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Predictive Power of Dependence and Clinical-Social Fragility Index and Risk of Fall in Hospitalized Adult Patients: A Case-Control Study

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Objectives: Accidental falls are among the leading hospitals' adverse events, with incidence ranging from 2 to 20 events per 1.000 days/patients. The objective of this study is to assess the relationship between in-hospital falls and the score of 3 DEPendence and Clinical-Social Fragility indexes.

Methods: A monocentric case-control study was conducted by retrieving data of in-hospital patients from the electronic health records.

Results: Significant differences between the mean scores at the hospital admission and discharge were found. The BRASS scale mean (SD) values at the admission and at the discharge were also significantly higher in cases of in-hospital falls: at the admission 10.2 (±7.7) in cases versus 7.0 (±8.0) in controls ($P = 0.003$); at the discharge 10.0 (±6.4) versus 6.7 (±7.5) ($P = 0.001$). Barthel index mean (SD) scores also presented statistically significant differences: at the admission 60.3 (±40.6) in cases versus 76.0 (±34.8) in controls ($P = 0.003$); at discharge 51.3 (±34.9) versus 73.3 (±35.2) ($P = 0.000$).

Odds ratios were as follows: for Barthel index 2.37 (95% CI, 1.28–4.39; $P = 0.003$); for Index of Caring Complexity 1.45 (95% CI, 0.72–2.91, $P = 0.255$); for BRASS index 1.95 (95% CI, 1.03–3.70, $P = 0.026$). With BRASS index, the area under the curve was 0.667 (95% CI, 0.595–0.740), thus indicating a moderate predictive power of the scale.

Conclusions: The use of only Conley scale—despite its sensitivity and specificity—is not enough to fully address this need because of the multiple and heterogeneous factors that predispose to in-hospital falls. Therefore, the combination of multiple tools should be recommended.

Key Words: falls, diagnosis, intervention, prevention, risk assessment

(*J Patient Saf* 2024;20: 240–246)

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The authors disclose no conflict of interest.

All the authors contributed substantially to the study design, data collection, data analysis and interpretation, drafting, critically review, and final approval of the version submitted for publication. Those entitled to authorship are listed as authors.

The local ethics committee approved this study (prot. 12720/22 ID: 4859).

BACKGROUND

Accidental falls, defined as "inadvertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects,"[1] are among the leading hospitals' adverse events, with incidence ranging from 2 to 20 events per 1.000 days/patients (depending on the setting of care).[2–7] Accidental falls mainly concern fragile patients, especially those affected by dementia[8]: approximately a third of patients older than 65 years falls at least once a year and the 10% of the events causes significant injuries.[9] Different factors, like age, sex, comorbidities, physical/psychological impairment, and drugs, tend to increase the risk of in-hospital factors.[10]

Approximately 78% of in-hospital falls as classified as predictable—being due to individual factors that need to be assessed at the clinical evaluation,[11] while the remaining 14% are classified as accidentals (e.g., slipping on wet floors), and 8% as unpredictable in strict sense—being due to sudden individual factors (e.g., loss of consciousness). Indeed, a comprehensive assessment of the patient's conditions is a key factor to prevent in-hospital falls that are to a large extent related to physical (e.g., degree of patient' autonomy in the daily life activities), neurocognitive, biometabolical, emodynamical, and social factors.[12–15] DEPendence and Clinical-Social Fragility indexes (DEP-CSF indexes) are commonly used to assess the fall risk, being able to evaluate risk factors like the caring complexity (Index of Caring Complexity), the functional dependence in daily life activities (Barthel index) and the need a more comprehensive discharge plan (Blaylock Risk Assessment Screening Score [BRASS]).[16–18] Albeit—as just said—there are different DEP-CSF indexes based on different risk factors, there is no tool based on the combined assessment of multiple risk factors but for the Conley scale, which has six items and flags fall risk when more of an item is found.[19] This tool is relatively easy to use; however, its sensitivity is 60% to 69% and specificity 41% to 61%, with positive predictive value of 2.7%.[20–22] As such, many authors advise against the use of this only tool for a comprehensive assessment.[14,16]

The primary objective of this study was to assess the predictive power of 3 DEP-CSF indexes in identifying the in-hospital falls, and the secondary objective was to evaluate the association between DEP-CSF indexes and in-hospital falls risk.

MATERIALS AND METHODS

Study Design

A monocentric case-control study was conducted at Fondazione Policlinico Universitario A. Gemelli IRCCS (Rome, Italy), by retrieving data of in-hospital patients from the electronic health

TABLE 1. General Characteristics

		Fall n	Fall %	No Fall n	No Fall %	Total n	Total %	Fall Mean	Fall SD	No Fall Mean	No Fall SD	Total Mean	Total SD
Case-control groups		108	50	108	50	216	100						
Sex	Male	69	63.9	47	43.5	116	53.7						
	Female	39	36.1	61	56.5	100	46.6						
Age								69.0	13.4	66.7	17.4	67.8	15.6
Education	Elementary school	7	6.5	9	8.3	16	7.4						
	Middle school	21	19.4	21	19.4	42	19.4						
	High school	21	19.4	25	23.1	46	21.3						
	University	14	13.0	16	14.1	30	13.9						
	No education	3	2.8	3	2.8	6	2.8						
	N/A	42	38.9	34	31.5	76	35.2						
Hospital admission	Planned	54	50	54	50	108	50						
	Unplanned	54	50	54	50	108	50						
Diagnosis at the admission	Cancer	42	38.9	42	38.9	84	38.9						
	No cancer	66	61.1	66	61.1	132	61.1						
Discharge	Discharge	92	85.2	92	85.2	184	85.2						
	Transfer to a public hospital	4	3.7	6	5.6	10	4.6						
	Transfer to private hospital	2	1.85	2	1.85	4	1.85						
	Death	10	9.3	8	7.4	18	8.3						
Hospital stay								31.7	44.8	9.6	10.5	20.7	34.3

N/A, not available.

records. The data referred to January 1, 2021, to July 30, 2021. The study was approved by the local ethics committee on April 7, 2022 (prot. 12720/22 ID: 4859).

Study Populations

Cases are defined as in-hospital falls as flagged by the incident reporting system of the hospital. An equal number of controls were considered, defined as in-hospital patients experiencing no falls in the same period. The 2 groups were homogeneous in terms of age (older than 18 y), education, kind of hospital admission (planned/unplanned), diagnosis at the admission, and type of discharge.

Samples Size

As no similar study has been published in the literature, we assumed a dz (effect size) value of 0.5. Applying the Student *t* test with *P* values <0.05, it was estimated that at least 108 cases had to be analyzed.

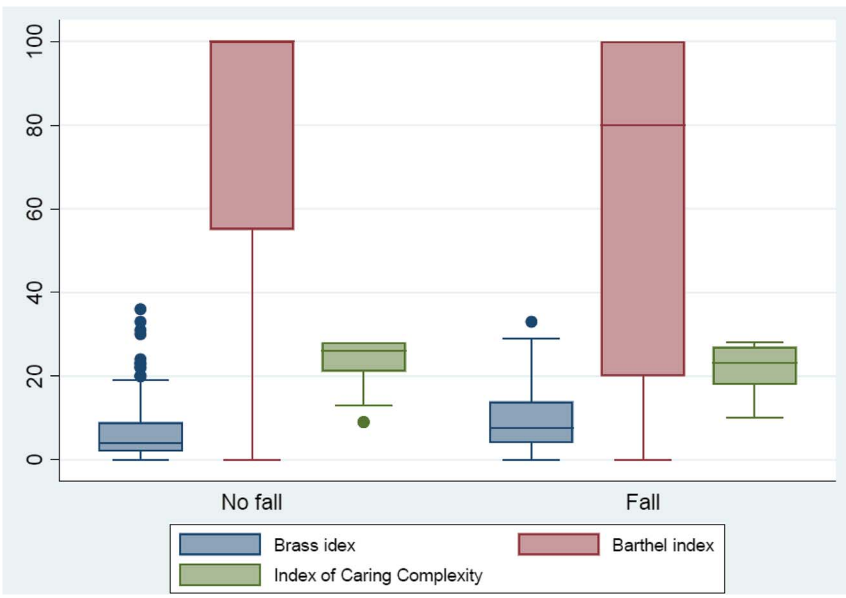

FIGURE 1. Dependence clinical-social fragility index and type fall/no fall groups: differences between the means.

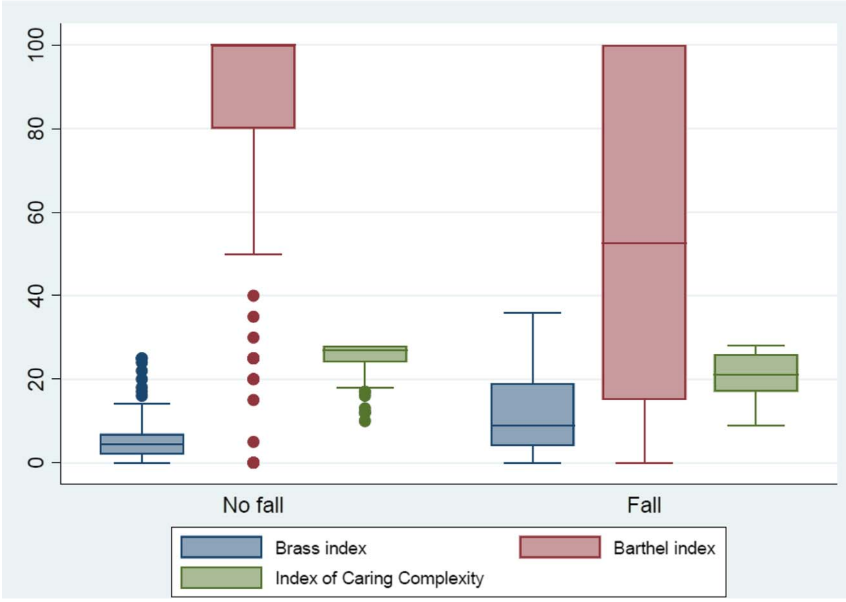

FIGURE 2. Dependence clinical-social fragility index and type of hospital admission: differences between the means.

Dependence and Clinical-Social Fragility Indexes

•Index of Caring Complexity[16]: it reflects the caring complexity. The scores range from 7 to 28, with critical values between 12 and 19 indicating high risk and between 7 and 11 very high risk;
•Barthel index[17]: it reflects daily life activities. The scores range from 0 (completely dependent on caregivers) to 100;
•BRASS[18]: it reflects recommendations regarding discharge planning. The scores going from 0 to 40 with values between 11 and 19 indicating high risk and between 20 and 40 very high risk.

Endpoints

The primary objective of this study was to assess the predictive power of 3 DEP-CSF indexes in identifying the in-hospital falls, and the secondary objective was to evaluate the association between DEP-CSF indexes and in-hospital falls risk.

TABLE 2. Statistically Significant Differences Between the Means of the Groups (Dep-CSF Indexes, and Fall/No Fall, Planned/Unplanned Hospital Admission)

	Group	n	Mean	SD	95% CI	*P*
Barthel	No fall (control)	108	76.0	34.8	69.3–82.6	0.003
	Fall (case)	108	60.3	40.6	52.6–68.1	
BRASS	No fall (control)	108	7.0	8.0	5.4–8.5	0.003
	Fall (case)	108	10.2	7.7	8.7–11.6	
IDA	No fall (control)	108	24.0	4.9	23.1–25.0	0.004
	Fall (case)	108	22.0	5.4	21.0–23.0	
Barthel	Planned	108	82.7	31.4	76.7–88.7	0.000
	Unplanned	108	53.6	39.5	46.0–61.1	
BRASS	Planned	108	5.8	5.6	4.7–6.8	0.000
	Unplanned	108	11.4	9.0	9.6–13.1	
IDA	Planned	108	25.1	4.3	24.3–25.9	0.000
	Unplanned	108	20.9	5.3	19.9–21.9	

Statistical Analysis

Software Stata/IC v. 16.1 was used for statistical analysis. Shapiro-Wilk test was used as a test of normality. Variables of interest in the cases and in the controls were compared using Student *t* test and Mann-Whitney test. *P* values ≤0.05 were adopted as threshold for statistical significance. Accuracy and cutoff values were evaluated through receiver operating characteristics (ROC) curves. Finally, odds ratios (ORs) were calculated using χ^2 tests to express the association between in-hospital falls and DEP-CSF indexes.

RESULTS

Cases and Controls

One hundred eight cases and 108 controls were included by applying the eligibility criteria. The 53.7% of the total study population was of male sex and the leading age group was the 71 to 80 (36.5% of the cases) followed by the 51 to 60 (17.5%). Main diagnosis at the admission was SARS-CoV-2 infection (25.9%) and most of the patients were discharged (75%) while the 8.3% of them died during the hospital stay. Other general characteristics are summarized in Table 1.

TABLE 3. Relationship Between Conley Scale and Fall/No Fall

Group	Obs	Mean	SE	SD	95% CI	p50	IQR	*P*
No fall (control)	108	1.3	0.18	1.9	0.92–1.7			0.001
Fall (case)	108	2.4	0.24	2.6	1.9–2.9			
No fall (control)	108					0	1.5	0.001
Fall (case)	108					2	4	

IQR, interquartile range; p50, 50th percentile.

TABLE 4. Predictive Performance—Conley Index

		Observed Falls				
		+	−	Total	Se	54.6%
Predicted fall	+	59	27	86	Sp	75.0%
	−	49	81	130	PPV	68.6%
	Total	108	108	216	NPV	62.3%
					Correctly classified	64.8%

PPV/NPV, positive and negative predicted values; Se, sensitivity; Sp, specificity.

Relationships Between Variables of Interest

Statistically significant differences between the mean (SD) scores at the hospital admission and discharge were found when Index of Caring Complexity was evaluated (Fig. 1): at the admission 22.0 (±5.4) in cases of in-hospital falls versus 24.0 (±4.9) in controls (P = 0.004); at discharge 21.5 (±4.8) in cases versus 23.3 (±5.3) in controls (P = 0.014). The BRASS mean (SD) values at the admission and at the discharge were also significantly higher in cases of in-hospital falls: at the admission 10.2 (±7.7) in cases versus 7.0 (±8.0) in controls (P = 0.003); at the discharge 10.0 (±6.4) versus 6.7 (±7.5) (P = 0.001). Finally, Barthel index mean (SD) scores also presented statistically significant differences: at the admission 60.3 (±40.6) in cases versus 76.0 (±34.8) in controls (P = 0.003); at discharge 51.3 (±34.9) versus 73.3 (±35.2) (P = 0.000).

Significant differences between mean (SD) scores in the cases of planned admission versus unplanned admission (Fig. 2): for Index of Caring Complexity at the admission 20.9 (±5.3) versus 25.1 (±4.3) (P = 0.000) and at discharge 20.8 (±5.7) versus 24.0 (±3.8) (P = 0.000); for BRASS at the admission 11.4 (±9.0) versus 5.8 (±5.6) (P = 0.000) and at discharge 10.7 (±8.0) versus 6.0 (±5.2) (P = 0.000); using Barthel index at the admission 53.6 (±39.5) versus 82.7 (±31.4) (P = 0.000) and at discharge 47.5 (±35.8) versus 77.0 (±32.4) (P = 0.000) (Table 2).

Predictive Performance

Conley Index

The mean (SD) values using Conley Index showed statistically significant differences between cases of in-hospital falls 2.4 (±2.6) and controls 1.3 (±1.9) (P = 0.001). If median (interquartile values) values were considered, the differences were still significant: 2 (4) versus 0 (1.5) (P = 0.001) (Table 3). Of 108 cases, 59 were correctly identified as at risk (sensitivity = 54.6%) while 81 of the 108 controls were correctly identified as not at risk (specificity = 75%) (Table 4).

Dep-CSF Index

Odds ratios were as follows: for Barthel index 2.37 (95% CI, 1.28–4.39, P = 0.003); for Index of Caring Complexity 1.45 (95% CI, 0.72–2.91, P = 0. 255); for BRASS index 1.95 (95% CI, 1.03–3.70, P = 0.026).

Predictive performance was computed based on 108 falls from 214 subjects. With BRASS index, the area under the curve (AUC) was 0.667 (95% CI, 0.595–0.740), thus indicating a moderate predictive power of the scale. With IDA's index, the AUC was 0.628 (95% CI, 0.555–0.702), thus indicating a moderate predictive power of the scale. Finally, with Barthel index, the AUC was 0.624 (95% CI, 0.554–0.694), thus indicating a moderate predictive power of the scale (Fig. 3).

The ORs end ROC curve are reported in Table 5.

The best cutoff was for BRASS 5 (64.8%), for Index of Caring Complexity 26 (60.20%), and for Barthel index 60 (59.70%) (Table 6).

DISCUSSION

In our sample, each risk assessment tool revealed strengths and weaknesses. In comparison with previous evidence,[20–22] Conley index showed higher specificity and positive predictive value but lower sensitivity. The observed prevalence of correctly classified cases entails that more than a third of the patients was misclassified (64.8%), a finding that—if combined with the relatively low sensitivity (54.6%)—implies that this index may expose the hospital to a relatively high chance of underestimating the risk

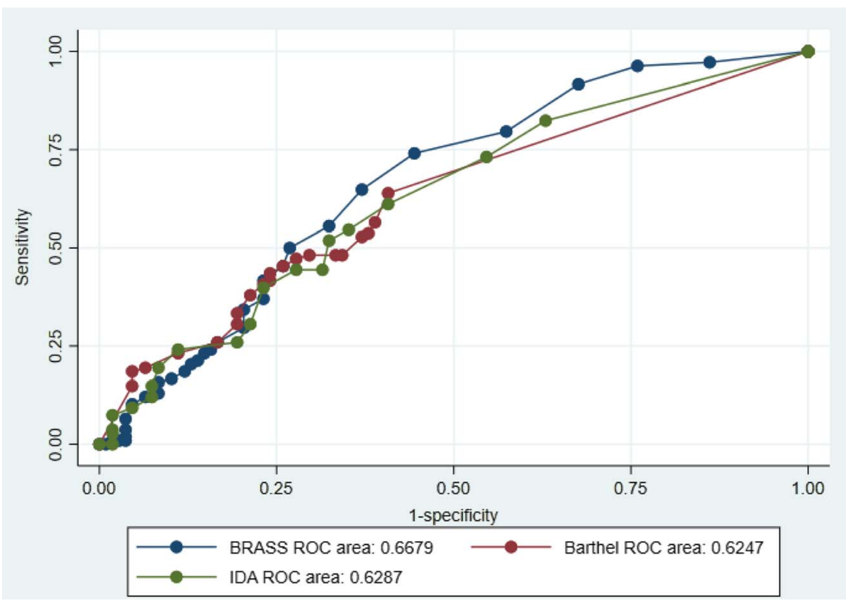

FIGURE 3. Predictive fall performance with ROC.

TABLE 5. Predictive Performance Dep-CSF Index

	Obs	ROC Area	OR	95% CI	P
Barthel	216		2.37	1.28–4.39	0.003
		0.62		0.55–0.69	0.001
BRASS	216		1.95	1.03–3.70	0.026
		0.67		0.59–0.74	0.001
IDA	216		1.45	0.72–2.91	0.255
		0.63		0.55–0.70	0.001

of in-hospital falls and then mainly to avoidable indirect costs (i.e., compensations in cases of personal damages). Similarly, in the "risk area" (Table 6), BRASS index showed relatively poor sensitivity but high specificity.

Barthel index presented a sensitivity that inversely correlated with cutpoint, being particularly high at lower cutpoints. Instead, but for cutpoint 100 (that is outside the "risk area"), specificity was relatively low. At different cutpoints, this index related to prevalences of correctly classified patients ranging from 50.00% and 59.70%. Therefore, in our study, Barthel index was associated with an overestimation of the risk and thus with the implementation of unnecessary preventive measures (an issue that can mainly impact on direct costs). Similarly, in the "risk area," IDA's index related to good sensitivity but low (lower than 20%) specificity.

In detail, our study found a statistically significant relationship between variations in the scores of DEP-CSF indexes (Barthel index, Index of Caring Complexity, and BRASS) and in-hospital falls.

This evidence can be explained by the fact that physical/neurological impairment and in general a decreased physical activity and capacity of performing daily life activities predispose to a higher risk of falling.[23–28] Therefore, because all these factors are associated with long hospital stays, it can be inferred that length of hospitalization may expose (especially at-risk) patients to the risk of falling.[29]

The secondary endpoint of this article was to evaluate whether DEP-CSF indexes can reliably predict the risk of in-hospital falls. For each scale, ROC curves were considered to find the best cutoff, leading to findings consistent with previously reported cutoffs.[14,21,22,30–32] Moreover, the ORs supported a significant relationship between variations in these scales (in particular of Barthel index).

That being said, according to Swets classification, we evaluated the accuracy of the scores considering the areas under the ROCs, finding values (0.63–0.67) slightly under the lower limit (0.7) for the range corresponding to moderate accuracy.[33]

This evidence supports the necessity of combining Conley scale with other indexes, in particular to achieve a better accuracy in identifying patients at high risk and tailor specific preventive interventions.[34] Indeed, many authors advised against the adoption of a single index, because of the high number of factors that may predispose to in-hospital falls.[33,35]

Another relevant finding is given by the statistically significant relationship between decrease in all the DEP-CSF indexes and the unplanned hospital admission. For instance, we found a statistically significant difference in values of Barthel index at the unplanned admissions—53.6 (SD, ±39.5)—versus at the planned admissions—82.7 (SD, ±31.4). Unplanned hospital admissions entail the admissions to emergency rooms, which are environments presenting different hazards, and combining our findings, it can be stated that this kind of admission may cause a further increase in the risks of patients that can be classified as fragile in the light of DEP-CSF indexes scores. However, because the numbers of planned and unplanned admissions were equal between cases and controls, this evidence is limited and should be confirmed by future research.

Empowering clinicians with risk assessment tools considering multiple factors could lead to a decrease in the hospital costs because, as said, besides their impact on morbidity and mortality, in-hospital falls cause an increase in the rate of hospital admissions and in the length of stay, adjunctive diagnostic/therapeutic interventions and, thus, an inflation of the costs of care.[36] Moreover, according to MEDMAL report on medical malpractice in a sample of Italian public and private healthcare facilities, the 13.6% of noncompensated medical malpractice claims was due to in-hospital falls in the 2010–2019 period. In the studied cases, in-hospital falls were the third leading cause of medical

TABLE 6. Predictive Performance: Best Cutoff

Barthel				BRASS				IDA			
CP	SE	SP	CC	CP	SE	SP	CC	CP	SE	SP	CC
0	**100.0%**	**0.0%**	50.00%	0	100.0%	0.0%	50.0%	**9**	**100.0%**	**0.0%**	**50.00%**
5	**85.2%**	**4.6%**	55.10%	3	91.7%	32.4%	62.0%	**10**	**100.0%**	**1.9%**	**49.10%**
15	**80.6%**	**6.5%**	56.50%	5	74.1%	55.6%	64.8%	**12**	**96.3%**	**1.9%**	**50.90%**
25	**74.1%**	**16.7%**	54.60%	7	55.6%	67.6%	61.6%	**14**	**90.7%**	**4.6%**	**52.30%**
35	**66.7%**	**19.4%**	56.90%	9	45.4%	74.1%	59.7%	**16**	**85.2%**	**7.4%**	**53.70%**
45	**59.3%**	**23.2%**	58.80%	**11**	**37.0%**	**76.9%**	**56.9%**	**18**	**75.9%**	**11.1%**	**56.50%**
55	**56.5%**	**24.1%**	59.70%	**15**	**24.1%**	**84.3%**	**54.2%**	**19**	**74.1%**	**19.4**	**53.20%**
60	**54.6%**	**25.9%**	59.70%	**19**	**18.5%**	**88.0%**	**53.2%**	20	69.4%	21.3%	54.60%
65	**52.8%**	**27.8%**	59.70%	**21**	**15.7%**	**91.7%**	**53.7%**	22	55.6%	27.8%	58.30%
75	**51.9%**	**33.3%**	57.40%	**25**	**6.5%**	**96.3%**	**51.4%**	24	48.2%	32.4%	59.70%
85	47.2%	37.0%	57.90%	**31**	**0.9%**	**97.2%**	**49.1%**	26	38.9%	40.7%	60.20%
95	43.5%	38.9%	58.80%	**36**	**0.0%**	**100.0%**	**50.0%**	28	17.6%	63.0%	59.70%
100	0.0%	100.0%	50.00%					28	0.0%	100.0%	50.00%

Bold text indicates risk area.

CP, cutpoint; SE, sensitivity; SP specificity.

malpractice claims (after diagnostic and surgical errors)[37,38]; 97% of the cases led to physical injuries and in the 2.4% to death.[32] Preventing in-hospital falls could thus entail a decrease also in hospital costs for medical malpractice claims, being at the least a part of these events preventable.

A possible future perspective of this research consists in verifying through prospective studies whether DEP-CSF indexes may be used as a predictor of in-hospital falls when combined with specific tools like Conley. This question remains open because our evidence only partly supports this hypothesis.

LIMITATIONS

We cannot exclude the presence of selection bias and/or recall bias (related to the heterogeneity of anamnestic data of the 2 groups of the study population).

Furthermore, the 2 groups (planned and unplanned) the 2 groups are not entirely homogeneous.

CONCLUSIONS

The main scope of developing an accurate and reliable approach to assess the risk of in-hospital falls in adult inpatients is to stratify the risk, aiming to flag the cases at highest risk who could be targeted by specific preventive interventions. The use of only Conley scale—despite its sensitivity and specificity—is not enough to fully address this need because of the multiple and heterogeneous factors that predispose to in-hospital falls. Finally, as discussed, in the risk areas, the tools showed heterogeneous values of specificity and sensitivity, implying that the use of multiple tools may be a forced choice not only to address the complexity of risk factors but also to offset benefits and deficits of each single index. However, the use of multiple tools can be quite impractical, and creating a single tool tackling all aspects would be a possible solution of this issue.

REFERENCES

1. WHO global report on falls prevention in older age. 2007. Available at: https://apps.who.int/iris/handle/10665/43811. Accessed January 20, 2023.
2. Fischer ID, Krauss MJ, Dunagan WC, et al. Patterns and predictors of inpatient falls and fall-related injuries in a large academic hospital. *Infect Control Hosp Epidemiol*. 2005;26:822–827.
3. Healey F, Monro A, Cockram A, et al. Using targeted risk factor reduction to prevent falls in older in-patients: a randomised controlled trial. *Age Ageing*. 2004;33:390–395.
4. Oliver D, Daly F, Martin FC, et al. Risk factors and risk assessment tools for falls in hospital in-patients: a systematic review. *Age Ageing*. 2004;33: 122–130.
5. Morris R, O'Riordan S. Prevention of falls in hospital. *Clin Med (Lond)*. 2017;17:360–362.
6. Kobayashi K, Imagama S, Inagaki Y, et al. Incidence and characteristics of accidental falls in hospitalizations. *Nagoya J Med Sci*. 2017;79:291–298.
7. Ueki S, Ikegame K, Kozawa M, et al. Risk analysis of falls in patients undergoing allogeneic hematopoietic stem cell transplantation. *Clin J Oncol Nurs*. 2014;18:396–399.
8. Oliver D, Connelly JB, Victor CR, et al. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses. *BMJ*. 2007;334:82.
9. Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off". *JAMA*. 2010;303:258–266.
10. Ganz DA, Bao Y, Shekelle PG, et al. Will my patient fall? *JAMA*. 2007;297: 77–86.
11. Morse JM. Enhancing the safety of hospitalization by reducing patient falls. *Am J Infect Control*. 2002;30:376–380.
12. Gates S, Fisher JD, Cooke MW, et al. Multifactorial assessment and targeted intervention for preventing falls and injuries among older people in community and emergency care settings: systematic review and meta-analysis. *BMJ*. 2008;336:130–133.
13. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev*. 2012;2012:CD007146. Published 2012 Sep 12.
14. Swift CG, Iliffe S. Assessment and prevention of falls in older people—concise guidance. *Clin Med (Lond)*. 2014;14:658–662.
15. DiBardino D, Cohen ER, Didwania A. Meta-analysis: multidisciplinary fall prevention strategies in the acute care inpatient population. *J Hosp Med*. 2012;7:497–503.
16. Simonetti V, Comparcini D, Buccolini M, et al. Index of Caring Complexity as a management tool in a surgical setting: an observational study [in Italian]. *Prof Inferm*. 2014;67:235–242.
17. Mahoney FI, Barthel DW. Functional evaluation: the Barthel index. *Md State Med J*. 1965;14:61–65.
18. Mistiaen P, Duijnhouwer E, Prins-Hoekstra A, et al. Predictive validity of the BRASS index in screening patients with post-discharge problems. Blaylock Risk Assessment Screening Score. *J Adv Nurs*. 1999;30:1050–1056.
19. Conley D, Schultz AA, Selvin R. The challenge of predicting patients at risk for falling: development of the Conley Scale. *Medsurg Nurs*. 1999;8: 348–354. Erratum in: *Medsurg Nurs* 2000;9(1):50.
20. Chiari P, Mosci D, Fontana S, et al. Valutazione degli strumenti di misura del rischio di cadute dei pazienti. *Assist Inferm Ric*. 2002;21:117–124.
21. Guzzo AS, Meggiolaro A, Mannocci A, et al. Conley scale: assessment of a fall risk prevention tool in a general hospital. *J Prev Med Hyg*. 2015;56:E77–E87.
22. Palese A, Gonella S, Lant A, et al. Post-hoc validation of the Conley scale in predicting the risk of falling with older in-hospital medical patients: findings from a multicentre longitudinal study. *Aging Clin Exp Res*. 2016;28:139–146.
23. Ferrer A, Formiga F, Sanz H, et al, Grupo Octabaix. Successful aging and indicators of frailty in the elderly. Octabaix Study [in Spanish]. *Aten Primaria*. 2014;46:475–482.
24. Franco MR, Tong A, Howard K, et al. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. *Br J Sports Med*. 2015;49:1268–1276.
25. Tricco AC, Thomas SM, Veroniki AA, et al. Comparisons of interventions for preventing falls in older adults: a systematic review and meta-analysis. *JAMA*. 2017;318:1687–1699.
26. Sherrington C, Michaleff ZA, Fairhall N, et al. Exercise to prevent falls in older adults: an updated systematic review and meta-analysis. *Br J Sports Med*. 2017;51:1750–1758.
27. Huggan PJ, Akram F, Er BH, et al. Measures of acute physiology, comorbidity and functional status to differentiate illness severity and length of stay among acute general medical admissions: a prospective cohort study. *Intern Med J*. 2015;45:732–740.
28. Strini V, Piazzetta N, Gallo A, et al. Barthel index: creation and validation of two cut-offs using the BRASS Index. *Acta Biomed*. 2020;91(2-S):19–26. Published 2020 Mar 13.
29. Miwa Y, Yamagishi Y, Konuma T, et al. Risk factors and characteristics of falls among hospitalized adult patients with hematologic diseases. *J Geriatr Oncol*. 2017;8:363–367.
30. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel index for stroke rehabilitation. *J Clin Epidemiol*. 1989;42:703–709.
31. Szumilas M. Explaining odds ratios. *J Can Acad Child Adolesc Psychiatry*. 2010;19:227–229. Erratum in: *J Can Acad Child Adolesc Psychiatry*. 2015 Winter;24(1):58.
32. Dupépé EB, Kicielinski KP, Gordon AS, et al. What is a case-control study? *Neurosurgery*. 2019;84:819–826.
33. Swets JA. Measuring the accuracy of diagnostic systems. *Science*. 1988; 240:1285–1293.

34. National Collaborating Centre for Nursing and Supportive Care (UK). *Clinical Practice Guideline for the Assessment and Prevention of Falls in Older People*. London: Royal College of Nursing (UK); 2004.
35. Strini V, Schiavolin R, Prendin A. Fall Risk Assessment Scales: a systematic literature review. *Nurs Rep*. 2021;11:430–443. Published 2021 Jun 2.
36. Ministero della Salute. Raccomandazione n. 13. 2011. Available at: http://www.salute.gov.it/imgs/C_17_pubblicazioni_1639_allegato.pdf. Accessed January 20, 2023.
37. Marsh. Report MEDMAL. Studio sull'andamento del rischio da medical malpractice nella sanità italiana pubblica e privata. 2021. 12° Edizione. Available at: https://www.marsh.com/it/it/about/media/medmal-2021-medical-malpractice-sinistri-sanita.html. Accessed January 20, 2023.
38. Patrini E. Andamento e costo del contenzioso a livello nazionale. Medmal Claims Analysis. 4th ed. 2013. Available at: https://www.quotidianosanita.it/allegati/allegato2440520.pdf. Accessed January 20, 2023.

