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Effectiveness of an online computer-tailored physical activity intervention in a real-life setting

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Abstract

The aim of this study was to evaluate the effectiveness of a computer-tailored physical activity intervention delivered through the Internet in a real-life setting. Healthy adults (n = 526), recruited in six worksites, between 25 and 55 years of age were randomized to one of three conditions receiving, respectively, (i) online-tailored physical activity advice + stage-based reinforcement e-mails, (ii) online-tailored physical activity advice only, (iii) online non-tailored standard physical activity advice. At 6-month follow-up, no differences in physical activity between study conditions were found; total physical activity, physical activity at moderate intensity and physical activity in leisure time significantly increased in all study conditions between baseline and follow-up. Further evaluation of the intervention materials showed that the tailored advice was more read, printed and discussed with others than the standard advice. Most of the respondents in the e-mail group indicated to be satisfied about the number, frequency and usefulness of the stage-based e-mails. In conclusion, although tailored advice was appreciated more than standard advice, no evidence was found that an online-tailored physical activity intervention program outperformed online standard information.

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Introduction

Regular physical activity has an important influence on the health status and well-being of adults [1–3]. To take advantage of the health benefits of physical activity, adults are recommended to accumulate at least 30 min of physical activity at moderate intensity on most, preferably all days of the week [4]. However, most adults in Western countries do not meet this guideline [5, 6]. Therefore, effective interventions promoting an active lifestyle that can reach large population groups are needed.

Computer-tailored interventions have induced significant changes in smoking, diet and physical activity [7–10] and have the potential to provide individualized behaviour change information to many individuals at low costs [11]. Few computer-tailored programs evaluated to date are interactive [12]. This means that after completing a computer diagnostic questionnaire, participants immediately receive personally adapted advice [13]. The use of interactive computer programs makes tailored interventions more cost-effective and useful at the population level.

The Internet is now regarded as a promising channel for the distribution of interactive computer-tailored interventions [14]. It has the advantage of reaching a wide variety of people at once, at any time and location. In 2003, Belgium had the highest

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rate of broadband connections in Europe [15], and in the first quarter of 2005, 53% of the Belgian population were using the Internet regularly [16]. Today, the increase of Internet users is largest in underserved populations like the elderly, lower educated persons and women, and consequently, the gaps among age, educational attainment and gender are narrowing [16].

Although much is published about the potential of the Internet in health behaviour change, very little evidence is available to date on the effectiveness of Internet-based tailored interventions. We are aware of only one tailored Internet intervention study in the physical activity domain [17] specifically aimed at diabetes patients. Two other studies investigating intervention for healthy adults targeted the physical activity information to the stages of change, but did not truly 'tailor' to other behavioural constructs or determinants [18, 19]. The present study is therefore the first to test an Internet-based computer-tailored intervention to promote physical activity in the general population.

The tailored intervention used in the present study was based on earlier work of our research group. An interactive computer program promoting physical activity was developed as a CD-ROM version. This program was evaluated on it's efficacy in a randomized controlled design in supervised laboratory conditions and appeared to be effective in increasing the level of physical activity after 6 months [20] as well as after a follow-up at 2 years [21]. For the present intervention, this tailored physical activity program was transferred to an Internet version. Using the Internet meant that additional stage-based e-mail could be sent and evaluated. The aim of the present study was to investigate the effectiveness of the Internet version of the tailored physical activity advice, outside the laboratory. The effect of this online computer-tailored intervention was studied with and without additional stage-based e-mail reminder messages and compared with a standard intervention (online generic physical activity information). We hypothesized that the tailored intervention leads to a larger increase in physical activity than the standard intervention and that additional stage-based e-mail reminders will further improve the effects of the online-tailored intervention.

Methods

Participants and procedure

Participants were recruited by spreading e-mail messages, posters and internal newsletters in six worksites in the northern part of Belgium, including four commercial settings and two local governmental institutes (n = 8000 employees). Inclusion criteria were as follows: between 25 and 55 years of age, no history of cardiovascular disease and Internet access (including e-mail access) either at home or at work. Individuals who were interested and met the inclusion criteria could react by e-mail, after which more detailed information about the study was sent. As an incentive for participation, respondents could win a gift coupon of 25 euros or two film tickets. Baseline questionnaires accompanied by an informed consent form were sent by regular mail to 570 persons who wanted to participate in the study (7% response rate). In total, 562 employees (92%) actually returned the baseline questionnaire with the informed consent form and were randomized individually into one of the three conditions. Group 1 (n = 174) received computer-tailored physical activity advice supplemented with five stage-of-change targeted reminder e-mails during 8 weeks; Group 2 (n = 175) received tailored physical activity advice without emails; and Group 3 (n = 177) received standard advice (Fig. 1). Respondents in Group 3 who returned their 6 months post-baseline questionnaire were given the opportunity, as an incentive for their participation, to receive tailored advice online after completing and returning this questionnaire. The study was approved by the Ghent University Ethics Committee.

Tailored intervention

The tailored intervention was based on a previously designed intervention that was carefully developed and subjected to formative and efficacy evaluations in laboratory settings. This stepwise development process and the contents of the intervention have

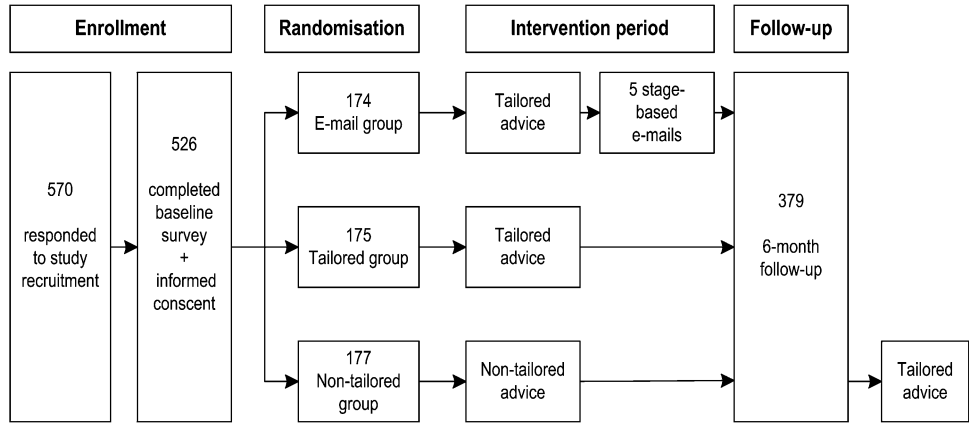

Fig. 1. Flow diagram of participants' progress through the phases of the randomized trial.

been described in more detail elsewhere [20, 22]. In short, the tailored intervention consisted of 'physical activity advice' and an 'action plan'. In order to receive tailored physical activity advice, participants were required to log on to the website using a confidential username and password and complete both a physical activity and a psychosocial determinants questionnaire. The tailored advice appeared immediately on the computer screen and contained normative physical activity feedback as well as tips and suggestions for increasing physical activity. The advice was tailored to participants' stage of changes [23], both by content and the way in which the participants were approached, and to the constructs of Theory of Planned Behaviour [24] by giving the participants personal advice about intentions, attitudes, self-efficacy, social support, knowledge, benefits and barriers of physical activity. Participants with positive intentions to increase their level of physical activity were encouraged to make a personal 'Action Plan'; that is, a specific plan to assist in putting their intentions into actions [25].

Reinforcement e-mails

After having received their tailored advice, participants in Group 1 were further encouraged to change their behaviour by five stage-of-change targeted e-mail tip sheets during a period of 8 weeks (Fig. 1). For each e-mail, participants were first asked to click-on one of five statements that best described their current stage of change and were then automatically transferred to the website for more personalized information corresponding with that stage of change. The type of information ranged from pros and cons of physical activity (pre-contemplation stage) to behaviour change suggestions for respondents in higher stages of change.

Standard advice

Participants in the non-tailored comparison group received a standard physical activity advice via the Internet. The webpage provided information about the benefits of physical activity, current public health recommendations, the difference between moderate- and vigorous-intensity activities and tips and suggestions to assist in becoming more physically active. This standard advice was also based on information present in the computer-tailored program; however, it was not tailored to the individual.

Measurements

All participants were asked to fill out a paper-and-pencil questionnaire at baseline and at 6-month follow-up. To assess physical activity, the long usual week version of the International Physical Activity Questionnaire (IPAQ) was used. IPAQ is a valid and reliable instrument to assess physical

activity at population level [13, 26]. This questionnaire measures physical activity at work, as transportation, for household chores as well as during leisure time; it also assesses daily sitting time. Each reported physical activity was expressed in min week^{-1} by multiplying frequency (day week^{-1}) and duration (min day^{-1}) of the activity. A 'total moderate-intensity and vigorous-intensity physical activity' index was computed by summing all reported physical activities executed at moderate and vigorous intensity. Participants were classified as complying with the American College of Sports Medicine recommendation when their score on this index was at least 210 min week^{-1} (average of 30 min day^{-1}).

At the 6-month follow-up, the questionnaire also included questions about exposure to and use of the advice respondents had received (i.e. whether participants remembered the advice; whether they read, printed or discussed it with others and whether they thought the advice had had a positive impact on their physical activity behaviour and opinions). Respondents in Group 1 (reinforcement e-mails) received questions about the number of e-mails they received and read, and their opinion of the number, frequency, usefulness and effectiveness of the e-mail tip sheets.

In one of six worksites (an automobile company), participants were asked to participate in additional objective assessments of potentially relevant outcomes. Height, body weight, body fatness (bioelectric impedance with Bodystat 1500), blood pressure (Bauman metre), heart rate at rest (with polar heart rate monitor, tempo) and physical activity [Computer Science Application (CSA) accelerometer Inc., model 7164] worn on the hip during 7 consecutive days were measured in volunteers at baseline (n = 66) and at 6-month follow-up (n = 57). Nine employees did not complete their measurements at follow-up due to work time constraints or sickness.

Statistics

Data were analysed for those having completed pre–post test data and also using an intention-to-treat analysis [27]. As no major differences were found, only the results of the complete cases analyses are presented. One-way analyses of variance (ANOVAs) were used to test for differences in baseline participant characteristics between the three intervention conditions. A drop-out analysis was executed using independent-samples t-tests for differences in level of physical activity, age, gender, body mass index (BMI), education and stage of change at baseline. Repeated measure ANOVAs, with time (baseline and 6-month follow-up) as within-subjects factor and intervention condition as between-subjects factor, were conducted to evaluate the effects on physical activity. All analyses were performed using SPSS 11.0. Statistical significance was set at a level of 0.05.

Results

Participant characteristics

Of the initial sample, 379 (72%) persons responded to the post-tests after 6 months and were included in the analyses: 116 (66%) in the tailored intervention + e-mail group, 122 (69%) in the tailored intervention group and 141 (79%) in the standard intervention group (total drop-out = 28.9%). Drop-out analysis showed that younger participants, precontemplators and contemplators and those who did not meet the guidelines at baseline were more likely to drop-out. No significant differences were found for gender, education, BMI or total physical activity.

Baseline characteristics of the total study group are shown in Table I. Participants were predominantly male and had a mean age of 39.5 years. More than half had a higher education and were office workers. The mean total physical activity score measured by the IPAQ was 651 min week^{-1}. About 65% of the total sample met the minimal recommendation for physical activity. Gender-specific analysis showed that 72.3% of men and 47% of women complied with the recommendation at baseline. Baseline measurements did not differ significantly between the three intervention groups.

Table I. *Baseline characteristics of total sample and three intervention groups (mean ± SD or %)*

	Total sample (n = 379), mean ± SD	Tailored advice + e-mail (n = 116), mean ± SD	Tailored advice (n = 122), mean ± SD	Standard advice (n = 141), mean ± SD
Demographics				
Men (%)	69.4	67.2	68.0	73.0
Women (%)	30.6	38.8	32.0	27.0
Age (year)	39.5 ± 8.5	39.7 ± 8.9	39.3 ± 8.7	40.9 ± 8.0
BMI (kg/m^2)	24.4 ± 3.3	24.3 ± 3.0	24.4 ± 3.5	24.4 ± 3.1
College or university degree (%)	61.7	63.4	68.9	59.6
Work status				
Factory workers (%)	21.9	22.4	21.3	22.0
Office workers (%)	54.1	60.3	51.6	51.1
Managers (%)	24.0	17.2	27.0	27.0
Physical activity (PA)				
Total PA (min week^{-1})	651 ± 465	696 ± 510	640 ± 422	622 ± 462
Moderate- and vigorous-intensity PA (min week^{-1})	390 ± 331	438 ± 373	362 ± 292	376 ± 325
30 min of PA on most days (%)	64.6	68.1	67.2	59.6
Stages of change				
Pre-contemplation (%)	8.5	6.9	7.6	10.7
Contemplation (%)	15.2	13.8	13.4	17.9
Preparation (%)	10.7	11.2	10.1	10.7
Action (%)	12.8	12.9	16.0	10.0
Maintenance (%)	52.3	55.2	52.9	49.3

Self-reported measurements

Changes in physical activity

Participants from all the three study groups reported a significant increase in their level of physical activity at 6-month follow-up (Table II). Time effects were found for total physical activity, moderate- to vigorous-intensity physical activity and physical activity in leisure time. There were also positive changes in amount of time spent sitting. Minutes sitting on both weekdays and weekend days significantly decreased for the total study group at 6-month follow-up. However, no significant group × time interactions were found, indicating that there were no differences in effects between the three intervention groups.

Subgroup analyses (data not shown), focussing on participants meeting versus not meeting the physical activity recommendation of 30-min moderate and vigorous activity per day, showed similar time effects, but no interaction effects. In the group that did not meet the recommendation at baseline (n = 129), time effects were found for the same variables as described above. Additional time effects were found for vigorous-intensity physical activity [F (1,131) = 12.826, $P < 0.001$] and household physical activity [F (1,131) = 6.161, $P < 0.05$].

Additional analyses, comparing physical activity increase of participants in the first four stages of change at baseline (pre-contemplation, contemplation, preparation and action) with those of participants in the maintenance stage, showed a greater increase in moderate- to vigorous-intensity physical activity for the participants in the first four stages [F (1,367) = 8.592, $P < 0.01$], irrespective of the intervention condition. No interaction effects were found for other physical activity variables.

Receipt, use, appreciation and subjective impact of intervention materials

Process evaluation at 6-month follow-up showed positive results in favour of the tailored intervention

Table II. *Mean physical activity (PA) scores (min week^{-1}) and time spent sitting (min day^{-1}) at baseline and at 6-month follow-up for all conditions and total group*

	All cases (=379)			Tailored advice + e-mail (n = 116)	Tailored advice (n = 122)	Standard advice (=141)	Time × group
	Mean ± SD	Change[a] (±SD)	F time	Mean ± SD	Mean ± SD	Mean ± SD	F
Total PA (min week^{-1})							
Baseline	651 ± 465			696 ± 510	640 ± 422	622 ± 462	
6-month	720 ± 503	+69 (±334)	10.951***	776 ± 540	682 ± 452	708 ± 514	0.935
Total moderate- to vigorous-intensity PA (min week^{-1})							
Baseline	390 ± 331			438 ± 373	362 ± 292	376 ± 325	
6-month	434 ± 356	+44 (±236)	9.539*	479 ± 376	397 ± 310	428 ± 374	0.598
Total vigorous-intensity PA (min week^{-1})							
Baseline	136 ± 177			155 ± 200	134 ± 158	122 ± 174	
6-month	132 ± 161	−4 (±127)	0.064	161 ± 181	111 ± 140	128 ± 160	3.120
Transportation PA (min week^{-1})							
Baseline	108 ± 143			125 ± 173	108 ± 128	93 ± 126	
6-month	120 ± 150	+12 (±115)	2.713	127 ± 164	108 ± 125	125 ± 157	2.000
Household PA (min week^{-1})							
Baseline	251 ± 241			276 ± 279	249 ± 236	232 ± 208	
6-month	279 ± 264	+28 (±223)	2.426	320 ± 289	262 ± 225	260 ± 272	1.138
Leisure-time PA (min week^{-1})							
Baseline	159 ± 164			174 ± 191	154 ± 150	151 ± 152	
6-month	194 ± 189	+35 (±142)	26.554***	211 ± 220	190 ± 188	185 ± 161	0.044
Job-related PA (min week^{-1})							
Baseline	156 ± 303			176 ± 345	137 ± 244	157 ± 313	
6-month	159 ± 293	+3 (±186)	0.103	166 ± 310	136 ± 239	175 ± 320	0.885
Sitting on weekday (min day^{-1})							
Baseline	481 ± 202			482 ± 183	492 ± 202	470 ± 217	
6-month	433 ± 174	−48 (±165)	29.392***	443 ± 168	438 ± 172	419 ± 181	0.288
Sitting on weekend day (min day^{-1})							
Baseline	305 ± 168			308 ± 160	296 ± 160	309 ± 182	
6-month	272 ± 137	−33 (±137)	10.733**	276 ± 131	268 ± 141	271 ± 139	0.143

[a]Changes are computed by subtracting baseline data from 6-month data. Plus and minus signs are shown to indicate the direction of change.
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ within group.

materials (Table III). Almost twice as many participants from the tailored groups recalled having received their tailored advice in comparison with the non-tailored group. In the non-tailored group, 41% could not remember the online standard advice, while the rest were aware of the non-tailored website but did not visit it because expectations of the site were not positive enough or because of lack of time, forgetfulness and problems with PC or Internet.

Further, the process evaluation showed that the tailored advice was more likely to be read completely, printed out and discussed with others compared with the standard advice. For one item, the non-tailored information outperformed the tailored information: participants perceived it as more credible. Finally, more people in the tailored groups than in the non-tailored group reported to have changed their physical activity behaviour and opinions about physical activity after reading their physical activity advice.

Most participants of the e-mail group recalled at least three of the five reinforcement e-mails, read them completely and were satisfied with the number and frequency of the e-mails. Further, half of the participants who were inactive at baseline found the e-mail tip sheets to be useful and 41% reported that the e-mails helped them to become or remain physically active.

Objective measurements

Table IV shows the results of the health measurements taken at baseline and 6-month follow-up in one employee setting (n = 57). A significant decrease in BMI [F (1,42) = 5.340, $P < 0.05$], fat percentage [F (1,42) = 9.402, $P < 0.01$] and diastolic blood pressure [F (1,42) = 7.335, $P < 0.01$] was found. A significant time × group interaction for percentage of body fat [F (2,41) = 3.641, $P < 0.05$] indicates a greater decline in percentage of body fat in the e-mail group in comparison with the other two groups.

Due to technical errors or not wearing the accelerometer during for at least 5 days, complete pre–post data of CSA accelerometer measurements could be analysed for only 55 out of 66 participants in the subgroup. Participants spent an average of

Table III. *Process evaluation of the intervention materials*

Intervention materials	Tailored advice + e-mail		Tailored advice		Standard advice	
	Total (n = 128)	Inactive[a] (n = 45)	Total (n = 139)	Inactive[a] (n = 44)	Total (n = 156)	Inactive[a] (n = 64)
Tailored/general physical activity (PA) advice						
Received (%)	97	98	94	96	53	53
Read completely (%)	96	96	98	100	82	88
Printed out (%)	55	64	75	71	17	12
Discussed with others (%)	64	64	59	60	32	27
Find advice credible (%)	66	66	61	57	73	78
Changed opinions about PA (%)	49	52	37	43	29	31
Reported behavioural changes (%)	38	50	23	29	20	24
E-mails						
Received ⩾ three e-mails (%)	92	95				
Read completely (%)	77	86				
Satisfied by number e-mails (%)	87	84				
Satisfied by frequency e-mails (%)	86	91				
Useful (%)	45	52				
Reported behavioural changes (%)	33	41				

[a]Participants not meeting the recommendations for PA at baseline.

Table IV. *Objective health measurements at baseline and 6-month follow-up*

Health measurements	All cases (n = 57)		Tailored advice + e-mail (n = 14)	Tailored advice (n = 22)	General advice (n = 21)	Time × group
	Mean ± SD	F time	Mean ± SD	Mean ± SD	Mean ± SD	F
Body mass index (kg m^{-2})						
Baseline	26.0 ± 3.4	5.340*	25.3 ± 3.7	26.1 ± 3.4	26.2 ± 3.4	0.842
6-month	25.8 ± 3.3		25.0 ± 3.6	26.1 ± 3.3	25.9 ± 3.4	
Difference	−0.2 ± 0.7		−0.3 ± 0.8	0.0 ± 0.6	−0.3 ± 0.6	
Body fat (%)						
Baseline	22.1 ± 6.0	9.402**	21.1 ± 6.8	21.8 ± 7.0	23.0 ± 4.3	3.641*
6-month	21.2 ± 5.9		19.0 ± 5.4	21.9 ± 6.5	22.1 ± 5.9	
Difference	−0.9 ± 2.5		−2.1 ± 3.8[a]	+0.1 ± 1.6[b]	−0.9 ± 1.9[b]	
Systolic blood pressure (Hg cm)						
Baseline	12.5 ± 1.4	0.077	12.1 ± 1.5	12.5 ± 1.3	12.8 ± 1.5	3.217
6-month	12.4 ± 1.6		12.4 ± 1.4	11.9 ± 1.2	13.0 ± 2.0	
Difference	−0.1 ± 1.3		+0.3 ± 1.1	−0.6 ± 1.3	+0.2 ± 1.3	
Diastolic blood pressure (Hg cm)						
Baseline	8.4 ± 1.2	7.335**	7.9 ± 1.1	8.5 ± 1.2	8.6 ± 1.1	0.656
6-month	7.8 ± 1.5		7.6 ± 1.3	7.9 ± 1.2	7.8 ± 2.0	
Difference	−0.4 ± 1.4		−0.3 ± 1.0	−0.6 ± 0.8	−0.8 ± 2.0	
Heart rate at rest (beats min^{-1})						
Baseline	64.1 ± 9.6	1.115	65.2 ± 11.3	63.6 ± 10.2	63.8 ± 8.3	0.013
6-month	62.8 ± 9.2		63.9 ± 10.6	62.1 ± 10.0	62.9 ± 7.8	
Difference	−1.3 ± 8.6		−1.3 ± 9.5	−1.5 ± 8.2	−1.1 ± 8.9	

Differences are computed by subtracting baseline data from 6-month data. Plus and minus signs are shown to indicate the direction of change.
[a,b]Means with different superscripts are significantly different from each other (Tukey honestly significantly difference, $P < 0.05$).
*$P < 0.05$, **$P < 0.01$.

326 ± 172 min week^{-1} at baseline and 338 ± 161 min week^{-1} at 6-month follow-up undertaking moderate- to vigorous-intensity physical activity. No statistically significant time or time × group interaction effects were found (data not shown).

Discussion

In the present study, there was no convincing evidence found that an online computer-tailored physical activity intervention outperformed online standard advice. However, respondents in all the three study groups reported increases in physical activity and decreases in sedentary behaviour. Further, the tailored physical activity advice was more positively evaluated than the non-tailored advice and participants were satisfied with the content and frequency of the reinforcement e-mails.

Cavill and Bauman [28] have argued that the evaluation of physical activity promotion campaigns should focus not only on behaviour change but also on antecedent variables (for example awareness, knowledge, saliency, beliefs, etc.). Our analyses of these variables found that more participants in the intervention groups discussed their tailored advice with others and changed their opinions about physical activity in comparison with participants in the standard advice group. This suggests that the tailored advice had a superior impact on participants, even though there were no between-group differences in behaviour change. When considering the behavioural outcomes measured by the IPAQ in this study, it is promising to find increases in physical activity across the

three study groups, because earlier studies reported no increases in physical activity levels in Belgian adults between 1997 and 2001 [6]. Nevertheless, these results should be interpreted with caution, since an overall increase in physical activity was not confirmed in the subgroup in which objective physical activity data were obtained.

A recent systematic review of the literature [12] concluded that the evidence for effectiveness of computer-tailored health education is convincing for nutrition education, but mixed for physical activity. Furthermore, the authors also mentioned that many of the studies reporting significant effects used no-intervention control groups and did not test Internet applications.

Different reasons might explain the lack of the superior effect on behaviour by the interactive computer-tailored intervention compared with online non-tailored intervention in the present study.

First, possibly ceiling effects might have occurred as baseline physical activity levels were already high. More than 64% of participants met the recommendations at baseline despite explicit recruitment of inactive participants. Belgian adults apparently associate physical activity with sports activities of vigorous intensity, based on national physical activity campaigns in the past which aimed to increase sports participation. Therefore, it is possible that employees who were not engaged in any sports activity but were indeed physically active at moderate intensity enrolled in our study. More detailed analyses showed that especially the male participants in the present study already had high baseline physical activity scores in comparison with the general male population (72% versus 57% meeting the recommendations), whereas female participants were more representative of the population (47% versus 48% meeting the recommendations) [6].

Second, it is possible that intervention effects were not found due to measurement effects. As was shown in a study by Van Sluijs *et al.* [29], participation in physical activity measurement itself can substantially influence physical activity behaviour in adults, making it harder to interpret the results.

Further, the standard deviations in the IPAQ data were very large, which makes it more difficult to find a significant interaction effect. A possible latent effect of the tailored advice may have resulted following the process evaluation, in which 50% of the initially inactive participants from the e-mail group mentioned that the advice stimulated them to make behavioural changes (Table III).

The results of the present study are comparable with earlier Internet-based intervention studies found in literature. Mostly, only time effects for physical activity were found [17, 19, 30, 31] and only one study identified short- and medium-term interaction effects on physical activity behaviour [18]. In the latter study, the participants in the intervention group who received stage-based physical activity feedback were more physically active at moderate intensity after 1 month compared with the control group. However, this effect disappeared after 3 months. The only effect that sustained over time was the increased amount of time spent in walking activity in favour of the intervention group.

The tailored physical activity advice used in the present study has been proven earlier to be effective in increasing physical activity [20], but failed to produce significant effects here. Several reasons could explain this. First, the original study was conducted under lab conditions, implying that all participants had come to the university computer class on a specific weekend day to obtain their tailored advice. This could have created a sample more motivated to make behavioural changes. The computer class also allowed for more control over respondents: researchers could check if each participant had completed all questions and if the advice was printed out and handed over to the participant. Second, differences in sample characteristics could additionally account for some of the variations in outcomes. The participants in the previous study were less physically active at baseline (56.8% met the physical activity recommendation) leaving more room for physical activity improvement. Moreover, participants were mainly female (64%) in contrast to the present study where the proportion of women was smaller (31%). The fact that males outnumbered females in the present study could be explained by males comprising the majority of employees in the two biggest worksites where

recruitment was done (an automobile company and a company in the steel industry). Further research is needed to determine whether tailored interventions, and more specifically physical activity interventions, may be more effective among women than men.

Strengths and limitations

This study is one of the few to examine the effect of a physical activity tailored intervention delivered through the Internet and the first in a general healthy population setting. Using the Internet as a delivery channel enabled stage-based e-mails to be evaluated. Another strength was that the intervention was tested in 'real Internet conditions' and, therefore, no personal contact was required. In comparison with other Internet-based intervention studies, a relatively large sample was studied using a randomized design. Further, intervention materials were based on behavioural change theories and physical activity advice was tailored to current behaviour, physical activity determinants and behavioural constructs. The tailored intervention was compared with online standard advice instead of a no-intervention control group, as seen in other studies.

There are several limitations to note, however. First, the estimated response rate was low. Only 7% of all employees were initially interested in participating in the study. Irvine *et al.* [32], who used the same recruitment strategies as the present study, also obtained a low response rate: 10% of the employees of two worksites participated in the Interactive Multimedia program to influence eating habits. In contrast, two physical activity promotion studies, which used more intensive recruitment strategies like e-mails to all employees [19] or a combination of e-mails and telephone calls [33], found higher response rates (57 and 37%, respectively). However, the usefulness of the workplace as a recruitment setting in Internet intervention has been discussed in both studies. Demanding work tasks and receiving many electronic mailings every day could limit employees to react by e-mail and enrol in a study that has little to do with their job [19, 33]. In the present study, we choose not to use an intensive recruitment strategy as we wanted to mimic the real-life implementation as much as possible. Nevertheless, the low response and participation rate may reduce the external validity of our results and should be taken into account when considering larger scale implementation.

A second limitation is the fact that participants could take part voluntarily, causing self-selection bias. Other studies have shown that the majority of employees who participate in worksite physical activity interventions are already interested in physical activity or have been physically active in the past [34–39]. This is confirmed by high numbers of already sufficiently active participants at baseline in this study. These high levels of baseline activity, the fact that male participants outnumbered the female and that more participants had a university degree, indicate that the present sample is not representative of the Belgian population. A final limitation of the study is that physical activity findings are based on self-reported information, which could create a response bias.

Conclusion

No convincing evidence suggests that the present online-tailored physical activity intervention was more effective than online standard advice. However, the computer-tailored intervention was better used and appreciated by participants. The present study also shows that implementation of an online-tailored physical activity advice is possible. However, the results of our study showed that the Internet is a very specific communication channel and effects of the same tailoring program delivered in a different way could not be simply replicated. More research under real-life conditions should be executed to enhance our knowledge of how we can use the Internet effectively to promote physical activity. Future studies might investigate how we can reach our target group, attract them to visit the website and stay there long enough to complete the computer program and read their tailored advice.

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Conflict of interest statement

None declared.

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