RESEARCH ARTICLE

Dr. Reimund C. Serafica

Dr. Tricia K. Gatlin

Web-based Interventions Among Adults: Relevance to Anthropometric Indicators

Abstract

Purpose: Web-based interventions offer low cost and practical strategies to promote self-care for adult individuals with various health conditions and status issues around the globe. The purpose of this review was to summarize the current recent literature in examining the effectiveness of web-based interventions to promote healthy lifestyles related to anthropometric measurements in adult individuals with various health conditions and status.

Design: A systematic review of literature was conducted. Search of the literature was employed to web-based intervention studies in refereed journals written in the English language. The databases searched were PubMed, Ovid MEDLINE, CINAHL, and Google Scholar, with a search period of 2004–2014. In addition to these databases, a manual search was also used.

Methods: All studies were examined by three reviewers for eligibility using the Jadad scoring system. Thirteen randomized controlled trial (RCT) studies (n=13) met criteria in this review and revealed significant associations between the utilization of web-based health promotion interventions on anthropometric measurements in adult populations with health related conditions.

Findings: Seven studies reported overall positive changes in the participants' anthropometric measurements at the completion of each study. Four out of seven studies reported that adult participants' in the intervention groups had greater weight loss as compared to the control groups. In addition, one study out of the seven studies reported a larger reduction in BMI of the participants in the intervention group. Two studies out of 13 studies reported positive changes in BMI, waist circumference, body fat, and waist-hip-ratio in the control groups.

Conclusions: The outcomes from this review may prove useful information of effectiveness of web-based interventions relative to physiological outcomes such as anthropometric measurements. These programs can inform transformative practice and improvement of global health.

Introduction

Studies have consistently documented alarming rates of rapid weight gain, excess weight and obesity worldwide (Hossain, Kawar, & El Nahas, 2007; Malik, Willett, & Hu, 2013; Skinner & Skelton, 2014), and excess weight has been linked to multiple diseases. Excess weight and obesity are characterized by extreme or abnormal accumulation of fat in the body that may affect the overall health (Diabetes Prevention Program Research Group, 2002; Williams, Hamm, Shulhan, Vandermeer, & Hartling, 2014). Individuals with or at risk for diabetes and cardiovascular disease (CVD) are at particular risk for adverse effects of overweight and obesity (Gudzune, Hutfless, Maruthur, Wilson, & Segal, 2013). Overweight and obesity also increase blood pressure, which, in turn, contributes to development of hypertension and related complications, including congestive heart failure and even death.

Numerous lifestyle modification nursing and non-nursing studies have examined anthropometric outcomes such as weight, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-hip-ratio (WHR) and percentage of body fat (Esposito et al., 2004; Hoeger et al., 2004; Serafica, Lane, & Ceria-Ulep, 2013; Wadden, Webb, Moran, & Bailer, 2012). BMI is a standard indicator for body fat (Serafica et al., 2013; Shah & Braverman, 2012). In most adult individuals, a high BMI is illustrative of overweight status, and a higher BMI signifies obesity. Increases in anthropometric indicators and prevalence of overweight calls for an alarm since comorbidities s tend to occur at higher BMI. As stipulated by the Centers for Disease Control and Prevention, classification of BMI is as follows: BMI is classified as follows: BMI < 18.5 (underweight), BMI $\geq$ 18.5<24.9 (normal weight), BM $\geq$ 25 <29.9 (overweight), and BMI $\geq$ 30 (obese). Other organizations have also established anthropometric reference patterns of BMI with cut-off points to define overweight and obesity in Asian populations (Serafica, 2014; Serafica et al., 2013).

Although most lifestyle modification studies have concentrated on general obesity, abdominal obesity has been argued being is also considered to be an independent predictor of myriad risks factors (Grothe & Park, 2000; Gudzune et al., 2013; Serafica et al., 2013). Waist circumference (WC) is a risk factor of intra-abdominal fat mass (Iacobellis, 2008; Serafica et al., 2013). According to the Centers for Disease Control and Prevention, any waist circumference above 102 cm (40 inches) for men as well as 88 cm (35 inches) for non-pregnant women can as an antecedent to the development of Type 2 diabetes, hypertension, and coronary artery disease. Waist-hip ratio (WHR) has also been used as an indicator of health and - of the risk of developing serious health conditions. Research exemplify how individuals with apple-shaped bodies (with weighty waists) are prone to higher health risks (Serafica et al., 2013) in comparison to those having pear shaped bodies (with weighty hips; Price, Uauy, Breeze, Bulpitt, & Fletcher, 2006). Men should have a WHR of $\leq$ 0.9, and women should have a WHR of $\leq$ 0.8. A WHR $\geq$ 1.0 indicates an increased risk for heart disease, diabetes, and cancer (Serafica et al., 2013; Tol, Swinkels, De Bakker, Veenhof, & Seidell, 2014).

The weight-gain and obesity epidemic has prompted health researchers and nurse scientists around the globe to develop innovative, web-based strategies to address the problem. The multiple benefits of using web-based or Internet to promote self-care and lifestyle change programs are well established(Cruz et al., 2014; Neubauer et al., 2013). Web-based interventions have shown promise as effective and accessible solutions to lifestyle interventions (Warmerdam, Smit, van Straten, Riper, & Cuijpers, 2010). Additionally, using web-based approaches other than traditional face to face lifestyle interventions can let populace health involvements to be conveyed, upheld, and extensively disseminated at reasonably low cost (Warmerdam et al., 2010; Watson, Bickmore, Cange, Kulshreshtha, & Kvedar, 2012). The advantages of using web-based technology as part of health interventions are numerous. Users can access the web 24/7 and can use interventions anonymously and at any pace. Furthermore, web-based interventions might grasp adult individuals who otherwise would not receive the intervention that they need and can mimic costly face-to-face sessions (Kohl, Crutzen, & de Vries, 2013; Tang, Abraham, Greaves, & Yates, 2014; Warmerdam et al., 2010).

Background and Purpose

Many studies have found that the use of web-based technologies (Maon, Edirippulige, Ware, & Batch, 2012) with health interventions, such as diet and physical activity behaviors (Bacigalupo et al., 2013; Collins et al., 2012; Manzoni, Pagnini, Corti, Molinari, & Castelnuovo, 2011), generated encouraging peer-support and behavioral consequences. However, what is not yet clear is the effectiveness of web-based interventions on study participants' measured anthropometric indicators. In some studies, authors have indicated concern about the reliability and quality control of self-reported changes in anthropometric measurements (Cruz et al., 2014; Harvey-Berino, Pintauro, Buzzell, & Gold, 2004; Nawaz, Chan, Abdulrahman, Larson, & Katz, 2001). The recent proliferation of web-based intervention studies on lifestyle modifications suggests the need to further explore the effect of technology on the anthropometric measurements of the study participants.

Although some evidence suggests that web-based interventions address psychological outcomes more effectively than lifestyle interventions alone, what is less clear is whether web-based interventions are more effective in producing and maintaining weight reduction or whether such interventions can significantly modify anthropometric outcomes. A systematic review of literature is conducted to methodically integrates research evidence that involves narrative integration at the end of the review.

The purpose of this systematic review is to describe the efficacy of using the web-based delivery platform on anthropometric indicators. This study presents a systematic review of recent, randomized controlled trials (RCTs) that examined the use of web-based interventions.

This review summarizes the current literature examining the effectiveness of web-based interventions intended to support healthy lifestyles related to anthropometric measurements in adult individuals with various health conditions and statuses. Specifically, the objectives were to

1. identify recent RCT studies that used web-based interventions that address changes in anthropometric indicators as one of the outcomes and
2. conduct a quality appraisal of selected RCT studies using the Jadad scoring system.

Material and Methods

Design

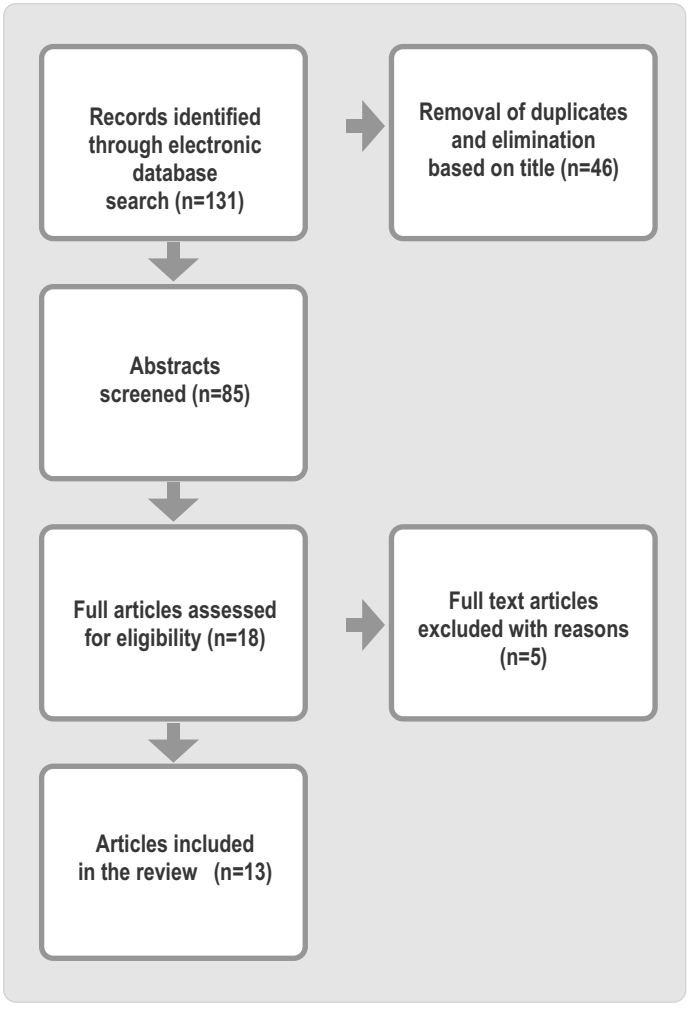
A systematic search of the literature was considered to web-based intervention studies in refereed journals and in the English language. The databases searched were PubMed, Ovid MEDLINE, CINAHL, and Google Scholar, with a search period of 2004–2014. In addition to these databases, a manual search was also employed. Key words for the search were anthropometric measurements, web-based technology effectiveness, web-based interventions, internet, e-health, self-care, adults, and randomized controlled trial. There were no precise health conditions listed in the review of literature and search. The two authors performed the review of the findings accordingly.

Sample and Inclusion and Exclusion Criteria

Web-based interventions with adults and RCTs of such interventions were chosen for inclusion in this study. Studies that focused on web-based interventions with children (below 18 years of age) or psychologically ill individuals were excluded because a broader set of interventions tends to be used with participants in such studies. Studies involving major health issues such as cancer patients or studies involving pregnant women were also excluded for similar reasons. Studies involving self-reported anthropometric measurements were excluded for consistency. Studies involving the use of social media and smartphones were also eliminated due to a recent systematic review publication in this area (Williams et al., 2014).

The initial search generated a total of 131 papers from all search databases. To obtain rigorous scientific evidence, only RCT studies on key outcomes and interventions were selected for inclusion. One reviewer screened the study title and abstract as the first screening stage and narrowed the articles to 18 papers. Duplicate studies that appeared in multiple data bases were also eliminated. Based on the inclusion criteria, three reviewers examined the full papers and identified 13 studies that met the inclusion criteria. Figure 1 shows the process of selecting the studies included in the systematic review.

Figure 1. *Flowchart of the systematic review*



Instrument

The key instrument engaged in this analysis was the Jadad Scoring of Quality of Reports of Randomized Clinical Trials (JSQRRC; Inouye, Braginsky, & Kataoka-Yahiro, 2011; Jadad et al., 1996; Moher, Jadad, & Tugwell, 1996). The instrument (JSQRRC) has been widely used in appraising the methods and quality of clinical trial studies (Inouye et al., 2011). We also used the 13-point JSQRRC scoring method to determine the quality of the RCTs in this review. The Jadad tools is comprised of 11 items as shown in Table 1.

Table 1. *Jadad's 11 item appraisal tool.*

Jadad's criteria
Was the study design randomized and appropriate?
Was the study design double blind and appropriate?
Was there a description of withdrawal and dropouts?
Were the objectives of the study defined?
Were the outcome measures defined clearly?
Was there a description of the inclusion and exclusion criteria?
Was the sample size justified (e.g., power calculation)?
Was there a clear description of the intervention?
Was there at least one control (comparison) group?
Was the method used to assess adverse effects described?
Were the methods of statistical analysis described?

Analyses of Jadad Scores

Evaluation of the data included a detailed analysis of the study characteristics (such as country of origin, age, gender, and health conditions), methodology (total methodological score using JSQRRC and contextual analysis of RCT methods), and outcomes. The reviewers examined the articles collected and extracted and reviewed each manuscript independently. The reviewers rated each study using the JSQRRC to assess the methodological quality score for the studies. In the case of any disagreement in scores among reviewers, a face-to-face meeting was held to achieve consensus with the presence of an additional external reviewer.

Findings

Jadad Analysis

Thirteen randomized controlled trials were included in this systematic review. A description of included studies can be found in Table 2. Six studies were based in the United States (Bennett et al., 2010; Carr et al., 2009; Patrick et al., 2011; Rosal et al., 2014; Thorndike et al., 2012; Watson et al., 2012), two in United Kingdom (Carter, Burley, Nykjaer, & Cade, 2013; Tapper, Jiga-Boy, Maio, Haddock, & Lewis, 2014), and five in other countries (Castelnuovo et al., 2011; Collins et al., 2012; Imanaka, Ando, Kitamura, & Kawamura, 2013; Pressler et al., 2010; van Genugten et al., 2012). The anthropometric measures met the inclusion criteria for all 13 studies, which consisted of male and female participants (Bennett et al., 2010; Carr et al., 2009; Carter et al., 2013; Castelnuovo et al., 2011; Collins et al., 2012; Imanaka et al., 2013; Patrick et al., 2011; Pressler et al., 2010; Rosal et al., 2014; Tapper et al., 2014; Thorndike et al., 2012; van Genugten et al., 2012; Watson et al., 2012). Two studies were gender specific: one included only male participants (Collins et al., 2012), and the other included only female participants only (Rosal et al., 2014). Additionally, two studies were conducted involving minority and other ethnic group (Imanaka et al., 2013; Rosal et al., 2014).

The 13 studies reviewed used a variety of outcome measures. Among these, our review focused on weight-related measures (i.e., BMI, WC, central adiposity, WHR). Other outcome measures reviewed here include percentage of body fat, central adiposity, physical activity level, physical fitness, dietary intake, fruit and vegetable consumption, and psychosocial variables). In this review, the effectiveness of the studies' interventions was determined by reviewing the anthropometric results. The Jadad scores range from 8 to 11, and the average score is 9.4.

Description of the studies

Participants' characteristics. Studies included participants with various health conditions, such as hypertension (Bennett et al., 2010), hyperlipidemia (Bennett et al., 2010), type 2 diabetes (Castelnuovo et al., 2011; Rosal et al., 2014), obesity (Bennett et al., 2010; Castelnuovo et al., 2011; Imanaka et al., 2013; Watson et al., 2012), overweight (Carr et al., 2009; Carter et al., 2013; Collins et al., 2012; Imanaka et al., 2013; Pressler et al., 2010; Tapper et al., 2014; van Genugten et al., 2012; Watson et al., 2012), and mixed conditions (Bennett et al., 2010; Carr et al., 2009; Castelnuovo et al., 2011; Imanaka et al., 2013; Watson et al., 2012). The overall mean age of the participants was 54, with a range from 45 to 70. Only one study cited regarding participants' familiarity on the usage of computers and/or internet technologies (Carter et al., 2013). In the 13 reviewed studies, both experience in computer and web-based or internet usage use were assessed with different types of self-reported questionnaires, ranging from hours per week to number of years of experience; this multiplicity in assessments made it challenging to appraise measures of the reviewed studies.

Table 2. *Study Characteristics*

Author (year), country	JADAD Score	Aim of study	Population (total enrolled/ complete), intervention (n), control (n), W, age of participants	Web-based Intervention	Other intervention (s)	1. Duration of intervention period (months) 2. Intervention time and amount; 3. Data collection time	Assessment of study aim outcome measures Other outcomes	Outcomes- Study aim: significant outcome (s); Changes in Anthropometric measurements, Conclusions
Bennett et al. (2010), USA	8	To evaluate the short-term efficacy of a web-based behavioral weight loss intervention .	101, 85 intervention (51) control (50) W, 16 (25-65 years)	interactive weight loss approach	Behavioral skills training; regular health coach support	1.3 months 2. at least 3x weekly for 3 months; 3. baseline, 3 months	Changes in body weight (kg) at 12 weeks Other outcomes: Changes in BMI, BP, WC	Intervention group lost a greater % of baseline bodyweight (-2.6% +-3.3%); Intervention participants lost a larger reduction in BMI(-0.94)+-1.16 kg/m^2) No change in BP
Carr et al. (2009), USA	8	To determine whether increased PA following the 16 week internet based intervention is maintained 8 months later in sedentary and overweight rural adults	32, 19 Intervention (9) Control (10) W, 8* (21-65 years)	website access	workbook; interactive activities, behavior modification strategies	1. 16 weeks (3 months) 2. Weekly email/phone contact for the first 2 weeks with email contact every other week thereafter for 16 weeks 3. One week before baseline, 3 months, and 8 months	PA levels have relapsed (-1340 steps/days) Other outcomes: Total cholesterol, triglycerides, and central adiposity	From the end of the intervention to 8 months, HDL levels decreased, and total cholesterol and triglyceride levels were lower at 8 months. Central adiposity was reduced and maintained 8 months later; waist circumference was not statistically significant but was maintained at 8 months.
Carter et al. (2013), United Kingdom	9	To determine acceptability and feasibility outcomes of a self-monitoring weight management intervention delivered by website and paper diary	128, 79 Intervention (42) Control 1 (42) Control 2 (43) W, 49 (18-65 years)	Weight Loss Resources-web based	Web-based Paper Diary	1.6 months 2. not stated 3. baseline, 6 weeks,6 months	The web-based is feasible and acceptable weight loss intervention.	At 6 months, weight change was statistically significantly greater compared to the diary group.
Castelnuovo et al. (2011), Italy	9	To examine the effectiveness of a 12 month multidisciplinary tele care intervention for weight loss provided to obese patients with type 2 diabetes	72, 12 (12 months); 34 (3 months); 21 (6 months). Intervention(37) Control (39) W , 23 (45-60 years)	TECNOB program	Dietary software into cellular phones; electronic armband	1. 13 months 1 month inpatient intensive; 12 months outpatient 2. nutrition- 45 minutes each 2x a week; psychological counseling 3. baseline, 6 months, 12 months	Weight change (kg); energy expenditure, glycated hemoglobin, Other outcomes: Disordered eating behavior and cognition	Significant outcomes in Interpersonal distrust at 12 months in control group. No significant differences in weight change between control and intervention group at 3, 6, 12 months. The inpatient program has a very high effect in the first month after discharge.

Imanaka et al. (2013), Japan	10	To compare the effect of weight change between WSHS (web-based) and EHS (e-mail).	193, 165 Intervention, 87 Control, 88 W, 18 (35-65 years)	Intervention –personal communication with own Control- can only email the dietician and no access to their peers' health status	Motivation level and photograph of meal	3 months Baseline, 12 weeks	Changes in the body weight Other outcomes: Quality of Life	The WHSH group is more effective than EHS group The loss in body weight was significantly greater in the WHS group than in EHS group.
Morgan et al. (2012), Australia	10	To evaluate the impact of workplace-based weight loss for male shift workers	127, 110 Intervention=65 Control 45 W, 17	Workplace POWER (WP) Web-based program	Physical activity	1.3months 2. once a week reporting of daily weight diaries (feedback provided) Baseline, 3 months	Significant effect of change of weight at 14 week Other outcomes: Sleepiness, quality of life, workplace productivity, injuries at work, absenteeism	There was a significant difference in percentage weight loss between groups. More participants in the WP group had lose more than 5% of their baseline weight compared to the control group. The study resulted in significant improvement work domains, quality of life, and on the job injuries.
Patrick et al. (2011), USA	9	To test the efficacy of a Web- based intervention designed for overweight and obese men.	441, 309 Intervention, 224 Control, 217 W, 132 (25-55 years)	Web-based interventions of diet and PA	Behavioral targets Individualized feedback	1.12 months 2. weekly web-based activities/ not stated 3. baseline, 12 months	No significant effect on intervention group on BMI	Outcome (not significant) for web-based group-showed no significant improvement compared to the control group at end of intervention No changes in the anthropometric measurements Several weight related diet and PA behaviors were improved.
Pressler et al. (2010), Germany	10	To evaluate the effect of structured vs. non-structured internet-delivered exercise.	N-140, 77 Intervention-50 Control=27 W, 63 (25-60 years)	Internet based interventions	Structured exercise	1.12 weeks 2. Intervention= 3 workouts per week (105-165 minutes/wk.) Control- no structured schedule 3. baseline, 12 weeks	Significant changes in BMI in control group	Outcomes Significant changes in BMI, WC, and body fat in control group. A reduction in WC was seen in a majority (80%) of participants (control and intervention).
Rosal et al. (2014), USA	11	To examine the feasibility of delivering a group-based diabetes intervention via a virtual environment	89, 84 Intervention, 46 Control, 43 W, 5 (48-59 years)	Web-based intervention	Not stated	1.8 week 2. 90 minute group sessions weekly 3. baseline, 8 weeks	No changes in Body weight, BMI, WC Other outcomes: behavioral and psychosocial outcomes	Outcome (not significant) for web-based group No significant changes in anthropometric The web- based and face to face interventions were both comparable.

Tapper et al. (2014), United Kingdom	9	To examine the effects of an internet based intervention on consumption of fruit and vegetables, saturated fat, and added sugar over a 6 month period.	N= 100, 95 Intervention, 50 Control, 50 W= 5 Mean age for control, 37.7 Mean age for intervention, 41.1	Web-based, email	Health Values Healthy Eating Program	1. 24 weeks 2. once every week 3. baseline,3 months, 6 months	Changes in F and V consumption, smoking, alcohol, PA, dietary behavior Other outcome: BMI, WHR.	Outcome (reductions in BMI and WHR) in control. Significant reductions in BMI and WHR in control but no interaction within groups.
Thorndike et al. (2012), USA	9	To determine if a 9 month maintenance intervention would prevent/ regain of the weight loss	N= 406, 302 Intervention= 157 Control=145 W, 104	Web-based, email	Personal contact with nutritionist, personal trainer and or attending a seminar.	1. 9 months 2. Weekly logs of exercise, nutrition, and weight goals. 3. Baseline, 10 weeks, 12 months	Weight, WC Other outcomes: nutritional goals and PA	Outcomes- all study participant maintained a mean weight loss of 3.0 lbs. Weight, BMI, waist were lower for both groups at 10 weeks and 1 year.
van Genugten et al. (2012), Netherlands	9	To evaluate the efficacy of the computer-tailored intervention in weight related anthropometric measures and energy balance-behaviors in a RCT.	N=539, 313* (312) Intervention=161 Control=151 W, 226 (18-65)	Wed-based, computer tailored intervention (TI)		1. 6 months 2. Once a week (90 minutes in total). 3.baseline, 6 months	BMI, WC, and skinfolds Other outcomes: PA, and dietary behaviors	Outcomes- not significant BMI did not change, and there was no difference between the two groups. The results of the study showed that weight remained stable over time.

Intervention characteristics. The study characteristics for the intervention and control groups are also described in Table 2. The degree of detail provided about the web-based interventions varied extensively. In particular, the frequency, design, delivery, and duration of the interventions differed widely. For instance, duration varied between 1 month and 12 months. The intended frequency or the intensity of the interventions was not overt in most studies. A schedule for intervention use was mentioned in two studies (Collins et al., 2012; Imanaka et al., 2013) such as twice a week or three times a week, whereas in other studies, only evidence about the value of interventions was reported (Tapper et al., 2014; Thorndike et al., 2012). Regardless of the disparity among the intervention content, most studies reported the significance of adding the web-based interventions. A combination of web-based intervention and other types of technology was also highlighted, and additional interventions was merged in various approaches.

All studies revealed a decrease in web-based program utilization throughout the intervention phase, while a number of studies portrayed common attrition rates (Carr et al., 2008; Castelnuovo et al., 2011; Collins et al., 2012; Pressler et al., 2010). Many studies also used an intention-to-treat analysis; however, of the 13 studies with an attrition rate greater than 50%, only three studies used this analysis method (Collins et al., 2012; Pressler et al., 2010; Watson et al., 2012). Furthermore, several studies accredited the feasibility of web-based technologies intervention, and three studies suggested more research to expand ways to determine standard dosage of intervention and to foster completion of engagement participation among participants (Carr et al., 2008; Pressler et al., 2010; van Genugten et al., 2012).

Employment of web-based technology. Although the interventions varied highly, they were generally attempted by implementing simple to multifaceted interventions utilizing a web-based platform as the technology element. Most of the interventions integrated education components for the sample and individual-report record of food intake, together with a complimentary support component using dietician support, coach support, and virtual support (Bennett et al., 2010; Castelnuovo et al., 2011; Imanaka et al., 2013; Rosal et al., 2014). Only a single study excluded the engagement of any support nature and

facilitated a standalone internet-based program to its sample (Tapper et al., 2014).

Effectiveness of web-based technology to health conditions. Two studies showed that web-based interventions showed minimal improvements in health outcomes. Study populations consisted of participants with hypertension, hyperlipidemia, and diabetes. One study observed no significant changes between control and virtual intervention group in measures of blood pressure and total cholesterol, and, when an analysis of within-group change was conducted from baseline to a 6-month follow up. The groups also revealed a non-statistically significant reduction in HbA1C in the virtual intervention group (Rosal et al., 2014). Another study did not show any group difference on blood pressure, in both systolic and diastolic readings, between the control and intervention groups (Bennett et al., 2010).

Effectiveness of web-based technology to secondary outcomes. Other outcomes of the studies reviewed consisted of changes in physical activity intensities (Carr et al., 2009; Tapper et al., 2014; Thorndike et al., 2012; van Genugten et al., 2012; Watson et al., 2012); behaviors related to dietary self-monitoring (Carter et al., 2013; Castelnuovo et al., 2011; Tapper et al., 2014; van Genugten et al., 2012); eating-related behaviors and cognition (Castelnuovo et al., 2011; Rosal et al., 2014; Thorndike et al., 2012); quality of life (Collins et al., 2012; Imanaka et al., 2013); sleepiness, workplace efficiency, occupational accident, not showing to work (Collins et al., 2012); performance at the lactate anaerobic threshold (Pressler et al., 2010); psychosocial outcomes (Rosal et al., 2014);vegetables and fruit intake, saturated fats and added sugar, heart rate variability, smoking habits (Tapper et al., 2014); and self-efficacy (Watson et al., 2012). Web-based interventions showed promising effects on improving the participants' quality of life (Collins et al., 2012; Imanaka et al., 2013). Nevertheless, other studies found no nonsignificant enhancements in nutritional behaviors or physical activities (Carter et al., 2013; Castelnuovo et al., 2011; Pressler et al., 2010).

Effectiveness of web-based technology to anthropometric measurements. Seven studies reported an overall positive change in the participants' anthropometric measurements at study completion (Bennett et al., 2010; Carr et al., 2009; Carter et al., 2013; Collins et al., 2012; Imanaka et al., 2013; Pressler et al., 2010; Tapper et al., 2014). Four studies reported that adult participants in the intervention groups had greater weight loss than adults in the control group (Carter et al., 2013; Collins et al., 2012; Imanaka et al., 2013). In addition, one study reported a significant change in BMI of the participants in the intervention group (Bennett et al., 2010). Two studies reported moderate alterations in BMI, WC, body fat, and WHR in the control groups (Pressler et al., 2010; Tapper et al., 2014). Short-term effects of web-based interventions were found (fewer than 12 months of follow-up) in all six studies. Although the other five studies reported other positive outcomes, no changes were reported in the anthropometric findings of the participants (Castelnuovo et al., 2011; Rosal et al., 2014; Thorndike et al., 2012; van Genugten et al., 2012; Watson et al., 2012).

Discussion

The purpose of this review was to present the literature published in 2004 to 2014 addressing the effectiveness of web-based interventions to promote healthy lifestyles related to anthropometric outcomes in adults. Seven studies reported moderate to significant changes on anthropometric measurements among the participants. Four out of seven studies reported that adult participants' in the intervention groups had greater weight loss as compared to the control groups. One study out of the seven studies reported a larger reduction in BMI of the participants in the intervention group. Also, two studies out of 13 studies reported positive changes in BMI, waist circumference, body fat, and waist hip ratio in the control groups. These results further support the idea of potential benefits of web-based modalities in promoting health interventions. Although the interventions varied in terms of frequency, duration, intensity, delivery, and study design, it can be suggested that web-based design are encouraging specifically from the studies that generated significant results. Reflecting on the study designs as well as the control group requirements considered in this systematic review, uncertainties exist regarding the overall functionality of web-based interventions compared to face to face lifestyle modification modalities. On the other hand, there exist sufficient evidence from these studies regarding positive clinical outcomes towards BMI and overall weight reduction. Specifically, web-based interventions exhibit firm indication of efficiency when utilized as concurrent treatment resources. Most of the studies used in the review generated positive results upon being merged with social support, feedback, educational information, and counseling by virtual facilitators. Such interventions have demonstrated to facilitate virtual interactive engagement between facilitators and participants in several settings.

These results support previous research on lifestyle modification and its effect on anthropometric variables. There are also possible explanations with regards to moderate effect of web-based interventions to anthropometric indicators. For

instance, participants might have reduced their overall physical activity or increased their food intake, or the physical activity stimulus might have been insufficient. Additionally, sedentary participants might have increased their muscle mass without changing weight. Future studies could address this issue by employing accurate measures of body composition.

Despite the varying levels of effectiveness and even the neutral results in several studies, web-based interventions continue to grow in popularity among researchers in health field because they can be implemented in diverse populations in many settings. The recent web-based intervention studies reviewed herein have provided a fountain of knowledge for improving anthropometric indicators, but much still needs to be learned about web-based interventions for improving health status such as those participants with chronic conditions. Several studies have also found that increased frequency of personal contact and the amount of interaction should be considered a key element for successful implementation of web-based interventions; however, most studies in this review did not explicitly report the number of times that participants interacted with their facilitators online or with one another.

Attrition was high in several studies and could have biased the findings. However, participants' engagement is a universal problem in most studies; an initial step in tackling abrasion in weight related intervention studies is to widely account for the adherence rate (van Genugten, van Empelen, & Oenema, 2014). More participants' engagement during the development of the interventions could be tried in research designs to assist with the attrition rates. Similarly, it is crucial to argue that such engagement ought to have equally been affected by previous web-based knowledge usage and regular web access utilization by the participants (Williams et al., 2014). There is also a need to extend the study period as well as the post- treatment assessment in order to evaluate the enduring effects of healthy-diet and physical-activity on maintaining weight loss due to potential relapse that can hinder positive health outcomes in the long term.

Although the RCT method was used in all studies, it is still difficult to determine which intervention's components or sections added up to the impact of anthropometric indicators and health conditions presented in this review. None of the studies compared the results of the intervention and control groups in terms of quality intervention. In many cases, the web-based modality was used to supplement psychosocial components of the treatment delivery, in addition to face-to-face interactions, and, in most studies, various components in the treatment delivery were used as a whole.

Finally, only two studies (Imanaka et al., 2013; Rosal et al., 2014) in the systematic review included minority groups or vulnerable populations. There is the need to offer consideration and attention to these groups since weight gain, and obesity concerns equally have detrimental impact on minorities especially those at risks for developing central adiposity. Nurse researchers in the Philippines and overseas need to consider this type of modality in lifestyle interventions that targets Filipinos with various health conditions here and abroad. Broader samples would enrich web-based intervention research and better inform models that, to date, are mostly based on general populations, which makes them inappropriate or limited to deliver in many settings.

Limitations

This review has some limitations. First, the authors searched the literature in five major bibliographic databases between 2004 and 2014, but other similar studies might have been found in other databases. Second, only constrained importance amid-group results were recognized.

This may have been a consequence of some participants might have changed their behavior due to improper blinding technique which ultimately affected the change in their anthropometric outcomes because they knew that they were being studied. Third, although anthropometric measures were typically measured by the authors and not self-reported, some studies did not indicate the standard they followed when recording the participants' biometrics. Also, the reviews differed substantially in terms of study populations, locations, intervention components, comparison groups, and outcome measures. Therefore, it is difficult to identify which participants' groups are likely to benefit from which specific intervention. Fourth, publication bias may have been the result of the exclusion of social media and smartphones intervention studies and small individual studies with negative results, which could lead to overestimation of overall benefits. Finally, due to the diversity of the studies in terms of using different and complex variables, a meta-analysis was inappropriate for statistical integration and therefore using a common metric for combining evidence was a drawback.

Implications for Nursing Practice and Research

Nursing practice implications include utilization of these finding in planning lifestyle modifications using web- based platforms. In situations where the nurses are obliged to promote lifestyle modification, they need to provide other options such as the use of web based interventions as an alternative form of health promotion specifically to patients who have access to this modality and those who cannot commit to face to face interventions. Future nursing research in the area should prioritize well-designed efficacy trials comparing web-based interventions with the traditional methods of delivering lifestyle interventions (e.g. individual and group-based counseling) or to waiting list controls. In addition, studies should be designed to determine which components of web-based interventions are critical in achieving positive anthropometric changes.

Conclusions and Future Directions

This review systematically searched for the RCT studies to identify published accounts of web-based interventions and their efficacy on anthropometric measurements of different adult populations. An appraisal of the selected RCT studies was also carried out using the Jadad scoring system. Although web-based interventions show great potential for improving anthropometric measurement outcomes in health-promotion and disease-prevention programs, more research is clearly needed. Predominantly, due to their reputation, they can attain a huge and varied audience. Additionally, compared to face-to-face interventions, web-based interventions tend to be more feasible and more accessible to adults with various health conditions. However, studies that have examined web-based interventions' effects on anthropometric outcomes have tended to show low levels of participation and also adherence. Only by first addressing these methodological flaws will it be possible to develop web-based interventions that are more sustainable and effective.

As web-based technologies are constantly changing, future studies are pertinent for the purposes of investigating their anthropometric indicators efficacy as another intervention approach that can be more engaged, more so when combined with other lifestyle health promotion and modifications modalities. These can be supplemented by peer support, expert support, and facilitator support. It is also imperative to the strength of web-based interventions to include culturally tailored interventions for minority groups and vulnerable populations in future studies due to the scarcity of literature in this regard. This review is timely and provides an overview of the field's current merits regarding the effectiveness and benefits of web-based technologies as promising intervention tool.

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About the Authors

Dr. Reimund C. Serafica (first and corresponding author) received his undergraduate and graduate degrees in nursing from Gardner-Webb University in North Carolina and obtained his PhD in Nursing from the University of Hawaii at Manoa. He is an Assistant Professor at the University of Nevada, Las Vegas (UNLV). His research interests are dietary acculturation and practices among first generation immigrants in United States and emerging topics in nursing education. He is a Filipino descent.

Dr. Tricia K. Gatlin received her undergraduate degree in nursing from the University of Memphis in Tennessee and her graduate degree from the University of Portland in Oregon. She obtained her PhD in Nursing from the University of Arizona in Tucson, Arizona. She is an Assistant Professor at the University of Nevada, Las Vegas (UNLV). Her research interests are social supports to enhance self-management for those with diabetes.

Every great personal story you have to tell involves overcoming adversity. If you shy away from adversity, you take away your ability to tell new stories.

Farrel Droke