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Internet-Based Physical Activity Interventions

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Abstract

This article provides a comprehensive review of Internet– and Website–based physical activity interventions targeting adult populations. Search procedures identified 72 unique Internet-based physical activity interventions published in peer-reviewed journals. Participants of the studies were predominately White, middle-aged (mean age = 43.3 years), and female (65.9%). Intervention durations ranged from 2 weeks to 13 months (median = 12 weeks). Forty-six of the studies were randomized controlled trials, 21 were randomized trials without a control condition, 2 were non–randomized controlled trials, and 3 used a single-group design. The majority of studies (n = 68) assessed outcomes immediately following the end of the intervention period, and 16 studies provided delayed postintervention assessments. Forty-four of the 72 studies (61.1%) reported significant increases in physical activity. Future directions for Internet-based physical activity interventions include increasing representation of minority and male populations in Internet-based efforts, conducting delayed postintervention follow-up assessments, and incorporating emerging technologies (ie, cellular and Smartphones) into Internet-based physical activity efforts.

Keywords

physical activity; exercise; Internet; Web-based

Physical activity is an independent risk factor for reducing all cause mortality;[1] thus, the more physically active people are, the less likely they are to die prematurely. Additional health benefits of physical activity include the prevention and treatment of various health conditions, including cardiovascular disease, type 2 diabetes, osteoarthritis, metabolic syndrome, stroke, high blood pressure, and select cancers such as breast and colon.[2] Given the overwhelmingly positive health benefits associated with physical activity, it is not surprising that researchers have long attempted to discover effective methods in which to promote physical activity.

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Internet– and Website–based physical activity interventions represent a potential method in which to intervene and promote physical activity. These types of interventions show promise because many Americans already use the Internet on a daily basis. National statistics show that approximately 71% of Americans have household Internet access and that this percentage increases to 77% for those who have attended some college and to 89% for those who have a college degree.[3] Rates of Internet use are similar among men and women[3,4] but slightly higher among Whites (84%) than African Americans (73%) and Latinos (74%).[5] However, recent trend data indicate that Internet use (via cellular and Smartphone technology, in particular) among racial/ethnic minorities is rapidly approaching levels reported by Whites.[4] Benefits of using Internet-based technology to promote physical activity include the potential to reach a large number of people at a relatively low cost; ability to provide 24-hour access to intervention materials, which increases the convenience, access, and exposure of intervention messages; and the capacity to instantaneously deliver tailored intervention messages to participants without the delays commonly found in print or telephone-delivered interventions.[6]

Past reviews have been conducted on this topic. However, approximately 5 years has passed since the most recent narrative reviews were conducted.[7,8] The purpose of this article is to provide a comprehensive up-to-date review of Internet-based physical activity intervention research targeting adult populations. As a more recent meta-analysis[9] focused strictly on studies with randomized controlled trial designs, the current review includes relevant studies of all research designs to provide a more complete picture of what has been performed thus far in this fast moving field of research. Findings derived from this review provide important insight on the current status of the published literature on Internet- and Web-based approaches to promoting physical activity.

Method of Review

The current review focused exclusively on Internet– and Website–based interventions targeting adult populations. Articles were included in the review if they (*a*) focused on adult populations (defined as including individuals ≥18 years of age), (*b*) were published prior to August 2012, (*c*) used the Internet or email as the primary intervention delivery method, (*d*) identified physical activity as the primary or one of the primary focuses of the intervention, (*e*) provided both baseline and postintervention outcomes for a physical activity measure, and (*f*) were published in English. Articles were excluded from the review if they (*a*) focused exclusively on child or adolescent populations, (*b*) focused exclusively on elderly populations, or (*c*) targeted individuals with severe mental illness (ie, schizophrenia or any other mental illness that may have inhibited comprehension of intervention); however, studies focusing on individuals with depression/anxiety were included in the review.

Articles were located by searching the PubMed and PsycINFO electronic search databases. The search strategy involved locating articles at the intersection of 2 key concepts: (*a*) type of behavior and (*b*) type of intervention delivery. Search terms used for type of behavior included “physical activity” and “exercise.” Search terms for type of intervention delivery included “Internet,” “Web-based,” and “email.” An example of a search iteration performed included “physical activity AND Internet.” Two independent reviewers performed the

search procedures and abstracted articles to be included in the review; any disagreements regarding inclusion/exclusion criteria were resolved by the 2 reviewers reaching a consensus. Reference lists of relevant articles retrieved during search procedures were reviewed to identify additional Internet-based physical activity studies not retrieved during the online search process.

Results

Seventy-two unique Internet-based interventions promoting physical activity met the inclusion criteria for the review. Articles were published between 2001 and 2012, with the modal year of publication being 2009 (n = 11). Tables 1, 2, and 3 provide a brief summary of each of the studies included in the review.

Participant Characteristics

The total number of participants enrolled in the studies was 24 966, and the median sample size was 142.5 participants (mean = 346.8, standard deviation [SD] = 462.7) per study. Samples ranged from 15 to 2159 participants, and participants were mostly middle-aged (mean age 43.3, SD = 10.8) and female (65.9% female, excluding 2 studies that did not include the number of males/females). The majority of the studies targeted both males and females (n = 62); however, 7 studies focused exclusively on women* and 3 studies focused exclusively on men.[41,42,48] Few studies included a substantial number of racial and ethnic minorities despite the fact that these populations, specifically African Americans and Latinos, report disparate levels of physical activity[2] and share a disproportionate disease burden of many conditions associated with insufficient physical activity levels (ie, obesity, cardiovascular disease, colon cancer).[88] Only one study comprised a majority Hispanic sample (78%),[37] and no studies consisted of a majority Black/African American sample. Other studies with notable samples of minorities included those conducted by LaChausse (44% Hispanic/Latino),[32] Glasgow (22% Hispanic/Latino),[19] Gow (22% Black),[20] and Winett (23% Black).[58]

Eleven countries were represented by the 72 studies included in the review. Most were conducted in the United States (n = 49), followed by Australia (n = 7),† the Netherlands (n = 5),[28,45,52,56,79] Canada (n = 3),[33,50,59] and the United Kingdom (n = 2).[25,39] Other countries represented from studies included in the review were Belgium,[54] Germany,[71] Scotland,[51] South Korea,[29] Switzerland,[81] and Taiwan.[24] Study populations targeted by the Internet-based interventions varied. The most frequently targeted populations were worksite employees (n = 16), overweight/obese adults (n = 13), university students (n = 10), healthy adults (n = 9), insufficiently active/sedentary adults (n = 7), and individuals diagnosed with type 2 diabetes (n = 7).

Among studies providing ample data to calculate attrition (n = 68), attrition ranged from 0% to 69%, and the mean attrition across studies was 22.3% (SD = 14.5). Attrition appeared to be slightly higher among interventions with longer durations. For example, mean attrition

*References 15, 24, 30, 46, 57, 62, 86.
†References 41, 42, 60, 63, 67, 74, 80.

rates for interventions less than 6 months in duration (n = 49) was 20.9 (SD = 13.8), and attrition rates for studies with a duration of 6 months or greater (n = 20) was 24.4 (SD = 14.7).

Study Design and Duration

Of the 72 studies included in the review, 46 were randomized controlled trials (Table 1), 21 were randomized trials without a control group (Table 2), 3 were single-group pre–post test designs, and 2 were non–randomized controlled trials (Table 3). Studies were considered randomized controlled trials if they reported using either a no-contact/wait-list control group (n = 25) or an attention contact/usual care control group (n = 21). Among the 21 randomized trials not using a control group, 11 compared 2 types of Website–based interventions,[‡] 6 evaluated Website–based versus in-person interventions,[§] 2 evaluated a Website–based intervention versus a print-based intervention,[66,67] and 2 compared 2 email-based approaches.[62,73] Duration of the interventions ranged from 2 weeks to 13 months, and the mean duration across the studies was 17.5 weeks (SD = 14.2, median = 12 weeks). Fifty-two studies had a duration of less than 6 months, and 20 studies had a duration of 6 months or greater.

Behaviors Targeted

Thirty-seven of the studies targeted physical activity as the sole outcome of the intervention. The remaining 35 studies targeted multiple behavioral outcomes that included physical activity. Examples of additional behaviors targeted by interventions included weight loss (n = 19), improvement in diet/nutritional intake (n = 8), self-management of cardiovascular risk factors (n = 7), self-management of type 2 diabetes (n = 1), weight control (n = 1), and self-management of arthritis (n = 1).

Theoretical Backgrounds

Forty-nine studies (68%) identified a behavioral health theory driving intervention activities. Of these, 37 identified a single behavioral theory and 12 identified more than 1 behavioral theory in which intervention activities were based. The most commonly identified theories were the Social Cognitive Theory (n = 24) and Transtheoretical Model (n = 27). Other theoretical backgrounds included Self-efficacy Theory (n = 6), Theory of Planned Behavior (n = 6), the Social Ecological Model (n = 3), Health Belief Model (n = 2), Precaution Adoption Process Model (n = 2), Self-management/Self-regulation Theory (n = 2), Social Support Theory (n = 1), Protection Motivation Theory (n = 1), and Goal Setting Theory (n = 1).

Intervention Delivery

A variety of Internet-based methods were used to deliver the physical activity interventions. The majority of studies employed a Website–based approach for the primary intervention delivery method (n = 48). Six studies were email-only based,[22,47,49,55,62,73] 20 studies evaluated combined website– and email-based approaches,[‖] and 1 study used a combined

[‡]References 60, 61, 63, 71, 72, 76, 77, 79–82.
[§]References 64, 65, 69, 70, 74, 78.

approach consisting of a Website, email, and text messages.[25] Additionally, several studies included non-Internet-based approaches such as in-person contact[19,38,58,70,74] and telephone contact[56] to complement their Internet-based physical activity promotion efforts.

Internet-Based Components to Promote Physical Activity

A variety of Internet-based strategies were used to promote physical activity. One of the most prominent methods identified was the use of Web-based educational/informational modules for participants to self-navigate (n = 16).[¶] For example, Magoc and colleagues[37] used the *WebCt* platform to deliver 7 structured educational modules to promote physical activity. These modules were based on the Social Cognitive Theory and covered various topics such as self-monitoring, goal setting, and identifying barriers to physical activity. Additionally, the modules were accompanied by various tasks (ie, specifying barriers to physical activity, setting behavior goals) for participants to complete over the course of the intervention.

Several studies (n = 9) reported the use of automated computer-tailored feedback to promote physical activity.[#] In the *Step into Motion* trial conducted by Marcus et al,[66] participants completed monthly online questionnaires throughout the duration of the 12-month intervention. Responses to these questionnaires were analyzed using a computer algorithm, which provided instantaneous, individually tailored feedback to participants on strategies for increasing physical activity.

Another approach used by researchers to promote physical activity involved providing participants with frequent access to study staff via email or through message boards/chat rooms on the study Website (n = 13).[**] For example, in a study conducted by Carr et al,[61] participants were encouraged to pose physical activity and health-related questions to study staff by using an “Ask the Expert” message board on the study Website. Study staff monitored the message board forum and responded to participant posts. The purpose of this message board forum was to foster social support for physical activity and to maintain participant engagement in the study.

Many studies also reported incorporating goal-setting and self-monitoring applications with their Internet-based physical activity promotion efforts (n = 27).[††] Examples of these strategies include recording physical activity or step counts performed on the study Website in order to track progress throughout the Intervention. For instance, Booth et al[60] asked participants to upload their pedometer assessed step counts to the study Website on a weekly basis. Once participants uploaded their steps, the online system automatically calculated each participant’s average daily step count and provided feedback on strategies to maintain and/or improve their physical activity levels.

[‖]References 12, 15, 20, 23, 33, 36, 41, 42, 44, 46, 48, 50, 54, 57, 63, 67, 76, 77, 84, 85.
[¶]References 10, 13, 19, 31, 32, 37, 38, 43, 46, 48, 50, 58, 60, 74, 79, 81.
[#]References 15, 25, 39, 45, 52, 66, 72, 81, 82.
[**]References 11, 21, 23, 33, 40, 42, 48, 50, 56, 57, 59, 61, 63.
[††]References 10, 19, 20, 23, 33, 35–38, 40–42, 46, 57, 58, 60, 61, 63–65, 67, 69, 70, 76, 82.

Last, several studies included online-based applications to promote social support among participants (n = 10).‡‡ Liebreich and colleagues[33] allowed participants to interact with each other via message boards on the study Website. These boards provided a forum for participants to exchange ideas and receive support from each other in order to promote behavior change. Similarly, Dlugonski et al[84] fostered social support among participants via scheduled, online chat sessions. Participants in this study were asked to engage in twice per week chat sessions for discussions regarding physical activity behavior change.

Analyses to Account Missing Data

Studies employed various strategies to account for missing data at follow-up assessments. The majority of studies (n = 31) evaluated physical activity outcomes using a complete case approach and only included participants with complete physical activity data at both the baseline and follow-up in outcome analyses.§§ Twenty-one studies assessed outcomes based on the intent-to-treat principle and carried forward participants' previous assessment data for missing data at follow-up,‖‖ and 5 studies reported outcomes using both complete case and intent-to-treat analyses.[45,48,54,64,80] Other statistical approaches used by studies to account for missing data included mixed model repeated measures (n = 6),¶¶ multiple imputation (n = 3),[19,27,50] and a "pragmatic approach" (n = 1).[58] Three studies did not report how missing data were accounted for in statistical analyses.[30,40,57]

Assessment of Physical Activity

The majority of the studies (n = 68) reported a physical activity outcome immediately following the conclusion of the Internet-based intervention. Additionally, 16 studies reported more distal physical activity outcomes of the intervention within the article or in a subsequent publication.## Among these studies, the delayed postintervention assessment periods ranged from 1 to 9 months following the conclusion of the intervention (median = 6 months).

Various measures were used to assess physical activity across the studies. Fifty-six studies reported physical activity outcomes using a self-report measure only, 7 studies reported physical activity outcomes using an objective measure only*** and 9 reported physical activity outcomes using both self-report and objective measures.††† Among studies using an objective measure, 11 used pedometers,‡‡‡ 4 used accelerometers,[12,38,81,84] and 1 used ActiWatches (an accelerometer-based tool developed for the study).[25] The most frequently used self-report measures were the International Physical Activity Questionnaire (n = 12), Godin Leisure Time Exercise Questionnaire (n = 8), Seven-Day Physical Activity Recall (n = 8), Paffenbarger Physical Activity Questionnaire (n = 6), and the Active Australia Survey (n = 4). Additionally, 4 studies incorporated an aerobic fitness outcome (eg, submaximal

‡‡*References* 17, 20, 23, 31, 33, 34, 40, 64, 65, 84.
§§References 13, 17, 22, 24, 26, 29, 31, 32, 34, 37, 43, 44, 46, 49, 53, 56, 59, 60, 62, 69–73, 78, 81–83, 85–87.
‖‖References 12, 15, 20, 23, 33, 35, 36, 39, 41, 42, 51, 52, 55, 61, 63, 65–67, 74, 76, 84.
¶¶References 10, 16, 21, 38, 77, 79.
##References 13, 16, 20, 24, 34–36, 41, 49, 50, 52, 57, 58, 74, 78, 87.
***Reference 13, 38, 41, 46, 58, 71, 72.
†††References 12, 25, 50, 53, 60, 81, 82, 84, 85.
‡‡‡References 13, 41, 46, 50, 53, 58, 60, 71, 72, 82, 85.

treadmill test or walk test),[37,59,66,69] and 3 studies did not specify the measure used to assess physical activity.[59,81,85]

Physical Activity Outcomes

The majority of studies (n = 44, 61.1%) reported a significant improvement in physical activity for 1 or more of the Internet-based approaches evaluated by the intervention, 27 studies reported null outcomes, and 1 study reported a significant decrease in physical activity.[79] Among the 16 studies with delayed postintervention follow-up assessments, 6 reported significant improvements in physical activity at the end of the intervention and at the delayed follow-up assessment(s),§§§ 6 reported null physical activity findings at all assessment periods,[16,20,34–36,52] and 4 reported significant improvements in physical activity at the end of the intervention but null findings at the delayed follow-up assessment.[13,24,57,87]

Significant improvements were found in 6 of the 7 studies reporting only an objective measure of physical activity|||||| and 33 of the 54 studies using only a subjective measure to assess physical activity. Among the 9 studies using both objective and subjective measures, 4 reported significant improvements in physical activity for both measures,[25,50,53,60] and 1 study reported an increase in pedometer measured physical activity but not self-reported activity.[84] Thirty (57.7%) of the 52 studies with durations less than 6 months reported significant improvements in physical activity and 14 (70.0%) of the 20 studies with durations of 6 months or greater reported significant improvements in physical activity.

Of the 37 studies targeting only physical activity, 26 (59.1%) reported a significant increase in physical activity; meanwhile, 18 (51.4%) of the 35 studies targeting multiple health behaviors reported a significant increase in physical activity. Among the 49 studies identifying a behavioral theory as the basis of intervention activities, 30 (61.2%) reported improvements in physical activity at the most proximate assessment following the conclusion of the intervention. Similarly, 14 (60.9%) of the 23 studies that did not identify a behavioral theory reported positive increases in physical activity.

Four studies compared an Internet-based versus a print-based approach to deliver the exact same physical activity intervention. Results for these studies were identical for both delivery methods; 2 studies reported significant increases in physical activity,[29,66] and 2 studies reported null findings.[67,83] Nine studies evaluated Internet-delivered versus in-person delivered physical activity interventions. Four of these studies specified delivery of the same intervention material to participants in both the in-person and Internet groups.[69,70,74,78] Results from these 4 studies showed significant improvements in physical activity for both the in-person and Internet-delivered groups. The remaining 5 studies showed similar findings with 2 studies demonstrating significant increases in physical activity for both delivery methods,[21,65] 2 showed null findings for both delivery methods,[23,32] and 1 showed a significant increase for the in-person group but null findings for Internet group.[64]

§§§*References* 41, 49, 50, 58, 74, 78.
||||||*References* 13, 38, 41, 46, 58, 72.

Discussion

The current article provides a comprehensive review of Internet-based studies promoting physical activity among adult populations. Findings indicated that most Internet-based physical activity interventions (61.9%) were associated with significant increases in physical activity, which is consistent with the findings of previous reviews[7,8,89] and meta-analyses on this topic.[9,90] This study adds to the physical activity literature in several ways. First, it provides an updated narrative review of Internet-based approaches to promoting physical activity. Prior to this review, the most recent systematic reviews were conducted in 2007;[7,8] the current article included articles published through August 2012. Second, this review included intervention studies of all research designs, which provides a full overview of published Internet-based physical activity interventions. Previous systematic reviews and meta-analyses examining Internet-based physical activity interventions have restricted their inclusion criteria to only include studies with randomized research designs.[7–9]

Results of this review showed that the use of randomized controlled trials have increased in recent years. Earlier reviews (conducted in 2007) reported a much lower prevalence of randomized controlled trials in their studies (ie, n = 10 and n = 14).[7,8] We identified 46 randomized controlled trials, with 33 published after 2007. Thus, the study designs of Internet-based physical activity interventions have improved in recent years.

Several studies compared Internet-based versus in-person[69,70,74,78] or print-based[29,66,67,83] delivery of the same physical activity intervention material. All these studies yielded the same physical activity outcomes regardless of the delivery method. This finding suggests that Internet-delivered physical activity interventions are equally as effective in promoting behavior change as more established delivery methods such as in-person or print. Furthermore, since Internet-based interventions have the potential to reach a greater number of people at a lower cost, they represent a cost-effective method in which to promote physical activity.[6,91]

A number of studies reported the use of additional communication strategies, such as telephone calls[56] and in-person contact,[19,38,58,70,74] to complement their Internet-based physical activity efforts. However, a surprising finding was that only 1 study[25] identified the use of mobile/cellular phone technology to complement their Internet-based physical activity efforts. Mobile and cellular/Smartphone phone technology represents a rapidly growing field of communication that can provide an additional point contact with participants (ie, via SMS/text messaging). Furthermore, these additional contacts can help prompt/direct the participants to the study Website, thereby boosting Website utilization and potentially resulting in greater increases in physical activity. Future studies should attempt to incorporate cellular/Smartphone technologies into their Internet-based physical activity intervention activities as these technologies may assist with the successful promotion of physical activity.

A promising finding of this review was that longer-term interventions (greater than 6 months in duration) appeared to be as successful in promoting improvements in physical activity as shorter-term interventions, which differs from a previous review on this topic.[8] However,

fewer longer-term interventions (in comparison to shorter-term interventions) were identified in the literature with only 20 studies in the current review having intervention periods of 6 months or longer. Additionally, only 20% of Internet-based physical activity studies (n = 16) incorporated delayed follow-up assessments to evaluate the longer-term impacts of their physical activity efforts. While the results of these studies were encouraging with 60% (6 out of 10) of the studies that reported significant improvements in physical activity at the end of the intervention also reporting sustained improvements in physical activity at delayed follow-up assessment, the need exists for more studies to incorporate delayed postintervention follow-up assessments. Incorporation of more distal postintervention assessments of physical activity will provide valuable insight as to whether initial increases in physical activity are maintained after the end of the intervention period.

An unexpected outcome of this review was that theoretically based interventions had similar outcomes as non–theoretically based interventions. This was surprising due to the significant body of research suggesting that physical activity interventions grounded in behavioral theory are more effective than non–theoretically based interventions.[8,90] A possible explanation for the similar physical activity findings across these studies could involve the fidelity in which theoretically based interventions actually targeted the intended theoretical constructs. Future researchers should further explore whether theoretically based physical activity interventions are more effective than non–theoretically based interventions. We also found that interventions targeting multiple behavioral outcomes were similarly as efficacious as those targeting physical activity only, which mirrors the outcome of a previous review on this topic.[8] Thus, this finding provides support for incorporating other behavioral outcomes with Internet-based physical activity efforts, as targeting multiple behaviors does not appear to adversely affect physical activity outcomes.

Attrition remains a point of concern for Internet-based interventions. The mean attrition among the studies included in the intervention was approximately 22%, with studies longer in duration reporting higher attrition. Researchers should continue to investigate ways to maintain participant engagement in Internet-based approaches to physical activity. Potential strategies may include increasing monetary or tangible incentives for participants, updating Website content more frequently, and increasing contact with participants (ie, via email, telephone or text message).

Findings of this review indicate several issues for improvement in future Internet-based physical activity studies. Only one fifth of the studies reviewed (n = 16) reported using an objective measure to assess physical activity. Due to the various methodological issues associated with self-report of physical activity (eg, recall bias, overreporting of activity),[92] future studies should attempt to incorporate objective physical activity measures into their evaluation plans. Additionally, less than one third of the studies reported physical activity outcomes using intent-to-treat analyses. Intent-to-treat analyses provide a conservative estimate of study outcomes and help account for attrition-related bias.[93] Therefore, it is our recommendation, along with other resarchers,[8,9] that future studies use an intent-to-treat approach when assessing study outcomes.

Future studies should also attempt to incorporate delayed postintervention follow-up assessments as they provide a method to evaluate the longer-term impacts of the Internet-based physical activity interventions. Furthermore, the need exists for additional studies to explore the effectiveness of Internet-based physical activity interventions among men. In this review, the majority of participants were female (66% across all studies) and only 3 studies focused exclusively on males. Given that 50% of men are insufficiently active[2] and that they are equally as likely to use the Internet as women,[3,4] Internet-delivered interventions may provide a method in which to successfully promote physical activity in this population.

Last, minimal research has evaluated the effects of Internet-based physical activity interventions among minority populations such as African Americans or Latinos. The current review identified only 1 study comprising a majority Latino population[37] and no studies with a majority African American population. Data suggest that only 42% of Latinos and 40% of African Americans achieve recommended physical activity levels[2] and that these populations are disproportionately affected by many health conditions associated with insufficient physical activity.[88] Future studies should attempt to oversample these populations in their recruitment efforts and/or design Internet-based interventions specifically for these populations. Moreover, with recent data showing that the Internet-related digital divide is rapidly closing among these populations,[4,5] Internet-based methods may provide a key strategy in which to intervene and help resolve physical activity–related health disparities.

Conclusions

The current study provides a comprehensive review of Internet-based physical activity interventions targeting adult populations. Overall, the literature suggests that Internet-based physical activity studies are an efficacious method in which to promote physical activity. However, several methodological issues exist among published studies that need to be addressed by future studies (ie, longer postintervention follow-ups, targeting minority/male populations). As Internet-based technology continues to advance at a rapid pace, researchers should attempt to stay abreast of emerging technology trends and incorporate new and innovative technologies (ie, the use of cellular and SmartPhones) in their Internet-based physical activity promotion efforts.

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Table 1

Studies With Randomized Controlled Trial Designs.

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
Bennett et al, 2011[10]	N = 145 worksite managers; mean age 41.5; 64% female; 82% White; 25% attrition	Two-arm trial evaluating the *ExecuPrev* Website; Groups: (*a*) access to *ExecuPrev* Website that consisted of self-monitoring tools and interactive learning modules, (*b*) no contact control	PA; nutrition; weight loss	6 months; no delay between intervention and outcome measurements	NR	GLTEQ	No significant increase in PA for either group
Bosak et al, 2010[11,12]	N = 22 adults with metabolic syndrome; mean age 50.7 years; 27% female; 91% White; 14% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to study Website that consisted of goal-setting tools, applications to increase self-efficacy, email feedback from staff, (*b*) usual care group that received standard feedback from a physician following baseline assessment	PA	6 weeks; no delay between intervention and outcome measurements	SE	7-Day PAR; accelerometers	No increase in PA for either group
Carr et al, 2008, 2009[13,14]	N = 32 adults; mean age: intervention group 41.4 years; 49.4 for control; Percent male/female not described; race NR; 52% attrition	Two-arm trial evaluating the *Active Living Everyday* Website; Groups: (*a*) access to the *Active Living Everyday* Website that consisted of self-paced modules to increase PA, (*b*) wait-list control	PA; reduction of cardiovascular risk	16 weeks; outcome measurements assessed immediately following intervention and 8 months postintervention	SCT; TTM	Pedometers	Web-based group significantly increased steps/day at the end of 16 weeks, no change for control group; at 8 month follow-up intervention group regressed back to baseline step levels
Dunton and Robertson, 2008[15]	N = 156 adult females; mean age 42.8 years; 100% female; 65% White; 16% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that consisted of interactive Web-pages and individually tailored feedback to promote PA, also received weekly emails to promote PA, (*b*) wait-list control	PA	3 months; no delay between intervention and outcome measurements	HBM; TTM	Standardized activity inventory format	Intervention group significantly increased PA in comparison to the control group
Franko et al, 2008[16]	N = 476 college students from 6 universities; mean age 20.1 years; 56.3% female; 58% White; 11% attrition	Three-arm trial evaluating the *My Student Body* Website; Groups: (*a*) access to *My Student Body* Website that consisted of learning modules and individualized feedback (2 required Website visits), (*b*) access to *My Student Body* Website (3 required visits), and (*c*) attention control that accessed an anatomy Website	PA; nutrition	6 months; outcome measurements assessed immediately following intervention and at 3 and 6 months postintervention	NR	IPAQ	No improvement in PA for any group
Glasgow et al, 2003[17]	N = 320 type 2 diabetes patients; mean age 59 years; percent male/female not described; race NR; 18% attrition	Three-arm trial evaluating the *D-Net Diabetes Program*; Groups: (*a*) access to a Website that consisted of tailored self-management training and twice per week online coaching with study staff, (*b*) access to same Website as group plus additional peer support to message board forums, (*c*) information only Website with links to generic articles on diabetes (control)	Nutrition; blood profiles; PA	10 months; no delay between intervention and outcome measurements	SE; Social Support Theory	PA Scale for the Elderly	No improvement in PA for any group
Glasgow et al, 2010, 2012[18,19]	N = 463 type 2 diabetes patients; mean age 58.4 years; 49.8% female; 72% White; 19% attrition	Three-arm trial evaluating the *My Path to Health* Website; Groups: (*a*) access to the *My Path to Health Life* Website that consisted of educational information, goal-setting, and self-monitoring tools, (*b*) access to the *My Path to Health Life* Website plus a single in-	PA; eating behaviors; biological outcomes	4 months initially reported; 12 months reported in subsequent publication; no delay between intervention and outcome measurements	Social Ecological Theory; Self-Management Model	Community Health Activities Model Program for Seniors Questionnaire (CHAMPS)	4 month assessment: Both intervention groups significantly increased PA compared to baseline (no difference between

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
		person group support session, (*c*) access to usual care Website that consisted of health risk appraisal (information only)) access to usual care Website that consisted of health risk appraisal (information only)) access to usual care Website that consisted of health risk appraisal (information only)					intervention groups); 12 month assessment: authors reported combined results for both intervention groups, the combined groups significantly increased PA from baseline in comparison to the control group
Gow et al, 2010[20]	N = 170 first year college students; mean age NR; 73.7% female; 54% White (22% Black); 26% attrition	Four-arm trial evaluating varying Web-based and email-based intervention strategies; Groups: (*a*) access to Website that consisted of weekly modules targeting PA and weight loss/weight gain prevention, (*b*) received 6-weekly weight and caloric feedback emails based on weekly weights sent to research team, (*c*) access to the Website and received email feedback, (*d*) no contact control	PA; prevention of weight gain	6 weeks; outcome measurements assessed immediately following intervention and at 3 months postintervention	SCT	IPAQ–Short Form	No significant increase in PA for any study group
Grim et al, 2011[21]	N = 233 college students; mean age 21.2 years; 82% female; 82% White; 28% attrition	Three-arm trial evaluating a Web-based versus an in-person PA intervention; Groups: (*a*) access to Web-based course that consisted of Web-based lectures and content to increase PA, (*b*) in-person class to increase PA, (*c*) attention control (in-person health class)	PA	10 weeks (college semester); no delay between intervention and outcome measurements	SCT	7-Day PAR	Both the Web-based and in-person PA classes significantly increased PA; no change in PA for control group
Hager et al, 2002[22]	N = 525 university employees; mean age 42 years; 56% female; 94% White; 23% attrition	Three-arm trial evaluating email messages to promote PA; Groups: (*a*) received tailored stage-based email messages, (*b*) received standard email messages based on action and maintenance stages (action message group), (*c*) attention control received emails regarding nutrition	PA	6 weeks; no delay between intervention and outcome measurements	TTM	7-Day PAR; questionnaire adapted from Health Insurance Plan of New York Questionnaire	Both staged and action-message groups significantly increased PA
Harvey-Berino et al, 2002[23]	N = 46 overweight healthy adults; mean age 46.3 years; 80% female; predominately White; 10% attrition	Three-arm trial evaluating varying support strategies to promote weight loss/maintenance following a 15-week behavioral weight control intervention; Groups: (*a*) Internet support that consisted of biweekly emails and online chat sessions with therapist, (*b*) in-person support that consisted of biweekly meetings with study staff, (*c*) no contact control	Weight loss maintenance; PA	22 weeks; no delay between intervention and outcome measurements	NR	Paffenbarger PA Questionnaire	No increase in physical activity for any group
Huang et al, 2009[24]	N = 130 Taiwanese female freshman; mean age NR; 100% female; 7% attrition	Three-arm trial evaluating a theoretically based Website and a non–theoretically based Website; Groups: (*a*) access to interactive Website that consisted of individually tailored stage-matched messages and exercise demonstration videos, (*b*) access to Website (same as group "*a*" but messages were not stage-matched, (*c*) in-class lecture group (control)	PA	2 months; no delay and 5-month delay between intervention and outcome measurements	TTM	NR	Both Website groups significantly increased PA at the end of the intervention period; at 5-month postintervention assessment, participants in both Web-based groups regressed back to baseline PA levels
Hurling et al, 2007[25]	N = 77 healthy British adults; mean age 40.4 years; 66% female; 99% White; 0% attrition	Two-arm trial evaluating a Web-based physical activity intervention; Groups: (*a*) access to interactive Website that consisted of goal-setting and self-monitoring applications, mobile phone messages, and email feedback, (*b*) no contact control	PA	9 weeks; no delay and 5-month delay between intervention and outcome measurements	NR	IPAQ; Actiwatches (accelerometer-based watches developed for the study)	Intervention group significantly increased moderate intensity PA; no change for control group

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
Irvine et al, 2011[26]	N = 221 manufacturing plant employees; mean age 45 years; 42.2% female; 79% White; 7% attrition	Two-arm trial evaluating the *Get Moving* Website; Groups: (*a*) access to the *Get Moving* Website that consisted interactive applications and goal-setting activities, (*b*) no contact control	PA	1 month; no delay between intervention and outcome measurements	NR	Single item: "On a typical day, how many minutes do you spend in PA?"	Intervention group significantly increased PA in comparison to the control
Kelders et al, 2010, 2011[27,28]	N = 269 Dutch adults; mean age 41.5 years; 66% female; race NR; 47% attrition	Two-arm trial evaluating the *Healthy Weight Assist* Website; Groups: (*a*) access to the *Healthy Weight Assist* Website that consisted of individually tailored feedback and goal setting, (*b*) wait-list control	PA; dietary habits	12 weeks; no delay between intervention and outcome measurements	NR	Dutch Standard for Healthy PA	No improvement in PA for either group at either follow-up assessment
Kim and Kang, 2006[29]	N = 73 South Korean adults with type 2 diabetes; mean age 55.1 years; 46.6% females; attrition NR	Three-arm trial comparing 2 intervention delivery methods; Groups: (*a*) access to Website that delivered interactive stage-matched messages to promote PA, (*b*) printed intervention material (same information as group *a*), (*c*) usual care control	PA; glycemic control	12 weeks; no delay between intervention and outcome measurements	TTM	7-Day PAR	Significant increase in PA among Web-based and print-based intervention groups, no change in PA for usual care group
Kim et al, 2012[30]	N = 49 postpartum females diagnosed with gestational diabetes; mean age 35.7 years, 71% White; 14% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that consisted of educational materials, self-monitoring tools, and step count goal setting, (*b*) no contact control	PA	13 weeks; no delay between intervention and outcome measurements	NR	Self-reported pedometer steps per day	No improvement in PA for either group
Kosma et al, 2005[31]	N = 75 individuals with disabilities; mean age NR; 72% female; 89% White; 50% attrition	Two-arm trial evaluating Web-based PA intervention; Groups: (*a*) access to Website that consisted of educational modules to promote PA, (*b*) attention control group that received weekly "thought of the week" messages	PA	1 month; no delay between intervention and outcome measurements	TTM	13-item PA Scale for Individuals with Disabilities	No change in PA for any either group
LaChausse, 2012[32]	N = 320 college students; mean age 24.6 years; 73% female; 21% White (44% Hispanic); 3% attrition	Three-arm trial evaluating the *My Student Body* Website; Groups: (*a*) access to *My Student Body* Website that consisted learning modules and individualized feedback, (*b*) on-campus PA course, (*c*) no contact control	PA; weight loss	12 weeks; no delay between intervention and outcome measurement	NR	Youth Risk Behavior Survey	No improvement in PA for any group
Liebreich et al, 2009[33]	N = 49 Canadian adults diagnosed with type 2 diabetes; mean age approximately 54 years; 59% female; race NR; 10% attrition	Two-arm trial evaluating the *Diabetes NetPLAY* Website; Groups: (*a*) access to the *Diabetes NetPLAY* Website that consisted of educational materials, message boards, self-monitoring tools, weekly email counseling, (*b*) control group received links to the Canadian Diabetes Association's Clinical Practice Guidelines	PA	12 weeks; no delay between intervention and outcome measurements	SCT	GLTEQ	Intervention group significantly increased PA compared to the control
Lorig et al, 2006[34]	N = 958 adults diagnosed with heart disease, chronic lung disease, or type 2 diabetes; mean age 57.5 years; 71.4% female; 88% White; 19% attrition	Two-arm trial evaluating a Web-based behavior change intervention; Groups: (*a*) access to a Website that consisted of interactive education materials and discussion groups, participants also received a reference book, (*b*) usual care control group	PA; chronic disease management	6 weeks; outcome measurements performed at 6 and 12 months after baseline	SE	Instruments developed and validated by the Stanford patient Education Research Center	Intervention group had significant improvement in stretching and strengthening exercise at 12-month evaluation in comparison to control group; No improvement in aerobic PA for either group
Lorig et al, 2008[35]	N = 855 adults diagnosed with arthritis or fibromyalgia; mean age 52.5 years; 90.2%	Two-arm trial evaluating a Web-based self-management intervention; Groups: (*a*) access to a Website that consisted of message boards, interactive	PA; arthritis self-management	6 weeks; outcome measurements performed at 6 months postintervention	SE	Instruments developed and validated by the Stanford patient Education Research Center	No improvement in PA for either group

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
	female; 90.5% White; 24% attrition	lessons on PA, and self-assessments, (*b*) usual care					
	female; 90.5% White; 24% attrition	control					
Lorig et al, 2010[36]	N = 761 adults; mean age 54.3 years; 73% female; 76% White; 15% attrition	Three-arm trial evaluating a Web-based intervention versus a Web-based plus email delivered intervention; Groups: (*a*) access to Website that consisted of interactive Web-pages, self-monitoring tools, discussion boards, links to other Websites, (*b*) Web-based intervention (same as group *a*) with email reinforcement, (*c*) usual care control	PA; diabetes self-management	6 weeks; outcome measurements performed at 6 months postintervention	SE	Instruments developed and validated by the Stanford patient Education Research Center	No improvement in PA for any group
Magoc et al, 2011[37]	N = 104 college students; mean age 25.5 years; percent female NR; 78% Hispanic; 11% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that consisted of educational modules to increase PA and goal-setting/self-monitoring applications (delivered via *WebCt*), (*b*) contact control that received a 1-time 15-minute presentation and printed tip sheet on PA	PA	6 weeks; no delay between intervention and outcome measurements	SCT	IPAQ	Intervention group significantly increased PA; no change in PA for control group
Mailey et al, 2010[38]	N = 47 college students with mental disorders; mean age 25 years; 68.1% females; 68% White; 9% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that consisted of educational modules to increase PA and 2 in-person meetings with an activity counselor, (*b*) no contact control	PA	10 weeks; no delay between intervention and outcome measurements	SCT	Accelerometers	Both groups significantly increased PA at follow-up; however, intervention group had a significantly greater PA increase than the control group
McConnon et al, 2007[39]	N = 221 obese British adults; mean age 45.8 years; 77% female; 95% White; 13% attrition	Two-arm trial of a Web-based PA/weight loss intervention; Groups: (*a*) access to Website that provided personalized advice, tools, and information to promote PA and weight loss, (*b*) usual care printed materials	PA; weight loss	12 months; no delay between intervention and outcome measurements	NR	Baecke PA Questionnaire	No improvement in PA for either group
McKay et al, 2001[40]	N = 78 type 2 diabetes patients; mean age 52.3 years; 53% female; 82% White; 13% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to study Website that consisted of tailored online personal coaching, applications to foster social support among participants, and self-monitoring tools, (*b*) information only control (provided with links to articles on diabetes)	PA	8 weeks; no delay between intervention and outcome measurements	SEM	BRFSS Survey	Significant increase in PA for both groups
Morgan et al, 2009[41]	N = 65 overweight/obese male staff and students at an Australian university; mean age 35.9 years; race NR; 17% attrition	Two-arm trial evaluating the *Shed It* program; Groups: (*a*) access to the *Shed It* program that consisted of one face-to-face informational session, access to *Calorie King* Website, and personalized email feedback on progress from study staff, (*b*) control group that received the same one-time informational session	PA; weight loss	3 months; outcome measurements assessed immediately following intervention and at 3 months postintervention	SCT	Pedometers	Both groups significantly increased PA from baseline at both follow-up assessment periods (no difference between groups)
Morgan et al, 2011[42]	N = 110 overweight/obese Australian male factory employees; mean age 44.4 years; 0% female; race NR; 27 % attrition	Two-arm trial evaluating the *Workplace POWER* program; Groups: (*a*) access to the *Workplace POWER* program that consisted of a single face-to-face group meeting, access to *Calorie King* Website, and individualized email feedback on progress from intervention team, (*b*) wait-list control	PA; weight loss	3 months; no delay between intervention and outcome measurements	SCT	GLTEQ	Intervention group significantly increased PA in comparison to control group

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
Motl et al, 2011[43]	N = 54 adults diagnosed with multiple sclerosis; mean age 45.6 years; 90% female race NR; 11% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to study Website consisting of 4 multimedia modules to increase PA, (*b*) wait-list control	PA	12 weeks; no delay between intervention and outcome measurements	SCT	GLTEQ	Intervention group significantly increased PA, no change in PA for control group
Napolitano et al, 2003[44]	N = 65 sedentary hospital employees; mean age NR; 84% female; 91% White; 20% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that provided computer-tailored feedback to promote PA, also received weekly emails with tips to increase PA, (*b*) wait-list control	PA	3 months; no delay between intervention and outcome measurements	SCT; TTM	BRFSS PA Scale	Intervention group significantly increased PA at 1 month in comparison to the control; at the end of the intervention there was no significant increase in PA for either group
Oenema et al, 2008[45]	N = 2159 Dutch adults over the age of 30; mean age 43.6 years; 54% female; race NR; 20% attrition	Two-arm trial evaluating a multiple behavior change Website; Groups: (*a*) access to Website that provided computer-generated individually tailored feedback, (*b*) wait-list control	PA; fat intake; smoking cessation	1 month; no delay between intervention and outcome measurements	Precaution Adoption Process Model	IPAQ	No improvement in PA for either group
Ornes and Ransdell, 2007[46]	N = 112 female college students; mean age 20.2 years; 100% female; race NR; 7% attrition	Three-arm trial evaluating 2 pedometer-based interventions; Groups: (*a*) sealed pedometer control group, (*b*) unsealed pedometer control group, (*c*) Web-based pedometer intervention that consisted of educational modules on strategies to increase PA, self-monitoring/goal-setting applications, and personalized email feedback	PA	4 weeks; no delay between intervention and outcome measurements	SCT	Pedometers	Web-based group significantly increased PA in comparison to both control groups
Parrott et al, 2009[47]	N = 170 sedentary college students; mean age 20.2 years; 38.2% female; 94% White; 0% attrition	Three-arm trial comparing persuasive messages delivered via email to promote PA; Groups: (*a*) positively framed emails to promote PA, (*b*) negatively framed emails to promote PA, (*c*) no contact control	PA	2 weeks; no delay between intervention and outcome measurements	TPB	GLTEQ	Positively framed email group significantly improved PA in comparison to control
Patrick et al, 2011[48]	N = 441 overweight/obese male adults; mean age 43.9 years; 0% female; 71% White; 30% attrition	Two-arm trial evaluating a PA/weight loss Website; Groups: (*a*) access to study Website that consisted of weekly learning modules and individually tailored feedback, optional email access to study experts (eg, dietician, psychologist), (*b*) wait-list control	PA; weight loss	12 months; no delay between intervention and outcome measurements	SCT	IPAQ	Intervention group significantly increased PA in comparison to control group
Plotnikoff et al, 2005[49]	N = 2121 worksite employees; mean age 45.0 years; 73% female; race NR; 18% attrition	Two-arm trial evaluating an email-based PA intervention; Groups: (*a*) received weekly emails promoting PA and nutrition, (*b*) wait-list control	PA; nutrition	12 weeks; outcome measurements assessed immediately following intervention and at 3 months postintervention	SCT; TTM; TPB; PMT	GLTEQ	Baseline to month 3 outcomes: Intervention group increased PA; control group decreased PA; month 3 to month 6 outcomes: both groups significantly increased PA; baseline to month 6 outcomes: intervention group reported significantly greater PA than the control group
Reid et al, 2012[50]	N = 223 adults admitted to a Canadian hospital for acute coronary syndrome; mean age 56.4 years; 15.7% female; race NR; 31% attrition	Two-arm trial evaluating the *CardioFit* Website; Groups: (*a*) access to the *CardioFit* Website that consisted of learning tutorials to promote PA, participants were also provided with a computer-tailored PA plan and email contact with counselors, (*b*)	PA	6 months; outcome measurements assessed immediately following intervention and at 6 months postintervention	NR	Pedometers; GLTEQ	Intervention group significantly increased pedometer assessed and self-report PA when compared to the control

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
		usual care control (provided with an education booklet from physician) usual care control (provided with an education booklet from physician)					group at both follow-up assessment periods
Skår et al, 2011[51]	N = 1273 students at a Scottish university; mean age 22.8 years; 63.4% female; race NR; 42% attrition	Three-arm trial evaluating 2 different planning strategies to promote PA; all participants completed an online questionnaire and then were asked to do one of the following: Groups: (*a*) developed plans on when and where they would perform PA (known as advance planning), (*b*) developed plans on how they would cope with barriers to PA (known as coping plans), (*c*) develop both action and coping plans, (*d*) no contact control	PA	8 weeks; no delay between intervention and outcome measurements	TPB	Validated self-reported measure of PA, "How often have you participated in physical activities for at least 30 minutes per session in your free time?" Attendance at university sport facilities (secondary outcome measures)	No improvement in PA for any group
Slootmaker et al, 2009[52]	N = 102 Dutch office workers; mean age 31.8 years; 60% female; race NR; 22% attrition	Two-arm trial evaluating a Web-based PA intervention; Groups: (*a*) access to Website that consisted of individually tailored content on how to increase PA, (*b*) provided with generic PA print materials (control)	PA	3 months; outcome measurements assessed immediately following intervention and at 5 and 8 months postintervention	NR	The Activity Questionnaire for Adolescents and Adults	No improvement in PA for either group
Smith et al, 2009[53]	N = 41 sedentary overweight adults; mean age 43.5 years; 80.5% female; race NR; attrition NR	Two-arm trial evaluating the *Active Living Everyday* Website; Groups: (*a*) access to the *Active Living Everyday* Website that consisted of self-paced modules to increase PA, (*b*) wait-list control	PA	16 weeks; no delay between intervention and outcome measurements	TTM; SCT	7-Day PAR; pedometers; supervised 1-mile walk test	Intervention group significantly increased moderate-intensity PA and steps per day; both groups improved fitness via walk test; control group decreased moderate-intensity PA
Spittaels et al, 2007[54]	N = 434 parents and staff at secondary schools in Belgium; mean age 41.4 years; 61.6% female; race NR; 35% attrition	Three-arm trial evaluating strategies to deliver a Web-based PA intervention; Groups: (*a*) access to a interactive computer Website that generated tailored individualized PA advice, (*b*) access to same Website as group a plus email reminders to logon to Website, (*c*) wait-list control	PA	6 months; no delay between intervention and outcome measurements	TPB; TTM	IPAQ	Significant increase in PA for both Internet groups (no difference between groups) in comparison to the control group
Sternfeld et al, 2009[55]	N = 787 administrative office employees; mean age 44.0 years; 79% female; 38% White (55% reported as "mixed/unknown"); 30% attrition	Two-arm trial evaluating the *Alive* email program; Groups: (*a*) received individually tailored email messages (*Alive* program) to increase daily step counts, (*b*) no contact control	PA; diet	16 weeks; outcome measurements assessed immediately following the intervention at 4 months postintervention	NR	Adapted questions from the Cross-Cultural Active Patterns Questionnaire	Intervention group significantly increased PA at 16 weeks and at a 4-month postintervention follow-up in comparison to control
van Wier et al, 2009[56]	N = 1386 Dutch worksite employees; mean age 43 years; 33% female; race NR; 43% attrition	Three-arm trial evaluating complementary support methods for Web-based PA/weight loss intervention; Groups: (*a*) access to Website that consisted of 10 educational modules that provided information on PA and nutrition plus telephone counseling, (*b*) access to Website (same as group *a*) plus email counseling, (*c*) usual care/control (lifestyle brochures)	PA; weight loss	6 months; no delay between intervention and outcome measurements	NR	The Short Questionnaire to Access Health– Enhancing PA	Website plus phone group significantly increased PA; no change in PA for Website plus email or control groups
Wadsworth and Hallam, 2010[57]	N = 91 college females; mean age NR; 100% female; race NR; 11% attrition	Two-arm trial evaluating a Web-based PA promotion intervention; Groups: (*a*) received weekly emails designed to promote PA and included links to study Website; the content on study Website coincided with	PA	6 weeks; outcome measurements assessed immediately following intervention and at 6 months postintervention	SCT	IPAQ	Intervention group significantly increased in PA at 6 weeks in comparison to control; at 6-month follow-up, PA

Study	Baseline Sample Characteristics	Intervention Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
		information included in emails, weekly email counseling, (information included in emails, weekly email counseling, (					regressed back to baseline levels
Winett et al, 2007[58]	N = 1071 adults; mean age 53.0 years; 67% female; 23% Black (other races NR); 13% attrition	Two-arm trial evaluating the *Guide to Health Trial*; Groups: (*a*) access to *Guide to Health* Website that consisted of online educational modules and self-monitoring applications, (*b*) access to *Guide to Health* Website plus church support, (*c*) wait-list control	PA; weight loss	7 months; outcome measurements assessed immediately following intervention and at 9 months postintervention	SCT	Pedometers	The *Guide to Health* plus church support group increased steps compared to the control group immediately following the intervention and at the 9-month postintervention follow-up. No differences were found between the control and *Guide to Health*–only group at either assessment period
Zutz et al, 2007[59]	N = 15 Canadian adults referred to cardiac rehabilitation programs; mean age 58.5 years; 20% female; race NR; 13% attrition	Two-arm trial evaluating a Web-based cardiac rehabilitation program; Groups: (*a*) access to a Web-based cardiac rehabilitation program that consisted of weekly educational materials delivered via slide presentations and one-on- one chat sessions with exercise specialist, dietician, and nurse, (*b*) no contact control	PA; cardiac risk factor management	12 weeks; no delay between intervention and outcome measurements	NR	Minnesota Leisure Time PA Questionnaire; treadmill exercise stress test	Intervention group significantly improved self-reported PA and significantly improved exercise capacity (METs), as measured by the treadmill test; no change in study PA outcomes for the control group

Abbreviations: PA, physical activity; NR, not reported; SCT, Social Cognitive Theory; TTM, Transtheoretical Model; TPB, Theory of Planned Behavior; HBM, Health Belief Model; 7-Day PAR, 7-Day Physical Activity Recall; IPAQ, International Physical Activity Questionnaire; BRFSS, Behavioral Risk Factor Surveillance System; SE, Self-efficacy Theory; SEM, Social Ecological Model; PMT, Protection Motivation Theory; GLTEQ, Godin Leisure Time Exercise Questionnaire.

Table 2

Studies With Randomized Trial Designs.

Study	Baseline Sample Characteristics	Study Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
Booth et al, 2008[60]	N = 53 overweight Australian adults; mean age 46.3 years; 79% female; race NR; 27% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) access to Website that provided information on how to increase exercise, components included a self- monitoring application where participants uploaded daily step counts and received automated weekly feedback on how to increase their daily step counts, (*b*) same exercise content as Website in group a plus dietary/weight loss information on the Website	PA; weight loss	12 weeks; no delay between intervention and outcome measurements	Goal-setting Theory	Adapted version of the Active Australian Survey; pedometers	Both groups significantly increased steps per day via pedometers (no between group differences); no significant increases in self-reported PA for either group
Carr et al, 2013[61]	N = 53 sedentary healthy adults; mean age 36.9 years; 87% White; 10% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) enhanced version of the *Step into Motion* Website that consisted of various theory-based applications to promote PA, (*b*) standard Internet group that received access to 6 Websites that had previously demonstrated success for increasing PA	PA	6 months; no delay between intervention and outcome measurements	SCT	7-Day PAR	At 3 months, the enhanced Internet group had a significantly greater increase in PA compared to the standard Internet group; at 6 months, both groups had significant increases in PA compared to baseline (no between group differences)
Dinger et al, 2007[62]	N = 56 insufficiently active females; mean age 41.5 years; 100% female; 86% White; 18% attrition	Two-arm trial comparing 2 email delivered pedometer interventions; Groups: (*a*) weekly emails reminders to wear pedometers and return activity logs, (*b*) same weekly emails as group a plus Transtheoretical Model–based stage-matched messages to increase step count	PA	6 weeks; no delay between intervention and outcome measurements	TTM	IPAQ–Short Form	Both groups significantly increased PA at follow-up; no difference between groups
Ferney et al, 2009[63]	N = 106 inactive Australian adults; mean age 52 years; 72% female; race NR; 18% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) access to a neighborhood environment–focused Website tailored for the participants' residence, (*b*) access to *Active Living Online* Website (comparison group); both groups received emails	PA	26 weeks; no delay between intervention and outcome measurements	SCT	Active Australia Questionnaire	Both groups significantly increased PA from baseline; however, the neighborhood group had a significantly greater increase in PA than comparison group
Harvey-Berino et al, 2002[64]	N = 122 overweight healthy adults; mean age 48.4 years; 85% female; 97% White; 17% attrition	Three-arm trial comparing a Web-based intervention versus 2 in-person interventions (participants were randomized into groups following a 6-month face-to-face obesity treatment); Groups: (*a*) Internet support that consisted of weekly emails, Internet chat sessions with therapist/other participants, and self-monitoring tools, (*b*) frequent in-person support (biweekly), (*c*) minimal in-person support	Weight loss; PA	12 months; no delay between intervention and outcome measurements	NR	Paffenbarger Physical Activity Questionnaire	All groups increased PA during face-to-face treatment (which was the baseline assessment for this study); only in-person support maintained an increase at end of maintenance
Harvey-Berino et al, 2004[65]	N = 255 healthy overweight or obese adults, mean age 45.8 years; 82% female; race NR; 24% attrition	Three-arm trial comparing a Web-based intervention versus 2 in-person interventions: participants were randomized after 6-month behavioral weight loss program; Groups: (*a*) received access to a Website–based support program that consisted of self-monitoring applications, message boards, and b-weekly online chats, (*b*) frequent in-person support plus telephone	PA; weight loss	12 months; no delay between intervention and outcome measurements	NR	Paffenbarger Physical Activity Questionnaire	All groups significantly increased PA

Study	Baseline Sample Characteristics	Study Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
		calls, (*c*) minimal in-person contact that met monthly for the first 6 months of the 12-month study) minimal in-person contact that met monthly for the first 6 months of the 12-month study					
Marcus et al, 2007[66]	N = 249 health sedentary adults; mean age 44.5 years; 82% female; 81% White; 10% attrition	Three-arm trial comparing 2 Web-based interventions versus a print intervention; Groups: (*a*) access to Website that provided computer-tailored feedback to promote PA, (*b*) received computer-tailored print material (same information as group *a*) via mail, (*c*) standard Internet with links to 6 public PA Websites	PA	12 months; no delay between intervention and outcome measurements	TTM; SCT	7-Day PAR; submaximal graded exercise test	All groups increased PA; no difference in PA across groups
Marshall et al, 2003, 2005[67,68]	N = 655 staff at an Australian university; mean age 43 years; 51% female; race NR; 22% attrition	Two-arm trial comparing 2 delivery methods of the same intervention; Groups: (*a*) access to *Active Living* Website and biweekly personalized stage-matched emails, (*b*) *Active Living* print material and weekly letters to initiate use of print materials	PA	8 weeks; no delay between intervention and outcome measurements	TTM	IPAQ–Short Form	No improvement in PA for either group
Nguyen et al, 2008[69]	N = 50 individuals diagnosed with chronic obstructive pulmonary disease (COPD); mean age 69.5 years; 44% female; 97% White; 24% attrition	Two-arm trial comparing 2 delivery modes of the same intervention; Groups: (*a*) access to a Web-based intervention that consisted of individualized tailored exercise planning, self-monitoring of respiratory symptoms and exercise, and personalized reinforcement and feedback for exercising, (*b*) face-to-face delivered intervention (same as group *a*)	PA; COPD symptom management	6 months; no delay between intervention and outcome measurements	SCT	Self-reported frequency and duration of exercise; 6-minute walk test	Both groups showed significant improvements in self-reported exercise time; Web-based group significantly improved distance covered in the 6-minute walk test when compared to the face-to-face group
Pellegrini et al, 2012[70]	N = 51 overweight/obese adults; mean age 44.2 years; 86.3% female; 88% White; 24% attrition	Three-arm trial comparing intervention delivery methods; Groups: (*a*) access to a Website where participants uploaded activity data collected by an energy monitoring armband, received instant self-monitoring feedback from uploaded data, and received weekly individualized feedback on progress, (*b*) access to Website (same as group *a*) plus in-person meetings, (*c*) in-person meetings only	PA; weight loss	6 months; no delay between intervention and outcome measurements	NR	Paffenbarger Physical Activity Questionnaire	All groups significantly increased PA; no difference between groups
Pressler et al, 2010[71]	N = 140 German employees of an automobile company; mean age 48 years; 11% female; race NR; 45% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) Website access with structured exercise prescriptions and weekly goal-setting activities, (*b*) Website access without structured exercise prescriptions or goal-setting activities	PA; cardiovascular risk	12 weeks; no delay between intervention and outcome measurements	NR	Pedometers	No improvement in PA for either group
Richardson et al, 2007[72]	N = 35 individuals diagnosed with type 2 diabetes; age range 38–71 years; 57% female; 77% White; 14% attrition	Two-arm trial comparing 2 Web-based goal-setting pedometer interventions; Groups: (*a*) lifestyle goals targeting step counts, (*b*) structured goals targeting 10 minute step bouts	PA (step counts)	6 weeks; no delay between intervention and outcome measurements	HBM	Pedometers	Both groups significantly increased step counts; no difference between groups
Rovniak et al, 2005[73]	N = 61 sedentary adult women; mean age 20.2 years; 100% female; 82% White; 18% attrition	Two-arm trial comparing 2 types of email messages to promote PA; Groups: (*a*) high fidelity SCT emails, (*b*) low fidelity SCT emails	PA (Walking)	12 weeks; no delay between intervention and outcome measurements	SCT	Self-reported walking; PA logs	No improvement in PA for either group
Steele et al, 2007, 2009[74,75]	N = 192 Australian adults; mean age 38.7 years; 83% female; race reported as	Three-arm trial comparing 3 intervention delivery methods of the same educational content; Groups: (*a*) weekly face-to-face intervention delivery from study staff, (*b*) Internet delivered intervention via weekly	PA	12 weeks; outcome measurements assessed immediately following	SCT	Active Australia Questionnaire	All groups improved PA at all assessment periods; no difference between the groups

Study	Baseline Sample Characteristics	Study Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measure(s)	Major Findings
	predominately White; 17% attrition	educational modules and emails (same contents as face-to-face group) and 2 additional face-to-face meetings with study staff, (*c*) Internet-delivered intervention only		intervention and at 2 and 5 months postintervention			
Tate et al, 2001[76]	N = 91 overweight healthy hospital employees; mean age 40.9 years; 89% female; 84% White; 22% attrition	Two-arm trial comparing 2 Web-based programs; Groups: (*a*) access to Website that consisted of self-monitoring applications and basic information on diet and PA (Internet education group), (*b*) access to Website (same as group *a*) and weekly behavioral therapy emails that consisted of weight loss lessons and feedback on progress	Weight loss; PA	6 months; no delay between intervention and outcome measurements	NR	Paffenbarger Physical Activity Questionnaire	Significant increase in PA for both groups at 3 and 6 months; no difference between groups
Tate et al, 2003[77]	N = 92 overweight adults at risk for type 2 diabetes; mean age 48.5 years; 90% female; 89% White; 16% attrition	Two-arm trial comparing 2 Web-based delivery methods: Groups: (*a*) access to Website that consisted of tutorials on weight loss/PA, tip sheets, and links to other Internet resources, (*b*) access to Website (same as group *a*) plus email counseling	Weight loss; PA	12 months; no delay between intervention and outcome measurements	NR	Paffenbarger Physical Activity Questionnaire	No change in energy expenditure (PA)
Touger-Decker et al, 2010[78]	N = 137 workplace employees; mean age 46.5 years; 6.6% female; 46% White (54% reported as “non-White”; 18% attrition	Two-arm trial comparing 2 intervention delivery methods of the same educational content: (*a*) in-person delivered education sessions, (*b*) Internet-delivered education sessions	PA; weight loss; cardiovascular risk	12 weeks; outcome measurements assessed immediately following intervention and at 14 weeks postintervention	NR	IPAQ	Both groups significantly increased PA at 12 weeks; at the 26 week postbaseline follow-up, participants in both groups maintained significant postbaseline increases in PA
van Genugten et al, 2012[79]	N = 539 overweight Dutch adults; mean age 47.8 years; 69% female; race NR; 67% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) access to a computer-tailored Website to prevent weight gain that consisted of 4 education modules, (*b*) access to generic Website that consisted of 3 modules with generic information to prevent weight gain	PA, dietary intake; weight loss	6 months; outcome measurements assessed at 1 month and 6 months	Self-regulation Theory, TPB, Precaution Adoption Process Model	The Short Questionnaire to Access Health-Enhancing Physical Activity	Both groups significantly decreased PA over the duration of the intervention; no difference between groups
Vandelanotte et al, 2012[80]	N = 863 Australian adults; mean age 52.4 years; 60.7% female; race NR; 66% attrition	Three-arm trial evaluating whether participants’ preference of message delivery would influence PA outcomes of a Web-based program; Groups: (*a*) text-based messages, (*b*) video-based message, (*c*) text and video-based messages	PA	1 month; no delay between intervention and outcome measurements	TPB; TTM	Active Australia Survey	All groups significantly increased PA; no association among individual preferences for delivery methods and PA outcomes
Wanner et al, 2009[81]	N = 1531 German adults; mean age 43.7 years; 74.9% female; race NR; 56% attrition	Two-arm trial comparing 2 Web-based interventions: Groups: (*a*) access to *Active Online* Website that consisted of self-paced educational modules and individually tailored feedback, (*b*) nontailored Website with generic information on how to increase PA	PA	13 months; no delay between intervention and outcome measurements	TTM	Short 4-item questionnaire (not specified); accelerometers	Both groups significantly increased PA at 6 weeks and 6 months; no changes at 13 months from baseline
Watson et al, 2012[82]	N = 70 overweight adults; mean age 42.0 years; 84% female; 76% White; 11% attrition	Two-arm trial comparing 2 Web-based interventions; Groups: (*a*) access to Website with a computer-animated virtual coach that delivered individually tailored messages, upload pedometer data, (*b*) access to pedometer company Website to upload pedometer steps and view graphs	PA	12 weeks; no delay between intervention and outcome measurements	NR	Pedometers; 7-Day PAR	No change in step counts or PA levels for either group

Abbreviations: PA, physical activity; NR, not reported; COPD, chronic obstructive pulmonary disease; SCT, Social Cognitive Theory; TTM, Transtheoretical Model; TPB, Theory of Planned Behavior; HBM, Health Belief Model; 7-Day PAR, Seven-Day Physical Activity Recall; IPAQ, International Physical Activity Questionnaire; SE, Self-efficacy Theory; SEM, Social Ecological Model; PMT, Protection Motivation Theory.

Table 3

Studies With Single Group or Nonrandomized Designs.

Study	Baseline Sample Characteristics	Study Description	Behaviors Targeted	Intervention Duration/ Follow-up	Theoretical Framework	Physical Activity Measures	Major Findings
Cook et al, 2007[83]	N = 480 worksite employees; mean age NR, 74% Female; 81% White; 13% attrition	Two-arm nonrandomized controlled trial evaluating a Web-based versus print-based behavior change intervention; Groups: (*a*) access to Website that consisted of interactive audio/video modules to promote behavior change, (*b*) received print materials to promote behavior change (same content as Web-based group)	PA, stress management, nutrition/weight management	3 months, no delay between intervention and outcome measurements	SCT, SE	GLTEQ	No improvement in PA for either group
Dlugonski et al, 2011[84]	N = 21adults with multiple sclerosis; mean age 46.4 years; 90% female; 90% White; 10% attrition	One-group pre–post design; Participants received Website access, participated in online chat groups with other participants, and email support	PA	12 weeks; no delay between intervention and outcome measurements	SCT	Accelerometers; IPAQ, GLTEQ	Significant increase in PA at 12 weeks assessed by accelerometers and the IPAQ; No improvement in activity assessed by the GLTEQ
Faghri et al, 2008[85]	N = 206 state worksite employees; mean age NR; 81.8% female; 59% White; 44% attrition	One-group pre–post design assessing the effects of a Website and email-based pedometer walking intervention	PA (steps per day)	10 weeks; no delay between intervention and outcome measurements	TTM	Pedometers, self-report PA with an unspecified measure	No improvement in steps per day
Lieber et al, 2012[86]	N = 892; mean age NR, range from 18 to >75 years; 100% female; 85% White; attrition not applicable	One-group pre–post design assessing the American Heart Association's *Choose to Move* Program that consisted of 12 online modules and quizzes designed to promote PA	PA	12 weeks; no delay between intervention and outcome measurements	TTM	Adapted questions from Nurses' Health Study and Women's Health Study	Significant increase in PA
Woolf et al, 2006[87]	N = 271 adults, mean age NR, age range 18–60, mostly female, 51% attrition at 1 month after initial Website visit, 69% attrition at 4 months after Website visit	Two-arm nonrandomized controlled trial evaluating the *My Healthy Living* Website, a physician referral Website; Groups: (*a*) directed by physician to the *My Healthy Living* Website that consisted of a one-time assessment, individualized feedback on behavior change, and links to local and national organization Websites to promote behavior change, (*b*) no contact control	PA, diet, alcohol use, smoking	One-time Website visit; follow-up at 1 month and 4 months after initial visit	NR	Two items: (*a*) "In a typical week, how many days do you do light or moderate activities for at least 30 minutes that cause only light sweating or a slight to moderate increase in breathing or heart rate?" (*b*) "In a typical week, how many days do you do vigorous activities for at least 20 minutes that causes heavy sweating or large increases in breathing or heart rate?"	Significant increase in light/ moderate PA at 1 month for intervention group; no improvement for either group at month 4

Abbreviations: PA, physical activity; NR, not reported; SCT, Social Cognitive Theory; TTM, Transtheoretical Model; SE, Self-efficacy Theory; IPAQ, International Physical Activity Questionnaire; GLTEQ, Godin Leisure Time Exercise Questionnaire.