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The Belgian physiotherapy reimbursement criteria for fall prevention fails in screening appropriately fall-prone community-dwelling older adults

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ABSTRACT
Objectives: The incidence of falling in older adults has remained unchanged over the past decades, despite evidence-based prevention initiatives. Therefore, it is appropriate to reflect on the current screening approach for preventive initiatives. The objective of this study was to determine whether the multifactorial algorithm proposed by Lusardi et al. (2017) exhibits superior predictive validity compared to the currently employed algorithm by the Belgian National Institute for Health and Disability Insurance (NIHDI).
Methods: The current study includes a secondary analysis of data collected from a falls-related study in the Department of Rehabilitation Sciences at Ghent University to compare the predictive validity of the two algorithms. Sensitivity, specificity, positive and negative predictive value and area under the curve (AUC) were calculated to ascertain which algorithm is more accurate.
Results: The database included a total of 94 community-dwelling older adults (mean age 76 years ±7.4, 35% male). Thirty-nine participants experienced at least one fall in the 8 month follow up. Lusardi's approach has a higher sensitivity score (89.7% compared to 10.3%) and negative predictive value (89.9% compared to 61.1%), but a lower specificity score (61.8% compared to 100%) and positive predictive value (62.2% compared to 100%) than the NIHDI approach. The AUC is 0.76 for Lusardi's approach and 0.55 for the NIHDI approach.
Conclusion: The use of the multifactorial algorithm proposed by Lusardi et al. may be significant and more accurate in identifying adults at risk to falls. Further research is needed particularly with a larger, more heterogenous group of older adults.

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Older adults; falls; physiotherapy; falls risk; prediction

Introduction

It is evident that our society is experiencing the effects of an ageing population. While we should view the increasing life expectancy as one of the most remarkable achievements of mankind and medicine in recent centuries, we must also acknowledge the less favourable aspects of the ageing process [1]. Falls and fall-related injuries are a common reality for adults of older age and are often associated with a decline in independence, quality of life and an increased risk of hospitalization, frailty, institutionalization, health-related costs, and even mortality [2,3]. The annual incidence of falls among adults aged 65 and older ranges between 24 and 40% depending on age and characteristics of the studied populations [2,3]. What is most notable is that these numbers have remained relatively unchanged in recent decades, despite significant research efforts in fall prevention that have demonstrated effectiveness within certain timeframes [4–8].

As the proportion of older adults continues to increase in the coming decades, it is anticipated that there will be a significant rise in the number of falls. Falls and fall-related injuries not only have a considerable impact on the health of older adults but also place a burden on healthcare systems [9]. Consequently, healthcare systems have a vested interest in fall prevention, both from a healthcare perspective and economic standpoint [10,11]. Fall prevention measures can effectively reduce fall-incidents, fall-related injuries, and the subsequent need for related care [12–14]. However, it is important to acknowledge that these prevention measures also entail increased utilization of healthcare services and expenditures [10,11]. Despite the proven effectiveness of various multidomain preventive interventions, funding and reimbursement resources remain limited [10,11,15,16]. Policymakers are therefore focused on cost-effective prevention. While they are willing to invest, they also expect a return on their investment [11]. This conditional intention-to-pay is reasonable considering the wealth of evidence demonstrating the effectiveness of preventive measures [12–14].

The implementation of evidence-based strategies in daily practice is the essential aim and crucial challenge.

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However regardless of implementation of the appropriate content, the first and perhaps crucial step is the screening or selecting fall-prone older adults. This enables us to target the right older persons for (reimbursed) prevention [3,17,18]. Over the past decades, an astonishing amount of screening instruments, tests, tools and questionnaires with various accents and approaches were developed and used for this purpose [19–21]. The information obtained through these instruments has allowed researchers and healthcare systems to create integrated algorithms or flowcharts. These algorithms or flowcharts use sets of answers from questionnaires and intake forms, along with clinical test results. They guide decision trees to identify adults at risk of falling, who are then labelled as targets for prevention and are eligible for reimbursed prevention efforts. However, due to the stable incidence of falls over the years, it is worth considering whether these compiled and condensed algorithms, which provide a YES/NO answer regarding fall risk, are indeed the most accurate approaches to motivate targeted reimbursed prevention. Perhaps an algorithm, which for example results in a graded level of fall risk, would be more accurate than the current dichotomous algorithm. Subsequently, if numeric, one could develop reimbursed fall prevention initiatives for each level of fall risk category (e.g. number of reimbursed treatments) and presumably could be able to monitor more precisely the changes in fall risk.

In Belgium, an algorithm has been developed and used since 2002 for the reimbursed fall-preventive physiotherapy nomenclature. In case a person meets all conditions, 60 physiotherapy sessions will be provided. The current conditions for eligibility in Belgium, as established by the National Institute for Health and Disability Insurance (NIHDI or RIZIV in Dutch) are as follows [22]:

- Being older than 65 years,
- Having a history of falling

Additionally, an existing risk of recurring falls must be supported by:

- A positive test result on the Timed Up and Go test (TUG, >20″) AND
- A positive test result on the Sit-To-Stand test (STS >14″) OR the Tinetti-test (<20 out of 28).

Belgium has one of the highest incidence rates for falls requiring health care, and the disability-adjusted life years (years lived with a disease and years lost due to a disease) due to falls have increased by 34% over the last three decades [23]. Given these data and the future perspectives, it raises the question of whether the currently used algorithm is an accurate and cost-effective approach. When examining the validity of the integrated tests within the NIHDI algorithm, they all have a potential to assess fall risk factors such as gait, balance, strength and functional mobility in older adults [22]. However, individually, they lack ideal appropriateness in predicting future falls and differentiating between fallers and non-fallers [24]. This does not imply that the assessed parameters are irrelevant, but it suggests that simply compiling them in a sequence may not yield the ideal profile for identifying potential fallers in the future [16]. Recently Lusardi et al. (2017) described an interesting integrated approach to fall screening, which combines several parameters and calculates likelihood ratios to generate a final risk score. They aimed to determinate whether a multifactorial statistical aggregate (see 'Methods'), comprising subdomains assessed through medical history questions, self-reported measures, and performance-based measures, could effectively predict future fall risk in community-dwelling older adults.

In the Department of Rehabilitation Sciences of the Ghent University, several study trials have been conducted over the past decades concerning fall risk detection and prevention. To address the question of the relevance of the current approach and initiate a discussion on potentially improving the screening process, these existing data were re-evaluated from the perspective of Lusardi et al., with the goal of generating a percentage risk score that could be compared with the existing NIHDI algorithm.

Methods

Purpose

The purpose of this study was to compare the predictive validity of the NIHDI algorithm and the integrated approach proposed by Lusardi et al.

Description database and population

The database used in this study was obtained from a falls-related study conducted at the Department of Rehabilitation Sciences, Ghent University. It involved a prospective fall-risk cohort study with an 8-month follow-up (FU) period. Participants were recruited through an informational letter distributed by medical doctors and physiotherapists. Falls were recorded by a falls calendar. Each participant completed and sent in the calendar each month. In case a fall was registered, the participant was contacted to provide more information about the characteristics of the fall. Participants who forgot to send in the calendar were also contacted. The database contained a vast amount of clinical and technical variables, including force plate measurements of balance, gait analysis with the GAITRite®, as well as the parameters of the NIHDI algorithm (age, fall-history, Timed Up & Go (TUG), Tinetti

Table 1. Parameters and their cut-off scores used in the NIHDI-algorithm and Lusardi approach.

NIDHI-algorithm	Approach of Lusardi et al.
• Age (>65y)	Age (≥ 80y)
• Fall history (Yes/No)	Polypharmacy (≥4)
• TUG >20″	Fall history (Yes/No)
• 5xSTS >14″ OR Tinetti <20/28	Fear of falling (Yes/No)
	Walking aid (Yes/No)
	TUG (≥11″)
	STS (≥12″)
	Tinetti (<25)
	Unipedal stance (<6,5″)
	Gait speed (<1m/s)

and Sit To Stand (STS)). For the multifactorial model proposed by Lusardi et al., the following variables, along with their cut-off score or answers, could be used to calculate a cumulative post-test probability (cPoTP): age (≥80y); polypharmacy (≥4); fall history (Yes/No); Fear of falling (Yes/No); Walking aid (Yes/No); TUG (≥11″); STS (≥12″); Tinetti (<25); unipedal stance (<6,5″) and gait speed (<1 m/s) [25]. Parameters used in both methods are showed in Table 1.

The study received ethical approval from the Ethical Committee (EC) of University of Ghent and Ghent University Hospital, with the following registration number B670201214920.

Analysis

To compare the two screenings methods, both were applied to the database. Fall risk was determined for each participant using both the NIHDI algorithm and the approach of Lusardi et al. Lusardi et al. analysed the data for each parameter stepwise, starting from sensitivity and specificity to positive and negative likelihood ratios, and the resulting odds [26]. They aimed to determine a post-test probability (PoTP) and the change in the diagnostic estimate. The pre-test probability (PrTP) was set at 30% based on the epidemiological consistency of falls in the community or the average chance of an adult aged 65 years and older to sustain a fall [22].

The algorithm proposed by Lusardi et al., which uses a clinical diagnostic framework, will calculate a new risk of falling based on the presence or absence of risk factors, such as fall history, age, balance, etc. They propose a final risk assessment based on the following cut-off scores: risk < 30% was considered low fall risk, 31–59% moderate fall risk and > 60% a high fall risk.

For example, the presence of a fall history as a positive parameter, in addition of the PrTP, yielded a PoTP of 44%, while the absence of previous falls decreased the PoTP to 26%. After calculating the PoTP's for all variables, they selected a core set of variables within the subdomains that showed the highest PoTP's for positive results and the lowest PoTP's for negative results. Consequently, they proposed a cumulative post-test probability (cPoTP) calculation that could be either incremental or decremental. The final cPoTP% represents the cumulative risk, with a value of 63% indicating a 2.1-fold increased risk from the initial PrTP of 30%. This suggests that further in-depth analysis preventive initiatives are necessary. On the other hand, if the cPoTP falls below 30% (lower than theoretical chance of falling), it implies that interventions such as education and information regarding fall risks and home safety for example may be sufficient for fall prevention.

Sensitivity was calculated by dividing the number of adults who had fallen and either passed the NIHDI reimbursement steps or scored a high(er) fall risk according to the Lusardi approach by the total amount of fallers during the FU period. Specificity was calculated by dividing the number of adults who had not fallen and did not pass the NIHDI reimbursement steps or scored a low fall risk according to Lusardi approach by the total number of non-fallers during the FU period.

Positive predictive value was calculated by dividing the number of true fallers by the number of adults who were expected to fall (those who passed the NIHDI reimbursement steps or scored a high(er) fall risk based on the approach of Lusardi et al.). Negative predictive value was calculated by dividing the number of true non-fallers by the number of adults who were expected not to fall (those who did not pass the NIHDI reimbursement steps or scored low fall risk based on the approach of Lusardi et al.). The area under the curve (AUC) was calculated using SPSS 28.

Results

Table 2 shows the baseline characteristics of all participants. Ninety-four community-dwelling adults older than 65 years were included in the study. The mean age was 76 years (± 7.4 years) and 35% of the participants were male.

Table 3 reports the number of fallers during the FU period in relation to the eligibility for reimbursement according to the NIHDI approach for the 94

Table 2. Baseline characteristics of all participants.

	Fallers	Non-fallers	Total sample
N	39	55	94
Mean age (SD)	78,4(7,8)	73,5(6,5)	75,5 (7,4)
women N (%)	27 (69,2)	34 (61,8)	61(64,9)

Table 3. Entitlement to reimbursement for fallers and non-fallers according to the NIHDI.

	Fallen (FU)	Not fallen (FU)	Total
Entitled to reimbursement	4	0	4
Not entitled to reimbursement	35	55	90
Total	39	55	94

participants. At baseline, five out of 94 participants scored positive on the TUG (NIHDI-threshold of > 20''), Tinetti (<20/28) and STS test (STS >14''). Of these five participants, one had no history of falls and was therefore not eligible for reimbursement. Therefore, only 4 out of the 94 participants (4,3%) would have met the actual requirements described in the NIHDI regulation at baseline to be eligible for 'falls prevention' [22]. Since all 4 of these participants did experience falls during the FU period, indicating that they were correctly identified as adults with a high(er) risk of falling. Out of the 39 fallers in the FU, 35 (89,7%) did not meet the NIHDI requirements and were therefore not eligible for any fall prevention initiatives according to the NIHDI [22]. All 55 patients who did not experience a fall were correctly withheld from reimbursement.

Table 4 presents the number of fallers during the FU period in relation to the assignment of a risk profile according to Lusardi et al. Upon examining the 38 older adults categorised as low risk, it was found that 4 persons experienced falls, indicating that almost 90% of the estimated low-fall-risk older adults remained fall free during the FU period. Combining the older adults with an estimated moderate or high risk, out of the 56, 35 adults experienced falls. This means that over 60% of the fallers was correctly identified as individuals at risk of future falls. When calculating the percentage of fallers for each risk category, it was observed that 80% of the older persons in the high-risk group experienced falls. These percentages were lower in the moderate-risk and low-risk group, with 33,3% in the moderate-risk group and 10,5% in the low-risk group.

To assess the predictive validity of both approaches, scores on various psychometric measures are presented in Table 5. The approach of Lusardi et al.

Table 4. Assignment of a risk profile for fallers and non-fallers according to the approach of Lusardi et al.

	Fallen (FU)	Not Fallen (FU)	Total
High risk	28	7	35
Moderate risk	7	14	21
Low risk	4	34	38
Total	*39*	*55*	*94*

Table 5. Predictive performance for both the NIHDI/RIZIV-approach as the approach from Lusardi et al.

	NIHDI/RIZIV [22]	Lusardi et al.[25]
Sensitivity (%)	10,3	89,7
specificity (%)	100	61,8
Positive predictive value (%)	100	62,2
Negative predictive value (%)	61,1	89,5
AUC	0.55	0.76

demonstrates a higher sensitivity score (89,7%), indicating its ability to correctly identify individuals who will experience falls. The NIDHI approach results in a sensitivity of 10.3%. However, the Lusardi approach has a lower specificity (61,8%) than the NIDHI-approach (100%), implying a higher chance of false positives. The NIHDI approach exhibits a higher positive predictive value (100%) compared to the Lusardi approach (62,2%). Conversely, the negative predictive value is higher for the Lusardi approach (89,5%) compared to the NIHDI approach scores (61,1%). In terms of the area under the curve (AUC), the Lusardi approach performs better with a score of 0.76 compared to the NIHDI approach with a score of 0.55 This indicates that Lusardi approach is more effective in distinguishing between older adults who are likely to experience falls and those who are not.

Discussion

Among the most prevalent and preventable incidents affecting older adults in our ageing society are falls [2,3]. These falls are believed to have motor impairments as a common contributing factor. There is significant evidence suggesting the specific exercises can help reverse these motor impairments, promoting stability, safer movement, and ultimately preventing falls [12–14,27]. Besides improving the independence and quality of life for older adults, this approach can also lead to substantial socio-economic benefits [9–11].

This paper discusses the availability of a reimbursed physiotherapy approach consisting of 60 sessions, as outlined in the nomenclature of the NIHDI [22]. It presents the algorithm used in this nomenclature and reflects on its validity. The current algorithm may not effectively target the older adults who are at a higher risk of falling. This could contribute to the limited reduction in the incidence of falls among older adults in recent decades.

Recently, Lusardi et al proposed a more comprehensive probability tool to assess the risk of future falls [25]. This paper describes their approach and attempts to apply their calculations to existing data. By applying the approach proposed by Lusardi et al. [25] to the data of a prospective study, we found a striking contrast: 89,7% of fallers could be accurately identified for reimbursed fall prevention compared to only 10,3% with the NIHDI approach. This shows that a substantial number of older adults who could have benefited from preventive physiotherapy treatment were not identified.

The high cut-off score for the TUG (>20″) and its significant impact in the NIHDI algorithm, as the primary determinant for reimbursement, may be the key factor contributing to the disappointing quality of the current fall risk selection process. It is worth mentioning that the TUG is also included in the core set of variables proposed by Lusardi et al., albeit with a lower cut-off score of > 11″ [25]. Out of 30 participants (31,9%) who had fallen both in the past year and during the FU period, 26 of them (86,7%) scored negative on the TUG of > 20″. Consequently, regardless of their age and fall history, they would not have been eligible for reimbursed physiotherapy according to the NIHDI criteria. However, if the cut-off score of > 11″ from the Lusardi approach was applied in the NIHDI algorithm, 21 out of the 39 fallers (53,8%) would have been eligible for reimbursement, a substantial increase compared to 10,3% identified using the of > 20″ cut-off score. Only one older person would have been incorrectly entitled to reimbursement when using the lower cut-off score. When the in literature most commonly used cut-off score of > 13,5″ was applied, 16 out of the 39 fallers (41,0%) would have been eligible for reimbursement. No one would be incorrectly entitled to reimbursement using this cut-off score.

Considering that only four individuals were detected solely based on the TUG score, it would be unfair to make definitive judgements about the value of the STS and the Tinetti-test, which are mandatory steps following TUG in the algorithm. In the identified four cases, these tests were also positive. It can be inferred that a TUG score over 20″ may indicate impairments in balance, gait and/or strength, as assessed by the STS and the Tinetti test. These impairments are likely to manifest in the TUG performance. When applying the cut-off score of > 11″ to the TUG, it was found that 22 out of the 37 cases who passed the TUG, would also pass the STS or Tinetti test.

Based on the full NIHDI algorithm, using a different cut-off for the TUG (>11″ instead of > 20″) would result in only 46,2% of the fallers in the FU period not being detected, instead of 89,7% when using the currently used NIDHI algorithm. Lowering the TUG cut-off score improves the accuracy of predicting fall risk and selecting appropriate candidates for prevention. While 46,1% is still a relatively high percentage, it represents a significant improvement. Further enhancements to the accuracy could be achieved by incorporating additional variables into the decision-making process, considering the multifactorial nature of falls in older adults.

In terms of the predictive validity tests, it is noteworthy that the NIHDI approach achieves 100% specificity and positive predictive value. However, it should be noted that this approach is highly selective, making it unlikely for individuals to score positive. Consequently, if someone meets all the criteria and becomes eligible for physiotherapy, a fall is almost inevitable. When the criteria are set so strictly, and it is highly unlikely for fallers to meet the criteria, excluding non-fallers is a logical outcome of the process.

The high specificity protects the NIHDI from investing in older adults who won't fall, which results in lower investment costs. However, it is questionable whether the lower investment costs outweigh the higher direct costs due to consequences of falls in the older people who did fall but were not eligible for fall prevention (low sensitivity). Investment in fall prevention increases the investment costs but can reduce on the other hand direct costs in the long run and be therefore cost effective [11]. A study by Davis et al. shows that an exercise program, specifically for fall prevention, can reduce the number of falls and thereby be cost saving [28]. Thus, a calculation of the cost benefits between direct and investment costs should be elaborated.

The AUC is a measure that provides insight into a test's ability to differentiate between positive or negative outcomes. When the AUC score is close to 1, it indicates that the test is highly effective in distinguishing between the two. In the case of the fall risk assessment, the AUC score of the Lusardi approach is 0.76, whereas the NIDHI approach only achieves a score of 0.55 These results suggest that the approach developed by Lusardi et al. is more accurate in identifying both high and low fall risk in older adults.

The use of a combination of measures, as demonstrated in the approach developed by Lusardi et al., can be considered a superior alternative for predicting falls risk compared to the criteria employed by NIHDI. This approach offers greater accuracy, improved predictive validity, and encompasses various variables related to falls, providing a specific numerical indication of the magnitude of fall risk. By categorizing individuals into three groups based on the 'size' of their fall risk, interventions can be tailored in terms of content, intensity, and frequency. Adopting alternative approaches also raises a fundamental discussion concerning cost-benefit considerations: while the cost of providing physiotherapy may increase due to a larger number of vulnerable and fall-prone older adults becoming eligible for reimbursement, the costs associated with falls (such as injuries, treatment, and hospitalisations) may increase as fewer older adults remain eligible under the current model and are therefore at a higher risk of frequent falling. Health insurance institutions should carefully consider and investigate which approach yields the greatest economic and societal benefit. This Lusardi approach could also serve as a benchmark for physiotherapist and other healthcare professionals, enabling them to monitor changes in risk profiles and make necessary adjustments to their approach as needed.

While interpreting the results, it is important to acknowledge certain limitations in this reviewer analysis. First, the sample size of the reanalysed database is relatively small. Additionally, the population under study consists of healthy older adults, without any neuromuscular or musculoskeletal pathologies. To generalize the results to the broader population of older adults, further research with a larger and more diverse group of participants is necessary. Furthermore, it is worth considering that the effectiveness of screening instruments may differ between research settings. In research setting, there is typically more time and resources available to conduct thorough screenings for everyone. However, in clinical practice, constrains such as time and financial limitations may affect the feasibility and accuracy of screening procedures. Therefore, when translating research findings to clinical setting, it is crucial to exercise caution and consider the nuanced implications of the outcomes.

Conclusion

The re-analysis of existing data from a previous fall research study has provided confirmation that utilizing an extensive multifactorial assessment, for example the use of the Lusardi approach, can be highly significant for individuals susceptible to falls. Such an approach aids in, identifying and subsequently offering preventive measures to those at risk, while also enabling healthcare providers to concentrate on the targeted population. This comprehensive and numerical assessment tool is a valid and well-founded endeavour, aiming to full explore the potential of selecting older adults prone to falls. By implementing this approach, it is anticipated that a reduction in fall incidents can be of great importance for people prone to falls (being picked up and eventually admitted to preventive measures) and for healthcare providers to focus on the population at risk. It seems a valid and motivated effort to further address the potential of a combined and numeric assessment tool in selecting fall-prone older persons to support a decrease in fall incidents.

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Ethical approval

The reanalysed study was approved by the Ethics committee (EC) of Ghent University (UGent) and Ghent University Hospital (UZ Gent). The Belgian registration number provided by the EC is B670201214920.

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