FLOOR-RECOVERY TRAINING IN GERIATRIC CARE: CLINICAL EVALUATION OF THE BACKWARD CHAINING METHOD AND DEVELOPMENT OF A PROFESSIONAL READINESS ASSESSMENT TOOL AMONG HUNGARIAN PHYSIOTHERAPISTS

PhD thesis booklet

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1. Introduction

1.1. Demographic challenges and falls

It is well-established that approximately one-third of individuals aged 65 and older experience at least one fall annually. Beyond immediate traumatic injuries, a fall can lead to the so-called “long lie”. This term is used to describe a period of prolonged immobilization on the floor due to an individual’s inability to rise independently. A long lie can cause serious medical complications, including hypothermia, dehydration, pneumonia, or pressure ulcers and psychological distress as well, which will lead to an increased fear of falling. Due to this fear, older adults may avoid activities they perceive dangerous, thereby limiting their own physical activity. Over time, this will lead to restricted mobility, decreased functional capacity, and ultimately, an increased risk of future falls.

1.2. Physiotherapy and fall prevention

To mitigate these risks, the latest global fall prevention guidelines recommend floor-recovery training (FRT), but it has not become a standard component of the daily practice of physiotherapists. Reasons include the lack of knowledge regarding current guidelines, or the perception, held either by the therapists or the patients, that practicing the movement sequence is too difficult or dangerous. This thesis focuses on this neglected but vital element of fall prevention: teaching older adults how to stand up from the floor safely and effectively and to assess the professional readiness amongst physiotherapists to carry out such an intervention.

1.3. Floor-recovery training via the BCM

The Backward Chaining Method (BCM) was developed specifically for the older population for the safe practice of the movement sequence required to get down to the floor, thereby learning, how to stand up from it. The core principle of BCM is to introduce the sequence starting from standing position and systematically progress down to the floor to supine position. Progression to a next step only happens when the individual can perform the preceding one confidently and securely. By starting from a standing position, BCM minimizes psychological stress and fosters self-confidence while also serves as a therapeutic exercise that enhances lower-limb strength and functional mobility. Therefore, practicing the movement sequence remains beneficial even if the individual is eventually unable to learn how to rise from the floor.

1.4. Evaluating professional readiness

For floor-recovery training to become a routine part of geriatric physiotherapy, it is essential to evaluate the current professional knowledge, attitudes and daily practice of physiotherapists regarding fall prevention using the Knowledge, Attitude, and Practice (KAP) model. This model examines the level of knowledge regarding, and the attitude towards a given topic and their manifestation in daily practice. Identifying the gaps in the Knowledge, Attitude and Practice domains is necessary to provide direction for the targeted training of physiotherapists in floor-recovery training.

1.5. Barriers between clinical evidence and professional implementation

While the BCM offers a clinically proven strategy to mitigate the risks of falls and the long lie, its effectiveness depends on its implementation. Currently, there are barriers between international fall prevention guidelines and their daily clinical application. By evaluating the clinical effects of the BCM on older adults and assessing physiotherapists' current knowledge, attitudes, and practices, this thesis seeks to align clinical evidence with daily professional practice.

2. Objectives

This dissertation comprises two separate but interconnected studies: a clinical intervention trial of the Backward Chaining Method and the development of a professional assessment tool using the KAP-model.

2.1. Clinical evaluation of the BCM

The objective of the first study (S1) was to examine the clinical effects and acceptability of the BCM from two aspects: First, to evaluate its clinical effects on functional mobility, muscle strength, fear of falling, and life-space mobility among long-term care residents. Second, to assess the acceptability of this structured intervention within an institutionalized elderly population to determine its feasibility for broader clinical implementation.

2.2. Questionnaire development and validation

S2 aimed to develop and validate a specialized measurement tool named the KAP-FALL-HU (Knowledge, Attitude and Practice – Fall – Hungarian)

questionnaire, tailored for Hungarian physiotherapists. It is designed to assess the level of knowledge regarding fall prevention and floor-recovery training among professionals, to identify their attitudes towards these interventions, and to examine their daily clinical practices. Together, S1 and S2 aim to provide a holistic view: confirming a viable solution for falls and the long lie while simultaneously identifying the professional requirements and barriers to making the floor-transfer training a standard part of geriatric physiotherapy.

3. Methods

3.1. Design of S1

This research utilized a single-blinded, double-arm randomized controlled trial design, and was conducted among residents of a long-term care facility in Budapest, Hungary. Residents were included in the study if they were at least 65 years old, had been a resident of the long-term care facility for at least two months, and maintained the ability to walk independently or with the use of an assistive device. Potential participants were excluded from the study if they were deemed unfit for floor-recovery training due to severe pain (Visual Analog Scale >7/10), lower limb endoprosthesis surgery within the preceding six months, other significant physical constraints, uncontrolled hypertension (>160/90 mmHg), cognitive impairment preventing cooperation (determined by psychological assessment) or planned relocation from the facility during the study period.

3.1.1. Measures

Participant demographics and health-related characteristics, including weight, height, Mini Mental

State Examination scores, use of assistive devices, fall history within the previous six months, and existing chronic conditions were obtained from nursing records. Outcome assessments were performed at baseline and following the intervention period by a trained physiotherapist:

– Functional mobility was assessed using the Timed Up and Go (TUG) test which measures the time required for a participant to stand up from a standard armchair, walk three meters ahead to a marker, then turn around, walk back to the chair, and sit down again.
– Functional lower limb strength was assessed using the 30-second Chair Stand Test (30CST), which records the total number of sit-to-stand repetitions completed through a full range of motion within 30 seconds.
– Grip strength was quantified in kilograms using a Kern MAP 40K1 digital dynamometer.
– Fear of falling was assessed using the Hungarian version of short Falls Efficacy Scale International (FES-I) which consists of seven items designed to evaluate an older adult's level of concern about falling during the performance of routine daily activities.
– The extent and frequency of the resident's mobility, also known as life-space mobility, was assessed using the Nursing Home Life-Space Diameter (NHLSD). The NHLSD evaluates the resident's mobility across four domains: within the resident's room, within the unit, outside the unit, and beyond the facility. NHLSD also accounts for the independence: if a resident moves through a domain without human assistance, the score for that item is doubled, resulting in the independent NHLSD scores (I-NHLSD).

3.1.2. Control Group activity

Participants randomized to the control group (CG) received the standard of care typically provided in long-term care facilities. This consisted of 40-minute chair-based, low-intensity exercise sessions, combined with communicative social activities.

3.1.3. Intervention Group activity

Additionally, residents randomized to the intervention group (IG), participated in a structured, seven-week BCM training program three times per week. Acceptability of the intervention was evaluated based on participant adherence rates and the occurrence of any adverse events.

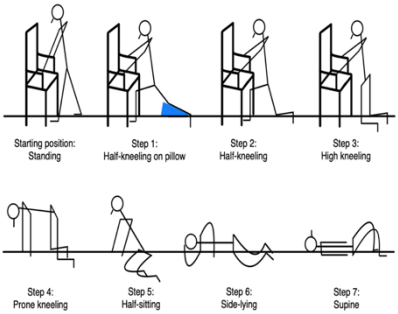

Figure 1: Steps of the BCM

3.2. Design of S2

The study was conducted in two phases: Phase I involved the development of the questionnaire, while Phase II consisted of its psychometric evaluation.

3.2.1. Phase I: Questionnaire development

The development phase was structured into three stages:

1. Item generation and construction
2. Assessment of content validity
3. Assessment of face validity

Phase I, Stage 1: Item generation and construction

The initial stage involved formulating the items, establishing response options and defining the scoring system. To ensure the scientific basis of the items, a literature review was conducted across the MEDLINE, CINAHL, and Web of Science databases. Keywords for the search included: “knowledge,” “attitude,” “practice,” “fall,” “fall prevention,” “floor-transfer training,” “floor-recovery training,” “older people,” and “physiotherapist”. The search initially yielded 16,517 results, which were screened by title. Following the exclusion of duplicates and papers unrelated to the KAP-model, falls, fall prevention or floor-recovery training, 34 potentially relevant publications were identified out of which 14 publications were selected as basis for item generation. Finally, a total of 126 items related to fall prevention were drafted and categorized into the three domains (Knowledge: 37, Attitude: 35, Practice: 54 items) of the KAP-model.

Phase I, Stage 2: Assessment of content validity

Content validity was examined using both qualitative and quantitative evaluation to ensure the instrument accurately represented the intended domains. During the qualitative evaluation, a panel of 5 experts (one physician, three physiotherapists, one nurse) conducted a comprehensive review of the items. They identified and removed duplicates, overlapping content, or items irrelevant to physiotherapy. Additionally, ten new items were formulated regarding sociodemographic data and work experience. This process resulted in an initial 68-item questionnaire prepared for quantitative evaluation.

In the subsequent quantitative evaluation, 10 independent physiotherapists were recruited to assess the 68 items based on essentiality, professional relevance, clarity, and simplicity of response. Ratings were collected using binary and four-point scales. Furthermore, respondents were encouraged to provide qualitative feedback and specific suggestions for item modification. Based on their assessment the Content Validity Ratio (CVR) and Item-level Content Validity Index (I-CVI) were calculated. CVR quantifies the essentiality of each item using the following formula:

$$\mathbf{CVR = (N_e - N/2) / (N/2)}$$

N_e: the number of respondents who considered a given item essential
N: the total number of respondents

CVR values range from -1 to 1, where a value of 1 indicates a perfect consensus on an item's necessity. I-CVI quantifies the relevance, comprehensibility, and ease of response for each item using the following formula

$$\mathbf{I\text{-}CVI = N_{e3\text{-}4} / N}$$

$N_{e3\text{-}4}$: the number of respondents who rated a given item as 3 or 4
N: the total number of respondents

I-CVI values range from 0 to 1, where values > 0.79 indicate that the item is relevant, clear and simple to respond. Values between 0.70 and 0.79 indicate a need for the modification of the item. Items with values below 0.70 are removed based on expert consensus. In addition, the Scale-level Content Validity Index (S-CVI/Ave) was calculated to determine the average validity of the entire instrument, using the following equation:

$$\mathbf{S\text{-}CVI/Ave = \Sigma I\text{-}CVI / n}$$

$\Sigma I\text{-}CVI$: sum of the item-level content validity indices of each item
n: the total number of items in the questionnaire

Following revisions from the first round of quantitative content validity analysis, a second round was performed to confirm that the final instrument achieved an S-CVI/Ave index of 1.0, indicating perfect expert consensus on the final item pool.

Phase I, Stage 3: Assessment of face validity

After completion of the content validity calculations, the final 67-item questionnaire was structured into four domains for online distribution using the Google platform. The first, general information domain consisted of 10 questions focusing on sociodemographic data, education level occupational field and work experience.

The Knowledge domain consisted of 21 items evaluating the knowledge regarding falls, its risk factors, the concept of long lie, and information about various preventive interventions including floor-recovery training. Respondents provided their answers on a three-point scale ("True", "False", or "I don't know") where each correct answer was scored one point, while an incorrect answer or "I don't know" was scored zero. A higher total score in this section indicated a higher level of knowledge.

The Attitude domain consisted of 20 items addressing professional attitudes toward falls, fall prevention and floor-recovery training. These questions were rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Items 2, 4, 5, 6, 9, 12, 14, 16, 17, and 20 were inversely scored. A higher total score indicated a more positive attitude.

The Practice domain consisted of 16 items, assessing the frequency of physiotherapy activities aimed at fall

prevention and floor-recovery training. Respondents provided their answers on a four-point Likert scale ranging from 1 (never) to 4 (always) where a higher total score indicated a higher frequency of evidence-based clinical practice. To evaluate face validity, a pretest was conducted with a pilot sample of 25 physiotherapists. They were required to complete the questionnaire, rate the clarity of each item, and measure the time needed to complete the questionnaire.

3.2.2. Phase II: Psychometric evaluation

After the development of the questionnaire, its psychometric properties were evaluated:

- Construct validity using 2-Parameter Logistic Item Response Theory for the Knowledge domain and Exploratory Factor Analysis for the Attitude and Practice domains.
- Internal consistency using Kuder-Richardson-20 for the Knowledge domain and Cronbach-alpha coefficient for the Attitude and Practice domains.
- Test-retest reliability using Kappa coefficients for the Knowledge domain and Interclass Correlation coefficient for the Attitude and Practice domains.

4. Results

4.1. Results of S1

Following the initial screening of the residents, 26 of them were randomly assigned to participate in the study in either the intervention group (IG, n=13) or the control group (CG, n=13). A total of 24 participants (92%) adhered to the study protocol.

The outcome measures at baseline and after the seven-week intervention period are presented in Table 1:

Table 1: Outcome measures

	IG		CG	
	at baseline	**after 7 weeks**	**at baseline**	**after 7 weeks**
TUG[a] (sec)	13 (10.8-30.8)	14.5 (10.8-28.1)	13 (10.8-30.8)	20.8 (16.4-30.1)
30CST[a] (number)	9 (4.5-10.5)	7 (2.75-10.5)	4.5 (0-9.25)	4 (0-7.5)
Grip-strength[b] (kg)	12.65 (5.7)	12.95 (5.5)	12.1 (3.6)	11.9 (3.6)
FES-I[b] (score)	12.92 (4.13)	10.69 (3.75)	13.38 (4.99)	14.92 (5.45)
NHLSD[b] (score)	30.54 (5.7)	32.77 (4.8)	29.15 (3.7)	24.77 (7.04)
I-NHLSD[b] (score)	58.23 (14.8)	61.62 (14.02)	56.08 (9.4)	47.46 (17.08)

Regarding physical performance, there were no significant between-group differences in functional mobility, lower limb strength, or grip strength after the intervention and no significant within-group changes were detected either. However, looking at the psychological and behavioural effects, there were significant changes:

- FES-I scores decreased significantly within the IG from baseline to post-intervention as indicated by paired t-tests ($t(12) = 3.371$, $p = 0.006$, Cohen's $d=0.63$ representing medium effect) resulting in a

significant between groups difference F(1, 23) = 13.16, p = 0.001 with a large effect size ($\eta^2 = 0.364$).

- NHLSD scores increased significantly within the IG from baseline to post-intervention as indicated by paired t-tests (t(12) = -2.441, p = 0.031, Cohen's d=0.44 representing medium effect) resulting a significant difference between groups (F(1, 23) = 10.46, p = 0.004), with a large effect size ($\eta^2 = 0.313$).
- I-NHLSD scores increased significantly within the IG from baseline to post-intervention as indicated by paired t-tests (t(12) = -2.757, p = 0.017, Cohen's d=0.24 representing small effect), resulting in a significant difference between groups (F(1, 23) = 6.975, p = 0.015), with a large effect size ($\eta^2 = 0.233$).

4.2. Results of S2

4.2.1. Knowledge domain

- Construct validity: The 2-Parameter Logistic Item Response Theory resulted in discrimination (a) parameters that fell between 0.06 and 2.61, while the difficulty (*b*) parameters showed a wide range between -31.68 and -0.47.
- Internal consistency: the Kuder-Richardson-20 coefficient was 0.702, indicating a satisfactory level of internal consistency across the Knowledge domain.
- Test-retest reliability: Kappa coefficients were between 0.8 and 1.0 indicating strong reproducibility.

4.2.2. Attitude domain

- Construct validity: The results of the Kaiser-Meyer-Olkin (KMO) measure (0.804) and the Bartlett test (<0.001) indicated the factorability of the items.

Based on the eigenvalue and the scree plot, 3 factors were identified, which accounted for 47.2% of the total variance.

- Internal consistency: The overall internal consistency for the Attitude domain was good, with a Cronbach's alpha of 0.778.
- Test-retest reliability was excellent based on the Intraclass Correlation coefficients that was between 0.869 and 1.0.

4.2.3. Practice domain

- Construct validity: The results of the Kaiser-Meyer-Olkin (KMO) measure (0.847) and the Bartlett test (<0.001) indicated the factorability of the items. Based on the eigenvalue and the scree plot, 3 factors were identified, which accounted for 61.32% of the total variance.
- Internal consistency: The overall internal consistency for the Attitude domain was good, with a Cronbach's alpha of 0.864.
- Test-retest reliability was excellent based on the Intraclass Correlation coefficients that was between 0.879 and 1.0.

5. Conclusions

This doctoral research addressed the gap between the evidence regarding floor-recovery training and its implementation in geriatric care. S1 examined the effectiveness of a training program aimed to teach older adults to stand up from the floor, while S2 aimed to develop a validated professional assessment tool to

examine why physiotherapists are not (if so) teaching this skill for their elderly patients.

5.1. Conclusions of S1

S1 demonstrated that the BCM is a feasible, well-tolerated intervention in a long-term care setting, evidenced by high adherence and positive participant feedback. The data suggest that it can significantly reduce fear of falling and expand life-space mobility among institutionalized older adults.

5.2. Conclusions of S2

S2 presented the development and validation of the KAP-FALL-HU, designed to assess the knowledge, attitude and everyday practice of Hungarian physiotherapists regarding fall prevention and floor-recovery training. The instrument demonstrated valid and reliable psychometric indicators, confirming its utility to assess professional readiness of physiotherapists, thus contributing to professional development.

5.3. Comprehensive summary

Together, these studies aim to address the challenge of falls and long lies therefore this thesis hopes to support the integration of floor-recovery training into geriatric care.

By combining a proven clinical intervention with a tool designed to track the barriers to its implementation, this research aims to translate evidence-based guidelines into daily geriatric care, thereby enhancing the safety and independence of older adults.

6. Bibliography of the candidate's publications

6.1. Publications related to the dissertation

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Kubik, A. Z., Gyombolai, Z., Simon, A., & Kovács, É. (2025). Backward Chaining Method for Teaching Long-Term Care Residents to Stand Up from the Floor: A Pilot Randomized Controlled Trial. *Journal of Clinical Medicine*, *14*(15), 5293. https://doi.org/10.3390/jcm14155293

6.2. Other publications

Gyombolai, Z., Simon, A., **Kubik, A. Z.**, Jónásné Sztruhár, I., Mayer, R., & Kovács, É. (2025). Tartós ellátást nyújtó intézményben élő idős személyek mobilitási képessége. A de Morton Mobilitási Index (DEMMI) magyar nyelvű verziójának alkalmazása [Mobility of older people in institutions providing long-term care. Applying the Hungarian de Morton Mobility Index (DEMMI)]. *Orvosi Hetilap, 166*(45), 1777–1785. http://doi.org/10.1556/650.2025.33414

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