were made. The internal consistencies (Cronbach's α) of the revised measures were between .08-.90, indicating high inter-item correlation. The knowledge measure was also analyzed for the difficulty index to ensure that it is age appropriate. This involves scrutinizing the responses received and removing or modifying items that are too difficult and ensuring that there are not too many easy items so that the measure is a good discriminator of children's knowledge. The difficulty index of the knowledge measure was between 0.23-0.71.

Interventions

There were two interventions in this study, the SSII-Healthy Eating Intervention and the SSII-Physical Activity Intervention. Each of the two interventions were created using the self-efficacy (Bandura, 1977, 1997), self-control (Kazdin, 2001), and implementation intention principles (Gollwitzer, 1993, 1999), were informed by a review of the literature, and were scrutinized by experts in psychology and behavioral science, and a parent representative. Formative research on the interventions was also conducted with 32 students from the same population. Overall, the major focus of the SSII-Healthy Eating intervention was the development of self-efficacy and self-control related to healthy eating, and thereby to enhance healthy eating behavior. This intervention consisted of six weekly, 90-minute activity lessons in food skills and knowledge which were as follows: (1) knowledge about food pyramid, calorie, alternative low-calorie food, healthy snack, and label reading; (2) self-monitoring on food; (3) food buying, storage, serving, and eating, with the 'Supermarket Tour'; (4) food preparing: demonstration, cooking activity, with the 'Menu assignment'; (5) understanding food as an emotional coping mechanism and providing alternative coping strategies; and (6) knowledge about obesity and Type 2 diabetes. The SSII-Physical Activity Intervention Program was also composed of six weekly, 90-minute activity lessons in exercise and physical activity skills and knowledge which included: (1) exercise knowledge: type, importance, energy expenditure; (2) self-monitoring on physical activity; (3) exercise demonstration; (4) planning to increase energy expenditure; (5) physical activity as a lifestyle-based activity with walk rally; and (6) Class review. The major focus of the SSII-Physical Activity intervention was the

development of self-efficacy and self-control related to physical activity which might enhance or maintain healthy eating behavior.

The lessons incorporated traditional learning styles (lecture) and practical experiences, and use of interactive and cooperative learning techniques such as games, and cooking. Parents were invited to participate in the lessons and encouraged to collaborate with their children at home to increase healthy eating behavior.

Procedure

The SSII-Healthy Eating intervention was first implemented in the school sample, followed by the SSII-Physical Activity Intervention. The study procedures consisted of a preparation stage, screening of participation stage, baseline measures (T1), implementation of the SSII-Healthy Eating intervention, endpoint measures (T2), implementation of the SSII-Physical Activity Intervention, and combined intervention measures (T3). All dependent variables were measures at T1, T2, and T3. Participants were also weighed weekly over the 12-week SSII-Healthy Eating and Physical Activity interventions.

Statistical analyses

One-way repeated measures ANOVA was used to test whether there were changes in psychosocial, behavioral and anthropometric variables overtime within the study sample.

Results

Mean and standard deviation of the dependent variables were presented in Table 1. Table 2 showed results of One-way repeated Measures ANOVA for all dependent variables over times of measure in the participants. Mauchly's test indicated that the sphericity assumptions were met ($p > .05$) for those variables. The ANOVA results demonstrated that there were significant differences in all variables between three times of measurement: baseline (T1), endpoint measure (T2), combined intervention measure (T3). It was found that knowledge showed the highest partial Eta-Squared (.59); followed by healthy eating behavior (.47), and healthy eating self-efficacy (.37), respectively, suggesting that relation between the repeated-measure factor and knowledge was strongest among dependent variables. Bonferroni comparisons revealed that, after the individual SSII-Healthy Eating Intervention (T2 versus T1); knowledge, healthy eating self-efficacy,

healthy eating self-control, and healthy eating behavior significantly increased from the baseline but BMI significantly decreased (Table 3) which supported hypothesis 1.

Table 1

Total Mean and SD of The Psychosocial, Behavioral and Anthropometric Variables by Time of Measures (n = 21)

	Baseline measure		Endpoint measure		Combined intervention measure	
Variables	*M*	SD	*M*	SD	*M*	SD
1. Knowledge	5.81	1.29	6.76	1.34	8.14	1.85
2. Healthy eating self-efficacy	43.00	7.75	48.67	4.51	47.81	5.70
3. Healthy eating self-control	52.14	7.48	56.86	6.40	56.62	7.34
4. Healthy eating behavior	22.00	2.12	23.19	1.86	25.19	2.36
5. Weight (Kg)	59.66	11.66	59.06	11.37	60.40	11.58
6. BMI (Kg/m^2)	27.52	3.50	27.02	3.53	27.28	3.64

Table 2

The Result of One-Way Repeated Measures ANOVA for Knowledge, Healthy Eating Self-Efficacy, Healthy Eating Self-Control, Healthy Eating Behavior, and BMI Over Times of Measure (T) (n=21)

Source of variation	*SS*	*df*	*MS*	*F*	*p*	*Partial* η^2
Knowledge about obesity-related Type 2 diabetes						
Time (T)	57.81	2	28.91	28.30*	.00	.59
Residual	40.86	40	1.02			
Healthy eating self-efficacy						
Time (T)	391.84	2	195.92	7.11*	.00	.37
Residual	1101.49	40	27.54			
Healthy eating self-control						
Time (T)	296.22	2	148.11	3.30*	.04	.14
Residual	1797.11	40	44.93			
Healthy eating behavior						
Time (T)	109.17	2	54.59	17.40*	.00	.47
Residual	125.49	40	3.14			
BMI						
Time (T)	2.63	2	1.31	6.81*	.00	.25
Residual	7.51	40	0.193			

Note. * $p < .05$.

Table 3

Pairwise Comparisons of Mean Scores for Knowledge, Healthy Eating Self-Efficacy, Healthy Eating Self-Control, Healthy Eating Behavior, and BMI Across Times of Measure (T) (n=21)

Variables	Time of measure	Mean scores	Pairwise comparison	Mean differences	*p*
Knowledge	T1	5.81	T2 – T1	.95*	.00
	T2	6.76	T3 – T1	2.33*	.00
	T3	8.14	T3 – T2	1.38*	.00
Healthy eating self-efficacy	T1	43.00	T2 – T1	5.67*	.02
	T2	48.67	T3 – T1	4.81*	.01
	T3	47.81	T3 – T2	-.86	1.00
Healthy eating self-control	T1	52.14	T2 – T1	4.71*	.03
	T2	56.86	T3 – T1	4.47	.27
	T3	56.62	T3 – T2	-.24	1.00
Healthy eating behavior	T1	22.00	T2 – T1	1.19*	.04
	T2	23.19	T3 – T1	3.19*	.00
	T3	25.19	T3 – T2	2.00*	.01
BMI	T1	27.52	T2 – T1	-.50*	.00
	T2	27.02	T3 – T1	-.24	.45
	T3	27.28	T3 – T2	.26	.09

Note. * $p < .05$.

Combined effects

Table 3 showed that all three means of healthy eating behavior were significantly different from each other. Mean behavior was significantly higher after the individual SSII-Healthy Eating Intervention (*Mean* = 23.19) than before the individual program (*Mean* = 22.00). The mean score after the combined intervention (*Mean* = 25.19) was significantly higher than that before and after the individual program. For BMI, it was significantly lower after the individual SSII-Healthy Eating Intervention (*Mean* = 27.02) than before the individual intervention (*Mean* = 27.52). The mean BMI after the combined intervention (*Mean* = 27.28) was not significantly different from that before and after the individual program. Thus, the hypothesis 2 was partially supported.

Discussion

The results revealed that after the 6-week SSII-Healthy Eating Intervention; mean score of knowledge about obesity-related Type 2 diabetes, healthy eating self-efficacy, healthy eating self-control, and healthy eating behavior significantly increased from the baseline and BMI significantly decreased, suggesting that the individual SSII-Healthy Eating Intervention was effective in enhancing self-efficacy and self-control in relation to healthy eating behavior and thereby improved healthy eating behavior resulting in the reduction in BMI.

The success of this individual intervention could be explained by two factors. *First*, it may be due to changes in healthy eating behavior, which was, in turn, likely to have resulted from increases in healthy eating self-efficacy and healthy eating self-control which is supported by Roach et al. (2003). Change in healthy eating behavior, leading to the reduction in BMI, may be affected by forming implementation intention used in the intervention and this is supported by Luszczynska et al. (2007). *Secondly*, it may be because of parental influences. Parents might be role models and provide verbal encouragement. In addition, parental obesity may be another factor used to explain parental influence on childhood obesity which was supported by previous studies, suggesting that parental obesity significantly correlated with obese children (Davison & Birch, 2002; Duangchan, 2007).

The SSII-Healthy Eating Intervention was first implemented in the participants, and followed by the SSII-Physical Activity Intervention. Results showed that the combined effects of the SSII-Healthy Eating and Physical Activity Intervention on healthy eating behavior were greater than that of the individual SSII-Healthy Eating Intervention, but not for BMI. Discussion of change in each variable after the combined interventions was presented below.

Healthy eating behavior: The result showed that all three means were significantly different from each other. Mean behavior was significantly higher after the individual SSII-Healthy Eating Intervention Program than before the individual program. The mean score after the combined intervention was significantly higher than that before and after the individual program. These results suggested that 1) the combined interventions

were effective at improving healthy eating behavior, and 2) combined effect of the SSII-Healthy Eating and Physical Activity Intervention on healthy eating behavior was greater than that of the individual program. The increase in healthy eating behavior after the combined interventions following the SSII-Physical Activity Intervention was implemented may be explained in several ways. *First*, it may be due to an association between physical activity and healthy eating behavior. The results from a previous research (Duangchan, 2007) demonstrated a significant correlation between physical activity and healthy eating behavior ($r = .45$, $p < .01$) in schoolchildren. *Second,* it may due to a strong correlation between intention-behavior resulting from forming implementation intentions in the intervention.

BMI: It was found that mean BMI was significantly lower after the individual SSII-Healthy Eating Intervention than before the individual intervention. The mean BMI after the combined intervention was not significantly different from that before and after the individual intervention. These results suggested that 1) the combined interventions was as effective as the individual program at producing reduction in BMI, and 2) combined effect of the SSII-Healthy Eating and Physical Activity Intervention on BMI was not greater than that of the individual program. There have been some explanations for this finding. *First*, it may due to duration of the intervention. As suggested by a meta-analytic review of obesity prevention programs for children and adolescents (Stice, Shaw, & Marti, 2006), interventions with a relatively shorter duration produced a significantly larger effect than those that were longer in duration. This might be because interventions that are long in duration are not attractive to students, which causes them to disengage from the program. *Second*, because BMI naturally increases with age, maintenance of BMI, and in some cases even small increase in BMI, could be considered a success (Nemet, Barkan, Epstein, Friedland, Kowen, & Eliakim, 2005).

Although the results of this study demonstrated effectiveness of the interventions in improving healthy eating behavior, the conclusion that can be drown may be limited by the small sample size, lack of control group and the fact that this sample volunteer to participated in the study. The effectiveness of SSII-Physical Activity intervention was not mentioned in this paper.

Implications and suggestions for future research

The SSII-Healthy Eating Intervention could serve as a model for improving healthy eating behavior and thereby resulting in the reduction in BMI. Cooperative and interactive learning is important for behavioral interventions designed for children. Thus, having experience in these learning styles together with clear understanding of self-efficacy, self-control, and implementation intention concepts probably leads to program success. For the combined intervention, the healthy eating intervention may be first implemented and followed by physical activity intervention. This order is suggested from the results of this study as well as the results of a previous study of the researcher (Duangchan, 2010) as implementing the two interventions at the same time is likely to yield only maintenance in healthy eating behavior, but not an increase. However, long-term follow-up studies are needed to determine whether maintenance of behaviors and weight control can be achieved over the longer term. Parent groups should be also included in future study to determine if parent participation is associated with outcomes.

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