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ORIGINAL ARTICLE

Performance validity tests in nonlitigant patients with functional motor disorder

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Abstract

Background and purpose: Performance validity tests (PVTs) are used in neuropsychological assessments to detect patterns of performance suggesting that the broader evaluation may be an invalid reflection of an individual's abilities. Data on functional motor disorder (FMD) are currently poor and conflicting. We aimed to examine the rate of failure on three different PVTs of nonlitigant, non-compensation-seeking FMD patients, and we compared their performance to that of healthy controls and controls asked to simulate malingering (healthy simulators).

Methods: We enrolled 29 nonlitigant, non-compensation-seeking patients with a clinical diagnosis of FMD, 29 healthy controls, and 29 healthy simulators. Three PVTs, the Coin in the Hand Test (CIH), the Rey 15-Item Test (REY), and the Finger Tapping Test (FTT), were employed.

Results: Functional motor disorder patients showed low rates of failure on the CIH and REY (7% and 10%, respectively) and slightly higher rates on the FTT (15%, $n = 26$), which implies a motor task. Their performance was statistically comparable to that of healthy controls but statistically different from that of healthy simulators ($p < 0.001$). Ninety-three percent of FMD patients, 7% of healthy simulators, and 100% of healthy controls passed at least two of the three tests.

Conclusions: Performance validity test performance of nonlitigant, non-compensation-seeking patients with FMD ranged from 7% to 15%. Patients' performance was comparable to that of controls and significantly differed from that of simulators. This simple battery of three PVTs could be of practical utility and routinely used in clinical practice.

KEYWORDS
functional neurological disorders, neuropsychological assessment, performance validity tests

INTRODUCTION

A cornerstone of neuropsychological assessment is the investigation of patterns suggestive of negative response bias or impaired engagement through performance validity tests (PVTs) [1, 2]. PVTs have historically been described as “effort tests,” partly because low scores on tests might suggest poor effort, whereas scores below chance using a "forced choice" paradigm may indicate that the subject intentionally chooses not to give the correct answer. Basically, these tests are designed to appear complicated on the surface, but they are, instead, easy to pass. In the absence of interfering factors, performance could be expected to be good, even in patients with moderate cognitive or psychiatric impairment [1]. Therefore, failure of PVTs can invalidate the broader neurological or neuropsychological assessment and can also have implications in forensic or medicolegal contexts. Critically, however, the interpretation of failure on PVTs needs to be embedded in a comprehensive evaluation of patients' history and clinical presentation. Moreover, several factors, such as pain, fatigue, apathy, anxiety, or emotional distress as well as involvement in lawsuits or disability claims, might affect performance. Thus, results should always be interpreted with caution.

The literature on PVTs has proliferated in recent years, and base rates of performance on several tests have been studied across multiple clinical populations, but mainly in those seeking financial compensation (i.e., disability claimants or litigating subjects) or in mixed clinical and litigant populations [1]. However, to better understand how these measures might inform standard psychological evaluations, it is nonetheless essential to have data on PVT performance in different clinical groups, in the absence of known external motivations. Improved understanding of performance validity is especially important in functional motor disorder (FMD), in which patients often experience stigma associated with misperceptions that they may be feigning or exaggerating their symptoms [3]. FMD is a common and disabling neurological condition [4], characterized by movement abnormalities where there is typically evidence of inconsistency of motor performance over time, changing in frequency or amplitude, worsening with attention, and attenuating with distraction [5]. Because FMD involves a disturbance of voluntary movements, it has often been confused with feigning, either as a factitious disorder or malingering [6, 7]. Malingering is defined as the fabrication, feigning, or exaggeration of symptoms for an external gain (i.e., financial compensation/avoiding duties), whereas those with a factitious disorder feign symptoms for a psychological reason [8]. In both cases, individuals are fully conscious of their behavior and voluntarily simulate symptoms, for example, failing easily achievable tasks. Because malingering might be prosecutable, a confident differentiation from FMD is highly desirable [9]. Unfortunately, to date, no shared and validated tools or biomarkers can differentiate functional disorders from willful exaggeration or simulation. New proposed criteria for neurocognitive malingering include the evidence of an invalid cognitive presentation as an essential criterion to detect malingering with the demonstration of it achieved either with compelling inconsistencies (documented with written, audio, and video) or using PVTs [10].

A recent systematic review has reported that failure of single PVTs is common in several clinical groups, for example, epilepsy and Parkinson disease, with rates exceeding 25% in some groups, with failure rates no higher in functional disorders than in other clinical conditions [1]. However, most studies have been conducted in patients with functional seizures [1, 11], whereas data on FMD patients are poor. Few previous studies addressed performance validity in the context of neuropsychological assessment in the FMD population, and results were conflicting [12–14]. In one study, valid test performance was present in most patients [12]. Low rates of failure of effort tests were shown in a mixed population of patients with medically unexplained symptoms compared to the performance of mild and strong simulators [13]. Conversely, patterns compatible with noncredible performance were found in psychogenic jerky movement disorder patients, but patients involved in lawsuits were not excluded [14]. To date, no studies have addressed nonlitigant or non-compensation-seeking FMD patients, and measures for motor effort have never been assessed in this population.

In the present study, we aimed at assessing rates of failure of nonlitigant, non-compensation-seeking FMD patients on three different PVTs, the Coin in the Hand Test (CIH), the Rey 15-Item Test (REY), and a test involving a motor task, the Finger Tapping Test (FTT). We compared the performance of FMD patients to that of a group of matched healthy controls asked to simulate cognitive malingering (healthy simulators) and healthy controls who did not receive specific instructions.

METHODS

Participants

Twenty-nine patients with a clinically established diagnosis of FMD [15], aged ≥18 years, were recruited at the FMD Clinic of the Parkinson's Disease and Movement Disorders Unit in Verona, Italy. Exclusion criteria were involvement in litigation or disability claims, prominent nonepileptic seizures, prominent and severe arm weakness, the presence of cognitive decline scored <70 on the Wechsler Memory Scale [16], the presence of pain on the Numerical Rating Scale (>3), the presence of severe anxiety (Beck Anxiety Inventory score > 22) [17], and severe depression (Beck Depression Inventory-II score > 19 for women and > 17 for men) [18]. Involvement in disability claims or litigation was detected through a structured interview. We also enrolled two groups of healthy controls ($n = 29$ each), selected through an advertisement among university students and health care personnel, matched for sex and education level. All participants gave their written, informed consent to participate in the study, which was carried out under the Declaration of Helsinki tenets (2013). Approval was obtained from the institutional ethics committee (University of Verona, Prog. 1757CESC).

Performance validity tests

FMD patients, healthy simulators, and healthy controls were assessed with three different PVTs: the CIH [19], the REY [20], and the FTT [21]. The three tests were administered in a counterbalanced order within each group.

The CIH is a well-known, easy-to-administer bedside forced-choice test, initially developed to detect malingering among patients with memory disorders [19]. The examiner shows participants a 2-euro coin in one hand for approximately 2 s and then closes his hands. Subjects are asked to close their eyes and count aloud backward from 10 to 1, then point to the examiner's hand where the coin is held. The task must be repeated for 10 trials with the sequence R L L R R L R L R L, where R stands for right and L for left [22]. This forced-choice paradigm test also allows for scoring the chance level, that is, the one expected from random responding [19]. Scoring below the chance level is so low that blind guessing would have resulted in a better score, and it is considered a meaningful metric to suggest feigning.

The REY is a non-forced choice recognition memory performance two-sessions test. The first session is the "recall trial," in which a sheet with 15 items (including letters, numbers, and figures) arranged in five rows is shown for approximately 15 s [20]. Subjects are then given a blank sheet where they should reproduce previously seen items. In the second session, called the "recognition phase," they are asked to circle the items previously seen on a sheet of 30 different figures with letters and numbers. The final performance is scored as follows: the number of correct recalled items + (correct recognition items − false positive) [20, 23].

Finally, given the nature of FMD, we chose the FTT, because it requires a motor task. The FTT is a non-forced choice test that assesses randomly, unrealistically slow, or erroneous responses, highlighting inconsistency of response patterns compared to the performance in well-documented neurological disorders. On the FTT, participants are asked to place both hands on the computer keyboard and tap one key (key B of a qwerty keyboard) as often as possible with the index finger until the examiner stops them [21]. Participants undergo five consecutive trials, each lasting 10 s, with the dominant and then with the other hand. A 10-s rest break is given after each trial, and a 30-s break after each third trial. The score consists of the total number of presses in a given time (10 s), and the final performance is as follows: FTT score = dominant hand average score + nondominant hand average score.

Whereas FMD patients and the healthy control group were asked to complete the test to the best of their ability without further specific instructions, subjects in the healthy simulator group were deliberately asked to deceive [24]. Healthy simulators were explicitly told: "I'd like you to play a role. You have been involved in a car accident during which you reported a serious head trauma; you lost consciousness for some minutes and have been hospitalized for some days. Six months afterward, you still suffer from headaches, irritability, difficulty remembering things, staying focused for more than a few seconds, and your mood is always low. It is difficult for you to remember what you read. Your insurance company asks you to undergo a medical examination. Be aware that the more you appear compromised, the higher the probability of receiving the compensation you deserve. So, it is in your interest that the doctor understands that your symptoms are serious."

Statistical analysis

Statistical analyses were performed through SPSS 24 software for Mac. Data were summarized as mean and SD. A one-way analysis of variance test was used to compare the performance on the PVTs with "group" as a between-subject factor. Post hoc analyses for multiple comparisons were also performed. The significance level was set at $p \le 0.05$, and the Bonferroni correction was applied for multiple comparisons.

In the absence of an absolute reference cutoff score for the three PVTs, we first computed cutoffs based on the performance of the healthy control group. We employed a criterion cutoff point using the formula "mean − (2 × SD)." Scores lower than these cutoffs were used to classify subjects as having failed the test. To assess the performance of each group on the combination of the three tests, we used the criterion of passing at least two of three tests (percentage of participants who scored above cutoffs in at least two tests).

RESULTS

We enrolled 29 FMD patients (23 females, median age = 43 years, interquartile range [IQR] = 18–62; median years of education = 13, IQR = 10–18), 29 healthy simulators (22 females, median age = 44 years, IQR = 28–68; median years of education = 13, IQR = 13–19), and 29 healthy controls (23 females, median age = 43 years, IQR = 20–60; median years of education = 13, IQR = 8–20). FMD patients had a mean disease duration of 4.6 (±3.6) years and predominant clinical phenotypes of functional weakness (72%, $n = 21$), tremor (48%, $n = 14$), and dystonia (45%, $n = 13$).

Three FMD patients did not complete the FTT due to physical limitations; one reported both hands being too weak to perform the test, one suffered from paresis of the left hand, and one presented worsening motor symptoms while performing the test. Most participants were right-handed (23 right-handed FMD; 28 right-handed healthy simulators; 25 right-handed healthy controls). Frequency of failure and "fail" cutoff scores based on the healthy control group performance (CIH = 9, REY = 20, FTT = 62) are reported in Table 1. Mean (and SD) scores of performances of the three groups and group comparisons are reported in Table 2.

Patients with FMD had a failure frequency of 10% on the CIH test (3/29), 7% (2/29) on the REY test, and 15% (4/26) on the FTT

TABLE 1 Rate of failure on each performance validity test and frequency of passing the combination of tests

	Cutoff for failure[a]	FMD, $n = 29$[b]	HS, $n = 29$	HC, $n = 29$
Coin in the Hand Test	<9	10% ($n = 3$)	93% ($n = 27$)	0%
Rey 15-Item Test	<20	7% ($n = 2$)	72% ($n = 21$)	0%
Finger Tapping Test	<62	15% ($n = 4$)	86% ($n = 25$)	0%
Above cutoff in 2/3 tests		93% ($n = 27$)	7% ($n = 2$)	100% ($n = 29$)

Abbreviations: FMD, functional motor disorders; HC, healthy controls; HS, healthy simulators.
[a]Cutoff calculated on our HC group performance as mean − 2 SD.
[b]$n = 26$ for Finger Tapping Test.

TABLE 2 Performance scores and group comparisons on the PVTs

	Performance score mean ± SD	Three-group comparison, one-way ANOVA	Two-group comparison, FMD vs. HS, *p*	Two-group comparison, FMD vs. HC, *p*	Two-group comparison, HS vs. HC (*p*)
Coin in the Hand Test	FMD: 9.4 ± 1.4 HS: 4.5 ± 2.6 HC: 9.9 ± 0.3	F (2.86) = 87.4 $p < 0.001$[a]	<0.001[a]	0.860	<0.001[a]
Rey 15-Item Test	FMD: 26.4 ± 4.3 HS: 13.9 ± 5.9 HC: 26.5 ± 3.5	F (2.86) = 68.5 $p < 0.001$[a]	<0.001[a]	1.00	<0.001[a]
Finger Tapping Test	FMD: 90.7 ± 29 HS: 33.8 ± 21.5 HC: 100.6 ± 19.3	F (2.83) = 67.8 $p < 0.001$[a]	<0.001[a]	0.367	<0.001[a]

Note: Mean and SD of the performance scores on the PVTs with the relative *p*-value for the comparison between the groups.

Abbreviations: ANOVA, analysis of variance; FMD, functional motor disorder; HC, healthy controls; HS, healthy simulators; PVT, performance validity test.

[a]Statistically significant.

(of note, three patients did not complete the FTT due to physical problems, as specified above). One patient (3%), no healthy controls, and 12 (41%) healthy simulators scored below chance on the CIH, a forced-choice test. When comparing the groups, as shown in Table 2, FMD patients' performance on the CIH, REY, and FTT was statistically different from that of the healthy simulator group (all $p < 0.001$), whereas it did not significantly differ from that of the healthy control group (CIH, $p = 0.860$; REY, $p = 1.00$; FTT, $p = 0.367$; Table 2, Figure 1). Also, between the healthy simulator and the healthy control groups, we found significantly different performance in all three tests (all $p < 0.001$; Table 2, Figure 1). Considering the three tests together, according to the criterion of passing at least two tests, overall, 93% of patients, 7% of healthy simulators, and 100% of healthy controls passed the tests.

DISCUSSION

In this study, we aimed to assess whether FMD patients exhibit abnormal performance on a battery of three tests that are typically used to evaluate validity of performance in comparison to a group of healthy simulators and a group of healthy controls matched for age, sex, and educational level. Hence, we wanted to investigate whether nonlitigant, non-compensation-seeking FMD patients have performances that could raise suspicion of poor effort or symptom exaggeration, according to a proposed algorithm of three tests. We found that FMD patients generally performed well on PVTs, with a low rate of failure of 10% on the CIH, 7% on the REY, and a slightly higher rate of failure (15%) on the FTT, which involves a motor task. FMD patients' performance was statistically different from that of healthy simulators but not from healthy controls. Conversely, healthy simulators scored clearly under the cutoffs, confirming that they correctly followed the instructions for simulating cognitive malingering. Of note, the performance of healthy simulators was statistically different from that of FMD and healthy controls in each test. We also found that most FMD patients passed a combination of the three tests. Ninety-three percent of patients passed at least two tests of three.

To the best of our knowledge, this is the first study that has specifically tested PVTs in nonlitigant, non-compensation-seeking FMD patients. Our results expand the existing evidence of functional patients showing low failure rates on PVTs [12, 13], which aligns with their reasonably expected performance capacity and with the nature of functional symptoms that are not intentionally feigned or exaggerated [6, 25]. Moreover, our results support previous attempts to demonstrate the value of PVTs in assessing FMD patients [12–14]. Kemp et al. found that patients with medically unexplained symptoms and somatoform disorders had a low rate of test failure of cognitive PVTs (only 11%) in a sample of 43 patients [13]. Additionally, they found that patients performed differently compared to two groups of "mild" and "strong" cognitive impairment simulators. In keeping with these results, Věchetová et al. reported a 10% failure rate of PVTs in 30 FMD patients undergoing neuropsychological

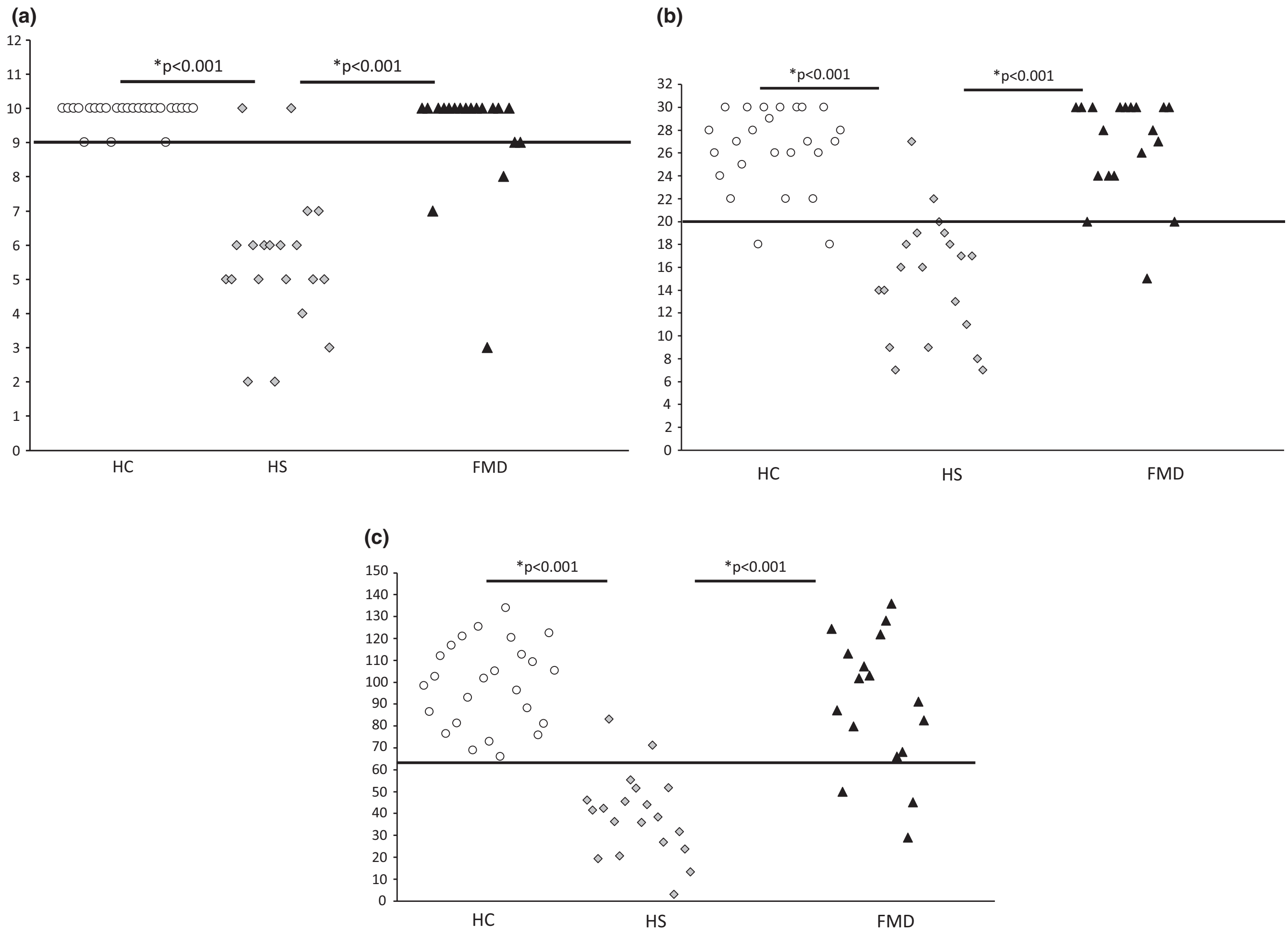

FIGURE 1 Healthy controls (HC), healthy simulators (HS), and functional motor patients (FMD). Continuous line: cutoff calculated as mean − 2 SD; $^*p < 0.001$. (a) Scatter plot of performance of the three groups on the Coin in the Hand Test. (b) Scatter plot of performance of the three groups on the Rey 15-Item Test. (c) Scatter plot of performance of the three groups on the Finger Tapping Test.

assessment [12]. Similarly, our sample showed a frequency of failure ranging from 7% to 15%, with the highest proportion of patients failing on the FTT, a measure of motor effort. Given the nature of FMD, our study's proposed test battery integrates effort-related measures for both motor and cognitive domains. FMD patients often show a complex phenomenology, including motor and nonmotor symptoms (including cognitive complaints) that are considered to rely on the same pathophysiological mechanisms. Conversely, another study by Heintz and collaborators found that patients with psychogenic myoclonus exhibited worse performance on a cognitive PVT than patients with Gilles de la Tourette syndrome, who served as a patient control group, and healthy control subjects [14]. However, some of the patients in their sample were involved in lawsuits or other financial compensation matters. The authors could not exclude the possibility that this accounted for their failure on PVTs. Additionally, they employed only one test to detect noncredible performance, whereas using at least two tests is soundly recommended in the literature [14].

Cochrane et al. demonstrated that participants who are asked to simulate make errors on the CIH test compared to patients with memory disorders, who do not make errors [26]. In our study, the median of the performance on the PVTs of the healthy simulator group was lower than that of the healthy control and FMD groups, confirming the higher number of errors made by the healthy simulator group.

Importantly, given the lack of published reference cutoffs, we calculated novel cutoffs based on the performance of our sample of healthy controls. In previous reports, the CIH test has demonstrated high sensitivity (86%) in distinguishing simulators from healthy nonsimulators and brain-injured patients with a cutoff of <8.5 [22] and even higher employing a cutoff of <9 to identify 95% of volunteers asked to feign memory problems [27]. Our results were based on a similar cutoff of 9. Similarly, the REY is a fast and easy-to-administer PVT used in clinical settings. It has shown excellent specificity (92%) and good sensitivity (71%) when used to differentiate patients with a suspect effort from neurological patients, learning-disabled students, and controls using a cutoff of <20 [20]. We found the same cutoff score of <20 based on our controls' performance. The FTT has been previously used to differentiate simulators from head-injured patients [28]. In our study, we found a cutoff score of <62, which has been previously employed to distinguish people meeting the criteria for definite malingering neuropsychological dysfunction from individuals with a history of moderate to severe brain injury [28]. Similar scores were obtained in other studies evaluating FTT, confirming our results [21].

This study presents some limitations. First, instead of assessing real simulating patients, we asked healthy subjects to simulate. It is an issue in nearly all studies on willful exaggeration that it is hard to find a gold standard for malingering, especially in relation to functional motor disorders. It could be that our healthy simulators were performing much worse than practiced simulators would do in real life. Second, the lack of comparison to another clinically relevant group might preclude conclusions on the diagnostic utility of the battery of PVTs used in this study, and the use of novel cutoff scores calculated on the performance of our groups of healthy controls could limit the generalizability of results. However, our cutoffs are comparable to those reported in previous studies [20, 21, 28]. Moreover, although a motor task could be expected to be altered in FMD, testing performance across multiple domains is warranted, as FMD is commonly affected by cognitive symptoms. Nevertheless, we excluded patients with cognitive decline or prominent arm weakness. Additionally, when instructed to feign cognitive impairment, all healthy simulators scored below cutoffs for FTT, suggesting that it is a test that may be more generally applicable to performance. Finally, it could be argued that excluding patients with cognitive impairment could represent a selection bias. However, even in the presence of poor cognition, performance on a PVT is not impaired.

These limitations notwithstanding, our study indicates that FMD patients do not exhibit abnormal performance on PVTs and supports the hypothesis that poor effort is not common in nonlitigant, non-compensation-seeking functional patients. These findings also suggest that the proposed battery of PVTs has some use as an adjunctive tool in studying performance validity in FMD patients. This simple battery of three PVTs may yield a reliable tool that should be employed routinely in neuropsychological testing of FMD, thus being of practical utility in evaluating patients. Failure rates of these and other PVTs among FMD patients involved in litigation and disability claims compared to nonlitigant FMD patients would be of interest, as well as a greater emphasis on below-chance performance that more accurately determines the presence of willful exaggeration.

AUTHOR CONTRIBUTIONS

Ilaria A. Di Vico: Supervision, writing–original draft, data curation, formal analysis. **Jon Stone:** writing–review & editing, supervision. **Laura Mcwhirter:** Supervision, writing–review & editing. **Marianna Riello:** Formal analysis, data curation, investigation, writing–original draft. **Maria Elisabetta Zanolin:** Data curation, formal analysis. **Michela Colombari:** Investigation, data curation. **Mirta Fiorio:** Conceptualization, methodology, supervision, writing–review & editing. **Michele Tinazzi:** Conceptualization, supervision, writing–review & editing, methodology, formal analysis.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available on request to the authors.

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