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Short communication

Functional gait disorders: Demographic and clinical correlations

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ABSTRACT

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Functional gait disorders
Knee-buckling
Astasia-abasia
Slow gait

Objective: We aimed to describe the prevalence and clinical-demographical features of patients with functional gait disorders (FGDs) and to compare them to patients with functional motor disorders (FMDs) without FGDs (No-FGDs).
Methods: In this multicenter observational study, we enrolled patients with a clinically definite diagnosis of FMDs in 25 tertiary movement disorders centers in Italy. Each subject with FMDs underwent a comprehensive clinical assessment, including screening for different subtypes of functional gait disorders. Multivariate regression models were implemented in order to estimate the adjusted odds ratio (OR; 95% confidence interval) of having FGDs in relation to sociodemographic and clinical characteristics.
Results: Out of 410 FMDs, 26.6% (n = 109) of patients exhibited FGDs. The most frequent FGDs were slow gait (n = 43, 39.4%), astasia-abasia (n = 26, 23.8%), and knee buckling (n = 24, 22%). They exhibited single FGDs in 51.4% (n = 56) or complex FGDs (more than one type of FGDs) in 48.6% (n = 53) of cases. On multivariate regression analysis, the presence of FGDs was more likely associated with older age (OR 1.03, 95% CI 1.01–1.04), functional visual symptoms (OR 2.19, 95% CI 1.08–4.45), and the diagnosis of somatic symptoms disorder (OR 2.97, 95% CI 1.08–8.17). FGDs were also more likely to undergo physiotherapy (OR 1.81, 95% CI 1.08–3.03).
Conclusions: People with FMDs may present with different and overlapping types of FGDs, which may occur in older age. The association of FGDs with functional visual symptoms and somatic symptoms disorder opens up to new avenues to the understanding of the neural mechanisms of these disorders.

1. Introduction

Gait disorders are a core feature and a major source of disability and poor quality of life in of many chronic neurological conditions. The International Classification of Functioning, Disability and Health suggests that gait impairments can be among the most frequently sources of disability regardless of the type of underlying cause.

Gait disorders may be a prominent manifestation of functional motor disorders (FMDs), which account for 2–20% of patients referred to movement disorder outpatient clinics. The phenomenology of functional gait disorders (FGDs) encompasses a variety of abnormal types of gaits (i.e., slow gait, knee buckling) which may appear in isolation or combination with other FMDs such as tremor, weakness and parkinsonism [1]. The diagnosis of FGDs is difficult and the occurrence of gait dysfunction is associated to poorer diagnostic agreement among general neurologists [2]. Indeed, the clinical features of FGDs may be similar to those reported in other neurological diseases (i.e., knee buckling can be seen in idiopathic dystonia), despite a recent phenomenology-based classification of FGDs has been proposed in order to define positive diagnostic features similarly to other FMDs diseases [3].

Notwithstanding, only few studies have investigated the prevalence of FGDs in a large population of FMDs. Two retrospective studies found that 39.2–42.3% of people with FMDs have FGDs in association to other FMDs and the presence of isolated FGDs (without other FMDs) accounted for 5.7–8.5% [1,4]. Other case series studies have described different types of functional gaits [5], but have reported little information on the demographical and clinical features associated with each one of them. Moreover, it is unknown whether patients having one (i.e., only slow gait) or multiple functional gait patterns (i.e., slow gait + knee buckling) may have different demographical or clinical variables. Based on these premises, we aimed to evaluate the prevalence and demographical-clinical features of patients with FGDs and to compare them to patients with FMDs without FGDs (No-FGDs). We hypothesized that patients with FGDs might have a distinctive phenotype and different associated demographical and clinical variables. We also hypothesized that within the group of patients with FGDs, the occurrence of multiple type of gait disorder might delay diagnosis and complicate treatment. Accordingly, we looked for demographical and clinical variables associated to having multiple phenotypes of FGDs. We believe that defining such features associated to FGDs might be of relevance for diagnosis and treatment.

2. Methods

For this cross-sectional study, data were extracted from the Italian Registry of Functional Motor Disorders (IRFMD) managed by the Department of Neurosciences, Biomedicine and Movement Sciences, University of Verona, and by the Italian Academy for the Study of Parkinson's Disease and other Movement Disorders (Accademia LIMPEDISMOV RADAC project) and Fondazione LIMPE.

The full methods of IRFMD have been detailed in a previous study [6]. Briefly, we enrolled consecutive outpatients with FMDs from 25 tertiary movement disorders centers fulfilling the following inclusion criteria: age ≥10 years, occurrence of one of more FMDs; a clinically definite diagnosis of FMDs based on Gupta and Lang diagnostic criteria; presence of at least one of the following phenomenological manifestations: tremor, weakness, jerks, dystonia, gait disorders, parkinsonism, and facial motor disorders. We excluded patients with cognitive or physical impairment that precluded signing the informed consent form for participation in the study. At each enrolling center, a movement disorders neurologist assessed patients in a single session, confirmed the diagnosis of FMDs and administered a structured interview encompassing many demographical and clinical variables.

One section of the IRFMDs investigated the presence of any FGDs including slow gait, astasia-abasia, knee buckling, paraparetic gait, ice walking gait, hemiparetic gait, tightrope gait and other (a free text enter was allowed) [4,7]. Accordingly, subjects who had features compatible with FGDs were compared to those who did not report any gait disorders, here defined "No-FGDs". Each subject with FGDs may present with a single type of gait disorder (single FGDs) or two or more type of FGDs (complex FGDs). Approval was obtained by the institutional ethics committee of the coordinator center (University of Verona, Azienda Ospedaliera Universitaria Integrata Verona, Prog. 1757CESC) and confirmed by the ethical committees of each participating centers. All patients (or their guardians) were informed about the nature of the study and gave their written consent to participate (consent for research).

2.1. Statistical analysis

Data are expressed as mean ± standard deviation (SD) for continuous variables, counts and percentages for categorical variables. We compared groups (FGDs versus No-FGDs; single FGDs versus complex FGDs) using Mann-Whitney *U* test for continuous variables and Chi-squared test or Fisher's exact test (in case of expected frequencies ≤5) for categorical variables.

Logistic regression models were used to estimate the adjusted odds ratio (OR; 95% confidence interval [CI]) of FGDs (dependent variable) in relation to sociodemographic and clinical characteristics (independent variables. Statistical analyses were performed using SPSS statistical software (version 20; IBM-SPSS, Armonk, NY, USA).

3. Results

Out of 410 patients with FMDs, 26.6% (n = 109) had FGDs. FGDs

were more frequent in subjects with functional weakness and tremor. The most common type of FGDs was slow gait, followed by astasia-abasia and knee buckling (Fig. 1, panel A). Paraparetic, ice walking, hemiparetic, and tightrope gait occurred less frequently in FGDs. A phenomenology not classifiable within the previous categories occurred in 27.5% and was defined "Other FGDs". When analyzing the distribution of different FMDs phenotypes based on the phenomenology of FGDs, weakness, tremor and dystonia were the most frequent associated motor disorders in each type of functional gait pattern (Fig. 1, panel B). Knee buckling was more likely to be associated to functional weakness.

Patients with FGDs were older (p = .007), had more frequently fatigue (p = .015), pain (p = .036), functional visual symptoms (p = .001), a diagnosis of somatic symptoms disorder (p = .008) compared to No-FGDs patients (supplementary table 1). They also were more likely to have received surgical procedures (p = .053), general anesthesia (p = .003), neurophysiological testing (p = .035) and physiotherapy (p = .001) compared to No-FGDs. In multivariate regression analysis, the diagnosis of FGDs was significantly associated with older age (p = .001), functional visual symptoms (p = .03), and a diagnosis of somatic symptoms disorder (p = .035). FGDs were also more likely to receive physiotherapy (p = .023) (Table 1).

Single FGDs (51.4%, n = 56) were slightly more frequent than complex FGDs (48.6%, n = 53). Patients with complex FGDs pattern had more frequently tremor (p = .017), functional nonepileptic seizures (p = .039) and were more likely to have undergone magnetic resonance imaging (p = .041) and neurophysiological testing (p = .041) compared to isolated FGDs. The intake of benzodiazepine was also more frequent in complex FGDs (p = .039) (supplementary table 2). No other statistically significant differences were found between single and complex FGDs pattern.

4. Discussion

In this large Italian multicenter study of FMDs, up to 26.6% of patients had FGDs. Slow gait, astasia-abasia and knee buckling were the most frequent FGDs occurring in association to FMDs. A single FGDs

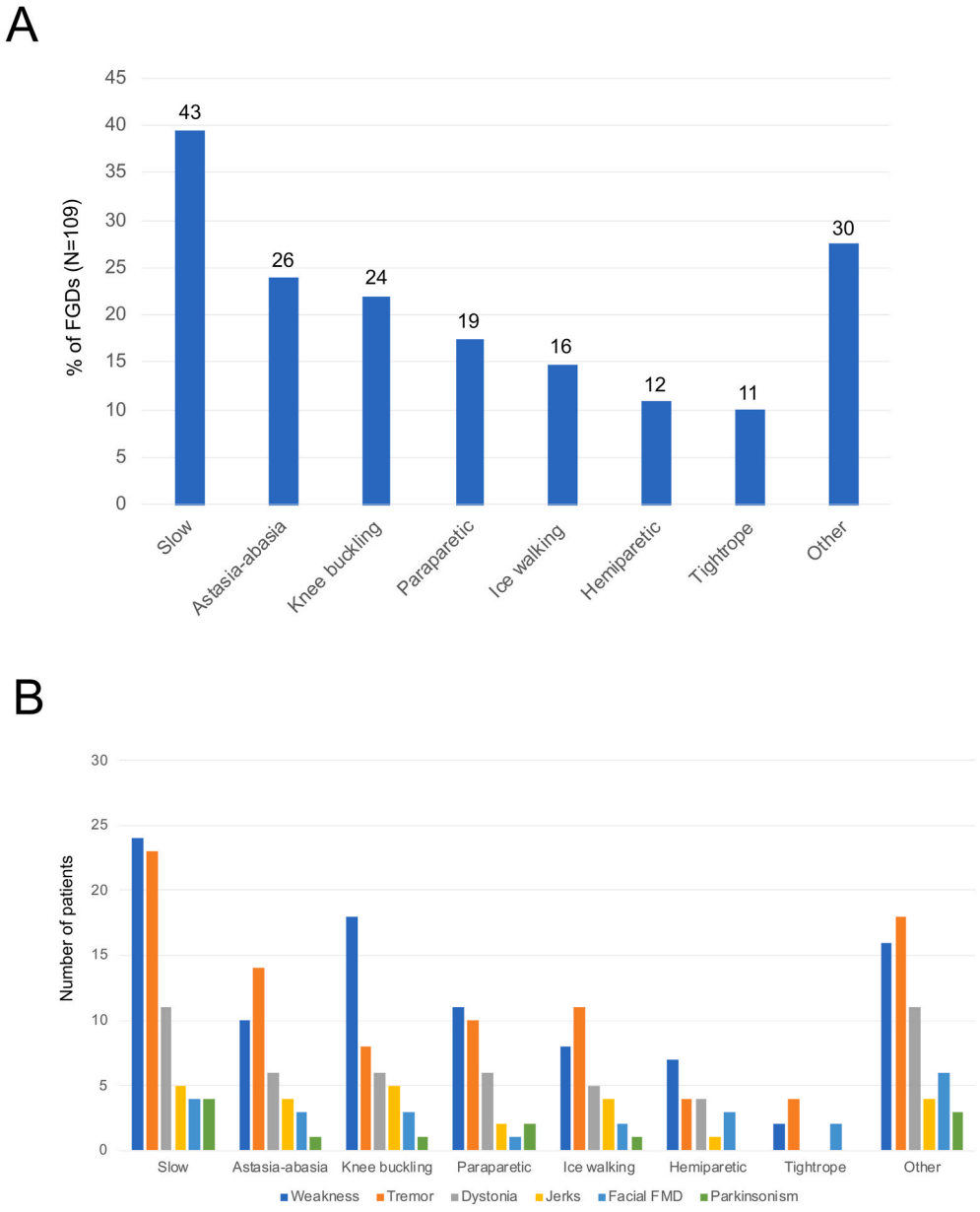

Fig. 1. Panel A: absolute frequency (and percentage) of FMDs patients with one or more FGDs; Panel B: distribution of different FMDs phenotypes according to different patterns of FGDs.

Table 1
Multivariate regression analysis of clinical and demographic variables associated with FGDs.

Independent Variable	Adjusted		
	OR	95% CI	P-Value
Age, y	1.03	1.01–1.04	**.001**
Gender, male vs females	1.31	0.78–2.19	.307
Non-motor symptoms §			
Fatigue, yes vs no^	1.35	0.82–2.22	.235
Pain, yes vs no^	1.26	0.76–2.10	.374
Headache yes vs no^	1.09	0.63–1.88	.77
Other FNDs			
Visual functional symptoms, yes vs no^	2.19	1.08–4.45	**.03**
Sensory functional symptoms, yes vs no^	1.20	0.68–2.11	.518
Psychiatric comorbidities			
Somatic symptoms disorder, yes vs no^	2.97	1.08–8.17	**.035**
Precipitating factors			
Surgery, yes vs no^	0.87	0.38–2.09	.764
General anesthesia, yes vs no^	2.18	0.74–6.43	.157
Investigations and treatment			
Neurophysiological tests, yes vs no^	1.41	0.79–2.49	.245
Physiotherapy yes vs no^	1.81	1.08–3.03	**.023**

FMDs = Functional Motor Disorders; FGDs = FMDs patients with functional gait disorders; § = Patients' self-reported non-motor symptoms; ^ = reference category; n = number; y = years; CI = confidence interval; FNDs = functional neurological disorders; OR = odds ratio; significant associations at $P < .05$. Significant values are in bold.

pattern appeared in half of cases (51.4%), while the remaining exhibited a complex FGDs pattern with a wide overlap with different gait subtypes. On multivariate regression analysis, FGDs were more likely associated with older age, functional visual symptoms and the diagnosis of somatic symptoms disorder and were also more likely to undergo physiotherapy, probably related to disability.

The prevalence rate of FGDs in our cohort is smaller compared to two previous studies. The presence of FGDs was reported in 39.2–42.3% of patients with FMDs, with isolated FGDs ("pure", not associated with other FMDs) accounting for 5.7–8.5% of patients [1,4]. In our study, we found a lower prevalence, respectively 26.6% and 4.1% for the combined and isolated FGDs [6]. Differences in prevalence rates of FGDs reported in other studies compared with ours are likely due to dissimilarities in the study design (the previous works were retrospective series from a single tertiary movement disorder center), different inclusion criteria (we considered only diagnoses of "clinically definite" FMDs) and different definitions employed to characterize functional gait disorders [1,3,4].

In our cohort, we found that slow gait (39.4%), astasia-abasia (23.8%), and knee-buckling (22%) were the most frequent FGDs among people with FMDs. These frequencies are consistent with previous retrospective studies whereby slow-hesitant gait (42.5%) and astasia-abasia (18.3%) were the most common FGDs [1,4]. The distribution of other motor manifestations of FMDs in each type of functional gait patterns were representative of the frequency of different FMDs phenotype, with weakness, tremor and dystonia being the most frequent FMDs [6]. A previous study on a smaller cohort found this pattern to occur only in the context of isolated FGD. Conversely, a novel clinical observation arising from our data was the frequent association between functional weakness and knee-buckling gait disorder.

Our study also provided novel insights on the clinical and demographical variables associated to FGDs, which might be helpful to identify subjects at risk for such disturbances. First, a complex FGDs pattern (i.e., slow gait + knee buckling) may exist in the same patient.

We also demonstrated that FGDs were more likely to be present in older age. This is a relevant finding, as FMDs occur less frequently in older subjects and misdiagnosis of FMDs might occur because of an age bias [2]. Moreover, FDGs were associated to more frequent functional visual symptoms, a data previously reported in smaller study cohorts [8,9]. The association with older age and visual symptoms is intriguing and might suggest some insights on the pathophysiology of FGDs. Indeed, gait slows with age and balance may be impaired by joint diseases or compromised vision. Visual impairment may contribute to a loss of self-confidence and fear of falling resulting in "cautious gait" [5] and consequently disability.

In the present study, we did not have any quantitative measure of disability in people with FGDs. Yet, they were more likely to undergo physiotherapy compared to FMDs without gait disorders. This suggests either FDGs patients may have a higher burden of disability or might be more prone to benefit from physiotherapy interventions. Finally, FGDs patients received more frequently the diagnosis of somatic symptoms disorder. The diagnosis of somatic symptoms disorder is one of the most prevalent psychiatric diagnosis among neurological patients [10] and is often associated with combined FMDs, i.e. patients having multiple FMDs phenotypes [6].

All groups displayed similar rates of other neurological and psychiatric comorbidities, associated FNDs, predisposing and precipitating factors and self-reported non-motor symptoms, with exception of fatigue and pain, that were found to be more common in patients with FGDs. These results may support the concept that common mechanisms might underlie different types of FMDs, as also suggested by occurrence in the same patient of different patterns of FGDs or other FMDs [11]. It is important to point out that differences in the clinical history (i.e. physical trauma resulting from previous falls) and the presence of neurological comorbidities may trigger the development of FGDs [12].

Few patients in both groups were treated with physiotherapy and psychotherapy which denote the need of implementing a three-stage approach for treating FMDs [13] in our centers. We are unable to establish whether this data was determined by difficulty to access such interventions, as we did not specifically investigate such variable. Also, this might reflect lack of referral to these interventions. In general, we have reported low utilization of physiotherapy (28.3%) and cognitive behavioral therapy (10.2%) in the whole FMDs population [6], despite these represent the pillars of FMDs treatment. Indeed, the therapeutical approach endorses the neurologist, as first step, to refer patients to physiotherapist (along with support of psychiatrist when necessary) for a brief intervention and later on to the other components of the rehabilitation team [13].

Our study has several limitations. Although we identified FGDs in a large sample of people with FMDs, their diagnosis is challenging [3], and over/underestimation of this population cannot be excluded due also to their misdiagnosis [2]. We cannot rule out the association between specific FGDs patterns and specific types of FMDs (i.e., weakness, tremor, dystonia), given the difficulty in characterizing such gait disturbances based exclusively on clinical features. Hence, a more reliable definition of FGDs based on objective spatiotemporal gait parameters is needed, in order to consistently appraise associations of subtypes of FGDs. Finally, we cannot exclude the contribution of comorbid neurological diseases to worsening gait in FGDs patients, as 21.7% of our cohort had other neurological disorders associated to FMDs [12]. Yet, distribution of neurological comorbidities was similar between FGDs and No-FGDs.

As a strength, we provided novel data on the demographical and clinical associations of FGDs in a large cross-sectional multicenter cohort of FMDSs patients which allowed us to have a standardized collection of clinical data.

In conclusion, people with FMDs may present with different and overlapping types of FGDs, which may occur in older age. The association of FGDs with functional visual symptoms and somatic symptoms disorder opens up to new avenues to the understanding of the neural mechanisms of these disorders. Further studies are needed to explore the pathophysiology of FGDs and their impact on disability, prognosis and variability overtime.

Ethical compliance statement

Approval was obtained by the Institutional Ethics Committee of the Coordinator Centre (University of Verona, Azienda Ospedaliera Universitaria Integrata Verona, Prog. 1757CESC) and confirmed by the Committees of each participating centers. All patients (or their guardians) were informed about the nature of the study and gave their written consent to participate (consent for research). Participants were free to withdraw from the Registry at any time. We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this work is consistent with those guidelines.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.parkreldis.2021.08.012.

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