Journal of Telemedicine and Telecare
0(0) 1–7

DOI: 10.1177/1357633X17745471
journals.sagepub.com/home/jtt
SAGE

The efficacy of a telemedicine-based weight loss program with video conference health coaching support

Michelle K Alencar[1,2], Kelly Johnson[3], Rashmi Mullur[4], Virginia Gray[5], Elizabeth Gutierrez[5] and Olga Korosteleva[6]

Abstract

Introduction: Clinically significant weight loss is defined as a $\geqslant 5\%$ of initial body weight loss within a 6-month period. The purpose of this study was to assess body weight change from a 12-week telehealth-based weight loss program that integrated health coaching via video conferencing.

Methods: A total of 25 obese participants (12 males, 13 females) were recruited for this fully online 12-week weight loss program. Participants were randomly assigned to either an intervention group or control group ($n = 13$ intervention, body mass index (BMI) $= 34.7 \pm 4.5\,kg/m^2$; $n = 12$ control, BMI $= 34.4 \pm 4.43\,kg/m^2$). All participants were given access to a secure platform for data tracking and video conferencing with the research team. The intervention group met with the medical doctor once per month and with a registered dietitian, weekly. Control participants met with the research team at baseline and at 12 weeks. Independent samples *t*-tests and Chi-square tests were used via SPSS version 24 with significance set to $p < 0.05$.

Results: There was a significant difference between the intervention and control groups for body weight loss (7.3 ± 5.2 versus $1.2 \pm 3.9\,kg$, respectively, $p < 0.05$) as well as for percent body weight loss (7.16 ± 4.4 versus $1.5 \pm 4.1\%$, respectively, $p < 0.05$). Clinically significant weight loss was achieved in 9 out of 13 (69.2%) in the intervention group versus 1 out of 12 (8%) in the control group.

Discussion: Mobile phone-based health coaching may promote weight loss. Weekly video conferencing with education may be an applicable tool for inducing significant body weight loss in obese individuals.

Keywords

Ehealth, telehealth, online health, BMI, obesity

Date received: 14 September 2017; Date accepted: 6 November 2017

Introduction

National obesity statistics indicate more than two-thirds (68.8%) of adult Americans have a body mass index (BMI) $> 30\,kg/m^2$.[1] According to the Centers for Disease Control and Prevention (CDC), the estimated annual cost of obesity in the United States (US) in (2006) is 147 billion US dollars, with the cost of each obese patient being approximately $1429 more each year than Americans who are of normal weight.[2] Weight losses of 5% of total body weight have been shown to produce significant improvements in cardiometabolic diseases and overall mortality.[3–6] Paralleling the escalation in obesity is the boom in 'smart device' technology. Currently, 58% of adults in the US own a smart phone, highlighting the mass accessibility of health and fitness apps among populations with and without access to healthcare.[7] Many commercially available apps focus on both calorie counting and physical activity.[8] These

[1]Department of Kinesiology, California State University, Long Beach, CA, USA
[2]inHealth Medical Services, Inc. Los Angeles, CA, USA
[3]Department of Physical Therapy, University of Saint Mary, Leavenworth, KS, USA
[4]Division of Endocrinology, Diabetes, and Metabolism, David Geffen School of Medicine at University of California, Los Angeles, CA, USA
[5]Department of Family and Consumer Sciences, Nutrition and Dietetics, California State University, Long Beach, CA, USA
[6]Department of Mathematics and Statistics, California State University, Long Beach, CA, USA

Corresponding author:
Michelle Alencar, Department of Kinesiology California State University, Long Beach, 1250 Bellflower Boulevard, HHS2-220, Long Beach, CA 90840-4901, USA.
Email: Michelle.Alencar@csulb.edu

applications, however, are for personal monitoring and do not connect with a secure electronic platform nor do they provide live health coaching such as video conferencing. Although, these types of applications exist, there are very few commercial-based programs that include live video conferencing with a health and wellness professional to deliver wellness coaching and lifestyle modification strategies.[9] Unlike telephonic or text messaging-based communications, using real-time audio and visual systems with video conferencing maintains a face-to-face advantage. Practitioners can attest to verbal and non-verbal cues from the patient, building rapport and providing customized feedback to encourage lifestyle and behavior changes.[10]

Despite the improved accessibility to telehealth platforms supporting video conferencing, its application to reduce excess body weight has not been widely adopted in structured weight loss programs. Currently, clinicians are primarily using this technology for psychiatric visits, urgent care needs, or chronic illness follow ups.[11] Little evidence is available related to impacts of structured video conferencing in combination with health coaching on meaningful weight loss.[12,13] The use of health coaching or wellness coaching is becoming more prevalent for delivery of behavior modification education because of the personalized attention for the individual. Health coaching has been shown within the Veterans Affairs system and through health insurance companies to produce greater weight loss in comparison with traditional methods.[14]

Cornerstone, multicenter, and internationally reputable clinical trials for weight loss management (including the LOOK Ahead trial,[15] the Diabetes Prevention Program,[16] and PoundsLost trial[17]) elucidate common characteristics for success. These common features include: 1) frequent contact with weight management professionals, 2) structured behavior modification education, 3) frequent self-monitoring of nutrition, physical activity, and body weight and 4) personalized feedback to provide solutions for common obstacles with weight loss.[18]

Self-monitoring and mobile health (mHealth) devices provide a systematic observation of individual behavior. Self-monitoring behaviors that have been shown to facilitate adherence and increased weight loss include: weighing frequently, recording of food/beverage intake, and tracking physical activity.[19–22] Several mHealth devices exist including accelerometers, wireless Bluetooth scales, and blood pressure cuffs. These devices provide more real-time feedback and thereby provide more information for the user. Furthermore, combining devices with a health coach allows for greater individualized feedback.[23]

This randomized controlled trial (RCT) sought to determine the efficacy of a medically monitored weight management program with weekly health coaching versus no health coaching through video conferencing for weight loss using mobile health devices. Tracking, mHealth device usage, and physical activity were measured weekly for progress evaluation.

Methods

Study population

A total of 12 men and 13 women aged 23–64 years, with a BMI of $34.6 \pm 4.33\,kg/m^2$ volunteered for this 12-week single-blinded RCT. Participants were weight stable, not using tobacco products, did not have metabolic or renal disease, and were not using medications known to alter metabolism (antidepressants, insulin, thermogenics, etc.). Participants on stable blood pressure medications who were otherwise determined healthy (by self-reported medical history and with clearance with the study physician) were eligible to participate. Patients were eligible to participate if they lived in the state of California, USA owned and were able to operate an Apple iPhone® version 4 or newer smart phone, and had access to internet connection to support video streaming. Exclusion criteria included: diagnosis of type 1 or 2 diabetes mellitus, receiving treatment for a serious medical condition (i.e. cancer), taking medications specifically for weight loss, or actively participating in a medically supervised weight loss program.

Patients were recruited via flyers, word of mouth, and email list-serve of individuals previously consenting to receive email marketing from inHealth Medical Services, Inc., USA. Participants were recruited irrespective of sex, place of residence (inner city, countryside) and educational level. After interested volunteers made initial contact, pre-participation screening was conducted by the research team which determined volunteers' suitability for participation according to the inclusion and exclusion criteria. Based on initial interest in the study, participants were randomly assigned to the video conferencing (VC) group with health coaching, or the control (CON) group, without health coaching (Table 1). Stratified randomization was completed by a statistician following a baseline questionnaire. The treating medical team was unaware of group assignment until the initial visit (Figure 1). Both the VC and CON groups were single-blinded to their randomized condition.

Approval was obtained from the California State University, Long Beach Institutional Review Board, USA prior to commencement of the study.

Weight loss program

All participants participated in a 12-week telemedicine-based weight loss program where the program structure was similar to a commercially available weight loss program from inHealth Medical Service, Inc. A total of three wireless Bluetooth devices were delivered to each participant's home: an accelerometer (Withings® Activite Pop, Cambridge, MA, USA), a blood pressure monitor (Withings® Wireless Blood Pressure Monitor, Cambridge, MA, USA), and a body composition scale (Withings® Body Scale, Cambridge, MA, USA) free of charge. Phone and video conferencing calls were used to demonstrate use and application of the devices, including one-on-one support to connect devices and a username

Table 1. Baseline demographics.

	VC ($n = 13$)		CON ($n = 12$)	
Parameter	*M*	*SD*	*M*	*SD*
Age (year)	41.2	13.9	52.4	23.9
Weight (kg)	106.7	25.5	99.8	19.1
Body Mass Index (kg/m^2)	34.7	4.5	34.7	4.3

Note: No significant differences were found between VC and CON groups at baseline. Data are presented as mean (*M*) ± standard deviation (*SD*).
CON: control group; VC: video conferencing group

and password to enter the American Well® (Amwell®, Boston, MA, USA) site and app. Amwell is a HIPAA secured telemedicine platform providing video conferencing data collection capabilities. All devices provided real-time feedback to the participant via Bluetooth connectivity of their mobile device. All devices were connected to the Amwell secure database via the secure Amwell app for wireless transmission of device data.

All participants were instructed by the study medical doctor to follow a caloric deficit to induce body weight loss of 1–2 lbs/week. To assist in compliance with caloric

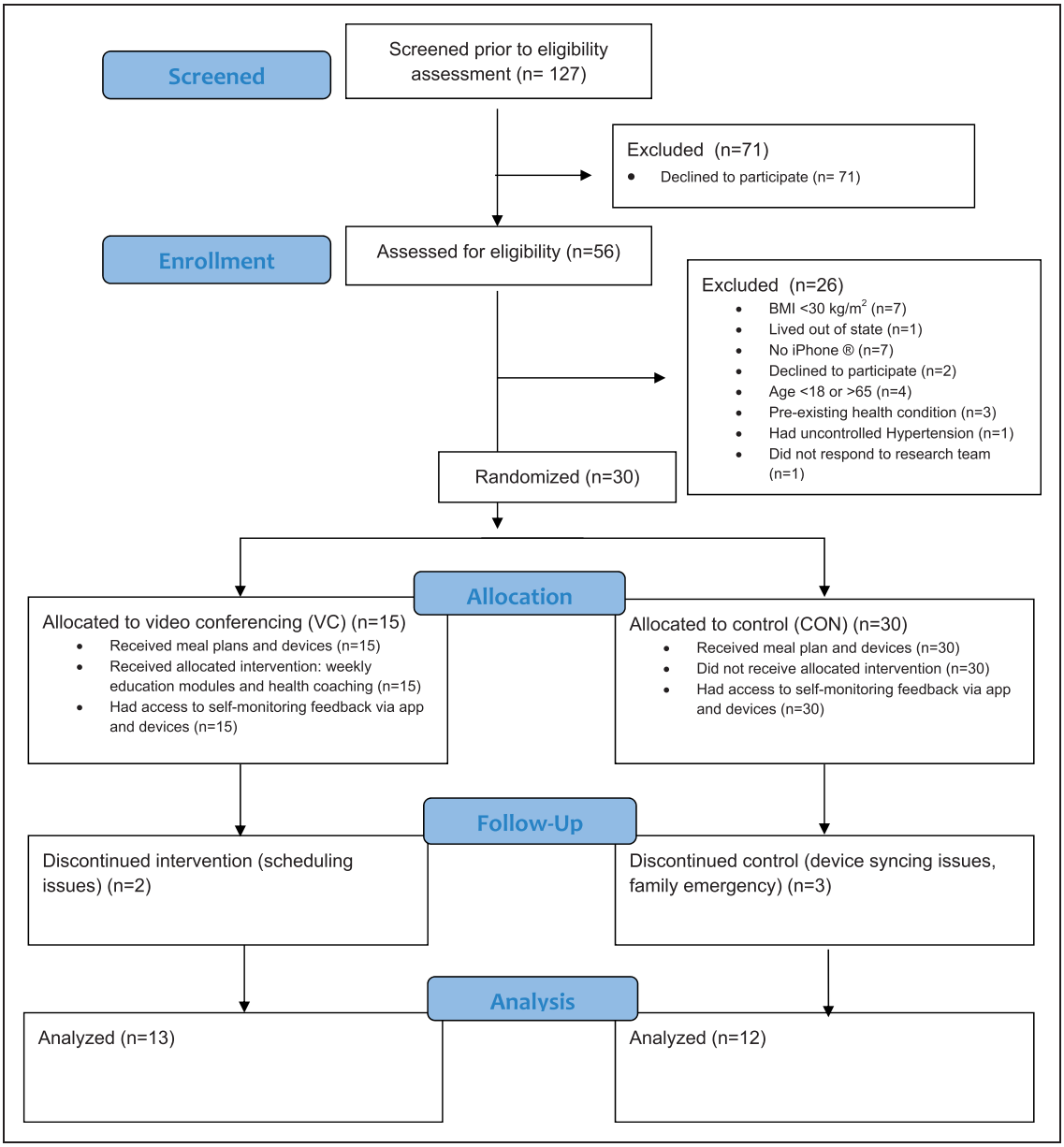

Figure 1. Participant flow diagram.
BMI: body mass index; CON: control group; VC: video conferencing group

recommendations, participants were instructed by the research team at baseline to electronically report dietary intake and physical activity via MyFitnessPal® where data were accessible through the Amwell secure database. MyFitnessPal® is a commercially available application that can be accessed on a mobile device to provide real-time feedback that automatically calculates caloric intake as well as grams of carbohydrate, protein, and fat intake per day.[24]

Each video conference with the medical doctor or registered dietitian was conducted using the Amwell site in both the VC and CON groups. The study medical team included one medical doctor (endocrinologist) and two registered dietitians. All health coaching was performed weekly and was based on the education content administered to the patient that week. Health coaching sessions were done one-on-one by the same a registered dietitian with a Level 2 Certificate in weight management administered by the Academy of Nutrition and Dietetics. The study-registered dietitians administered feedback to the patients related to the weekly content on nutrition, fitness, and behavioral change techniques.

Control group. The participants that were assigned to the CON group received the Bluetooth, scale, watch, and blood pressure cuff but did not have weekly health coaching sessions. Participants completed the same video conference-based examination with the study physician, calorie recommendations, and physical activity guidelines from the registered dietitian at baseline. Patients had a final visit with the same medical doctor and dietitian post intervention.

Video conference group. The participants assigned to the VC group received an online curriculum (created using content derived from national organizations, designed and compiled by a team of health professionals from inHealth Medical Services, Inc., Los Angeles, CA, USA) that emphasized the nutrition needs for weight loss and management and behavioral principles of self-monitoring, exercise, goal setting, behavior modification, cues and triggers, problem solving, stress management, and lapse prevention (see Table 2). Educational curriculum was delivered via the secure website as a once per week video module and educational handout. The registered dietitian provided individualized feedback during the weekly session with the participant based on the weekly education module.

Table 2. Weight management education program treatment.

Description	
Nutrition education	Nutrition label reading, mindful/intuitive eating, fiber, hydration, macronutrients, calorie counting
Fitness education	Current guidelines for physical activity, increasing NEAT calories, problem solving, measuring intensity, nutrition and exercise
Behavior modification	Gathering support, managing lapses, SMART goal setting, stress management

Educational topics as module videos and handouts provided to the VC group only.
NEAT: non-exercise activity thermogenesis; SMART: specific, measurable, achievable, relevant, timely; VC: video conferencing

Statistical analysis

The primary outcomes were change in body weight, BMI, and weekly usage of trackers. We used a two-sample Student's *t*-test to assess the difference in average change from baseline between the intervention and control groups. We used two-sided tests with a significance level of $\alpha = 0.05$. We performed intent-to-treat analysis with the most conservative method of substituting baseline for the final for those with incomplete data. Further exploratory analyses among the participants who received the intervention included linear regression to assess an association between primary outcomes and both the number of sessions attended and the number of weights recorded (a measure of self-monitoring). All analyses were performed using SPSS version 24 (SPSS Inc., Chicago, IL, USA).

Results

A total of 30 participants were enrolled in the study and 25 completed the trial (3 CON and 2 VC participants failed to complete the program) (Figure 1). Baseline characteristics of randomized study participants are summarized in Table 1. There were no significant differences in baseline characteristics of sex, weight, age, or starting BMI between those randomized into the VC or CON groups ($p > 0.05$).

The VC group had a significantly larger mean reduction in total body weight loss (BWL) (7.3 ± 4.4 kg), in comparison with the CON group (1.5 ± 4.1 kg) ($p < 0.05$). Concurrently, mean percent BWL was significantly greater in the VC group (7.2 ± 4.4 %) versus the CON group (1.5 ± 4.1 %) ($p < 0.05$). Furthermore, there was a significantly greater mean decrease in percent body fat (%BF) in the VC group (-9.0 ± 8.3%) when compared with the CON group (1.3 ± 7.7 %) ($p < 0.05$). The VC had a significantly greater increase in mean weekly steps ($30{,}163.8 \pm 30{,}117.6$ steps/week) when compared with the CON group ($-5972.0 \pm 22{,}286$ steps/week) ($p < 0.05$). There were no significant differences between groups for change in systolic blood pressure (SBP) or diastolic blood pressure (DBP) ($p > 0.05$). Results are summarized in Table 3.

Discussion

Our findings suggest that health coaching using telemedicine-based weight loss program may be effective at reducing clinically significant body weight (>5%) in obese adults.[5,6] The current weight loss program combines three key elements shown to improve weight loss

Table 3. Summary of results.

	VC ($n = 13$)		CON ($n = 12$)	
Parameter	*M*	*SD*	*M*	*SD*
%BWL	7.2*	4.4	1.5	4.1
%BF	−9.0*	8.3	1.3	7.7
BWL (kg)	7.3*	4.4	1.3	3.9
Weekly step change	30,163.8*	30,117.6	−5972.0	22,286.0
SBP change (mmHg)	3.4	7.0	−3.3	9.5
DBP change (mmHg)	0.62	4.0	−4.3	8.3

*significant difference between VC group versus CON group, $p < 0.05$. Data are presented as mean (M) ± standard deviation (SD)
AT: activity tracker; BF: body fat; BPC: blood pressure cuff; BWL: body weight loss; CO: control; DBP: diastolic blood pressure; SBP: systolic blood pressure; VC: video conferencing

outcomes: a low-calorie diet with a preference for low glycemic carbohydrates, physical activity monitoring, and support for behavior change through a multi-disciplinary approach to treatment.

The use of internet-based weight loss programs is on the rise. Multiple media have been introduced such as phone, text or internal messaging, email, and video conferencing, with all showing promising results on weight loss.[25–27] Research suggests that internet-based weight management programs are effective with the provision of individualized feedback, but little is known about the impact of video conferencing.[27] In the present study, participants received face-to-face counseling with a medical doctor and registered dietitian to provide individualized feedback. Patients also participated in structured educational modules related to nutrition, fitness, and behavior modification. Another key feature of the study design was that all VC participants had access to educational content online. This is consistent with analyses of other behavioral weight loss programs including the Centers for Disease Control and Prevention (CDC), Diabetes Prevention Program (DPP). McTigue et al. tested the approach to delivering weight management education in a virtual setting.[28] Participants included in this study experienced obesity related co-morbidities; participants who completed the curriculum achieved significant weight loss after 12 months (average 4.8 kg) and found significant improvement in metabolic markers of health.[28] In the present study, participants in the VC group who completed the study lost significantly more weight than the control group (7.2% ± 4.4% versus 1.5 ± 4.1%, respectively, $p < 0.05$) where 70% of the VC participants achieved clinically significant weight loss, compared with 8% among the CON participants. All participants in the VC group completed their weekly visit and education modules. Our results are similar to studies using video conferencing. During an 11-week study, Das et al. (2017) reported a mean %BWL of 7.4% ± 3.6%, where 74% of participants achieved significant weight loss.[25]

A key component of the intervention was the ability for participants to self-monitor their progress using Bluetooth wireless mHealth devices (body composition scale, activity tracker, and blood pressure cuff). Participants were able to set goals and be accountable to their health coach using the mHealth tools for immediate feedback. During weekly one-on-one sessions, the health coach provided individualized feedback to guide the participant into positive behavior changes. Self-monitoring is the most common reason individuals download mobile apps or purchase mHealth devices.[27,29–31] The action of logging health-related information into the application including food choices, weight, and/or exercise duration provides instantaneous feedback for the user. However, without direct feedback from a health care provider, self-monitoring is not often enough to promote long-term engagement or change.[31] This was shown in the present study. Participants in the CON group were provided the same Bluetooth devices, dietary recommendation, and applications. Participants in the VC group lost significantly more total body weight and increased their average steps per week, in comparison to the control group. Our study suggests that the high engagement of the VC group with their health coach contributed to this difference. National organizations and committees have recognized the need for cost effective and convenient weight loss solutions for patients and health care providers.[32]

There are some limitations to consider when interpreting these results. All participants were iPhone® smart phone users due to compatibility requirements with the Amwell platform. Since all participants owned a smart phone there may be bias toward people of higher socioeconomic status and arguably a reduced prevalence of obesity related disease. The control group was only provided caloric and physical activity guidelines and was not provided access to educational modules, thus the results of this study should be interpreted as the combination of health coaching and patient education. Technical challenges with hardware and connectivity are likely contributed to lack of data points given the demand for technical support requests. Funding did not allow for a full-time technical team. Furthermore, due to five participant withdrawals, there were uneven completing groups.

Conclusion

This study supports the use of weekly video conferencing with a health coach and educational modules as an effective form of treatment for obesity by reducing body weight and increasing physical activity. A mobile-app based weight management program delivering may be an effective delivery method for patient education, health coaching, and self-monitoring using a multi-disciplinary approach for weight loss. Video conferencing allows for face-to-face interaction to enhance use of self-monitoring devices. More studies are needed to support the use of

video conferencing-based health coaching in combination with patient education tools to support weight loss.

Acknowledgements

We would like to thank all of our participants and our research team including: Shelby Yaceczko, MS RDN, Amy Zhong, MS RDN, and Bria Morse, MS. Our gratitude is also extended to inHealth Medical Services, Inc. for project and program-related content, modules, and technical support. Platform services and funding was supported by American Well® Amwell. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health, USA. This study was registered at ClinicalTrials.gov ID: NCT03283618.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: One of the co-primary investors, Dr Michelle Alencar owns stock ownership in inHealth Medical Services, Inc. The other co-primary investigator, Dr Virginia Gray, and all other authors declare no potential conflicts of interest. All authors were collectively active in study design; collection, analysis, and interpretation of data; writing of the report; the decision to submit the report for publication. inHealth Medical Services, Inc. provided project-related content including education content, modules, and technology support only.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health (award number 8UL1GM118979-02).

References

1. Ogden CL, Carroll MD, Kit BK, et al. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014; 311: 806–814.
2. Finkelstein EA, Trogdon JG, Cohen JW, et al. Annual medical spending attributable to obesity: Payer-and service-specific estimates. *Health Aff (Millwood)* 2009; 28: w822–831.
3. Mao AY, Chen C, Magana C, et al. A mobile phone-based health coaching intervention for weight loss and blood pressure reduction in a national payer population: A retrospective study. *JMIR Mhealth Uhealth* 2017; 5: e80.
4. He J, Whelton PK, Appel LJ, et al. Long-term effects of weight loss and dietary sodium reduction on incidence of hypertension. *Hypertension* 2000; 35: 544–549.
5. Blackburn G. Effect of degree of weight loss on health benefits. *Obes Res* 1995; 3(Suppl 2): 211s–216s.
6. Williamson DA, Bray GA and Ryan DH. Is 5% weight loss a satisfactory criterion to define clinically significant weight loss? *Obesity (Silver Spring)* 2015; 23: 2319–2320.
7. Pratt M, Sarmiento OL, Montes F, et al. The implications of megatrends in information and communication technology and transportation for changes in global physical activity. *Lancet* 2012; 380: 282–293.
8. Garber CE, Blissmer B, Deschenes MR, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Med Sci Sports Exerc* 2011; 43: 1334–1359.
9. Hutchesson MJ, Rollo ME, Krukowski R, et al. EHealth interventions for the prevention and treatment of overweight and obesity in adults: A systematic review with meta-analysis. *Obes Rev* 2015; 16: 376–392.
10. Rollo ME, Hutchesson MJ, Burrows TL, et al. Video consultations and virtual nutrition care for weight management. *J Acad Nutr Diet* 2015; 115: 1213–1225.
11. Kvedar J, Coye MJ and Everett W. Connected health: A review of technologies and strategies to improve patient care with telemedicine and telehealth. *Health Aff (Millwood)* 2014; 33: 194–199.
12. Vadheim LM, McPherson C, Kassner DR, et al. Adapted diabetes prevention program lifestyle intervention can be effectively delivered through telehealth. *Diabetes Educ* 2010; 36: 651–656.
13. Meyers AW, Graves TJ, Whelan JP, et al. An evaluation of a television-delivered behavioral weight loss program: are the ratings acceptable? *J Consult Clin Psychol* 1996; 64: 172–178.
14. Shahnazari M, Ceresa C, Foley S, et al. Nutrition-focused wellness coaching promotes a reduction in body weight in overweight US veterans. *J Acad Nutr Diet* 2013; 113: 928–935.
15. Sacks FM, Bray GA, Carey VJ, et al. Comparison of weight-loss diets with different compositions of fat, protein, and carbohydrates. *N Engl J Med* 2009; 360: 859–873.
16. Diabetes Prevention Program Research Group. The Diabetes Prevention Program (DPP): description of lifestyle intervention. *Diabetes Care* 2002; 25: 2165–2171.
17. Anton SD, LeBlanc E, Allen HR, et al. Use of a computerized tracking system to monitor and provide feedback on dietary goals for calorie-restricted diets: the POUNDS LOST study. *J Diabetes Sci Technol* 2012; 6: 1216–1225.
18. Gilmore LA, Duhe AF, Frost EA, et al. The technology boom: A new era in obesity management. *J Diabetes Sci Technol* 2014; 8: 596–608.
19. Jeffery RW, Sherwood NE, Brelje K, et al. Mail and phone interventions for weight loss in a managed-care setting: Weigh-To-Be one-year outcomes. *Int J Obes Relat Metab Disord* 2003; 27: 1584–1592.
20. Linde JA, Jeffery RW, French SA, et al. Self-weighing in weight gain prevention and weight loss trials. *Ann Behav Med* 2005; 30: 210–216.
21. Butryn ML, Phelan S, Hill JO, et al. Consistent self-monitoring of weight: a key component of successful weight loss maintenance. *Obesity (Silver Spring)* 2007; 15: 3091–3096.
22. Reyes NR, Oliver TL, Klotz AA, et al. Similarities and differences between weight loss maintainers and regainers: a qualitative analysis. *J Acad Nutr Diet* 2012; 112: 499–505.
23. Hebden L, Cook A, van der Ploeg HP, et al. Development of smartphone applications for nutrition and physical activity behavior change. *JMIR Res Protoc* 2012; 1: e9.
24. Hartman SJ, Nelson SH, Cadmus-Bertram LA, et al. Technology and phone-based weight loss intervention: Pilot RCT in women at elevated breast cancer risk. *Am J Prev Med* 2016; 51: 714–721.
25. Das SK, Brown C, Urban LE, et al. Weight loss in videoconference and in-person iDiet weight loss programs in

worksites and community groups. *Obesity (Silver Spring)* 2017; 25: 1033–1041.
26. Hutchesson MJ, Collins CE, Morgan PJ, et al. Changes to dietary intake during a 12-week commercial web-based weight loss program: A randomized controlled trial. *Eur J Clin Nutr* 2014; 68: 64–70.
27. Neve M, Morgan PJ, Jones PR, et al. Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: A systematic review with meta-analysis. *Obes Rev* 2010; 11: 306–321.
28. McTigue KM, Conroy MB, Hess R, et al. Using the internet to translate an evidence-based lifestyle intervention into practice. *Telemed J E Health* 2009; 15: 851–858.
29. Mattila E, Parkka J, Hermersdorf M, et al. Mobile diary for wellness management–results on usage and usability in two user studies. *IEEE Trans Inf Technol Biomed* 2008; 12: 501–512.
30. Blomfield RL, Collins CE, Hutchesson MJ, et al. Impact of self-help weight loss resources with or without online support on the dietary intake of overweight and obese men: The SHED-IT randomised controlled trial. *Obes Res Clin Pract* 2014; 8: e476–487.
31. Rivera J, McPherson A, Hamilton J, et al. Mobile apps for weight management: A scoping review. *JMIR Mhealth Uhealth* 2016; 4: e87.
32. Jensen J, Ryan D, Apovian C, et. al. Guidelines (2013) for managing overweight and obesity in adults. Preface to the Expert Panel Report (comprehensive version which includes systematic evidence review, evidence statements, and recommendations). *Obesity (Silver Spring)* 2014; 22(Suppl. 2): S40.