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VALIDATION OF THE HAMOCODI MEASURING SYSTEM FOR WRIST FINE MOTOR ASSESSMENT

VALIDACIJA HAMOCODI MJERNOG SUSTAVA ZA PROCJENU FINE MOTORIKE ŠAKE

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ABSTRACT

Proper neuromuscular function of the wrist joint is essential for a wide range of daily and sports activities. However, many existing assessment tests rely primarily on strength measures or subjective evaluations. The aim of this study was to examine the metric properties and validate the *HAMOCODI* measurement system for the assessment of fine motor function of the hand. A total of 96 students (32 females, 64 males; age 23,98 ± 4,01 years) from the Faculty of Kinesiology in Zagreb participated in the study. The research was conducted at the Faculty of Kinesiology in Zagreb, with prior approval from the institutional Ethics Committee. Measurements were performed using the *HAMOCODI* system through tests of Force tracking and Position tracking at the wrist joint. The *9-Hole Peg Test* was used as the reference standard. Normality of data distribution was confirmed using the Kolmogorov-Smirnov test. Correlation analysis did not reveal a significant association with the reference test, and the obtained low and negative values suggest that the tests assess different dimensions of wrist function. While successful performance of the 9-Hole Peg Test requires a precise fingertip pincer grip, the HAMOCODI system measures movement and force control in the wrist joint. High reliability in both tests was established using internal consistency methods, with Cronbach's alpha and the Kaiser–Caffrey coefficient calculated. Test homogeneity was assessed through correlations between three consecutive trials, indicating satisfactory item homogeneity. The HAMOCODI measurement system proved to be a reliable instrument for assessing specific components of wrist joint function, but not a valid one in relation to the reference

SAŽETAK

Pravilna živčano-mišićna funkcija zgloba šake značajna je u velikom broju svakodnevnih i sportskih aktivnosti. Međutim, velik broj postojećih testova za njezinu procjenu oslanja se isključivo na dimenziju jakosti ili na subjektivne pokazatelje. Cilj ovog rada bio je ispitati metrijske karakteristike i validirati *HAMOCODI* mjerni sustav za procjenu fine motorike šake. U istraživanju je sudjelovalo 96 studenata Kineziološkog fakulteta u Zagrebu (32 žena, 64 muškaraca; dobi 23,98 ± 4,01 godina). Istraživanje je provedeno na Kineziološkom fakultetu u Zagrebu, uz prethodno dobiveno etičko odobrenje Povjerenstva za znanstveni rad i etiku. Mjerenja su provedena na *HAMOCODI* sustavu kroz testove precizne modulacije sile i precizne modulacije pokreta u zglobu šake. Kao referentni standard korišten je *9-hole peg test*. Normalnost distribucije potvrđena je Kolmogorov-Smirnovljevim testom. Korelacijskom analizom nije utvrđena značajna povezanost s referentnim testom, a dobivene niske i negativne vrijednosti ukazuju na to da testovi procjenjuju različite dimenzije funkcije šake. Dok je za uredno ispunjenje zadatka u *9-hole peg* testu potreban precizan pincetni hvat na razini prstiju, sa HAMOCODI sustavom mjeri se kontrola pokreta i sile u zglobu šake. Visoka pouzdanost u oba testa utvrđena je metodom interne konzistencije izračunom Cronbachovog i Kaiser-Caffreyevog koeficijenta. Homogenost testova procijenjena je korelacijom između tri uzastopna ponavljanja, pri čemu je utvrđena zadovoljavajuća homogenost čestica. *HAMOCODI* mjerni sustav pokazao se kao pouzdan instrument za procjenu specifičnih komponenti funkcije zgloba šake, no ne i kao validan u odnosu na referentni standard *9-hole peg* standard, the 9-Hole Peg Test, suggesting that the two tests measure different dimensions of fine motor skills, each at a satisfactory level.

Keywords: *wrist function, movement coordination, force control, performance accuracy, motion control*

test, sugerirajući na različite dimenzije fine motorike, koje svaki test zasebno mjeri na zadovoljavajućoj razini.

Ključne riječi: *funkcija šake, koordinacija pokreta, kontrola sile, preciznost izvedbe, kontrola pokreta*

INTRODUCTION

The wrist joint, as an anatomical structure involved in a wide range of daily activities, is susceptible to various traumatic injuries and degenerative changes due to its functional complexity[6]. Although more than 15 muscles cross the wrist, only 6 of them are sufficient to perform all wrist joint movements[2], indicating a well-organized and highly coordinated motor system. A better understanding of the function of the muscles responsible for controlling wrist joint movements can be achieved through the implementation of specific motor control assessment tests. Given the important functional role of the hand in everyday life, it is particularly important to investigate the ability to precisely modulate force and movement at the level of the wrist joint. In this context, proper neuromuscular function of the wrist joint is essential for the performance of numerous daily and task-specific activities across all stages of life. In older adults, deterioration of muscle function in the hand region reduces quality of life and independence[12]. This is due to the loss of muscle mass, strength, and coordination, as well as reduced sensation in the palmar region and degeneration of the central nervous system[12]. Over time, these impairments may accumulate and significantly compromise movement control at the wrist joint, while a limited range of motion further impairs the performance of simple everyday tasks such as opening a can, answering the telephone, or unlocking a door[1]. Pain in the wrist joint area considerably reduces wrist mobility and function and occurs more frequently in physically active individuals, particularly manual laborers and athletes, compared with less active individuals[7]. Among athletes, 3% to 9% of all sports injuries involve the hand and wrist[10]. Given the aforementioned importance of wrist joint functionality in everyday life, its comprehensive assessment requires the measurement of various aspects, such as sensation, motor function, pain, and discomfort[14]. Contemporary clinical methods rely on subjective evaluations and are therefore insufficiently sensitive to detect subtle changes associated with impairments[17]. Although subjective hand function tests demonstrate good validity, reliability, and sensitivity[16], strength and movement control are significantly associated with overall hand function[15], highlighting the need for further improvement of instruments used to assess performance quality. Accordingly, studies investigating force control in post-stroke rehabilitation[13], as well as motor learning and performance enhancement[11], have utilized the principle of hand grip and its modulation. However, objective assessments of movement control remain rare and often require inaccessible technology, while a comprehensive evaluation of fine motor skills cannot rely on a single dimension due to differences in the demands of precise tasks, such as drawing and shape tracing[3]. Given the lack of existing tests for assessing precise modulation of force and movement at the wrist joint, the *HAMOCODI* measuring system (Hand Motor Control Diagnostic system) could provide an additional tool for investigating wrist joint function, without relying exclusively on the subject's subjective perception or maximal force production, but rather through the presentation of objective data on more subtle dimensions of movement control.

In this context, the aim of the present study is to validate the HAMOCODI system for the assessment of neuromuscular hand function, specifically the ability to precisely modulate force and movement at the wrist joint.

PARTICIPANTS AND METHODS

The study included a convenience sample of 96 students from the Faculty of Kinesiology, University of Zagreb, consisting of 32 females and 64 males students, age 23,98 ± 4,01 years. The sample included only participants with a dominant right hand. The exclusion criterion for participation in the study was the presence of pain or injury in the hand, arm, or shoulder region of the dominant side.

Organization of Measurements

The study was conducted in the Kinesiotherapy Laboratory at the Faculty of Kinesiology in Zagreb, with ethical approval granted by the Faculty's Committee for Scientific Research and Ethics (34/2024). Prior to participation, all participants were informed about the aims and methods of the study and provided written informed consent for participation.

Protocol Description

The protocol consisted of two main assessments: the 9-Hole Peg Test (9HPT), used as a reference test with established factorial validity, and tests performed using the HAMOCODI system. The estimated duration of the measurement protocol for each participant was 15 minutes. During the assessments, only the participant and the examiner were present in the room, preventing observation of task performance by other participants. Prior to testing, basic personal data were collected from each participant, including name, age and sex. The 9HPT was administered according to the official test administration guidelines[8], using the dominant hand.

HAMOCODI Measurement System

HAMOCODI is a measurement system designed for the assessment of neuromuscular function of the hand and fingers (Figure 1). It enables precise measurement of numerous indicators of hand neuromuscular function in participants of different ages, health statuses, and training levels. The apparatus can be adjusted to different hand sizes and is suitable for both laboratory and field measurements. HAMOCODI enables the assessment of maximal and explosive strength of the hand flexor and extensor muscles, as well as finger flexors, precise modulation of submaximal force in the wrist and finger joints, and precise modulation of movement in the wrist joint.

The tests begin with adjustment of the apparatus to the participant's forearm in order to avoid discomfort and ensure proper support during test performance. Preparation is completed when the forearm is correctly positioned and the center of the palm rests on the pads located on the side walls. Before each measurement, the HAMOCODI software performs calibration to prevent unintentional influence on the apparatus sensors caused by accidental pressure during the resting phase.

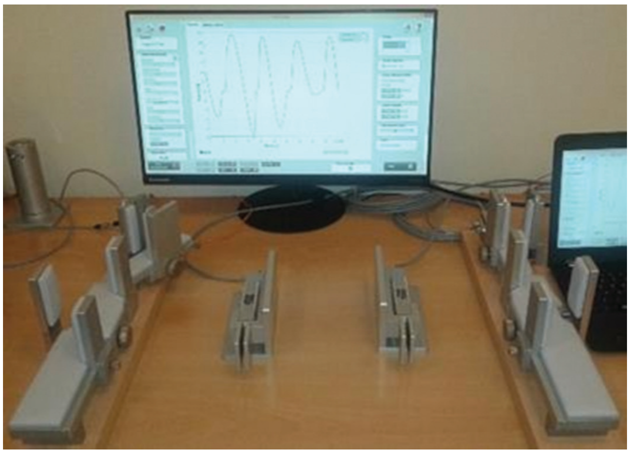

Figure 1. HAMOCODI measuring system
Slika 1. HAMOCODI mjerni sustav

In this study, the following tests were administered in the given order: (a) precise modulation of submaximal force in the wrist joint (FTR – force tracking), and (b) precise modulation of movement in the wrist joint (PTR). Prior to the official testing, measurements of maximal strength of the wrist flexor muscles (MVCF), as well as the maximal range of motion in wrist flexion (ROM-FL) and extension (ROM-EX), were obtained in order to enable individual adjustment of relative force and range of motion for each participant.

Force tracking test of precise submaximal force modulation at the wrist joint (FTR test)

Precise submaximal force modulation was assessed using a FTR test involving the reproduction of a randomly generated curve through fine force modulation via a dynamometer. Participants were instructed to control a cursor on a computer screen for 40 seconds by applying varying levels of pressure on the dynamometer, thereby tracking the presented target curve. The curve amplitude ranged from 10% to 60% of the values obtained during the MVCF test. The test was performed three times, following one familiarization trial, with a 60-second rest interval between repetitions.

Position tracking test of precise movement modulation at the wrist Joint (PTR test)

Precise movement modulation was assessed using a position-tracking task involving the reproduction of a randomly generated curve through wrist flexion and extension movements. Participants were instructed to control a cursor on a computer screen for 40 seconds by performing wrist flexion and extension movements in order to track the target curve. The target amplitude ranged from 60% of ROM-FL (portion of the curve above zero) to 60% of ROM-EX (portion below zero). These reference values were determined based on the highest of three results obtained in the range of motion (ROM) test, with 0 representing the neutral wrist position. The task was performed three times, following one familiarization trial, with a 60-second rest interval between repetitions.

RESULTS

Descriptive statistics

Descriptive statistics of the measured variables are presented in Table 2. For each variable, the Kolmogorov-Smirnov (K-S) test of normality was also performed, which showed that the obtained distribution of results did not significantly differ from the theoretical normal distribution.

The mean values for all observed variables and all measurement trials are presented in Table 3.

Table 1. Variables from the FTR and PTR tests used in data analysis
Tablica 1. Varijable iz testova FTR i PTR korištene u analizi

Variable	Unit of measurement	Variable description
Mean Absolute Error (MAE)	Newtons (N) in the force modulation test; degrees (°) in the movement modulation test	Mean absolute deviation from the target curve
Standard Deviation of Absolute Error (SDE)	Newtons (N) in the force modulation test; degrees (°) in the movement modulation test	Standard deviation calculated from deviations from the target curve
Root mean square error (RMSE)	Newtons (N) in the force modulation test; degrees (°) in the movement modulation test	Root mean square error from the target curve
Area (A)	(N*s) in the force modulation test; (°*s) in the movement modulation test	Area between the obtained and target curves calculated as the integral of the absolute differences between the two curves
Normalized Performance Error (NPE)	Percent (%)	Quality of performance relative to the target curve (a score of 100 represents the mean deviation of the maximal amplitude)
Weighted Normalized Error (WNE)	Percent (%)	In calculating performance quality, this variable assigns greater weight to deviations further from the target curve and lower weight to those closer to it
Time above/below the curve (TA/TB)	Percent (%)	Proportion of time the obtained curve spends above/ below the target curve

Table 2. Descriptive statistics of the measured variables
Tablica 2. Deskriptivna statistika mjerenih varijabli

Test	Variable	Mean	MIN	MAX	RAN	SD	SKEW	KURT	K-S
9HPT	t (s)	17,06	11,93	24,01	12,08	2,12	0,61	1,29	0,09
MVCF	MVC (Nm)	93,86	35,47	156,70	121,2	28,45	0,19	-0,85	0,08
ROM	ROM-FL (°)	80,18	55,43	93,47	38,03	8,40	-1,02	0,44	0,12
	ROM-EX (°)	69,06	27,13	84,33	57,20	9,55	-1,08	2,71	0,07
FTR	MAE (Nm)	10,85	4,14	23,13	18,99	3,93	0,86	0,63	0,10
	SDE (Nm)	8,79	3,31	17,97	14,65	3,13	0,65	0,05	0,08
	RMSE (Nm)	13,98	5,65	29,30	23,65	5,00	0,77	0,39	0,10
	A (Nm*s)	436,3	166,70	931,00	764,30	158,00	0,86	0,64	0,10
	NPE (%)	0,20	0,10	0,34	0,25	0,04	0,63	1,07	0,08
	WNE (%)	0,08	0,01	0,27	0,26	0,04	1,76	4,69	0,13
	TA (%)	0,46	0,33	0,61	0,28	0,06	0,12	-0,07	0,05
	TB (%)	0,54	0,39	0,67	0,28	0,06	-0,12	-0,07	0,05
PTR	MAE (°)	9,92	5,54	20,70	15,16	2,47	0,98	2,52	0,08
	SDE (°)	7,70	4,32	15,50	11,18	1,84	1,08	2,59	0,08
	RMSE (°)	12,58	7,09	25,90	18,81	3,05	1,02	2,69	0,09
	A (°*s)	398,90	222,7	833,00	610,30	99,40	0,98	2,54	0,09
	NPE (%)	0,13	0,07	0,25	0,18	0,03	1,19	3,62	0,07
	WNE (%)	0,08	0,02	0,20	0,18	0,04	0,86	0,34	0,11
	TA (%)	0,36	0,25	0,59	0,34	0,06	0,91	1,09	0,11
	TB (%)	0,64	0,41	0,75	0,34	0,06	-0,91	1,09	0,11

Legend: 9HPT - 9-Hole Peg Test; MVCF - maximal strength of the wrist flexor muscles; ROM - range of motion; FTR – force tracking; PTR – position tracking; t – time; MVC – maximal voluntary contraction; FL – flexion; EX – extension; RAN – range; the remaining variables and their abbreviations are presented in Table 1.

Table 3. Mean values of all participants' measurements across three trials for all observed variables
Tablica 3. Srednje vrijednosti promatranih varijabli svih mjerenja sudionika

Test	trial	MAE	SDE	RMSE	A	NPE	WNE	TA	TB
FTR	1.	11,85	9,91	15,47	476,50	0,22	0,10	0,48	0,52
	2.	10,63	8,43	13,57	427,00	0,20	0,08	0,46	0,54
	3.	10,08	8,01	12,89	405,30	0,18	0,07	0,44	0,56
PTR	1.	11,14	8,74	14,18	448,00	0,14	0,10	0,36	0,64
	2.	9,63	7,31	12,10	387,10	0,12	0,07	0,36	0,64
	3.	9,00	7,05	11,44	361,5	0,11	0,06	0,36	0,64

Legend: FTR – force tracking; PTR – position tracking; the remaining variables and their abbreviations are presented in Table 1.

Validity and reliability

Validity was assessed using correlation analysis between results obtained with the HAMOCODI system and those achieved in the 9HPT (Table 4). Correlation coefficients ranging from -0.13 to 0.25 indicate negligible or very low associations between almost all variables and the 9HPT.

Test reliability was determined using the internal consistency method. Cronbach's alpha (Cronbach's α) and the Kaiser-Caffrey reliability coefficient (αKaiser-Caffrey) were calculated. The results indicate generally high levels of reliability of the HAMOCODI system. In the force modulation test, Cronbach's alpha values ranged from 0.79 to 0.95, while in the movement modulation test the same values ranged from 0.76 to 0.92. Similar results were obtained using the αKaiser-Caffrey calculation. Table 5 shows the highest reliability levels in both tests for the MAE and A variables, while the WNE variable showed the lowest reliability.

Table 4. Correlation coefficients (r) between HAMOCODI test results and 9HPT outcomes
Tablica 4. Koeficijenti korelacije (r) između rezultata testova HAMOCODI i 9HPT

Variable	FTR/9HPT	PTR/9HPT
MAE	0,22	-0,13
SDE	0,25	-0,11
RMSE	0,23	-0,12
A	0,22	-0,13
NPE	-0,02	-0,07
WNE	-0,02	-0,07
TA	-0,11	-0,03
TB	0,11	0,03

Legend: FTR – force tracking; PTR – position tracking; 9HPT – 9-Hole Peg Test; the remaining variables and their abbreviations are presented in Table 1.

Homogeneity

Homogeneity was assessed by analyzing results across three measurement trials and calculating the average inter-trial correlation coefficient of the measurement instrument. The mean correlation coefficients for all observed variables are presented in Table 6. Higher homogeneity of measurement trials was observed in the FTR test (0.81-0.87) compared to the PTR test (0.55-0.80).

DISCUSSION

Validity of the HAMOCODI measuring system tests

The results of the correlation analysis between the HAMOCODI and 9HPT tests suggest that they do not assess the same underlying motor abilities, as indicated by the low associations between their outcomes. Accordingly, HAMOCODI appears to measure aspects of motor performance that are not directly comparable to those captured by the 9HPT. Although the 9HPT is the most commonly used and clinically standardized test of hand function, it assesses motor control through finger and hand coordination, including hand stability and pinch grip[8]. On the other hand, the majority of measures used in the HAMOCODI system assess wrist function without involving the fingers. While the 9HPT requires coordination of a large number of muscles of the upper limb and shoulder girdle, the HAMOCODI tests isolate the wrist joint and the muscles responsible for producing force and movement at this joint. It can therefore be assumed that the difference in task complexity is the main reason for the obtained results. From the perspective of the measurement properties of the variables derived from the HAMOCODI tests, the results suggest that these new tests assess a different dimension of wrist motor control compared to the 9HPT. From a practical perspective, this highlights the need to assess motor control across multiple tasks in order to capture the complex

Table 5. Cronbach's and Kaiser-Caffrey reliability coefficients for all measured variables in the FTR and PTR tests
Tablica 5. Cronbachov i Kaiser-Caffreyjev koeficijent pouzdanosti za sve izmjerene varijable u FTR i PTR testovima

Test	coef.	MAE	SDE	RMSE	A	NPE	WNE	TA/TB
FTR	Cronbachov α	0,950	0,928	0,946	0,952	0,858	0,794	0,816
	αKaiser-Caffrey	0,952	0,929	0,947	0,952	0,859	0,796	0,826
PTR	Cronbachov α	0,920	0,830	0,899	0,920	0,867	0,761	0,784
	αKaiser-Caffrey	0,925	0,842	0,906	0,926	0,876	0,826	0,788

Legend: FTR – force tracking; PTR – position tracking; coef – coefficient; the remaining variables and their abbreviations are presented in Table 1.

Table 6. Mean correlation coefficients across all measurement trials
Tablica 6. Srednji koeficijenti korelacije u svim mjernim pokušajima

Test	MAE	SDE	RMSE	A	NPE	WNE	TA/TB
FTR	0,87	0,81	0,86	0,87	0,67	0,56	0,61
PTR	0,80	0,64	0,76	0,80	0,70	0,61	0,55

Legend: FTR – force tracking; PTR – position tracking; the remaining variables and their abbreviations are presented in Table 1.

function of the wrist joint, whose biomechanics involve a large range of motion together with the simultaneous transfer and distribution of load from the palm to the forearm[6]. Although the results did not confirm validity, they were not entirely unexpected. While both instruments to some extent assess hand function, the 9HPT is focused on fine motor control of the fingers, with an emphasis on pinch grip[4], whereas HAMOCODI, through the tests used in this study, primarily assesses wrist joint function without involving the fingers. HAMOCODI involves movement at the wrist joint with the palm fixed, whereas the 9HPT requires precise coordination of the fingers and hand. One of the limitations of this study is the choice of the validation instrument, given that HAMOCODI is a novel measurement tool and there is no directly comparable gold standard test. When individual variables in the force and movement modulation tests are considered, none show a significant correlation with the 9HPT, and most correlations are negative, which is not expected if better motor control contributes to performance across all tests. Therefore, the selected validation test did not prove optimal for validating the HAMOCODI system, with the results suggesting that the instruments assess different dimensions of hand function. The findings do not indicate a lack of validity, but rather highlight the need for further validation using a test that more reliably measures the same dimensions of hand function.

Reliability of the HAMOCODI measurement system tests

Using the internal consistency method, very high reliability of the FTR variables was observed. Variables expressed in absolute values showed higher internal consistency, whereas variables based on percentages and ratios demonstrated lower internal consistency. The PTR test showed lower reliability across almost the entire set of variables compared to the other tests, with consistent differences between variables. As expected, the highest reliability was observed for MAE and A, given that they measure the same dimension of performance (absolute deviation from the target curve). Among the variables expressed in relative form, the highest reliability was observed for NPE, which assesses mean deviation from the curve on a scale up to 100. These variables demonstrate a satisfactory level of reliability. The gradual improvement in results across trials and variables, as shown in Table 3, raises the question of whether the reliability of the measurement instrument could be further improved by increasing the number of trials. Although the effect of motor learning would likely diminish with a greater number of repetitions, the contribution of fatigue could simultaneously increase, particularly in the FTR test, where precise force modulation is required over multiple trials[18]. Task familiarization effects observed in repeated testing may also influence the pattern of reliability across trials[19]. Although there is still room for further investigation of the instrument's reliability, most variables already demonstrate a satisfactory level of reliability, with MAE and A standing out as the most reliable in both tests.

Homogeneity of the HAMOCODI measurement system tests

The homogeneity of the tests, assessed through correlations between repetitions, indicates that the trials in the FTR test measure the same motor ability, with a high average correlation observed for variables expressed in absolute values. Higher correlations between consecutive repetitions compared to the comparison between the first and third measurements may indicate gradual adaptation to the conditions and demands of a task requiring precise force control, as well as a gradual accumulation of fatigue during performance (Table 3). It is assumed that with a greater number of repetitions, differences between adjacent trials would decrease, while differences between early and later measurements might increase due to task familiarization effects[19]. It should also be noted that the force modulation task within the range of 10 to 60% MVCF may be influenced by fatigue, and that the use of a greater number of trials could lead to a renewed decline in performance in later trials as a result of fatigue[18]. Other variables, expressed as percentages or ratios, generally show moderate to high correlations.

A similar trend was observed in the PTR test, with correlations between trials varying depending on the variable. Such findings may be explained by the fact that the PTR test requires initial adaptation and learning, particularly due to its different characteristics and the additional movement component compared to the previous test. The first trial may be interpreted as a familiarization phase with the task, whereas later trials are more likely to reflect true performance. It is assumed that with a greater number of repetitions, results would stabilize with a reduced learning effect, while the influence of fatigue would be relatively smaller than in the FTR test. These findings indicate the need for further research with a larger number of trials in order to determine the optimal number of repetitions that ensures measurement of the targeted ability rather than task learning effects. A performance improvement trend is evident across almost all measurement trials, with the PTR test reaching "optimal" performance more quickly. In the case of the FTR test, given that prolonged isometric contraction impairs performance in tracking tasks, the occurrence of fatigue toward the end of trials may have a significant negative impact on the results[9]. Since muscular fatigue develops relatively quickly during physical activity and reduces maximal force production[5], it is difficult to eliminate completely; however, it could be mitigated by adjusting the duration of work intervals or rest periods between trials. In the context of fatigue in the FTR test, future research could monitor the dynamics of fatigue development or examine whether its influence can be reduced by prolonging rest intervals between trials. Although increasing the number of trials or extending rest periods would lengthen the overall testing duration, such an approach could contribute to more reliable results. The findings suggest a possible difference in the level of familiarization between PTR and FTR tasks, with FTR requiring control and adaptation against external resistance. Finally, regarding the homogeneity of variables derived from the HAMOCODI system tests, the most homogeneous variables in the PTR test were MAE, SDE, RMSE, and A, whereas in the FTR test the most homogeneous variables were MAE and A.

The main strengths of the study include a large and relatively homogeneous sample of participants, as well as a simple and repeatable measurement protocol conducted under low-cost and controlled conditions. Methodological variability was reduced by ensuring that all measurements were performed by the same examiner. A limitation of the study is the lack of a fully appropriate validation test for the HAMOCODI system, as the 9HPT does not assess the same motor abilities. It is also necessary to further consider the effects of motor learning and fatigue, and potentially increase the number of trials to obtain more precise estimates.

CONCLUSION

The aim of this study was to determine the reliability and validity of the HAMOCODI measurement instrument. Validity in relation to the 9HPT was not confirmed, with results indicating that the instruments do not assess the same motor abilities. HAMOCODI evaluates wrist joint function, whereas the 9HPT primarily assesses fine finger motor skills, which makes direct comparison not feasible. HAMOCODI demonstrated high reliability, with certain differences observed between variables, where variables expressed in absolute values were consistently more reliable and more homogeneous. HAMOCODI can be considered a reliable instrument for assessing specific components of wrist joint function, namely precise modulation of submaximal force and precise movement modulation.

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