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Cost Analysis of Internet vs. Print Interventions for Physical Activity Promotion

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Abstract

Objective—The objective of this study was to compare the costs associated with Internet and print-based physical activity interventions.

Method—The costs associated with delivering tailored print and Internet-based interventions were estimated from a randomized controlled physical activity trial (n=167). The estimates were based on research assistant time sampling surveys, web development invoices, and other tracking procedures.

Results—Web-development costs for the Internet intervention were \$109,564. Taken together with the website hosting fees and staff costs, the cost per participant per month was \$122.52. The cost of the print intervention was \$35.81 per participant per month. However, in a break-even analysis, the Internet intervention became more cost-efficient, relative to the print intervention, when the total number of participants exceeded 352.

Conclusions—Relative to print-based interventions, Internet-based interventions may be a more cost efficient way to reach a large number of sedentary individuals.

Keywords

Exercise; Web; Sedentary

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Introduction

Internet-based interventions are effective for improving health (e.g., Lustria, Cortese, Noar, & Glueckauf, 2009; Murray, Burns, See Tai, & Nazareth, 2005). For example, results from a Cochrane review indicated that “interactive health communication applications,” which are usually Internet-based, are effective for increasing knowledge and may improve outcomes (Murray et al., 2005). Similarly, a recent review found that Internet-based interventions that are tailored to the individual show promise for improved health (Lustria et al., 2009). Several studies have examined the efficacy of Internet-based interventions specifically targeting physical activity (for reviews see Ciccolo, Lewis, & Marcus, 2008, Vandelanotte, Spathonis, Eakin, & Owen, 2007) and have found that Internet-based physical activity interventions appear to be similarly efficacious to previously validated interventions (Ciccolo et al., 2008).

Despite the increased research examining Internet-based physical activity interventions, there is a lack of studies examining the cost associated with these interventions (Murray et al., 2005; Murray, 2008). Several studies have examined the cost of delivering physical activity interventions; however, a majority of these studies included face-to-face interventions (Elley et al., 2004; Proper et al., 2004; Sevick et al., 2000; Stevens, Hillsdon, Thorogood, & McArdle, 1998). Only one study, that we are aware of, has examined the cost-effectiveness of non face-to-face interventions for physical activity promotion. Specifically, Sevick and colleagues (2007) found that a print intervention was more cost-effective than a telephone intervention. The cost of moving a participant from sedentary to active status during the first 6 months of the intervention was \$1,290 for the telephone intervention and \$756 for the print intervention. The costs were \$3,967 and \$955 at 12 months, respectively.

The purpose of the present study was to examine the relative cost of an Internet and print-based physical activity intervention that were matched for content and were equally efficacious (Marcus, Lewis, Williams, Dunsiger, Jakicic, et al., 2007; Marcus, Lewis, Williams, Whiteley, Albrecht et al., 2007). No study, that we are aware of, has examined the cost of an Internet-based physical activity intervention relative to another mode of delivery. It is a widely held belief among researchers that Internet-based physical activity interventions are less costly than traditional modes of delivery such as print. However, there is a lack of empirical data to support this widely held belief. Internet-based interventions can be very costly to develop and therefore, it is important to examine Internet-based interventions relative to other modes of delivery. It is also important to examine at what point (i.e., number of participants) Internet interventions become more cost efficient than other types of interventions. For the current study, it was hypothesized that a theory-based, individually-tailored Internet intervention, though more expensive to develop, would be less expensive than a print intervention as the number of participants increased.

Methods

Participants

Participants were healthy, sedentary (90 minutes or less of physical activity per week) adults ages 18 and older ($n = 249$) who participated in a randomized controlled trial examining the relative efficacy of print and Internet-based interventions for physical activity adoption (see Figure 1). The sample was primarily non-Hispanic Caucasian individuals (76.3%) and women (82.7%) who were recruited primarily through newspaper advertisements from the Providence, RI (75% of sample) and Pittsburgh, PA areas. Participants read and signed consent forms, which were approved by both institutional review boards

Design of the Overall Trial

In the overall trial, participants were randomly assigned to one of three conditions: (1) Tailored Internet ($n = 81$); Tailored Print ($n = 86$); or Standard Internet ($n = 82$). To conduct the randomization, a random numbers table was generated by the study statistician using a computer software program and envelopes containing group assignment were created. The sample was stratified on baseline stage of change and gender. The randomization allocation envelopes were opaque and sequentially numbered for each stage of change and gender. The participant opened the envelope in the presence of study staff not involved in the intervention and assessments were conducted by staff not involved in the intervention. Sample size estimates for the current study were calculated using effect sizes obtained from a previous similar trial (Marcus et al., 1998).

Tailored Internet participants received access to the study website, obtained regular automated email prompts, and received automated motivationally tailored theory-based feedback based on the Transtheoretical Model and Social Cognitive Theory. According to the Transtheoretical Model, participants move through a series of stages when making a behavior change (i.e., precontemplation, contemplation, preparation, action, and maintenance). Participants received targeted messages depending on which stage of change they were at (Marcus & Forsyth, 2009). For example, participants in the contemplation stage (i.e., thinking about increasing their physical activity) received messages designed to motivate them to begin a physical activity program and participants in the action stage received messages about strategies to maintain their physical activity in the long-term. Another theory used in the intervention was Social Cognitive Theory, which states that self-efficacy (i.e., one's confidence for physical activity) is an important component of behavior change (Bandura, 1977).

Participants completed questionnaires that assessed key theoretical constructs related to the Transtheoretical Model and Social Cognitive Theory including behavioral processes, cognitive processes, self-efficacy, and decisional balance. The tailored feedback was based on responses to the questionnaires. For example, if a participant scored low on self-efficacy, the participant received messages outlining strategies to increase self-efficacy. Participants also self-monitored their physical activity and set goals through the study website. Participants completed the questionnaires each month and received intervention materials weekly during the first month, bi-monthly during months two and three, and monthly during months 4–12. Regarding retention, 89.2% of the participants completed the 6 months follow-up and 87.1% completed the 12-month follow-up. There was no differential drop-out between the three groups.

Print intervention participants received the same intervention except it was delivered through the mail. Standard Internet participants were regularly prompted to self-monitor online and to access six websites available to the public. Tailored feedback was not provided for the Standard Internet arm. It was not possible to calculate the costs of the publicly available websites. Moreover, the purpose of the study was to compare the costs associated with the Internet and Print interventions that were matched for content. Therefore, the cost analysis included only the Tailored Internet and Tailored print conditions ($n = 167$).

Results of the Main Trial

The results of the overall findings are presented elsewhere (Marcus et al., 2007a). In brief, participants in all three conditions significantly increased their moderate to vigorous physical activity but there were no differences between groups. Participants in the tailored Internet arm increased from a median of 0 minutes per week at baseline to 120 minutes at six months and 90 minutes at 12 months (medians are reported due to skewed data) based on

the 7-Day Physical Activity Recall Interview (i.e., the primary outcome variable). The tailored print arm increased from a median of 0 minutes per week at baseline to 112.5 minutes at six months and 90 minutes at 12 months. The Standard Internet arm increased from a median of 10 minutes per week at baseline to 90 minutes at six months and 80 minutes at 12 months

Procedure

Start-up costs and cost per participant were compared for both interventions. For the print intervention, cost per participant was calculated by summing the cost of paper, ink, printer maintenance, envelopes, and postage. For the Tailored Internet intervention, invoices from the web developer were totaled and costs associated with research only (e.g., costs for tracking website use) were subtracted from the total cost. Internet hosting and maintenance fees were calculated per participant. Regarding staff costs, a time sampling procedure was conducted in which staff documented minutes per day spent on the interventions over one week. Tasks for the print arm included mailing the questionnaires, scanning the questionnaires, mailing the tailored reports, and answering any questions participants may have had. Tasks for the Internet arm included trouble shooting problems participants may have had with the intervention website. Staff time costs per participant were calculated by multiplying the number of hours by their hourly rate and dividing by the number of participants enrolled in the intervention at the time of the assessment week. Because the two intervention conditions (Internet and print) were equally efficacious in this study, an overall cost analysis was conducted for the interventions rather than a cost-benefit analysis (physical activity is already controlled by nature of the equivalent outcomes).

Results

Tailored Print Intervention

The cost of the interventions is outlined in Table 1. Specifically, the cost of materials (i.e., paper, envelopes), printer/scanner maintenance, and postage for the tailored print intervention was \$64.69 per year per participant. Based on the time sampling surveys, the staffing cost was \$365 per year per participant for the tailored print intervention. Therefore, the total cost of delivering the 12-month print intervention was \$429.69 per participant, which was \$35.81 per month (consistent with Sevick et al., 2007).

Tailored Internet intervention

The cost of developing the intervention website was \$109,564 (per participant cost was \$1,352.64). The per participant cost of hosting and maintaining the website was \$45.15. The average cost of staff time per participant was \$72.50. Taken together, the cost of the 12-month Tailored Internet intervention per participant was \$1,470.29, which was \$122.52 per month.

Comparison of Interventions

Figure 2 summarizes what the total costs for the tailored print and tailored Internet interventions would be based on the cost calculation above (i.e., per participant cost) and the number of participants enrolled in the intervention. In other words, how much the intervention would cost was calculated depending on how many people are using the intervention. Based on the extrapolation, the Internet intervention becomes less costly per participant relative to the print intervention as the number of participants increases past 352.

Discussion

Several studies have examined the efficacy of Internet-based physical activity interventions (Vandelanotte et al., 2007); however, little is known regarding the cost of these interventions relative to other non-face-to-face interventions such as print. Some researchers have suggested that Internet interventions are advantageous to other non face-to-face intervention given their potential for widescale dissemination (Napolitano & Marcus, 2002); however, Internet interventions can be costly to develop. The results of the present study indicated that 352 participants would be needed to overcome the start-up costs of the Internet-based intervention relative to our print-based intervention. Thus, these findings suggest that Internet-based interventions may be less costly to disseminate than print interventions for larger samples; however, additional research is needed to confirm this finding. It should be noted that barriers to disseminating Internet-based interventions have been documented in the literature. For example, it is important for interventions to contain strategies that increase the probability of participants revisiting the intervention website and the amount of time needed to participate in the intervention should be reasonable (e.g., Crutzen et al., 2008).

There are a few limitations to the above study. First, the staff time sampling exercise was self-report and this may not have accurately reflected time spent on completing the intervention related tasks. Second, the analysis examining at which point the Internet became less expensive than print was an extrapolation of the data and therefore, the findings should be interpreted cautiously. Furthermore, the extrapolation of the cost estimates assumes the same additional cost for each added participant. A third limitation is that the measurement of physical activity as part of the trial's primary outcome measure may have influenced participants' physical activity levels (i.e., reactivity of assessment). Finally, the sample consisted of mostly Caucasian individuals and women, which may not generalize to all populations.

In summary, the study findings suggest that even though Internet-based interventions may be more costly to develop than print-based interventions, Internet interventions may be less costly per participant as the number of participants increase. Staff time and mailing costs continue to increase with each additional participant for print interventions; however, cost associated with Internet-based intervention only minimally increase as the number of participants increase. Therefore, Internet-based intervention can potentially impact an unlimited number of people for almost no additional cost. Consequently, regarding widescale dissemination, it may be more cost efficient to use the Internet rather than mail-based interventions for physical activity intervention dissemination. It is important to note that a full scale cost-benefit analysis was not conducted and therefore, the study findings should be interpreted with caution. Future studies utilizing larger sample sizes and various types of Internet interventions should be conducted to better understand intervention cost.

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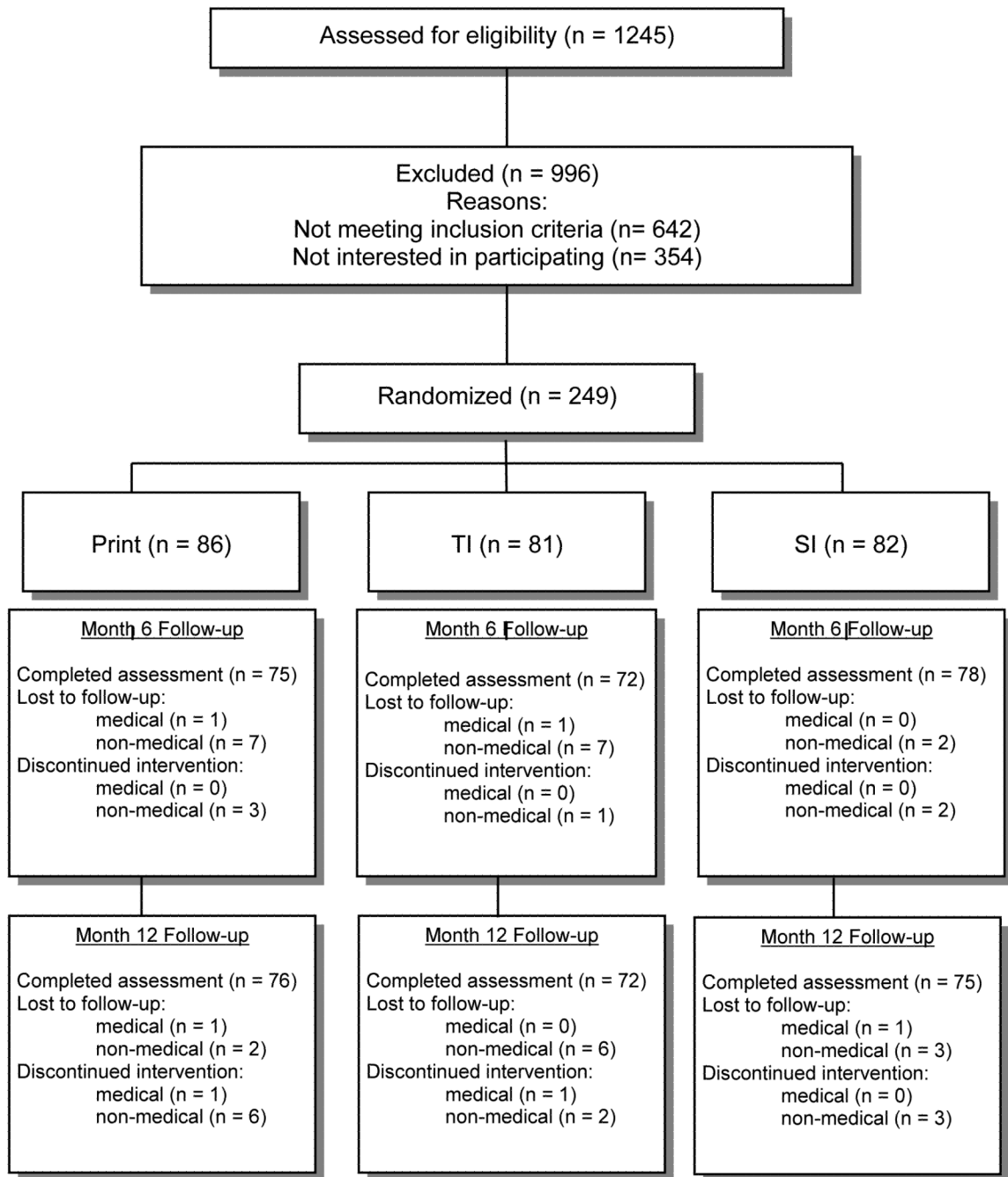


Figure 1.
Participant Flow Diagram

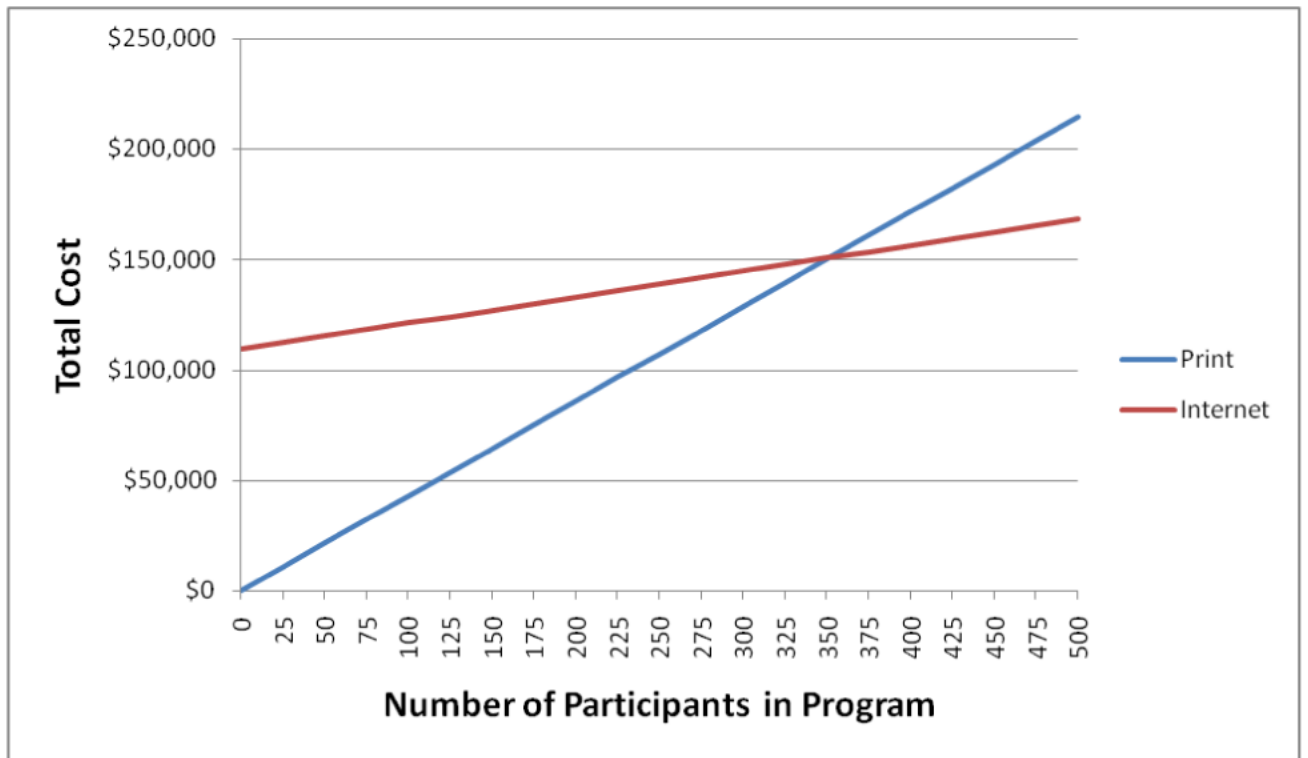


Figure 2. Cost of Implementing Intervention Program by Number of Participants in the Intervention and Type of Intervention.

Table 1

Per Participant Cost of Tailored Print and Tailored Internet Interventions

Cost Source	Tailored Print	Tailored Internet
Paper for Tailored Reports	\$0.56	\$0.00
Questionnaire Scan Paper	\$2.71	\$0.00
Printer Maintenance *	\$4.65	\$0.00
Ink for Printer	\$12.95	\$0.00
Envelopes for Mailing	\$9.13	\$0.00
Postage	\$34.69	\$0.00
Staff Costs **	\$365.00	\$72.50
Website Development	\$0.00	\$1,352.64
Website Maintenance	\$0.00	\$20.00
Website Hosting	\$0.00	\$25.15
Per Participant Total	\$429.69	\$1,470.29

* Based on total cost divided by number of participants in the print arm (n=86).

** Staff costs were based on time estimate surveys completed by study staff.