Inpatient rehabilitation of working-age adults with ischemic stroke: comparing men and women clinical and functional characteristics at admission and predicting functionality

Alejandro García-Rudolph, Sara Laxe, Blanca Cegarra, Joan Saurí-Ruiz, Eloy Opisso, Josep M. Tormos, Montserrat Bernabeu

Introduction. The role of gender in functional independence for activities of daily living after ischemic stroke is still controversial. We aim to a) compare clinical characteristics of men and women at inpatient rehabilitation admission b) compare their functional independence at admission and discharge c) identify predictors of functional independence.

Materials and methods. Retrospective observational cohort study. State-of-the-art variables were used for admission and discharge comparisons and to predict total FIM (Functional Independence Measure) at discharge, FIM gain, FIM efficiency and FIM effectiveness using multivariate linear regressions.

Results. 144 patients (33% women) admitted to inpatient rehabilitation in a Spanish specialized center, with less than 3 weeks since ischemic stroke onset were included. Men were older (p = 0.039), 19.6% of men had diabetes mellitus (6.4% of women) (p = 0.038), with 52.6% of men being non-smokers (72.3% of women) (p = 0.022). No significant differences were observed in FIM at admission, discharge, FIM gain, efficiency or effectiveness (total, motor either cognitive FIM). Regression analysis identified sex (β = –0.13), stroke severity (β = –0.25) and admission total FIM (β = –0.69) as significant predictors of total FIM gain (R^2 = 0.42). The same variables predicted discharge total FIM: sex (β = –0.12), severity (β = –0.23) and admission total FIM (β = 0.59) (R^2 = 0.51). FIM efficiency was predicted by admission total FIM (β = –0.64), severity (β = –0.24), age (β = –0.17) and length of stay (β = –0.45) (R^2 = 39.9). FIM effectiveness model explained only 13.5% of the variance.

Conclusions. No functional differences between men and women in any independence measure were found. Sex was a significant predictor but leaving half of the variance unexplained.

Key words. Activities of daily living. Brain ischemia. Gender. Rehabilitation. Sex. Stroke.

Introduction

Stroke is the main cause of long-term disability in Western society [1]. Recent publications are increasingly recognizing differences between women and men in relation to stroke. For example, each year, approximately 55,000 more women than men have a stroke with a higher lifetime risk (attributed to women's higher life expectancy) [2], women have more severe strokes [3], symptoms at onset are more often non-specific in women [4], the time interval between symptoms onset and both the presentation to hospital and the beginning of treatment is longer in women than in men [5]. Evidence increasingly shows that risk factors for stroke differ between men and women: male patients are more likely to smoke [6] and have cardiovascular disease [7], whereas women are older at the time of stroke onset, rates of hypertension and atrial fibrillation are higher in women than in men [5], meanwhile rates of diabetes mellitus are lower in women than in men [8], nevertheless it has been recently reported that the excess risk of stroke from diabetes mellitus is higher in women than in men [9]. Related research also suggests that abdominal obesity has a stronger effect on stroke risk among women than men [10] as well as depression [4].

Therefore, understanding sex differences at rehabilitation admission and outcomes, considering treatment efficiency and effectiveness, is important since could provide evidence for reducing potential sex disparities [11]. Despite the growing body of knowledge in many stroke fields, the existing literature on the role of gender in functional recovery after stroke rehabilitation is limited and still controversial. Some reports have shown no differences in functional outcome between men and women [12-16] some have reported better functional out-

Department of research and innovation. Institut Guttmann. Institut Universitari de Neurorehabilitació-UAB (A. García-Rudolph, B. Cegarra, J. Saurí-Ruiz, E. Opisso, J.M. Tormos, M. Bernabeu). Fundació Institut d'Investigació en Ciències de la Salut Germans Trias i Pujol. Badalona (A. García-Rudolph, B. Cegarra, J. Saurí-Ruiz, E. Opisso, J.M. Tormos, M. Bernabeu). Universitat Autònoma de Barcelona. Bellaterra, Cerdanyola del Vallès (A. García-Rudolph, B. Cegarra, J. Saurí-Ruiz, E. Opisso, J.M. Tormos, M. Bernabeu). Rehabilitation Department. Hospital Clinic de Barcelona. Barcelona, Spain (S. Laxe).

Corresponding autor:
Dr. Alejandro García-Rudolph. Department of research and innovation. Institut Guttmann-Hospital de Neurorehabilitació. Cami de Can Ruti, s/n. E-08916 Badalona (Barcelona).

E-mail:
alejandropablogarcia@gmail.com

Funding:
This research was partially funded by EU H2020 PRECISE4Q - Personalized Medicine by Predictive Modeling in Stroke for better Quality of Life (Grant Agreement 777107 – Research and Innovation Action).

Accepted:
15.12.21.

Conflict of interests:
None declared

Ethical standards:
The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

→

A. García-Rudolph and S. Laxe contributed equally as first authors.

How to cite this article: García-Rudolph A, Laxe S, Cegarra B, Saurí-Ruiz J, Opisso E, Tormos-Muñoz JM, et al. Inpatient rehabilitation of working-age adults with ischemic stroke: comparing men and women clinical and functional characteristics at admission and predicting functionality. Rev Neurol 2022; 74: 69-77. doi: 10.33588/rn.7403.2021297.

Versión española disponible en www.neurologia.com

© 2022 Revista de Neurología

come in men [17-19], while others point to better recovery in women [20].

Functional independence has been previously reported from a sex perspective in Spanish population, Roquer et al [21] (n = 1581) reported women to be on average, 6 years older than men, had a longer hospital stay and remained more disabled than men. Mean age in men was 74.6 ± 11.4 and in women was 68.8 ± 11.9. Vázquez-Guimaraens et al [22] (n = 365) included sex as independent predictor of functional independence at discharge, being admission functional independence the only significant predictor. The mean age of all included patients was 66.8 ± 12.0. Murie-Fernández et al [23] (n = 143) reported age, sex and stroke severity as significant predictors of functional outcome in their multivariate regressions. Mean age was 64.9 ± 13.8. Moreno-Palacios et al [24] (n = 231) included sex as prognostic factor but was found non-significant. Mean age was 74.26 ± 13.1.

Preliminary data screening performed in our sample led us to hypothesize that the mean age in our included patients would be younger than in previous (national and international) research and the inclusion of scarcely reported factors may contribute to the existing literature.

In this study we propose a) to compare men and women at inpatient rehabilitation admission using variables identified in previous research, such as stroke severity, age, hemiparesis, further extending them with specific clinical factors (diabetes, atrial fibrillation, dysphagia, body mass index and depression) to add to limited data on these variables in Spanish population with first time ischemic stroke, admitted to rehabilitation within 3 weeks since onset to rehabilitation admission b) compare men and women functionality at admission and discharge, and c) analyze sex as predictor of functionality at discharge.

Materials and methods

Study design

A retrospective observational cohort study enrolling patients with first time ischemic stroke admitted to the rehabilitation unit of the acquired brain injury department of the Institut Guttmann-Hospital de Rehabilitació in Barcelona (Spain) was conducted following the STROBE Guidelines [25]. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Participants and setting

Eligible participants were adult patients (≥ 18 years at the moment of admission, no other age restriction was imposed to participants) with the diagnosis of first-time ischemic stroke, receiving inpatient rehabilitation between September 2014 and December 2020.

Patients were excluded for the following reasons: major musculoskeletal problems, more than 3 weeks of the onset of symptoms since admission to inpatient rehabilitation, cases of transient ischemic attack or subarachnoid hemorrhage, diagnosis of stroke in the context of another concomitant comorbidity (e.g., traumatic brain injury) and a previous history of another disabling condition.

Functional assessments

The Functional Independence Measure (FIM) [26] and the Barthel Index (BI) [27] were used as functional assessments (though BI was only used at admission). These measures are routinely administered within 24 hours after inpatient admission by trained and certified evaluators of the physical medicine and rehabilitation unit.

FIM gain was defined as the difference between FIM at admission and FIM at discharge. FIM efficiency was defined as FIM gain divided by length of stay (LOS) and FIM effectiveness as: (final score-initial score) / (maximum score-initial score) × 100 [28].

In order to classify patients at admission according to their functionality, we followed the quality-based procedures (QBPs) [29] where severity-specific rehabilitation patient groups (RPGs) were identified using cognitive FIM, motor FIM and age [30].

Clinical variables

The following data was abstracted from the hospital's electronical health records (EHRs): demographics (such as age, sex, education and marital status); stroke severity, using the National Institutes of Health Stroke Scale (NIHSS) and the location of stroke, classified using the Oxfordshire Community Stroke Project [31] as total anterior circulation infarcts (TACI), partial anterior circulation infarcts (PACI), lacunar circulation infarcts (LACI) and posterior circulation infarcts (POCI). Stroke related risk factors, comorbidities and medical complications, such as diabetes, dysphagia, depression, hypertension, body mass index (BMI), smoking habits and atrial fibrillation, reported in EHRs using ICD9 codes were also collected.

Rehabilitation program

All patients admitted at the rehabilitation unit are referred from different acute care setting hospitals and fulfill the hospital criteria for admission which include SMART (specific, measurable, achievable, relevant and time-bound) objectives and social support for discharge in case of severe disability. The rehabilitation program includes five hours of intensive treatment oriented towards cognitive, swallowing, behavioral and physical problems as well as training in activities of daily life living. Variables related to the rehabilitation program such as the time in between onset of stroke and initiation of the rehabilitation program –time since onset to admission (days)– and length of stay (LOS) were also reported.

Statistical analyses

All statistical analyses were performed in R-v3.5.1 (64 bits), level of significance was set at $p = 0.05$. Patients were stratified into two groups (women and men). Descriptive statistics were used for demographic and clinical characteristics of participants as well as functional assessments. The two groups were compared using the χ^2 test for categorical variables and the Kruskal-Wallis test for continuous and ordered variables.

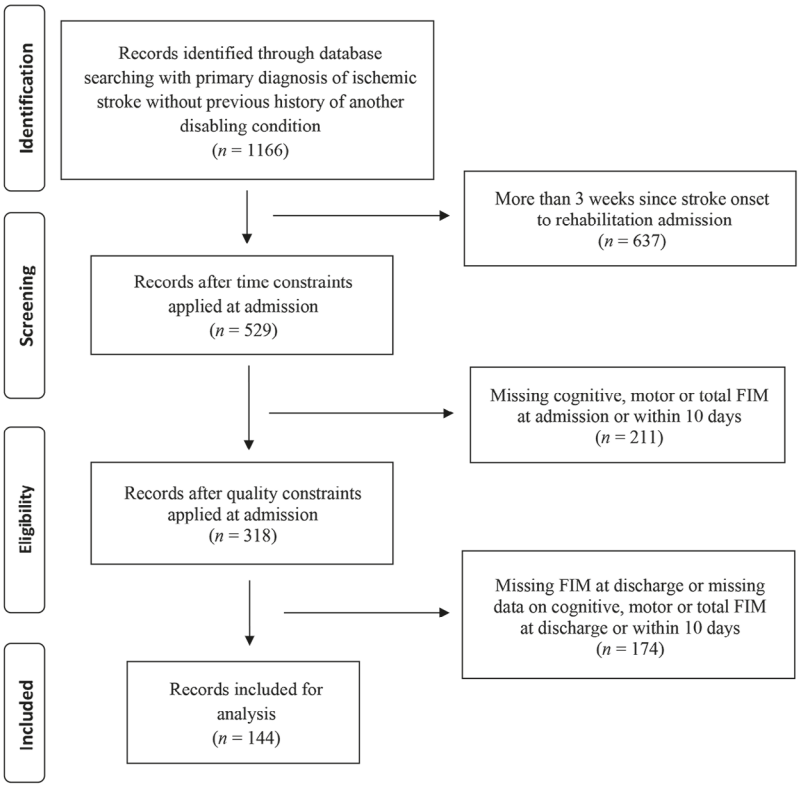
Associations with FIM were examined among the potential predictor variables using multivariate regression analyses. All variables were submitted to the multivariate analysis using the all-subsets method in order to maximize R^2 and adjusted R^2 performing an exhaustive search (forward and backward stepwise) using the leaps R package [32]. Categorical variables were dichotomized (yes = 1, no = 0; woman = 1, man = 0; current smoker and former smoker = 1 and nonsmoker = 0; less than 12 years of education = 0, more than 12 years of education = 1).

Multicollinearity of independent variables is tested by the variance inflation factor (VIF) and the tolerance (1/VIF). Tolerance is associated with each independent variable and ranges from 0 to 1. A tolerance below 0.40 and/or a VIF of 5 and above indicates a multicollinearity problem [33].

The assumption of independent errors is evaluated using the Durbin-Watson. The closer to 2 that the value is, the better. As a conservative rule it is suggested that for values less than 1 or greater than 3 the assumption of independence is not met [33].

The dependent variables in multivariate regressions were: total FIM gain, total FIM efficiency, total FIM effectiveness and total FIM at discharge.

Figure. Patients' selection flowchart.



Results

The source sample was the total number of ischemic stroke patients admitted to the rehabilitation unit of the acquired brain injury department of the hospital during the whole period under study (September 2014 to December 2020). Patients' selection flowchart is detailed in the figure.

A total of 1,166 records were identified through database searching for adult patients with primary diagnosis of ischemic stroke without previous history of another disabling condition. After removing $n = 637$ patients with more than 3 weeks since stroke onset to rehabilitation admission, $n = 211$ patients with missing FIM at admission and 174 with missing FIM at discharge, there were 144 patients left to include in the analysis.

Table I presents patients characteristics at admission, 67.3% of all participants were men and 32.7% women. The median age was 50.11 (53.11 for men and 46.18 for women), being women signifi-

Table I. Characteristics at admission for men and women.

	Men (*n* = 97)	Women (*n* = 47)	*p*		Men (*n* = 97)	Women (*n* = 47)	*p*
Age at admission in years	51.20 (7.48)	47.87 (9.7)	0.039	BMI at discharge	25.38 (3.46)	24.74 (3.82)	0.322
Age Ranges at admission, %				BMI (Discharge – Admission)	–0.36 (2)	–0.45 (1.45)	0.929
19-34	3.1	4.3		Smoking habits, %			
35-44	14.4	40.4	0.004	Current smoker	32	25.5	0.022
45-54	45.4	25.5		Former smoker	15.5	2.1	
55-64	37.1	29.8		Nonsmoker	52.6	72.3	
OCSP classification at admission, %				Hypertension, %	45.4	29.8	0.074
LACI	3.2	2.2		Hemiparesis, %			
POCI	8.4	4.3	0.149	Left	24.7	29.8	0.335
TACI	75.8	78.3		No	1	4.3	
PACI	11.6	6.5		Right	74.2	66	
NIHSS at admission	13.36 (5.66)	13.38 (4.31)	0.988	Dysphagia, %	39.2	25.5	0.107
NIHSS stratification at admission,%				Aphasia, %	43.3	48.9	0.524
Mild	22.7	12.8	0.038	Depression medication at admission, %	60.8	68.1	0.397
Moderate	39.2	61.7		Diabetes, %	19.6	6.4	0.038
Severe	38.1	25.5		Atrial fibrillation, %	3.1	4.3	0.721
RPG at admission, %				Educational level, %			
1100	50.5	57.4		Illiterate	4.2	0	0.382
1120	23.7	25.5		Read and write (≤1 years)	3.1	4.5	
1130	9.3	6.4	0.672	Primary (2-6 years)	47.9	38.6	
1140	3.1	2.1		Secondary (7-12 years)	26	38.6	
1150	8.2	8.5		Higher (≥13 years)	18.8	18.2	
1160	5.2	0		Missings	1	3	
RPG stratification at admission, %				Marital status, %			
Mild-RPG	13.4	8.5	0.617	Married	70.5	61.7	0.625
Moderate-RPG	36.1	34		Divorced	8	6.4	
Severe-RPG	50.5	57.4		Separated	4.5	6.4	
Time since onset to admission in days	20.11 (6.25)	19.32 (6.2)	0.34	Single	17	25.5	
BMI at admission	25.75 (3.73)	25.19 (3.99)	0.385	Length of stay in rehabilitation in days	63.27 (22.81)	68.49 (26.02)	0.214

All characteristics are presented as mean (SD) unless otherwise indicated (e.g., %). BMI: body mass index; LACI: lacunar infarcts; NIHSS: National Institutes of Health Stroke Scale; OCSP: Oxfordshire Community Stroke Project; PACI: partial anterior circulation infarcts; POCI: posterior circulation infarcts; RPG: rehabilitation patient group; SD: standard deviation; TACI: total anterior circulation infarcts.
Note: the RPG range from 1100 to 1160, where a lower number indicates greater severity. The RPG assigned to each patient was used to classify stroke severity as mild, moderate, or severe as follows: mild-RPG: 1150, 1160; moderate-RPG: 1120, 1130, 1140 and severe-RPG:1100, 1110.

cantly younger (p = 0.039) (mean age was 51.20 ± 7.48 for men and 47.87 ± 9.70 for women), all 144 patients were at their working-age.

When stratifying by age groups, in women the largest proportion of participants was aged 35-44 (40.4%) meanwhile in men only 14.4%. The largest proportion of men was aged 45-54 (45.4% of participants) meanwhile in women only 25.5% (p = 0.004). No significant differences were found in NIHSS total score.

The proportion of men with diabetes was significantly higher: 19.6% men had type II diabetes meanwhile only 6.4% in women (p = 0.038).

Functional assessments

Regarding functional assessments, as reported in table II, no significant differences were observed in FIM at admission, either at discharge, when considering total FIM, motor or cognitive subtests. Similarly, no significant differences were observed in relation to FIM gain, efficiency or effectiveness when considering total, motor either cognitive FIM subtests.

Multivariant analysis

Significant predictors of total FIM gain (Table III, model 1) are total FIM at admission (β = –0.69, p < 0.0001), NIHSS (β = –0.92, p = 0.029) and sex (β = –0.13, p = 0.039), explaining 42.02% of the variance.

In relation to total FIM at discharge, model 2 identifies total FIM at admission (β = 0.59, p < 0.0001), NIHSS (β = –0.92, p < 0.0001) and sex (β = –0.12, p = 0.0395), explaining 51.12% of the variance.

In relation to total FIM efficiency, model 3 identifies total FIM at admission (β = –0.64, p < 0.0001), LOS (β = –0.45, p < 0.001) NIHSS (β = –0.24, p = 0.002) and age at admission (β= –0.17, p = 0.02), explaining 39.9% of the variance.

Regarding total FIM effectiveness, model 4 identifies NIHSS (β = –0.31, p = 0.001) and sex (β = –0.16, p = 0.049), explaining only 13.50% of the variance.

Table II. Functional assessments at admission and discharge.

	Men (n = 97)	Women (n = 47)	p
T-FIM at admission	58.88 (25.33)	59.27 (24.5)	0.885
C- FIM at admission	20.5 (9.74)	22.59 (9.61)	0.262
M-FIM at admission	38.38 (19.64)	36.68 (17.99)	0.602
BI at admission	32.37 (21.76)	33.29 (21.47)	0.806
T-FIM at discharge	93.51 (20.25)	90.63 (20.68)	0.4
C- FIM at discharge	25.83 (8.36)	26.66 (7.71)	0.719
M-FIM at discharge	67.68 (14.9)	63.98 (16.65)	0.217
T-FIM Gain	34.63 (19.23)	31.36 (17.54)	0.356
C- FIM Gain	5.33 (5.58)	4.06 (4.86)	0.171
M-FIM Gain	29.29 (16.39)	27.29 (15.31)	0.603
T-FIM Efficiency median (P_{25}-P_{75})	0.53 (0.35-0.7)	0.48 (0.26-0.68)	0.284
T-FIM Efficiency mean (SD)	0.56 (0.32)	0.5 (0.31)	
C-FIM Efficiency median (P_{25}-P_{75})	0.07 (0.01-0.12)	0.04 (0-0.09)	0.1
C-FIM Efficiency mean (SD)	0.08 (0.08)	0.06 (0.07)	
M-FIM Efficiency median (P_{25}-P_{75})	0.45 (0.3-0.61)	0.44 (0.26-0.6)	0.509
M-FIM Efficiency mean (SD)	0.48 (0.28)	0.44 (0.28)	
T-FIM Effectiveness median (P_{25}.P_{75})	53.96 (38.09-67.85)	50.00 (34.7-60.8)	0.246
T-FIM Effectiveness mean (SD)	52.27 (22.51)	47.42 (21.3)	
C-FIM Effectiveness median (P_{25}-P_{75})	31.81 (4.76-60)	27.27 (0-45)	0.142
C-FIM Effectiveness mean (SD)	37.94 (33.64)	27.65 (35.32)	
M-FIM Effectiveness median (P_{25}-P_{75})	57.14 (36.84-71.93)	55.86 (38.4-65.42)	0.365
M-FIM Effectiveness mean (SD)	55.07 (23.31)	50.62 (23.19)	

BI: Barthel index; C-FIM: cognitive FIM; FIM: Functional independence measure; FIM gain: FIM at discharge – FIM at admission; FIM efficiency: FIM gain divided by length of stay; FIM Effectiveness: (final score – initial score) / (maximum score-initial score) × 100; T-FIM: total FIM; M-FIM: motor FIM; T-FIM: M-FIM + C-FIM.

Discussion

This study compared inpatient rehabilitation admission characteristics and functionality of adults with ischemic stroke, from a sex perspective. Results confirmed our hypothesis about the young age of our participants; in fact, all included patients turned to be at their working-age (when this was not an inclusion criteria).

One of the findings that caught the attention of the authors was the low proportion of included women (67% men and 33% women). This does not seem to be only explained by age [34-35]. Literature on the subject has already detected that women after stroke tend to receive fewer specialized rehabilitation than men [36]. In an European Concerted Action involving 7 countries (Spain was one of

Table III. Multivariate linear regressions. non-standard β. 95% CIs. standard β. VIF. R^2 and adjusted R^2.

	Variables	β (95% CI)	Std β	VIF	Tol	*p*	R^2	Adj R^2	10FCVR10
1 TFIM gain	Hemiparesis	–3.21(–8.54. 2.12)	–0.07	1.05	0.95	0.235	0.4567	0.4202	0.4198
	Depression	3.65 (–1.58. 8.9)	0.09	1.16	0.85	0.17			
	Diabetes	–6.39 (–13.16. 0.37)	–0.12	1.07	0.92	0.063			
	TFIM adm	–0.51 (–0.64. –0.39)	–0.69	1.70	0.58	**<0.001**			
	LOS	0.08 (–0.02. 0.19)	0.107	1.29	0.77	0.139			
	Gender. Woman	–5.55 (–10.83. –0.27)	–0.13	1.11	0.89	**0.0395**			
	NIHSS	–0.92 (–1.45. –0.38)	–0.25	1.4	0.7	**< 0.001**			
	Hypertension	–2.8 (–7.97. 2.36)	–0.07	1.16	0.85	0.285			
	Age adm	–0.23 (–0.54. 0.06)	–0.1	1.18	0.84	0.128			
	Durbin test	D-W = 2.29; p = 0.07							
2 TFIM Dis	Hemiparesis	–3.21 (–8.54. 2.12)	–0.07	1.05	0.95	0.23	0.5419	0.5112	0.5102
	Depression	3.65 (–1.58. 8.9)	–0.07	1.16	0.85	0.17			
	Diabetes	–6.39 (–13.16. 0.37)	–0.11	1.07	0.92	0.063			
	TFIM adm	0.48 (0.35. 0.6)	0.59	1.70	0.58	**<0.001**			
	LOS	0.08 (–0.02. 0.19)	0.09	1.29	0.77	0.139			
	Gender. Woman	–5.55 (–10.83. –0.27)	–0.12	1.11	0.89	**0.0395**			
	NIHSS	–0.92 (–1.45. –0.38)	–0.23	1.4	0.71	**<0.001**			
	Hypertension	–2.8 (–7.97. 2.36)	–0.06	1.16	0.86	0.285			
	Age adm	–0.23 (–0.54. 0.06)	–0.09	1.18	0.84	0.128			
	Durbin test	D-W = 2.2; *p* = 0.074							
3 TFIM Effi	Hemiparesis	–3.4 (–13.01. 6.2)	–0.04	1.05	0.95	0.484	0.399	0.359	0.351
	Depression	7.5 (–1.94. 16.96)	0.11	1.16	0.85	0.118			
	Diabetes	–8.04 (–20.24. 4.14)	–0.09	1.07	0.92	0.194			
	TFIM adm	–0.83 (–1.05. –0.6)	–0.64	1.7	0.58	**<0.001**			
	LOS	–0.6 (–0.8. –0.4)	–0.45	1.29	0.77	**<0.001**			
	Gender. Woman	–6.41 (–15.93. 3.11)	–0.09	1.11	0.89	0.185			
	NIHSS	–1.51 (–2.47. –0.55)	–0.24	1.4	0.7	**0.002**			
	Hypertension	–3.69 (–13.01. 5.61)	–0.05	1.16	0.85	0.433			
	Age adm	–0.65 (–1.2. –0.1)	–0.17	1.18	0.84	**0.02**			
	Durbin test	D-W = 2; *p* = 0.792							

Table III. Multivariate linear regressions. non-standard β. 95% CIs. standard β. VIF. R^2 and adjusted R^2 *(cont.)*.

	Variable	β (95% CI)	Std β	VIF	Tol	*p*	R^2	Adj R^2	10FCVR10
4 TFIM Effe	Hemiparesis	−2.94 (−10.94. 5.05)	−0.06	1.05	0.95	0.467	0.135	0.114	0.121
	Depression	4.45 (−3.41. 12.33)	0.09	1.16	0.85	0.264			
	Diabetes	−9.02 (−19.17. 1.12)	−0.14	1.07	0.92	0.08			
	TFIM adm	−0.04 (−0.23. 0.13)	−0.05	1.7	0.58	0.598			
	LOS	0.08 (−0.08. 0.25)	0.09	1.29	0.77	0.321			
	Gender. Woman	−7.96 (−15.89. −0.03)	−0.16	1.11	0.89	**0.049**			
	NIHSS	−1.3 (−2.1. −0.51)	−0.31	1.4	0.7	**0.001**			
	Hypertension	−3.22 (−10.97. 4.53)	−0.07	1.16	0.85	0.412			
	Age adm	−0.28 (−0.74. 0.174)	−0.1	1.18	0.84	0.222			
	Durbin test	D-W = 2.11; *p* = 0.694							

NIHSS: National Institutes of Health Stroke Scale, FIM: Functional independence measure; TFIM: total FIM, LOS: Length of stay; 10FCVR10: 10-fold cross validation repeated 10 times. In bold, significant variables.

them), (n = 4499) being woman and not stroke severity, was reported to be a major discriminating factor for the use of diagnostic resources or therapeutic interventions [37]. Several previous studies have already indicated that recommended treatments were administered less often to women suffering myocardial infarction [38-40]. Key treatments such as intravenous thrombolysis was reported as less likely to be offered to older women than to members of other demographics [41]. Women are less likely than men to be sent to specialized centers for large vessel occlusion acute ischemic stroke as recently reported [42].

In our scenario we could not control the gender ratio in the admitted patients or if there was a gender bias in the referral from acute treatment units. When compared to similar studies in Spanish population, mixed results are found, for example Roquer et al [21] reported 51.7% men, Vázquez-Guimaraens et al [22] 62.19%, Murie-Fernández et al [23] 50.8% and Moreno-Palacios et al [24] 55.4%. Nevertheless, we did not conduct an exhaustive search of related studies, leaving this as future research.

Our results confirm previous reports in relation to the rates of diabetes mellitus being significantly lower in women than in men [8]. The prevalence of type 2 diabetes mellitus increases with age [43] in our sample women are significantly younger, furthermore the largest proportion of women participants is in the 35-44 range whereas it is 45-54 for men.

In relation to functionality no significant differences between men and women were observed (in FIM at admission, either at discharge, when considering total, motor or cognitive FIM, FIM gain, efficiency or effectiveness when considering total, motor either cognitive FIM) adding to similar previous recent results [13-15]. Nevertheless, our population is remarkably younger. Norlander et al [13] reported median age was 75 (28–97) in women and 78 (55–96) in men; Hay et al [14] mean age was 76.7 ± 10.1 in women and 74.8 ± 9.8 in men and MacDonald et al [15] reported 80% of participants being older than 70 years old. Furthermore, as recently reported, associations between factors for ischemic stroke and clinical outcomes have been analyzed predominantly in older rather than younger patients [44].

In our multivariate regression analysis, sex was a significant predictor of total FIM at discharge and total FIM gain, being the third most important predictor in both cases (after total FIM assessment at admission and NIHSS), these results are similar to the EPICA study in Spanish population [23].

Study limitations

The data for this study was collected in a single

monographic rehabilitation hospital, suggesting that the generalization of these results should be considered carefully.

It is recommended to predict for a specific subsequent time point rather than the expected outcome at discharge [45]. It is our aim to analyze functional outcomes from a gender perspective at specific time points in future work. Several known predictive factors for functional independence in stroke were not included in this study (such as white matter [46], fatigue [47] or visuospatial inattention [48]) which could probably have increased the models' explained variance. Finally, a large number of patients with ischemic stroke were not eligible for this study, as detailed in Figure 1, nevertheless, the proportion of men and women (as well as their age) was similar in those included and excluded.

Conclusions

We were not able to detect any impact of sex on the functional assessments of adult patients admitted to a specialized care rehabilitation center after sustaining an ischemic stroke. Nevertheless, being a woman was found as significant predictor of total FIM at discharge, total FIM gain and total FIM effectiveness. All included patients were younger than 65 years, though this was not an inclusion criterion, therefore our findings add to the scarce literature reporting on working-age participants. Our sample showed a clear predominance of men (67%), in line with previous and recent related publications. Do women with stroke have less opportunities for being admitted in a rehabilitation program? This question still remains to be answered and highlights the importance of future related research.

References

1. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics-2020 update: a report from the American Heart Association. Circulation 2020; 141: e139-596.
2. Poggesi A, Insalata G, Papi G, Rinnoci V, Donnini I, Martini M, et al. Gender differences in post-stroke functional outcome at discharge from an intensive rehabilitation hospital. Eur J Neurol 2021; 28: 1601-8.
3. Dehlendorff C, Andersen KK, Olsen TS. Sex disparities in stroke: women have more severe strokes but better survival than men. J Am Heart Assoc 2015; 4: e001967.
4. Bushnell C, Howard VJ, Lisabeth L, Caso V, Gall S, Kleindorfer D, et al. Sex differences in the evaluation and treatment of acute ischaemic stroke. Lancet Neurol 2018; 17: 641-50.
5. Cordonnier C, Sprigg N, Sandset EC, Pavlovic A, Sunnerhagen KS, Caso V, et al. Stroke in women –from evidence to inequalities. Nat Rev Neurol 2017; 13: 521-32.
6. Peters SA, Huxley RR, Woodward M. Do smoking habits differ between women and men in contemporary Western populations? Evidence from half a million people in the UK Biobank study. BMJ Open 2014; 4: e005663.
7. Kapral MK, Fang J, Hill MD, Silver F, Richards J, Jaigobin C, et al; investigators of the Registry of the Canadian Stroke Network. Sex differences in stroke care and outcomes: results from the Registry of the Canadian Stroke Network. Stroke 2005; 36: 809-14.
8. Ullberg T, Zia E, Petersson J, Norrving B. Changes in functional outcome over the first year after stroke: an observational study from the Swedish stroke register. Stroke 2015; 46: 389-94.
9. Peters SA, Huxley RR, Woodward M. Diabetes as a risk factor for stroke in women compared with men: a systematic review and meta-analysis of 64 cohorts, including 775,385 individuals and 12,539 strokes. Lancet 2014; 383: 1973-80.
10. Rodríguez-Campello A, Jiménez-Conde J, Ois Á, Cuadrado-Godia E, Giralt-Steinhauer E, Vivanco RM, et al. Sex-related differences in abdominal obesity impact on ischemic stroke risk. Eur J Neurol 2017; 24: 397-403.
11. Scrutinio D, Battista P, Guida P, Lanzillo B, Tortelli R. Sex differences in long-term mortality and functional outcome after rehabilitation in patients with severe stroke. Front. Neurol 2020; 11: 84.
12. Bassi A, Colivicchi F, Santini M, Caltagirone C. Gender-specific predictors of functional outcome after stroke rehabilitation: Potential role of the autonomic nervous system. European Neurology 2010; 63: 279-84.
13. Norlander A, Jönsson AC, Ståhl A, Lindgren A, Iwarsson S. Activity among long-term stroke survivors. A study based on an ICF oriented analysis of two established ADL and social activity instruments. Disabil Rehabil 2016; 38: 2028-37.
14. Hay CC, Graham JE, Pappadis MR, Sander AM, Hong I, Reistetter TA. The impact of one's sex and social living situation on rehabilitation outcomes after a stroke. Am J Phys Med Rehabil 2020; 99: 48-55.
15. MacDonald SL, Hall RE, Bell CM, Cronin S, Jaglal SB. Sex differences in the outcomes of adults admitted to inpatient rehabilitation after stroke. PM R 2021; [Epub ahead of print].
16. Tanlaka E, King-Shier K, Green T, Seneviratne C, Dukelow S. Sex differences in stroke rehabilitation care in Alberta. Can J Neurol Sci 2020; 47: 494-503.
17. Paolucci S, Bragoni M, Coiro P, De Angelis D, Fusco FR, Morelli D, et al. Is sex a prognostic factor in stroke rehabilitation? A matched comparison. Stroke 2006; 37: 2989-94.
18. Liljehult MM, von Euler-Chelpin MC, Christensen T, Buus L, Stokholm J, Rosthøj S. Sex differences in independence in activities of daily living early in stroke rehabilitation. Brain Behav 2021 [Epub ahead of print].
19. Gargano JW, Reeves MJ. Sex differences in stroke recovery and stroke-specific quality of life: Results from a statewide stroke registry. Stroke 2007; 38: 2541-8.
20. O'Brien SR, Xue Y. Predicting goal achievement during stroke rehabilitation for Medicare beneficiaries. Disabil Rehabil 2014; 36: 1273-8.
21. Roquer J, Campello AR, Gomis M. Sex differences in first-ever acute stroke. Stroke 2003; 34: 1581-5.
22. Vázquez-Guimaraens M, Caamaño-Ponte JL, Seoane-Pillado T, Cudeiro J. Factors related to greater functional recovery after suffering a stroke. Brain Sci 2021; 11: 802.
23. Murie-Fernández M, Marzo MM. Predictors of neurological and functional recovery in patients with moderate to severe ischemic stroke: the EPICA study. Stroke Res Treat 2020; 2020: 1419720.
24. Moreno-Palacios JA, Moreno-Martínez I, Bartolomé-Nogues A, López-Blanco E, Juárez-Fernández R, García-Delgado I. Factores pronósticos de recuperación funcional del ictus al año [. Rev Neurol 2017; 64: 55-62.
25. STROBE Strengthening the reporting of observational studies in epidemiology. URL: https: //strobe-statement.org/index.php?id=available-checklists. Last consultation date: 22.08.2021.

26. Granger CV, Hamilton BB, Zielezny M, Sherwin FS. Advances in functional assessment in medical rehabilitation. Topics in Geriatric Rehabilitation 1986; 1: 59-74.
27. Wade DT, Collin C. The Barthel ADL Index: a standard measure of physical disability? Int Disabil Stud 1988; 10: 64-7.
28. Tokunaga M, Higashi T, Inoue R, Ohkubo T, Watanabe S. Comparison of Functional Independence Measure (FIM) gain between groups with extreme differences in FIM score at admission. Int J Phys Med Rehabil 2017; 5: 402.
29. Health Quality Ontario; Ministry of Health and Long-Term Care. Quality-based procedures: clinical handbook for stroke (acute and postacute). Toronto: Health Quality Ontario; 2016.
30. Lai W, Buttineau M, Harvey JK, Pucci RA, Wong APM, Dell'Erario L, et al. Clinical and psychosocial predictors of exceeding target length of stay during inpatient stroke rehabilitation. Top Stroke Rehabil 2017; 24: 510-6.
31. Asdaghi N, Jeerakathil T, Hameed B, Saini M, McCombe JA, Shuaib A, et al. Oxfordshire community stroke project classification poorly differentiates small cortical and subcortical infarcts. Stroke 2011; 42: 2143-8.
32. Lumley T. Regression subset selection. URL: https: // cran.r-project.org/web/packages/leaps/leaps.pdf. Last consultation date: 22.08.2021.
33. O'Brien RM. A caution regarding rules of thumb for variance inflation factors. quality & quantity. 2007; 41: 673-90.
34. Gibson CL. Cerebral ischemic stroke: is gender important? J Cereb Blood Flow Metab 2013; 33: 1355-61.
35. Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA. Gender differences in stroke incidence and poststroke disability in the Framingham heart study. Stroke 2009; 40: 1032-7.
36. Reeves MJ, Bushnell CD, Howard G, Gargano JW, Duncan PW, Lynch G, et al. Sex differences in stroke: epidemiology, clinical presentation, medical care, and outcomes. Lancet Neurol 2008; 7: 915-26.
37. Di Carlo A, Lamassa M, Baldereschi M, Pracucci G, Basile AM, Wolfe CD, et al; European BIOMED Study of Stroke Care Group. Sex differences in the clinical presentation, resource use, and 3-month outcome of acute stroke in Europe: data from a multicenter multinational hospital-based registry. Stroke 2003; 34: 1114-9.
38. Gan SC, Beaver SK, Houck PM, MacLehose RF, Lawson HW, Chan L. Treatment of acute myocardial infarction and 30-day mortality among women and men. N Engl J Med 2000; 343: 8-15.
39. Miller TD, Roger VL, Hodge DO, Hopfenspirger MR, Bailey KR, Gibbons RJ. Gender differences and temporal trends in clinical characteristics, stress test results and use of invasive procedures in patients undergoing evaluation for coronary artery disease. J Am Coll Cardiol 2001; 38: 690-7.
40. Vaccarino V, Parsons L, Every NR, Barron HV, Krumholz HM. Sex-based differences in early mortality after myocardial infarction. National Registry of Myocardial Infarction 2 Participants. N Engl J Med 1999; 341: 217-25.
41. Fredwall M, Sternberg S, Blackhurst D, Lee A, Leacock R, Nathaniel TI. Gender differences in exclusion criteria for recombinant tissue-type plasminogen activator. J Stroke Cerebrovasc Dis 2016; 25: 2569-74.
42. Tariq M, Salazar-Marioni S, Khose S, McCullough L, López V, AbdelKhaleq R, et al. Women with large vessel occlusion acute ischemic stroke are less likely to be routed to comprehensive stroke centers. Journal of Neuro Interventional Surgery 2021; 13: A23-A24.
43. Mordarska K, Godziejewska-Zawada M. Diabetes in the elderly. Prz Menopauzalny 2017; 16: 38-43.
44. Lutski M, Zucker I, Shohat T, Tanne D. Characteristics and outcomes of young patients with first-ever ischemic stroke compared to older patients: the National Acute Stroke Israeli Registry. Front Neurol 2017; 8: 421.
45. Stinear CM, Smith MC, Byblow WD. Prediction tools for stroke rehabilitation. Stroke 2019; 50: 3314-22.
46. Kang HJ, Stewart R, Park MS, Bae KY, Kim SW, Kim JM, et al. White matter hyperintensities and functional outcomes at 2 weeks and 1 year after stroke. Cerebrovasc Dis 2013; 35: 138-45.
47. Lerdal A, Gay CL. Acute-phase fatigue predicts limitations with activities of daily living 18 months after first-ever stroke. J Stroke Cerebrovasc Dis 2017 Mar; 26: 523-31.
48. Gerafi J, Samuelsson H, Viken JI, Blomgren C, Claesson L, Kallio S, et al. Neglect and aphasia in the acute phase as predictors of functional outcome 7 years after ischemic stroke. Eur J Neurol 2017; 24: 1407-15.

Rehabilitación en régimen de ingreso en adultos en edad laboral tras un ictus isquémico: análisis clinicofuncional desde una perspectiva de género

Introducción. El papel del género en la independencia funcional en las actividades de la vida diaria tras un ictus isquémico es aún controvertido. Proponemos: a) comparar características clínicas de hombres y mujeres en el momento del ingreso a rehabilitación hospitalaria; b) comparar su independencia funcional en el ingreso y en el alta, y c) identificar predictores de independencia funcional.

Materiales y métodos. Estudio de cohortes retrospectivo observacional. Se incluyeron variables descritas en estudios previos en comparaciones ingreso-alta y en regresión lineal multivariante de la *Functional Independence Measure* (FIM) en el momento del alta, la ganancia, la eficiencia y la efectividad.

Resultados. Se estudió a 144 pacientes (33%, mujeres) admitidos a rehabilitación en un centro español (≤ 3 semanas tras un ictus isquémico). Los hombres eran mayores (p = 0,003), un 19,6% diabéticos (un 6,4% de las mujeres; p = 0,03) y un 52,6% fumadores (un 72,3% de las mujeres; p = 0,02). No observamos diferencias significativas en la FIM en el momento del ingreso, del alta, la ganancia, la eficiencia ni la efectividad (FIM total, motora ni cognitiva). El análisis de regresión identificó el sexo (beta = –0,13), la gravedad (beta = –0,25) y la FIM total en el momento el ingreso (beta = –0,69) como predictores de la ganancia de la FIM total (R^2 = 0,42). Las mismas variables predicen la FIM total en el alta: género (beta = –0,12), gravedad (beta = –0,23) y FIM total en el ingreso (beta = 0,59) (R^2 = 0,51). La FIM en el ingreso (beta = –0,64), la gravedad (beta = –0,24), la edad (beta = –0,17) y el tiempo de estancia hospitalaria (beta = –0,45) predicen la eficiencia de la FIM total (R^2 = 39,9%). El modelo de efectividad de la FIM explica únicamente el 13,5% de la varianza.

Conclusiones. No encontramos diferencias funcionales entre hombres y mujeres. El sexo es un predictor significativo, pero no explica la mitad de la varianza.

Palabras clave. Actividades de la vida diaria. Género. Isquemia cerebral. Ictus. Rehabilitación. Sexo.