

The Acceptability of a Community-Based Perturbation-Based Balance Training to Older Adults and Healthcare Professionals

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Abstract

Background: Perturbation-based balance training (PBT) is a promising fall risk reduction method that involves inducing unexpected perturbations to balance to train participants reactive balance control. Due to the unpredictable nature of PBT, its acceptability to older adults could present a barrier to the implementation of PBT in the community. **Aim/Purpose:** The purpose of this study was to assess the perceived acceptability of a community-based PBT program to both older adults and healthcare professionals (HCPs). **Methods:** Nineteen older adults (aged 69.6 ± 6.6 years, 17 women, 2 men) and three HCPs participated in the qualitative study. Participants completed four PBT sessions facilitated in conjunction with HCPs. Interviews, based on the theoretical framework of acceptability, were conducted before and after PBT and analyzed using template analysis. **Results:** PBT was perceived as effective by older adults and HCPs. However, HCPs perceived the equipment cost as a substantial barrier to feasibility in the community.

Keywords

perturbation-based balance training, acceptability, balance, community-based

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What This Paper Adds

- To our knowledge, this is the first study to evaluate:
 - the acceptability of PBT from multiple temporal perspectives;
 - the perceptions of both older adults and healthcare professionals simultaneously.
- The community setting of the present study provides insights into perceived barriers and facilitators in a different light than previous investigations conducted in the laboratory.

Applications of Study Findings

- PBT fall prevention programs were acceptable to both older adults and HCPs in a rural community.
- The type of equipment used to implement PBT may influence perceived acceptability.
- There is a need for PBT modalities that can be more feasibly implemented in a community setting.

Introduction

Falls are a leading cause of morbidity and mortality in older adults (Bergen et al., 2016). Conventional Balance Training (CBT) programs, which are typically exercise-based and may target both strength and balance, have been demonstrated to reduce falls to an extent (Sherrington et al., 2020). However, CBT targets static and proactive balance control (Huxham et al., 2001) and requires a relatively large training dose to elicit protective effects against falls while the

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Table 1. Theoretical Framework of Acceptability.

Acceptability	A multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experiential cognitive and emotional responses to the intervention	
<i>Components of acceptability:</i>		
Affective attitude	How an individual feels about the intervention	
Burden	The perceived amount of effort that is required to participate in the intervention	
Ethicality	The extent to which the intervention is a good fit with an individual's value system	
Intervention coherence	The extent to which the participant understands the intervention and how it works	
Opportunity costs	The extent to which benefits, profits, or values must be given up to engage in the intervention	
Perceived effectiveness	The extent to which the intervention is perceived as likely to achieve its purpose	
Self-efficacy	The participant's confidence that they can perform the behavior(s) required to participate in the intervention	

Source. Adapted from Sekhon et al. (2017).

retention of these effects appears to be dependent on continued participation (Sherrington et al., 2020). CBT programs are primarily comprised of predictable and volitional quasistatic tasks (Burns et al., 2023). Yet, most older adults fall because of unexpected losses of balance such as slips, trips, or stumbles (Blake et al., 1988; Luukinen et al., 2000; Talbot et al., 2005). As such, CBT appears to have insufficient task specificity to efficiently minimize fall risk in older adults.

Perturbation Balance Training (PBT) is a balance training paradigm that has garnered increased interest since the early 2000s due to its task-specific nature and its potential to effectively reduce fall risk in older adults (Devasahayam et al., 2022). Briefly, the goal of PBT is to improve participants' reactive balance control (i.e., the ability to recover from unexpected balance disruptions such as slips, trips, or stumbles). PBT targets reactive balance by repeatedly delivering unexpected perturbations to balance in a safe environment. For a detailed description of PBT, we recommend McCrum et al. (2022). Early reports on PBT indicated it may be highly effective for preventing falls in older adults and required a substantially lower training dose than CBT (Pai et al., 2010; Sherrington et al., 2020). However, more recent findings have been conflicting, and further research is required to fully understand the dose-response relationship for PBT (Gerards et al., 2023). Therefore, researchers and practitioners are gaining interest in PBT as a means to improve reactive balance and mitigate the negative outcomes of a fall for older adults. There are, however, still many considerations to be addressed before PBT can be effectively implemented on a meaningful level. These include understanding the relative efficacy of the different methods of PBT, equipment requirements, and identifying barriers and facilitators to implementing PBT in both clinical and community settings (McCrum et al., 2022).

Surveys of healthcare professionals (HCPs) regarding PBT have identified a lack of knowledge of PBT and the perception that large expensive equipment is necessary for PBT as some of the primary barriers to implementing

PBT in clinical practice (Mansfield, Danells, et al., 2021; Margalit et al., 2023). Acceptability can be either a facilitator or barrier to the implementation of any health care intervention. The acceptability of an intervention could influence participant adherence (Hommel et al., 2013; McCrum et al., 2022) or the way HCPs deliver the intervention. For instance, interventions considered less acceptable by HCPs may be delivered with a lower level of fidelity, which can in turn impact the efficacy of the intervention (Borrelli et al., 2005). The Theoretical Framework of Acceptability (TFA) (Sekhon et al., 2017), proposes that the acceptability of a healthcare intervention is a multidimensional construct with seven components (Affective Attitude, Burden, Ethicality, Intervention Coherence, Opportunity Costs, Perceived Effectiveness, and Self-efficacy) that can be assessed prospectively, concurrently, and retrospectively. Please refer to Table 1 for a description of the seven TFA components.

Until recently, evidence regarding the acceptability of PBT to older adults has been limited to indirect measures such as training adherence, adverse events, and dropout rates reported by previous studies (Mansfield et al., 2010; Okubo, Sturnieks, et al., 2019). Recently, Gerards et al. (2022) utilized the TFA to describe the acceptability of PBT to older adults with a history of recent falls. To our knowledge, the study by Gerards et al. was the first and only direct investigation of the acceptability of PBT, the authors reported that PBT was perceived to be acceptable by older adults. The novelty of PBT and the improved self-efficacy and balance confidence were identified as facilitators of perceived acceptability. The authors also noted several limitations to their study including the retrospective design which makes it difficult to determine how participants' perceptions of PBT changed throughout the intervention. Additionally, the analysis by Gerards et al. (2022) was conducted as part of a larger trial set in a university hospital and therefore the results may not be generalizable to PBT interventions delivered in community settings. Finally, while Gerards et al. investigated the perceived acceptability of PBT to older adults, they did not



Figure 1. PBT treadmill.

consider the acceptability of practitioners delivering the intervention which may be an equally important consideration, according to the authors of the TFA Sekhon et al. (2017).

To our knowledge, no studies have directly assessed the acceptability of PBT to both the older adults participating in the training and the HCPs delivering the training. Therefore, the purpose of this study was to assess the perceived acceptability of a community-based PBT program to both older adult participants and local HCPs.

Methods

Context

To maintain a community perspective while conducting PBT within a research project, the present study was codesigned with members of the Cooperative Extension System (CES). The CES is affiliated with land grant universities in each state in the US and has offices in most of the nation's counties (*Extension | National Institute of Food and Agriculture*, 2022). Extension agents in each county offer community members access to research-based programs ranging from financial education to health promotion which make them ideal candidates for implementing community-based programs, including ones on fall prevention. The PBT program was advertised by local extension programs in rural communities and the PBT intervention was delivered at the local community center, as is common with programs delivered through the CES. Refer to Figure 1 for an idea of the training setting. Extension agents also recruited local HCPs working in the rural communities to deliver the PBT intervention.

PBT Protocol

The PBT intervention protocol consisted of four 30 to 45-min sessions over 4 weeks (one session per week). Perturbations were delivered using a custom dual belt treadmill capable of producing perturbations similar to those previously reported (Gerards et al., 2021; Grabiner et al., 2008). Participants wore a safety harness at all times when on the treadmill. After a brief warmup, older adults were exposed to postural and gait perturbations which were delivered via unexpected changes in direction and velocity of the treadmill belts. Treadmill belt acceleration profiles (i.e., perturbation intensity) were selected based on previously published PBT protocols (Gerards et al., 2021; Wang et al., 2019). Participants experienced 20 to 45 perturbations per session. Perturbation intensity and volume were progressed on an individual basis throughout the protocol and generally increased throughout the protocol.

Participants

Nineteen community-dwelling (i.e., living independently in the community) older adults (60–85 years) were recruited from a rural area using convenience and purposive sampling. Older adults were eligible if they were community-dwelling and able to walk without an assistive device. Exclusion criteria included risk factors that may have influenced the safety of training such as osteoporosis, recent injuries to the lower extremities such as fractures or major strains, a score of 23 or less on the Mini-Mental State Examination (Tombaugh & McIntyre, 1992), or the use of medications known to impair balance. Three HCPs were also recruited from the local area by extension agents to deliver the PBT program in the rural community setting, which accounted for approximately 70% of available HCPs within the communities.

Data Collection Procedures

The TFA is a framework designed specifically to assess participant and HCP perceptions of acceptability in the evaluation of the implementation and outcomes of programs specific to improving health outcomes (Sekhon et al., 2017). Thus, the development of the interview questions was based on the TFA (Sekhon et al., 2017); semi-structured interviews were used to assess the prospective and retrospective perceived acceptability of PBT to older adults and local HCPs. Each construct within the TFA was operationalized into corresponding, semi-structured interview questions per the previous investigation conducted by Gerards et al. (2022). Table 2 provides a list of example interview questions and corresponding constructs. As in Gerards et al., questions regarding context-specific considerations such as training location and training individually as opposed to in a

Table 2. TFA Components, Interpretations and Related Questions.

Theme	Interpretation and related questions
Affective attitude	Interpretation—How an individual feels about PBT HCP: How appropriate do you feel PBT was for your community members/How do you feel facilitating PBT affected your other programs OA: Now that the details of the PBT program have been explained to you, can you tell me how you feel about participating in the training?
Burden	Interpretation—The perceived amount of effort that is required to participate in or deliver PBT HCP: Were there any aspects of implementing PBT that you feel affected your ability to facilitate other programs or execute other aspects of your job? Either positive or negative OA: To what extent do you expect the training to be difficult?
Ethicality	Interpretation—The extent to which the intervention has a good fit within an individual's value system HCP: How appropriate do you feel PBT was for your community members OA: To what extent does PBT fit with your views on fall prevention?
Intervention coherence	Interpretation—The extent to which the participant understands the goal of PBT and how it works HCP: Not addressed for HCPs since all were familiar with PBT before the intervention OA: Can you explain to me what the goal of the training is?
Opportunity cost	Interpretation—The extent to which benefits, profits or values must be given up to participate in or deliver PBT HCP: What costs (if any) did facilitating PBT incur on you or your other programs OA: To what extent do you anticipate having to give up other activities or things you value to participate in PBT?
Perceived effectiveness	Interpretation—The extent to which the participants perceived PBT to be effective HCP: Did you observe any positive or negative effects of participation in PBT on the participants/ Do you feel that the PBT program was implemented successfully OA: To what extent do you think the training will be a benefit to your recreational or occupational activities?
Self-efficacy	Interpretation—The participants are confident that they can perform PBT HCP: To what extent do you feel capable of continuing to offer PBT/How efficiently do you feel the PBT program was implemented OA: How do you feel you will do during PBT?

group setting were added to understand their potential impact on the perceived acceptability of PBT.

Interviews were conducted at a local community center. All participants (older adults and HCPs) were interviewed twice, prospective interviews were conducted 1 week before PBT and the retrospective interviews were conducted 1 week after PBT. Interviews lasted approximately 10 min and were conducted between August and September 2022. Interviews were primarily conducted by DT, a gerontologist with extensive experience conducting interviews and qualitative research. DT was not involved in delivering the PBT program but was familiar with PBT such that she was able to ask relevant individualized follow-up questions. The interview guide was updated iteratively to account for the emergence of new themes. All interviews were recorded using a digital voice recorder and transcribed verbatim. A second researcher was always present as an observer during interviews and training sessions to take field notes for triangulation.

Analytical Procedures. This study utilized a qualitative method known as template analysis to analyze data from the prospective and retrospective interviews. Template analysis is a type of thematic analysis which is a broad

category of qualitative approaches used to develop themes from textual data (Brooks et al., 2015). Template analysis allows for flexible, hierarchical coding and is an effective method when using a priori themes within an analysis. In template analysis, researchers construct an initial template for coding data utilizing a priori themes. A subset of the data is reviewed, and the template is modified to include any emerging themes. A second subset of the data is then reviewed, and if needed, the template is modified. The review of the data and subsequent modification of the template occurs until the researchers reach a consensus that all themes are represented on the template (Brooks et al., 2015).

Coding. The original template utilized a priori themes, based on the TFA and results from Gerards et al. (2022). Using a similar process to Gerards et al. (2022), prospective and retrospective interviews and field notes for four transcripts were coded independently by DT and JW. Researchers discussed the codes until a consensus was reached and the template was updated accordingly. This process was repeated for the next four transcripts and the template was adjusted. For the third iteration of the process, another four transcripts were reviewed.

Consensus was reached between the researchers and the template was deemed complete. A total of 12 transcripts were reviewed during this reiterative process. JW coded the remaining transcripts independently. Coding was conducted using NVivo version 1.7.1.

Triangulation and Reflexivity. For triangulation, an independent researcher who had not been involved in data collection or analysis thus far (MG) independently coded all interviews using the final template. All three researchers (JW, DT, and MG) discussed the codes, and consensus was reached that the final version of the template encompassed all themes present in the interviews and that coding saturation was reached. Notably, due to logistical constraints, DT was unable to conduct pre-training interviews for six participants. JW, who was involved in the PBT intervention conducted interviews for these participants. Coding the interviews by JW revealed no new themes, which can be considered secondary confirmation of saturation.

Results

Participants

A convenience sample of 19 older adults (17 women and 2 men, average age 69.6 ± 6.6 years) across three communities completed the study. For reference, 28 older adults were approached but several were excluded due to medication ($n=5$), cognitive impairment ($n=1$), and the presence of chronic health conditions ($n=3$). Two participants dropped out due to illness not related to training. Three participants missed one session due to scheduling conflicts. One participant elected to drop out of the study during their second training session due to fear of falling. Refer to Table 3 for an overview of participant characteristics. Overall training adherence was 93% for study participants. Three local HCPs (two physical therapists and an occupational therapist) were approached and agreed to participate in the study. Ethics approval was obtained from the Montana State University Institutional Review Board and all participants provided written informed consent before participation. Please refer to Table 4 for a summary of results organized by TFA theme.

Acceptability

Findings from interviews with older adults and HCPs are presented within the seven components of the TFA. If temporal differences in perceived acceptability were found for a given construct, they are reported under the associated construct.

Affective Attitude

Older Adults. The prospective affective attitude was high amongst older adults in this study. Most older adults reported that they would be able to complete the

Table 3. Participant Characteristics.

Participant	Sex	Age (years)	Interviewer (pre/post PBT)
P02	Female	81	DT
P04	Female	68	DT
P05	Female	70	DT
P07	Female	75	DT
P08	Male	65	DT
P11	Female	79	DT
P14	Female	66	DT
P15	Female	64	DT
P17	Female	84	DT
P20	Female	74	DT
P22	Female	75	DT
P24	Female	66	DT
P25	Female	70	DT
P26	Female	61	DT
P30	Female	61	DT/JW
P31	Female	70	DT/JW
P32	Male	63	DT/JW
P33	Female	63	DT/JW
P34	Female	68	DT/JW

training without too many difficulties, and the benefits of the training would outweigh any difficulties. When asked about how well they would do in the training, one older adult stated,

Oh, I think I'll do fine. I feel that I'm physically fit enough. . . To be able to learn and be able to do it. (P04)

After completion of the PBT program most older adults indicated it was a positive experience and that they would participate in PBT again.

It built my confidence (. . .) and it reassured me that if I trip, chances are I'm not going to fall, I'll catch myself. And I like that. (P14)

Most participants reported they typically exercised in a group setting and tended to prefer group environments for conventional exercise. However, the individual nature of the PBT program was not identified as a barrier by any participants and several reported that they preferred the individual nature of the PBT program.

I'm used to doing more group things, group activities, I could see that this does need to be more individualized and yeah, I appreciate the opportunity to have that. (P20)

A few described the potential embarrassment from an unsuccessful balance recovery attempt as a contributing factor to their preference for training individually.

It was kinda nice to just be individual, so it'd be less embarrassing if you did crash and burn. Only they don't let you crash and so. . . But still. (P24)

Table 4. Summary of Findings.

Theme	Interpretation and related questions
Affective attitude	HCP: Generally, HCPs maintained a positive affective attitude in both prospective and retrospective interviews. OA: Some initial apprehension was reported, but this generally dissipated as the PBT program progressed. Overall older adults maintained a positive affective attitude toward the PBT program.
Burden	HCP: The physical and logistical burden of facilitating PBT was perceived as acceptable however the financial burden of acquiring PBT equipment was perceived as a substantial barrier. OA: Prospective perceptions of burden were split between those who believed PBT would be challenging and those who thought it would be easy or did not have an opinion. In retrospect, many older adults reported the burden of PBT to be acceptable.
Ethicality	HCP: All HCPs reported that PBT fit within their views on fall prevention and was appropriate for older adults in their community. OA: Almost all older adults perceived PBT as a good fit within their views on health and fall prevention both prospectively and retrospectively.
Intervention coherence	HCP: All HCPs were familiar with the general concept of PBT before the intervention and received training on PBT delivery. OA: All older adults were able to communicate the general purpose of PBT before the program and many displayed a full understanding of PBT during retrospective interviews.
Opportunity costs	HCP: Overall HCPs perceived the opportunity cost of PBT as acceptable with time being reported as the only cost. OA: No older adults reported having to give up any activities, either directly or indirectly, to participate in PBT.
Perceived effectiveness	HCP: Prospective and retrospective perceived effectiveness of PBT was high for HCPs. OA: Prospectively many older adults expected PBT to be effective, and retrospectively many older adults described perceived positive effects resulting from PBT.
Self-efficacy	HCP: All HCPs reported that they perceived themselves capable of implementing PBT on their own, provided they had access to proper equipment. OA: Most older adults perceived gains in self-efficacy throughout the PBT program.

Several reported initial apprehensions regarding the PBT treadmill and fall arrest system. These participants described their hesitancy stemmed primarily from differences between the PBT treadmill and typical commercial treadmills, specifically the split belt and lack of a control panel and handrails.

Oh, I didn't like the way it was split. . . 'cause I didn't know to straddle it (. . .) that made me feel unsure. (P14)

Well, first you go, "Well, where's the handrail?" [chuckle] And then when you realize that's not part of the deal. . . (P32)

However, these differences were not identified as barriers. Rather, some perceived the novelty of the equipment as a facilitator.

That's a pretty cool setup they got there. I had no idea. I figured it'd be just a simple treadmill, not something kind of high tech (. . .) It's pretty interesting. It looks pretty cool. It's not anything like I expected. (P32)

HCPs. Overall, HCPs maintained a positive affective attitude toward delivering PBT in both the prospective and retrospective interviews. One HCP described how

she felt positive about the impact PBT would have on older adults in the local community.

I think it's gonna be very appropriate and very good. (. . .) So, I'm super-excited to see how much [PBT] does help them (. . .) to see improvement and that's what I'm hoping. (C02)

While all HCPs viewed PBT positively, one noted concern regarding participants' comfort during PBT and fear of falling as potential barriers to participation.

It will be interesting to see how their comfortability, if that limits them at all (. . .) I just think that can be a barrier. The fear of falling will probably be the biggest barrier, I think. (C02)

However, her concerns were attenuated after delivering the PBT program and the safety equipment was identified as a facilitator of her positive effect toward PBT.

I think it's definitely appropriate and I think it would be easy to implement, especially with the harness. It makes it safe for anybody to participate. (C02)

Several HCPs expressed that the translational community-based aspect was a facilitator.

I think it's a great opportunity to see what these programs might look like in a real-life (. . .). And really just trying to improve clinic care out of research. (C01)

Burden

Older Adults. Most agreed that the burden associated with the difficulty of the PBT protocol was acceptable. Prospective to the PBT program, participants were split between those who indicated they thought the training would be challenging and those who believed the training would be easy or did not have an opinion on how challenging the training would be.

Yes. Some of the balance stuff I'm sure will be [challenging]. I feel like sometimes my balance isn't as good as it used to be. Yeah (P25)

I have no idea. I'm going into this open-minded. (P32)

One participant, who elected to discontinue training during the second session, cited the difficulty of recovering from perturbations and fear of falling as barriers to her continued participation.

I just had to grab on, because I felt very insecure (. . .) Mentally, I just couldn't do it (. . .) It was just the treadmill, when [it] stopped that's what got to me. (P07)

Retrospectively, most older adults stated that the level of difficulty was acceptable. One older adult did indicate in the retrospective interview that she perceived the difficulty of PBT as unacceptable due to her fear of falling and cited the fact that the program was being administered as part of a research study as the only reason she completed the program. However, all others agreed that while the training was acceptably challenging and pushed them to their limits, it was not so difficult that it pushed them past their limits. The goal of PBT is to effectively challenge participants about the velocity and number of perturbations but not to exceed their capacity to recover.

If it went super-fast, it could have been challenging, but it wasn't, (. . .) I mean, they went to my limit, but they didn't go over my limit. (P11)

HCPs. Prospectively, HCPs indicated that PBT would be something that could be done at their clinics with little burden. When asked if PBT would be something that could be successful in their community, one HCP stated,

If the set-up was available, [it would be] super easy. (C04)

Retrospectively, the physical burden of delivering PBT was perceived as acceptable and easy to implement (assuming access to proper equipment) by all HCPs. The

ease of use and scalability of perturbation magnitude afforded by the treadmill were cited as facilitators.

It seems very easy to implement, just like any other protocol that would be lined out, easy to adjust, easy to scale. (C01)

One HCP identified the compatibility with practices that are already in place at her clinic as a facilitator.

It would probably work well with what my job is, as I work in the [local occupational therapy clinic] (. . .) It would actually go really nicely with what I do with the elderly folks over there. (C04)

All HCPs agreed, however, that they did not feel confident in their ability to obtain a PBT treadmill independent of the research project, citing the cost of the PBT treadmill as the sole/primary barrier to implementation.

Financial [barriers] would be the only thing I could see. (C01)

Cost was identified as a barrier during both pre- and post-PBT interviews.

Like the split treadmill is not gonna be something that's feasible for, I don't think, any of us (. . .) We're very limited 'cause we have a budget that we have to stick to for the entire year, and there is no leeway often time in those. (C02)

One HCP described her perception that while PBT on the split-belt treadmill used in the present study was not affordable, manual PBT may be more feasible to implement in her clinic.

I think manually, I think we can implement something super-easy. The split treadmill would be. . . cost-wise, a problem. (C02)

Ethicality

Older Adults. Prospectively and retrospectively, many older adults perceived PBT as a good fit within their value system concerning overall health and fitness, citing a desire to maintain a level of functional independence as a motivating factor.

I think it's going to help me a lot in keeping healthy, and I don't wanna sit in a chair and watch TV all day. (. . .) I think it'll be a big help to get me outta the house. [laughter] (P02)

Participants generally agreed that PBT fit within their values regarding fall prevention. Although several noted that they had not specifically thought about fall prevention before the interview, this was not perceived as a barrier to participation.

I thought it was really good. I think it's a good idea for all of us to be aware of falling and being in a position of vulnerability, tripping or falling because on ice or on anything like that it can happen so fast that whether or not you have the opportunity to avoid it. . . it's a good idea. (P34)

Awareness of the potential consequences of falling and the importance of fall risk reduction was identified as a facilitator.

[It's] sometimes the beginning of the end, whether if they break a hip, if they break an arm, if they break a leg, it's so hard for elderly people to recover from that, and you know they lose that ability to live independently, so it's pretty important, I think to prevent falls and to help yourself. (S34)

Several participants indicated they valued contributing to a scientific study, specifically noting an appreciation for the translational nature of the project.

HCPs. All HCPs prospectively and retrospectively agreed that PBT fit within their views on health and fall prevention and perceived it to be appropriate for the older adults in their community, both of which were identified as facilitators.

I think it'll be very appropriate because there's a lot of people in our elderly population (. . .) I think it would be good for them. (C04)

Before delivering PBT, one HCP worried it may be too difficult for many older adults. After delivering the PBT program, however, she described how the individualization and scalability of perturbation intensity helped lessen her concern.

Initially, I was concerned about their physical activity level, but I don't think that's something I'm as concerned about, considering you can titrate it to their various fitness levels and abilities. (C01)

Intervention Coherence

Older Adults. Prospectively, most older adults were able to communicate the purpose of PBT to the extent that it is intended to help them learn to fall or to catch themselves in a fall. When asked about the purpose of the training two older adults reported that that purpose was:

To keep me from falling (P33); to teach me to catch myself when I fall (P31);

However, other older adults attributed the training to better balance, as evidenced by one older adult who claimed,

. . . it's to make balance easier or better for me so that I don't fall (P26)

Retrospectively, older adults were able to state that the purpose was to improve balance and were able to expand on this idea. While a few perceived the purpose of the intervention to be related to increasing balance awareness or building balance confidence, others accurately identified that PBT aims to improve balance recovery specifically and provided more detailed explanations.

To teach me to catch myself when I fall (. . .) So the idea is if you stumble in here then (when) you're in the real world you'll have muscle memory. (P31)

Further, those who demonstrated a more comprehensive understanding of the specific and reactive nature of PBT and its potential to translate to real-world losses of balance tended to perceive PBT as more effective and identified as a facilitator of participation.

HCPs. Prospectively, HCPs had previous knowledge regarding the use of PBT to improve balance recovery in older adults. One area of interest to the HCPs was the protocol that would be used in the study.

I'm not sure yet about the protocol. If there is a standardized protocol. . .that'd be interesting to see what the dosage needs to be. . .(C01)

During the weekly PBT sessions, HCPs received training on PBT delivery which included education on the efficacy and mechanisms of PBT. As such, all HCPs fully recognized the purpose of PBT and this question was not addressed in retrospective interviews.

Opportunity Cost

Older Adults. Prospectively, the majority of older adults reported that participation would not impact their ability to participate in PBT. When asked if they would have to give up any current activities to participate in PBT, many older adults reported that they made time for the training. One older adult stated,

I scheduled [the training] on purpose. (P15), and another My schedule's pretty flexible. (P25)

Retrospectively, no participants reported having to give up any activities to participate in the PBT program. There were no reported negative impacts from PBT on other recreational or occupational activities. Further, most reported that training at the community center, which was in the center of town, was a convenient location. Many had to commute from out of town for training but did not identify the location as either a facilitator or a barrier to participation.

I really don't feel like I had to give up anything. . .they worked around a time schedule that worked for me (P34).

HCPs. Prospectively, HCPs reported that PBT would have a positive opportunity cost in that it would support other work occurring within their clinics. One HCP stated,

I think that [PBT] would be easy to implement so long as the treadmill or equipment could be applied to not only geriatric population but maybe other types of conditions as well (C01)

Retrospectively, HCPs agreed that the opportunity costs associated with facilitating PBT were acceptable. The only potential opportunity cost identified was the time required for training, but it was not reported to be a barrier. Most identified the compatibility of PBT with their current balance training protocols as a facilitator for the low opportunity costs.

It went right with what we're already doing. (C02)

At this point, I foresee no negative impacts on like insurance reimbursement, anything like that with it, so I imagine it would be mostly positive as well. (C01)

Perceived Effectiveness

Older Adults. Older adults reported in pre-intervention interviews the perception that PBT would be effective. In post-intervention interviews, many older adults described positive psychological effects including gains in balance confidence and an increased awareness of their balance and perceived threats to balance. Regarding gains in physical abilities related to balance, a few participants noted perceived changes in gait. One described how increased balance awareness led her to change her normal walking gait in a manner that she perceived as more effective.

I'm very glad I did it. I think it improved my walking. (. . .) I feel I pick up my toes better when walking so I shouldn't fall. (. . .) I consciously take bigger steps after the training, and I wasn't doing that before. (P11)

However, concerning physical abilities, most older adults perceived that their abilities either stayed the same or that the changes were imperceptible. Many participants cited the fact that they had not experienced a slip, trip or fall during the study as a reason potential physical changes were not perceptible. The perception of little physical change was not identified as a barrier to participation in the program.

I can't honestly say that I did because I haven't tripped or done anything of that kind. (P14)

One participant noted that while she did not observe any physical gains, they expected some may have occurred because of PBT.

(. . .) I mean I haven't fallen, so it's hard to tell. (. . .) But I think the training should help with catching myself. (P05)

Overall, older adults reported positive psychological changes associated with PBT, yet the effectiveness of PBT for physical changes was less perceptible by older adults.

HCPs. Prospective perceived effectiveness was high for all HCPs. Prior knowledge of PBT research and educational training provided by researchers before delivery were identified as facilitators.

Oh no, I think they'd all be positive. I do think oftentimes, it's more than what they are experiencing at their baseline, so I'm expecting mostly positive effects. (C01)

Retrospectively, similar to older adults, HCPs reported difficulty observing physical improvements resulting from balance training due to the duration of the PBT protocol and the infrequent nature of slips, trips, and stumbles. However, the lack of observable physical improvements was not reported as a barrier. HCPs reported receiving positive feedback from older adults regarding the PBT program which was identified as a facilitator of perceived effectiveness.

I have heard good feedback from community members that are doing it. (. . .) I had a lot of them be like, "Oh, I feel better. I feel like it's helping. I feel like I'm walking better, taking bigger steps". So, I definitely heard good feedback from the [participants]. I haven't heard any negative. (C02)

Self-Efficacy

Older Adults. According to prospective interviews, older adults felt that they would be able to successfully complete the PBT training. From retrospective interviews, all who completed the PBT program reported they felt able to successfully participate in PBT throughout the program. Most older adults described an increase in self-efficacy throughout the PBT program. Several expressed lower self-efficacy during earlier PBT sessions, especially after experiencing more difficult perturbations or near-/unsuccessful balance recovery attempts.

The most nerve-wracking part was the waiting. The anticipation that it was gonna be more difficult than it was. (. . .) I think I got used to it in the next sessions. But the first one definitely when we're just getting used to it, I expected it to be worse than it was. (P33)

Many of these participants went on to describe how feelings of apprehension were replaced with feelings of accomplishment and growing confidence in their abilities as the PBT program progressed. One described her gains in confidence in detail:

There was one time I got a little spooked (. . .) I did lose my balance a little but didn't fall. So I was really proud of myself. (. . .) It built my confidence (. . .) and it reassured me that if I trip, chances are I'm not going to fall, I'll catch myself. And I like that. (P14)

HCPs. Based on their prior knowledge of the benefits of PBT, all HCPs prospectively agreed they felt capable of efficiently implementing PBT on their own in their clinics. When one HCP was asked about their ability to implement PBT, the HCP responded,

I think that it would be easy to implement (C01).

Retrospectively, HCPs maintained and reinforced their ability to implement PBT. One HCP described that she felt the efficient nature of PBT was a facilitator of her ability to implement it in the clinic.

I think it was very efficient. The time that it actually took the participants to run through the protocol was really quick and actually quite streamlined. (. . .) [I feel] very capable. It seems really easy to implement, just like any other protocol that would be lined out, easy to adjust, easy to scale. (C01)

Thus, based on the HCP's time observing and assisting with the implementation of PBT, they stated that they felt capable in their ability to implement PBT in a clinical setting.

Discussion

The purpose of this study was to assess the prospective and retrospective acceptability of a community-based PBT program for older adult participants and HCPs. Understanding the acceptability of PBT for both older adults and HCPs helps to identify potential facilitators and barriers, which is a necessary step toward implementing PBT in rural communities. Our results indicate that both older adults and HCPs perceived the PBT program to be generally acceptable but also identified perceived barriers and considerations for future community-based PBT interventions. Since there was often overlap between the components of the TFA concerning the perceived acceptability of PBT, we structured the discussion in three sections: (1) Facilitators, which discusses themes identified as facilitators of participation in PBT for both older adults and HCPs, (2) Community Education, which discusses the influence educational seminars provided to the community may have had on the perceived acceptability of the PBT program, and (3) PBT equipment, which is discussed in its own section as a barrier to perceived acceptability.

Facilitators of Acceptability

Overall, the older adults in this study perceived PBT to be acceptable based on the prospective and

retrospective interviews utilizing the TFA to attain the perceptions of acceptability. One component of the TFA is self-efficacy. Gains in self-efficacy and high perceived efficacy were described as facilitators of participation in PBT by older adults. These findings comport with previous reports that while older adults may be initially apprehensive due to the unpredictable nature of PBT (Miller et al., 2018; Okubo, Brodie, et al., 2019), these feelings of apprehension tend to be replaced by gains in self-efficacy as training progresses (Gerards et al., 2022). A novel finding from the present study was the theme of "fall awareness," which emerged during pre-PBT interviews and was developed to represent an awareness by older adults of the potential consequences of falling as a facilitator to the decision to participate in PBT. Fall awareness was mostly described by older adults who knew someone in their social circle who had experienced a fall and subsequently lost a degree of functional independence. For older adults in this study, prospective fall awareness appears to have facilitated high prospective perceptions of ethicality in PBT. For instance, most older adults in the present study described PBT as fitting within their views on health and fall prevention. In contrast, Gerards et al. found that older adults often had not thought of fall prevention before PBT or that they felt they did not need it (Gerards et al., 2022).

Community Education. Another facilitator of participation in the PBT program was the inclusion of community education seminars. Notably, one free optional educational seminar was offered to all members of the local community by the research team in partnership with local extension agents before any discussions regarding the research project. Seminars offered general information on falls and fall risk reduction strategies for older adults, education on different types of balance (i.e., static vs. dynamic and reactive vs. proactive) and covered balance training resources, including PBT. While it was not explicitly described by older adults, we suggest these seminars may have facilitated the theme of fall consequence awareness as well as the high levels of prospective perceived ethicality described by older adults in the present study. Indeed, Hawley-Hague et al. (2014) reported that promoting positive benefits is a crucial factor in older adults' perception of fall prevention technology. Others demonstrated that intent to participate in balance training is related to both support from health professionals (Lindgren De Groot et al., 2011) and the perception that family, friends, and HCPs would approve of their participation (Yardley et al., 2007).

Local HCPs also demonstrated high levels of perceived ethicality toward PBT prospectively and retrospectively. HCPs described PBT as effective and highly compatible with their existing fall prevention practices and did not perceive there would be a high burden or opportunity cost associated with delivering PBT. Previously, Mansfield, Danells, et al. (2021) reported

that a lack of knowledge regarding PBT appeared to be a primary barrier to implementing PBT in the clinic among HCPs. However, lack of knowledge was not described as a barrier by HCPs in the present study. Again, we suggest this may be attributed to the brief educational training provided to HCPs by the research team before delivering PBT.

Considering the high prospective levels of perceived efficacy and ethicality described by older adults and HCPs, we suggest that future community-based PBT programs provide educational opportunities to enhance the prospective acceptability of PBT.

Barriers to Acceptability

PBT Equipment

Older Adults. Several aspects of the treadmill were described as off-putting by older adults in the present study including the lack of handrails and control console, the split belt design, and the elevation of the treadmill deck. While these features were not described as barriers to participation in PBT, it is notable that Gerards et al. (2022) reported older adults described the PBT equipment and training environment as a facilitator to participation. Because our treadmill was designed for use in the community it had to be portable and more affordable than laboratory-grade alternatives. As such, there were several notable differences between the treadmill used in this study and the treadmill used by Gerards et al. (2022). Firstly, due to the portable design, the treadmill deck was approximately 30cm above the floor whereas the treadmill in Gerards et al. (2022) was built into a platform such that the participant is at floor level when using the treadmill. Second, the treadmill in Gerards et al. (2022) did not have handrails or a control panel. Rather, they utilized virtual environments displayed on a 180° screen in front of participants throughout training and found that most older adults described them as positive and enhancing their experience with PBT. While the use of virtual environments was not plausible in the present study due to portability and financial constraints, their use may have created a more immersive experience and attenuated concerns regarding the lack of handrails and a control panel.

Healthcare Providers. Despite the portability of the treadmill used in the current study and the fact that it was an order of magnitude less expensive than laboratory-grade alternatives, all HCPs in the present study described the financial burden of acquiring a mechanical perturbation system, such as the treadmill, as a seemingly insurmountable barrier. Similarly, Mansfield, Danells, et al. (2021), surveyed HCPs regarding perceptions of PBT and found that purchasing PBT equipment was perceived as a barrier by over half of the HCPs surveyed. Although the present study asked HCPs about their perceptions regarding PBT using a perturbation treadmill, there are many forms of PBT

which can include alternative low-tech methods of perturbation delivery that do not require mechanical perturbation systems. One such low-tech method is manual PBT, which involves therapist-applied perturbations. The goal of manual PBT is the same as any other PBT intervention; however, perturbations are delivered by an individual rather than a mechanical system. For a more detailed description of manual PBT, we refer readers to Mansfield, Inness, et al. (2021). An HCP in the present study indicated she perceived manual PBT as a much more feasible form of PBT in the clinic and suggested that without the need for a mechanical perturbation system, the financial and logistical burden of delivering PBT would be much lower.

Considering perceived barriers relating to mechanical perturbation equipment found in the present study and reported previously by Mansfield, Danells, et al. (2021), it appears that low-tech alternatives such as manual PBT may be a more acceptable and feasible means of delivering PBT in the community. However, there have been few randomized controlled trials to investigate the efficacy of PBT outside the lab and even fewer still that have compared different methods of PBT (Gerards et al., 2017; McCrum et al., 2022). As such, there is a clear need for future research to evaluate the effects of different PBT methods, including manual PBT, on falls in daily life for community-dwelling older adults as well as the feasibility and acceptability of conducting different PBT methods in a community setting.

To our knowledge, this is the first study to evaluate the acceptability of PBT from multiple temporal perspectives and evaluate the perceptions of both older adults and healthcare professionals simultaneously. Additionally, the community setting of the present study provides insights into perceived barriers and facilitators in a different light than previous investigations conducted in laboratory settings. There are several limitations to be considered when interpreting the results of this study. Although a researcher (DT) who was not involved in the PBT intervention conducted most of the interviews, JW conducted pre-training interviews for six participants. No new themes emerged from these interviews but JW's involvement in the PBT intervention may have influenced participant responses. The study was co-designed through the CES and local agents assisted with recruitment, therefore perceptions of PBT described by older adults may differ from a PBT intervention delivered exclusively in a clinical environment. Our sample size ($n=19$) must be considered when interpreting the results of this study. Due to the extremely low population density of the communities where this research took place as well as seasonal limitations (i.e., roads that are inaccessible during winter and harvest in the summer), there was only a window of a few months where participant recruitment and data collection were possible. Additionally, our sample of 19 older adults was comprised solely of white, American, older adults and

was predominantly female; as such, their perspectives may not accurately reflect those of all older adults. Similarly, our sample of three HCPs and their previous knowledge of PBT, which was comprised exclusively of white American females, is not large enough to draw any definitive conclusion and does not reflect the perspectives of all HCPs toward PBT. Lastly, the self-selection of participants in the study may preclude those older adults who have a fear of falling and thus may have a different perception of the acceptability of PBT. Future research should investigate perceptions of PBT in more diverse settings and groups of older adults.

Conclusion

Our findings suggest that a community-based PBT program is acceptable to community-dwelling older adults. Gains in self-efficacy, balance confidence, and high perceived efficacy were identified as facilitators of participation. Healthcare professionals identified low levels of burden and opportunity cost as well as high perceived effectiveness and ethicality as facilitators of PBT delivery. Pre-PBT educational seminars may have increased prospective acceptability for both older adults and healthcare professionals. However, some older adults reported anxiety regarding the design of the perturbation treadmill and all HCPs described the financial burden of acquiring a mechanical perturbation system as a substantial barrier to delivering PBT. Taken together, these results suggest PBT is acceptable in the community, but also demonstrate a need for training methods that are more feasibly implemented outside of the laboratory. Further investigation of methods of PBT delivery is warranted to further understand the acceptability of PBT to older adults and HCPs in the community. Specifically, investigations into low-tech alternatives such as manual PBT may offer solutions.

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Ethical Approval

This study involves human participants and was approved by the Montana State University Institutional Review Board, MSU IRB# 2022-204. Participants gave written informed consent before taking part in the study.

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Supplemental Material

Supplemental material for this article is available online.

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