Determining the reach of a home-based physical activity program for older adults within the context of a randomized controlled trial

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Abstract

Determining the reach of physical activity (PA) programs is challenging due to inconsistent reporting across studies. The purpose of this study was to document multiple indicators of program reach for a 6-month, Digital Versatile Disc (DVD)-delivered home-based PA program. Radio, newspaper and direct mailing advertisements were tracked to determine costs as well as the number and representativeness of older adults exposed and responding to recruitment. It was estimated that all older adults in the recruitment area (n = 105,515) may have been exposed to at least one of the recruitment strategies—563 responded and 383 were screened as eligible. Of those that enrolled (n = 307), the DVD reached between 81% and 97% of the participants over each month within the 6 month period. Newspaper advertisements were most effective (n = 222) at a cost of $78 per participant enrolled. Conclusion: Using multiple indicators of reach supports the accurate calculation and generalizability of recruiting older adults into PA programs.

Introduction

The health benefits of regular, moderate-intensity physical activity (PA) for older adults have been well documented [1]. Over 85% of older adults suffer from at least one chronic disease, a majority of which can be alleviated by engaging in PA [2], and recent evidence indicates that there are important benefits to be gained when the PA includes strength and flexibility training [3]. There is a need to implement effective PA programs that have the ability to reach a broad cross-section of older adults for the following reasons: (i) the rapidly increasing older adult population (i.e. increasing to 72 million people within the next 25 years) [4] and (ii) the very low prevalence of PA (as low as 2.4% in some cases) that characterizes this population [5]. Indeed, the public health promise of increased PA for older adults is based on both the reach and effectiveness of newly developed interventions.

The reach of an intervention is characterized by the number, proportion and representativeness of intervention participants when compared with the target population [6]. However, few PA interventions for older adults are designed in such a way as to enhance the potential reach. For example, a series of intervention studies have been successful in enhancing psychosocial function, cardiorespiratory fitness and brain structure and function [7–9]. However, these programs required participants to attend three weekly exercise sessions, each lasting approximately 1 hour, over the course of a 12-month period. Although the efficacy of these interventions has been examined, we know little about the proportion of older adults who participate in these intensive center-based programs and whether those who...
chose to participate are representative of the general aging population in terms of chronic disease risk factors and diagnoses and sociodemographic characteristics.

More broadly, there is evidence that it is difficult to translate intensive, in-person behavioral programs into typical clinical or community programs [10]. Regarding the former, intensive PA programs do not fit well within the current clinical structure; practitioners often lack confidence in delivering behavior change information, there is a lack of resources available and it is difficult to receive insurance payments for these programs [11, 12]. That is, it is not likely that intensive PA programs can be delivered and sustained within the current clinical care model. Similarly, intensive interventions are difficult to integrate into community settings, where those who deliver health education programs place value on the feasibility of a given intervention relative to their available time and resources [13]. Finally, potential intervention participants are less likely to agree to participate in research programs that meet frequently over a long period [14].

In this study, we were interested in developing a way to package and deliver a center-based program that focused on flexibility, toning and balance. This packaged program would have the potential to reach older adults who typically would be unable to come to our center-based program across a wide geographic location. To this end, we developed the FlexToBa™ program, a Digital Versatile Disc (DVD)-delivered home-based exercise program for older adults specifically designed to have high reach [8]. The FlexToBa trial tested the effectiveness of a home-based PA program focusing on improving flexibility, strength and balance that was low cost with few time, resource or implementation requirements. Initial indications were that the program significantly improved the functional performance of intervention participants when compared with the control condition, and the changes were statistically and clinically meaningful [3].

In this article, we provide a comprehensive description of the reach of the FlexToBa trial by reporting on four proportional indicators of reach. We examined the representativeness of the study participants relative to the geographic region and compared them with eligible participants who declined participation. Although this article reports on reach, the overall trial was designed and evaluated using the Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) framework [15] which guides researchers to consider costs associated with engaging participants and delivering content as well as program effectiveness [16]. As such, we also report on the relative cost across recruitment strategies used with the FlexToBa trial. Finally, we were interested in determining reach over the course of the 6-month intervention (e.g. participant reporting of use of the DVD over time).

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### Methods

#### Design

Community dwelling adults aged 65 years and older who were not meeting PA recommendations, but had no conditions likely to be exacerbated by flexibility, toning and balance exercises, were eligible for the study. These broad eligibility criteria were implemented to increase external validity and generalizability of findings [6]. Following all baseline testing, eligible participants were randomly assigned to an active intervention (FlexToBa DVD) or an educational control matched on format of delivery (i.e. Healthy Aging™ DVD). For the protection of the participants, the University of Illinois at Urbana-Champaign Institutional Review Board approved all procedures.

#### Intervention and control conditions

FlexToBa was a 6-month DVD-delivered program that combined flexibility, toning and balance exercises. This PA structure (i.e. flexibility, toning and balance) has been associated with reduced risk of chronic disease, increased quality of life and chronic disease management [1]. To increase compliance and adherence to the PA protocol of the program, FlexToBa is heavily driven by the basic tenets of social cognitive theory [17]. Participants completed daily exercise logs that were mailed to the research
staff on a monthly basis. Data from these logs were used to create individualized feedback on progress and to provide tips for setting and meeting new goals. The control arm received a DVD (Healthy Aging by Andrew Weil, MD) that provided information relative to a variety of domains of healthy aging (e.g. emotional, physical, spiritual well-being, diet, etc.). Participants in both conditions received telephone support calls that were delivered in a titrated manner (further detailed elsewhere) [3]. The DVD program had significant improvements in the Short Physical Performance Battery, lower extremity flexibility and upper body strength [3].

Determining the sample
We targeted 83 towns and cities from 29 counties across 5000 square miles of central Illinois for intervention delivery. Potential reach was calculated using census data to determine the total number of people who were over the age of 65 \((n = 293,916)\) in this area and an estimation of the proportion of older adults who were not engaging in leisure time PA according to the Behavioral Risk Factor Surveillance System \((35.9\%)\) [18]. Therefore, across the counties targeted, 105,515 people were considered potentially eligible for study participation.

Reach and recruitment
Six recruitment strategies were used to attract the target audience. These strategies included paid newspaper advertisements and free radio announcements; interpersonal invitations through family, friends and church membership; mailings sent to participants currently enrolled in the trial to give to friends or family who might be interested in participating; and contacts to individuals in existing databases. Finally, local access stations and community magazines were also used. Radio and television recruitment was aimed at those stations that identified older adults in central Illinois as part of their core demographic (e.g. local radio and televised network news programs). Targeted paid advertisements were placed in local newspapers for the four large metropolitan areas within the study region. Telephone calls were made and e-mails were sent to individuals in existing study databases who had been ineligible for previous studies but who had indicated interest in participating in future research studies. All materials included information for potential participants that the program was convenient for in-home use, developed by professionals and free of cost.

Measures
To thoroughly evaluate the reach of the trial, we developed four distinct indicators. Each of the indicators follows a temporal progression of study activities ranging from the proportion of the target population exposed to recruitment strategies to the reach of the DVD within the study sample over the 6-month program.

Indicator 1: Proportion of target population exposed to recruitment strategies
This indicator was quantified by identifying the number of people over the age of 65 in each of the counties exposed to recruitment strategies based on census data. The denominator was estimated through the use of available census data to project the number of potentially eligible people within a geographic location (e.g. Behavioral Risk Factor Surveillance System (BRFSS), National Health and Nutrition Examination Survey (NHANES), Healthcare Data). The numerator was calculated using the projected number of customers or listeners provided by newspapers and radio stations and the number of direct mailings made. We also collected demographic information on the populations reached by the newspapers and radio stations, as well as the characteristics of those living in neighborhoods where mailings were made based on census data. There may be potential for recruitment effort overlap. To control for this, the research team asked participants to identify which recruitment strategy first made them aware of the study.

Indicator 2: Ability of recruitment strategy to engage participation
This indicator was quantified by using the numerator from indicator 1 (i.e. proportion of target audience
exposed to recruitment) as the denominator. The numerator for this indicator is based on those that responded to the recruitment efforts (i.e. those who initiated contact with the research team via a telephone call to begin participant screening process). Representativeness was again descriptively compared with the characteristics of the overall target population. Direct costs associated with each strategy were also determined.

**Indicator 3: Study reach**

This indicator was calculated by dividing the number of eligible participants who enrolled in the study by the number exposed to recruitment. Representativeness was determined by a descriptive comparison with the overall target population (i.e. census data) and by comparison of basic demographic characteristics of those who were eligible and enrolled and those who were eligible and declined.

**Indicator 4: Reach of each intervention in participant homes**

Participants were asked to view DVDs with evidence-based flexibility, strength training and balance exercises each month for 6 months. For this study, reach indicator 4 was related to the number of DVDs viewed rather than the number of DVDs received. That is, these data relate to receipt of intervention dose and participant engagement rather than a measure of implementation.

On a monthly basis, participants submitted exercise logs with which they reported use of the DVD, from which the average usage per month across the participants was calculated. We present DVD reach data based on the proportion of those who submitted exercise logs and the proportion of reach based on the number of participants randomized to the FlexToBa condition. Given the small sample size, representativeness was not calculated for monthly reach. Indicator 4 was calculated as the proportion of participants who viewed the DVD at least once for the given month. Participants in the educational control condition (i.e. those who received the Healthy Aging DVD) were asked during support calls at weeks 2, 4 and 6 if they had yet viewed the DVD. Participants reported if they had viewed all or some parts of the DVD at each of these three time points.

**Data analysis**

Proportions were used to describe reach indicators 1–4. Direct costs associated with each recruitment strategy were divided by the number of participants who were recruited using that strategy. Representativeness was determined using inferential statistics (t-tests) to determine whether the program participants differed from the target population on important demographic characteristics such as ethnicity, gender, age, education, income and marital status.

**Results**

**Indicator 1: Proportion of target population exposed to recruitment strategies**

The target audience was predominantly Caucasian and resided in 83 towns and cities across central Illinois. Based on census data, 19% of the target audience had a bachelor’s degree, with a mean income of $49,000. Census data also indicated that within the targeted towns and cities there were an even proportion of both genders (50%). There were 293,916 older adults living in the targeted area. Based on the national average, 35.9% of those older adults were estimated to be insufficiently active or inactive ($n=105,515$). This proportion was used as the denominator for the proportion of the target population targeted by the recruitment strategies. The total readership and listenership across recruitment strategies conducted through newspapers and radio was 412,668 older adults, which included those outside the geographic region. As there were only 293,916 older adults in the area, and estimating 35.9% of those readers and listeners are likely to not be meeting the PA recommendations, this suggests that approximately 105,515 eligible older adults were exposed to the recruitment strategies. This may well suggest...
that the recruitment procedures saturated the market and that some older adults were likely exposed to recruitment advertisements through multiple sources.

**Indicator 2: Ability of recruitment strategy to engage participation**

The numerator from indicator 1 (105,515) was used as the denominator to determine which recruitment strategy was most successful in engaging participation from the target audience. Participants who responded to any recruitment effort \( (n = 562) \) were then screened for eligibility. Of those, 25.6\% \( (n = 144) \) were ineligible due to being unable to obtain a physician’s approval for PA \( (n = 54) \), being too active (i.e. engaging in 30 min of PA more than twice per week; \( n = 54 \)), scoring greater than 21 on the cognitive function assessment Telephone Interview of Cognitive Status [19], being younger than 65 or older than 85 \( (n = 18) \) and participating in another PA study \( (n = 1) \). We were unable to make contact with 20 individuals and an additional 15 individuals were categorized as having testing issues (e.g. unable to travel to screening site); therefore, the eligibility is unknown for these 35 \( (6.23\%) \) individuals. Thirteen percent \( (n = 76) \) declined participation due to the following reasons: not interested \( (n = 52) \), time commitment \( (n = 11) \), not willing to be randomized \( (n = 7) \), family issues \( (n = 4) \) and other \( (n = 2; \) deaf, religious reasons). Demographic profiles were compared for adults responding to the recruitment methods. Those who responded were more likely to be female \( (P < 0.01) \) and less likely to meet the age requirement (e.g. 65+ years; \( P = 0.028 \)) than those in the target audience (Table I).

Direct costs were assessed for each recruitment strategy. For the newspaper advertisement, 389 people responded and 222 eventually became participants. Newspaper advertising had a total cost of $17,235 resulting in a cost of $78 per enrolled participant. Recruitment letters were mailed to 37 churches in the area, for a total cost of $17.39, from which three participants were recruited \( ($5.79 per participant). Seventy-nine participants \( (26\%) \) were recruited free of cost through newsletters, radio public service announcements, referral from family/friends or contact via existing databases. Three participants fell into the ‘other’ category, two of whom did not provide a reason, and one stated they found us on our website; therefore, recruitment costs for these individuals are unobtainable.

**Indicator 3: Study reach**

The numerator for overall study reach was based on those contacted and eligible. Using the previous two indicators (i.e. those potentially eligible and those exposed to recruitment), 383 met these criteria and 307 accepted the invitation to participate \( (80\%) \). Taking the broadest perspective, based on the projected saturation of the target population with recruitment strategies, the total number exposed to recruitment was 105,515 with 307 final participants resulting in a study reach of 0.3\%. Based on independent \( t \)-tests, participants did not differ from non-participants on any demographic indicator \( (P > 0.05) \).

**Indicator 4: Reach of each intervention in participant homes**

Finally, the data collected in this study provided a unique opportunity to assess the reach of each intervention component over the course of the intervention. The reach of DVD components was operationalized as a participant viewing the DVD at least once over the course of the month. With the total of 307 participants, 158 were randomized into the intervention arm. Of those who submitted monthly exercise logs (month 1, \( n = 147 \); month 2, \( n = 132 \); month 3, \( n = 125 \); month 4, \( n = 116 \); month 5, \( n = 108 \); month 6, \( n = 109 \)), 99\% used the DVD in the first month, 97\% in the second, 94\% in the third, 88\% in the fourth, 87\% in the fifth and 81\% in the sixth months. When considering the use of the DVD based on the total sample that was assigned to the FlexToBa condition, the DVD reached 92\%, 81\%, 74\%, 65\%, 60\% and 56\% of the sample,
respectively, from months 1 to 6. Eighty-three percent of participants in the control condition ($n = 124$) had watched at least some parts of the DVD, and 77% of participants ($n = 114$) reported watching the entire DVD by week 6 of the intervention.

### Discussion

This study presents a systematic approach to addressing the issue of study reach within the context of randomized controlled trials and the RE-AIM framework. Results indicate that newspaper and radio advertisements are likely to reach a large proportion of older adults, that those who respond to these recruitment efforts were representative of the general older adult population in the targeted area with respect to demographic characteristics, and that individual reach of DVDs was high in this study population. Ultimately, these data help us understand how to recruit representative participants to enhance the generalizability of research findings [20].

Recruiting (i.e. enlisting as a participant in a given study) older adult samples for exercise trials, who are representative based on sex, race and functional capacity, is often rather difficult [21]. Barriers to participation in this population include the demands of and time for involvement in the programs, as well as a lack of trust in the research process [22]. To overcome barriers associated with transportation and time commitment, FlexToBa provided
participants with a minimally burdensome program to improve their health, allowing them to exercise at their convenience in the privacy of their own homes.

The evaluation process used in this study provides information on the costs of recruitment and the likelihood of success of each of the strategies. These data indicate that, within this population, the use of newspaper advertisements may be the best way to engage a large number of potential participants in a short period of time. In addition, as this is a representative sample across a large geographic location, it is likely that newspaper recruitment would be successful for the recruitment of older adults in other locales. While the relative cost of doing so (i.e. $78 per participant) seems reasonable from a research perspective, other recruitment strategies were free of cost to this study (or at least had no incremental costs over the rate paid to a research assistant) and also likely to engage eligible participants. Unfortunately, the proportion of eligible participants recruited free of cost (26%) indicated both slower and lower recruitment success than the newspaper advertisements. From a population perspective, the higher cost of newspaper advertising may be a deterrent when considering long-term implications of this recruitment method. That is, for a population-based study that may aim to recruit thousands (or hundreds of thousands) of participants, $78 per person may be outside the scope of the intervention budget. Conversely, as the program continues, perhaps the free cost recruitment strategies (e.g. family/friend referral, newsletters, radio advertisement) may gain a larger reach and maintain their attractive price tag. Finally, the recruitment strategies employed for this study echo suggested strategies for recruitment of older adults, including a focus on adequate recruitment budgets, for which mailings and targeted newspaper advertisements are a low-cost, high-yield option [21].

One strength of the FlexToBa program, given the home-based DVD delivery system, was the ability to recruit from a wide and diverse geographic range. That is, the program was available to participants in their home and no travel was required of those receiving the intervention, thereby expanding the geographic distance for recruitment with minimal additional costs. The only travel involved assessors going to test sites for baseline and post-intervention assessments.

An additional strength of this study design was to utilize recruitment strategies that may reach a larger proportion of older adults across a relatively large geographic location. At first glance, the public health impact of this study may not seem significant since the reach was low (i.e. 0.3%). However, with the broad inclusion criteria and data on readership and listenership utilized for recruitment, it is important to note that this estimate is conservative, and as a result, likely a vast underestimate. In contrast, most interventions are not using the information presented in indicator 1, as in this study, but rather only report information on those contacted, eligible and subsequently recruited (i.e. indicator 3). Thus, it is hard to generalize if a 0.3% reach is relatively low (or high) when compared with the current body of literature. This is a key difference between the novel approach of using the four indicators proposed herein that align with RE-AIM when compared with a different reporting metrics related to recruitment.

For example, an author may report as follows: there were 100 000 ‘potentially’ eligible individuals; of these individuals, the research team was able to contact 3000 individuals and subsequently recruit 500 based on eligibility criteria. The researchers may conclude that their reach was 16% (500 of the 3000 contacted). Alternatively, using the number of those who were potentially eligible and exposed to ‘any’ recruitment effort and those who ultimately joined the study, the authors may have reported a far different reach; perhaps as low as 0.5%. If you aimed to extrapolate who may have been eligible of the 70 000, analyses of reach and recruitment may become murky. A clean method of analysis is the combination of these four reach indicators. Furthermore, this type of indicator has practical implications such as considering the cost effectiveness of strategies and the number of strategies needed to saturate the sample. These data are supplemental to indicator 3 in this study.

That is, our third indicator of reach—the proportion of those who were eligible, responded to recruitment efforts and enrolled—was 80% in FlexToBa.
This is a relatively high reach, especially when compared with studies such as a recent summary of cost-effective recruitment strategies for older adults, in which 305 individuals were contacted for participation, of which 42 individuals expressed interest and 23 individuals were subsequently enrolled (i.e. 55%) [23].

Finally, this study explored the degree to which the home-based intervention components were able to reach the intended audience over time. These data can be used to address the fidelity associated with the reach of the underlying program components that are necessary to increase the effectiveness of the intervention [24]. For participants who turned in monthly exercise logs, the receipt of the intervention was very high (i.e. >81% each month). Even when considering monthly use based on exercise logs using the study sample as the denominator, about two-thirds of the sample, on average, used the DVD each month. It is of note that the use of the DVD content decreased over time. However, higher reach may not be necessary to influence outcomes given the significant effects of the program on measures of physical performance, flexibility and strength at 6 months (effectiveness reported in more detail elsewhere [3]).

Because reach or recruitment rates can be defined in a number of different ways, it is difficult to generalize across PA interventions for older adults. That is, many studies report on the proportion of eligible individuals who made contact with the research team. In our study, this proportion was 80%. The drawback of using this type of proportion is that it does not account for individuals who were eligible and exposed to recruitment efforts but did not respond to those efforts. Over time the reporting of reach through a standardized method will provide an opportunity for comparisons across older adult PA intervention studies, and even comparative information across different behavioral intervention targets. The public health impact of the this study is that it highlights the often inconclusive reporting of a program’s ability to reach eligible older adults and the need for transparent reporting on individuals who are not attracted to a program based on the recruitment strategies utilized. Our suggestion is to use all four indicators of reach for greater accuracy.

This study is not without its limitations. First, it is difficult to generalize the reach of an intervention within the context of a randomized controlled trial, like FlexToBa, to the reach of these programs when delivered in typical community or clinical settings. Participants who agree to participate may make decisions based on the topic of the research (e.g. PA), the potential conditions (e.g. intervention or control) and the amount of assessment required for participation in the intervention (e.g. surveys and measurements). However, understanding the relative reach across these areas within randomized controlled trials can provide information on interventions that may be more or less likely to engage the target population in typical clinical or community settings.

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**Conflict of interest statement**

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**References**