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Prospective Emergency Screening Tool Identifies Functional Problems in Geriatric Patients on Admission - Findings of a Validation Study

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Abstract

Objective: To validate the Geramover Screening (GS) against the Comprehensive Geriatric Assessment (CGA) as non-inferiority screening tool for identifying geriatric patients in the emergency department.

Method: Using a retrospective database and medical record analysis of GS and CGA results, 189 geriatric patients matched for functional impairment, Barthel index, and derived recommendations on the screening tool.

Results: Of the admitted patients 87% were defined as geriatric patients by the GS. The GS showed the following sensitivity/specificity/PPV/NPV compared to the CGA for acute functional disorders: disorders in cognition (0.765/0.772/0.871/0.62; p=0.000), locomotion (0. 938/0.808/0.965/0.700; p=0.000), autonomy (0.927/0.909/0.986/0.645; p=0.000), nutrition (0.379/0.958/0.959/0.374; p=0.000), and overall condition (0.877/1.000/1.000/0.457; p=0.000). The GS, like the CGA, shows a significant negative correlation (-0.316 versus -0.473; p=0.000, 2-sided) between the number of dysfunctions to the level of the Barthel index.

Conclusion: The GS, as a valid emergency screening tool for geriatric patients, is not inferior to the CGA in correct, early detection of functional disorders and mapping of the correlated autonomy scale Barthel Index.

Keywords: Geriatric patients; Geriatric screening; Functional disorders; Validation study; Gold standard; CGA

Introduction

The number of elderly patients in the emergency department is increasing annually [1-6]. At the same time, the likelihood for these elderly patients to be hospitalized is increasing too [7]. The geriatric patient presents with age-related functional limitations, multimorbidity, older age (>75 years), increased vulnerability, and deterioration in self-help status [8]. Regulated triage [9] or appropriate screening is necessary for geriatric patients [10,11]. Based on evidence and practicality the Identification Seniors at Risks (ISAR) instrument has been recommended for the identification of geriatric patients since 2012 [12]. The 6-question assessment is controversially discussed [13], as different assessments are available, some of which differ considerably in scope and validation. LACHS [14] 1990, AFGIB Screening 2011 [15], Geramover Screening (GS) 2012 [16], Geriatrics Check 2017 [17]). The ISAR score, TRST, and Geriatrics Check have been formally validated [17-19] as have the INTER AI [20] and SHERPA [21] and most recently the APOP screening from Leiden University [22,23].

The hypothesis of the present study is that GS screening is non-inferior to Comprehensive Geriatric Assessment (CGA) as a gold standard screening tool for identifying geriatric patients in the emergency department. To this end, a retrospective database and medical record analysis of GS and CGA results in 189 geriatric patients is applied, relating dysfunction, Barthel index, and derived recommendations to the screening tool used.

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Method

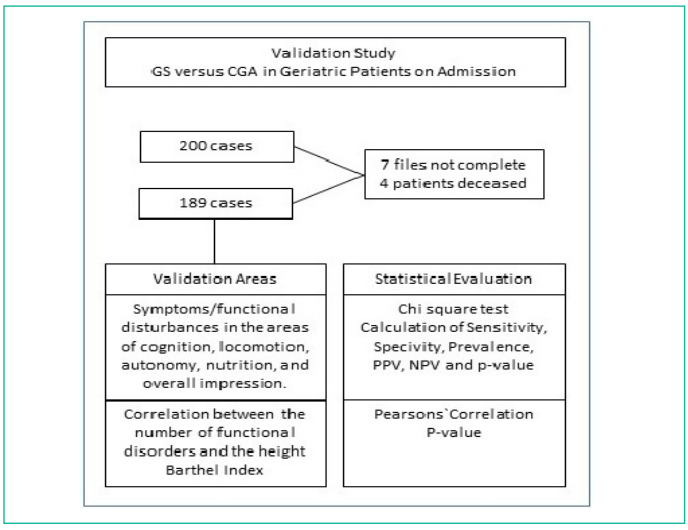
Data collection for the present validation study was performed at Wartenberg Hospital. This hospital is the largest geriatric acute and rehabilitation hospital in Bavaria under the sponsorship of the Prof. Dr. med. H. Selmair Foundation. The main focus of the clinic is the acute care of patients with internal, geriatric-neurological clinical pictures. The clinic has four leading specialists for geriatric medicine and manages 190 beds (149 beds geriatric rehabilitation, 55 beds internal medicine/ acute geriatrics, 11 beds for appraisal patients.

The GS was developed in 2003 as a screening tool with the aim of detecting acute dysfunction in geriatric patients in the emergency department at the earliest possible stage. It is a database-driven online screening tool that staff can use to detect dysfunction and symptoms in geriatric patients in the admission setting after special training. In addition to two days of training, a Structured Geriatric Curriculum (SGCu) and exam must be completed. The GS is based on 42 symptoms/dysfunctions in five core geriatric domains: cognition, locomotion, autonomy, nutrition, and overall health. For clinic operations and use in the emergency department, the GS can be integrated with clinic software. In 2018, screening was expanded to include clarification of prehospital treatment needs. The GS had been integrated into Wartenberg Clinic's clinic software and admission staff was trained since 2013.

In the admission process, trained staff selects the present and observed symptoms/dysfunctions. Detailed recommendations for more in-depth clarification of diagnoses and processes to be implemented are generated automatically via a stored logic. Supplementary screening algorithms, such as ISAR screening, are built into the checking logic and additionally generate corresponding scores and identifiers ("geriatric patient according to DGG") GG. The results are stored in the patient-specific database.

All admitted inpatients are standardized to a CGA within 72h. This is provided by a specialist-led Multi-Professional Team (MPT) of registered nurses, physiotherapists, occupational therapists, dieticians, speech therapists, psychologists and social workers. CGA results are fixed at the patient-specific database (GERIDOC).

The validation study retrospectively statistically compared the collected GS results of admission with those of the collected CGA results. Retrospective data processing was applied to validate the admission process data without affecting the medical process.



Selection criterion was age >75 years. Participants who received palliative care or died during hospitalization were excluded. Also excluded were patients with incomplete records. Of the 200 records drawn, 5 were incomplete and 6 patients were deceased. Ethics committee votes were available from the University of Cologne (for the preliminary study) and the Wartenberg Hospital Ethics Council.

Statistics

SPSS data analysis and statistics software (version 24.0) was used for statistical analysis. Pearson's chi-square test was performed. The results were presented in cross tabulations. For correlations, Pearson's correlation coefficient was performed and the relationships were also presented graphically. Values such as sensitivity, specificity, prevalence, PPV and NPV were also determined and discussed. A power analysis was calculated here: test = t test, statistical test = correlation, type of power analyze = a priori, pages: two-sided test, effect size: 0.3 (medium effect), α: 0.05 and a power of 0.95 .With these properties, this would give us a total sample size of N = 134 people. With 189 patients the number ordered was reached and exceeded.

Results

There were 73 men (median 82 years; MW 81.47 ± 5.24 years) and 116 women (median 84 years; MW 82.92 ± 6.01 years) included in the analysis. The overall median age was 83 years. The 5 main diagnoses were fractures (m 15.1%/w 22.4%), heart failure (w 13.1%/w 7.8%), apoplexy (m 11.0%/w 6.0%), CHD (m 8.2%/w 2.6%), and COPD (m 5.5%/w 3.4%). On average, males took 8.54 ± 3.26 (median 9), and females tended to take more medications, but not significantly, at 8.89 ± 3.60 (median 8). Men had slightly more secondary diagnoses at 8.39 ± 3.54 (median 8), whereas women had only 7.85 ± 4.13 (median 8) secondary diagnoses, but this was also not significantly different. In 87% the admitted patients were defined as "geriatric patients according to DGG" by GERAMOVER- screening. This means that 13% of the admitted patients had an ISAR score of <2 points and were therefore formally not geriatric patients according to ISAR score.

The following questions were investigated and were statistically analyzed:

1. How do GS scores relate to CGA scores (gold standard) in terms of dysfunction in cognition, locomotion, autonomy, nutrition, and overall health?

A total of 1421 functional disorders were detected in 189 GS. This was an average of 7.4 ± 4.7 (median 7) functional disturbances per patient. These were distributed across the 5 core geriatric domains as shown below.

Focus	Sensitivity	Specifity	Prevalence	PPV	NPV	p-Wert
Cognition	0.765	0.772	0.669	0.871	0.62	0.000
Locomotion	0.938	0.808	0.849	0.965	0.700	0.000
Autonomie	0.927	0.909	0.872	0.986	0.645	0.000
Nutrition	0.379	0.958	0.721	0.959	0.374	0.000
	1.000	1.000	0.906	0.877	0.457	0.000

In more than half (66.9%) of the cases, the GS detected dysfunction in cognition (testing of 12 factors focusing on attention, delirium, dementia, and depression). Sensitivity and specificity compared to the gold standard was above 75%. The positive

predictive value for cognitive impairment was 87.1%.

In more than three quarters of all cases (84.9%), the GS detected dysfunction in locomotion (testing of 10 factors focusing on transfer, walking ability and walking distances, and falls). Compared to the gold standard, the sensitivity was 93.8% and the specificity was above 80.8%. The positive predictive value for locomotor dysfunction was 96.5%.

The GS detected functional disturbances in the area of autonomy just as strongly (87.2% of cases) (testing of 6 factors with a focus on incontinence, food residues on clothing (swallowing disturbance), increased need for care when bathing and dressing). Compared to the gold standard, sensitivity was 92.7% and specificity was above 90.9%. The positive predictive value for autonomic dysfunction was 98.6%.

In almost three quarters of the cases (72.1%), the GS detected functional disorders in the area of nutrition (testing of 11 factors with a focus on weight loss, dehydration, hand strength, swallowing disorders). Compared to the gold standard, sensitivity was 37.9% and specificity was above 95.8%. The positive predictive value for nutritive disorders was 95.9%.

In almost all (90.6%), the GS detected dysfunction in the area of overall impression (testing 8 factors focusing on perceptions, signs of neglect, previous hospitalizations, number of medications), with GS results congruent with MPT results.

2. How do GS results relate to CGA results in terms of correlations between number of dysfunctions and Barthel index?

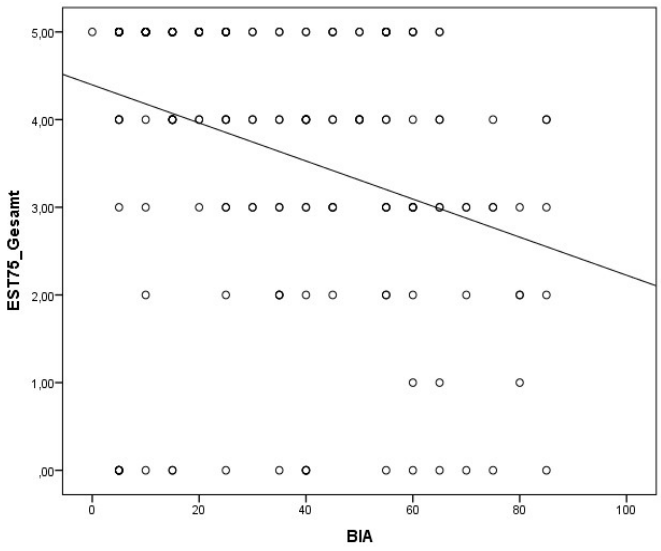
35.4% of patients (n=67) had a Barthel index of 0-15 points, were severely in need of care by definition. 29.6% of the patients (n=56) had a Barthel index of 20-40 points, were in increased need of care. 21.6% of the patients (n=41) had a Barthel index of 40-60 points, were in low need of care.13.2% of the patients (n=25) had a Barthel index of greater than 60 points, were by definition increasingly independent.

Barthel-Index	Number Dysfunctions GS	Number Dysfunctions CGA
0-15	4.14 ± 1.64	3.68 ± 1.52
20-40	3.58 ± 1.56	3.17 ± 1.49
45-60	3.65 ± 1.38	2.70 ± 1.58
>60	2.56 ± 1.52	1.32 ± 1.31

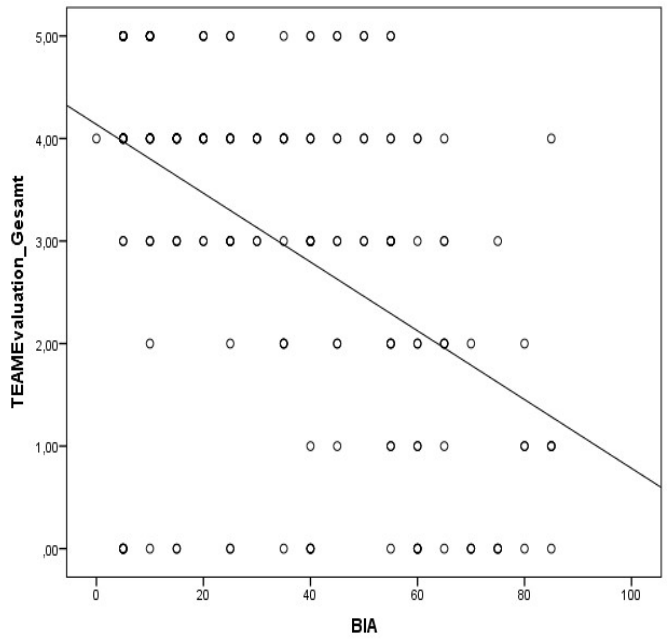
Meanvalue ± Standard Deviation

			GS	CGA
Barthel Index	Correlationaccordingto Pearson	1	-,316**	-,473**
	Significance (2-sided)		0	0
	N	189	189	189
GS Gesamt	Correlationaccordingto Pearson	-,316**	1	,853**
	Significance (2-sided)	0		0
	N	189	189	189
CGA_Gesamt	Correlationaccordingto Pearson	-,473**	,853**	1
	Significance (2-sided)	0	0	
	N	189	189	189

**.The correlation is significant at the 0.01 level (2-sided).



Boxplot 1: Geramover Screening (GS) vs. Barthel Index (BI)



Boxplot 2: Comprehensive Geriatric Assessment (CGA) versus Barthel Index (BI).
The boxplots of the examination of the GS and CGA against the Barthel Index SsA show the same significant, negative correlation (p=0.000, 2-sided) with the Barthel Index Assessment (BI). This means that as the number of dysfunctions increases, the Barthel Index decreases, i.e., autonomy becomes worse. This correlation is more pronounced for CGA scores (-0.473) than for GS (-0.316).

Additional Result

In 189 GS, 726 recommendations for more in-depth assessment were also generated for differential diagnoses (immobility, incontinence, pain, room mobility, dysphagia, lack of social control, dehydration, and falls). Only recommendations with a frequency >5% (number of mentions at least 35) are listed. With 436 mentions, these represented >60% of all recommendations

Automated recommendations selected by frequency criteria consistently show very high specificity with lower sensitivity.

Clarification recommended for	Number	Sensitivity	Specificity	Prevalence	PPV	NPV
Immobilization	77	0.68	0.87	0.11	0.40	0.96
Incontinence	66	0.63	0.8	0.09	0.24	0.96
Pain	59	0.65	0.98	0.08	0.80	0.97
Roommobility	59	0.29	0.63	0.08	0.07	0.91
Dysphagia	55	0.73	0.75	0.07	0.19	0.97
Absence of socialcontrol	47	1.00	1.00	0.06	1.00	1.00
Dehydration	37	0.60	0.86	0.05	0.19	0.98
Fall	36	0.34	0.95	0.05	0.27	0.97

Discussion

The patients present in the validation study are comparable in the number of medications, diagnoses, and dysfunctions to those presented by Huyse et al. in a European study [25] in the emergency department. They are typical representatives of multimorbid patients with needs for more complex nursing interventions and an increased risk of disease complications [25]. According to Hoogerduijn et al, screenings in this group are clearly indicated to select patients who are at increased risk for functional decline [26]. Screenings in emergency departments should be able to test the focus areas (loss of autonomy, multimorbidity, geriatric need for treatment [27], delirium, falls, pain, and need for care) in principle if patients with geriatric need for action are to be found for a Comprehensive Geriatric Assessment (CGA). CGA is correlated with better autonomy scores and higher survival according to Ellis et al. 2014 [28]. Although quality outcomes are not consistently consistent in terms of evidence (Ellis 2017 [29]), the CGA currently represents a gold standard in clinical care for the elderly with essential clinical quality structures. Because CGA is not feasible for every patient due to the time involved, selecting elderly patients with dysfunction using screening in the admission process makes sense. Results of GM screening against the complex CGA structure-a procedure that has been used repeatedly. For example, in 2021 Gretarsdottir et al. validated the Inter AI in terms of construct validity and its ability to detect outcomes against the TRST and the ISAR [20]. The geriatric check was validated against the ISAR in 2021 [17]. Due to the complex data collection in the GS with 42 items, the CGA was used as the gold standard for validation against it, for which there are comparable studies. Cavusoglu et al. validated the G8 against the CGA in 2021 [30]. Sepehri et al. validated the electronic form of the Frailty index against the CGA in 2020 [31] to develop a paperless form. Mueller et al. validated a brief geriatric assessment against the CGA in 2018 [32].

At the first level of validation, the GS asks about dysfunctions in the five central areas of aging patients. Here, the screening is required to be as sensitive as possible. It should be able to find this disorder if it is positive. On the other hand, it is very important to understand whether disorders that are not present are correctly shown as not present. For this, it needs the highest possible specificity. Compared to the gold standard, one would therefore require the highest possible sensitivity and specificity for screening functional disorders. The validation study shows that the GS has well to very good sensitivities and specificities of 80% and 88%, respectively, for all five disorder domains. In comparison with other validation studies, the results hold up (ISAR score > 2 points Sens./Spec. 88.8%/24.8% [18]; TRST 30-day IADL decline Sens./Spec. 74%/30% [19]; SHERPA score < 3.5 Sens./Spec. 85%/45% [21]; Geriatric Check vs ISAR Sens./Spec. 82.0%/ 62.1% [17]. Acute functional impairment in cognition, locomotion, autonomy, nutrition, and overall health can be validly assessed with the GS, with particularly good functional impairment for autonomy/locomotion, with Sens./Spec. of 92%/90% and 93%/80%.

At the second level, the recorded relationship number of functional impairments and the Barthel index [33] was investigated. This is essential for the clinical care of geriatric patients, as clinics must employ and use the Barthel index or the extended Barthel index. Payers' review the level of the Barthel index in geriatric services in acute care settings because they can infer a relationship with the level of care the patient receives. For example, Barthel indices >60 points are correlated with increasing independence, while those of <30 points are correlated with increasing care dependence [34]. The validation study shows a significant negative correlation between the number of recorded functional disorders and the Barthel index for both the GS and the CGA. That is, the more functional disorders a patient have, the lower the Barthel autonomy index. The correlation between Barthel index and GS versus CGA are -0.375 versus -0.475 comparable to correlations of other complex studies as shown by Huyse et al. in the COMPRI study [24] with values between 0.25 and 0.44.

Three to four additional recommendations are triggered for in-depth investigations because of suspected diagnoses. Some of which showed good results in the review. For this area, the GS works like the APOP screening [35]. Both detects valid disorders and risks, triggers recommendations for further clarifications and necessary processes.

Limitations and Restrictions

The number of cases in the study was low at just under 200, although this was due to the high complexity of the data collection and allowed for a preliminary study of 250 patients. However, statistical analysis was well possible based on the nearly 200 cases in this question.

In addition, the CGAs were conducted by different physicians - 4 geriatricians were involved in the validation study, potentially allowing for professional and content differences in the evaluation. However, here the study by Locatelli et al. 2017 [36] shows that the comparison of 9 geriatricians in performing tests shows good to excellent agreement except for malnutrition, visual impairment, and prevention of falls. Further, the number is relatively low with 189 data evaluated. This was due to the time-consuming data entry for the analysis.

Summary

The GS has been successfully validated against the CGA. The GS can reliably and validly detect dysfunction in geriatric patients and correctly correlates it with the Autonomy Index. However, in addition to the latter, additional recommendations for more in-depth assessment are formulated, providing useful information on suspected diagnoses as well as processes. Thus, geriatric patients can be rapidly evaluated in the admission situation and protective measures can be taken. A follow-up study on the outcome of screened patients should be performed to assess the therapeutic consequences of improved diagnosis.

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