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Original Article

Investigating the combined effects of diet and physical exercise on reducing body weight and waist circumference among mountain-dwelling Taiwanese people: Natural experiment of healthy community project

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Background and purpose: Obesity increases morbidity and mortality. Dieting and exercise are the most frequently methods used to decrease body weight. However, the superiority of diet alone, exercise alone, or a combination of the two in reducing body weight is still controversial. We evaluated the role of diet and exercise instruction on decreases in body weight, body mass index (BMI), and waist circumference (WC) among a group of mountain-dwelling Taiwanese. We were particularly interested in how body weight, BMI, WC reduction were associated with diet alone, exercise alone, two activities combined.
Method: An intervention study of diet education (2 weeks) and exercise instruction (10 weeks), as part of the healthy community project which served as a natural experiment, was conducted with residents of Fushing Township, northern Taiwan.
Results: A total of 50 adults participated in the program. The mean BMI was 26.1 kg/m^2 and 68% were overweight (BMI≥24 kg/m^2) at baseline. After the diet education and exercise program, there were significant reductions in body weight (0.8 kg), BMI (0.3 kg/m^2), and WC (1.7 cm). These reductions in body weight (r=-0.42), BMI (r=-0.41), and WC (r=-0.53) were most significantly correlated with total attendance in the diet and exercise activities combined.
Conclusion: This natural experiment of healthy community project showed that participants' body weight, BMI, and WC reduction were most correlated with overall frequency of attendance in diet and exercise classes combined.

Key words: diet, physical exercise, healthy communities, weight loss, waist circumference

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Introduction

Healthy city

The World Health Organization (WHO) has advanced the idea of a healthy city, defining it as one that is continually creating and improving its physical and social environment and expanding

community resources that enable people to mutually support each other in performing all the functions of life, so as to reach their maximum potential[1].

In 1999, Taiwan began to promote the Healthy Community Project, which was based on the WHO concept of the healthy city. The project allows residents to participate in local health plans to enhance access to health services and create a supportive physical, social, and economic environment, with the goal of enhancing individual health promotion. The Healthy Community Project adheres to the health promotion principle of primary health care[2]. Every year, the Taiwan Department of Health generously subsidizes local health promotion activities (including fitness and diet lectures) to encourage more people to participate in health promotion and lead healthy lives[3].

The health threat of obesity and overweight

Obesity increases morbidity and mortality and is, therefore, an important health issue that requires urgent attention. Obesity has been found to be associated with coronary heart disease, hypertension, stroke, certain types of cancer, type 2 diabetes mellitus, gallbladder disease, dyslipidemia, osteoarthritis, gout, pulmonary diseases, and sleep apnea[4].

The prevalence of obesity has increased in an increasing number of countries. A recent review article indicated that during the period from the 1970s to 2006 the prevalence of obesity had increased in Brazil, Canada, Mexico, and the United States[5]. In Taiwan, the prevalence of obesity (body mass index (BMI) $\geq$ 27 kg/m^2) was found to increase from 10.5% in men and 13.2% in women in the 1993-1996 survey to around 17% in 2005. The prevalence of being overweight (BMI=24.0-26.9) which was approximately 20% between 1993 and 1996 in both men and women, increased to 30% among men in 2005[6]. One study reported that the prevalence of obesity among mountain-dwelling Taiwanese range between 16% to 32.1%, and that this prevalence was higher in aboriginal Taiwanese (male 26.1%, female 32.1%) than in non-aboriginals (male 16%, female 20.2%)[7].

The effects of diet and physical exercise on weight loss

Dieting and physical exercise are the most frequently methods used to decrease body weight[8]. However, the superiority of diet alone, exercise alone, or a combination of the two in reducing body weight has been debated for some time. Kraemer et al. studied men whose BMI >28 and noted that the DES (diet + aerobic + strength training) group achieved a significantly greater loss in body fat percentage (-8.42%) at week 12 than did the DE (diet+aerobic exercise) group (-4.70%) and the D (diet only) group (-3.62%)[9]. Ho studied the effects of diet alone, exercise alone, and their combination on 28 menopausal women, and found that the combined regimen resulted in a decrease in body weight of 6.4 kg, which was greater than the effect of diet alone (–4.4 kg) or regular exercise alone (–5.2 kg)[10]. In a large-scale (n=436), community-based, 15-month intervention trial, a significant reduction of body weight was observed between the intervention and control groups by gender (change in body weight, –1.0 vs. -0.1 kg, respectively, for males; –1.8 vs. –0.6 kg for females)[11]. A meta-analysis of 25 years of research on weight loss from dieting, exercise, and dieting plus exercise interventions found that a 15-week diet, and a diet plus exercise program, resulted in a weight loss of approximately 11 kg and that, after 1 year, 6.6±0.5 kg and 8.6±0.8 kg, respectively, of this weight loss were maintained[12]. A systemic review of papers published between year 1998 and 2010 concluded that moderate physical activity for middle aged people (40-64 years) in combination with reduced calorie intake has a positive impact on body fat and body weight reduction[13].

Changing multiple behaviors

While many individual health behaviors are important, the impact of multiple behavior changes is increasingly being appreciated[14,15]. Noar et al. examined how health behavior theory might be applied to the growing literature on multiple behavior change. They described the approaches: a behavior change principles approach, a global health/behavioral category approach, and an approach regarding linkage among multiple

behaviors[16].

In the behavior change principles approach, the commonly used individual-level theories of health behavior and behavior change have been applied to a single behavior at a time. Several articles have attempted to integrate diverse behaviors, but more work is needed to better understand whether a common set of behavioral principles does indeed exist[16], and to determine whether there are theoretical differences between one-time behaviors versus those that are maintained, and between adoption versus cessation behaviors[17].

The global health/behavioral category approach assumes that there might be an entire network of health attitudes and beliefs that are interrelated when considering multiple behaviors. Hornik hypothesized the existence of a hierarchical structure of health behavior attitudes[18]. In this hierarchical structure, global health attitudes predict (or global self-efficacy predicts self-efficacy) behavioral categories; attitudes toward behavioral categories predict attitudes toward specific behaviors, and attitudes toward specific behaviors predict those actual behaviors. One's general orientation toward health may not lead directly to specific health behaviors, but it may increase the chances of particular health-related attitudes, which may in turn lead to specific health behaviors[16].

The third theoretical approach focuses on linkages among health behaviors, how particular health behavior constructs relate to one another, and how individuals actually change multiple health behaviors. King et al. (1996) concluded that multiple behavior change is more likely to occur sequentially (versus simultaneously), because those who had successfully changed one behavior were more likely to be motivated to change another[19].

Aims

This report describes a program involving diet (2 weeks) and physical exercise (10 weeks) for residents of the mountainous area of Fushing Township in Taoyuan County, northern Taiwan, undertaken as part of the Healthy Community Project, a program subsidized by Department of Health, Taiwan. This data can serve as a natural experiment to examine the role of diet and physical exercise in body weight, body mass index (BMI), and waist circumference (WC). We were particularly interested in how body weight, BMI, WC reduction were associated with diet alone, exercise alone, two activities combined.

Materials and Methods

Study area

Fushing Township is located in Taoyuan County, northern Taiwan. It is a mountainous area, 200-640 meters above sea level. It encompasses an area of 350.8 km^2, and includes 10 villages and 10511 residents, about 70% of whom are aboriginal Taiwanese[20-22].

Study subjects and recruitment

We invited employees from the Public Health Office, Township Office, Farmers' cooperative, and elementary schools in Fushing Township to participate in the diet and exercise program. We also posted the information about the program on bulletin boards in three township offices (Sanmin Village, Tsejen Village, and Lofu Village) and asked the village chiefs to invite local residents to participate in the program. Broadcasting in the village was made two hours ahead of each activity to remind residents to attend.

This study was approved by the Institutional Review Board of Chang Gung Memorial Hospital (No. 97-0682B). Because a number of fraudulent activities have occurred in this region in recent years, we did not request written informed consent for participation.

Program content

The program took place from March through June 2008 (12 weeks). Lectures on diet were held during the first and second weeks (once each week, 2 hours each lecture), after which there were ten exercise classes (once a week, 1 hour each class). During the first diet lecture, the instructor (a dietician) taught participants how to calculate their ideal body weight; the relationship between BMI, disease and death; and the relationship between diet and body weight. Participants were also taught the number of calories required for men and women of different ages, and how to calculate the number

of calories in different foods. The instructor also emphasized that managing one's diet is a successful method for controlling body weight. The participants were then asked to record their 24-hour diet at home. In the first half of the second lecture, the dietician examined individual diet records, explained the advantages and disadvantages of their dietary habits, and offered suggestions for improvement. In the second half of the second lecture, the dietician provided information on healthy food, including cooking methods, the use of sauces, dining locations, calories in drinks, cold snacks, snacks, and night snacks. The instructor also explained the weight loss plateau phenomenon and how to overcome it. In the 10 exercise classes, qualified yoga teachers taught yoga and aerobic exercise, emphasizing improvement in heart-lung function, muscle strength, endurance, and flexibility.

Measurement

Because all participants voluntarily attended the program, their body height, body weight, and waist circumference (WC) were measured when the participant first attended the program (baseline measurement). Their body weight and WC were measured again at the last 3 exercise classes and the averages of these 3 measurements of body weight and WC were used as the post-intervention measurements. All measurements were conducted before the beginning of that day's diet or exercise class. For participants who left the program before the last 3 exercise classes, the project managers measured their body weight and WC on the day of or day after the last exercise class. A participation log (including participants' names and dates of attendance) was kept to calculate the duration and times of participation.

BMI (kg/m^2) was calculated by body weight (kg) divided by the square of body height (m^2). Body weight and body height was measured using automatic height scale (HW-3050), which was calibrated by the supplied manufacturer every month.

WC was measured at the part of the trunk located midway between the lower costal margin (bottom of lower rib) and the iliac crest (top of pelvic bone) while the person was standing with feet approximately 25 to 30 cm apart. The measurer stood beside the individual and fitted the tape snugly, but without compressing any underlying soft tissues. Circumference was measured to the nearest 0.5 cm (1/4 inch), at the end of a normal exhalation. For this study, 4 measurers were trained; the intra-class correlation coefficient ICC[23] were 0.97, respectively, for measurements of 10 participants.

Statistical analysis

Not all participants attended the whole program, so the effects of diet class and exercise on decreases in body weight, BMI, and WC were determined by the frequency of attendance. The participants were classified into 5 types based on their attendance to the diet and exercise classes. Type A was based on the frequency of attendance in diet lectures (0=none, 1=1 class, 2=2 classes); type B was based on the frequency of attendance in exercise classes (1=0-3 classes, 2=4-6 classes, 3=7-10 classes); type C was based on combined attendance in the two activities, but ranked by diet frequency and then by exercise class frequency (1=0 diet class and 0-3 exercise classes, 2=0 diet class and 4-6 exercise classes, 3=0 diet class and 7-10 exercise classes, 4=1 diet class and 0-3 exercise classes, 5=1 diet class and 4-6 exercise classes, 6=1 diet class and 7-10 exercise classes, 7=2 diet classes and 0-3 exercise classes, 8=2 diet classes and 4-6 exercise classes, 9=2 diet classes and 7-10 exercise classes); type D was based on the combined attendance in the two activities, but ranked by exercise class frequency and then by diet class frequency (1=0-3 exercise classes and 0 diet class, 2=0-3 exercise classes and 1 diet class, 3=0-3 exercise classes and 2 diet classes, 4=4-6 exercise classes and 0 diet class, 5=4-6 exercise classes and 1 diet class, 6=4-6 exercise classes and 2 diet classes, 7=7-10 exercise classes and 0 diet class, 8=7-10 exercise classes and 1 diet class, 9=7-10 exercise classes and 2 diet classes); and type E (5 levels) was based on total attendance in these 2 activities (sum of A and B).

The paired t-test was used to compare body weight, BMI, and WC at baseline and after the intervention. The Spearman correlation coefficient was used to measure the magnitude of linearity

between the reduction in body weight, BMI, WC, and duration in each type. The significance level was 0.05.

Results

Demographic characteristics

There were 50 participants in the diet and exercise classes; the average age was 42.7 years (SD=11.2). Most (43) were women (86%), and 23 (46%) were aboriginal Taiwanese. The mean BMI was 26.1 kg/m^2; 34 (68%) participants were overweight (BMI≥24). The mean WC was 86.7 cm for male participants and 83.8 cm for female participants.

Reduction in body weight, BMI, waist circumference

After the diet and exercise classes, the mean reduction in body weight was 0.8 kg, which was statistically significant (p<.001). The correlation between the reduction in body weight and the frequency of attendance was strongest for type E (r = -0.42, p =.003) (Table 1). The mean reduction in BMI was 0.3 kg/m^2, which was statistically significant (p<.001). The correlation between the reduction in BMI and attendance frequency was strongest for type E (r= -0.41, p=.003) (Table 2). WC was decreased in 1.7 cm, which was statistically significant (p<.001). The correlation between the reduction in WC and the frequency of attendance was strongest for type E (r=-0.53, p<.001) (Table 3).

The mean duration of participation was 1.5±0.8 months. The correlation coefficients between changes in body weight, BMI, and WC and the duration of participation in diet and exercise classes were -0.29, -0.31, and -0.33, respectively; all correlations were significant.

Discussion

This study reported findings from a 12-week diet and exercise program organized by the Public Health Office of Fushing Township (a mountainous township), Taoyuan County in Taiwan, under the Healthy Community Project subsidized by Department of Health, Taiwan. The results show that the body weight, BMI, and WC of participants were significantly lower after the diet and exercise intervention. The correlation between the decreases in body weight, BMI, and WC and the overall frequency of attendance (type E) was most significant.

In this study, after the 12-week diet and exercise intervention, body weight, BMI, and WC were all significantly reduced (by 0.8 kg, 0.3 kg/m^2, and 1.7 cm, respectively). These findings are consistent with those of Haruyama et al., who described a 6-month diet plus exercise program in Japan[11]. The body weight of men and women were reduced by 0.4 and 0.7 kg, respectively, and their BMI were reduced by 0.1 and 0.3 kg/m^2 [11]. The comparable reduction in BMI observed by us and by Haruyama et al.[11] is most likely due to the similarity in the subjects' baseline body weights.

In this study, the decreases in body weight, BMI, and WC were less than those noted in studies by Chung et al.[24] and Lai et al.,[25] possibly because the participants in those earlier studies were more overweight than those in the present study. When the intervention periods of the earlier studies were longer (24 weeks to 15 months), their decreases (1.0 to 8.3 kg for body weight, 0.3 to 3.3 kg/m2 for BMI, and 1.2 to 4.8cm for WC)[26-29] were more substantial than those of the present study.

Although the present study was not a randomized control trial, the healthy community project can serve as a natural experiment to examine the role of the two activities in the reduction of body weight, BMI, and WC. We have provided a useful and straight forward method of examining the effects of diet, exercise, and their combination on the reduction of body weight, BMI, and WC by examining the frequency of attendance to the 2 activities. The results show that decreases in body weight, BMI, and WC were most significantly correlated with type E (frequency of attendance). The greater the frequency and time of attendance in diet plus exercise classes, the more significant the changes in body weight, BMI, and WC. The combined effects on decreases in body weight, BMI, and WC were clearly more significant than those produced by any one activity. The order

Table 1. Change in body weight (kg) by type of attendance

Type	n	Baseline (mean±SD)	Post-intervention (mean±SD)	Change (mean±SD)
Total	50	63.2±8.3	62.3±8.3	-0.8±1.5
p[1]		-	-	<.001
A				
0	22	63.5±7.0	63.2±7.1	-0.3±1.4
1	16	63.1±10.6	62.1±10.6	-1.1±1.1
2	12	62.7±7.8	61.2±7.3	-1.5±1.9
r / p[2]				-0.30 / .03
B				
1	21	62.4±9.9	62.0±9.7	-0.5±0.9
2	16	66.0±6.8	65.0±7.0	-1.0±1.0
3	13	60.9±6.6	59.7±6.7	-1.3±2.5
r / p[2]				-0.29 / .04
C				
1	7	60.4±6.1	60.5±6.0	0.1±0.5
2	10	66.9±7.4	66.0±7.7	-0.9±0.8
3	5	61.0±4.7	61.4±6.5	0.4±2.6
4	8	64.5±13.5	64.0±13.4	-0.5±0.6
5	4	63.1±7.0	62.1±6.8	-1.0±1.4
6	4	60.4±8.7	58.2±8.3	-2.2±1.0
7	6	62.0±9.0	61.0±8.4	-1.0±1.2
8	2	67.5±2.1	66.4±3.4	-1.1±1.3
9	4	61.4±8.4	58.9±6.9	-2.5±2.8
r / p[2]				-0.38 / .01
D				
1	7	60.4±6.1	60.5±6.0	0.1±0.5
2	8	64.5±13.5	64.0±13.4	-0.5±0.6
3	6	62.0±9.0	61.0±8.4	-1.0±1.2
4	10	66.9±7.4	66.0±7.7	-0.9±0.8
5	4	63.1±7.0	62.0±6.8	-1.0±1.4
6	2	67.5±2.1	66.4±3.4	-1.1±1.3
7	5	61.0±4.7	61.4±6.5	0.4±2.6
8	4	60.4±8.7	58.2±8.3	-2.1±1.0
9	4	61.4±8.4	58.9±6.9	-2.5±2.8
r / p[2]				-0.38 / .01
E				
1	7	60.4±6.1	60.5±6.0	0.1±0.5
2	18	65.8±10.3	65.1±10.3	-0.7±0.7
3	15	62.0±6.8	61.4±6.9	-0.5±1.8
4	6	62.8±7.7	60.9±7.9	-1.8±1.1
5	4	61.4±8.4	58.9±6.9	-2.5±2.8
r / p[2]				-0.42 / .003

r: Spearman correlation coefficient, [1]: Paired t test, [2]: test of Spearman correlation
Type A, B, C, D, E: please refer to the section of statistical analysis.

of two activities was not important.

From the perspective of a global health/ behavioral category approach[18], diet and exercise belong in the similar behavioral category; hence, we saw significant reductions in body weight, BMI, and WC. From the perspective of the linkage among multiple behaviorals[19], our diet education and exercise program was offered sequentially to participants who lost weight or reduced their WC after practicing dietary changes. They were then

Table 2. Change in body mass index (kg/m^2) by type of attendance

Type	n	Baseline (mean±SD)	Post-intervention (mean±SD)	Change (mean±SD)
Total	50	26.1±3.7	25.6±3.7	-0.3±0.6
p[1]		-	-	<.001
A				
0	22	26.6±3.8	26.4±3.7	-0.1±0.5
1	16	25.5±4.1	25.1±4.1	-0.4±0.5
2	12	26.0±3.3	25.4±3.2	-0.6±0.7
r / p[2]				-0.30 / .04
B				
1	21	25.9±3.8	25.7±3.7	-0.1±0.3
2	16	27.1±4.2	26.7±4.2	-0.4±0.4
3	13	25.1±2.9	24.6±2.8	-0.5±1.0
r / p[2]				-0.30 / .04
C				
1	7	26.1±3.1	26.1±3.0	0.04±0.2
2	10	27.9±4.5	27.5±4.1	-0.4±0.3
3	5	24.7±2.4	24.8±2.3	0.1±1.0
4	8	25.9±5.1	25.7±5.0	-0.2±0.3
5	4	24.4±3.0	24.1±3.2	-0.4±0.5
6	4	25.9±3.6	25.0±3.4	-0.9±0.4
7	6	25.8±3.1	25.4±3.0	-0.4±0.5
8	2	28.8±3.6	28.3±3.0	-0.5±0.6
9	4	24.8±3.6	23.9±3.3	-1.0±1.1
r / p[2]				-0.38 / .01
D				
1	7	26.1±3.1	26.1±3.0	0.04±0.2
2	8	25.9±5.1	25.7±5.0	-0.2±0.3
3	6	25.8±3.1	25.4±3.0	-0.4±0.5
4	10	27.9±4.5	27.5±4.6	-0.4±0.3
5	4	24.5±3.0	24.1±3.2	-0.4±0.5
6	2	28.8±3.6	28.3±3.0	-0.5±0.6
7	5	24.7±2.4	24.8±2.3	0.1±1.0
8	4	25.9±3.6	25.0±3.4	-0.9±0.4
9	4	24.8±3.6	23.9±3.3	-1.0±1.1
r / p[2]				-0.39 / .01
E				
1	7	26.1±3.1	26.1±3.0	0.04±0.2
2	18	27.0±4.8	26.7±4.7	-0.3±0.3
3	15	25.1±2.7	24.8±2.7	-0.2±0.7
4	6	26.9±3.6	26.1±3.4	-0.8±0.5
5	4	24.8±3.6	23.9±3.3	-1.0±1.1
r / p[2]				-0.41 / .003

r: Spearman correlation coefficient , [1]: Paired t test, [2]: test of Spearman correlation
Type A, B, C, D, E: please refer to the section of statistical analysis.

more confident or more motivated to remain in the exercise program.

Study limitations

This was a study of a 12-week diet and exercise program that was part of a healthy community project. Thus, our study suffered many drawbacks.

Table 3. Change in waist circumference (cm) by type of attendance

Type	n	Baseline (mean±SD)	Post-intervention (mean±SD)	Change (mean±SD)
Total	50	84.2±8.2	82.5±8.1	-1.7±2.8
p[1]		-	-	<.001
A				
0	22	82.5±5.9	82.1±6.1	-0.4±0.9
1	16	84.9±10.0	82.7±10.5	-2.2±3.3
2	12	86.2±9.0	82.7±8.5	-3.5±3.3
r / p[2]				-0.38 / .01
B				
1	21	85.1±9.1	84.1±8.7	-1.1±2.2
2	16	85.0±7.3	83.7±6.9	-1.3±2.2
3	13	81.6±7.4	78.4±7.6	-3.2±3.6
r / p[2]				-0.32 / .02
C				
1	7	81.6±1.8	81.9±1.8	0.3±0.3
2	10	83.7±7.8	82.9±8.0	-0.8±0.8
3	5	81.6±5.8	80.9±6.4	-0.7±1.1
4	8	85.5±13.4	85.0±13.0	-0.5±0.6
5	4	85.5±6.9	84.2±6.5	-1.3±1.1
6	4	83.3±5.8	76.7±7.4	-6.6±4.1
7	6	88.8±6.6	85.4±7.5	-3.4±2.9
8	2	90.5±6.4	86.3±0.5	-4.2±6.8
9	4	80.0±11.6	76.9±10.3	-3.1±3.1
r / p[2]				-0.49 / <.001
D				
1	7	81.6±1.8	81.9±1.8	0.3±0.3
2	8	85.5±13.4	85.0±13.0	-0.5±0.6
3	6	88.8±6.6	85.4±7.5	-3.5±2.9
4	10	83.7±7.8	82.9±8.0	-0.8±0.8
5	4	85.5±6.9	84.2±6.5	-1.3±1.1
6	2	90.5±6.4	86.3±0.5	-4.2±6.8
7	5	81.6±5.8	80.9±6.4	-0.7±1.1
8	4	83.3±5.8	76.7±7.4	-6.6±4.1
9	4	80.0±11.6	76.9±10.3	-3.1±3.1
r / p[2]				-0.45 / .001
E				
1	7	81.2±1.8	81.9±1.8	0.3±0.3
2	18	84.5±10.3	83.9±10.2	-0.6±0.7
3	15	85.5±6.7	83.6±6.7	-2.0±2.3
4	6	85.7±6.5	79.9±7.6	-5.8±4.6
5	4	80.0±11.6	76.1±10.3	-3.1±3.1
r / p[2]				-0.53 / <.001

r: Spearman correlation coefficient , [1]: Paired t test, [2]: test of Spearman correlation
Type A, B, C, D, E: please refer to the section of statistical analysis.

(1) There was no control group, assignment of participants was not randomized, and the participants and measurers were not masked. (2) We could not determine how many subjects participated in the healthy community project. However, statistical power (91%) was sufficient to see a Pearson correlation coefficient of -0.4 with a sample size of 50 at 0.05 significance level. (3) We did not assess the participants' pre-intervention dietary habits; thus, we do not know whether

their habits changed after the diet education. However, these limitations are common in research of this type. (4)We measured only body height, body weight, and WC, and did not collect other information on the participants' health status. Thus, we cannot examine the effects of diet and exercise instruction on parameters such as blood pressure and blood cholesterol. (5) Most studies of exercise interventions measure participants' muscle strength, knee flexion and extension, flexibility, and the functioning of the heart and lungs. However, this study only focused on body weight and WC. (6) Usually, body weight , BMI, WC reduction vary with gender and the statistical analysis should be stratified by gender. As the sample size is quite small, we could not stratify the data by gender. (7) Because body weight and WC were not measured at the end of the diet classes, the effect of diet alone could not be separately investigated.

Conclusion

This study examined a 12-week diet and exercise intervention and found that the participants' body weight, BMI, and WC were significantly lower at completion of the program (0.8 kg, 0.3 kg/m^2, and 1.7 cm), and that the correlation with type E (overall frequency of attendance in diet and exercise classes) was most significant.

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Competing interests

The authors declare that they have no competing interests.

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Original Article

飲食控制與運動對山地民眾在體重、腰圍下降之成效探討：社區健康營造計畫的自然實驗

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背景與目的：肥胖會增加疾病率及死亡率。飲食控制與運動是最常被用來減重的方法。但是單純採用飲食控制、單純採用運動，或採用合併此兩種方法在減重之效果何種較佳尚無定論。本研究評估山地民眾飲食控制與運動之綜合效果對減重之影響，我們特別對上述方法（單純考慮任一種、同時考慮兩種）在減重之效果作統計分析。

材料與方法：本研究為社區健康營造計畫的一部份，可視為一自然實驗，屬單組有前後測的實驗設計。介入活動在桃園復興鄉施行，包括飲食控制課程2週及運動課程10週。

結果：共50位成人參加活動。活動介入前平均BMI為26.1 kg/m^2，且有68%的人屬過重範圍（BMI≧24 kg/m^2）。經過飲食控制及運動課程的介入後，體重（0.8公斤）、BMI（0.3 kg/m^2）、腰圍（1.7公分）均有明顯的減少。且飲食控制及運動合併與體重、BMI、腰圍下降之相關最強，相關係數分別為-0.42，-0.41，-0.53。

結論：本社區健康營造的自然實驗結果顯示，飲食控制及運動合併對體重、BMI、腰圍下降的效果最佳。

關鍵詞：飲食控制、運動、社區健康營造、減重、腰圍

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