Can a Website-Delivered Computer-Tailored Physical Activity Intervention Be Acceptable, Usable, and Effective for Older People?

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Abstract

Despite the numerous health benefits, population physical activity levels are low and declining with age. A continued increase of Internet access allows for website-delivered interventions to be implemented across age-groups, though older people have typically not been considered for this type of intervention. Therefore, the purpose of this study was to evaluate a website-delivered computer-tailored physical activity intervention, with a specific focus on differences in tailored advice acceptability, website usability, and physical activity change between three age-groups. To mimic "real-life" conditions, the intervention, which provided personalized physical activity feedback delivered via the Internet, was implemented and evaluated without any personal contact for the entire duration of the study. Data were collected online at baseline, 1-week, and 1-month follow-up and analyzed for three age-groups (≤44, 45-59, and ≥60 years) using linear mixed models. Overall, 803 adults received the intervention and 288 completed all measures. The oldest age-group increased physical activity more than the other two groups, spent the most time on the website, though had significantly lower perceived Internet self-confidence scores when compared with the youngest age-group. No differences were found in terms of website usability and tailored advice acceptability. These results suggest that website-delivered physical activity interventions can be suitable and effective for older aged adults.

Keywords

acceptability, computer-tailoring, old age, physical activity, usability, website-delivered

Regular physical activity reduces the risk of chronic diseases such as different types of cancer, diabetes, cardiovascular disease, and osteoporosis (Warburton, Nicol, & Bredin, 2006). To meet the Australian physical activity recommendations, adults should be physically active for at least 30 minutes on at least 5 days a week with moderate intensity (Department of Health and Ageing, 1999). For healthy people older than 65 years, the importance of additional strength training is emphasized to enhance long-term functional capacity (Nelson et al., 2007). Yet in Australia more than half of the population is insufficiently physically active and the incidence of inactivity increases with age (Bauman, Ford, & Armstrong, 2001; Vandelanotte, Duncan, Caperchione, Hanley, & Mummery, 2010). Thus, given this and the fact that populations are ageing in Western countries (U.S. Department of State, 2007), there is a growing need for interventions that can effectively increase physical activity in large and older populations at low cost.

Research showed that physical activity interventions for older age-groups can be effective (Jancey et al., 2008; King, 2001; Wilcox et al., 2008) and indicated that programs for elderly people should be simple and convenient to engage in, moderate in intensity, undertaken outside formal class or group setting, and be relatively inexpensive (King, 2001). Elderly people have a wide range of barriers to attend supervised center-based physical activity programs, such as lack of transportation facilities, financial considerations, lack of affiliation to the fitness center culture, or social embarrassment (Schutzer & Graves, 2004). As such, computer-tailored interventions delivered through the Internet might be well suited for this age-group. Computer-tailored interventions

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provide participants with personally relevant feedback about their physical activity levels and offer tips and suggestions on how they can become more active (Kreuter, Farrell, Olevitch, & Brennan, 2000; Vandelanotte & De Bourdeaudhuij, 2003). When delivered via the Internet, these interventions provide the benefits of being accessible at any time, in the privacy of their own home, and at low cost (Riper et al., 2008). Several studies and reviews demonstrated the effectiveness of computer-tailored interventions, also among adults older than 60 years (de Vries, Kremers, Smeets, Brug, & Eijmael, 2008; Dijkstra, 2005; Hageman, Walker, & Pullen, 2005; Kroeze, Werkman, & Brug, 2006; Spittaels, De Bourdeaudhuij, & Vandelanotte, 2007; Walker et al., 2009). For example, a study highlighted that tailored online newsletters were an effective tool for reaching and increasing physical activity among elderly (Walker et al., 2009).

However, there are concerns for implementing website-delivered interventions in older age-groups, and it is not clear to what extent the Internet is a suitable mode to deliver tailored health messages targeted at elderly people. Though Internet usage is generally high in Western societies (in Australia, 72% of households had Internet access in 2009), it is a lot lower in high age-groups (Australian Bureau of Statistics, 2009). Furthermore, research showed that young people are more technically adept and familiar with the use of the Internet and seem to better accept website-delivered interventions when compared with older people (Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004). To be suitable for elderly people, websites need to be designed accordingly, for example, it is necessary that the type faces are readable and that navigation elements are not too closely spaced, since this target group has more cognitive limitations (Kaufman et al., 2006; Pak, Price, & Thatcher, 2009). Moreover, reasons for using the Internet differ according to age-groups. Whereas younger people use the Internet predominantly for entertaining reasons, older generations are more likely to use the Internet as a utilitarian tool, such as seeking for health information (Jones & Fox, 2009). Additionally, older people are more concerned about their health when compared with younger people (Zunft et al., 1997).

Hence, one might assume that older people are more interested in receiving health behavioral change interventions via the Internet when compared with younger people, despite lower access rates and technical abilities to use the Internet. However, according to our knowledge no previous studies examined how suitable and effective website-delivered interventions are comparing older with younger age-groups. Intervention effectiveness in web-based approaches can often be better understood in relation to data on website usability and acceptability (De Cocker, Spittaels, Cardon, De Bourdeaudhuij, & Vandelanotte, 2012; Vandelanotte & De Bourdeaudhuij, 2003). The purpose of the present study was to evaluate a brief website-delivered computer-tailored physical activity intervention in terms of website usability, tailored advice acceptability, and physical activity behavioral change according to three age-groups.

Method

Participants and Procedure

In January and February 2011, 3,233 male and female adults older than 18 years were invited by e-mail to participate in the study. Participants were members of the Australian Health and Social Science (AHSS) panel, a random sample of the general Australian population (Hanley & Mummery, 2009). The AHSS panel members were recruited using the computer-assisted telephone interviewing method. Random phone numbers, available in the electronic white pages, were dialed by the Population Research Laboratory at Central Queensland University. Each panel member agreed to be contacted for participation in web-based surveys and each member had the right to withdraw their participation from the panel at any time by e-mailing the Population Research Laboratory. The AHSS panel members complete regular online surveys on various issues related to physical and mental well-being, and health outcomes. To be eligible for this study, participants had to have Internet access and no medical constraints that prevent an increase in physical activity. The invitation e-mails contained a hyperlink to a website with information about the nature and purpose of the present study and access to the baseline survey. By accessing the baseline survey, participants provided consent to participate and agreed on that they were well informed about the study. The Physical Activity Readiness Questionnaire was applied to identify for participants for whom it was not safe to increase physical activity (Cardinal, Esters, & Cardinal, 1996). The study included three online data collection points: at baseline, at 1 week, and at 1 month follow-up. Nonresponders were reminded three times by e-mail to complete each assessment. The whole study was entirely web-based without any face-to-face components as part of the intervention or of the assessment; as such "real-life" conditions were mimicked as closely as possible. The study was approved by the Human Research Ethics Committees at the Central Queensland University. An overview of participant flow is provided in Figure 1.

Intervention

The intervention was based on previous computer-tailored studies (Spittaels, De Bourdeaudhuij, Brug, & Vandelanotte, 2007; Spittaels, De Bourdeaudhuij, & Vandelanotte, 2007; Vandelanotte & De Bourdeaudhuij, 2003; Vandelanotte, De Bourdeaudhuij, & Brug, 2004); however, additional focus group meetings and a statewide survey were conducted before the development of the intervention that was evaluated in this study (Vandelanotte & Mummery, 2011). Furthermore, the intervention was based on the theory of

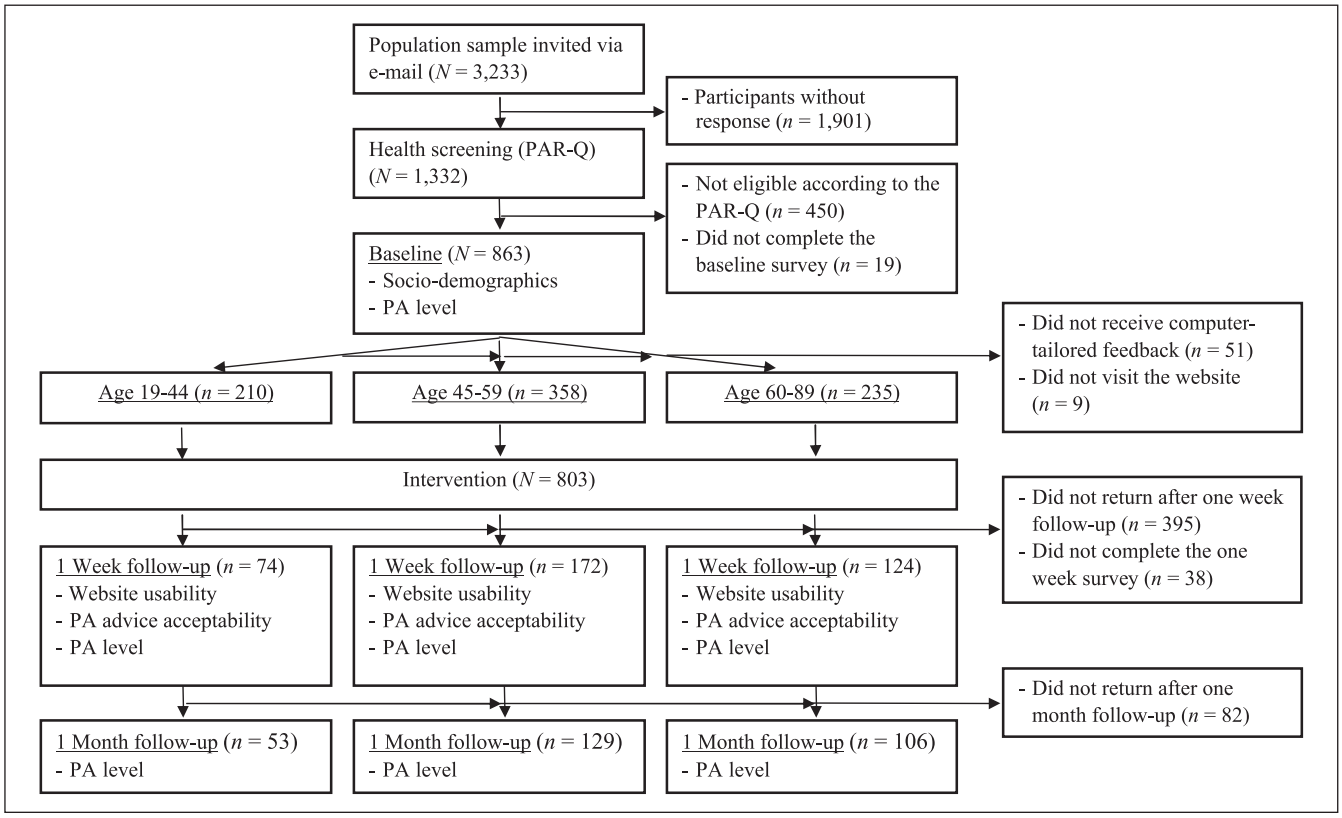

Figure 1. Participant flow
Note. PA = physical activity; PAR-Q = Physical Activity Readiness Questionnaire.

planned behavior (Ajzen, 1991) and the stage of change concept (Prochaska, Redding, & Evers, 2008). Constructs of the theory of planned behavior were represented by questions on psychosocial correlates of physical activity (attitudes, self-efficacy, intention, benefits, and barriers). The intervention content was modified according to participants' stage of change (see Table 1 for a simplified example). After participants completed a short questionnaire on their physical activity levels, they immediately received personalized physical activity advice on their screen. Participants had the opportunity to receive more feedback when completing additional questions about the psychosocial correlates of physical activity and were allowed to revisit the intervention website unlimitedly during the intervention period.

In the first part of the feedback participants were addressed by their name and received a short introduction about the purpose of their personal advice. Next, participants' physical activity level was put into relation to the physical activity recommendations. Participants older than 45 years, with a body mass index (BMI) higher than 25 kg/m^2, or with very low levels of physical activity received additional tailored messages. The second part of the feedback was related to participants' stage of change and continued with personally relevant tips and suggestions for a more active lifestyle, such as being active for transportation, around the house, or at work. Furthermore, personal information on how to achieve benefits, how to overcome barriers, and how to increase self-efficacy was allotted.

Measures

The following *demographic* information was collected: gender, age, height, and weight (which allowed calculating body mass index), employment status (unemployed, employed), level of education (low education = elementary education; medium education = high school; high education = professional or academic education), and confidence in using the Internet (whereby "not confident at all," "not confident," and "neither confident nor not confident" were scored as low confidence; and "very confident" and "confident" were scored as high confidence).

Physical activity level was measured using the Active Australia Survey, which has demonstrated good validity also in older age-groups (Brown, Trost, Bauman, Mummery, & Owen, 2004; Heesch, Hill, van Uffelen, & Brown, 2010). Questions included items on duration and frequency of walking, moderate-intensity physical activity, and vigorous-intensity physical activity in the previous week. According to the Active Australia Survey guidelines for analysis and reporting, total weekly physical activity minutes were computed by

Table 1. Intervention Content According to Participants' Stage of Change

Precontemplation: Insufficient physical activity level at baseline and not motivated to become more active within the next 6 months.	Hello again! It is good to have you back! People in general feel so much better and healthier when they are active, but that doesn't mean it is always easy to be active. Your physical activity levels are really low though, and you should know that any increase in physical activity, even if it is not enough to meet the guidelines, is good for you and will give you some benefit. So give it a try! Good luck!
Contemplation: Insufficient physical activity level at baseline and wants to become more active within 6 months' time.	You have indicated that you want to become more active in the next half year. That's an excellent idea, because you are currently not active enough to enjoy health benefits.
Preparation: Insufficient physical activity level at baseline and wants to become more active within 1 month's time.	It is good to have you back! You have indicated that you want to become more active pretty quickly. That's an excellent idea! The following tips and suggestions will help you to become sufficiently active. Good luck!
Action phase: Became sufficiently active within the past 6 months.	You have recently become more active, so it is not inconceivable that you might slip back into old habits, again reducing your activity level. The tips and suggestions in this video might prevent that and keep your physical activity levels up, I hope you find them helpful.
Maintenance: Sufficient physical activity level for more than 6 months.	You are meeting the physical activity guidelines; that's great! The tips and suggestions in this video are mainly meant to make sure you stay active at your current level.

Note. In the interest of space, the provided examples are a summary of the message content that was provided in the actual intervention.

summing time spent on walking, moderate-intensity physical activity, and vigorous-intensity physical activity of the past week (vigorous-intensity physical activity was weighted by 2; Australian Institute of Health and Welfare, 2003). To generate the total number of physical activity sessions in the past week, number of walking, moderate-intensity session, and vigorous-intensity session were added. Each activity type was truncated to 14 hours per week and total activity was truncated at a maximum of 28 hours per week to account for overreporting. To be included, all activities had to be performed continuously for at least 10 minutes at a time. A sufficient level of physical activity was defined as being active for at least 150 minutes spread across at a minimum of five sessions each week (Australian Institute of Health and Welfare, 2003).

For the assessment of *physical activity advice acceptability* and the *website usability*, surveys were largely based on previous published questionnaires (Hinchliffe & Mummery, 2008; Vandelanotte & De Bourdeaudhuij, 2003; Vandelanotte et al., 2004). *Physical activity advice acceptability* was questioned by 13 items and divided into 2 scales; "physical activity advice content" ($\alpha = .90$) and "physical activity advice delivery" ($\alpha = .87$). *Website usability* was measured by 22 items and also divided into two scales; "website layout" ($\alpha = .92$) and "website ease of use" ($\alpha = .94$). Additional information about the physical activity advice acceptability and website usability scales are available from the authors.

Website user statistics were collected, using the "Google Analytics" service, during the entire intervention period of 1 month. "Time spent on website" reflects the active minutes spent on the website, whereas "visits" states the number of logins on the website to receive the feedback again.

Data Analysis

The study sample was divided into younger working aged (started to use the Internet early in life): 19 to 44 years of age ($n = 210$, 26.1%), older working aged (started to use the Internet during work life/adulthood): 45 to 59 years of age ($n = 358$, 44.6%), and retired aged (started to use the Internet late in life): 60 to 89 years of age ($n = 235$, 29.3%). For convenience the outcomes are presented in the descriptive terms of young, middle, and old ages. Multinominal/binary logistic regression analyses were conducted to examine baseline differences between age-groups and to test for dropout characteristics, respectively. Univariate analyses of covariance and post hoc tests (Bonferroni) were applied to investigate the relationship between age-groups and physical activity advice acceptability, website usability, and website user statistics, controlled for the baseline differences. To evaluate the intervention effects on physical activity, linear mixed model analyses (with age and time as main effects, Age* Time as interaction effect, and baseline differences as covariates) were conducted using both an intent-to-treat analysis (ITT; expectation maximation imputation method; $N = 803$; Blankers, Koeter, & Schippers, 2010) and a retained sample analysis ($N = 288$). Contrast analyses and post hoc tests (Bonferroni) were carried out to determine between- and within-group differences. Furthermore, change scores were calculated from baseline to 1 week, from 1 week

Table 2. Sociodemographic Differences Between the Age-Groups at Baseline

	Total Study Population at Baseline; *N* = 863; *n* (%)	Intervention			Difference Between Age-Groups at Baseline[a]; *p* Value
		Young; *N* = 229; *n* (%)	Middle; *N* = 381; *n* (%)	Old; *N* = 253; *n* (%)	
Gender					
Male	339 (39.3)	82 (35.8)	137 (36.0)	120 (47.4)	.75[b]; .00[c]
Female	524 (60.7)	147 (64.2)	244 (64.0)	133 (52.6)	
Age (*M, SD*)	52.4 (12.0)	37.4 (5.9)	52.0 (4.4)	66.6 (5.0)	—
Body mass index (*M, SD*)	27.3 (6.2)	27.24 (5.8)	27.65 (6.5)	26.64 (6.1)	.76[b]; .57[c]
Employment status					
Unemployed	252 (29.2)	36 (15.7)	58 (15.2)	158 (62.5)	.69[b]; .00[c]
Employed	611 (70.8)	193 (84.3)	323 (84.8)	95 (37.5)	
Internet confidence					
Low confidence	135 (15.6)	17 (7.4)	51 (13.4)	67 (26.5)	.03[b]; .00[c]
High confidence	728 (84.4)	212 (92.6)	330 (86.6)	186 (73.5)	
Education level					
Low education	4 (0.5)	1 (0.4)	—	3 (1.2)	.15[b]; .12[c]
Medium education	187 (21.7)	37 (16.2)	83 (21.8)	67 (26.5)	
High education	672 (77.9)	191 (83.4)	298 (78.2)	183 (72.3)	
Baseline physical activity level					
Insufficient	369 (42.8)	106 (46.3)	169 (44.4)	94 (37.2)	.63[b]; .22[c]
Sufficient	494 (57.2)	123 (53.7)	212 (55.6)	159 (62.8)	

a. Multinominal logistic regression analyses.
b. Reference category is young age-group; parameter is middle age-group.
c. Reference category is young age-group; parameter is old age-group.

to 1 month, and from baseline to 1 month. *T* tests were used to assess differences in changes between the groups. The statistical analyses were executed with SPSS 18.0 and the results were considered as significant if $p < .05$.

Results

Baseline Characteristics and Dropout

At baseline, the average age of all respondents was 52.4 years (range = 19-89 years) and the majority was female (61%; Table 2). Within the young age-group, significantly more participants were female when compared with the old age-group (64% vs. 53%, odds ratio [OR] = 2.43, 95% confidence interval [CI] = 1.58-3.74). More than 70% of the total study sample was employed, but in the old age-group, significantly less participants were employed when compared with the young age-group (OR = 9.00, 95% CI = 5.68-14.25). Furthermore, the middle and old age-groups reported a significant lower confidence in Internet usage compared with the young age-group (OR = 1.88, 95% CI = 1.05-3.36 and OR = 4.29, 95% CI = 2.31-7.78, respectively). No significant differences between the age-groups were found with regard to BMI, education level, and physical activity level at baseline. Young and middle age-group participants were significantly more likely to drop out than respondents within the old age-group (OR = 2.31, 95% CI = 1.49-3.59 and OR = 1.81, 95% CI = 1.24-2.63, respectively). Participant flow is presented in Figure 1.

Physical Activity Advice Acceptability, Website Usability, and Website User Statistics

The physical activity advice acceptability and website usability were generally modest to high and little differences were found between the age-groups (Table 3). A significant difference was revealed for time spent on the website ($F = 8.44$, $p < .01$): The young age-group spent significantly less time on the website (10.6 minutes) when compared with the middle age-group (13.6 minutes) and old age-group (16.3 minutes). No age-group differences were observed in terms of revisiting the website. On average, 4% visited the website at least twice.

Physical Activity Changes

Table 4 shows outcomes of the linear mixed model analyses and Figure 2 provides an overview of change in physical activity. Concerning total physical activity minutes and sessions, group and time effects were observed. Post hoc

Table 3. Differences Between the Three Age-Groups in Physical Activity Advice Acceptability, Website Usability, and Website User Statistics

	Total Study Population; *N* = 370; *M* (*SD*)	Young; *N* = 74; *M* (*SD*)	Middle; *N* = 172; *M* (*SD*)	Old; *N* = 124; *M* (*SD*)	ANCOVA *F* Value	Post Hoc (Bonferroni)
PA advice acceptability[a]						
PA advice content	3.2 (0.7)	3.2 (0.7)	3.2 (0.7)	3.3 (0.7)	1.00	
PA advice delivery	3.9 (0.5)	3.9 (0.5)	3.9 (0.5)	3.9 (0.5)	0.09	
Website usability[a]						
Website layout	3.7 (0.5)	3.7 (0.5)	3.7 (0.6)	3.7 (0.6)	0.96	
Website ease of use	4.0 (0.5)	4.1 (0.5)	4.1 (0.5)	3.9 (0.6)	2.03	
Website user statistics						
Average time spent on website[b]	13.7 (12.2)	10.6 (11.0)	13.6 (11.9)	16.3 (12.9)	8.44**	Y < M*, O**
Visits	1.02 (0.2)	1.02 (0.2)	1.02 (0.2)	1.02 (0.2)	0.34	

Note. ANCOVA = analysis of covariance; PA = physical activity; Y = young age-group; M = middle age-group; O = old age-group.
a. 1 = *strongly disagree* to 5 = *strongly agree*.
b. Minutes.
*$p < .05$. **$p < .01$.

analyses showed that the old age-group engaged in significantly more total physical activity minutes than the young age-group. Also, the old age-group performed in significantly more total physical activity sessions when compared with the middle age-group. On average, all age-groups increased their weekly total physical activity minutes and the number of total physical activity sessions significantly over time from baseline to 1-month follow-up (+31 minutes/+1.2 sessions). However, no significant interaction effect was observed for change in total physical activity.

In-depth analyses of the different types of physical activity revealed that on average the old age-group spent significantly more minutes walking when compared with the other two age-groups (Table 4). Moreover, the elderly people had significantly higher change scores for walking from 1 week to 1 month (ITT: +30 vs. +5) and from baseline to 1 month (ITT: +40 vs. +14) when compared with the middle age-group and significantly higher change scores from baseline to 1 month (ITT: +40 vs. +16) compared with the youngest age-group (Figure 2). Furthermore, on average the old age-group performed significantly more minutes of moderate-intensity physical activity in comparison with the young and middle age-groups. Yet the old age-group increased their minutes spent on moderate-intensity physical activity significantly more from baseline to 1 month compared with the young and middle age-groups (ITT: +15 vs. −15, −6, respectively), as such a significant interaction effect was observed ($F = 1.45$; $p < .05$). On average, the old age-group performed significantly less minutes of vigorous-intensity physical activity compared with the young age-group; however, the oldest age-group showed significantly higher change scores from baseline to 1 month (ITT: +15 vs. −6) compared with the middle age-group.

Discussion

The present study was designed to determine acceptability, usability and effectiveness of a website-delivered computer-tailored physical activity intervention according to three age-groups. The results indicate that the old age-group increased physical activity more than the other two age-groups. This finding is especially interesting, as the old age-group reported significantly lower Internet self-confidence at baseline compared with the young age-group. Furthermore, the oldest age-group indicated more interest to continue to use the website than the young age-group (this specific item was part of the "ease of use" scale and was not reported in the result section). Finally, significantly fewer old-aged participants dropped out of the study when compared with the other age-groups. All the above suggest that website-delivered interventions can be effective for people of older age. This is in contrast to earlier suggestions implying that older people might not be keen or skilled enough to use the Internet, let alone participate in website-delivered health behavior change interventions (Kaufman et al., 2006; Slegers, van Boxtel, & Jolles, 2008).

For all three age-groups, a significant increase in total physical activity sessions and minutes was observed during the course of the intervention study. This is in line with findings of a systematic review, which highlighted predominantly short-term efficacy in website-delivered physical activity interventions in the general population (Vandelanotte, Spathonis, Eakin, & Owen, 2007). Because of the minimal nature of the current intervention, it is unlikely to result in long-term behavior change. Almost two thirds (63%) of the oldest age-group was already meeting the physical activity recommendations at baseline, yet they increased physical

Table 4. Differences Between the Three Age-Groups in the Intervention Effect on Physical Activity

	Intention-to-Treat (N = 803)							Completers (N = 288)						
				F^a							F^a			
	Young (n = 210); M (SD)	Middle (n = 358); M (SD)	Old (n = 235) M (SD)	Age	Time	Age *Time	Post Hoc (Bonferroni)	Young (n = 53); M (SD)	Middle (n = 129); M (SD)	Old (n = 106); M (SD)	Age	Time	Age * Time	Post Hoc (Bonferroni)
Total physical activity minutes														
B	301 (318)	332 (368)	327 (334)					226 (211)	346 (371)	346 (371)				
W	304 (257)	347 (320)	358 (292)					236 (177)	364 (328)	364 (328)				
M	316 (269)	342 (304)	404 (345)	3.74*	2.25*	1.0	Y < O*	280 (244)	354 (349)	354 (349)	7.65**	1.0	0.30	Y < M**, O**
Total physical activity sessions														
B	8.0 (7.3)	8.1 (7.1)	8.3 (7.2)					6.2 (5.6)	7.9 (6.2)	8.1 (6.2)				
W	8.5 (6.4)	8.6 (6.3)	9.2 (6.9)					6.3 (4.1)	8.8 (7.6)	9.1 (6.5)				
M	9.3 (7.1)	8.8 (6.2)	10.1 (7.6)	2.25*	6.56**	0.47	M < O*	7.8 (5.3)	8.7 (6.7)	10.2 (8.1)	7.70**	3.18*	0.44	Y < M*, O**
Walking minutes														
B	113 (131)	144 (163)	152 (163)					92 (116)	143 (165)	155 (170)				
W	109 (103)	156 (152)	162 (134)					89 (87)	153 (156)	157 (137)				
M	128 (108)	160 (146)	193 (164)	22.20**	5.50**	1.00	Y < M**, O**; M < O*	106 (109)	155 (158)	188 (177)	14.69**	1.22	0.30	Y < M**, O**
Moderate-intensity minutes														
B	35 (83)	45 (96)	78 (167)					17 (35)	46 (108)	77 (166)				
W	44 (63)	54 (87)	72 (119)					25 (52)	62 (118)	65 (107)				
M	28 (37)	48 (74)	87 (128)	32.84**	0.28	1.45*	O > Y**, M**; M > Y*	20 (32)	53 (109)	86 (139)	12.51**	0.21	0.63	O > Y**, M*; M > Y*
Vigorous-intensity minutes														
B	80 (130)	73 (134)	54 (112)					59 (83)	79 (133)	44 (75)				
W	76 (93)	71 (106)	66 (108)					61 (81)	81 (134)	58 (89)				
M	80 (114)	67 (104)	70 (122)	4.31*	0.15	0.73	O < Y*	74 (115)	74 (129)	55 (111)	7.44**	0.28	0.32	O < M**

Note. B = baseline; W = 1-week follow-up; M = 1-month follow-up; Y = young age-group; M = middle age-group; O = old age-group.
a. Linear mixed model analyses.
*p < .05. **p < .01.

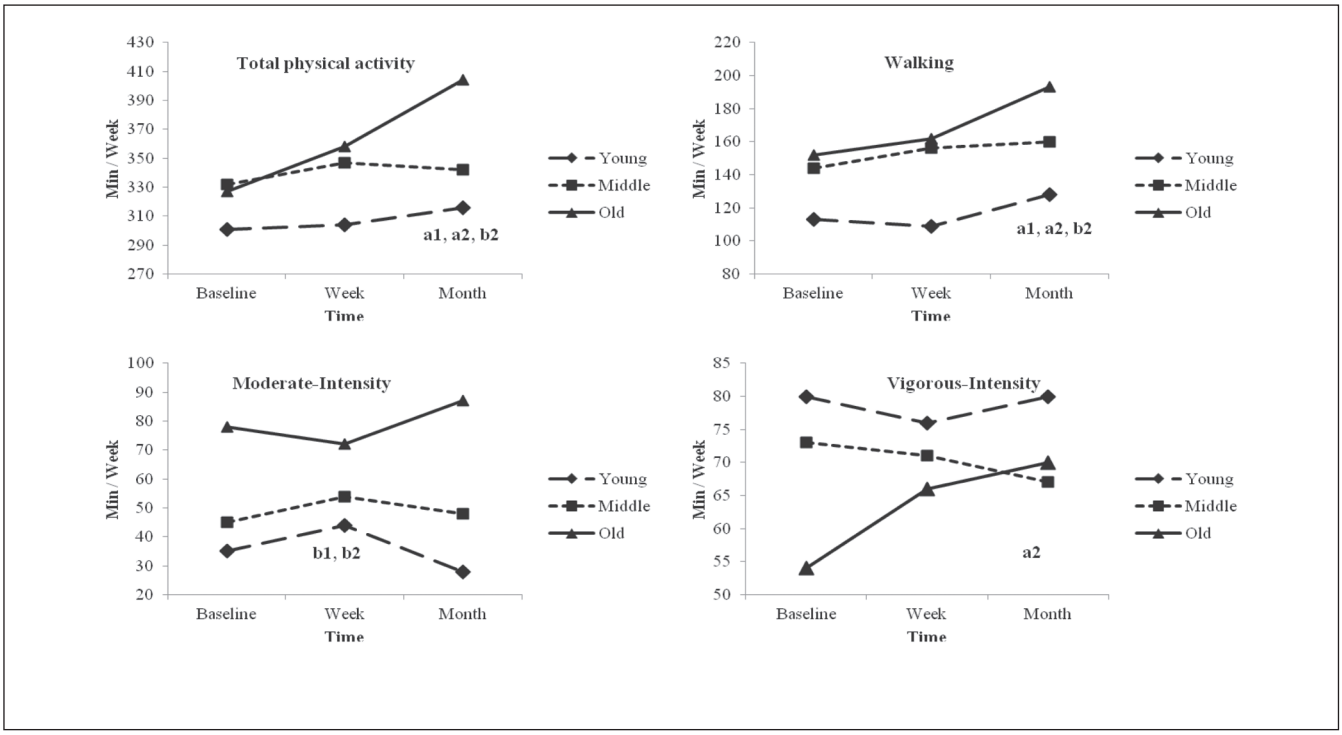

Figure 2. Changes in physical activity minutes from baseline to the end of the study (when applying intention-to-treat)
Note. Significant group-by-time interactions were noted ($p < .05$). a1 = baseline to month: old > young; a2 = baseline to month: old > middle; b1 = week to month: old > young; b2 = week to month: old > middle.

activity more when compared with the other age-groups, especially for moderate-intensity physical activities. It is known that older adults place greater importance to their health compared with younger adults (Monteiro et al., 2003; Zunft et al., 1997), this might increase interest in taking advantage of such interventions. Alternatively, retirees have more leisure time than the working-age participants and can easier implement changes into their daily life (Sjösten et al., 2012; Touvier et al., 2010).

In the present intervention, the young participants spent significantly less time on the website which might reflect that the young generation is more technically adept and therefore faster in processing computer matters (Pak et al., 2009). This is in line with previous studies, which showed that older participants take more time to read instructions, inspect visual features, and accomplish tasks (Liu, Kemper, & McDowd, 2009; van Horen, Jansen, Noordman, & Mases, 2005). Hence, the outcomes of this study demonstrated that having lower computer knowledge and skills are not insurmountable barriers for behavioral change. Furthermore, generally high website usability was observed, with no significant differences across age-groups, which supports our design of the web-based intervention. These findings are in contrast to those of Pak et al. (2009); younger participants outperformed the older generation in terms of remembering contents while tracking other website pages. Previous studies (Ownby & Czaja, 2003; Vandelanotte & De Bourdeaudhuij, 2003) and focus group testing (Vandelanotte & Mummery, 2011) demonstrated that a simple but robust website design can be suitable for older people or those who do not use the Internet very often. For example, our website pages included little text and links, big buttons and fonts. Additionally, the survey section featured clear instructions, few questions on one single page, a short overall survey, and a progress indicator.

The present study indicates modest acceptability of the personalized advice, which is in line with other computer-tailored physical activity interventions (Eysenbach, 2005; Leslie, Marshall, Owen, & Bauman, 2005; Marshall, Owen, & Bauman, 2004; Skinner, Strecher, & Hospers, 1994). A possible reason is people's overestimation of their own physical activity levels. As a consequence, they receive personally tailored advice that is not accurate and which might result in lower acceptability of the advice (Nyman & Yardley, 2009). In the current study no significant differences between age-groups were observed in terms of physical activity advice acceptability. This implies that the tailored advice was well targeted throughout the age-groups and is in line with an earlier study by Vandelanotte and De Bourdeaudhuij (2003) where no differences in physical

activity advice acceptability could be revealed between age-groups. Alternatively, the framing of the tailored messages was positive and stressed the health gains more than the losses. Rothman and Salovey (1997) suggested that gain-framed information is more persuasive when advocating disease prevention behaviors as it makes people risk averse and thus more likely to engage in relatively safe disease prevention behaviors.

The present study was subject to some limitations. First, the current study recorded high dropout levels, which were comparable to those of other website-delivered studies with similar protocols (Eysenbach, 2005; Kosma, Cardinal, & McCubbin, 2005; Woolf et al., 2006). The low-intensity "real-life" implementation (e-mail recruitment, no face-to-face or telephone contact for the entire study) was more than likely responsible; however, we need this type of interventions to prevent too optimistic predictive accuracy (Bennett & Glasgow, 2009; Grobbee & Hoes, 2009; Wantland et al., 2004). Second, self-reported data should be treated with caution as people often overreport self-reported physical activity (Adams et al., 2005; Sallis & Saelens, 2000). The use of objective measures of physical activity is recommended over self-reported questionnaires (Kroeze et al., 2006). Third, the study sample was recruited from a database containing people who previously indicated their willingness to participate in possible studies. As such, they were not representative of the wider Australian population. This might have especially been the case in the oldest age-group, as it had proportionally more males when compared with the youngest age-group; it is difficult to explain these differences without speculating. Fourth, the present intervention was conducted without a control group, which makes it harder to rule out confounding variables (Grimshaw, Campbell, Eccles, & Steen, 2000).

Despite these limitations, this study demonstrates that website-delivered computer-tailored advice on physical activity can have positive effects across age-groups. This "real-life" intervention, with minimal dosage and interaction, was shown to be especially beneficial for elderly people. This is important, as the level of physical activity decreases with advanced age, whereas health issues increase with age (Guthold, Ono, Strong, Chatterji, & Morabia, 2008; U.S. Department of Health and Human Services, 1996). Future research is needed to replicate the findings of this study and address experienced limitations.

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