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Original Research

An Assessment of the Toulouse Saint Louis University Mini Falls Assessment Tool to Predict Incident Falls among Older Adults Residing in Nursing Homes: A 6-Month Prospective Study

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Abstract

OBJECTIVES: Toulouse Saint Louis University Mini Falls Assessment (TSLUMFA) tool has been designed to predict falls. It was initially validated in a geriatric clinic in 2018. The primary objective was to evaluate the predictive capacity of the TSLUMFA for incident falls in older adults residing in nursing homes. The secondary objective was to determine the TSLUMFA optimal cut-off value identifying those older adults with a high-risk of falling.

SETTINGS: A longitudinal study was carried out over a period of six months.

PARTICIPANTS: 93 older adults residing in nursing homes were evaluated for the present study.

MEASUREMENTS: The TSLUMFA (made up of 7 criteria) was administered at baseline, and incident falls were recorded based on a registry of falls. Comparisons of TSLUMFA scores between fallers and non-fallers were performed using the U Mann-Whitney test or Chi^2. Correlation between the total TSLUMFA score (/30 points) and incident fall(s) was explored using the Cox proportional hazard model. ROC analysis enabled an optimal cut-off value to be established to identify those adults at the highest-risk of falling.

RESULTS: In the study, 93 older adults (61.3% women) with a median age of 80 (69-87) years were included. The median total TSLUMFA score was 21 (19-24.5) points. During the 6-month study period, 38 subjects (40.9%) experienced at least one fall. The total TSLUMFA score in older adults with incident fall(s) was significantly lower than in those who did not fall (20 (15.75-22.25) points versus 23 (20-25) points and a p-value of <0.001). For each 1-point higher score at the total TSLUMFA a 9% less chance of falling was observed during the study period (p-value = 0.006). The AUC was 0.736 (95%CI: 0.617-0.822) and p-value <0.001, clearly demonstrating its interesting performance as a screening tool. A score of ≤ 21 points was identified as the optimal cut-off to identify those older adults at a higher-risk of falling.

CONCLUSION: The TSLUMFA performed well and successfully identified older adults with a high risk of falling in a nursing home setting. Further comparisons with existing tools are warranted.

Key words: Screening tool, TSLUMFA, falls, public health, older adults.

Introduction

As individuals age and with the physiological changes occurring in the older, the risk of falling increases significantly: one in three older individuals over 65 and half of those over 80 will experience at least one fall per year (1). The consequences of these falls can be dramatic for the older. Indeed, falls represents one of the leading causes of accidental or injury deaths worldwide (2). In older adults, the most frequent outcomes are hip fractures and brain injuries (3). A significant decrease in the quality of life following a fall has also been demonstrated (4) as well as loss of functional decline (5), anxiety and depression (6) but also fear of falling (7). The health economic burden of falls is also considerable at patients, caregivers and society levels (8). The cost of treatment of injuries following falls, emergency and general holding ward costs, and hospitalization costs all need to be taken into consideration, with average costs representing several thousand dollars. Indirect costs are also to be deplored (e.g., the loss of productivity of family caregivers) (8).

Given the health issues these falls lead to and the resulting burden on public health services, tools must be developed to rapidly identify older adults with a high-risk of falling and to implement long-needed preventive strategies. With this in mind, the Toulouse Saint Louis University Mini Falls Assessment (TSLUMFA) was developed and initially validated in 2018 in 103 participants from a geriatric clinic setting (9). With this tool, six criteria related to the risk of falling were investigated: medication, blood pressure, sitting balance, standing balance and strength, gait and FRAIL score (10). This screening tool provided a sensitivity of 93% and a specificity of 90% in identifying community-dwelling older adults at risk of falls or not at risk of fall in the cross-sectional analysis. However, regarding longitudinal prediction, this tool did not predict incident falls with statistical significance, most likely due to the low follow up participation as noted by the authors. To the best of our knowledge, the interest of this tool has never been assessed in a nursing home setting.

The objective of the present study was therefore to investigate the predictive value of the TSLUMFA in older adults residing in a nursing home, where falls are more

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prevalent than in community-dwelling older individuals (11). The optimal cut-off value to identify older adults at a higher-risk of falling in this specific setting was determined using the TSLUMFA.

Methods

This prospective study protocol and informed consent forms were approved by the Hospital-Faculty Ethics Committee of our institution (CHU of Liège, Belgium).

Participants' characteristics

This prospective study, carried out over a 6-month period, used a convenience sample of participants due to logistical constraints. Five nursing homes were selected in Liège, Belgium. Four inclusion criteria had to be met: Older adults needed to be aged 65 years old and over, residing in a nursing home, able to fully understand the informed consent form and to have a good cognitive status (i.e., Mini-Mental State Examination ≥ 24 points (12)). Non-inclusion criteria included: Older adults without French as a mother tongue, and older adults unable to stand up with or without material aid. Following the eligibility criteria, 101 participants were deemed suitable to take part in the assessment. Exclusion criteria were also applied: missing data in the TSLUMA (n=4), death occurring over the 6-month period (n=1) and a move to another nursing home (n=3). The final sample was therefore composed with 93 older adults. Each participant had to read and sign the informed consent form. The same clinical research assistant has gathered participants' data.

Baseline assessments

General socio-demographic data were collected (i.e., age, sex, level of education and number of comorbidities) and the TSLUMFA was added. The TSLUMFA was applied to each participant, with a maximum possible score of 30 points. Within this assessment tool, there were six areas of interest to obtain relevant information: medication including vitamin D status (supplemented or not) (/5 points), blood pressure (/3 points), sitting balance (/1 point), standing balance and strength (/6 points), gait (/10 points) and FRAIL score(10) (/5 points) (a higher score indicate a better health). Each item was evaluated as yes (1 point) or no (0 point). The TSLUMFA has been described in detail elsewhere(9). The results were recorded and the lower the score, the higher the indication of a risk of falling.

Follow-up assessments

The main point of interest was the incidence of falling over the 6-month period. The number of falls and the date of each fall were recorded. A fall was defined as "an event which results in a person coming to rest inadvertently on the ground or floor or other lower level" (10). All of this information was recorded in the nursing home's fall register and collected at regular intervals during the 6-months of the study.

Statistical analysis

R version 4.0.3 software was used to perform all the statistical analyses. An initial step of descriptive statistics was undertaken. Normality of continuous variables were investigated using histogram, Q-Q plot, mean ≈ median and the Shapiro-Wilk test. As all the continuous variables followed a skewed distribution pattern, data were expressed as a median and percentiles (P25-P75). Furthermore, categorical variables were expressed as absolute (n) and relative (%) frequencies. Group comparisons (i.e., older adults with or without incident falls) were performed using U Mann-Whitney and Chi^2 tests for continuous and categorical data. The time-to-event relationship between the total TSLUMFA score (/30 points) and the number of falls over the 6-month period were assessed through the Cox proportional hazard ratio model, yielding a hazard ratio (HR) and its 95% confidence interval (CI). The model was adjusted for age, the predictor being significantly different between the two groups. Overall performance of the TSLUMFA was evaluated using a number of indicators: sensitivity (i.e., the proportion of older adults actually subject to falling having been identified as fallers using the TSLUMFA), specificity (i.e., the proportion of older adults not subject to falling having been identified as non-fallers using the TSLUMFA), positive predictive value (i.e., the probability of falling following a positive screening test) and negative predictive value (i.e., the probability of not falling following a negative screening test). Performances were assessed for the sample and also according to the score of <23 points (for a moderate risk of falling) and <21 points (for a high-risk of falling) at the TSLUMFA established in the initial validation of the tool (9). Area Under the Curve (AUC) using Receiver Operating Characteristics (ROC) analysis made it possible to assess the performance of the TSLUMFA and how successfully it identified those older adults at a higher-risk of falling. An AUC value of less than 0.5 reflected no discriminatory power, while an AUC between 0.5 and 1.0 was vital for clinical testing. An AUC closer to 1 demonstrated a higher screening power. A new optimal cutoff was calculated according to different statistical methods: the point that minimized the distance between the ROC curve and the perfect point (distance to corner 0.1) and the Youden's index (i.e., maximum [sensitivity + specificity - 1]). The overall results were considered statistically significant at the 5% critical level.

Results

Characterization of the studied population

The sample consisted of 93 older adults, a majority of women (61.3%) and a median age of 80 years. At least one fall occurred in 38 participants (40.9%) during the 6-month period. Among fallers, 2 was the median number of falls (1-3.25). Characteristics of the population and comparisons are laid out in detail in Table 1.

Table 1. Characterization of the studied population and comparison of these characteristics between incident falls non-fallers groups after the 6-month assessment period

	Whole sample (n=93)	Older adults with incident fall(s) (n=38)	Older adults without incident fall (n=55)	P-value
Age	80 (69-87)	84 (73.75-88)	78 (69-85)	0.04
Sex				
Women	57 (61.3%)	26 (68.4%)	31 (56.4%)	0.24
Men	36 (38.7%)	12 (31.6%)	24 (43.6%)	
Level of education				
Primary education	28 (30.1%)	11 (29.0%)	17 (30.9%)	0.77
Secondary education	44 (47.3%)	17 (44.7%)	27 (49.1%)	
Higher education	21 (22.6%)	10 (26.3%)	11 (20.0%)	
Number of comorbidities	4 (3-5)	4 (3-5.75)	4 (3-5)	0.40

Our analysis highlighted the fact that, unsurprisingly, the incident fall(s) group was significantly older than the non-fallers group (median age of 84 compared with 78 years, respectively, p-value =0.04). No other significant differences were observed between groups.

Table 2. TSLUMFA domains and total score comparisons between incident fallers versus non-fallers

	Whole sample (n=93)	Older adults with incident fall(s) (n=38)	Older adults without incident fall (n=55)	P-value
Medication (/5 points)	2 (2-3)	2 (1-3)	3 (2-3)	0.03
Blood pressure (/3 points)	2 (2-3)	2 (2-3)	3 (2-3)	0.88
Sitting balance (/ 1 point)	1 (1-1)	1 (1-1)	1 (1-1)	0.09
Standing balance and strength (/6 points)	5 (4-6)	5 (3.75-5)	6 (5-6)	0.009
Gait (/10 points)	8 (6-9)	7 (5.5-9)	9 (7-9)	0.004
FRAIL score (/5 points)	3 (2-4)	2 (1-3)	4 (3-5)	<0.001
Total TSLUMFA score (/30 points)	21 (19-24.5)	20 (15.75-22.25)	23 (20-25)	<0.001

TSLUMFA domains and total score in the sample

The complete sample obtained an overall median total score of 21 (19-24.5) TSLUMFA score. Table 2 illustrates the different comparisons of total and domains TSLUMFA scores between incident fall(s) group and non-fallers group.

The total TSLUMFA score was significantly lower in older adults have experienced at least one fall during the 6 months (p-value <0.001). Except for two criteria (i.e., blood pressure and sitting balance), older adults with incident fall(s) had significantly lower criteria scores than older adults with no incident falls (all p-values <0.05).

Association between the total TSLUMFA score and incident fall(s)

When considering the time-to-event relationship between the total TSLUMFA score and incident fall(s), analysis yielded an adjusted HR of 0.91 (95%CI: 0.85-0.97) meaning that an improvement of 1 point in the total TSLUMFA score meant there was a 9% lower risk of suffering from at least one fall during the 6-month period (p-value = 0.006).

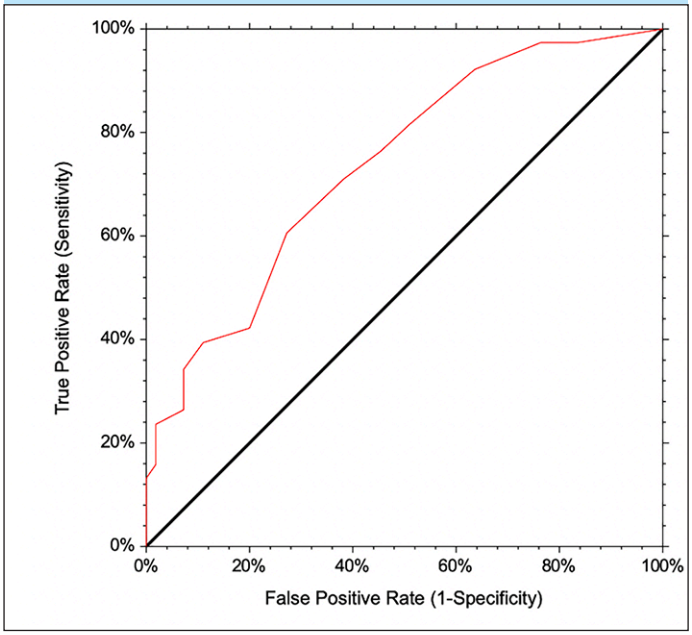
Performance of the TSLUMFA to identify older individuals with or without incident fall(s)

When applying the cut-off of <23 points in total TSLUMFA score to identify older adults with a moderate risk of incident fall(s) as proposed by the initial validation(9), the sensitivity was 76.3% (95%CI: 59.8%-88.56%), the specificity was 54.5% (95%CI: 40.5%-68.0%), the positive predictive value was 53.7% (95%CI: 45.2%-62.0%) and the negative predictive value was 76.9% (95%CI: 64.2% to 86.1%).

Furthermore, when modifying the proposed cut-off to <21 points, as also suggested by the initial validation (9), in total TSLUMFA score to identify older adults with a high risk of incident fall(s) in our sample, the sensitivity decreased to 60.5% (95%CI: 43.4%-76.0%), a specificity of 40.0% (95%CI: 21.1%-61.3%) was found, as well as a positive predictive value of 60.5% (95%CI: 50.4%-69.8%) and a negative predictive value of 40.0% (95%CI: 26.4%-55.4%).

The AUC was 0.736 (95%CI: 0.617-0.822, p<0.001) indicating that the TSLUMFA performed well and successfully discriminated older adults at risk of incident fall(s) and those not at risk (see Figure 1).

Figure 1. AUC from ROC analysis to optimize identification of older adults at high risk of incident falls



In our own studied sample, the optimal cut-off point to identify older adults at risk of incident fall(s) was ≤20 points of the total TSFUMLA score using the Youden index (0,3325 with sensitivity = 60.5% and specificity = 72.7%) and ≤ 21 points using the distance to corner method (0,4791 with sensitivity= 71.0%, specificity = 61.8%, positive predictive value = 60.5%).

Subgroup analysis: comparisons between unique and multiple falls groups

Deeper analysis showed that the total TSLUMFA score was significantly and negatively correlated to the number of falls (r=-0.31, p-value = 0.003): the lower the TSLUMFA total score, the higher the number of falls. We therefore performed a supplementary analysis separating unique and multiple fallers.

Among the 38 older adults with incident fall(s), 23 (60.5%) experienced 2 or more falls. Table 3 gives a description of the characteristics and TSLUMFA score differences between the unique fall and multiple falls groups (i.e., 2 or more incident falls). No significant difference was observed between the two groups.

Discussion

The present study highlighted that the TSLUMFA score was significantly lower in older adults subject to incident falls over a 6-month period than in older adults without incident falls. It was discovered that, the lower the total TSLUMFA score, the higher the risk of falling. The optimal cut-off score to identify older adults with a high-risk of falling was ≤21 points/30.

The initial validation of the tool(9) showed a lower total TSLUMFA score in older adults who had experienced a previous fall compared to non-fallers. However, the score of the older subjects who fell during the study period was not significantly different from those who did not fall (p-value = 0.12). A longer period of follow-up in our study (i.e., 6 months in our study versus 3 months in the initial validation) in a different setting (i.e., nursing home vs geriatric clinic) made it possible to highlight a highly significant difference in the total TSLUMFA score between the two groups (20 (15.75-22.25) points versus 23 (20-25) points, p-value <0.001). Further analysis in our study also demonstrated that adults with a TSLUMFA score which was at least 1 point higher had a 9% lower risk of suffering at least one fall during the 6-month period.

In terms of the performance of the tool, the AUC of 0.736 confirmed that the TSLUMFA was successfully able to identify older adults at a higher-risk of falling. When applying the cut-off scores proposed in the validation of the tool, the indicators of performance were slightly inferior to those initially observed (e.g., for the <23 points cut-off score, 76.3% of sensitivity in our sample versus 80.6% of sensitivity in the initial validation and for the <21 points cut-off score, 60.5% of sensitivity in our sample versus 92.9% of sensitivity in the initial validation). The discrepancies observed were probably due to differences in sample and setting. Nonetheless, a score >23 points is reassuring concerning the risk of falling and that, conversely, a score <21 points should lead to a reinforced fall prevention approach among residents who present this value. Optimal cut-off value to identify older adults at high-risk of falling were fairly similar between our study (i.e., ≤21 points) and the initial validation (i.e., <21 points), which reinforced the robustness of our findings.

Other tools already exist for screening for the risk of falling in older adults. These include the Tinetti Gait and Balance Instrument (TGBI) (13), widely recognized as the gold standard in the field. However, the TSLUMFA offers the possibility to quickly identify which of the 6 criteria (i.e., medication, blood pressure, sitting balance, standing balance and strength, gait and FRAIL score) and should be the object of a specific intervention in order to prevent future falls. The TSLUMFA could, therefore, be a constructive aid in clinical practice to identify patients at high-risk of falling, especially in a nursing home setting where older adults are increasingly institutionalized (i.e., around 8% of Belgians over 65 and 42% over 85 with a significant increase since 2006 (14)).

Our study defined several benefits: a longer period of assessment and a different population setting. Some limitations do however need to be taken into consideration. First, the representativeness of our sample could be said to be limited: the convenience sampling and the specific setting cannot allow generalization of our results to all older adults in nursing homes nor to the entire population of older adults. Second, potential other confounding factors could probably have been considered.

As a perspective, it would be interesting for other studies to assess whether the precise detection of the different parameters that are at the origin of these fall risks could allow more individualized, specific and targeted management and improve the patient's state of health. For example, it would be possible to treat a possible orthostatic hypotension and to review the prescription of certain drugs if possible. Adaptations in the environment of the elderly in order to avoid potential dangers

Table 3. Comparison of the characteristics and TSLUMFA scores between unique fall group and multiple falls group

	Unique fall group (n=15)	Multiple falls group (n=23)	P-value
Age	87 (74-94)	83 (70-97)	0.21
Sex			
Women	10 (66.7%)	16 (69.6%)	0.85
Men	5 (33.3%)	7 (30.4%)	
Level of education			
Primary education	5 (33.3%)	6 (26.1%)	0.15
Secondary education	4 (26.7%)	13 (56.5%)	
Superior education	6 (40.0%)	4 (17.4%)	
Number of comorbidities	4 (3-5)	4 (2.5-6)	0.70
Medication (/5 points)	2 (1-4)	2 (1-3)	0.55
Blood pressure (/3 points)	2 (2-2)	2 (2-3)	0.25
Sitting balance (/ 1 point)	1 (1-1)	1 (1-1)	0.66
Standing balance and strength (/6 points)	5 (4-6)	5 (3-5)	0.42
Gait (/10 points)	7 (6-9)	7 (4-9)	0.55
FRAIL score (/5 points)	2 (1-3)	2 (1-3)	0.98
Total TSLUMFA score (/30 points)	20 (17-24)	20 (15-21)	0.34

and the installation of appropriate technical aids (canes, walkers) could be effective solutions.

In conclusion, the TSLUMFA performed well at identifying nursing home residents at high-risk of falling, with a score of ≤ 21 points/30 being taken as the cut-off value in our sample. It could therefore be helpful to implement the tool at an early-stage of clinical practice intervention, thereby decreasing the likelihood of future falling from older adults. Indeed, preventative strategies are crucial as it has been suggested that the maintenance of physical or cognitive performances in the older could promote resistance to disabling conditions and consequently have an impact on falls.

Conflict of interest: none.

Funding: none.

Ethical statement: This prospective study protocol and informed consent forms were approved by the Hospital-Faculty Ethics Committee of our institution (CHU of Liège, Belgium). Experiments comply with the current law of the country.

References

1. Balzer K, Bremer M, Schramm S, Lühmann D, Raspe H. Falls prevention for the elderly. GMS Health Technol Assess 2012;8:Doc01. DOI: 10.3205/hta000099
2. Krug EG, Sharma GK, Lozano R. The global burden of injuries. Am J Public Health 2000.90:523–526. DOI: 10.2105/ajph.90.4.523
3. Stevens JA. Falls among older adults-risk factors and prevention strategies. J Safety Res 2005.36:409–411. DOI: 10.1016/j.jsr.2005.08.001
4. Jia H, Lubetkin EI, DeMichele K, Stark DS, Zack MM, Thompson WW. Prevalence, risk factors, and burden of disease for falls and balance or walking problems among older adults in the U.S. Prev Med (Baltim) 2019;126. doi:10.1016/j.ypmed.2019.05.025. DOI: 10.1016/j.ypmed.2019.05.025
5. Ek S, Rizzuto D, Xu W, Calderón-Larrañaga A, Welmer AK. Predictors for functional decline after an injurious fall: a population-based cohort study. Aging Clin Exp Res:2020;1–8. DOI: 10.1007/s40520-020-01747-1
6. Vetter NJ, Ford D. Anxiety and depression scores in elderly fallers. Int J Geriatr Psychiatry 1989;4:159–163. https://doi.org/10.1002/gps.930040307
7. Oshima K, Asai T, Fukumoto Y, Yonezawa Y, Nishijima A. Development and persistence of fear of falling relate to a different mobility functions in community-dwelling older adults: one-year longitudinal predictive validity study. Aging Clin Exp Res:2021;1–8. DOI: 10.1007/s40520-020-01756-0
8. Hendrie D, Hall SE, Arena G, Legge M. Health system costs of falls of older adults in Western Australia. Aust Health Rev 2004;28:363–373. DOI: 10.1071/ah040363
9. Rouck JE, Malmstrom TK, Morley JE. Initial Validation of the Toulouse St. Louis University Mini Falls Assessment in Older Adults. J Nutr Heal Aging 2018;22:880–884. DOI: 10.1007/s12603-018-1073-x
10. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged african americans. J Nutr Heal Aging 2012;16:601–608. DOI: 10.1007/s12603-012-0084-2
11. Vu MQ, Weintraub N, Rubenstein LZ. Falls in the Nursing Home: Are They Preventable? J Am Med Dir Assoc 2004;5:401–406. DOI: 10.1097/01.JAM.0000144553.45330.AD
12. Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. J Am Geriatr Soc 1992.40:922–35. DOI: 10.1111/j.1532-5415.1992.tb01992.x
13. Tinetti ME, Franklin Williams T, Mayewski R. Fall risk index for elderly patients based on number of chronic disabilities. Am J Med 1986;80:429–434. DOI: 10.1016/0002-9343(86)90717-5
14. Vers une Belgique en bonne santé - Vers une Belgique en bonne santé Available at: https://www.belgiqueenbonnesante.be/fr/. Accessed February 13, 2021.

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