Virtual small groups for weight management: an innovative delivery mechanism for evidence-based lifestyle interventions among obese men

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Abstract

While group interventions for weight management have been shown to be efficacious, adherence is often low, especially among men. This pilot study seeks to test whether group interventions using web-based group video conferencing (VC) technology is effective for weight loss. We adapted a 12-week curriculum based on the Diabetes Prevention Program, and delivered this intervention to a small group of men (BMI ≥ 30 kg/m²), using web-based group VC. Participants were randomized to intervention ($n=32$) or delayed-intervention control group ($n=32$). The intervention group lost 3.5 % (95 % CI 2.1 %, 4.9 %) of their initial body weight. Difference in mean weight loss was 3.2 kg ($p=0.0002$) and mean BMI decrease was 1.0 kg/m² ($p=0.0010$) between the two groups. Virtual small groups may be an effective means of allowing face-to-face group interaction, while overcoming some barriers to access.

Keywords

Lifestyle intervention, Weight management, Telehealth, Prevention, Obesity

INTRODUCTION

Lifestyle changes, such as diet and exercise, are central to weight loss and long-term weight management. In the USA, almost three in four adult men are considered to be overweight or obese [1]. Innovative, feasible, and effective prevention and control strategies are urgently needed to address the unabated obesity epidemic and its associated rising health care costs. The future of obesity treatment lies in the implementation of evidence-based interventions that must be sustainable, accessible, and cost-effective. New technology may facilitate the achievement of these goals [2]. Behavioral interventions which incorporate widely available technologies (e.g., Internet) offer the potential for highly scalable and cost-effective intervention strategies.

Intensive, highly structured, lifestyle interventions involving frequent face-to-face interactions with trained personnel lowers cardiometabolic risk [3, 4] and can produce on average a weight loss of 7–10 % of initial body weight after 6–12 months [5–7]. Small

Implications

Policy: Given the transformation of health care and payment models from being illness-centric to prevention-centric, the future of effective obesity treatment lies in the use of technology to improve clinical care.

Research: Video conferencing technology may be a cutting-edge alternative means of translating evidence-based, group behavioral weight management interventions into real-world setting.

Practice: Health care providers, peer support, and health services can be accessed in the convenience of your own home or office, providing the benefits of attending the in-person group meetings without the inconvenience of coming to the clinic.

group interventions have also been shown to be effective in promoting weight loss [8, 9] and maintenance, and have the added advantage of being more cost-effective [10]. Increasing social support [11–13] through small group interaction has proven to be equally or more effective than individual behavioral therapy for obesity [14]. A recent systematic review of studies that randomized obese participants to either a group or individual mode of weight loss treatment delivery concluded that group interventions were not only more effective, but may be more resource saving in terms of total health professional hours required per participant [14].

Frequent and sustained in-person contact presents cost and feasibility challenges, with group session attendance dropping markedly over time [15–17]. Further, men are a difficult population to engage in weight loss studies [18, 19]. Due to the high prevalence of obesity among men and the relative lack of weight loss studies among men, it is important to focus on this understudied population. The landmark Diabetes Prevention Program (DPP) lifestyle intervention is the gold standard in diabetes prevention [20, 21], finding 16 % lower diabetes risk per kilogram of weight lost [22, 23]. DPP participants were nearly 70 % female

[20]. In a recent study examining translated DPP lifestyle interventions in real-world settings, of the 28 studies examined, over 70 % of participants were female [24]. Among other evidence, a systematic review evaluating major commercial weight loss programs in the USA found that the vast majority of participants were women, upwards of 70 % in most cases [25].

Real-time video conferencing (VC) technology may improve access and offer the benefits of in-person, face-to-face group interaction from the comfort and convenience of the patients' preferred location. With the advent of high-quality, secure, inexpensive, web-based VC services, individuals can access the virtual meeting with a standard web camera and an internet connection on a computer, tablet, or mobile device, at low cost. According to the Pew Research Center, 80 % of US adults used broadband internet in 2013 [26]. Penetration rates for cell phone and web use in the US population are also high, with 87 % of White, 85 % of Black, and 83 % of Latino Americans owning a cell phone and nearly 90 % overall have mobile internet access [27, 28]. Potential savings on the part of the clinic staff in using VC may include decreased use of physical space and shared facility resources, greater flexibility in scheduling, and increased efficiency given that travel time and physical transition time is decreased.

In contrast to telephone interactions, VC makes possible the communication of multimedia intervention materials (text, audio, and video) as well as verbal and nonverbal cues to increase rapport in real time, similar to an in-person setting [29–31]. This technology has already been evaluated in several different health care specialties (e.g., psychiatry, emergency medicine, HIV/AIDS) with data suggesting safety, feasibility, and effectiveness [32–46]. The application of VC to weight management, however, has been limited. Most studies have explored the use of direct provider-to-patient VC. The few studies that have examined the use of VC in provider-to-small group interactions have found VC to be effective [46–48]. However, previous studies using VC for group-based weight management interventions involved a provider directly engaging in VC from one location (usually urban), with participants of the small group together in another, remote (usually rural) location. This type of intervention requires participants to travel to the designated clinic or community center rather than being able to participate remotely, from their own homes or offices, for instance [47, 49]. No studies to date have examined provider-to-multiple end-user interactions where the virtual meeting “room” is accessed from several different locations (as opposed to just two). In this pilot study [50], entitled “Virtual Small Groups for an Innovative and Technological Approach to Healthy Lifestyle” (VITAL), we tested group VC for weight loss. The primary aim of this randomized controlled pilot study was to use group VC to deliver an evidence-based lifestyle intervention to virtual small groups and to compare the change in body weight and BMI from baseline to 3 months between intervention and control groups.

MATERIALS AND METHODS

Participants

Participants were recruited from an outpatient multi-specialty group practice organization in Northern California. Men between the ages of 21–60 years old at the time of enrollment with a body mass index (BMI) between 30 and 40 kg/m² were invited to participate. Participants were required to be proficient in written and spoken English, and to have access to the internet to allow for weight tracking and participation in the virtual small group visits. Exclusion criteria included diagnosis of type 1 diabetes mellitus (or insulin-dependent), receiving treatment for a serious medical condition (i.e., cancer), taking medication specifically for weight loss, or participating in a medically supervised weight loss program.

Recruitment

Participants were first screened for eligibility and, if interested, were then invited to attend an in-person orientation session where informed consent was obtained. During the orientation visit, participants were given more information regarding the study and baseline clinical measures were obtained prior to randomization. Enrolled participants were notified of their random assignment via e-mail after completing the orientation. Data were collected between October 2012 and August 2013 in [Palo Alto, CA]. The Palo Alto Medical Foundation Review Board approved this study.

Study design and intervention description

Study participants were randomly assigned to the intervention group or a delayed-intervention control group (hereafter referred to as the control group). The 12-week intervention consisted of two main components: (1) 12 weekly classes, delivered through web-based, virtual small groups, and (2) wireless and internet-connected (Wi-Fi) “smart” scales for weekly weighing. The intervention consisted of the Diabetes Prevention Program-based Group Lifestyle Balance (GLB) core curriculum [51, 52] for 12 weeks through virtual small groups using Blue Jeans™, a real-time, encrypted, web and cloud-based VC software. Participants were given training on the software prior to the commencement of the program. Each virtual group session included eight participants and one trained facilitator, with participants joining the group from multiple, geographically distinct locations. These locations varied widely, and include anywhere from around the greater San Francisco Bay area to more distant locations, such as Hawaii, South Dakota, and China, as some participants joined the meeting while on vacation or during business trips. All participants could hear and see the other group attendees. Participants were provided with a high definition web camera with a built-in microphone, as needed, to ensure an optimal audio and video connection. No additional hardware or software was necessary for participation in the virtual group. Study participants were recruited in two cohorts, where individuals within each cohort

were randomized to either the intervention or control group. The second cohort began the intervention within 4 months of the first. Cohort effects were tested and were not significant.

Body weight was remotely monitored using Wi-Fi capable body scales (smart scales), provided to participants for use during the intervention phase of the study. Participants were instructed to attend the weekly classes from a remote location of their choice, and to weigh themselves at least weekly, preferably during the same day and time of the week, and prior to each weekly class using the smart scales. Weight measurements were displayed on the scale itself and also wirelessly transmitted to the study team.

Participants in the control group returned for a follow-up assessment at 3 months post-baseline and were not contacted by the study team between their baseline orientation and 3-month follow-up visit. At the conclusion of this 3-month time period, all participants randomized to the control group were offered the intervention (delayed-intervention control group).

Measures

Demographics

Baseline demographics variables were collected via questionnaire. These variables included age, race/ethnicity, education, internet accessibility, and measures of technology use and access, such as use of social media (i.e., Facebook, LinkedIn).

Clinical measures

Height was collected at baseline using a wall-mounted stadiometer. For the control group, weight was measured at baseline and 3 months to the nearest 0.1 kg using a digital clinic-based scale, with participants wearing light clothing and no shoes. The clinic-based scale has a margin of error of ± 0.5 kg (for individuals less than 99.8 kg) and ± 1.1 kg (for individuals 99.8–199.6 kg) according to manufacturer guidelines. BMI was calculated from height and weight measurements. Blood pressure was obtained using an automated cuff.

For the intervention group, to decrease participant burden and to add the benefits of remote assessment, all analyzed weights were recorded using smart scales, as has been successfully done in previous studies [53]. Participants in the intervention group were instructed to wear minimal clothing and no shoes when weighing themselves. Smart scales have a margin of error of ± 0.1 kg as per manufacturer guidelines (for individuals less than 180 kg).

Attendance and self-monitoring of body weight

For participants in the intervention group, attendance and body weight self-monitoring was recorded by the facilitator at each weekly class session. While participants were able to weigh themselves as frequently as they desired, a participant was determined to have

tracked their weight for a given week if they had a least one measurement within 7 days prior to the class session for that week.

Statistical analysis

The primary outcomes were change in body weight and change in BMI. We used a two-sample Student's *t* test to consider 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 (ITT) analysis with the most conservative method of substituting baseline weights for the final weights of those with incomplete data. Because this was a pilot study, we also performed a post hoc per-protocol analysis to determine if those who participated experienced clinical benefit. Further exploratory analyses among the participants who received the intervention included linear regression to determine 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 SAS 9.3 (Cary, NC) and Excel (Office 2010).

RESULTS

Enrollment and retention

The participants and enrollment process are outlined in Fig. 1. A total of 9,425 individuals were identified via an electronic health record (EHR) query to satisfy initial eligibility criteria. Of these, 500 were randomly chosen and mailed a study invitation letter and 107 were screened for eligibility via telephone. Of these, 82 individuals were scheduled for a baseline visit and a total of 64 individuals attended the orientation and baseline visit, were consented, and were subsequently randomly assigned to the intervention group ($n=32$) or the control group ($n=32$). Attrition was approximately 25 %. In the intervention group, four declined further participation immediately post-randomization and did not attend any sessions post-randomization and had no outcome data; two were lost to follow-up with only nominal attendance (<2 out of 12 sessions) and no final outcome data; and two attended a significant portion of the classes but did not have final outcome data. This resulted in 24 (75 %) intervention and 23 (72 %) control group participants with complete data at 3 months. There was no discernable pattern to the attrition, and each virtual group had at least six participants. We compared drop-outs with those who completed the intervention using *t* tests and chi-square and found no statistically significant between-group differences in any measured demographic variables (i.e., age, race/ethnicity, education, baseline weight, baseline BMI, and baseline blood pressure) or variables measuring use of technology.

Baseline characteristics

Table 1 shows baseline participant characteristics for all randomized participants. Baseline characteristics

Fig. 1 | Participant flow chart

did not differ significantly between the intervention ($n=32$) and control group ($n=32$). The average age of participants was 46.3 years old ($SD=9.5$). The majority of study participants were White/Caucasian (74 %). A majority (81 %) had obtained a college education or above. Additionally, nearly all participants reported having access to the Internet from multiple locations (e.g., home and work) and most participants reported having used social media, suggesting some level of comfort with the use of this technology.

Effects on clinical measures

In ITT analyses ($n=32$ intervention, $n=32$ control), participants in the intervention group lost significantly more weight, 3.5 % (95 % CI 2.1 %, 4.8 %), than those randomized to the control group (Table 2). They lost on average 3.2 kg more than the control group (95 % CI 1.6–4.8), and experienced a 1.0-kg/m² more decrease than their control counterparts (95 % CI 0.4–1.5). In a post hoc analysis, we analyzed the data per-protocol for the participants who completed the treatment regimen ($n=24$ intervention and $n=23$

Table 1 | Participant baseline characteristics

	Mean±SD		<i>p</i> value
	Intervention group, $n=32$	Control group, $n=32$	
Age, years	47.2±7.9	43.3±10.5	0.1042
Race, %			0.7010
White/Caucasian	74.2	78.1	
Asian	16.1	9.4	
Other	9.7	12.5	
Married (versus not)	71.9	68.8	0.7844
College education or above, %	71.9	84.4	0.2265
Use of social media	71.9	65.5	0.5923
Internet access			
Home	100.0	90.6	0.0760
Work/office	81.3	81.3	1.0000
BMI, kg/m ²	34.6±2.8	34.9±2.8	0.8102
Weight, kg	111.5±14.7	110.6±12.7	0.8102
SBP, mmHg	144.7±20.3	141.3±14.6	0.4497
DBP, mmHg	89.0±11.9	86.4±10.4	0.3481

Table 2 | Changes in body weight and BMI

	Intervention group, <i>N</i> =32	Delayed intervention control group, <i>N</i> =32	Between group difference	<i>p</i> value ^a
Average weight loss, kg	3.6 [2.2, 5.0]	0.4 [−0.3, 1.2]	3.2 [1.6, 4.8]	0.0002
Average % body weight loss	3.5 [2.1, 4.9]	0.5 [−0.3, 1.2]	3.0 [1.5, 4.6]	0.0003
Average BMI decrease, kg/m ²	1.4 [0.9, 1.8]	0.4 [0.1, 1.7]	1.0 [0.4, 1.5]	0.0010

^a *p* value for between-group differences

control—see description above). Differences were similar for both BMI and weight loss, with a mean between-group difference in average weight change of 4.1 kg (95 % CI 2.2–6.1).

Attendance, self-monitored body weight, and weight loss

On average, of the 12 weeks of the intervention, participants attended 9.0 sessions (8.0, 10.1), or 75 % (9 of 12). Figure 2 illustrates the relationship between the number of sessions attended and total weight change per participant. Participants in the intervention group transmitted weekly weights (weighed themselves at least once in a given week) 10.4 times (9.4, 11.4) over the course of the intervention period. Figure 3 illustrates the relationship between the number of weekly weights transmitted and total weight change per participant.

DISCUSSION

The VITAL study is the first attempt to our knowledge to deliver a weight loss curriculum in a “virtual” small

group setting using VC technology. Our findings suggest that virtual small groups may be an effective and feasible delivery mechanism for weight management interventions.

Participants who completed the intervention lost significantly more weight than those in the control group. Modest weight loss (5–10 % reduction in total body weight) for individuals who are overweight or obese has been shown to produce health benefits such as improvement in blood pressure, cholesterol, and glucose [54–56]. While participants in the intervention lost less than 5 % of their initial body weight, the outcome is notable given that more than one third (35.7 %) of US adults are obese [57] and individuals in the USA gain approximately 0.5 kg per year on average [58]. Any amount of weight reduction can change the default trajectory of weight gain and is helpful in reducing health risks. Further, this was a pilot study with several limitations which may have influenced the observed effect size.

Efforts to provide more accessible treatments through the use of remote technologies have the potential to enhance attendance and

Fig. 2 | Relationship between number of sessions attended and total weight change per participant. Each dot represents one of the 24 participants. The coefficient (SE) for this model was -0.9 (0.7), *p* value= 0.2335 . Dark gray line prediction line, gray shaded area 95 % confidence limits

Fig. 3 | Relationship between number of weeks self-monitored and total weight change per participant. Each dot represents one of the 24 participants. The coefficient (SE) for this model was $-1.4 (0.7)$, p value= 0.0632 . Dark gray line prediction line, gray shaded area 95 % confidence limits

adherence. Attrition from weight management treatments has been well-documented [25, 59–61]. In the landmark Diabetes Prevention Program trial, only 50 % of people in the lifestyle arm achieved the weight loss goal of 7 % of their body weight [3]. In general, low adherence and attendance are formidable challenges to the effectiveness of many existing clinic-based interventions, with group session attendance dropping markedly over time [15–17]. Among those who received the intervention, participants attended 75 % of the total sessions offered. This is particularly notable given that the study targeted obese men who are among the most difficult populations to engage in weight management and treatment programs [18, 19, 25]. While not statistically significant, the downward slope of both the attendance/weight loss and the self-monitoring/weight loss curves suggest a trend of weight loss with increased participation. While attendance and weight loss was not statistically significantly associated in this pilot study, attendance has been correlated with weight loss in other similar behavioral intervention trials [62, 63]. It is likely that the small sample size in our study has resulted in lack of sufficient statistical power to detect such an association, and this should be examined in further, larger studies. Small groups for weight management have been successfully implemented in clinical settings [17] and are traditionally conducted in-person as an isolated or series of group medical appointments that patients choose to attend for the management of various medical conditions. A recent study found this model to be successful for weight loss [17]; however, the extent of the success was closely related to the number of

classes attended within a given session. Also, women and older patients were most likely to attend the in-person clinic visits. While overall attendance was low (20 %), increased attendance resulted in greater weight loss [17].

Another innovative aspect of this study was the use of remote monitoring of body weight. Participants were asked to weigh themselves at least once per week during the course of the 12-week intervention. Participants complied with this recommendation on average 87 % of the time. For every week that a participant weighed themselves, they lost approximately 0.6 kg of additional body weight ($p=0.0632$). These findings are consistent with the extensive literature in support of self-monitoring as a crucial component of long-term weight management strategies [64, 65]. A recent study examining the efficacy of daily self-weighing with smart scales with tailored feedback produced clinically significant weight loss among participants compared to a control group [66]. This further demonstrates the potential benefits and feasibility of integrating remote monitoring of body weight into future technology-enhanced behavioral weight loss interventions.

There are several limitations to consider when interpreting findings from this study. This was a small pilot study. Very few studies include men only, making it difficult to compare our study outcomes to other previously published studies. A larger study is needed to more accurately assess the effect size of the intervention in larger and more diverse populations. We did experience a somewhat high amount of attrition, which has also been observed in other studies of this nature [67]. This could be due to several factors, which include our initial efforts in the set-up of the technology and also limited resources for

retention. We did analyze based on intention to treat as a secondary analysis by carrying forward the last known weight and found that the between-group differences in weight and BMI reduction were similar and remained significant. Our study participants were generally well educated and had internet access. A larger study is needed to truly understand which populations would benefit most from virtual groups. It is unclear as to how effective this intervention would be in lower socioeconomic populations, despite the high levels of internet access in the USA. The main technical issues were related to sound quality and echo. We attempted to fix this issue by directly helping participants to optimize their set-up and equipment within the first few sessions, but attendance may have been influenced by the quality of internet connection or experience of “audio lags.” We were unable to formally conduct cost-effectiveness analyses for the intervention. Based on our observations and feedback from intervention participants, cost-savings to the participants included reduction in travel time, mileage, and other associated costs; increased productivity; and reduction in lost wages and childcare costs.

Real-time, interactive VC is already a feasible mechanism for health care delivery. The Centers for Medicare and Medicaid Services (CMS) currently provide billing codes for telemedicine reimbursement, specifically for the provision of psychotherapy as well as health and behavioral services [68]. According to the National Conference of State Legislatures, 42 states currently reimburse telemedicine services to some degree [69]. Further, to date, 15 states have enacted legislation which mandates coverage for telemedicine services by private sector insurance companies [69, 70]. Some private insurance companies have begun to offer their own telemedicine services. To remain competitive in the new health insurance exchanges, an increasing number of private payers are likely to reimburse for telemedicine services. The Affordable Care Act (ACA) legislation seeks to advance the use of telemedicine, directly and indirectly, and offers provisions that also address health information technologies. Specifically, the ACA will direct the Center for Medicare and Medicaid Innovation to study ways to use technology to improve the capacity to provide health services for patients with chronic conditions, such as obesity [71].

This pilot study is a first attempt to evaluate the delivery of a group behavior weight loss intervention via VC in a primary care setting. Virtual small groups may be an effective means of health care service delivery and allow for face-to-face group interaction, while overcoming some barriers to access that a participant of an in-person program may face. More studies are needed to evaluate cost-effectiveness, and qualitative studies are needed to explore which populations may benefit most from technology-enhanced interventions.

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