

Internet provision of tailored advice on falls prevention activities for older people: a randomized controlled evaluation

LUCY YARDLEY* and SAMUEL R. NYMAN

School of Psychology, University of Southampton, Highfield, Southampton SO17 1BJ, UK

*Corresponding author. E-mail: l.yardley@soton.ac.uk

SUMMARY

Falls are very common in older persons and can result in substantial disability and distress. By undertaking strength and balance training (SBT) exercises, older people can reduce their risk of falling. The Internet offers a potentially cost-effective means of disseminating information about SBT to older people and their carers. A particular advantage of using the Internet for this purpose is that the advice given can be 'tailored' to the needs of the individual. This study used a randomized controlled design to evaluate an interactive web-based program that tailored advice about undertaking SBT activities. The participants were 280 people with an age range of 65–97 years recruited by advertising the website by email and the Internet. Those randomized to the tailored advice were presented with advice tailored to their personal self-rated balance capabilities, health problems and activity

preferences. Those in the control group were presented with all the advice from which the tailored advice was selected. After reading the advice, those in the tailored advice group ($n = 144$) had more positive attitudes ($p < 0.01$) than those in the control group ($n = 136$), reporting greater perceived relevance of the SBT activities, greater confidence in the ability to carry them out, and hence stronger intentions to undertake the activities. This study provides an initial indication that an interactive website might offer a cost-effective way to provide personalized advice to some older people. Further research is required to determine whether website-based advice on falls prevention changes behavior as well as intentions and whether the advice needs to be supplemented by other forms of support.

Key words: falls; prevention; elderly

INTRODUCTION

Falls are recognized as a major health risk for older people; one in three people aged over 65 fall each year, and falls are responsible for 80% of injury-related hospital admissions in this age group (Kannus *et al.*, 2005). Falls can result in restricted activity, loss of independence, social isolation, psychological distress and increased use of health and social services (Kannus *et al.*, 2005). The most effective way in which community-dwelling older people can reduce their risk of falling is by undertaking

strength and balance training (SBT), i.e. by regularly engaging in physical activities that increase muscle strength in the legs and improve balance (Chang *et al.*, 2004; Kannus *et al.*, 2005).

Interventions that provide personal training in individualized SBT exercises are resource-intensive and so are only reliably cost-effective for the more frail and elderly people who have the highest risk of falling (Chang *et al.*, 2004; Gillespie, 2004; Kannus *et al.*, 2005). However, interventions targeted at this group will only reach part of the population of older fallers, as

injurious falls also occur in those who are less old and frail (Stel *et al.*, 2003). There is consequently a need to develop and evaluate lower-cost interventions that can be recommended for all older people living in the community (Chang *et al.*, 2004; Skelton and Todd, 2004; Kannus *et al.*, 2005).

Promoting SBT to the wider population could have additional benefits. There is evidence that older people may be unwilling to engage in SBT if it is seen as an activity that is only necessary for those who are very old and frail, as they do not wish to be viewed in this way (Health Education Board for Scotland, 2003; Yardley *et al.*, 2006a). It may therefore be preferable to promote SBT as a means for those who are still fit and active to maintain their mobility and balance capabilities. It may also be beneficial for older people to become accustomed to carrying out SBT before they become very old and frail, as previous experience of the benefits of exercising has been cited as a reason for carrying out SBT in later life, whereas those who are very frail may lack the confidence or the cognitive capacity to begin exercising (Yardley *et al.*, 2006a).

The Internet provides an inexpensive and so potentially cost-effective means of widely disseminating information about SBT and falls prevention, both to older people themselves and to those who care for them. Currently, only a minority of older people use the Internet, but the proportion is growing very rapidly. In the UK, only 10% of people aged over 65 and one-third of those aged 55–64 said they had used the Internet when surveyed in October 2000, but by May 2005, twice as many in the oldest group (22%) and over half of those aged 55–64 reported that they had used the Internet (National Statistics, 2006). Seeking health information is one of the main uses older people make of the Internet (Morrell *et al.*, 2002).

A further potential advantage of using the Internet to provide information about SBT is that the advice can be ‘tailored’ to the user (Kreuter *et al.*, 1999), i.e. the needs, capabilities and preferences of the user can be assessed in order to select a package of advice that is individualized to the characteristics of the user. In practical terms, this means that the advice can provide more details of relevant information (for example, regarding management of their particular risk factors for falling) without burdening the user with a large amount of

irrelevant information. In psychological terms, if the proportion of material that is regarded as personally relevant and persuasive is increased, this will result in greater attention to the message and the formation of stronger and more enduring positive attitudes towards the behavior promoted (Kreuter *et al.*, 1999). Tailoring advice on SBT to the individual may be particularly important, since whether SBT is viewed as appropriate for someone like themselves is a key predictor of whether older people are motivated to undertake SBT (Yardley *et al.*, in press).

Although leaflets have been used most commonly to deliver the tailored information, there is now an increasing interest in the potential of interactive technology (Vandelanotte *et al.*, 2005). An interactive telecommunication system has been used to present tailored arguments for undertaking activity to older women (Jarvis *et al.*, 1997). A web-based program to promote physical activity in young disabled people allowed users to effectively tailor the information they viewed themselves, by clicking on links for advice relevant to their situation (Kosma *et al.*, 2005).

Our literature search found only one published evaluation of a website designed to present tailored information about falls prevention to older people (Ezendam *et al.*, 2005). This site presented a choice of 20 cases illustrating how people of different ages and genders and with different health problems approached the problem of falls prevention. In a small group of older users and carers, most reported that they were able to find a case that contained some appropriate information for their own situation, but many users felt that the cases were not personally relevant and contained too much situation-specific detail.

The aim of our study was to compare the attitudes towards undertaking SBT activities of two groups of older people, an intervention group presented with tailored advice on SBT and a control group presented with generic advice on SBT. Tailoring of advice was based on self-rated balance, health problems and activity preferences, which were used to create an individualized selection of the generic advice given to the control group. Our hypothesis was that website users who received tailored advice would see it as more interesting, personally relevant and suitable for them, would be more confident that they could carry it out and that it would be

effective and would therefore have stronger intentions to undertake the recommended SBT activities.

METHODS

Study design and procedure

Reactions to tailored and non-tailored advice were compared using a between-subjects design. The outcome measures were six items taken from Kreuter *et al.* (Kreuter *et al.*, 2000), scored from 1 (disagree strongly) to 6 (agree strongly), assessing: intention to carry out the recommended activities; self-efficacy (confidence in ability to do the activities); outcome expectancy (belief that the activities will improve balance); interest; suitability of the activities and personal relevance. Both groups were asked about their age, gender, self-rated balance and presence of health problems known to be related to balance and falling (Table 1).

The study was approved by the University of Southampton School of Psychology Ethics Committee, and the website was located at www.balancetraining.org.uk. Participants were recruited by advertising the balance training website on the websites of RioMed (a company providing software for UK health professionals working in the field of falls) and Help the

Aged, a leading UK charity for older people. An email advertising the website was sent to around 5000 people on the RioMed and Help the Aged distribution lists for information about falls prevention.

From the effect sizes obtained in an Internet study of tailoring nutrition education (Oenema *et al.*, 2001) that used similar measures, we calculated that we would need a sample size of 130 per group to have 80% power to test a two-tailed hypothesis with an alpha level of 0.05. Data were collected continuously from July to December 2005. We excluded data from people aged below 65 and those who entered the site more than once.

Website design

The website first explained what balance training consists of (described as physical activities that provide practice in moving freely in all directions and increase strength in the legs and body) and why it can benefit people of all ages, especially people with balance problems. The next page requested informed consent to collect data. The website then automatically randomized participants to the tailored or control (generic) advice groups depending on whether the exact time at which the participant entered the trial corresponded to an odd or an even number (thus maintaining blind, concealed allocation of participants). In both groups, the outcome measures were administered at the end of the pages on which the advice was presented.

Tailored webpages

The first part of the tailored pages consisted of questions used to tailor the advice, which was presented in the final pages. Self-rated balance and preferences for where the activity was carried out (at home, outside the home and/or in a group or class) were used to select a menu of advice about suitable activities and how these could contribute to improving balance. The most challenging activities (e.g. rambling and jogging, cycling, swimming, sports, dancing and going to the gym) were only recommended to those who indicated that their balance was good or quite good, whereas the least challenging activities (gardening, housework and home hazard reduction) were only recommended to those who indicated that they had balance problems. SBT exercises carried

Table 1: Frequencies (% of group) of participant gender, self-rated balance and health conditions as a function of advice condition

	Tailored (<i>n</i> = 144)	Control (<i>n</i> = 136)	Total (<i>n</i> = 280)
Gender			
Male	54 (37)	42 (31)	96 (34)
Female	90 (63)	94 (69)	184 (66)
Self-rated balance			
Good	11 (8)	13 (9.5)	24 (9)
Quite good	38 (26)	32 (23.5)	70 (25)
Have some problems	95 (66)	91 (67)	186 (66)
Health condition			
Unsteadiness	106 (74)	97 (71)	203 (73)
Poor vision	43 (30)	34 (25)	77 (28)
Take \geq 4 medications	51 (35)	60 (44)	111 (40)
Take <4 medications	52 (36)	38 (28)	90 (32)
Take no medication	41 (29)	38 (28)	79 (28)
Osteoporosis	44 (31)	42 (31)	86 (31)

out at home or in a class, walking and Tai Chi, Yoga and Pilates were recommended for all levels of self-reported balance, but were presented differently to the different groups (for example, regarding how strenuous the activity should be). Participants then selected their preferred activities from a list of suggested activities. Final personalized recommendations consisted of an explanation of how each kind of activity they had selected would improve their balance (e.g. either by strengthening the legs or by improving coordination) and additional advice relating to their particular health problems (e.g. poor vision, osteoporosis).

Control webpages

The control pages first assessed the demographic and health-related variables, then presented all of the advice from which the tailored advice was selected and grouped into meaningful categories (e.g. 'Balance training exercises that you can do at home' and 'Improving balance while getting out and about'). The description of all the activities was followed by an explanation of how each kind of activity would contribute to improving balance, and the advice relating to all the health problems known to be related to balance and falling.

RESULTS

Participant characteristics

A total of 280 people (144 tailored group, 136 control group) progressed through the entire website and completed the evaluation questionnaire. There was an equivalent dropout rate after entering the site in the tailored ($n = 77$, 35%) and control groups ($n = 69$, 34%). There were no significant differences between those who dropped out and those who completed in terms of age, gender, self-rated balance and health conditions. The participants were aged 65–97 y ($M = 77.25$, $SD = 7.11$), with no significant difference in age between the tailored ($M = 77.51$, $SD = 7.43$) and control ($M = 76.96$, $SD = 6.77$) groups. There were also no significant differences between the tailored and control groups in terms of gender, self-rated balance and health conditions (Table 1). Most participants reported some balance problems and unsteadiness.

Information was available from the tailored group regarding preferences for balance training activities. Most people ($n = 104$, 72%) chose home-based SBT exercises as their principal activity, whereas only 17 (11.8%) wanted to carry out SBT exclusively or additionally in a group or class.

Comparison of tailored and control advice groups

All outcome measures were log-transformed to reduce the skew in responses. MANOVA revealed a significant difference between the advice conditions on the outcome measures [$F_{(6,273)} = 2.98$, $p < 0.01$]. The tailored group expressed a stronger intention to do the recommended activities than the control group and reported that they found the advice more personally relevant and had greater confidence that they could carry it out (Table 2). Univariate tests confirmed that there was a significant difference between the tailored and control groups on ratings of the personal relevance of the advice [$F_{(1,278)} = 6.15$, $p = 0.014$], self-efficacy for carrying out SBT [$F_{(1,278)} = 3.98$, $p = 0.047$] and intention to carry out SBT [$F_{(1,278)} = 4.31$, $p = 0.039$], but not on reports of the advice being more suitable or interesting or expectation that the recommended activities would improve their balance.

Since the data were not normally distributed, non-parametric Mann–Whitney U tests were performed to check that our results were not influenced by violations of the assumptions of MANOVA. These tests also confirmed a significant difference between the tailored and control groups on the variables of intention to perform

Table 2: Mean (SD) post-advice questionnaire scores as a function of advice condition

Item	Tailored ($n = 144$)	Control ($n = 136$)	95% confidence interval for the difference
Intention	4.86 (0.61)	4.65 (0.79)	−0.068, −0.002
Personal relevance	4.83 (0.65)	4.60 (0.77)	−0.071, −0.008
Interest	5.03 (0.61)	5.08 (0.64)	−0.020, 0.048
Suitability	4.95 (0.60)	4.80 (0.79)	−0.055, 0.009
Self-efficacy	4.61 (0.70)	4.35 (0.95)	−0.069, −0.000
Outcome expectancy	4.78 (0.67)	4.79 (0.74)	−0.027, 0.039

balance training, personal relevance and self-efficacy.

We then carried out *post hoc* analyses to determine whether there were any differences in outcome according to age and gender and whether participants reported unsteadiness. Age was dichotomized using a median split into two age groups (65–77 and 78–98) and then entered into a MANOVA with advice condition as a second independent variable. Younger participants reported more positive attitudes on the post-advice questionnaire [$F_{(6,271)} = 3.12, p < 0.01$]. Univariate tests revealed that younger participants reported higher levels of personal relevance [$F_{(1,276)} = 6.25, p = 0.013$], suitability of the advice [$F_{(1,276)} = 4.94, p = 0.027$], self-efficacy [$F_{(1,276)} = 5.83, p = 0.016$] and outcome expectancy [$F_{(1,276)} = 7.99, p = 0.005$]. However, there was no interaction between age and advice condition, indicating that tailoring the advice was equally effective in promoting more positive attitudes in older and younger participants. Similarly, reporting unsteadiness influenced outcome [$F_{(6,271)} = 4.06, p < 0.001$], with those who were not unsteady reporting greater suitability of the advice [$F_{(1,276)} = 5.85, p = 0.016$] and strong beliefs in outcome expectancy [$F_{(1,276)} = 16.08, p < 0.001$]. However, there was no interaction between unsteadiness and advice condition, indicating that tailoring the advice was equally effective for those who were and who were not unsteady. MANOVA with gender and advice condition as the independent variables did not reveal any effect of gender on outcome, and there was no interaction between gender and advice condition.

DISCUSSION

Effects of tailored advice on attitudes and intentions

Tailored advice resulted in greater perceived relevance of the SBT activities, greater confidence in the ability to carry them out and hence stronger intentions to undertake SBT activities. Previous tailored studies have not always been able to influence attitudes and intentions regarding physical activity and exercise (Marcus *et al.*, 1998; Bull *et al.*, 1999a, b) and so these results indicate that we had correctly identified the factors that would affect

participants' views of the advice (Kreuter *et al.*, 2000). Although younger participants and those with better balance had more positive attitudes towards the advice to undertake SBT activities, tailoring the advice was equally effective for younger and older users and those who did and did not report unsteadiness.

Limitations of the study and recommendations for further research

The difference between ratings of the tailored and generic advice was small. This may have been because participants were self-selected and able to withdraw very easily, and so were mainly people who already had positive attitudes towards the kind of advice the website offered. This resulted in a ceiling effect on the extent to which tailoring could positively influence attitudes. Moreover, tailoring is most effective when the target population is heterogeneous (Kreuter *et al.*, 1999), but our self-selected sample was more homogeneous than we had expected, comprising mainly quite old and frail people with balance problems who wanted to carry out SBT exercises at home. While it is predictable that this population might be the most highly motivated to log on to the website, we had anticipated that the profile of older Internet users might include more fit and healthy older people. The tailored information had therefore been specifically designed to be attractive even to this group, who typically consider falls prevention advice irrelevant to them, by promoting enjoyable activities that could maintain functioning rather than emphasizing reduction of falls risk (Yardley *et al.*, 2006b).

The characteristics of the sample also limit the extent to which the findings can be generalized to the general population. As noted above, the self-selected sample had generally positive attitudes to falls prevention and a high prevalence of balance problems. Over one in three participants dropped out of the study without completing most of the measures, and it was not possible to determine why they dropped out. Further research is therefore required to determine whether the tailored advice can persuade older people who do not yet perceive themselves as having balance problems to undertake SBT or convince those with doubts about its suitability and efficacy.

Our website tailored advice according to activity preferences and self-rated health and

balance problems. A problem with relying on self-assessment of balance capabilities is that if participants over- or underestimate their abilities they may be provided with inappropriate advice. In future, it might be useful to develop and incorporate simple tests that older people could use to assess their capabilities realistically. In order to maximize participation in the study, we employed only single-item outcome measures that are likely to have had limited reliability and sensitivity. It would be useful to assess participants' views more comprehensively using both qualitative and quantitative methods (Kreuter *et al.*, 2000). Only basic tailored advice was provided, and future research could examine the benefits of matching advice more closely to the particular health needs and circumstances of the individual and their beliefs about the necessity, safety and feasibility of carrying out SBT activities. This study was only able to assess attitudes and intentions towards carrying out SBT. Intentions have been shown to predict behavior (Webb and Sheeran, 2006), but behavior is also influenced by additional factors such as planning, opportunities, skills and support. Further research is required to determine whether website-based advice on falls prevention does change behavior and whether the advice needs to be supplemented by other forms of support.

Education and socio-economic status were not assessed in this study, but it is well known that Internet users are more highly educated and wealthy than the general population (Morrell *et al.*, 2000). Many older people may have difficulty searching for and using health information on the Internet because of lack of education, confidence, access, cognitive impairment or physical disability (Morrell *et al.*, 2000). In addition, many older people need specialist assessment and management of their falls risk, for example, to correct medical conditions requiring treatment and to provide those who are at high risk of falling with personal advice, supervision and encouragement for performing SBT activities that they may find difficult and risky. Nevertheless, it may prove possible to use web-based advice as a resource for those who work with or care for older people who cannot themselves use it.

Summary and conclusions

This is the first study to compare the effect of tailored and generic falls prevention advice on

the attitudes and intentions of older people. We found that, in comparison with a control group presented with generic advice about SBT activities, an intervention group presented with advice tailored to their self-rated health, balance and activity preferences scored more highly on items assessing the perceived relevance of SBT activities, their confidence in undertaking them and their intention to carry them out. No difference between the groups was found on measures of the interest, suitability or perceived efficacy of the activities. Our findings provide some initial evidence that interactive websites might provide a cost-effective medium for promoting positive attitudes towards SBT. However, this format will not be suitable for all older people, and further research is needed to establish whether website-based advice can be used to promote an increase in performance of SBT activities.

ACKNOWLEDGEMENTS

This study was funded by a PhD studentship from the Economic and Social Research Council, UK. We thank Mario Mohammed and James Durrant (RioMed) for developing the website, Pamela Holmes and Cheryl Blake (Help the Aged, UK) for commenting on and advertising the website and members of the Prevention of Falls Network Europe (ProFaNE) for checking the safety and appropriateness of the advice on the website.

REFERENCES

- Bull, F. C., Jamrozik, K. and Blanksby, B. A. (1999a) Tailored advice on exercise—Does it make a difference? *American Journal of Preventive Medicine*, **16**, 230–239.
- Bull, F. C., Kreuter, M. W. and Scharff, D. P. (1999b) Effects of tailored, personalized and general health messages on physical activity. *Patient Education and Counseling*, **36**, 181–192.
- Chang, J. T., Morton, S. C., Rubenstein, L. Z., Mojica, W. A., Maglione, M., Suttorp, M. J. *et al.* (2004) Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomized controlled trials. *British Medical Journal*, **328**, 680–683.
- Ezendam, N. P. M., Alpay, L. L., Rövekamp, T. A. J. M. and Toussaint, P. J. (2005) Experimenting with case-based reasoning to present educative health information on the internet: the example of Senior Gezond. *Studies in Health Technology and Informatics*, **116**, 867–872.
- Gillespie, L. D. (2004) Preventing falls in elderly people. *British Medical Journal*, **328**, 653–654.

- Health Education Board for Scotland. (2003) The construction of the risks of falling in older people: lay and professional perspectives. Retrieved 4 April 2006 from www.hebs.scot.nhs.uk/topics/
- Jarvis, K. L., Friedman, R. H., Heeren, T. and Cullinane, P. M. (1997) Older women and physical activity: using the telephone to walk. *Women's Health Issues*, **7**, 24–29.
- Kannus, P., Sievanen, H., Palvanen, M., Jarvinen, T. and Parkkari, J. (2005) Prevention of falls and consequent injuries in elderly people. *Lancet*, **366**, 1885–1893.
- Kosma, M., Cardinal, B. J. and Mccubbin, J. A. (2005) A pilot study of a web-based physical activity motivational program for adults with physical disabilities. *Disability and Rehabilitation*, **27**, 1435–1442.
- Kreuter, M. W., Strecher, V. J. and Glassman, B. (1999) One size does not fit all: the case for tailoring print materials. *Annals of Behavioral Medicine*, **21**, 276–283.
- Kreuter, M., Farrell, D., Olevitch, L. and Brennan, L. (2000) *Tailoring Health Messages: Customizing Communication with Computer Technology*. Erlbaum, London.
- Marcus, B. H., Bock, B. C., Pinto, B. M., Forsyth, L. H., Roberts, M. B. and Traficante, R. M. (1998) Efficacy of an individualized, motivationally-tailored physical activity intervention. *Annals of Behavioral Medicine*, **20**, 174–180.
- Morrell, R. W., Mayhorn, C. B. and Bennett, J. (2000) A survey of world wide web use in middle-aged and older adults. *Human Factors*, **42**, 175–182.
- National Statistics. (2006). Adults who have ever used the Internet by sex/age (Great Britain): individual Internet access. Retrieved 14 March 2006 from <http://www.statistics.gov.uk/statbase/ssdataset.asp?vlnk=6928&More=Y>
- Oenema, A., Brug, J. and Lechner, L. (2001) Web-based tailored nutrition education: results of a randomized controlled trial. *Health Education Research*, **16**, 647–660.
- Skelton, D. and Todd, C. (2004) *What are the main risk factors for falls amongst older people and what are the most effective interventions to prevent these falls? How should interventions to prevent falls be implemented?* Health Evidence Network Synthesis, World Health Organization, Copenhagen.
- Stel, V. S., Pluijm, S. M. F., Deeg, D. J. H., Smit, J. H., Bouter, L. M. and Lips, P. (2003) A classification tree for predicting recurrent falling in community-dwelling older persons. *Journal of the American Geriatrics Society*, **51**, 1356–1364.
- Vandelandotte, C., De Bourdeaudhuij, I., Sallis, J. F., Spittaels, H. and Brug, J. (2005) Efficacy of sequential or simultaneous interactive computer-tailored interventions for increasing physical activity and decreasing fat intake. *Annals of Behavioral Medicine*, **29**, 138–146.
- Webb, T. L. and Sheeran, P. (2006) Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, **132**, 249–268.
- Yardley, L., Bishop, F. L., Beyer, N., Hauer, K., Kempen, G. I. J. M., Piot-Ziegler, C. *et al.* (2006a) Older people's views of falls prevention interventions in six European countries. *The Gerontologist*, **46**, 650–660.
- Yardley, L., Donovan-Hall, M., Francis, K. and Todd, C. (2006b) Older people's views of advice about falls prevention: a qualitative study. *Health Education Research*, **21**, 508–517.
- Yardley, L., Donovan-Hall, M., Francis, K. and Todd, C. J. Attitudes and beliefs that predict older people's intention to undertake strength and balance training. *Journal of Gerontology: Psychological Sciences*, (in press).