

Review and recommendations for online physical activity and nutrition programs targeted at over 40s

Abstract

Issues addressed: Australia's ageing population is becoming less physically active and increasingly overweight and obese. There is a need to support physical activity and healthy dietary practices to control overweight and obesity and to prevent chronic disease, amongst the middle aged and older population (40+ years). The Internet is emerging as a potentially effective method of delivering health promotion programs.

Methods: Literature relating to online physical activity and nutrition programs published from 2000-2009 were identified through a search of four databases and by examining reference lists of relevant articles.

Results: Eighteen relevant references were identified: 10 online physical activity programs; and eight online physical activity and nutrition programs. Twelve studies reported significant short term effects on behaviour change or weight loss, and four studies did not assess behaviour change, but focused on the usefulness of website strategies, attitude changes and/or recruitment methods. Seven studies experienced low retention rates.

Conclusions: Evidence to date suggests that the Internet is no more effective than print materials, face-to-face programs and other health promotion methods. Several studies found positive short term effects from using Internet based programs, including those aimed at the target group (40+ years). Therefore the use of the Internet as a method for delivering health promotion programs is worthy of future consideration.

So What? The Internet provides an opportunity for health promotion professionals to engage vastly more people in health promotion interventions, as well as providing a tool to interact and engage with them. From a population health perspective this is becoming more important as the incidence of lifestyle related diseases increase among middle to older aged people. Although online physical activity and healthy weight programs vary in degrees of effectiveness, the Internet cannot be ignored as a future medium for health promotion. More research is needed to evaluate the effectiveness of such programs.

INTRODUCTION

The prevalence of overweight and obesity in Australia has increased significantly over the last two decades with recent data indicating that nearly half of all Australian adults are overweight or obese (1). This is particularly concerning when coupled with an increasing ageing population and its accompanying levels of chronic disease (2). Older Australians are heavier than they were a generation ago, with 60% now classified as overweight or obese (3). Along with this, research has confirmed that in Australia, as age increases physical activity declines, with 50% of adults aged 45 to 59 and 46% of adults aged 60 to 75 being insufficiently active, and about one-third of older adults completely sedentary (4, 5).

Maintaining the recommended levels of physical activity (6), an appropriate diet (7), as well as maintaining a healthy weight are important public health goals to minimise the adverse physiological changes associated with ageing and are paramount to addressing chronic disease. However, there remains a need for more systematic assessment of health promotion strategies to improve health outcomes in the older population (8, 9) and recognition that older people are more likely to benefit from interventions that are tailored to their personal requirements and circumstances.

As use of the Internet escalates in Australia and throughout the world, it is increasingly recognised as a potential medium for health promotion programs to access large population groups (10). The Internet is seen as a technological step forward in promoting health enhancing behaviour, as data indicate that the majority of Australians access the Internet from home and of those who do not have access at home, 25% access it via another site (11).

Home access is reported to be dependent on a number of factors, including affordability, reliability of Internet connections and service providers, and the interest and capability of potential users of the Internet (11-13). Figures on Internet use indicate that access is linked to age, family composition, educational attainment, location and income. Indigenous people in Australia are about half as likely to have Internet access compared to the general population (11, 12).

There has been an increase in Internet usage by older Australians in the past few years, but it lags behind that of younger age groups (12, 14). Internet use is estimated at just over 70% for people aged between 15 and 45 years compared to 66%, 52%, 28% and 11% for 45-54, 55-64, 65-74 and 75 and over age groups respectively (12). The lower rates of Internet use among older adults may be related to reduced availability, a belief that it is not relevant or even due to physical disabilities such as arthritis (12).

The Internet has been promoted as a means to change health behaviour as it eliminates social barriers, it is flexible and convenient, it can provide tailored information that can be automatically processed and it facilitates interaction and social support (15-18). It also has the ability to combine other forms of media, so that written, videoed or photographic materials can be presented through the one medium. In addition, interaction can be facilitated through chat rooms, bulletin boards and email (19). However, there are limitations to utilising this medium. These include a lack of vocal cues which may affect the capacity for information to be optimally understood by all audiences, lack of regulation and control over the content by governing bodies and security issues for users (15-17, 20).

For many people, locating accurate and evidence-based information on the Internet, devoid of anecdotes and unbalanced views can be a challenge (20). The Internet holds great promise for the well educated who are already experienced in dealing with the health care system (20). However, for groups such as the elderly and those with less education and experience, it is likely that significant benefits from Internet information will only be derived if health information is designed carefully according to their needs and capabilities.

While the Internet has been around for over 20 years, its utilisation for health promotion is a recent occurrence. This review investigates online physical activity and nutrition programs aimed at adults aged over 40. It aims to identify the benefits and limitations of online health promotion programs; determine the appropriateness of online programs for this age group; and make recommendations for designing online health promotion programs for those in the target group.

METHOD

A comprehensive literature review was conducted using the electronic databases PubMed, Proquest Health, ScienceDirect and Oxford Journals. The literature search consisted of a combination of the following terms: online; Internet; electronic; computer-tailored; physical activity; exercise; nutrition; diet; adults; older adults; and seniors. The search was limited to English language journals published between 2000 and 2009. Abstracts of articles were reviewed for relevance and papers were read in full. Additional articles were sought by examining the reference lists of included articles and systematic reviews identified through the literature search. Other sources of literature such as government reports, reviews and relevant books and book chapters relating to the Internet and Internet use among the target group were also reviewed.

The focus of the research is adults aged 40 years and over. However, due to the Internet's unique ability to be accessed by broad population groups, intervention research programs specifically accessing populations aged over 40 are limited. Therefore, this review includes Internet interventions targeting populations aged over 18 that include the age group of interest, those aged 40 and over.

For inclusion in this review, the studies had to examine online computer-based interventions. Studies that contained computer based interventions that were not accessible via the Internet were excluded. Three raters reviewed the articles and established two categories based on the intervention strategies. Category a) incorporated physical activity intervention online strategies; and category b) incorporated physical activity and nutrition intervention online strategies.

RESULTS

The literature review resulted in 18 articles discussing specific online computer-based programs. The 18 studies used a range of methodologies including, randomised controlled trials (RCTs), pre- and post-test quasi-experimental designs and longitudinal studies. RCTs are recognised for their robust methodology in testing the effectiveness of interventions.

The articles are reported under two categories: a) online physical activity (PA) interventions (n=10); and b) online physical activity *and* nutrition (PA/Nut) interventions (n=8). A summary of the reviewed articles is contained in Appendix 1. The summary outlines the focus of each study; sample characteristics; theory; recruitment and engagement; and program outcomes.

Overview of the review

As stated in the methods section, the literature review focused on PA and PA/Nut programs targeting adults aged over 40. Age ranges and mean age were analysed and studies that targeted adults over 40 years were included in the review. The majority of online programs (n= 15) targeted a wide age range of adults (18+ years) (19, 23-36). Three studies specifically targeted older adults (Yardley 2007, Ferney 2009, Hageman 2005) in the age ranges of 65 to 97; 50 to 69; and 56 to 60 years respectively. Seven of the 18 studies were conducted in the general community (21-23, 27, 28, 30, 31); five in workplace settings (19, 26, 29, 32, 36); four in university settings (14, 24, 34, 35); one in a school (25); and one with church congregations (33).

Fourteen of the 18 studies reported behaviour change or weight loss outcomes. The remaining four studies reported other outcomes that included acceptability of websites, usefulness of website strategies and recruitment (14, 23, 34, 35). Twelve of the studies showed significant short term health effects from interaction with online health programs (19, 21, 24-29, 31-33, 36). Comparison groups were used in 15 of the studies, with nine of these comparing tailored websites with non-tailored or standard websites (14, 19, 21-23, 25, 26, 28, 33); and six comparing websites with offline or usual care methods (24, 27, 29-32). The major challenges for seven of the reviewed website delivering behaviour change programs was engaging and retaining participants (14, 25-28, 31, 32). In seven studies, the retention rate for the comparison group was higher than that of the intervention group (23-27, 31, 32).

Online physical activity interventions

Age ranges varied in the PA interventions, with five studies reporting general age ranges of between 18 and 59 years (35), over 18 years (23), or between 20 and 55 years (25, 26, 34)

and, three studies reporting age ranges of older adults 56 to 60 years (21), 50 to 69 years (22) and 65 to 97 years (14). Six of 10 PA online physical activity program studies consisted of participants with a mean age of over 40 (14, 21, 22, 24, 25, 27). Sample sizes varied from 30 to 7483 participants. Seven PA studies reported the education level of participants, with six studies reporting that more than 50% (21, 22, 24-26, 34) and one reporting that nearly 25% of participants had undertaken tertiary education (27).

The majority of PA studies were more successful recruiting females (n=9) (14, 21-25, 27, 34, 35), with only one recruiting more males (26). The most frequently reported challenges were recruiting or engaging participants and minimising attrition rates. Four studies reported retention rates below 75%; however as retention rates are reported for different intervention timeframes (eight-weeks to 13-months) comparisons are difficult (14, 25-27).

Participant recruitment or engagement methods included: flyers, newspaper and newsletter advertisements, letterbox drops, face-to-face contact and email contact through workplaces. One study (34) compared two different recruitment methods for their Internet program and found initial face-to-face contact was more successful for recruiting participants than the dissemination of flyers (34).

Of the 10 PA interventions included in the review, eight study designs included a comparison group. Six of the studies compared online tailored strategies with standard websites (14, 21-23, 25, 26) and one comparison group received print materials (24).

Program outcomes

Five out of the 10 online PA programs reviewed, reported positive results in behaviour change (21, 24-27). One reported significant increases in physical activity compared with a non-tailored website (21); and two reported no significant differences between tailored and non-tailored websites (26, 27). Marshall and colleagues (24) compared a physical activity website with print materials. They found that overall recall and use of the print materials, in the form of booklets and letters, was higher than recall and use of the website and emails, even though participants reportedly favoured receiving health information via electronic rather than print media. Another study by Yardley and Nyman (14) used the Internet for a falls prevention intervention, reporting that some users benefited from strength and balance training online advice. However, they acknowledged that a limitation of Internet -based programs for older adults was that many were not experienced Internet users (14). Buis et al. (35) found that overweight or obese participants involved in such programs were less likely to reach their physical activity goals than those of normal weight.

Ferney and colleagues (21) tested the effectiveness of a neighbourhood environment-focused online physical activity intervention, which was developed for residents of a specific neighbourhood and contained information relating specifically to their surrounding environment. The researchers found this method to be successful in increasing total physical activity and neighbourhood walking, and positive comments were reported about the program in post-intervention focus groups.

Online physical activity and nutrition promotion interventions

The majority of physical activity and nutrition (PA/Nut) website interventions (n=6) consisted of participants with a mean age over 40 years. Study sample sizes ranged from 73

to 1071 participants. Three studies reported the education level of participants, with one reporting that over 70% of participants (32) and two reporting that over 90% of participants had undertaken tertiary education (19, 29). Age ranges varied, with six studies reporting general age ranges of between 18 and 65 years (31); 18 and 60 years (19); 22 and 66 years (29); 25 and 70 years (28); 26 and 77 years (30); and, 35 and 50 years (32) respectively.

Reported retention rates for the PA/Nut interventions ranged from 59% to 87%, with less than a 75% retention rate reported in three studies (28, 31, 32). Comparisons across studies are difficult due to the varying time frames of the interventions (12-weeks to 18-months). Recruitment methods included newspaper advertisements, introductory letters and emails, posters, leaflets and flyers.

Of the eight PA/Nut interventions, seven study designs included a comparison group. Three studies compared online tailored strategies with online non-tailored/standard strategies (19, 28, 33). Four studies compared Internet programs with offline or usual care control groups (29-32).

Program outcomes

The online PA/Nut program studies showed mixed results, with seven studies reporting positive outcomes (19, 28, 29, 31-33, 36), and one having no significant results (30). Three studies demonstrated significant weight loss results (19, 31, 36) and four reported significant changes in physical activity and/or dietary behaviour (28, 29, 32, 33).

Booth and colleagues (28) concluded that a physical activity only online intervention was more successful in terms of weight loss than a combined physical activity and nutrition online

intervention. The inclusion of pedometers in this study appeared to be an effective means of motivating participants to be active, however, external factors that could have contributed to outcomes were not ruled out. Tate, Wing and Winett (19) demonstrated that a structured Internet behaviour therapy program consisting of tailored advice and self-monitoring diaries was more successful in reducing participants' weight and waist circumference than a standard Internet program. Sternfeld and colleagues' (32) intervention focused on increasing knowledge and skills; goal setting; self monitoring; consistent reminders; anticipating barriers; and rewarding accomplishments for achieving behaviour change and resulted in significant improvements in both diet and physical activity. Ware et al. (36) conducted a PA/Nut workplace web-based program that included monitoring devices to capture and send data to an automated web-based coaching program. The monitoring devices were costly but the program reported high levels of engagement and retention and resulted in significant participant weight loss. Harvey-Berino et al. (30) compared a web-based strategy to a face-to-face weight loss intervention and found the latter to be a more successful method for weight reduction.

DISCUSSION

Sample characteristics

The use of the Internet for health promotion programs is in its infancy and research exploring the effectiveness of online physical activity and nutrition programs specifically for those in the over 40-year age-group is very limited. Many of the programs included in the review were broad in regard to the age of their target group. This may reflect the recognised opportunities to reach broad audiences via the Internet, or highlight the need for more development of online health interventions that target specific age groups.

Twelve studies reported that participants' mean age was over 40 years and nine studies reported high education levels attained by participants. The high education levels may be indicative of more educated people accessing the Internet . However, four of the studies were conducted in university settings which may have influenced the high education levels that were reported.

Theory

Fourteen of the 18 studies reported basing their intervention on a theory. The most frequently used theory was the Trans-Theoretical Model (TTM), which was used alone, as well as in conjunction with other theories that included the Theory of Planned Behaviour and the Social Cognitive Theory (SCT). The TTM and SCT have been used in a variety of health programs such as sedentary lifestyle and dietary programs (38). TTM provides a useful framework due to its temporal dimension as behaviour change is not a finite event (39), making it a relevant model for online health interventions. However, four of the reviewed online health interventions were developed and implemented without reference to any theory. This is a limitation of these programs as there is substantial evidence to suggest that theory significantly assists the planning and delivery of program and in turn the program's success (40). Health promotion theory provides a framework for identifying factors that influence peoples' health behaviour choices and methods for achieving change, rather than simply basing intervention designs on tradition or intuition (39).

Recruitment and engagement

Engagement and retention of participants in online programs was revealed to be one of the most prominent challenges in the reviewed interventions. This limitation may be linked to the considerable choice that consumers have when accessing the Internet. Rather than

committing to a long-term demanding program, they may prefer to look for ‘quick-fixes’ on alternative websites. Alternatively, it may be a result of the online interventions targeting broad age ranges. This highlights the importance of designing an accessible, engaging and appropriate website and emphasises the need for formative research with the target group in the development stage of an online intervention (42). Interestingly, there did not appear to be any relationship between low retention rates and the settings from where participants were recruited, which may indicate the broad general appeal of the Internet for different population groups.

Program outcomes

Most of the reported intervention program outcomes were based solely on self-report without the confirmation of objective measures. The use of objective measures in addition to self-report when analysing Internet programs would provide additional evidence and add weight to the reported results (9). However, the additional subject burden and the impact of this burden on attrition rates needs to be considered when incorporating objective measures (50). Self report has been shown to produce adequately reliable results (51, 52).

This review identified a range of results in terms of behaviour change outcomes, with several studies providing evidence that web-based programs are an appropriate method for targeting populations with physical activity and nutrition intervention programs (21, 22, 25, 28, 32, 34, 36, 47, 53, 54). Neville, O’Hara and Milat (55) in their review of computer-tailored physical activity and computer-tailored dietary behaviour change interventions also concluded that the evidence for computer tailored health behaviour change programs is strong. However, they questioned whether behaviour change can be sustained and the generalisability of the reported results. It is suggested that a reasonable and hopefully achievable goal for online

programs is to produce small but ongoing positive improvement in a populations' health behaviour (33). There appears to be considerable scope to improve the quality of these programs that might lead to sustainable behaviour changes. Ongoing research along with rigorous evaluations should contribute to advancing such programs.

Although it is often stated that a benefit of online programs is their cost-effectiveness, there is a lack of evidence supporting this position (14, 56-58). Only one study included in this review investigated the cost-effectiveness of Internet interventions, and concluded that due to limited data relating to costs, the assumption that these programs are cost-effective could not be confirmed (56). It has been suggested that the cost effectiveness and economic sustainability of an Internet -based intervention is dependent on the effective planning (57) and it is recommended that program planners consider costs associated with running web programs in relation to their impact (15).

(Ebell 2006, quoted in Patton 2007)

Intervention components

Face-to-face communication in health promotion interventions has resulted in successful behaviour change in past programs (Ashenden, Silagy & Weller 1997 and Eakin, Glasgow & Riley 2000 cited in 41; DPP Research Group 2002 cited in 47). Online methods for health promotion interventions therefore mimic this method through tailoring, and by providing automated responses specific to the participants needs based on completed assessments (41). Even though introducing health promotion programs to the Internet may seem straightforward, studies have found this transition to be quite complex and more involved than previously predicted (42, 43). A basic informative website does not seem to be as effective as one that uses a number of interactive tools and engagement strategies outside of the Internet. Therefore, website development for health promotion needs to involve time and

commitment in the planning and development stage. The effectiveness and viability of Internet interventions appear to be influenced by the quality, duration, exposure, intensity, method of tailoring, source credibility of the program and the appropriate use of theory (44).

The reviewed literature supports consultation with potential target groups in the developmental stages of website production and constant monitoring and surveying of users to inform website adaptations to combat attrition rates (34, 37). Some studies have suggested that the role of the Internet in health promotion may be to deliver short, positive health messages as opposed to ‘therapy’ (45), or that an intervention which combines both face-to-face and online elements is preferable (46). Based on research conducted by Ferney and Marshall (16) four key themes are recommended for the development of online health promotion programs. Firstly, the website needs to be designed so that it is easy to use. Secondly, there needs to be interactive features such as online forums, contact with professionals, behaviour monitoring and goal setting. Thirdly, there should be consideration of the environmental context, with the inclusion of features relevant to the participant’s environment such as a calendar of events, maps and locations for different activities. Finally, the online content such as audio or video components, recipes and regular newsletters need to be relevant to the target group.

Internet access, Internet use and health literacy need to be considered as certain target populations may not benefit from an online program due to poor access and/or low literacy skills. Low socioeconomic status (SES) groups are less likely to have access to online health programs (12, 13), yet these are at risk groups that are a priority for engagement. Overweight and obesity is high among lower SES groups, those who have not progressed their education beyond high school, and those who live in regional and remote areas (10). Considering this,

there is a challenge to improve the accessibility of relevant Internet -based programs for these population groups that are most at risk of poor health outcomes. Nevertheless, there are encouraging indications that the biggest increase in access to the Internet is with at-risk groups, including baby boomers and older adults (12).

Although Internet access and Internet use could be considered problematic for engaging and retaining participants, the most common cited reasons for not using websites is lack of interest, low motivation levels and lack of readiness to participate (41, 47), signifying that technology is not the only barrier to individuals accessing such programs. Taha et al. (48) explored Internet use among older adults and found that users were equally satisfied with both on- and offline information. The study concluded that more strategies to teach effective Internet searching skills are needed for this age group.

Recommendations for online programs

Based on this review, the following recommendations are made for future online physical activity and nutrition programs for the ‘over 40s’.

Target population

1. Consult with the target group during the planning and designing stages of Internet interventions.

Theory

2. Use theory to inform the planning and delivery of interventions in order to better engage individuals, groups and communities.

Engagement and retention

3. To increase engagement of participants in website interventions: a) provide some form of face-to-face introduction such as personal development or training programs to

develop Internet skills; b) combine face-to-face interventions with online interventions; and c) combine telephone interventions with online interventions.

4. Regularly review and evaluate online interventions, in consultation with users, to adjust website tools and strategies, and to help to engage and retain users.

Intervention components

5. Include interactive elements such as goal-setting, logging and personalised tailoring so that the online program allows interaction between peers and is focused on the specific needs of participants.

6. Consider communities and their environments so as to make the program content relevant to particular neighbourhoods by including strategies such as a calendar of events and maps identifying surrounding locations for different activities.

7. Consider the use of pedometers as part of the online program as their use has been shown to increase motivation for physical activity.

Program Outcomes

8. Statistical monitoring of programs can be used to determine: the number of visitors, log-ins and registrants; goals and targets set by the participants and whether they are reached; the most frequently used web pages; and from where users have been directed to the website.

9. For research and evaluation purposes, collect objective data if feasible, as well as self-report data and consider following-up on long term outcomes.

Limitations of research

A limitation of three of the reviewed online interventions was the absence of a comparison group. These studies were included as they had sound community based evaluations providing useful practical information. RCT's are not always appropriate for evaluating multi-

dimensional community interventions, and there is growing acknowledgement of the importance of more practical evaluation methods for community application (McQueen 2001). In addition, the dearth of information specifically targeting the over 40 age group was also limiting. This limitation highlights the need for more evaluation research of online programs that target specific age groups, rather than a 'one size fits all' approach.

CONCLUSIONS

The use of the Internet is rapidly increasing in older age groups and therefore is likely to provide health promotion professionals with increased opportunities to access and engage this target group. The evidence collected in this review suggests that Internet programs targeting over 40s and general populations can result in short term positive health behaviour changes. However, more evidence is needed to determine the long-term effects of such programs, especially with the specific sub-populations such as the over 40s. Online health interventions with this group hold significant promise as a means of effectively engaging, and retaining them and achieving health behaviour change. The Internet is a medium that needs to be explored further so that it can be exploited to its full potential.

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Appendix 1

Reviewed studies

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
Online physical activity interventions						
<p>Buis et al. (2009) (35) Health issue: physical inactivity during winter months. To evaluate the Active U program using the Re-Aim framework.</p>	<p>Staff & graduate students at the University of Michigan</p> <p>Sample: n=7483</p> <p>Age range = 18 – 59 (96%)</p> <p>Males (41%) and females (59%)</p>	<p>Goal Setting Theory</p> <p>Theory of Self Regulation</p>	<p>Physical activity log</p> <p>Goal setting</p> <p>Motivational emails</p> <p>Team participation and competition</p> <p>Non-tailored information</p> <p>Weekly email</p> <p>Incentives</p>	<p>No comparison group</p>	<p>Recruited from the university community via intensive advertising (mailed flyers, campus press coverage, website banners, posters, ads on buses, screensavers)</p> <p>5885/7483 = 79% participated in program</p> <p>31% entered data for whole program; 80% used activity log at least once.</p> <p>8-week intervention</p>	<p>Staff members, older participants and those with a BMI <25 were more likely to reach physical activity goals.</p> <p>Average rate of meeting goals was higher among those joining a competitive team.</p> <p>Internet -mediated PA interventions that focus on PA logging and goal setting while incorporating team competition may help a significant percentage of the target population maintain their physical activity during the winter months.</p>
<p>Ferney et al (2009) (21) Health issue: physical inactivity A RCT to examine the efficacy of a neighbourhood environment focused PA website</p>	<p>General community, Brisbane, Australia</p> <p>Sample: n=106 (intervention n=49; control n=48)</p> <p>Age range – 56-60</p>	<p>Social Cognitive Theory</p> <p>Trans-theoretical Model</p>	<p>Local neighbourhood environment website intervention</p> <p>Motivational emails</p> <p>Goal-setting and self-monitoring tools</p> <p>Calendar of events</p> <p>Maps</p>	<p>Randomly assigned to comparison group</p> <p>Received emails & access to non-interactive website</p>	<p>Recruited via advertisements in community newspaper & letterbox drop</p> <p>Retention rate 93/106 = 87.7%</p>	<p>Statistically significant increases in walking and total physical activity.</p> <p>Findings suggest that a neighbourhood environment-focused website is more engaging than a motivational-information website for promoting physical activity.</p>

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
in terms of its use, acceptability and ability to encourage residents to be more physically active, relative to motivation website	Males (23%) and females (77%) 75% highly educated*		Bulletin board and news items Regular emails		86% intervention 80% comparison group 26-week intervention	
Hageman, Noble-Walker and Pullen (2005) (22) Health issue: physical inactivity Pre-post test quasi-experimental design to examine the feasibility & effectiveness of the internet to deliver behaviour change interventions	General community, Nebraska, USA Sample: n=30 (tailored intervention n=15; standard intervention n=15) Age range = 50-69 Females only 52% highly educated*	No theory stated	Delivery of 3 tailored and standard newsletter distribution via the Internet , based on responses	Randomly assigned to standard group or tailored group	Recruited via newspaper advertisements. 30/31 = 97% retention rate 3-month intervention	50% of participants reported the online newsletters as being helpful. Both groups improved in flexibility. No increase in self-reported physical activity time. Further research needed into standardised and tailored advice over a longer period.
Lewis et al. (2008) (23) Health issue: physical inactivity. RCT to examine differences in use patterns and perceived website usefulness between tailored and standard internet arms and examine if use patterns and perceived usefulness of the	Community based Rhode Island, and Pittsburgh, USA Sample: n=249 (tailored internet n=81; standard internet n=82; print n=86-not reported) Age range = 18+ Males (17%) and females (83%) 76% Caucasian	Trans-theoretical Model Social Cognitive Theory Re-Aim framework	Tailored advice Goal setting Physical activity log Interactive elements Weekly email Incentives	Non-tailored comparison group	Recruited primarily through newspaper advertisements Retention rate 223/249 = 89% Retention rate tailored = 89% and standard = 91% 12-month intervention	Tailored arm was more popular than standard (median of 50 times for Tailored Internet and 38 times for Standard Internet). Individuals in the Tailored arm reported website to be more useful than Standard Internet . Participants favoured physical activity logging, goal setting and tailored feedback. The higher the number of log ins from either groups, the greater the increase in physical activity.

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
intervention websites predicted physical activity behaviour change.						
Marshall et al. (2003) (24) Health issue: physical inactivity. RCT to assess effectiveness of a physical activity program delivered via an interactive stage-targeted website and email to those of print intervention plus print letters.	Staff from an Australian university. Sample: n=655 (intervention n=327; control n=328) Mean age = 43 years Males (49%) and females (51%) 70% highly educated*	Trans-theoretical Model	Physical activity readiness Interactive and animated features Quizzes with feedback Goal setting Activity planning Questionnaire Regular emails	Randomly assigned to comparison group (provided with print material)	Recruited university academic general staff via email Retention rate 512/655 = 78% Retention rate for print 80% and web 76% 10-week intervention	No significant increase in total reported physical activity. Significant decrease in average time spent sitting on a weekday. The 'print materials' group demonstrated slightly larger effects and a higher level of recognition of program materials.
Spittaels and De Bourdeaudhuij (2006) (34) Health issue; physical inactivity To test the effectiveness of a physical activity website and to assess if personal contact could enhance number of visits to a tailored physical activity website.	Visitors to a university hospital, Belgium. Sample: n=52 (personally approached n=41; flyer group n=6) Age range = 20-55 years Mean age = 38 years Males (49%) and females (51%) 60% highly educated*	Theory of Planned Behaviour Trans-theoretical Model	Pre-intervention face-to-face contact Goal setting Weekly planner P/A program Interactive tailored program Tailored advice	Comparison group for recruitment (flyer only, no face-to-face contact)	Recruited from visitors to university hospital personally and via flyers. Retention rate 47/52 = 90% 8-week intervention	More participants registered who had initial face-to-face contact (46 of 100). Most of the volunteers (n = 32/43 or 74%) found the tailored advice stimulating. Only 10 participants (23%) made behavioural changes immediately, another 10 indicated they intended to make some changes.
Spittaels, De Bourdeaudhuij	Parents & staff at 14 schools in 3 regions of	Theory of Planned Behaviour	Tailored advice Goal setting	Non-tailored Internet program	Recruited by distributing	Significant increases in active transport and leisure-time physical

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
and Vandelanotte (2007) (25) Health issue: physical inactivity Examine if a website-delivered physical activity intervention, that provides participants with computer-tailored feedback, can improve physical activity in the general population.	Belgium. Sample: n=434 (Intervention 1 n=173; Intervention 2 n=132) Age range = 20-55 years Mean age = 41.4 years Males (34%) and females (66%) 67% highly educated*	Trans-theoretical Model	Weekly plan Strength and flexibility exercises Start-to-run program Online forum	comparison program (access to program post intervention)	brochures to parents Retention rate 286/434 = 66% Retention rate intervention 60% and control 79% 6-month intervention	activity. Significant decrease in minutes sitting on week days. More research required on optimal intervening intensity.
Spittaels et al. (2007) (26) Health issue: physical inactivity Evaluate the effectiveness of a computer-tailored physical activity intervention delivered through the Internet.	Employees at 6 worksites in northern Belgium (4 commercial & 2 local government) Sample: n=526 (grp 1 n=174 computer tailored; grp 2 n=175 tailored without emails; grp 3 n=177 standard advice) Age range = 25-55 years Mean age = 39.5 years Males (69%) and females (31%) 62% highly educated	Theory of Planned Behaviour Trans-theoretical Model	Three groups Grp 1 tailored advice = email Grp 2 tailored advice Grp 3 standard advice Tailored advice Personal "Action Plan" Regular stage based emails Incentives	Randomised non tailored comparison group	Recruited by email messages, posters and internal newsletters in six worksites in the northern part of Belgium. Retention rate: grp 1 66%; grp 2 69%; grp 3 79% 6-month intervention	Significant increase in physical activity at 6-month follow up in all groups. Moderate physical activity for all groups. Minutes sitting on both weekdays and weekend significantly decreased for all groups. No significant differences between tailored, emailed, and non-tailored groups in terms of behaviour change. No evidence that online P/A tailoring outperformed standard advice.
Wanner et al. (2009) (27) Health issue:	General community Switzerland	Trans-theoretical Model	Tailored advice Reminder emails Organisational and	Randomised into comparison group + spontaneous	Recruited by advertisements in newspapers, magazines, and on	Used by mostly women. Significant increases in physical activity from self reports, but not significant from objective measures of

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
<p>physical inactivity</p> <p>A RCT to assess an active online tailored website (targeting 30 to 60 year olds) to a non-tailored website to increase physical activity levels. Do respondents recruited to study differ from spontaneous users of Active-online, and how does effectiveness differ between these groups?</p>	<p>Sample: n=1531 (intervention group n+681; control group n=688 + spontaneous group) (133 individuals had accelerometer data at baseline).</p> <p>Mean age = 43.7 years Males (25.1%) and females (74.9%) 24.9% highly educated</p>		<p>motivational material</p>	<p>users group</p>	<p>the Internet</p> <p>Response rate 688/1369 = 50% Retention rate intervention 42.4% and control 58% 13-month intervention</p>	<p>accelerometers.</p> <p>Significant increases in self-reported physical activity levels between baseline at 3 months in all participants, but there were no significant differences between the randomized groups.</p> <p>Active-online was not more effective than a non-tailored website in increasing physical activity levels in volunteers from the general population.</p>
<p>Yardley and Nyman (2007) (14)</p> <p>Health issue: strength and balance training to prevent falls</p> <p>RCT to evaluate an interactive web-based program that tailored advice about strength & balance training(SBT)</p>	<p>Academic/general staff at a UK university</p> <p>Sample = (n= 280: intervention :n=144; control n=136)</p> <p>Age range = 65-97 Males (34%) and females (66%)</p>	<p>No theory stated</p>	<p>Tailored advice</p>	<p>Randomly assigned to control group (non tailored generic intervention)</p>	<p>Recruited by advertising the website by email & internet</p> <p>Retention rate 426/280=65.7% Retention rate for intervention 35% and control 34%</p>	<p>Tailored group had significantly more positive attitudes to SBT activities than control group. Indicating greater confidence in the ability to carry them out, and hence stronger intentions to undertake the activities.</p> <p>Intentions to undertake strength and balance training activities was stronger as a result of the program</p> <p>Some initial evidence that interactive websites might provide a cost-effective medium for promoting positive attitudes towards SBT.</p> <p>However, further research required to establish whether website based advice can be used to promote an increase in performance of SBT activities.</p>

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
Online physical activity and nutrition promotion intervention						
Booth, Nowson and Matters (2008) (28) Health issue: healthy weight using physical and nutrition A RCT to assess whether two online programs including dietary advice plus exercise (ED) was more effective in reducing weight than an exercise-only program (EX)	General community Melbourne, Australia Sample: n=73 (EX n=26; ED n= 27) Age range 25 to 70 Males (21%) and females (79%) 81% Anglo-Australian	Goal Setting Theory Trans-theoretical Model	Goal setting Feedback Pedometer use Tailored advice	Randomised into physical activity only (EX) and nutrition and physical activity (ED)	Recruited through newspaper advertisements & community centres Retention rate 53/73 = 73% 12- week intervention.	Significant weight loss for EX group, but not ED group. Significant decrease in waist circumference for both groups. Dietary improvements in ED group. Overall there was significant increases in steps for both groups
Cook et al. (2007) (29) Health issue: physical inactivity, nutrition and mental health RCT to evaluate the effectiveness of a Web-based multimedia health promotion program for the workplace, designed to improve dietary practices, reduce stress, and increase physical activity.	Employees in three offices of human resources company Sample: n= 480 Workplace setting Age range=22-66 Male (27%) and females (73%) 95% highly educated*	Social Cognitive Theory Trans-theoretical Model	Multimedia Interactive elements Incentives	Randomly assigned to a comparison group (print based)	Recruited from three worksites via emails from managers Retention rate 419/480 = 86% Retention rate web 85% and print 87% 3- month intervention	Both groups showed significant improvements in reported dietary behaviours. Some significant changes in physical activity and stress. In comparison to print materials, website performed significantly better in dietary attitudes towards a healthful diet, but no significant difference with regard to physical activity and stress.

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
Harvey-Berino et al. 2002 (30) Health issue: healthy weight using physical activity and nutrition Longitudinal study to investigate the effectiveness of a weight maintenance program conducted over the internet	Overweight adults general community USA Sample : n= 122 Age range = 26 -77 Males (15%) and females (85%)	No theory stated	Chat room Self-monitoring of PA and diet Technical orientation Discussion group Bi weekly Therapist led emails Therapist video sessions Bulletin board Regular emails incentives	Randomly assigned to comparison group(Face-to-face)	Recruited through newspaper ads Retention rate 82% (6 mths) 76% (18 mths) 18- month intervention	No significant results for weight loss. In comparison to face-to-face groups, the Internet was not as effective. The results of this study suggest that Internet support does not appear to be as effective as minimal or frequent Intensive in-person therapist support for facilitating the long-term maintenance of weight loss.
McConnon et al. (2007) (31) Health issue: healthy weight using physical activity and nutrition. A RCT to determine the effectiveness and cost-effectiveness of an Internet - based resource for obesity management compared to usual care.	Obese people from general community Sample: n =221 (Intervention n=111; comparison group n=110) Age range 18-65 Mean age = 45.58 Males (24%) and females (77%) 95% Caucasian	No theory stated	Tailored advice on physical activity and nutrition Goal setting Motivational Progress reports Regular emails	“Usual Care” comparison group (print material+ face-to-face)	Recruited from GP practices via posters and flyers in Leeds Retention rate 152/221= 69% (6 months) 131/221 = 59% (12 months) Intervention 49% Usual care 70% 12- month intervention	Significant weight loss resulted, although not a large amount. In comparison to “usual care”, the Internet program showed no significant benefit. A significant reduction in self-rated physical activity score over the intervention period was identified with a mean reduction of 0.34 in the sample, the difference in change between the two groups over the 12 months was not significant
Sternfeld et al. (2009) (32) Health issue:	Employees at North Carolina worksite Sample: n= 351	Trans-theoretical Model	Email based Tailored advice specific to physical activity or nutrition Goal setting	Randomised Comparison group	Employees invited to participate via email	Significant increases in moderate, vigorous physical activity and walking. significant increases in the consumption of fruits and

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
physical inactivity and nutrition An RCT to determine if ALIVE program increased consumption of fruits and vegetables and physical activity and decreases in the consumption of saturated fats, trans fats, and added sugars	(Intervention n=787; control n=436) Age range 35-50 Mean age = 44.2 yrs Females (74%) males (26%) 72% highly educated*		Self-monitoring Anticipating barriers Consistent reminders Rewarding behaviour Tracking and stimulation tools		Retention rated 787/549 = 66% Retention rate intervention 66% and control 73% 16- week intervention	vegetables; and significant decreases in sedentary behaviour and in the consumption of saturated and trans fats relative to the control group. Decreases in the consumption of added sugars approached significance.
Tate, Wing and Winett (2001) (19) Health issue: healthy weight with physical activity and nutrition RCT to test the feasibility and initial efficacy of a structured Internet behavioural weight loss program compared with an educational Web site that was representative of weight loss resources widely available on the Internet .	Hospital employees Sample: n=91(education n=45; behavioural n=46) Age range 18 -60 Mean age = 40.6 Males (11%) and females (89%) 91% highly educated* 83% Caucasian	No theory stated	Self-monitoring diaries Regular emails Tailored advice Bulletin board Incentives Instruction on site use Information on diet, exercise, self monitoring, managing stress.	Randomly assigned to Internet education comparison group	Hospital workers recruited via email and intranet website Retention rate 3mths 76/91 85% (3 months) Retention rate at 6 - month 71/91 78% 6-month intervention	Behaviour therapy group lost more weight than the education group. The behaviour therapy group lost a mean (SD) of 4.0 (2.8) kg by 3 months and 4.1 (4.5) kg by 6 months. Weight loss in the education group was 1.7 (2.7) kg at 3 months and 1.6 (3.3) kg by 6 months. Changes in waist circumference were also significantly greater in the behaviour therapy group than in the education group at both 3 months and 6 months Log in frequency decreased over time.

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
<p>Ware et al. (2008) (36)</p> <p>Health issue: healthy weight with physical activity and nutrition</p> <p>Longitudinal observational study to assess the level of program engagement of a wide range of employees</p>	<p>Worksites north-west and south England</p> <p>Sample: n=265</p> <p>Mean age = 40.9 years</p> <p>Males (49%) and females (51%)</p> <p>92% Caucasian</p>	<p>Social Cognitive Theory</p> <p>Social Comparison Theory</p> <p>Decisional Balance Theory</p>	<p>Orientation to website</p> <p>Goal setting</p> <p>Email and mobile phone prompts</p> <p>Overcoming barriers</p> <p>Monitoring device</p>	<p>No comparison group</p>	<p>Recruited using leaflets from four worksites</p> <p>Retention rate 173/265 = 78%</p> <p>12-week intervention</p>	<p>Significant weight reduction for those using weight loss mode</p> <p>Mean PA level recorded throughout the program was 173 minutes (SE 12.8) of moderate/high intensity PA per week. Website interaction time was higher and attrition rates were lower (OR 1.38, $P = .03$) in those individuals with the greatest weight loss.</p>
<p>Winett et al. (2007) (33)</p> <p>Health issue: physical activity and nutrition</p> <p>RCT (group randomised design) to assess the impacts of corollary setting-based supports on shorter and longer term change to improve the nutrition and physical activity of adults and, secondarily, to prevent weight gain. Groups were randomly assigned to one of three study conditions.</p>	<p>Churches in the south Atlantic region of USA</p> <p>Sample: n=1071 (GTH-plus n=364; GTH-only n=364; control n=343)</p> <p>Median age = 53 years</p> <p>Males (33%) and females (67%)</p> <p>23% African American</p> <p>57% overweight or obese</p>	<p>Social Cognitive Theory</p>	<p>Tailored advice</p> <p>Self regulation strategies</p> <p>Goal setting</p> <p>Fast food planner</p> <p>On-screen visual and audio feedback</p> <p>Selection of behaviour change strategies</p> <p>Step counts</p> <p>Incentives</p> <p>GTH-Plus group: Prompts and reminders from the pulpit and in church bulletins; recognition in posters, church bulletins and newsletters</p>	<p>An internet program with a series of church-based supports (GTH-Plus) was compared to GTH alone (GTH-Only) and to a waitlist control condition.</p>	<p>23 churches were contacted to participate in the trial through an introductory letter and phone call to the minister; 21 churches agreed to meetings of the research staff. 14 churches (with between 60-340 members) agreed to participate.</p> <p>Retention rate 935/1071 = 87%</p> <p>Retention rate GTH-plus 90%</p> <p>GTH-only 85%</p> <p>Control 85%</p>	<p>Participants in GTH-Plus churches had higher log-in and module completion rates than participants in GTH-Only. Participants in GTH-Plus and GTH-Only churches showed significant changes in nutrition at post-test and follow-up compared to participants in control churches.</p> <p>GTH-Plus did not show significantly greater nutrition changes than GTH-Only participants at follow-up; both treatments showed positive outcomes. Changes in physical activity and weight among GTH-Only participants largely paralleled those of GTH-Plus participants but with smaller magnitude.</p> <p>The results suggest supports in a socially mediated intervention play an important role in behaviour change.</p>

Authors/study	Sample characteristics	Theory	Strategies	Comparison group	Recruit/engage	Program outcomes
					12-week intervention	

*Participants are reported to have undertaken tertiary (college or university) education