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Comparison of the Effectiveness of Online and Face-to-Face Weight-Loss Interventions in the Workplace: Evidence from Malaysia

(Perbandingan Keberkesanan Intervensi Pengurangan Berat Secara atas Talian dan Bersemuka di Tempat Kerja: Bukti dari Malaysia)

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ABSTRACT

A structured weight management programme at a workplace may help in reducing the prevalence of overweight and obesity. Therefore, this intervention study was to determine the effectiveness of weight loss programmes including face-to-face, online and control group at workplace among employees who are overweight and obese. A total of 108 overweight and obese adults were recruited and randomly divided into three groups (face-to-face group (FT), n=*38; online group (OG),* n=*31; control group (CG),* n=*39). In the FT group, the participants took part in health talks, interactive activities and counselling; the OG group was given access to an online weight management program and the CG group was provided with educational booklets on weight loss. All information given was related to nutrition, physical activity and motivation to reduce weight. Body weight, body mass index (BMI), waist circumference (WC), body fat percentage, dietary intake, fasting lipid profile and glucose levels were assessed at baseline and 4 months. The FT group showed greater reduction in body weight (-5.80 kg) compared to OG (-1.12 kg) and CG (-1.82 kg). Significant interaction effects were found for BMI, WC, fasting serum triglycerides, HDL-cholesterol and total cholesterol/HDL-cholesterol ratio (all* p*<0.05), with the FT group showing the biggest improvements, compared to the other groups. The face-to-face weight management program offered in the workplace showed to be the most effective at improving anthropometric profile, fasting serum triglycerides, HDL-C, total cholesterol/HDL-C ratio, and dietary intake among overweight and obese employees.*

Keywords: Intervention; obesity; structured program; workforce; workplace

ABSTRAK

Program pengurusan berat badan berstruktur di tempat kerja boleh membantu dalam mengurangkan berat badan berlebihan dan obesiti. Oleh itu, kajian intervensi adalah untuk menentukan keberkesanan program penurunan berat badan iaitu bersemuka, atas talian dan kumpulan kawalan di tempat kerja dalam kalangan kakitangan yang berlebihan berat badan dan obes. Seramai 108 kakitangan yang berlebihan berat badan dan obes telah direkrut dan dibahagikan secara rawak kepada tiga kumpulan (kumpulan bersemuka (FT), n=*38; kumpulan atas talian (OG),* n=*31; kumpulan kawalan (CG),* n=*39). Subjek kumpulan bersemuka diberikan ceramah kesihatan, aktiviti interaktif dan kaunseling; kumpulan OG diberi akses untuk satu program pengurusan berat badan atas talian dan kumpulan CG disediakan buku kecil yang mengandungi maklumat mengenai penurunan berat badan. Semua maklumat yang diberikan adalah berkaitan dengan pemakanan, aktiviti fizikal dan motivasi untuk menurunkan berat badan. Penilaian berat badan, indeks jisim tubuh (BMI), ukur lilitan pinggang (WC), peratus lemak badan, pengambilan makanan, profil lipid dan aras glukosa darah berpuasa dilakukan pada peringkat dasar dan 4 bulan. Kumpulan FT menunjukkan penurunan berat badan tertinggi (-5.80 kg) berbanding OG (-1.12 kg) dan CG (-1.82 kg). Selain daripada berat badan, didapati terdapat kesan interaksi yang signifikan bagi BMI, WC, trigliserida, kolesterol-HDL, dan nisbah kolesterol/kolesterol-HDL (*p*<0.05), dengan kumpulan FT menunjukkan penambahbaikan lebih tinggi berbanding kumpulan yang lain. Program pengurusan berat badan bersemuka yang ditawarkan di tempat kerja adalah yang paling berkesan dalam meningkatkan profil antropometrik, trigliserida, HDL-C, nisbah kolesterol/HDL-C dan pengambilan makanan dalam kalangan kakitangan berlebihan berat badan dan obes.*

Kata kunci: Intervensi; kakitangan; obesiti; program berstruktur; tempat kerja

INTRODUCTION

The worldwide proportion of adults with a body-mass index (BMI) greater than or equal to 25 kg/m^2 has increased between 1980 and 2013, from 28.8% to 36.9% in men and from 29.8% to 38.0% in women (Ng et al. 2013). According to World Health Organization (2018), overweight and obesity are now increased among those who are in low and middle-income countries and in the next 40 years, prevalence of obesity related non-communicable diseases (NCD) are expected to double or

more in the countries (Rtveladze et al. 2014). In Malaysia, the prevalence of overweight among adults increased from 16.6% to 30.0% between 1996 and 2015 (Institute of Public Health (IPH) 2015). Meanwhile, obesity rates increased from 4.4% to 17.1% in the same time period. Sedentary lifestyle, unhealthy diet, environment that and genetics are reported to be associated with overweight and obesity (National Institutes of Health 2016) and it becomes a risk factor for many chronic diseases, including cardiovascular disease, type II diabetes, hypertension and hypercholesterolemia (Centers for Disease Control and Prevention 2012). The environment changes and dietary habits are often thought to be related with the rising prevalence of obesity. Increased in nutrient-poor (ready-to-eat) foods, a greater number of meals consumed away from home (Ali & Abdullah 2017) and low physical activity levels are believed to be the risk factors of excessive weight gain (Anderson et al. 2009; Smith et al. 2013).

Employees have a high risk of gaining weight, mainly due to their physical and social workplace environments, which may influence their food choices and physical activity (French et al. 2010). The development of modern technology at workplace including increase computer use, often lead to prolonged sitting times (Cheong et al. 2010). In Australia, employees in the desk-based work settings were having more than 60% of daily occupational sitting time and most of the employees with longer sitting hours were associated with higher BMI (Bennie et al. 2015). While in Malaysia, it was reported that senior officers, managers, technical staff and associated groups had the highest prevalence of overweight (37.4%) due to sitting hours in front of computer (National Health and Morbidity Survey III (NHMS III), 2006).

Workplace has been widely recognized as an appropriate setting for health promotion and it has a great potential for improving public health (Wing et al. 2010). Changes that can be done at workplace are increasing employees' access to healthy food options, holding contests that promote weight loss, or providing places to carry out physical activities. These changes could impact employees by improving the work productivity as the quality of life and sick leave was associated with obese employees (Xian et al. 2016). Internet-based intervention programs have gained popularity and may be an effective medium in achieving significant weight loss (Neve et al. 2010) and increasing physical activity (Irvine et al. 2011). Conducting an intervention program at workplace is costly to the employer; therefore, it is important to adopt the most cost-effective method. Thus, in this study, we sought to examine the effectiveness of two different weight management interventions offered at a workplace, a structured face-to-face program and an online program. The effectiveness on the anthropometric, biochemical and dietary intake profiles of employees with excess weight and obese is assessed at the end of the programs.

Materials and Methods

Subjects

A quasi-experimental study with two intervention groups and a control group was conducted from February to May of 2014. The two active interventions were designed based on social cognitive theory (Sallis et al. 2008) and incorporated behavioural approaches (Berkel et al. 2005) to help participants set weight-related goals, monitor weight and weight related behaviours such as healthy diet and exercise and increase self-efficacy and social support. All participants in the intervention and control groups received education covering various aspects of diet, exercise and motivation. However, the delivery methods were different between groups. All participants were asked to complete a self-administered questionnaire on their socio-demographic characteristics at baseline. Anthropometric and biochemical parameters were assessed at baseline and four months later. The Medical Research and Ethics Committee of Universiti Kebangsaan Malaysia approved this study. Informed consent was obtained from all participants prior to the study commencement.

The study was advertised through e-mail, flyers, posters and websites. Office employees aged between 20 and 59 years with a BMI $\geq$24.9 kg/m^2 were recruited. Participants were selected from three different workplaces in the Klang Valley area and each workplace was randomly assigned with a specific intervention either face-to-face, online, or control group in order to minimise contamination bias. People having a severe cardiovascular, infectious or orthopaedic disease, uncontrolled type I or type II diabetes mellitus, high blood pressure, pregnant or those using weight reduction medications or on leave for more than one month were excluded.

Intervention Program

Face-to-face intervention (FT) Participants took part in a structured weight reduction program called Slim Shape Module™ that was developed by the research team (Rusali et al. 2016). This module consisted of sixteen 2-h sessions (32 h) of talks, demonstrations, interactive activities, hands-on activities and exercise sessions delivered over the 4-month period. Four sessions of talks were related to dietary aspects and four interactive and hands-on activities were related to healthy eating, including calorie counting for foods and beverages, healthy cooking demonstrations, supermarket and grocery tours and understanding food labels. All of the activities were conducted by dietitians. Aspects associated with physical activity were delivered through talks, exercise demonstrations and group exercises. It was conducted by a sport physiologist and physiotherapists. These sessions were mainly meant to empower the participants in improving their knowledge, attitudes and practices towards physical activity and exercise in order to reduce weight.

Online intervention (OG) Participants received all components of diet, behavioural and physical activity via an online weight reduction program over the four months. There were also technical orientation sessions led by one of the researchers regarding how to log in, how to access the modules on the website, self-monitoring of dietary intake, procedures for the chat room and bulletin board functions. All participants were allowed to have their own login name and password and they could log in to the website anytime and from anywhere.

Control group (CG) Participants received educational information about diet, physical activity and behaviour modification for weight reduction in printed booklets. These booklets were distributed during the first meeting. No talk, demonstrations or hands-on activities were conducted with this group for the duration of the study.

OUTCOME MEASURES

Primary outcome measures were body weight and composition. They were measured at baseline and four months. In addition, biochemical parameters and nutrient intakes were also assessed. At baseline, participants were interviewed using a set of structured questions to obtain information on the socio-demographic profiles of participants. The height of the participants was measured using a stadiometer (Seca 213 Portable Stadiometer Height-Rod, Germany), while body weight, BMI and body fat percentage were measured using a bioelectric impedance analyser (SC 330 S Body Composition Analyser, Tanita, Japan). Body mass index (BMI) was categorized according to WHO Expert Consultant (2004). In order to measure body weight and body fat percentage, participants were instructed to remove their socks, watch and accessories. The classification of body fat percentage was based on the 2003 study by Lee and Nieman (2003), in which unhealthy body fat percentage was defined as body fat percentage ≥ 25% for men and ≥ 35% for women. Waist circumference was measured using a flexible measuring tape to the nearest 0.1 cm at the midpoint between the lowest rib and iliac crest; > 80 cm for men and > 90 cm for women indicated risk of abdominal obesity (WHO/IOTF/IASO 2000).

Ten mL fasting venous blood samples were drawn and sent to a diagnostic lab for assessment of fasting blood sugar (FBS) and fasting lipid profile. Three-day dietary records were obtained from the participants. These three days consist of two weekdays and one weekend day, excluding days with substantially abnormal eating or fasting. The participants were asked to record the details of all foods and beverages consumed, including portion size, cooking method, brand names of processed food time and eating place. Standard household measuring cups and spoons were used to assist the participants in estimating portion size. Participants were asked to record the estimated amount of food consumed; this was then converted into grams. The Nutritionist Pro™ 2003 software was used to analyse the dietary data. For dishes that were not available in any food database, standard recipes were used to calculate the energy and nutrient content and the average values were used for the dietary analysis. The nutrient intake of participants in the groups was then compared with the recommended nutrient intake for weight loss, which is 1200-1500 kcal/day for women and 1500-1800 kcal/day for men (Jensen et al. 2013).

STATISTICAL ANALYSIS

Data were analysed using 'Statistical Package for Social Sciences' (SPSS) version 20.0, with statistical significance set at $p<0.05$. Kolmogorov-Smirnov test was used to assess the normality. Descriptive statistics were used for the demographic. To determine the differences between groups, the chi-squared was used for categorical variables and independent t-test was used for numerical variables. The effectiveness of the interventions was measured by using two-way repeated measure ANOVA adjusted for baseline and four months, with baseline energy, fat, and triglycerides as covariates.

RESULTS

From the 180 participants initially recruited, only 108 completed the study (38 in the face-to-face group, 31 in the online group and 39 in the control group) (Table 1). Forty percent dropped out sometime during the four months, for reasons such as pregnancy, moving to a new workplace, or having job commitments that restricted their ability to continue in the program. High rates of drop-out are frequently occur in studies of weight loss interventions and it could be up to 80% (Grave et al. 2005; Huisman et al. 2010). There were no significant differences in demographic characteristics across groups. Overcoming drop-out in the intervention program is a challenge. However, in our study, we developed a series of activities for the face-to-face group and reminder through emails to log in for online group to improve participants' adherence.

Significant interaction effects were found for body weight, BMI and waist circumference ($p<0.05$) (Table 2). Over the four-month period, the FT group showed a reduction in body weight (-5.8 kg), followed by the CG group (-1.9 kg) and the OG group (-1.2 kg), with a medium effect size ($\eta p^2 = 0.127$). An effect size greater than 0.14 is considered large, greater than 0.06 is medium and less than 0.01 is small (Jolly et al. 2011). A similar trend was observed for BMI, with a medium effect size ($\eta p^2 = 0.114$). It was found that the FT group had the highest reduction in BMI (-2.6 kg/m^2) compared to the OG group (-0.4 kg/m^2) and the CG group (-1.1 kg/m^2). Although there were no significant reductions in body fat percentage after the 4 months in all groups, the FT group showed the highest mean change in body fat percentage, with a reduction of -6.5%, followed by the CG group (-4.1%) and OG group (-1.3%). For waist circumference, the mean changes were -7.9 cm for the FT group and -4.4 cm for the OG group. The CG group actually showed an increase in waist circumference by +1.0 cm at 4 months.

TABLE 1. Baseline characteristics of participants (n=108)

	n (%)			
	Control group (n=39)	Online group (n=31)	Face-to-face group (n=38)	All participants (n=108)
Gender*				
Male	9 (23.1)	12 (38.7)	11 (28.9)	32 (29.6)
Female	30 (76.9)	19 (61.3)	27 (71.1)	76 (70.4)
Ethnicity*				
Malay	38 (97.4)	30 (96.8)	38 (100.0)	106 (98.1)
Other	1 (2.6)	1 (3.2)	0 (0.0)	2 (1.9)
Mean Age (year) (± SD)**	34.72 (± 7.05)	35.45 (± 8.23)	39.97 (± 8.54)	36.78 (± 8.22)
Marital Status*				
Single	8 (20.5)	8 (25.8)	2 (5.3)	18 (16.7)
Married	30 (76.9)	22 (71.0)	36 (81.5)	88 (81.5)
Divorced/Widowed	1 (2.6)	1 (3.2)	0 (0.0)	2 (1.8)
Education Level*				
Secondary School	17 (43.6)	7 (22.6)	13 (34.2)	37 (34.3)
University/College	22 (56.4)	24 (77.4)	25 (65.8)	71 (65.7)
Job category*				
Management	10 (25.6)	10 (32.3)	21 (55.3)	41(38.0)
Professional	17 (43.6)	12 (38.7)	11 (28.9)	40(37.0)
Support worker	12 (30.8)	9 (29.0)	6 (15.8)	27(25.0)
Monthly Salary (RM)[a]				
< 3501	21 (53.8)	16 (51.6)	14 (36.8)	51 (47.2)
3501 – 7500	13 (33.3)	8 (25.8)	15 (39.5)	36 (33.3)
> 7500	5 (12.8)	7 (22.6)	9 (23.7)	21 (19.4)

*p>0.05 not significant using Chi-Square, **p>0.05 not significant using independent t-test
[a]Monthly salary was expressed in RM (Ringgit Malaysia) or also known as Malaysian Ringgit (MYR)

Significant interaction effects were found for serum triglyceride, HDL-C and total cholesterol/HDL-C ratio, with medium effect sizes ($0.06<\eta p^2<0.14$) (Table 2). The FT group showed the largest mean reduction in triglycerides (-35.0%), as compared to the OG group (-7.14%) and the CG group (no change). An improvement in HDL-C level was observed in the FT group (+7.7%), while the OG group showed no change and CG group had a reduced level (-7.1%). Ratio of total cholesterol/HDL-C was reduced over time among participants in the FT group (-7.1%), while it was increased in the CG group (+2.6%) and showed no change in the OG group. A significant time effect was observed for FBG, with a medium effect size. All groups showed a reduction in FBG, with the OG group showing highest reduction (-7.7%), followed by FT (-7.5%) and CG (-4.0%). A similar trend was noted for total cholesterol, although not statistically significant, with the FT group showing the highest reduction in total cholesterol (-5.7%) followed by OG (-3.8%) and CG (no change). Although there was no significant difference in mean changes of LDL-C between the three groups throughout the intervention period, the LDL-C reduced (-3.0%) in the FT and OG groups, respectively.

Significant interaction effects were also found for energy, protein, carbohydrates and fat. The FT group showed the highest reduction in mean energy intake (-703 kcal/d), as compared to CG (-215 kcal/d) and OG (-209 kcal/d) (Table 3). The FT group also showed the highest reduction in carbohydrates (-38.7%) and fat (-41.2%).

Discussion

This study showed that the face-to-face intervention was more effective than the online programme in improving anthropometric and biochemical indicators among study participants. Other studies have also reported that face-to-face programmes had a greater effect on weight loss compared to online and control groups (Jolly et al. 2011; Mehring et al. 2013). Beyond behavioural counselling, the face-to-face approach may have worked better because the participants were provided with more intensive methods in groups (Ismail et al. 2012), together with interactive activities for weight management via diet modification, motivation to reduce weight and increased physical activity. Recent data shows that social support including involvement of group sessions, peer coaches and 'buddy' programs may have important implications for weight loss and weight loss maintenance (Lemstra et al. 2016). Those who attended the weight loss intervention program with their family, friends, peers, or providers were more likely to reduce their weight (Brantley et al. 2014) and enhanced dietary compliance (Shahar et al. 2016).

TABLE 2. Anthropometric and biochemical parameters by study group at baseline and 4 months

	Mean ± SD			P value (ηp²) (Power r)		
	Control group (*n*=39)	Online group (*n*=31)	Face-to-face group (*n*=38)	Time effect	Group effect	Interaction effect
Anthropometric [a]						
Weight (kg)				0.095	0.017*	0.001**
Baseline	81.8 ± 13.3	86.3 ± 23.5	81.9 ± 15.6	(0.027)	(0.076)	(0.127)
Four months	79.9 ± 12.8	85.1 ± 22.5	76.1 ± 13.3	(0.387)	(0.729)	(0.938)
BMI (kg/m²)				0.790	0.458	0.002**
Baseline	32.4 ± 5.6	32.2 ± 7.0	32.6 ± 4.6	(0.001)	(0.015)	(0.114)
Four months	31.3 ± 4.5	31.8 ± 6.7	30.0 ± 5.2	(0.058)	(0.177)	(0.905)
Body fat percentage (%)				0.646	0.947	0.194
Baseline	41.4 ± 10.0	38.6 ± 11.0	40.2 ± 7.7	(0.002)	(0.001)	(0.031)
Four months	39.7 ± 8.3	38.1 ±10.8	37.6 ± 8.8	(0.074)	(0.058)	(0.344)
Waist circumference (cm)				0.389	0.019*	0.000**
Baseline	96.4 ± 8.7	100.7 ± 13.8	98.4 ± 11.3	(0.007)	(0.074)	(0.229)
Four months	97.4 ± 10.2	96.3 ± 12.4	90.5 ± 10.0	(0.137)	(0.718)	(0.999)
Biochemical						
Total Cholesterol (mmol/L)				0.015*	0.925	0.460
Baseline	5.1 ± 0.87	5.3 ± 0.80	5.3 ± 0.84	(0.055)	(0.001)	(0.015)
Four months	5.1 ± 1.03	5.1 ± 0.95	5.0 ± 0.94	(0.690)	(0.061)	(0.180)
Triglyceride [b] (mmol/L)				0.000**	0.486	0.000**
Baseline	1.2 ± 0.60	1.4 ± 0.64	1.7 ± 1.14	(0.111)	(0.014)	(0.174)
Four months	1.2 ± 0.66	1.3 ± 0.64	1.1 ± 0.58	(0.948)	(0.170)	(0.990)
HDL-C (mmol/L)				0.783	0.803	0.002*
Baseline	1.4 ± 0.35	1.34 ± 0.31	1.3 ± 0.26	(0.001)	(0.004)	(0.114)
Four months	1.3 ± 0.32	1.33 ± 0.32	1.4 ± 0.30	(0.059)	(0.084)	(0.910)
LDL-C (mmol/L)				0.151	0.902	0.400
Baseline	3.2 ± 0.77	3.3 ± 0.73	3.3 ± 0.87	(0.020)	(0.002)	(0.017)
Four months	3.2 ± 0.86	3.2 ± 0.86	3.2 ± 0.90	(0.299)	(0.065)	(0.206)
Ratio of total cholesterol/ HDL-C (mmol/L)				0.043*	0.730	0.003*
Baseline	3.9 ± 0.99	4.1 ± 1.21	4.2 ± 1.09	(0.039)	(0.006)	(0.107)
Four months	4.0 ± 1.02	4.1 ± 1.36	3.9 ± 1.06	(0.529)	(0.099)	(0.890)
Glucose (mmol/L)				0.000**	0.421	0.147
Baseline	5.0 ± 0.58	5.2 ± 0.54	5.3 ± 0.90	(0.312)	(0.016)	(0.036)
Four months	4.8 ± 0.42	4.8 ± 0.53	4.9 ± 0.62	(1.000)	(0.196)	(0.396)

hp2 - partial Eta square
BMI- Body Mass Index
[a] Baseline energy and protein and [b] serum triglyceride as covariates
*p<0.05, **p<0.001, two-way repeated ANOVA

TABLE 3. Nutrient intake by study group at baseline and four months

	Mean ± SD			P value (ηp^2) (Power r)		
	Control group (*n*=39)	Online group (*n*=31)	Face-to-face group (*n*=38)	Time effect	Group effect	Interaction effect
Energy (kcal/d)[a]				0.000**	0.000**	0.000**
Baseline	1546 ± 391	1488 ± 395	1821 ± 518	(0.283)	(0.144)	(0.144)
Four months	1329 ± 331	1279 ± 388	1118 ± 314	(1.000)	(0.966)	(0.966)
Protein (g/d)				0.000**	0.532	0.006*
Baseline	64.1 ± 16.4	62.2 ± 18.9	68.3 ± 20.2	(0.294)	(0.012)	(0.093)
Four months	56.9 ± 14.4	52.6 ± 13.7	47.4 ± 12.8	(1.000)	(0.154)	(0.832)
Carbohydrates (g/d)				0.000**	0.559	0.006*
Baseline	191.2 ± 48.4	208.0 ± 91.9	230.7 ± 83.4	(0.247)	(0.011)	(0.144)
Four months	168.9 ± 83.2	185.3 ± 94.6	141.4 ± 40.3	(1.000)	(0.145)	(0.968)
Fat (g/d)[b]				0.000**	0.002*	0.002*
Baseline	60.0 ± 19.5	51.6 ± 17.3	68.0 ± 17.7	(0.338)	(0.117)	(0.117)
Four months	49.7 ± 13.4	42.3 ± 13.0	40.0 ± 14.2	(1.000)	(0.917)	(0.917)

ηp2 - partial Eta square
Baseline [a] energy and [b] fat as covariates
*p<0.05, ** p<0.001, two-way repeated ANOVA

In several web-based intervention studies, the web-based interventions became successful by providing information to participants via their websites along with holding weekly meetings, exercise sessions and activities for behavioural modification, and providing motivational telephone calls or emails (Sorgente et al. 2017). This resulted in significant weight reduction among participants after 6 months (Hunter et al. 2008). However, a longer intervention period is needed and more additional approaches should be determined in order to make it as an adherence tool for weight loss program that can be more effective in the future.

It is noteworthy that improvements in anthropometric profile were also demonstrated by the CG group, despite minimal intervention. Although the group relied on self-directed learning, they still received tips and guidance through printed booklets regarding diet, weight loss and motivation to engage in physical activity to gain a healthy lifestyle which it could influence the healthy eating behaviors (Krishnan & Rahim 2014). Similar to the participants in other groups, the CG group members had their anthropometric profile, fasting lipid profile and fasting blood glucose measured and were then informed about their weight and health status. Such information may bring awareness and motivate people to reduce their weight. The improvements seen in the CG group could also be due to the Hawthorne effect, a psychological phenomenon that refers to the tendency of some people to improve their behaviour or perform better in response to being observed (Chen et al. 2015).

In this study, significant interaction effects were observed for the biochemical parameters, including triglycerides, HDL-C, ratio of total cholesterol/HDL-C and fasting blood glucose. Participants from the FT group showed statistically larger improvements in these measures compared to the other groups. These improvements were similar to findings from other workplace studies (Christensen et al. 2011; Moy et al. 2006). The different results observed among the groups in the present study could be due to the methods of health information delivery and the skills taught to the participants. Participants in the FT group were taught more about calorie counting, how to cook healthy food and food labelling through interactive group activities and demonstrations. They also participated in exercise sessions during the intervention period.

Participants in both the OG and CG groups still showed significant improvements in some measures over the 4-month period. This could be due to the increase in awareness during the screening session, as all participants had their results explained to them. However, unlike the FT group, the OG and CG groups did not obtain adequate skills to modify their diet and behaviour so as to produce significant changes in most health parameters. In the present study, there was no interaction effect for LDL-C, similar to the finding of a previous study (Moy et al. 2006). The possible reason for this could be due to the duration of the intervention, as LDL-C would take longer to be reduced (DeBusk et al. 1994). However, in regards to weight loss interventions, previous studies have shown that web-based intervention were more effective that group who received minimal treatments but it was less effective when comparing to the face-to-face intervention (Sorgente et al. 2017).

The Recommended Nutrient Intake (RNI) for Malaysians (National Coordinating Committee on Food and Nutrition (NCCFN) 2005) prescribes a consumption range for carbohydrates (55-70%), protein (15-20%) and fat (20-30%), as a percentage of total energy. In this study, the contributions of protein and fat to the total energy of all groups were in accordance with the RNI, while the contribution of carbohydrates was not. In addition, a reduced energy intake of 217 to 703 kcal was reported in

this study, meeting the estimated energy deficit required for weight loss among obese individuals (Hill 2009) and individuals in general (Jensen et al. 2013). Participants in this study reported a reduction in their carbohydrate intake that might have caused weight loss, from 0.5 kg to 1 kg per week (Soler et al. 2010).

Future studies should provide these facts to facilitate other organizers in implementing cost-effective weight management programs for the workplace. Researchers may need to work with other partners such as caterers or food supply companies to create healthier cafeterias and provide convenient shops in the workplace; such changes will create a greater impact of a worksite weight management intervention. The sustainability of such interventions should also be examined. Despite the above limitations, this study has highlighted the effectiveness of a face-to-face, structured weight reduction intervention in the workplace that focused on diet, physical activity and behavioural changes using a multidisciplinary team approach, based on follow-up at 4 months, compared to programs delivered through websites or printed materials.

Conclusion

The results of the present study demonstrate that a workplace weight management program that uses a face-to-face intervention can have a positive impact on anthropometric and biochemical profiles, as well as energy and nutrient intake. Online intervention could be used as a method to reduce weight among highly motivated participants over a longer intervention time. This study suggests that weight reduction programs that involve support from employers and multidisciplinary health professionals produce more effective results than personalized online weight reduction programs.

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