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ORIGINAL ARTICLE

Correlates of participation six months after stroke in an Italian population: results from the RIPS (Post-Stroke Intensive Rehabilitation) Study

Chiara CASTAGNOLI [1], Silvia PANCANI [1], Teresa BARRETTA [1], Leonardo PELLICCIARI [1], Silvia CAMPAGNINI [1, 2] *, Benedetta BASAGNI [1], Camilla GUCCI [1], Alessandro SODERO [1, 3], Erika GUOLO [1], Bahia HAKIKI [1], Antonello GRIPPO [1], Andrea MANNINI [1], Claudio MACCHI [1, 4], Francesca CECCHI [1, 4]

[1]IRCCS Fondazione Don Carlo Gnocchi Onlus, Florence, Italy; [2]Sant'Anna School of Advanced Studies, The Biorobotics Institute, Pontedera, Pisa, Italy; [3]Section of Neuroscience, NEUROFARBA Department, University of Florence, Florence, Italy; [4]Department of Experimental and Clinical Medicine, University of Florence, Florence, Italy

*Corresponding author: Silvia Campagnini, IRCCS Fondazione Don Carlo Gnocchi Onlus, Via di Scandicci 269, 50143 Florence, Italy.
E-mail: scampagnini@dongnocchi.it

ABSTRACT

BACKGROUND: Stroke survivors report physical, cognitive, and psychological impairments, with a consequent limitation of participation. Participation is the most context-related dimension of functioning, but the literature on participation in Italian stroke patients is scant.
AIM: This study aimed to describe the recovery of participation six months after stroke with a validated Italian version of the Frenchay Activity Index (FAI) and to investigate potential correlates with higher participation scores.
DESIGN: The study is a prospective observational study.
SETTING: The cohort of patients was enrolled in four intensive inpatient rehabilitation units of IRCCS Fondazione Don Carlo Gnocchi Onlus, Florence, Italy.
POPULATION: Adults addressing postacute intensive inpatient rehabilitation after an ischemic or hemorrhagic stroke occurred within 30 days from recruitment were prospectively enrolled.
METHODS: Data were collected at admission to intensive inpatient rehabilitation, and a six-month follow-up. The primary outcome was participation, measured by a validated Italian version of the FAI; only patients whose data included both anamnestic FAI and FAI at six months follow-up were included in this analysis. The data were analyzed by univariate and multivariate linear regressions.
RESULTS: A cohort of 105 patients (median age 78 years [interquartile range, IQR=21]; 46.7% males) with completed FAI at follow-up were included in this study. The sample reported a FAI median score of 28 (IQR=8) at admission (referred to the participation in the 3-6 months before the stroke) and 13 (IQR=20) at follow-up. All items were significantly affected, with the exception of reading and making trips. The multivariate regression for all patients with good participation before the stroke (N.=101), showed that 6 months after the stroke a higher FAI Score was independently associated with better functioning in activities of daily living (modified Barthel Index) (*B*=0.133; P=0.015), and absence of cognitive impairment (*B*=4.755; P=0.027); a lower stroke severity in the postacute phase (NIHSS *B*=-0.832; P=0.001) and a higher prestroke FAI Score (*B*=0.410; P=0.028) were also independently related to follow-up FAI Score.
CONCLUSIONS: In our cohort of patients addressing postacute stroke rehabilitation, prestroke participation levels were on average good, while they were severely reduced six months after stroke for all the considered items except reading and making trips. Higher FAI at follow-up was independently associated with a higher functional level and no cognitive impairment at follow-up, with lower stroke severity in the postacute phase, as well as a higher anamnestic participation score.
CLINICAL REHABILITATION IMPACT: Our results suggest that investigating prestroke participation may be highly relevant to predict, and possibly address, participation recovery after stroke.

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KEY WORDS: Stroke; Patient participation; Physical and rehabilitation medicine.

Stroke is the first global cause of disability,[1, 2] and stroke survivors may present physical, cognitive and psychological impairments, a wide range of activity limitations, and participation restrictions.[3] Participation, defined as the involvement of people in all areas of life, plays a fundamental role in the post-stroke bio-psycho-social multidimensional perspective of the International Classification of Functioning, Disability and Health (ICF).[3] When the individual recovery progresses after the stroke, and the patient starts again interacting with different environments, it is more likely that barriers and restrictions on participation occur. In general, the domains that seek a certain level of physical, social, and cognitive ability are those that are perceived as more limited after the stroke.[4] However, each patient evaluates his/her recovery after the stroke based on the ability to participate in activities that were significant in his/her life before the event onset. For this reason, participation is a multifaced and complex construct and a gold standard measure is not available nor easy to be defined.[5] Despite being such a relevant aspect of stroke recovery, little is known about how individuals reintegrate into the community and which factors influence the ability to participate in daily activities after returning home.[6] Stroke survivors seem to have more participation restrictions than controls matched by demographics and comorbidities.[6] Higher age at stroke onset, stroke severity, dependency on activities of daily living (ADL), stroke recurrence, depression, and low cognitive function have been suggested as possible correlates of decreased participation at 6-12 months after stroke onset. However, findings are not consistent across studies,[4, 7] and the wide variety of tools used to measure participation does not allow a direct comparison of results.[8] Further, participation is the most context-related dimension of functioning, deeply connected to social habits and cultural aspects. Thus, different factors could be associated with participation given the geographical area where the study is conducted. Under this perspective, to the best of the authors' knowledge, in face of the well-known geographical variability in social network, lifestyle, economic and sociocultural features (OECD. Better Life Index Database. Retrieved September 2022, from https://stats.oecd.org/Index.aspx?datasetcode=HSL#) most of the studies reported in the literature have been conducted in North America and Northern Europe, while data collected in Mediterranean countries are remarkably scant.[8] In Italy, Andrenelli *et al.*[7] conducted a retrospective study on the correlates of participation evaluated using the Frenchay Activities Index (FAI)[9] in 45 Italian stroke patients, 2 years after stroke. They found participation restriction to be associated with functional ambulation impairment, global disability, depression, age, dementia, and autonomic dysfunctions. The FAI assesses a range of activities grouped into three domains, domestic chores leisure time, and outdoor activities[9] and has been recently proposed by the Italian Society of Physical and Rehabilitation Medicine (SIMFER), in the revision of the stroke assessment protocol (Minimal Stroke Assessment Protocol – PMIC 2020), among the tools for the multidimensional rehabilitation assessment of the stroke patient.[10] However, at the time the study by Andrenelli *et al.*[9] was conducted, the FAI was not validated in Italian, and only recently a trans-culturally validated Italian version o has been published.[11] Given the importance of the participation dimension for the recovery of stroke patients and the scarcity of available data, especially from Mediterranean countries, the aim of this study was to describe the participation outcomes, measured by the FAI, Italian version, and investigate the potential correlates of participation, six months after the stroke, in a prospective cohort of Italian patients addressing post-acute inpatient rehabilitation.

Materials and methods

Study design and setting

The data used in this study come from the admission and the follow-up assessments of the RIPS (Post-Stroke Intensive Rehabilitation) Study, a multicentric prospective study on predictors of functional outcomes in an Italian cohort of patients addressing post-acute intensive rehabilitation.[12] The recruitment took place in four intensive rehabilitation units (IRUs) of IRCCS Fondazione Don Carlo Gnocchi Onlus (Florence, La Spezia, Massa, and Fivizzano; Italy), from January 2020 to June 2021. The study protocol was a priori registered on ClinicalTrials.gov (NCT03968627) and was approved by the local ethics committees of each center (Florence: 14513; La Spezia: 294/2019; Massa and Fivizzano: 68013/2019). The reporting of this study followed the STROBE checklist for observational studies.[13] The studies involving human participants were reviewed and approved by Ethics Committees (Florence: 14513; La Spezia: 294/2019; Massa and Fivizzano: 68013/2019). The patients/participants provided their written informed consent to participate in this study.

Participants

In RIPS, all patients admitted to the above-mentioned IRUs were considered eligible and included if they met the following inclusion criteria:

- age ≥18 years;
- first-ever or recurrent ischemic or hemorrhagic stroke diagnosed clinically and with brain imaging; acute stroke (*i.e.*, onset ≤30 days);
- first-ever admission to the rehabilitation center for the considered index acute event (stroke); and written consent.

Assessments were performed at admission to intensive inpatient rehabilitation, at discharge, and six months from stroke onset. During the IRU stay, a comprehensive evidence-based integrated rehabilitation care pathway (ICP) was administered in all four rehabilitation centers.[14] The ICP had been developed according to the American Heart Association/American Stroke Association guidelines[15] and preliminarily tested in a pilot study.[14] Briefly, the treatment was delivered according to an interdisciplinary and patient-centered perspective for three hours per day (according to regional and national laws). The individual rehabilitation project was developed and weekly revised according to the patient's needs through a comprehensive team evaluation. The outpatient follow-up assessment was conducted by a physiatrist and a neuropsychologist; the telephone interview was performed by a neuropsychologist. At admission and discharge, the assessment was performed by the multi-professional rehabilitation staff (composed of physiatrists, neurologists, physiotherapists, speech therapists, neuropsychologists, occupational therapists, and nurses) of each center. The follow-up evaluations of those unable to reach the IRUs were performed through telephonic interviews; in these cases, when the patient was unable to perform the cognitive screening, or when the screening showed cognitive impairment, interviews about limitations in activities of daily living and restrictions of participation were carried out with a proxy. The FAI was administered at admission and at the follow-up visit, which was scheduled six months after the stroke. If the patient presented severe hearing disorders or cognitive decline (Mini-Mental State Examination <21 points)[16] or severe aphasia, the FAI was administered with a proxy, if available, otherwise, the patient was excluded. Further details on the RIPS study assessments and ICP are presented elsewhere.[12] For what concerns the inclusion of patients within this study, only participants who completed the follow-up evaluation, including the FAI assessment were selected.

Measures

The FAI[9] encompasses the larger daily activities of normal life, including 15 items concerning 3 areas: domestic activities, work/leisure activities, and outdoor activities. The first 10 items analyse the activities that the patient carried out in the 3 months before the assessment, while the remaining 5 items refer to the 6 months before the assessment, with a score ranging from 0 to 3 points. The score is given based on the frequency of the activity that has been carried out. Together with the FAI total score, scales have also been evaluated, in secondary analyses, to provide information about the different patterns of recovery of the activities assessed by the scale. More specifically, the subscales identified by Antonucci *et al.*[11] related to domestic activities and leisure and work areas were considered. Despite the analyses being performed using the continuous total score, in agreement with other Authors,[2] a description of a good or bad participation level was also provided, using the cut-off value of 15,[17] allowing for better interpretability of the scale. Furthermore, descriptive analyses of the activities described by each subitem were also presented. The variables included in this analysis as potential correlates of participation 6 months after stroke were:

- age;
- gender;
- education, reported as the number of years of education;
- stroke severity in the acute phase, at admission to rehabilitation measured with the NIHSS;[18]
- FAI anamnestic total score;
- Modified Rankin Scale (mRS) anamnestic total score;[19]
- Modified Barthel Index (mBI) total score at follow-up;[20]
- mRS total score at follow-up;
- cognitive impairment at follow-up, evaluated as a dichotomized Montreal Cognitive Assessment (MoCA) Score. Specifically, an equivalent score equal to 0 on the MoCA parallel version C and a total score ≤18 points for the telephonic version of the MoCA, indicated the presence of cognitive impairment; otherwise the absence of cognitive impairment was registered;[21]
- cohabitation;
- presence of architectural barriers, reported as living at the ground level or higher levels without an elevator;
- presence of aphasia at follow-up, obtained by the aphasia item of the National Institutes of Health Stroke Scale[18] for those who came to the outpatient visit, and from what by the proxy (yes/no) in the telephone interview;
- presence of depression, measured by the Hospital Anxiety and Depression Scale (HADS)[22] Italian version.[23]

Data availability

The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows (version 28.0.; IBM, Armonk, NY, USA). Firstly, descriptive statistics were computed for all independent and dependent variables. Particularly, mean and standard deviation, median with interquartile range, and frequency with absolute percentage were calculated for normal continuous, non-normal continuous, and categorical variables, respectively. For the normality of the distributions of continuous data, the Shapiro-Wilk Test was run. Secondly, to study the potential correlates of participation at six-month follow-up, univariate analyses were performed; for continuous independent variables, Pearson's correlations were computed, for dichotomized variables *t*-tests or Mann-Whitney tests were run, while for categorical variables with more than two classes One-Way ANOVA or Kruskal-Wallis Test was performed, according to the data distribution. Finally, multivariate linear regression was conducted using the variables resulting as significantly associated with the outcome in the univariate analysis corrected for age and gender. Time comparisons were performed using the paired *t*-test or Wilcoxon Test, depending on the normality of the distributions. For what concerns the analyses related to the secondary outcomes, the exact same procedures were applied. For all the tests, a P value <0.05 was considered statistically significant.

Results

A total of 235 post-stroke patients were enrolled in RIPS; 154 patients were assessed at a 6-month follow-up. Out of 154, 105 subjects completed both the prestroke FAI and the FAI at follow-up and were included in this study. In Figure 1, a flowchart of the study, indicating how the final sample of the study was obtained, is presented. Detailed demographic and clinical characteristics of the sample compared to that of the original RIPS sample are shown in Table I. The two samples did not differ in gender (P=0.432), education (P=0.374), time from stroke (P=0.195), type of stroke (P=1.000), as well as in length of stay (P=0.424). However, the patients included in the study were significantly younger (median age 78 *vs.* 82 years; P=0.008), presented a lower neurological impairment at admission to rehabilitation (NIHSS median score 3 *vs.* 4; P=0.026), and a lower disability as measured by the mBI (median score 37 *vs.* 19; P<0.001). In the included sample, 49 subjects (46.7%) were men. Regarding the FAI, the included sample reported a median anamnestic value of 28. Anamnestic and follow-up characteristics of the included sample, used within analyses, are summarized in Table II. The investigated population was younger and less impaired than the original sample, but these differences were no more significant when we removed the 40 patients who were deceased from the original sample group (Supplementary Digital Material 1: Supplementary Table I). For what concerns the FAI at follow-up, the median score was 13 and the percentage of persons with good participation was 41.9%. The median FAI Score was 28 at baseline and 13 at follow-up: out of the 105 participants, only 2 persons presented an improved participation level, while 78 patients decreased their participation level and only 25 persons had stable scores (data not shown). According to the anamnestic FAI Score, 101 patients presented good participation levels before the event and four patients were below the cut-off of 15 on the total score. These four patients were removed from subsequent analyses, given that their participation was already low, possibly related to pre-

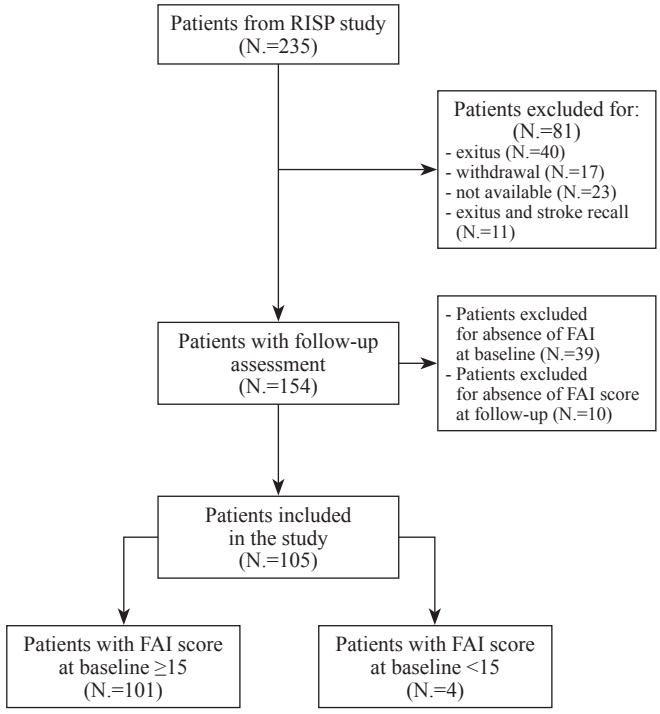

Figure 1.—Flowchart of the study.

TABLE I.—*Characteristics of the RIPS sample at admission and of the sample of patients included in this study.*

Variable	Descriptive						P value
	N.	Overall (N.=235)	N.	Group included in the analyses (N.=105)	N.	Group excluded from the analyses (N.=130)	
Variables collected at admission							
Age	235	80.0 [15.0]	105	78.0 [21.0]	130	81.5 [10.0]	0.008*
Gender	235		105		130		0.432
Male		117 (49.8%)		49 (46.7%)		68 (52.3%)	
Female		118 (50.2%)		56 (53.3%)		62 (47.7%)	
Education level	213	8.0 [8.0]	104	8.0 [8.0]	109	8.0 [8.0]	0.374
Etiology	235		105		130		1.000
Ischemic		186 (79.1%)		83 (79.0%)		103 (79.2%)	
Hemorrhagic		49 (20.9%)		22 (21.0%)		27 (20.8%)	
Time from event (days)	235	11.0	105	11.0 [9.0]	130	12.0 [8.0]	0.195
Side of the lesion	221		99		122		0.527
Right		98 (44.3%)		45 (42.9%)		53 (43.4%)	
Left		107 (48.4%)		49 (46.7%)		58 (47.5%)	
Bilateral		16 (7.3%)		5 (4.8%)		11 (9.1%)	
Area of the lesion	235		105		130		0.772
None		18 (7.7%)		10 (9.5%)		8 (6.2%)	
Subtentorial		24 (10.2%)		11 (10.5%)		13 (10.0%)	
Supratentorial		185 (78.7%)		80 (76.2%)		105 (80.8%)	
Both		8 (3.4%)		4 (3.8%)		4 (3.1%)	
FAI	138	28.0 [8.0]	105	28.0 [8.0]	33	28.0 [11.0]	0.261
mBI	229	26.0 [43.0]	102	37.0 [50.0]	127	19.0 [34.0]	0.001*
Variables collected at discharge							
Length of stay (days)	230	31.0 [28.0]	103	32.0 [25.0]	127	31.0 [30.0]	0.424
NIHSS	212	4.0 [7.0]	101	3.0 [5.0]	111	4.0 [10.0]	0.026*
mBI	221	62.0 [53.0]	102	77.5 [47.0]	119	52.0 [63.0]	<0.001*

Median [IQR] or frequencies (%).
*Statistically significant.

TABLE II.—*Anamnestic and follow-up characteristics of the sample included in the study (N.=105).*

Variables	Median [IQR] or frequencies	Numerosity
Anamnestic clinical variables		
FAI	Good participation level: 101 (96.2%) Compromised participation level: 4 (3.8%)	105
mRS, anamnestic	0.0 [0.0]	97
Variables collected at admission evaluation		
NIHSS, admission	6.0 [6.0]	103
Variables collected at follow-up evaluation		
FAI	13.0 [20.0]	105
FAI, dichotomized score	Good participation level: 44 (41.9%) Compromised participation level: 61 (58.1%)	105
Type of evaluation	In-person: 66 (62.9%) Through telephonic interview: 39 (37.1%)	105
mBI	86.0 [40.0]	104
mRS	4.0 [2.0]	105
MoCA, dichotomized score	Altered cognitive status: 29 (35%) Normal cognitive status: 53 (65%)	82
Cohabitation	No: 21 (20.0%) Yes: 77 (73.3%)	98
Barriers _ level of the house	Ground floor only: 14 (13.3%) Higher levels: 73 (69.5%)	87
Severe aphasia	No: 17 (16.2%) Yes: 6 (5.7%)	23

FAI: Frenchay Activities Index; IQR: interquartile range; mBI: Modified Barthel Index; MoCA: Montreal Cognitive Assessment; mRS: Modified Rankin Scale; NIHSS: National Institutes of Stroke Scale.

TABLE III.—*Univariate analyses with FAI at follow-up as the dependent variable, in patients with good premorbid participation (N.=101).*

Variables	Median [IQR] FAI on the groups or correlation coefficient	P value
Anamnestic clinical variables		
FAI, anamnestic	0.481	<0.001*
mRS, anamnestic	-0.128	0.221
Variables collected at admission evaluation		
Gender	Male: 12.0 [19.0] Female: 15.0 [21.0]	0.833
Age	-0.392	<0.001*
Schooling (years)	0.203	0.043*
NIHSS, admission	-0.496	<0.001*
Variables collected at follow-up evaluation		
MoCA, dichotomized score	Altered cognitive status: 5.5 [14.0] Normal cognitive status: 19.0 [19.0]	<0.001*
Cohabitation	No: 19.0 [14.0] Yes: 13.0 [20.0]	0.179
Barriers _ level of the house	Ground floor only: 8.5 [20.0] Higher levels: 16.0 [19.0]	0.186
Aphasia	No: 7.0 [14.0] Yes: 2.0 [11.0]	0.612
mBI	0.708	<0.001*
mRS	0.190	0.057

*Statistically significant.
FAI: Frenchay Activities Index; IQR: interquartile range; mBI: Modified Barthel Index; MoCA: Montreal Cognitive Assessment; mRS: Modified Rankin Scale; NIHSS: National Institutes of Health Stroke Scale.

stroke morbidity, thus making it highly unlikely that they may reach good participation after stroke. In Table III, the univariate analyses of the different socio-demographic and clinical characteristics, compared to the FAI total score at follow-up, are shown. A significant negative correlation was found between FAI at follow-up, admission NIHSS score (r=-0.496; P<0.001), and age (r=-0.392, P<0.001). The FAI Score at follow-up was positively correlated with the anamnestic FAI Score (r=0.481, P<0.001) and schooling (r=0.203; P=0.043). For what concerns follow-up data, subjects with altered MoCA had a significantly lower FAI than those with normal MoCA (5.5 *vs.* 19.0, P<0.001). A positive significant correlation was found also between FAI at follow-up and the mBI (r=0.708, P<0.001). Finally, Table IV reports the results of the multivariate regression. A higher FAI at follow-up was significantly associated with a lower NIHSS at admission (B=-0.832; P=0.001), a higher mBI (B=0.133; P=0.015), and the absence of cognitive impairment at follow-up (B=4.755; P=0.027), and a high FAI anamnestic score (B=0.410; P=0.028). This final model explained 55% of the outcome variance. Table V[11] describes FAI subscales and subitems at admission and follow-up, considering both the specific activities of the scale subitems and the subscales connected to domestic activities and leisure and work activities. All FAI items significantly decreased at the follow-up compared to the pre-stroke score. In Figure 2,[11] a graphical display of the FAI subitems is presented. In Figure 2A, B, the frequen-

TABLE IV.—*Multivariate analysis with FAI at follow-up as the dependent variable.*

Independent variables	Non-standardized coefficients		P value	95% confidence interval	
	B	Standard error		Lower limit	Upper limit
NIHSS, admission	-0.832	0.234	0.001*	-1.297	-0.366
Education	0.260	0.240	0.283	-0.219	0.739
mBI	0.133	0.053	0.015*	0.027	0.239
MoCA, dichotomized score (0: altered cognitive status, 1: normal cognitive status)	4.755	2.103	0.027*	0.563	8.948
Age	-0.115	0.083	0.173	-0.281	0.052
FAI, anamnestic	0.410	0.183	0.028*	0.045	0.775

Adjusted R^2=0.547. Results on the group included in the analyses (N.=101).
*Statistically significant.
FAI: Frenchay Activities Index; IQR: interquartile range; mBI: Modified Barthel Index; MoCA: Montreal Cognitive Assessment; NIHSS: National Institutes of Health Stroke Scale.

TABLE V.—*Description of FAI subscales and subitems at admission and follow-up for patients with good prestroke participation (N.=101).*

Subscales and subitems	Descriptives		P value
	T0	T2	
Total score	28.0 [8.0]	13.0 [20.0]	
Domestic acitivities#	12.0 [6.0-12]	4.0 [0.0-9.5]	<0.001*
Leisures and work#	20.0 [16.0-24.0]	8.0 [3.0-15.0]	<0.001*
Meals§	3.0 [1.0]	0.0 [3.0]	<0.001*
Dishes§	3.0 [1.0]	0.0 [3.0]	<0.001*
Laundry§	3.0 [2.5]	0.0 [3.0]	<0.001*
Light domestic activities§	3.0 [1.0]	2.0 [3.0]	<0.001*
Heavy domestic activities§	2.0 [2.0]	0.0 [0.0]	<0.001*
Shopping§	3.0 [0.0]	0.0 [3.0]	<0.001*
Social occasions§	3.0 [1.0]	1.0 [2.5]	<0.001*
Walking§	3.0 [0.0]	3.0 [3.0]	<0.001*
Hobby§	3.0 [2.0]	0.0 [2.5]	<0.001*
Transports§	3.0 [3.0]	0.0 [2.0]	<0.001*
Trips§	1.0 [3.0]	0.0 [2.0]	0.005*
Gardening§	1.0 [2.0]	0.0 [1.0]	<0.001*
Maintenance§	1.0 [1.0]	0.0 [1.0]	<0.001*
Reading§	1.0 [2.0]	0.0 [1.0]	0.039*
Work§	0.0 [2.0]	0.0 [0.0]	<0.001*

*Statistically significant; #subscales validated by Antonucci *et al.*;[11] §scale subitems.

cies on each subitem response are introduced for admission and follow-up scores, respectively. Figure 2C shows the box plots of the difference between the single items from pre-stroke to follow-up scores (delta values). Thus, information about median scores, variability and outliers are visible. The subitems are grouped according to the FAI subscales identified by Antonucci *et al.*[11] The subitems related to work, gardening, reading, and maintenance activities appear to be those with smaller median delta values and smaller variability of this quantity among patients. In particular, as to the subitem work, we found that only 31 people were working at T0 for at least 10 hours per week, and only 10 people at T2. For what concerns the factors associated with the decline in single FAI subscales, univariate analyses were conducted to identify potential correlates of FAI subitems and subscales at follow-up (Supplementary Table I). In the multivariate analysis (Table VI), we found that correlates were different among the two subscales. In fact, the recovery of domestic activities subscale appeared to be related to gender, (women presented a higher recovery compared to men (*B*=2.612; P=0.002)), pre-stroke FAI (*B*=0.216; P=0.011), stroke severity at admission (*B*=-0.311; P=0.003), and ADL disability at follow-up (*B*=0.068; P=0.008). Instead, the leisure and work activities subscale was only related to stroke severity at admission (*B*=-0.489; P=0.006) and the cognitive level at the follow-up (*B*=4.333; P=0.007).

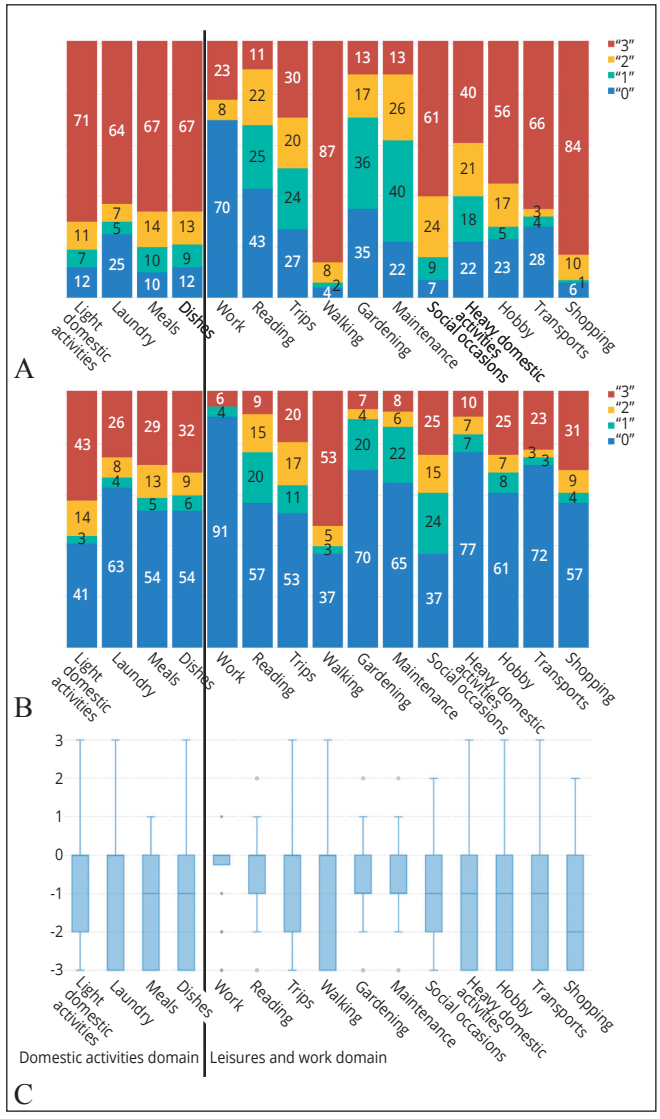

Figure 2.—Evolution of the FAI subitems (N.=101). A) The frequencies for each item class at admission (T0) are presented; B) the frequencies of each item class at follow-up (T2) are presented; C) the boxplots of the delta of the items between follow-up and admission are presented. The black vertical line is dividing the items contributing to the subscales of domestic activities and leisure and work by Antonucci *et al.*[11]

Discussion

This study presents a detailed description of participation scores and specific activities before the stroke and six months after the onset in a prospective cohort of Italian patients addressing intensive rehabilitation. An analysis of correlates for FAI total score and its subscales at six months after the stroke onset is also presented. Despite the old age of most participants, pre-stroke participation lev-

TABLE VI.—*Multivariate analyses with FAI subscales (N.=101).*

Independent variables	Non-standardized coefficients		P value	95% confidence interval	
	B	Standard error		Lower limit	Upper limit
Leisure and work (adjusted R^2=0.478);					
NIHSS, admission	-0.311	0.100	0.003*	-0.511	-0.111
Gender (0: male; 1: female)	2.612	0.806	0.002*	1.001	4.223
mBI	0.068	0.025	0.008*	0.018	0.117
MoCA, dichotomized score (0: altered cognitive status, 1: Normal cognitive status)	1.427	0.969	0.146	-0.511	3.364
Cohabitation (0: no; 1: yes)	-0.572	1.063	0.592	-2.696	1.551
Age	-0.008	0.035	0.821	-0.079	0.063
FAI, anamnestic	0.216	0.082	0.011*	0.051	0.381
Domestic activities (adjusted R^2=0.569).					
NIHSS, admission	-0.489	0.173	0.006*	-0.833	-0.145
mBI	0.063	0.039	0.112	-0.015	0.142
MoCA, dichotomized score (0: altered cognitive status, 1: normal cognitive status)	4.333	1.555	0.007*	1.233	7.432
Education	0.275	0.178	0.126	-0.079	0.629
Age	-0.102	0.062	0.102	-0.225	0.021
FAI, anamnestic	0.189	0.135	0.166	-0.080	0.459

*Statistically significant.
FAI: Frenchay Activities Index; IQR: interquartile range; mBI: Modified Barthel Index; MoCA: Montreal Cognitive Assessment; mRS: Modified Rankin Scale; NIHSS: National Institutes of Health Stroke Scale.

els were on average very good (median score 28) and 96% of participants had a score >15. Only four patients did not have a good prestroke level of participation; this was possible because of pre-stroke morbid conditions, but we did not investigate this issue. Six months after the stroke, our sample had a steep reduction in participation with a median value at follow-up of 13 and with only 41.9% of the study population with a good participation level. In the previous Italian retrospective study by Andrenelli *et al.*,[7] the FAI Score 2 years after stroke was much higher compared to our results, as the FAI total score was 31.3±10.0 points (median: 32; women: 32.2±9.2 points; men: 30.6±10.6 points). However, the above-mentioned study was restricted to people with first-ever stroke, without previous disability, and with younger ages (mean age 70.1±l9.0 years). Although we cannot exclude that the distance from the stroke may also have influenced this outcome, the differences between the two study samples may probably better explain why the participation levels from Andrenelli *et al.*[7] were so much higher than ours. Indeed, our results are much more in line with the international literature reporting that about 65% of stroke survivors present restrictions in participation.[24] As to changes in total FAI Score, out of our 105 study participants, 78 patients decreased their participation level and only 25 persons recovered their pre-stroke participation level at follow-up. Only 2 persons presented an improved participation level: both of them had minor stroke outcomes, and both reported that after the event they had decided to retire from work thus recovering more time for domestic and leisure activities. Indeed, the subitems related to work, gardening, reading, and maintenance activities appear to be those with smaller median delta values and smaller variability of this quantity among patients: these activities were rarely addressed already before the stroke and, considering the older ages of our sample, their low rate of change in occurrence frequency was indeed expected.[24] Different findings may occur when dealing with a younger stroke subpopulation, but our study is focused on those patients who are addressed to intensive inpatient rehabilitation and not on the whole population of stroke survivors. The factors correlating with the total FAI Score at follow-up resulted being the baseline NIHSS, the pre-stroke FAI Score, the cognitive impairment on the MoCA, and the follow-up functional level on the mBI. Indeed, the association between functional aspects and participation is well recognized in the literature, although mBI is rarely used to assess follow-up, many studies evaluate the global functional level using the functional independent measure[25, 26] or the mRS[17] rather than mBI. Actually, other studies investigated the association of participation with the walking ability,[27] which is also one of the items of the mBI. The second independent correlate of participation six months after stroke in our analysis was cognitive function, assessed with the MoCA. As most of the tasks included in the FAI require both physical and cognitive abilities to be carried out, the role of cognitive function in participation was also expected. Actually, although cogni-

tive impairment is related to functional independence,[27-29] we found that in our regression analysis, cognitive performance was correlated to participation independently from disability in ADLs as measured by the mBI. The NIHSS evaluates cognitive, sensory, and motor impairments in individuals who had a stroke. While cross-sectional studies did not find an association between NIHSS follow-up scores and participation,[4] a study by Jian-Feng Qu *et al.*,[30] in 2020, reported that age and NIHSS Score at admission were significant predictors of poor participation at one year. Also, Bertolin *et al.*,[31] in a retrospective analysis of acute clinical data and 6-month follow-up telephone interviews for 498 mild to moderate stroke patients, found that the NIHSS in the postacute phase was the only measure that significantly predicted basic and instrumental ADLs and participation 6 months post-stroke. On the other hand, a cross-sectional study by Foley *et al.* in 2019[5] demonstrated that the actual NIHSS Score was not a significant correlator of social participation in chronic, community-resident post-stroke survivors. Thus, in this prospective study, we used NIHSS as a measure of postacute stroke severity, potentially affecting participation six months after the stroke. Indeed, we found that independently from ADL disability and cognitive impairment at follow-up, as well as from previous participation levels, NIHSS was significantly related to FAI Scores. Further, when we performed separate regression analyses for the domestic activities and the leisure and work activities, we found that stroke severity in the postacute phase was the only variable that remained significant for both subscales. The fourth independent correlate of participation was the pre-stroke participation score. The purpose of FAI is to objectively quantify the level of previous activity and social participation,[32] to provide an assessment of the pre-stroke lifestyle of patients and to acknowledge changes in post-stroke activities at specific intervals, so that the chosen treatment plan can be adapted at any time.[9] A stroke is a catastrophic event, dramatically affecting all dimensions of functioning, and we did find that stroke severity was strongly associated with the recovery of good participation six months from the event. However, the association of anamnestic FAI with the FAI achieved six months after stroke, retained in the multivariate regression analysis, strongly implies that, other than assessing stroke severity, it is also mandatory to perform a systematic assessment of pre-stroke participation, to target the individual rehabilitation plan, and to improve the prediction of participation outcomes.[33, 34] For what concerns the FAI subscales, stroke severity predicts lower participation after stroke in both subscales, while the premorbid FAI remains an independent predictor of participation only for domestic activities, possibly because in our older population, this was the best-preserved area before the stroke. Contrary to other studies, we did not find an association of post-stroke participation with architectural barriers,[35, 36] living situation (cohabitation *vs.* living alone)[37] and education.[38-40] However, our study population was very unbalanced towards the presence of architectural barriers, cohabitation, and low education, and this may have influenced our results. Indeed, these negative results reflect the specific context experienced by our study population, but whether this is true for all Italian stroke patients addressed to intensive post-stroke rehabilitation remains to be explored. While other studies, as well as ours, did not find significant differences in participation recovery between men and women,[17, 25] when we considered the correlates of recovery for the two subscales of the FAI Score, the female gender was associated with higher recovery; this finding may be related to the Italian socio-cultural context, where, particularly in older persons, there is still a strong difference in gender roles, but to the best of our knowledge, this analysis has not been performed in other contexts, and these preliminary dates deserve further investigation. Depression proves to be a correlate of recovery of participation in many studies.[5, 25, 41] Also, in the previous Italian study, the depression inventory along with the functional ambulation categories was found as the only independent correlate of FAI scores two years after a stroke, but this was not observed in our patients. Unfortunately, we assessed depression in the follow-up only in-person, through the clinical interview, whereas we did not investigate it during the telephone follow-up, therefore we could include only 80 out of 101 patients in this analysis; this is a limitation of our study and therefore our results about depression must be taken with caution. Also, age did not correlate in the multivariate analysis unlike what is found in the literature.[2, 4, 17] One possible explanation is that previous works have investigated younger samples (*e.g.*, mean age in Palstam *et al.*[4] was 65 years) or groups that covered a wider range of age (*e.g.*, 24-85 years in Singam *et al.*[2]) in which the range of decline between the youngest and oldest participants may have been more pronounced. Further, none of the aforementioned studies considered premorbid participation as a correlate of post-stroke participation, hampering a direct comparison of results obtained, as a decline in participation is expected in older age, independent of stroke or other clinical conditions. Indeed, when we considered the correlates of good participation for the two

FAI subscales, younger age was found to be associated with higher participation in domestic activities, which were better preserved than leisure and work activities before the stroke, while leisure and work activities recovery was only related to stroke severity in the postacute phase and cognitive level at the follow-up.

Limitations of the study

Among the limitations of this study, first, we must mention that our follow-up data presented many drop-outs, due to a high prevalence of deceased patients (40) and also to the COVID-19 pandemic, causing many patients to refuse in-person follow-ups. As we investigated depression only in those who came in person, and this is another limit to our investigation. Finally, as our final model explained up to 56% of the variance of the primary outcome, we must acknowledge that we may have missed some relevant features that explain participation six months after stroke. On the other hand, this study has the strengths of being the first large prospective study on the recovery of participation, investigating a representative population of stroke survivors addressed to postacute inpatient rehabilitation in an Italian context, and measuring participation, including changes at the single item and subscale level, with a trans-culturally validated tool, thus providing an innovative contribution to the existing literature on this scarcely explored topic.

Conclusions

In this Italian study prospectively investigating with a trans-culturally validated tool the recovery and correlates of participation in those receiving post-stroke inpatient rehabilitation and surviving six months from the acute event we found that participation has severely deteriorated; most items of the FAI were significantly affected. Disability in activities of daily living (mBI) and impaired cognitive status (MoCA) at follow-up, stroke severity in the postacute phase, and low anamnestic FAI total score were independently associated with reduced participation at follow-up. These findings suggest that systematic investigation of prestroke participation is highly relevant, not only to set rehabilitation goals but also to predict participation six months after the event.

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