Feasibility and efficacy of a technology-based weight loss intervention program through public-private partnerships in Japan

Seika Kamohara^{1,2)*}, Yoshiko Terasaki²⁾, Sachiyo Tomita²⁾, Rika Kishino²⁾, Sayaka Kanmuri²⁾, Hiroe Ajioka²⁾, Hiromichi Seki²⁾

1) Health Science University, Yamanashi, Japan

2) DHC Corporation, Tokyo, Japan

Abstract:

Objectives: Measures by Public-Private Partnerships (PPPs) have been considered as possible modalities for local governments to conduct health promotion policies. The low energy meal replacement regimens are used for weight loss in obese patients. The aim of this project is to evaluate the feasibility and efficacy of a weight loss intervention program by a local government through PPPs in Japan.

Methods: Overweight or obese subjects in Sakai-town, Ibaraki pref., participated in the weight loss program, using telephone and/or personalized website to receive individual dietary counseling from medical professionals. Meal replacements were consumed once daily instead of regular meals. A standardized product contains 20.1 g of protein, one-third of the RDA of vitamins/minerals, and other food ingredients in 1 bag gross weight 50 g or 167 kcal. Anthropometric parameters and body composition were assessed before and after the 12-week weight-loss program.

Results: Ninety-two participants (male 47, female 45) completed the program between 1st, August 2018 and 13th, November 2018. Compared with the baseline, the significant decreases in BMI, body weight and waist circumference were observed.

Conclusion: The result demonstrated that a technology-based intervention, combined with meal replacements was feasible and effective for reducing body weight in obese subjects. The issues in implementing health promotion projects as PPPs will be examined, and further efforts to achieve the extension of the healthy lifespan will be taken to realize a healthy longevity society. The scheme of PPPs will play pivotal roles in the implementation of integrative health measure through public health services.

Keywords:

obesity, meal replacement, public-private partnerships, weight loss, Protein Diet

Personalized Medicine Universe 2020; 9: 46-50

1. Introduction

The prevalence of overweight and obesity has continued to increase over the last several decades worldwide [1]. They are defined as abnormal or excessive accumulation of fat that can increase the risks of several non-communicable diseases such as hypertension, dyslipidemia, and diabetes [2,3].

Currently, a variety of weight management interventions are available, and well-designed lifestyle interventions showed some benefits. Several studies have described the use of low energy liquid diets as components of intensive lifestyle modification programs for the treatment of obesity [4].

Clinic-based meal replacement programs are widely used for weight management. A healthcare company, DHC Cor-

*Corresponding author: Seika Kamohara, kamohara-seika@umin.ac.jp

Article history: Received 6 August 2020, Received in revised form 10 September 2020, Accepted 30 September 2020

<https://doi.org/10.46459/pmu.2020006>

Copyright © 2020 International Society of Personalized Medicine

poration, Tokyo, Japan, established a technology-based, indirect, personalized intervention for weight-loss [5].

In the field of public health, local governments are responsible for performing national policies, including reducing obesity and metabolic syndrome. However, they have faced challenges in conducting health promotion policies because of limited resources. Measures by Public-Private Partnerships (PPPs) have been considered as possible modalities to attract additional resources [6]. Besides, private companies would take efforts from CSR (Corporate Social Responsibility) to CSV (Creating Shared Value) for successful PPPs [7].

As of March 2020, DHC Corporation has signed comprehensive partnership agreements with 21 local governments nationwide of Japan for regional revitalization and health promotion [8]. Several local governments have started new health promotion plans with us. One of them was a technology-based weight loss intervention program as a high-risk approach.

Sakai-Town, Ibaraki prefecture adopted the DHC Weight loss program as part of health promotion measures since 2017. Previously, we reported the result of the weight loss program recruited and conducted in 2017, which showed some usefulness [9].

The aim of this project was to prove the efficacy of the meal replacement-based weight loss program and to evaluate the feasibility as a healthcare policy by a local government through PPPs.

2. Materials and methods

2.1. Public-Private Partnerships

Sakai-Town and DHC Corporation signed a comprehensive cooperation agreement on September 6, 2016, with the aim of revitalizing the local community and promoting the health of residents. After careful discussion regarding specific initiatives for health promotion, the town adopted implemented the DHC Weight loss program as a measure to improve obesity and metabolic syndrome for residents [10].

2.2. Subjects

Overweight or obese residents, otherwise healthy, in Sakai-Town were recruited by the town hall from May to June, 2018. Exclusion criteria were younger than 20 years old, BMI < 25 kg/m², cardiovascular disease, diabetes mellitus, psychiatric illness, eating disorders and other conditions contraindicating weight loss. The participants received individual dietary counseling from medical professionals for three months, using telephone and/or personalized website.

The procedures used in this evaluation were in accordance with the Declaration of Helsinki in the currently valid version amended by the 64th WMA General Assembly, Fortaleza, Brazil, October 2013, and were reported and approved by the Ethics Committee of the DHC Corporation. All participants gave their written informed consent before

their inclusion into the program.

2.3. Program design

'The Metabo/Obesity Escape Program[®] (DHC Corporation, Tokyo, Japan)' was adopted by the division of health promotion of Sakai-Town as 'the Sakai-town Obesity Escape Project[®]'. It was a standardized, meal replacement-based weight loss program with a duration of at least 12 weeks.

The program consisted of the following components.

(1) Meal replacement regimens

Low energy meal replacements, 'DHC Protein Diet[®]', were consumed once daily instead of regular meals. A standardized product of 'DHC Protein Diet[®]' contains 20.1 g of protein, one-third of RDA of vitamins and minerals, 7.5 g of dietary fiber in 1 bag gross weight 50 g or 167 kcal. The values of the RDA were based on Dietary Reference Intakes for Japanese (2015), Ministry of Health, Labour and Welfare. Nutrient composition of a standardized product is shown in Table 1. The meal replacement dissolved in 380 mL water for intake. The participants were advised to maintain their usual diet except for use of the meal replacements once daily. They were also informed that several medical studies had reported that such meal replacement in the morning was superior to that in the afternoon or evening in terms of weight-loss.

(2) An internet site for recording data

A dedicated internet site for recording daily body weight and lifestyles such as food intakes and physical activities was built and prepared for participants. Participants recorded percent body fat and lean body mass by bioelectrical impedance analysis (BIA), and body weight and waist circumference by conventional anthropometry. Contents of daily food intakes were also recorded. Once a month, participants submitted a self-reflective report on their status of weight loss.

(3) Personalized counseling

Individual dietary counseling from medical professionals was provided via telephone and/or personalized website. Participants received individual nutritional advice from registered dietitians based on information from the application form which had dietary habits and other lifestyle characteristics. As mentioned above, the participants were advised to maintain their usual meals except for use of the meal replacement once daily; i.e. two usual meals and one meal replacement per day. During the program, participants can inquire about their food intake, physical activities, and health-related issues via toll-free telephone or e-mail. Personalized nutritional advice was given when their usual diets were not appropriate for weight-loss; i.e. high fat diet, low fiber, excessive intake of energy or simple carbohydrates etc. They also received advice based on their self-reflective report on the status of weight loss.

Table 1. Nutrient composition of a standardized meal replacement product

Content	amount
Energy (kcal)	167
Protein (g)	20.1
Lipid (g)	1.5
Glucose (g)	14.7
Fiber (g)	7.8
Vitamin A (μg)	550
Vitamin B1 (mg)	1.5
Vitamin B2 (mg)	1.0
Vitamin B6 (mg)	1.0
Vitamin B12 (μg)	3.2
Vitamin C (mg)	60.0
Vitamin D3 (μg)	3.8
Vitamin E (mg)	6.5
Niacin (mg)	15
Folic acid (μg)	180
Pantothenic acid (mg)	4.5
Calcium (mg)	400
Magnesium (mg)	140
Manganese (mg)	2.2
Iron (mg)	8.0
Sodium (mg)	197
Potassium (mg)	950
Iodine (μg)	110
Selenium (μg)	20
molybdenum (μg)	30
Zinc (mg)	5
Copper (mg)	0.8
Chromium (μg)	30
Polyphenols (mg)	120
Coenzyme Q10 (mg)	35
Hyaluronic acid (mg)	20

1 The table showed a standardized formula of Strawberry milk flavor. Polyphenols derived from grape seed extract. Composition analysis was done by Japanese Food Research Laboratories.

(4) Educational information

Educational information on diet and exercise for weight loss was provided. For example, the participants were informed that several reports had shown that such meal replacement in the morning was superior to that in the afternoon or evening in terms of weight-loss. Participants received information on nutritional advice for weight-loss via weekly e-mail. The instructional materials for physical exercise were provided as DVDs and brochures.

(5) Measurement of the visceral fat area by abdominal CT

The visceral fat area was measured by an abdominal CT scan in applicants among the participants.

2.4. Statistical analysis

Values obtained after the 12-week supplementation period

Table 2. Characteristics of 92 participants

		n
sex	male	47
	female	45
BMI	25-30	70 (76.1%)
	30-35	16 (17.4%)
	over 35	6 (6.5%)

Table 3. Effects of the program on body composition

	Baseline	12 weeks	p value
BMI	28.9 ± 0.3	27.7 ± 0.3	p < 0.05
Body weight (kg)	76.4 ± 1.2	73.3 ± 1.2	p < 0.05
Waist circumference (cm)	95.9 ± 1.9	92.2 ± 1.8	p < 0.05

N = 92; BMI, body mass index. Values are represented as mean ± standard error. The p values indicate the difference between values at the baseline and at 12 weeks.

were compared to the baseline values by using the Wilcoxon signed-rank test. A p-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Change of BMI and anthropometric parameters

Ninety-two participants (male 47, female 45) completed the 12-week weight-loss program between 1st, Aug, 2018 and 13th, Nov, 2018. The characteristics of 92 participants is shown in Table 2. Anthropometric parameters, and body composition were assessed before and after the 12-week program.

The significant decreases of BMI (28.9 ± 0.3 to 27.7 ± 0.3 , $p < 0.05$), and body weight (76.4 ± 1.2 kg to 73.3 ± 1.2 kg, $p < 0.05$) were detected after 12 weeks, compared to the baseline level. Waist circumference (95.9 ± 1.9 cm to 92.2 ± 1.8 cm, $p < 0.05$) also significantly decreased (Table 3).

Eighty-four out of 92 participants (91.3%) decreased body weight compared with the baseline. Forty-eight of them (52.2%) showed decreased body weight more than 3% compared with the baseline. Twenty of them (21.7%) reached a BMI below 25. The total amount of the decreased body weight of all participants was 299 kg in 12 weeks.

3.2. Change of visceral fat area

The visceral fat area was measured in 36 participants (male 15, female 21, mean age 51.7 years). The visceral fat area (cm²) significantly decreased from 165.20 ± 13.29 to 138.99 ± 11.51 ($p < 0.05$).

4. Discussion

A Technology-Based Weight Loss Intervention Program,

Table 4. Effects of the program on visceral fat area

	Baseline	12 weeks	p value
visceral fat area (cm ²)	165.20 ± 13.29	138.99 ± 11.51	p < 0.01

The visceral fat area was measured by CT scan (N = 36, male 15, female 21, mean age 51.7 years). Values are represented as mean ± standard error. The p values indicate the difference between values at the baseline and at 12 weeks.

“Sakai-Town Metabo-Escape Project,” was implemented as a health promotion project targeting residents at the Sakai-town, Ibaraki Prefecture, Japan. The result showed the overall successful weight reduction among participants. Therefore, a certain degree of the efficacy and feasibility of the Information and Communications Technology (ICT)-based behavior management program with meal replacement regimens was demonstrated as a health promotion policy by a local government through public-private partnerships.

It was well-established that a weight loss of 3% or more can improve obesity-related conditions such as hypertension and dyslipidemia [11]. In this program, more than half (57.0%) of participants achieved a more than 3% weight loss.

A non-face-to-face ICT based weight loss program was developed and marketed as self-care for obesity and metabolic syndrome by DHC Corporation. Previously the efficacy of the program was reported as the results of the “DHC Diet Award” [12,13]. This time, the program was constructed based on those products and services developed for local governments. Sakai-town, a local government adopted as a part of the health promotion measures for obese residents [9,10].

As shown above, the efficacy and feasibility were found to some extent as the health promotion policy by Sakai-town. The reason was that a certain degree of behavioral change was achieved by the support of registered dietitians specializing in the weight loss program and follow-up via ICT such as a dedicated website on the internet.

The efficacy of meal replacements was well proven for use in energy-restricted diets for weight reduction. In recent years, numerous studies have also shown the usefulness of a non-face-to-face design weight loss program utilizing ICT [14]. In this program, in addition to the support of the program’s dedicated dietitians and follow-up using ICT, the establishment of an award ceremony sponsored by the local government called the “Sakai-town Diet Award” was conducted at the end of the program. It was considered that the award worked as an incentive for participating residents. It was one of the reasons to change their behavior for successful weight loss.

In recent years, the internet-based intervention programs for weight loss were validated. For example, in randomized controlled trials, obese patients with hypertension in primary care settings achieved significant weight loss using the web-based program [15–17]. Cost-effectiveness studies also showed that non-face-to-face weight loss maintenance pro-

grams via the internet were superior to conventional and analog-type programs [18–21].

In this program, there were several cases where local participants who did not get used to the internet site and needed to be advised through local government officials. Local governments’ health promotion measures were expected to involve people of all ages and backgrounds. Although ICT-based programs are considered to have certain usefulness and advantages, further improvement in convenience, operability, and follow-up systems are one of the issues to be studied in the future for local governments.

Generally, local governments are responsible for performing national policies, including health promotion and disease prevention. However, they have faced challenges in conducting those policies because of limited resources. Measures by Public-Private Partnerships (PPPs) have been considered as possible modalities to attract additional resources [6]. Besides, private companies would take efforts from CSR (Corporate Social Responsibility) to CSV (Creating Shared Value) for successful PPPs [7].

The meal replacement products used this time has the advantage of being more economically sustainable than similar products of the past, and is a cost-effective product for local governments. To encourage behavioral change, a nutrition and activity diary for self-reflection and a participant handbook for support and exercises at home were used as instruments of behavior therapy. After the weight reduction, there is the possibility to participate in a follow-up program for an unlimited period of time.

The scheme of PPPs could be applied public health services to promote measures based on the concept of integrative and complementary medicine.

5. Limitations

This study has several limitations as the project of health promotion policy by the local government through public private partnerships and affecting the generalizability of the findings across the local governments or the country.

First, the study was an open-label intervention with no control group. The reason is that the primary purpose of this project was not to detect the weight loss effect of the formula diet, but to verify the feasibility of the problem-solving health promotion policy by a local government. In other words, the weight-loss effect with formula diets has been well established as obesity treatment. So far, numerous intervention trials for obesity using formula diets have already been reported in various clinical settings. It is stated in the clinical practice guidelines as one effective dietary therapy. On the other hand, there are not many real-world applications such as local government health services. In other words, efficacy of formula diet for weight-loss has been well established. Numerous intervention trials for the treatment of obesity using a formula diet have already been reported and is clearly stated in the guidelines for the management of obesity disease published by the Japan Society

for the Study of Obesity.

On the other hand, practical applications for public health measures on weight-loss interventions have not been well reported on.

The purpose of this project is to evaluate the feasibility as a problem-solving health measure through public-private partnerships and to report as real-world evidence. Generally, health promotion projects conducted by local governments are not able to set up any control groups without intervention because they are required to provide measures to all potential residents equally. Therefore, only intervention group was set in this weight-loss project due to constraints of the real world setting in the field of public health. Nevertheless, this project met the objective to show feasibility and efficacy of a weight loss program implemented as a problem-solving health project based on public-private partnership in Japan. The scheme of PPPs is feasible and effective to conduct public health policies as problem-solving measures in the by local governments.

6. Conclusion

The result demonstrated that a technology-based intervention, combined with commercial meal replacements was effective and feasible for reducing body weight in obese subjects as health policy by a local government with PPPs.

Funding

This publication was supported by a research grant from the DHC Corporation, Tokyo, Japan.

Conflicts of interest

Seika Kamohara is a Special Research Advisor for the DHC Corporation.

Acknowledgments

The authors thank Mayor Masahiro Hashimoto, all the staff of the town hall, and residents of Sakai-Town for conducting the program; Ms. Reiko Kawahara for helping to prepare the manuscript.

References

- [1] Engin A. The Definition and Prevalence of Obesity and Metabolic Syndrome. *Adv Exp Med Biol* 2017;960:1–17.
- [2] Fava MC, Agius R, Fava S. Obesity and cardio-metabolic health. *Br J Hosp Med (Lond)* 2019;80(8):466–71.
- [3] Peters R, Ee N, Peters J, et al. Common risk factors for major noncommunicable disease, a systematic overview of reviews and commentary: the implied potential for targeted risk reduction. *Ther Adv Chronic Dis* 2019 Oct 15;10:2040622319880392.
- [4] Bray GA, Frühbeck G, Ryan DH, et al. Management of obesity. *Lancet* 2016;387:1947–56.
- [5] Andela S, Burrows TL, Baur LA, et al. Efficacy of very low-energy diet programs for weight loss: A systematic review with meta-analysis of intervention studies in children and adolescents with obesity. *Obes Rev* 2019;20:871–82.
- [6] Smith R, Rabadan-Diehl C. Public-Private Partnership in Countering NCD. *Glob Heart* 2016;11:143–4.
- [7] Jindal RM, Patel TG, Waller SG. Public-Private Partnership Model to Provide Humanitarian Services in Developing Countries. *J Am Coll Surg* 2017;224:988–93.
- [8] DHC Corporation site, <https://top.dhc.co.jp/company/en/index.html> [accessed 4 August 2020].
- [9] Terasaki Y, Kamohara S, Ajioka H, et al. Usefulness of the weight-loss program as a measure against obesity through public-private partnership. *J Jpn Soc Study Obesity* 2018;24(suppl):177.
- [10] Sakai-Town, Ibaraki Prefecture, Japan. Available online (in Japanese), <http://www.town.sakai.ibaraki.jp/page/page001313.html> [accessed 4 August 2020].
- [11] Fujioka K. Benefits of moderate weight loss in patients with type 2 diabetes. *Diabetes Obes Metab* 2010;123:186–94.
- [12] Kamohara S, Ajioka H, Imataka Y, et al. Efficacy of a technology-based 12-week weight loss intervention among obese adults. *Proceedings of the 6th Asian Congress of Dietetics, Taipei, Taiwan, 2014. OP9-1 2014, Aug.24.*
- [13] Kamohara S, Onishi M, Ajioka H, et al. Efficacy of A Technology-Based 12-Week Weight Loss Intervention Program, 'DHC DIET AWARD 2015'. *Proceedings of the 10th Asia Pacific Conference on Clinical Nutrition, Adelaide, Australia, 2017. Paper ID:209.*
- [14] Ho TJH, Lee CCS, Wong SN, et al. Internet-based self-monitoring interventions for overweight and obese adolescents: A systematic review and meta-analysis. *Int J Med Inform* 2018;120:20–30.
- [15] Bennett GG, Herring SJ, Puleo E, et al. Web-based weight loss in primary care: a randomized controlled trial. *Obesity (Silver Spring)* 2010;18:308–13.
- [16] Steinberg DM, Tate DF, Bennett GG, et al. The efficacy of a daily self-weighing weight loss intervention using smart scales and e-mail. *Obesity (Silver Spring)* 2013;21:1789–97.
- [17] Matsumoto Y, Yoshiuchi S, Miyauchi T, et al. Utility of a web-based weight loss program with auto-extraction of behavioural objectives and recording of daily weight and steps in pre-obese outpatients. *Asia Pac J Clin Nutr* 2014;23:473–80.
- [18] Meenan RT, Stevens VJ, Funk K, et al. Development and implementation cost analysis of telephone- and Internet-based interventions for the maintenance of weight loss. *Int J Technol Assess Health Care* 2009;25:400–10.
- [19] van Wier MF, Dekkers JC, Hendriksen IJ, et al. Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees. *J Occup Environ Med* 2011;53:680–6.
- [20] Nguyen B, Kornman KP, Baur LA. A review of electronic interventions for prevention and treatment of overweight and obesity in young people. *Obes Rev* 2011;12:e298–314.
- [21] Kodama S, Saito K, Tanaka S, et al. Effect of Web-based lifestyle modification on weight control: a meta-analysis. *Int J Obes (Lond)* 2012;36:675–85.