ORIGINAL ARTICLE

Effects of Consumption of Energy-Restricted Lunch Boxes and Nutrition Education on Nutritional Status among Overweight and Obese Students and Staff of the Valaya Alongkorn Rajabhat University, Thailand

Sujarinee Sangwanna,[1] Weerasak Seelarat,[2] Teerapap Panklai[3]

1. Division of Nutrition and Dietetics, Faculty of Science and Technology, Valaya Alongkorn Rajabhat University under the Royal Patronage, Khlong Luang, Thailand.
2. Division of Food and Beverage Innovation for Health, Faculty of Science and Technology, Valaya Alongkorn Rajabhat University under the Royal Patronage, Khlong Luang, Thailand.
3. Division of Food and Nutrition, Faculty of Home Economics Technology, Rajamangala University of Technology Thanyaburi, Khlong Luang, Thailand.

Correspondence to: Teerapap Panklai, Email: Teerapap_p@rmutt.ac.th, ORCiD: 0000-0003-4157-6949

ABSTRACT

Objective: To study the effect of providing energy-restricted lunch boxes (ERLB) and provision of nutrition education (NE) to overweight and obese students and staff of the Valaya Alongkorn Rajabhat University on weight loss.

Methods: This research was a randomized clinical trial conducted for 4 weeks between November – December 2019 at VRU. The participants were over weight and obese VRU students and staff. Participants were divided into 2 groups consisting of i) a group that received only ERLB, and ii) a group that received ERLB along with NE. The participants in both groups were given an ERLB which was suitable to their energy requirement for 4 weeks (400, 500, and 600 kcal). Nutritional status and nutrition knowledge were determined at baseline and week 4.

Results: Of 30 participants, 22 (73.3%) staff and 8 (26.7%) students aged between 18-59 years. The group that received the ERLB+NE had 16 participants while the group that received only the ERLB had 14 participants. The results showed that a group that received ERLB+NE significantly reduced waist circumference (p-value 0.017), body weight (p-value <0.001), percentage body fat (p-value 0.004), muscle mass (p-value 0.013), body mass index (p-value < 0.001), and visceral fat (p-value 0.003), while the group that received only ERLB did not show any change in body weight and other.

Conclusion: The results demonstrated that energy restriction together with nutrition education is effective in reducing weight and other weight-related indicators such as waist circumference, body weight, percentage body fat, muscle mass, body mass index, and visceral fat.

Keywords: Energy Restriction, Nutritional Counseling, Nutritional Status, Overweight, Weight Loss

Clinical trial registry #: TCTR20221231001

INTRODUCTION

Obesity is defined as an excess accumulation of body fat, which increases the risk of noncommunicable diseases (NCDs).[1] The World Health Organization (WHO) is estimated that by 2025, approximately 167 million people will become increasingly overweight or obese.[2]

A survey of Thai health problems in 2019-2022 found that Thai males and females have a body mass index (BMI) of 24.2 kg/m^2 and 25.2 kg/m^2, respectively.[3] Obesity and overweight are caused by changes in patterns of eating and physical activity levels. Social determinants of health, genetics, and taking certain medications also play a role.[4] Moreover, changes in the social environment, including a shift from rural to urban areas and an inactive lifestyle are determinants of overweight and obesity, etc. In addition, overweight and obese in Thailand, there is a tendency to expand further.[5]

In Thailand, there is a lot of food from foreign countries i.e., fast food. Disadvantage of fast food is that they are high in calories, lack nutrients, and are risk factors for obesity.[6,7] Losing weight with nutritional therapy will begin the first step by using a low-energy diet. Food in healthy lunchboxes is fresh, clean, and produced with

no fermentation process, and less seasoning.[8] Nutrition counseling has a goal to help patients understand information about good nutrition and healthy behavior changes.[9] Previous surveys showed that Thai people are interested in controlling weight gain. However, they are unable to manage their own weight due to personal factors.[10] Therefore, nutritional counseling is necessary to change lifestyle together with healthy food choices. The Valaya Alongkorn Rajabhat University under the Royal Patronage (VRU) students who are overweight and obese have overconsumption behavior.[11] This research aims to evaluate the effect of using energy-restricted lunch boxes (ERLB) along with provision of nutrition education (NE) compared with using only ERLB among overweight and obese subjects for improving nutritional status.

METHODS

This research was a randomized clinical trial conducted for 4 weeks between November – December 2019 at VRU. The study was approved by the Committee for Research Ethics, VRU (REC No. 0007/2562). All of the participants were informed about the objectives of the study and were asked to sign the consent form.

The sample size was calculated using a formula of Lwang *et al.*[13] resulting in 13 participants by adding a 10% non-response rate, the total sample was 16 participants in each group. The participants were 30 students and staff at VRU (5 males and 25 females). They were divided into 2 groups, the first group received ERLB, and the second group received ERLB along with NE.

The students and staff aged between 18-59 years, who have an Asian BMI[12] of more than 23 kg/m^2, and did not have severe diseases such as diabetes, kidney disease, or heart disease, participated in the study.

The students and staff who got pregnant, had dietary restrictions (i.e., vegetarian), and were unable to comply with the agreement (i.e., intake of drugs for losing weight) were excluded from the study.

The research instruments consist of i) Assessment of pre-and post-test of nutrition knowledge with 20 items (20 points) using the questionnaire, ii) The satisfaction questionnaire focused on determining the quality of the intervention research, which has two types: the first type has six items (energy-restricted lunch boxes, duration, nutrition education, consultation, applying in lifestyle, and overall), and the second type has four items (energy-restricted lunch boxes, duration, applying in lifestyle, and overall), iii) Three sets of ERLB offering 400, 500, and 600 kcal that were calculated energy and nutrients for weight loss using the Harris-Benedict equation[14] (total energy expenditure = the basal energy expenditure x activity factor), and provided to participants for 4 weeks, iv) Various media for educating about nutrition (i.e., food flags, food models, and measuring tools and equipment for cooking), and v) Nutritional assessment was as follows; body composition was measured using the BC-601 biological impedance analysis (BIA) consists of the percentage of body fat (%BF), muscle mass (kg), visceral fat (%), bone mass (kg), BMI (kg/m^2), percentage of body water (%BW), and basal metabolic rate (BMR) (kcal). Waist circumference (WC) (cm) and hip circumference (HC) (cm) were measured using a tape measure. Blood glucose was measured using blood glucose meter (Accu-Chek Performa). Blood pressure was measured using a Terumo machine model ES-P30 consisting of systolic blood pressure; SBP (mmHg) and diastolic blood pressure; DBP (mmHg). The procedure of assessment of participants is described in figure 1.

Data entry and analysis were done using Statistical Package for Social Sciences (SPSS) version 20.0. Mean±SD was computed for quantitative variables like total energy expenditure, total energy of ERLB in each week, satisfaction scores, nutritional status, and nutrition knowledge, while frequency and percentages were computed for categorical variables like, gender, age, height, and occupation. Inferential statistics were explored using paired sample t-test to compare mean difference of ERLB+NE and ERLB with nutritional status, and nutrition knowledge of the participants at baseline and 4 weeks. The p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Of thirty participants, 22 (73.3%) staff and 8 (26.7%) students aged between 18-59 years. There were 25 (83.3%) females and 5 (16.7%) males. The group that received the ERLB+NE had 16 participants, 12 (75.0%) were staff and 4 (25.0%) were students, 13 (81.3%) were females and 3 (18.7%) were males. While the group that received only the ERLB had 14 participants, 11 (78.6%) were staff and 3 (21.4%) were students, 12 (85.7%) were females and 2 (14.3%) were males.

As shown in Table 2 and Table 3, the total energy expenditure of all participants was between 1,782.89 ± 106.44 to 2,325.43 ± 25.90 kcal, in which more than half of participants received energy of 400 kcal. The energy of ERLB each week averaged between 459.98 ± 18.91 to 556.86 ± 19.15 kcal. Satisfaction scores in each parameter of both groups were found to be very satisfactory as shown in Table 4.

Body composition data of the group receiving the ERLB+NE at week 4 indicated that WC (p-value 0.017), weight (p-value<0.001), % BF (p-value 0.004), muscle mass (p-value 0.017), BMI (p-value<0.001), and visceral fat (p-value 0.003) were significantly reduced from baseline. However, the group receiving only the ERLB showed that body composition was not significantly different between baseline and week 4.

Blood pressure and blood glucose of the group which received the ERLB+NE at week 4 were not significantly different from baseline (p-value > 0.05). However, blood pressure and blood glucose of this group were normal range. Moreover, the group who received only the ERLB at week 4 showed that blood pressure was not significantly different from baseline (p-value > 0.05), but blood glucose was significantly reduced from baseline (p-value <0.001). Nutritional knowledge score at week 4 showed that the group receiving ERLB+NE and the group receiving only the ERLB had a slight increase in scores when compared to baseline (Table 5).
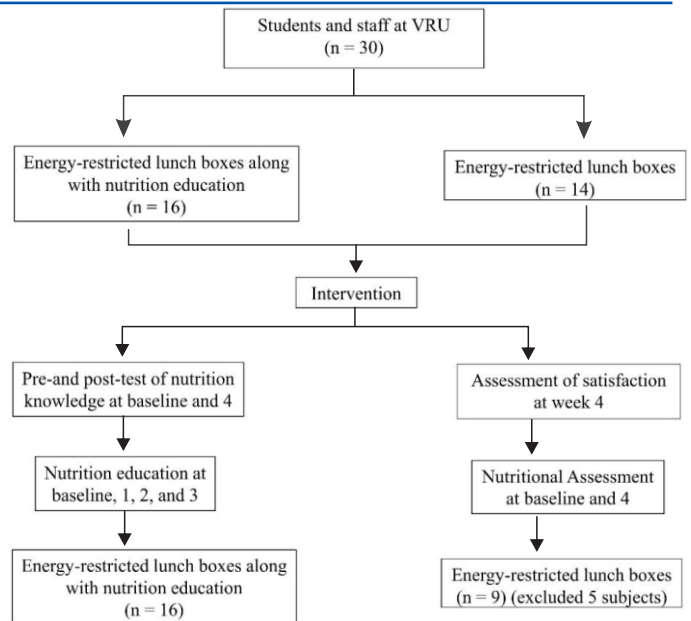

Figure 1: Procedure of the study
* The five participants were excluded because they did not follow the protocol of this research.

Table 1: Demographics characteristics of the participants (n=30)

Characteristics	Participants (n=30)	ERLB+NE (n=16)	ERLB (n=14)
	n (%)	n (%)	n (%)
Gender			
Males	5 (16.7)	3 (18.7)	2 (14.3)
Females	25 (83.3)	13 (81.3)	12 (85.7)
Age (Years)			
18 - 39	19 (63.3)	10 (62.5)	9 (64.3)
40 - 59	11 (36.7)	6 (37.5)	5 (35.7)
Height (cm)			
150 - 160	22 (73.3)	10 (62.5)	12 (85.7)
> 160	8 (26.7)	6 (37.5)	2 (14.3)
Occupation			
Student	8 (26.7)	4 (25.0)	3 (21.4)
Staff	22 (73.3)	12 (75.0)	11 (78.6)

- ERLB: Energy-Restricted Lunch Boxes, NE: Nutrition Education, Cm: Centimeter

Table 2: Total energy expenditure of the participants (n= 30)

Energy of ERLB (kcal)	Basal Energy Expenditure[*] x 1.3[**] (kcal) Mean ± SD	n (%)
400	1,782.89 ± 106.44	18 (60.0)
500	2,055.78 ± 98.62	10 (33.3)
600	2,325.43 ± 25.90	2 (6.7)

- ERLB: Energy-Restricted Lunch Boxes, S.D: Standard Deviation, Kcal: kilocalorie
[*] Calculated From Harris-Benedict Equation, [**] Activity Factor

DISCUSSION

This research studied the effect of ERLB and nutrition education on weight loss. The participants were divided into 2 groups: the first group received ERLB, and the second group received ERLB along with NE. The results showed that body composition, blood pressure, blood glucose, and nutrition knowledge scores of the group receiving ERLB along with NE (i.e., obesity, food exchange, clean food, and cooking demonstration) for

Table 3: Total energy of ERLB in each week

Week[*]	Energy (kcal) (Mean ± S.D.)		
	400	500	600
1	435.36 ± 29.94	508.42 ± 23.22	596.58 ± 5.77
2	464.60 ± 66.64	504.40 ± 54.12	539.20 ± 49.80
3	482.75 ± 23.82	506.50 ± 10.08	564.25 ± 37.56
4	457.20 ± 41.27	483.00 ± 38.90	527.40 ± 40.48
Average	459.98 ± 18.91	500.58 ± 19.09	556.86 ± 19.15

- ERLB: Energy-Restricted Lunch Boxes, S.D.=Standard Deviation, Kcal: kilocalorie
[*]In Each Week Consists Of 5 Days

Table 4: Satisfaction scores of the participants (n= 25)

Parameters	ERLB+NE (n=16)	ERLB (n=9)
	Mean ± S.D.	Mean ± S.D.
Energy-Restricted Lunch Boxes	4.56 ± 0.51	4.33 ± 0.50
Duration	4.38 ± 0.62	4.00 ± 0.71
Nutrition Education	4.56 ± 0.51	-
Consultation	4.56 ± 0.51	-
Applying in Daily Life	4.75 ± 0.45	4.22 ± 0.83
Overall	4.63 ± 0.50	4.44 ± 0.53

- ERLB: Energy-Restricted Lunch Boxes, NE: Nutrition Education, S.D.=Standard Deviation

4 weeks was better than the group receiving only ERLB. The group of ERLB+NE reduced body weight, %BF, BMI, and visceral fat. Changing patterns of food consumption habits in one meal per day led to better body composition. This is consistent with the study by Yamauchi *et al*, who studied changing patterns in the daily life of participants who were overweight and obese using nutritional counseling for 3 months. The study indicated that changing patterns in the daily life of participants could reduce body weight.[15] Similarly, Hutchesson *et al* reported that following a 12-week a commercial program on a website for weight loss could reduce body weight by ≥ 5.0%, by adjusting dietary intake in accordance with the program recommendations and dietary intake guidelines.[16] Whereas Socrates Pozo *et al* reported indigenous population migrant Puruha had a higher percentage of overweight and obese by changing their food pattern.[17] Moreover, Rolls *et al* studied main meal portion sizes (500, 625, 750, or 1,000 grams) for food consumption for 4 weeks. The results showed that food portion size could affect food consumption, and large portion sizes had higher energy than small portion sizes.[18] The design of Rolls *et al* study is similar to the current study which divided the energy of the main meal into three caloric levels (400, 500, or 600 kcal).[18] In addition, Morenga *et al* reported that a high-protein diet intake for 8 weeks in women at risk of obesity could reduce body weight to 4.5 kg, whereas our study found that such intake could reduce body weight to 2.3 kg (4 weeks).[19] Hisamitsu Ide *et al* reported similar results that the *bento* (lunch box) comprising functional foods could reduce both weight and abdominal fat and receiving dietary advice from a physician and nutritionist might help prevent diseases.[20] As well as Kevin Pham *et al* reported 4 weeks of receiving vegan boxed meal kits could reduce LDL-C and body weight. Therefore, receiving ERLB along with NE is better than receiving only ERLB for improving nutritional status.[21]

A strength of this research is the measurement of different makers of obesity and the information obtained from this research could be used as a guideline for planning solutions and promoting good weight loss. A limitation of this research is its relatively small sample size. A future large-scale and long-term observational study is necessary.

CONCLUSION

The results demonstrated that energy restriction together with nutrition education is effective in reducing weight and other weight-related indicators such as waist circumference, body weight, percentage body fat, muscle mass, body mass index, and visceral fat. Therefore, these findings could develop and adapt for planning suitable to help reduce body weight in the group of students and staff in VRU.

Table 5: Mean difference of ERLB+NE and ERLB with nutritional status, and nutrition knowledge of the participants at baseline and 4 weeks (n= 25)

Parameters	ERLB+NE (n=16)			ERLB (n=9)		
	Baseline Mean ± S.D.	Week 4 Mean ± S.D.	p-value	Baseline Mean ± S.D.	Week 4 Mean ± S.D.	p-value
Waist Circumference (cm)	89.39 ± 7.61	84.50 ± 8.97	0.017*	83.9 ± 4.34	81.71 ± 5.79	0.062
Hip Circumference (cm)	105.97 ± 8.38	106.23 ± 24.48	0.967	99.32 ± 3.89	99.36 ± 2.89	0.959
Waist-to-Hip Ratio	0.88 ± 0.11	0.81 ± 0.10	0.136	0.86 ± 0.10	0.80 ± 0.05	0.139
Weight (kg)	71.47 ± 11.34	69.21 ± 11.26	<0.001*	62.02 ± 6.05	62.03 ± 6.20	0.963
Body Fat (%)	37.11 ± 7.89	35.94 ± 7.46	0.004*	35.28 ± 4.54	35.22 ± 4.83	0.900
Muscle Mass (kg)	42.01 ± 6.69	41.41 ± 6.35	0.013*	38.01 ± 5.33	37.99 ± 5.62	0.941
Bone Mass (kg)	2.58 ± 0.41	2.54 ± 0.40	0.055	2.30 ± 0.31	2.27 ± 0.29	0.347
Body Mass Index (kg/m²)	27.63 ± 3.10	26.76 ± 2.89	<0.001*	24.97 ± 1.40	25.93 ± 1.34	0.724
Basal Metabolic Rate (kcal)	2,146.44 ± 364.27	2,143.25 ± 379.91	0.960	1,374.78 ± 109.69	1,974.44 ± 318.11	0.001*
Body Water (%)	45.64 ± 4.47	45.61 ± 4.19	0.956	45.37 ± 2.24	45.24 ± 2.34	0.895
Visceral Dat (%)	8.44 ± 2.34	7.88 ± 2.42	0.003*	6.67 ± 1.58	6.44 ± 1.51	0.169
Systolic Blood Pressure (mmHg)	124.22 ± 16.86	127.23 ± 20.12	0.541	120.33 ± 15.98	118.78 ± 11.54	0.750
Diastolic Blood Pressure (mmHg)	79.53 ± 8.43	82.20 ± 14.98	0.352	78.56 ± 13.13	78.72 ± 8.73	0.970
Blood Glucose mg/dl	108.31 ± 19.60	107.19 ± 23.06	0.887	114.44 ± 9.04	96.33 ± 8.89	<0.001*
Nutrition Knowledge (20 points)	12.63 ± 2.03	13.75 ± 2.79	0.057	11.78 ± 2.49	13.67 ± 2.96	0.090

- ERLB: Energy-Restricted Lunch Boxes, NE: Nutrition Education, S.D.=Standard Deviation, Kcal: kilocalorie, Cm: Centimeter, Kg: Kilogram, m²: Meter Square, mg/dL: Milligram per decilitre, mmhg: Millimeters of Mercury
Paired Samples t-test, *p-value ≤ 0.05

REFERENCES

1. World Health Organization, Regional Office for Europe. WHO European Regional Obesity Report 2022; World Health Organization, Regional Office for Europe: Copenhagen, Denmark, 2022.

2. World Health Organization. World obesity day 2022 – Accelerating action to stop obesity World Health Organization; 2022. [Internet]. Updated 2022 March 4; cited 2022 September 18. Available from: https://www.who.int/news/item/04-03-2022-world-obesity-day-2022-accelerating-action-to-stop-obesity.

3. Health Systems Research Institute (HSRI). The 6th Thai people's health survey by physical examination, 2019-2020 [Internet]. Health Systems Research Institute; 2021 [cited 2022 September 18]. Available from: https://www.hiso.or.th/hiso/picture/reportHealth/report/sreport6/sreport6_full.pdf.

4. Wright S M, Aronne L J. Causes of obesity. Abdom Imaging 2012; 37:730-2. doi:10.1007/s00261-012-9862-x

5. Thai Health Promotion Foundation. Thai people are the second most obese in ASEAN Thai Health Promotion Foundation; 2014. [Internet] Available from: https://www.thaihealth.or.th/?p=276173.

6. Waratornpaibul T. Consumption behavior: consumerism food and health-conscious food. Panyapiwat J 2014; 5:255-64.

7. Mohammadbeigi A, Asgarian A, Moshir E, Heidari H, Afrashteh S, Khazaei S, et al. Fast food consumption and overweight/obesity prevalence in students and its association with general and abdominal obesity. J Prev Med Hyg 2018; 59: E236–E40. doi:10.15167/2421-4248/jpmh2018.59.3.830

8. Sungpuag P, Sirichakwal P, Viriyapanit T. Low energy diet. J Ecos Persp 1997; 2:73-6.

9. Vasiloglou MF, Fletcher J, Poulia KA. Challenges and perspectives in nutritional counselling and nursing: A Narrative Review. J Clin Med 2019; 8:1489. doi:org/10.3390/jcm8091489

10. Brand Buffet. Thailand Health & Well Being Trend 2017. [Internet]. [cited 2022 September 18]. Available from: https://www.brandbuffet.in.th/2017/04/thailand-health-well-being-trend-2017/.

11. Sangwanna S, Phuphum J, Jansaard J, Changto T, Kraijaitrong A. Nutrition status of undergraduate students of Valaya Alongkorn Rajabhat University under the royal patronage. Poster session presented at the 6th Annual Conference of Science and Technology 2018, Samut Prakan, Thailand.

12. World Health Organization. The Asia-Pacific perspective: Redefining obesity and its treatment. Melbourne: International Diabetes Institute, 2000. Available from: https://apps.who.int/iris/handle/10665/206936

13. Lwanga SK, Lemeshow S. Sample Size Determination in Health Studies: A Practical Manual. Geneva: World Health Organization; 1991.

14. Pavlidou E, Papadopoulou SK, Seroglou K, Giaginis C. Revised harris–benedict equation: new human resting metabolic rate equation. Metabolites 2023; 13:189. doi:org/10.3390/metabo13020189

15. Yamauchi K, Katayama T, Yamauchi T, Kotani K, Tsuzaki K, Takahashi K, et al. Efficacy of a 3-month lifestyle intervention program using a Japanese-style healthy plate on body weight in overweight and obese diabetic Japanese subjects: a randomized controlled trial. Nutr J 2014; 13:108. doi:10.1186/1475-2891-13-108

16. Hutchesson MJ, Collins CE, Morgan PJ, Watson JF, Guest M, Callister R. Changes to dietary intake during a 12-week commercial web-based weight loss program: a randomized controlled trial. European J Clin Nutr 2014; 68:64-70. doi:10.1038/ejcn.2013.194

17. Pozo S, Gordillo J, Sanclemente G, Toral L, Gonzalez W, Delgado M. Change in the food pattern and its effects on the nutritional status of the indigenous population migrant Puruha (P04-045-9). Curr Dev Nutr 2019; 3:219-220. doi:10.1093/cdn/nzz051.P04-045-19

18. Rolls BJ, Morris EL, Roe LS. Portion size of food affects energy intake in normal-weight and overweight men and women. Am J Clin Nutr 2002; 76:1207-13. doi:10.1093/ajcn/76.6.1207

19. Te Morenga LA, Howatson AJ, Jones RM, Mann J. Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. Am J Clin Nutr 2014; 100:65-79. doi:10.3945/ajcn.113.081521

20. Ide H, Tsukada S, Asakura H, Hattori A, Sakamaki K, Lu Y, et al. A Japanese box lunch bento comprising functional foods reduce oxidative stress in men: a pilot study. Am J Mens Health 2022; 16. doi:10.1177/15579883221075498

21. Pham K, SKY J, Hill R, Haynes A, Pak S, A Shah S. Impact of vegan meal kits on cardiometabolic endpoints: a randomized, controlled clinical trial. Circulation 2022; 146:A15086.