Obesity Prevention and Control: Digital Health Interventions for Adolescents with Overweight or Obesity

Community Preventive Services Task Force
Finding and Rationale Statement
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CPSTF Finding and Rationale Statement

Context

In the United States, 21% of adolescents aged 12-19 years have obesity (Hales et al., 2018) and 14% have overweight (Ogden et al., 2014). Adolescents and children with obesity are more likely to have high blood pressure and cholesterol, fatty liver disease, gallstones, gastro-esophageal reflux, breathing problems such as asthma and sleep apnea, and impaired bone development (Africa et al., 2016; Cote et al., 2013; Mohanan et al., 2014; Narang et al., 2012; Pollock 2015). They are also at increased risk of impaired glucose tolerance, insulin resistance, and type 2 diabetes (Lloyd et al., 2012; Bacha et al., 2016). Adolescent and childhood obesity are also related to anxiety, depression, lower self-esteem, lower self-reported quality of life, and social problems such as bullying and stigma (Morrison et al., 2015; Halfon et al., 2013; Beck 2016). Lastly, adolescents who have overweight or obesity are at increased risk of having obesity as adults (Gordon-Larsen et al., 2010).

A cornerstone of many behavioral interventions to address obesity is self-monitoring (Burke et al., 2011), which is frequently incorporated into digital health interventions (Coons et al., 2012). The aim of self-monitoring is to increase one's awareness and evaluation of a particular behavior. It often includes recording information, which can be done using a digital device.

Digital health interventions have the potential to reach a large number of adolescents. In the United States, 93% of adolescents aged 13-17 years use the internet (Pew, 2019), 95% have access to a smartphone at home (Pew, 2018), and 88% have access to a computer (Statista, 2016).

Secondary prevention interventions aim to reduce the impact of disease that has already occurred. Self-monitoring digital health interventions that include self-monitoring, when implemented among adolescents with overweight or obesity, are considered secondary prevention interventions.

Intervention Definition

Digital health interventions target adolescents aged 12-18 years who have overweight or obesity. Interventions combine self-monitoring and goal setting using digital health (e.g., websites, mobile apps, or wearable devices) to increase adolescents' awareness of healthy dietary or physical activity behaviors that help with weight management. Trained personnel moderate the intervention programs with oversight by healthcare providers including psychologists, health counselors, dietitians, nurses, and pediatricians.

For a period of at least two months, adolescents record their weight and dietary or physical activity behaviors and track their progress toward meeting set goals. To enhance adolescents' self-monitoring skills, program personnel teach them how to use the digital health features through in-person, text, or written instructions.

Interventions also may include one or more of the following:

- Individualized feedback from healthcare providers or trained program personnel related to goals and intervention adherence
- Educational materials for parents or caregivers to help them support their child's healthier dietary and physical activity habits (e.g., newsletter, handbook)
- Peer or social support through internet forums or discussion groups

- Counseling from a healthcare provider about nutrition, physical activity, sedentary behaviors, or weight, either in-person or via phone, text, email, or mobile apps

CPSTF Finding (July 2019)

The Community Preventive Services Task Force recommends digital health interventions to assist adolescents with overweight or obesity with weight management. Sufficient evidence of effectiveness shows these secondary prevention interventions achieve small but meaningful weight reductions in adolescents. These interventions are typically delivered through websites, mobile apps, or digital devices.

Rationale

Basis of Finding

The CPSTF finding is based on evidence from studies identified in a published systematic review and an updated search. The search period from the original review by Ho et al. (2018) was through December 13, 2017 and resulted in eight studies with ten study arms. The updated search period was through March 27, 2019 and resulted in three studies.

The systematic review team synthesized weight-related outcomes (i.e., Body Mass Index z-score [BMIz], percent body fat, Body Mass Index (BMI)) to assess intervention effectiveness. Many of the included studies presented more than one weight-related outcome; this systematic review only included one outcome from each study arm. BMIz, the most commonly reported weight-related outcome, was selected as the primary outcome.

Evidence from the eleven included studies showed self-monitoring digital health interventions led to small, but meaningful reductions in BMIz, percent body fat, and BMI in adolescents when compared to controls (Table 1). Ten of the eleven studies provided treatment for control groups that ranged from low intensity (e.g., providing educational materials) to high intensity (e.g., clinical evaluation and counseling). The control groups in these ten studies typically reported favorable results.

Two studies provided similar self-monitoring content to intervention and control groups; the intervention group received a digital health intervention and the control group manually recorded and tracked their behaviors. In one study, the digital health group reported a 0.4 greater reduction in BMIz compared with controls. In the other study, the digital health group reported a 0.5 reduction in BMI compared to controls.

Table 1: Weight-related Outcomes

Outcome	Studies (arms)	Effect	Direction of Effect
BMIz	6 studies (8 arms)	Median decrease: 0.10 (IQI: -0.16 to -0.07)	Favorable
%Body Fat	3 studies	Median decrease: 0.49 percentage points (range: -0.92 to 1.4 percentage points)	Favorable
BMI	2 studies	Range: -0.39 to -0.27 kg/m2	Favorable

IQI: Interquartile Interval
kg/m^2: BMI = (weight in kilograms/(height in meters)^2)

Additional Outcomes of Interest

Some of the included studies reported additional outcomes of interest such as dietary intake, physical activity and sedentary time, and health-related quality of life.

Dietary intake was reported in four studies with six study arms. Two studies with four study arms reported a favorable increase in fruit and vegetable consumption, and one study reported a favorable change in the index of nutrition outcome measure. Two studies with four study arms reported mixed findings for fat intake.

Physical activity was reported in five studies with seven study arms. Two studies with four study arms found a median increase in physical activity of 17 minutes per day (range: 14.1 to 20.6 minutes per day). One study reported a 0.77 increase in the number of days per week that adolescents reported being active for at least 60 minutes. Two studies reported increased scores on fitness tests.

Sedentary activity was reported in three studies with five study arms. Sedentary activity decreased a median of 42 minutes per day (range: -120.0 to 16.6 minutes per day).

Health-related quality of life was reported in six studies with eight study arms. Findings were generally favorable.

Stratified Analyses

Digital health interventions that include self-monitoring vary by type of support provided by program personnel, focus of self-monitoring, type of technology used, the presence or absence of counseling, and intervention duration. The review team conducted stratified analyses to understand the influence of these factors on weight-related outcomes (Table 2).

Due to a small number of studies and different outcome measures, the review team was not able to draw many conclusions from the stratified analyses. Interventions were delivered through text messages, websites, mobile apps, in-person communication, or internet plus in-person communication. Self-monitoring most often focused on the combination of weight, diet, and physical activity, and used websites to track information. Interventions that included counseling (2 studies, 3 study arms) reported more favorable results than interventions that did not (9 studies, 10 arms). Intervention duration was typically between two and six months.

Table 2: Results from the Stratified Analyses

Characteristics		BMIz	% Body Fat	BMI
Support by Program Personnel	Text Message	Median decrease: 0.10 Range: -0.44 to 0.01 (3 studies*)	No studies	No studies
	Website/mobile app	Median decrease: 0.10 Range: -0.14 to -0.09 (3 studies*)	-0.49 (1 study)	-0.39 (1 study)
	In-person	0.02 (1 study)	1.4 pct pts (1 study)	-0.27 (1 study)
	Website/mobile app + in-person	-0.20 (1 study arm*)	-0.92 pct pts (1 study)	No studies
Focus on Self-monitoring	Weight	No studies	-0.49 (1 study)	No studies
	Physical Activity	No studies	1.4 pct pts (1 study)	-0.39 (1 study)

Characteristics		BMIz	% Body Fat	BMI
	Weight + Physical Activity	-0.10 Range: -0.10 to -0.2 (1 study*)	No studies	No studies
	Diet + Physical Activity	-0.44 and 0.01 (2 studies)	No studies	No studies
	Weight + Diet + Physical Activity	Median decrease: 0.09 Range: -0.14 to 0.02 (3 studies)	0.92 pct pts (1 study)	-0.27 (1 study)
Technology Used to Deliver Self-monitoring	Computers	Median decrease: 0.10 IQI: -0.14 to 0.02 (4 studies*)	-0.92 pct pts (1 study)	-0.27 (1 study)
	Wearable Device + Mobile Technology	-0.44 and 0.01 (2 studies)	1.4 pct pts (1 study)	No studies
	Computer or Mobile Device	No studies	-0.49 pct pts (1 study)	-0.39 (1 study)
Counseling	No counseling	Median decrease: 0.10 IQI: -0.14 to 0.01 (6 studies, 7 arms**)	-0.49, 1.4 pct pts (2 studies)	-0.27 (1 study)
	Counseling	-0.20 (1 study arm**)	-0.92 pct pts (1 study)	-0.39 (1 study)
Intervention Duration	2-3 months	0.01 (1 study)	-0.49, 1.4 (2 studies)	-0.39, -0.27 (2 studies)
	4-6 months	Median decrease: 0.12 Range: -0.4 to 0.02 (4 studies)	No studies	No studies
	12-24 months	Median decrease: 0.10 Range: -0.10 to -0.20 (1 study*)	-0.92 pct pts (1 study)	No studies

*One study included three arms. Adolescents were provided information through text messages in one arm, through a website in one arm, and through a website and in-person in one arm.

**One study included three arms. One arm had counseling; two did not.

IQI: Interquartile interval

pct pts: Percentage points

Applicability and Generalizability Issues

Included studies were conducted in the United States (6 studies), Portugal (2 studies), Norway (1 study), Italy (1 study), and Malaysia (1 study). Participants were recruited from health care settings (5 studies), schools (4 studies), or community organizations and schools (2 studies). Of the studies that reported information about urbanization, five were conducted in urban settings and two were conducted in urban and suburban settings; none were conducted in rural settings. Interventions were effective across countries and recruitment settings and in urban and suburban areas.

Interventions included adolescents aged 12 to 16 years. Included studies reported roughly equal numbers of males and females, and interventions reported similar effectiveness among both populations.

All six studies from the United States reported racial and ethnic distributions that demonstrated intervention effectiveness across groups. Populations included adolescents in the following groups: white (median 34.5%; 4 studies), black (median 14.0%; 4 studies), Hispanic (median 53.5%; 2 studies with 4 study arms), Asian American (median: 4.9%; 2 studies), or other race/ethnicity (median 5.9%; 4 studies). In one study, all of the participants were black, and in another, all of the participants were Chinese American.

Seven studies reported socioeconomic status (SES) and found similar effectiveness among low- and mixed-income populations.

Studies reported similar effectiveness for weight-related outcomes among students who had obesity (8 studies) or overweight (3 studies) at baseline.

Data Quality Issues

Study designs included randomized controlled trials (9 studies) and controlled trials (2 studies). All studies reported weight-related outcomes (BMIz, percent body fat, BMI) based on measurements taken by trained staff.

The most common limitation, according to Community Guide quality scoring methods, was for sampling methods (4 studies). These four studies did not describe the universe of selection for the study population. However, three of the four studies were randomized control trials where randomization occurred after participants were selected into the study.

Additional limitations included small sample sizes and unknown recruitment rates. Sample sizes ranged from 40-120, with a median of 80. Several studies reported difficulty recruiting participants for the intervention. Eight studies reported information to calculate recruitment rates, which ranged from about 21% to 100%. Studies with lower rates tended to recruit from school settings and those with higher rates tended to recruit from clinical settings. The median retention rate was 89% (range: 52% to 100%).

Other Benefits and Harms

Other potential benefits identified in these interventions included improvements in depressive symptoms. Four studies reported a median decrease of 1.1 (IQI: -1.6 to -0.40) in depressive symptoms measured with the Center of Epidemiologic Studies Depression Scale.

An additional four studies assessed disordered eating or body image and did not identify harms associated with the intervention.

No other potential harms were identified.

Considerations for Implementation

The following considerations for implementation are drawn from studies included in the existing evidence review, the broader literature, and expert opinion.

- Interventions incorporating technology are a convenient and relatively new way to reach individuals, especially younger generations. They have the potential for broad dissemination and scalability (Carter et al., 2013; Roess, 2017; Svetkey et al., 2015).

- Digital health is rapidly evolving and the impact of newer self-monitoring digital health interventions, such as interventions incorporating social media, were not represented in this body of evidence. Thus, the impact of digital health interventions that include social media impact is unknown.
- Confidentiality of personal information is critical; it should be encrypted and password-protected. Technology-supported counseling may raise legal issues regarding confidentiality and the integrity of services provided (Zamani et al., 2009; Mallen et al., 2005).
- Implementers need to ensure information administered to adolescents is age-appropriate and accurate. Involving trained professionals can help. Interventions in the included studies were supported by physicians, dietitians, exercise physiologists, and mental health providers.
- Self-monitoring digital health interventions may increase access for adolescents who are living in rural areas or have transportation challenges that make it difficult to participate in obesity treatment interventions.
- Self-monitoring digital health interventions that include involvement of a healthcare provider may reduce barriers to access, making it easier for providers to administer consultations (Mallow et al., 2015).
- Recruitment of adolescents can be challenging. It may be useful to partner with healthcare professionals who treat adolescents with overweight or obesity, particularly if programs want to recruit a group for discussions or peer support.

Evidence Gaps

Additional research and evaluation are needed to answer the following questions and fill existing gaps in the evidence base.

- What are the long-term effects of self-monitoring digital health interventions among adolescents? Studies with a follow-up period extending past 6 months would provide more evidence about the broader impact of these interventions.
- What is the ideal intervention duration or level of intensity? Is a short, intense intervention more, or less, effective than a longer and less intense intervention?
- How effective are these interventions across different populations and settings (e.g., low income populations, students with disabilities, rural communities, isolated populations)?
- Does intervention effectiveness vary if the intervention is tailored to a specific demographic population?
- Are interventions effective when implemented among adolescents aged 17 to 18 years who are more independent than younger adolescents?
- What are the effects of adding sleep duration and quality of sleep to the intervention?
- What are the effects of adding access to healthier foods or safe and accessible opportunities for physical activity to the intervention?
- What are the effects of adding social media to the intervention?

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