Original Research

A Review of Efficacious Technology-Based Weight-Loss Interventions: Five Key Components

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Abstract

Objective: *Obesity is highly prevalent among American adults and has negative health and psychosocial consequences. The purpose of this article was to qualitatively review studies that used technology-based interventions for weight loss and to identify specific components of these interventions that are effective in facilitating weight loss.* ***Materials and Methods:*** *We conducted a narrow, qualitative review, focusing on articles published in the last 10 years that used an experimental or pre/posttest design and used a technology-based intervention for weight loss.* ***Results:*** *Among the 21 studies reviewed, we identified the following five components that we consider to be crucial in technology-based weight-loss interventions that are successful in facilitating weight loss: self monitoring, counselor feedback and communication, social support, use of a structured program, and use of an individually tailored program.* ***Conclusions:*** *Short-term results of technologically driven weight-loss interventions using these components have been promising, but long-term results have been mixed. Although more longitudinal studies are needed for interventions implementing these five components, the interface of technology and behavior change is an effective foundation of a successful, short-term weight-loss program and may prove to be the basis of long-term weight loss.*

Key words: *obesity, weight loss, technology*

Introduction

One of the biggest public health concerns facing Americans today is obesity. For adults, obesity is determined by using weight in relation to height to calculate body mass index. A body mass index of <18.5 is underweight, 18.5–24.9 is healthy weight, 25.0–29.9 is overweight, and 30 or higher is considered obese. According to the Center for Disease Control and Prevention's Behavioral Risk Factor Surveillance System,[1] the prevalence of obesity nationwide has increased by about 15% in the last 15 years. The most recent available data have suggested that as of 2008, 32.2% of adult men and 35.5% of adult women in the United States are obese.[2]

Obesity affects all ages, with 13% of adolescents in the United States becoming obese as they transition into young adulthood.[3] Prevalence rates appear disproportionately high in adult women of color, affecting 39.2% of non-Hispanic black women and 29.4% of Hispanic women, compared with 21.8% of White women,[4] suggesting the need to understand the role of race, ethnicity, and culture in weight management.

OBESITY AND HEALTH OUTCOMES

Obesity has been associated with a variety of adverse health conditions, including hypertension, type 2 diabetes mellitus, sleep apnea, and other respiratory problems.[5,6] It is also one of the leading causes of coronary heart disease and death.[7] Further, it has been related to numerous psychological problems, including depression, anxiety, low self-esteem, and eating disorders.[8] Although obesity is mostly considered an individual clinical health condition, it has become a significant economic and public health crisis and greatly impacts the U.S. healthcare system.[4] A recent estimate suggests that obesity and overweight have cost nearly 147 billion dollars in out-of-pocket, private, and insurance spending.[9]

Given the chronic health conditions associated with obesity, physicians and other health providers are faced with the challenge to implement programs for both immediate and long-term weight loss. Although behavioral interventions for weight loss have shown encouraging short-term results, results for maintaining weight loss over a long period of time have been mixed.[10] Therefore, there is a critical need for better models of behavior change that can be delivered with relative ease and sustained over long periods of time. To that end, the interface of technology with traditional behavior change strategies for weight loss has shown promise.

BEHAVIORAL WEIGHT-LOSS INTERVENTIONS

Behavioral weight-loss interventions have been under study for over 30 years.[11] These interventions typically have consisted of diet, exercise, and behavior therapy.[12] Behavioral modification strategies usually include the following: self-monitoring, goal-setting, shaping, reinforcement, and stimulus control.[12] The basic treatment structure is typically weekly visits for approximately 4–6 months and adheres to a structured curriculum with a skill-building focus.

TECHNOLOGY-BASED WEIGHT-LOSS INTERVENTIONS

Successful commercial weight-loss programs tend to utilize strategies and principles found in empirically supported weight-loss interventions.[13] These strategies include a nutrition/exercise educational component, cognitive restructuring, and principles of behavioral

modification.[12] Finding ways to facilitate these strategies in a world that is increasingly relying on technology (e.g., cell phones, Internet) to communicate would enable individuals to gain access to more information as well as increase their ability to self-monitor with greater ease compared with traditional methods.

Although research on technologically based delivery of weight-loss interventions is in its infancy, logic suggests that the use of technology would enhance ease of delivery and implementation. To date, several systematic reviews have found that Web-based interventions may be a moderately effective way to facilitate lifestyle change and weight loss.[14,15] The purpose of this article was to further review studies published in the last 10 years that used technology-driven interventions for weight loss and/or management to determine if we could qualitatively identify key technology-based components of these successful interventions.

Materials and Methods

The studies reviewed were based on the following criteria: (1) published in the last 10 years (2000–2010); (2) published in peer-reviewed journals; (3) used randomized, controlled trials or an experimental pretest–posttest design; (4) used technology to facilitate weight loss; and (5) used weight reduction as an outcome measure. The following databases were searched: Medline, Psychinfo, and Google Scholar. We used the following key words to search: obesity, weight loss, technology, Internet, and handheld devices.

Results and Discussion

Among the 21 studies reviewed (*Table 1*), we identified the following five components that we consider to be key in technology-based weight-loss interventions that are successful in facilitating weight loss: (1) self monitoring; (2) counselor feedback and communication; (3) social support; (4) structured program; and (5) individually tailored program.

SELF-MONITORING

Self-monitoring refers to the process in which individuals regulate and keep track of their own behaviors. Self-monitoring is the core behavioral component of weight-loss efforts.[16–19] Moreover, there is research indicating that weight-loss programs must include dietary and physical activity self-monitoring for successful weight reduction.[20] This has been supported by recent findings indicating that consistent self-monitoring of exercise is associated with greater total weight loss, greater amount of exercise, and fewer difficulties with exercise.[21–24]

In moving past traditional methods of self-monitoring such as paper-and-pen diaries, research has found that technology can simplify the monitoring process.[25] This can include recording one's progress of food intake and physical activity using online journaling, handheld devices such as personal digital assistants (PDAs), and spreadsheets.

SELF-MONITORING AND TECHNOLOGY

Studies that use self-monitoring via various technological means have shown encouraging results. For instance, Internet-based studies often incorporate online journaling and online submission of diaries to manage weight, the frequency of which has been correlated with greater short-term weight loss.[26,27] Consistent with these findings, an online food and exercise journal is an important component for weight loss in both behavioral and commercial weight-loss programs delivered over the Internet.[28,29] An important feature of self-monitoring appears to be e-mailing daily food intake and energy expenditure journals to a weight-loss counselor rather than private record-keeping.[30–33] It may be that being accountable to someone other than oneself enhances motivation to continue with behavioral change activities. Authors have also commented on the importance of a dynamic, visually appealing self-monitoring tool that is enjoyable and easily used.[34,35]

Technology other than the Internet has also demonstrated successful self-monitoring. Several studies have found that the use of pedometers and handheld PDAs have resulted in greater ease and frequency of self-monitoring, which was associated with an increase in physical activity[36] and greater weight loss.[24,30,37–39] Additionally, continuous use of wearable body monitors and Internet diaries resulted in equivalent or greater weight loss compared with traditional pen-and-paper diaries.[24,38] The reason these technologies are likely to be effective is because portable body monitors, pedometers, and handheld PDAs are mobile and, therefore, can be easily used, resulting in continuous self-monitoring. Also, these devices are more convenient for individuals without access to a high-speed Internet connection.

COUNSELOR FEEDBACK AND COMMUNICATION

Feedback from a counselor regarding goals, progress, and results can encourage, motivate, and assist patients in successfully completing a weight-loss program.[35] However, face-to-face interactions can be time consuming and inconvenient. Technology-based programs often supplemented online weight-loss interventions with brief weekly or monthly in-person counselor or psychologist visits.[29,34,40] Of note, research suggests that online communication with a counselor can be just as effective as an in-person interaction,[31] which has implications for cost savings.

COUNSELOR FEEDBACK AND TECHNOLOGY

As previously noted, technology-based communication with a counselor is effective and communication through e-mail has particularly demonstrated positive results. Participants typically submit their weekly food and exercise journals online and receive personalized feedback, reinforcement, and recommendations from a counselor over e-mail.[26,30,31,33,38,41] Research that has compared interventions with a counselor with those that did not include a counselor found that participants in an online behavioral weight-loss intervention who received weekly counseling and feedback from a counselor via e-mail lost significantly more weight,[26,32,33,35,40] even when controlling for other Web components such as message boards.[32] Of note, computer-automated e-mail feedback appeared to be just as effective as human e-mail counseling when compared with no counseling at all.[33] Similar to e-mail, regularly scheduled contact

Table 1. Outcome Studies of Technology-Based Weight-Loss and -Maintenance Programs

STUDY	*N*	INTERVENTION	TECHNOLOGICAL COMPONENT(S) USED	AGE *M* (SD)	BMI *M* (SD)	LENGTH OF INTERVENTION	FOLLOW-UP	MEASUREMENTS	RESULTS (SIGNIFICANCE)
Clarke et al.[39]	93	Cohort	SM	27 (np)	35 (np)	8 weeks	8 and 24 weeks	Mean weight change (kg)	−6.9 lbs (np) (np)
Cussler et al.[50]	135	a: Internet weight-maintenance group ($n=52$) b: Self-directed group ($n=59$)	SM, GS, SP	a: 48.0 (4.6) b: 48.4 (4.3)	a: 32.3 (3.9) b: 30.4 (3.3)	12 months	4 and 16 months	Mean change in BMI	a: −2.1 (1.4) b: −1.3 (1.8) (nonsignificant)
Bennett et al.[34]	101	a: Web-based weight loss ($n=51$) b: Usual care ($n=50$)	SM, CFC, GS, SP, ITP	a: 54.4 (7.4) b: 54.5 (8.9)	a: 35.0 (3.5) b: 34.6 (3.2)	3 months	3 months	Mean weight change (kg)	a: −2.3 (3.2) b: 0.3 (1.9) (np)
Gold et al.[28]	124	a: VTrim ($n=62$) b: eDiets.com ($n=62$)	SM, GS, SP	a: 46.5 (10.7) b: 48.9 (9.9)	a: 32.3 (3.9) b: 32.5 (4.2)	12 months	6 and 12 months	Mean weight change (kg)	a: −7.8 (7.5) b: −3.4 (5.8) ($p=0.002$)
Harvey-Berino et al.[48]	122	Maintenance program: a: Internet ($n=30$) b: Minimal in-person ($n=28$) c: Frequent in-person ($n=32$)	SM, GS	a: 46.3 (11.1) b: 49.1 (9.1) c: 49.8 (8.4)	a: 32.2 (4.0) b: 32.8 (4.6) c: 31.5 (4.8)	12 months	6, 12, and 28 months	Mean weight change (kg)	a: −5.7 (5.9) b: −10.4 (9.3) c: −10.4 (6.3) ($p<0.05$ for "a" vs. "b" and "c")
Harvey-Berino et al.[49]	255	Maintenance program: a: Internet ($n=52$) b: Minimal in-person ($n=63$) c: Frequent in-person ($n=61$)	SM, CFC, GS	a: 46.5 (9.8) b: 46 (7.7) c: 45.3 (8.9)	a: 29.3 (5.2) b: 29.0 (4.3) c: 28.9 (3.8)	12 months	6, 12, and 18 months	Mean weight change (kg)	a: −7.6 (7.3) b: −5.5 (8.9) c: −5.1 (6.5) (nonsignificant)
Hunter et al.[31]	446	a: Behavioral Internet treatment ($n=224$) b: Usual care ($n=222$)	SM, CFC, SP	a: 33.5 (7.4) b: 34.4 (7.2)	a: 29.4 (3.0) b: 29.3 (3.0)	24 weeks	6 months	Mean change in BMI	a: −0.5 (1.4) b: 0.2 (1.1) ($p<0.001$)
Hurling et al.[36]	77	Physical activity monitor: a: Fully automated feedback ($n=47$) b: No feedback ($n=30$)	SM, CFC, SP, ITP	a: 40.5 (7.1) b: 40.1 (7.7)	a: 26.2 (2.8) b: 26.5 (4.1)	9 weeks	9 weeks	Mean change in percent body fat	a: −2.2 (0.6) b: −0.2 (0.8) ($p=0.04$)
McConnon et al.[41]	221	a: Internet weight-loss intervention ($n=54$) b: Usual care ($n=77$)	CFC, SP	a: 48.1 (np) b: 47.4 (np)	a: 34.5 (np) b: 34.4 (np)	12 months	12 months	Mean weight change (kg)	a: −1.3 (np) b: −1.9 (np) (np)
McTigue et al.[30]	50	Cohort	SM, CFC, GS, SP	51.9 (10.8)	np	12 months	12 months	Mean weight change (kg)	−4.8 (np) (np)
Micco et al.[40]	123	a: Internet +in-person treatment ($n=61$) b: Internet only ($n=62$)	CFC, GS	a: 47.1 (11.1) b: 46.5 (10.7)	a: 31.0 (4.1) b: 32.3 (3.9)	12 months	6 and 12 months	Mean weight change (kg)	a: −6.8 (7.8) b: −5.1 (7.1) (nonsignificant)

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Table 1. Outcome Studies of Technology-Based Weight-Loss and -Maintenance Programs *continued*

STUDY	*N*	INTERVENTION	TECHNOLOGICAL COMPONENT(S) USED	AGE *M* (SD)	BMI *M* (SD)	LENGTH OF INTERVENTION	FOLLOW-UP	MEASUREMENTS	RESULTS (SIGNIFICANCE)
Patrick et al.[42]	65	a: Phone-based dietary and weight-loss intervention ($n=33$) b. Printed weight-loss materials ($n=32$)	SM, CFC, SP	a: 47.4 (7.1) b: 42.4 (7.5)	a: 32.8 (4.3) b: 33.5 (4.5)	4 months	2 and 4 months	Mean weight change (kg)	a: −2.88 (np) b: −0.91 (np) ($p=0.02$)
Polzien et al.[38]	58	a: Cont-Tech ($n=19$) b: Int-Tech ($n=19$) c: SBWP ($n=19$)	SM, CFC	a: 42.6 (10.0) b: 41.1 (8.3) c: 40.2 (8.0)	a: 32.6 (2.7) b: 33.4 (2.8) c: 33.36 (2.7)	12 weeks	12 weeks	Mean weight change (kg)	a: −6.2 (4.0) b: −3.4 (3.4) c: −4.1 (2.8) ($p<0.05$ for "a" vs. "b")
Richardson et al.[37]	12	Pedometer feedback with nutritional counseling ($n=12$)	SM, CFC	52.7 (np)	37 (6.5)	3 weeks	3 weeks	Mean weight change (lbs)	−4.1 (np) ($p=0.004$)
Rothert et al.[46]	675	a: Web-based tailored ($n=306$) b: Web-based weight-management materials ($n=279$)	SP, ITP	a: 45.6 (12.1) b: 45.2 (12.0)	a: 33.0 (3.8) b: 31.1 (3.9)	6 weeks	3 and 6 months	Mean weight change (kg)	a: −2.8 (0.3) b: −1.1 (0.4) ($p<0.001$)
Svetkey et al.[47]	1032	Weight-loss maintenance a: Internet ($n=347$) b: Monthly in-person contact ($n=341$) c: Control ($n=341$)	SM, GS, SP	a: 55.7 (8.5) b: 55.4 (9.1) c: 55.8 (8.5)	a: 34.2 (4.9) b: 34.2 (4.8) c: 34.0 (4.8)	30 months	6, 12, 18, and 30 months	Mean weight regain (kg)	a: 5.2 b: 4.0 c: 5.5 ($p=0.001$ for "b" vs. "c")
Tate et al.[26]	91	Internet: a: Behavior therapy ($n=33$) b: Education ($n=32$)	SM, CFC, GS, SP	a: 41.1 (11.6) b: 40.6 (9.7)	a: 29.1 (3.0) b: 28.9 (3.1)	24 weeks	3 and 6 months	Mean weight change (kg) Reduction in weight circumference (cm)	a: −4.1 (4.5) b: −1.6 (3.3) ($p=0.04$) a: −6.4 (5.5) b: −3.1 (4.4) ($p=0.005$)
Tate et al.[32]	92	Internet weight-loss program plus: a: E-counseling ($n=46$) b: No counseling ($n=46$)	SM, CFC, GS, SP	a: 49.8 (9.3) b: 47.3 (9.5)	a: 31.0 (3.9) b: 33.7 (3.7)	12 months	3, 6, and 12 months	Mean weight change (kg)	a: −4.4 (6.2) b: −2.0 (5.7) ($p=0.04$)
Tate et al.[33]	192	Internet behavioral program plus: a: E-counseling ($n=64$) b: Automated feedback ($n=61$) c: No counseling ($n=67$)	SM, CFC, GS, SP	a: 47.9 (9.8) b: 49.7 (11.4) c: 49.9 (8.3)	a: 32.8 (3.4) b: 32.7 (3.5) c: 32.3 (3.7)	6 months	3 and 6 months	Mean weight change (kg)	a: −7.3 (6.2) b: −4.9 (5.9) c: −2.6 (5.7) ($p=0.001$ for "a" vs. "c")
Turner-McGrievy et al.[45]	78	a: Social cognitive weight-loss podcast ($n=41$) b: Commercial weight-loss podcast ($n=37$)	SP	a: 37.7 (11.8) b: 39.6 (12.2)	a: 31.8 (3.2) b: 31.4 (4.1)	12 weeks	12 weeks	Mean weight change (kg)	a: −1.0 (1.2) b: −0.1 (0.7) ($p<0.001$)

continued →

Table 1. Outcome Studies of Technology-Based Weight-Loss and -Maintenance Programs *continued*

STUDY	*N*	INTERVENTION	TECHNOLOGICAL COMPONENT(S) USED	AGE *M* (SD)	BMI *M* (SD)	LENGTH OF INTERVENTION	FOLLOW-UP	MEASUREMENTS	RESULTS (SIGNIFICANCE)
Webber et al.[27]	18	Online Motivational interviewing: a: Group with values ($n=9$) b: Group without values ($n=9$)	SM, GS, SP	40.6 (11.3)	31.0 (4.2)	8 weeks	8 weeks	Mean self-reported weight loss (kg)	a: −1.5 (2.2) b: −2.7 (2.9) (nonsignificant)
Wing et al.[44]	314	a: Internet self-regulation program ($n=104$) b: Face-to-face self-regulation program ($n=105$) c: Control ($n=105$)	SM, CFC	a: 46.5 (10.7) b: 48.9 (9.9)	a: 32.3 (3.9) b: 32.5 (4.2)	18 months	6, 12, and 18 months	Mean weight change (kg)	a: 4.7 (8.6) b: 2.5 (6.7) c: 4.9 (6.5) ($p=0.05$ for "b" vs. "c")
Womble et al.[29]	47	a: eDiets.com ($n=23$) b: Weight-loss manual ($n=24$)	SM, CFC, SP	a: 44.2 (9.3) b: 43.3 (11.1)	a: 33.9 (3.2) b: 33.0 (3.0)	16 weeks	16 and 52 weeks	Mean weight change (kg)	a: −0.8 (3.6) b: −3.3 (4.1) ($p=0.04$)
Yon et al.[24]	176	a: Personal digital assistant self-monitoring ($n=57$) b: Paper diary self-monitoring ($n=93$)	SM	a: 48.2 (8.7) b: 46.1 (9.2)	a: 32.3 (3.4) b: 30.9 (3.5)	6 months	6 months	Mean weight change (kg)	a: −6.3 (6.1) b: −7.2 (5.2) (nonsignificant)

BMI, body mass index; SM, self-monitoring; CFC, counselor feedback and communication; GS, group support; SP, structured program; ITP, individually tailored program; np, value not provided.

with a health counselor through short message service (SMS) text messaging or phone calls has also been an effective option in supplementing Internet-based weight-loss interventions with feedback and communication.[31,34,42] Fully automated feedback via SMS text messaging was also effective in increasing physical activity and decreasing percentage of body fat.[36] Overall, research suggests that regularly scheduled individual feedback regarding food and exercise diaries delivered through e-mail or other text-based technology is an important and effective component of Internet-based weight-loss programs.[32]

SOCIAL SUPPORT

A group treatment format is typically the preferred delivery of behavioral weight-loss interventions.[43] Not only is this a cost-effective method of delivering treatment to a larger number of people, but also group treatments leverage social support, an important facilitator of behavior change.[44] Group support can foster motivation, encouragement, and commonality.[43] In addition, group interventions are superior to individual interventions in facilitating weight loss.[43]

SOCIAL SUPPORT AND TECHNOLOGY

Technology can create social support using online systems such as message boards, electronic bulletin boards, chat forums, and chat rooms.[26–28,33,34,40] Although electronic message boards and forums are often used to facilitate communication among participants, "real-time" chat rooms or online meetings may be superior to message boards in fostering a perceived sense of social support and enhancing communication with a health counselor.[26,30,32,33,40] A greater perception of social support may foster higher log-in frequencies, which, in turn, enhances behavioral changes associated with weight loss. Indeed, use of chat rooms has been correlated with greater weight loss and better weight loss maintenance over longer periods of time.[28,35] Interestingly, there may be no difference in the efficacy of "real-time" meetings online versus in-person in terms of weight loss.[40] Of note, Internet-based weight-loss interventions that did not include an online social support system had low utilization rates and did not result in weight loss compared with usual, in-person care.[41]

STRUCTURED PROGRAM

Importantly, the most successful, technology-based weight-loss programs have been structured interventions that incorporated principles of behavior therapy and change.[26–29,31,34] Successful interventions were typically delivered online or, in one case, through podcasts on a personal digital music player.[45] They consisted of structured weekly lessons on various topics, including nutrition, exercise, stimulus control, self-regulation strategies, and

goal-setting.[26,30,45] In addition, participants were asked to submit food and exercise journals at regularly scheduled times,[26,32,33] which may have increased accountability and, therefore, adherence. Online structured weight-loss programs based on theories of behavior change have consistently been more effective than online commercial weight-loss programs,[28,29,45] highlighting the need for components such as weekly lessons and accountability of self-monitoring.

INDIVIDUALLY TAILORED PROGRAM

Interventions that were individually tailored to participant goals had higher rates of adherence and weight loss.[34] In one case, participants met with a health coach prior to receiving the intervention and selected four high-priority behavior change goals that were subsequently monitored and achieved through behavior skills training.[34] Another study delivered automated, real-time SMS text messages that were specific for each participant's barrier to exercise at that moment.[36] To date, only one study has explored the use of software to develop an individually tailored, Internet-based weight-loss intervention.[46] Using data from the baseline assessment, the tailored weight-loss program matched individual needs regarding nutrition, information on caloric deficits, eating cues, physical activity, body image, social support, and cognitive restructuring.[46] Participants in the tailored program lost significantly more weight than the online information-only group at 3 and 6 months. Moreover, the tailored program was particularly effective for women and African Americans.

LIMITATIONS

This was a narrow review that focused on identifying key components of technology-based weight-loss interventions. Given the fast pace of technological advances, we used only peer-reviewed articles published in the past 10 years. Further, we limited our scope to interventions that used an experimental or pre/posttest design and only examined interventions that used technology for weight loss. Although this review was focused on behavioral methods, we are aware that nutrition is a key component of successful weight loss, and future research should examine the interface of technologically based behavioral interventions with nutritional weight-loss programs. Despite the narrow focus of this review, we identified several key components of technologically based weight-loss programs that can facilitate weight loss, both immediately and over time.

IMPLICATIONS FOR SHORT- AND LONG-TERM WEIGHT LOSS

There is a growing body of evidence suggesting that technologically driven interventions are an effective way to deliver necessary health information and facilitate behavioral changes necessary for weight loss. Additionally, five key components that include self-monitoring, counselor feedback, social support, structure and principles of behavior change, and an approach that is individually tailored for the individual have been consistently associated with successful weight-loss interventions.

A technology-based model of behavior change for weight loss, using the five key components, is advantageous over traditional methods in several ways. First of all, the Internet can be used to deliver interventions to a wide range of individuals in a cost-effective way. With the widespread use of technology that includes the Internet, mobile telephones, and digital music players, individuals can access weekly lessons, online diaries, feedback from their counselor, and online support at their convenience. This type of convenience enables individuals to incorporate weight-loss programs into busy schedules and lifestyles, thereby reducing resistance to engage in a weight-loss intervention. Second, portable devices, such as handheld PDAs or pedometers, provide opportunities for continuous and discrete self-monitoring, which have been shown to increase weight loss when compared with traditional methods.[38] Finally, technology-based interventions can provide individuals with a sense of control that is essential for developing and implementing short- and long-term behavioral change.

Although technology-based interventions have several advantages over traditional, in-person, models, there are some limitations to using these methods. For instance, access to Internet services varies among rural and urban areas, wealthy and poor communities, as well as different regions globally. The studies reviewed above required participants to have access to high-speed Internet or mobile devices, which may limit the generalizability of the results to certain socioeconomic classes or geographic regions. Moreover, there is a minimum level of computer or electronic device literacy needed to effectively use online or mobile device health interventions. Finally, the short-term results of technology-based weight-loss programs are promising, but the long-term results are mixed.

Several studies have suggested that regular, in-person care provides modest benefits over Internet programs in preventing weight gain.[44,47–50] Research has also shown a strong correlation between online self-monitoring and weight loss only in the first 3–6 months of the intervention.[26,28] The strength of the relationship appears to weaken over time, suggesting that a successful weight-loss and -maintenance intervention should encourage self-monitoring and treatment adherence over longer periods of time. This could be accomplished with booster sessions that incorporate the five key components. Only two studies on Internet-based weight-maintenance programs have followed participants longer than 18 months, and results have not suggested that Internet-based weight-maintenance programs are more successful than in-person or active comparison programs.[47,48] Future research should evaluate the efficacy of booster sessions that incorporate the five key components. Given the tendency of individuals to regain weight gradually, these sessions should be delivered regularly over several years.

Despite certain limitations, technology has provided health professionals with an opportunity to improve behavior change models by making them more convenient, accessible, and continuous. Technology that incorporates the five components is likely to facilitate behavior change that has substantial impact on public health. As rates of obesity and associated health problems continue to rise in the

United States, the interface of technology and behavior change is an effective foundation of a successful, short-term weight-loss program and may prove to be the basis of long-term weight loss.

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