Standardization of the *Jebsen-Taylor* hand Function test for the brazilian population

Normatização do teste de função Manual Jebsen-Taylor para população brasileira

Christian Guimarães Cilento Negrão[1], Larissa Albuquerque Rufino[1], Aline Bernardes de Souza[2], Raquel Cymrot[3], Silvana Maria Blascovi-Assis[4]

[1] Physical therapists from Universidade Presbiteriana Mackenzie, São Paulo (SP), Brazil; [2] PhD in Developmental Disorders from Mackenzie Presbyterian University. Professor at University Center of Brusque (Unifebe), Brusque (SC), Brazil; [3] Master in Statistics from the University of São Paulo. Professor at Mackenzie Presbyterian University, São Paulo (SP), Brazil; [4] PhD in Physical Education from the University State of Campinas (UNICAMP). Professor at Mackenzie Presbyterian University, São Paulo (SP), Brazil.

[*] **Corresponding author**: Aline Bernardes de Souza. E-mail: alinebernardessouza@yahoo.com.br

ABSTRACT

The aim of this study was to present normative data for the JTHF for the Brazilian population. Participated 360 individuals between 06 and 49 years old, divided into six groups by age, being 178 males and 182 females. The data were presented separately for the different age groups, for men and women. Values for means and standard deviation were calculated for each of the seven tasks, considering dominant and non-dominant hands. Superior performance was observed for the dominant hand, with a significant difference for the sum of the seven tasks, in both sexes (p = 0.001). The results obtained is a reference parameter for the Brazilian population and contribute to quantitative assessments of manual performance in programs of assessment or rehabilitation of the upper limb.

Keywords: Motor skills. Psychomotor performance. Functional laterality.

RESUMO

O objetivo deste estudo foi apresentar dados normativos para o TFMJT para a população brasileira. Participaram do estudo 360 pessoas, entre 06 e 49 anos, divididas em seis grupos por faixa etária, sendo 178 do sexo masculino e 182 do sexo feminino. Os dados foram apresentados separadamente para as diferentes faixas etárias, para sexo masculino e feminino. Os valores referentes às médias e ao desvio padrão foram calculados para cada uma das sete tarefas, considerando mão dominante e mão não dominante. Observou-se desempenho superior para mão dominante, com diferença significante para a soma das sete tarefas, em ambos os sexos (p=0,001). Os resultados obtidos poderão servir de parâmetros de referência para a população brasileira e contribuir para avaliações quantitativas do desempenho manual em programas de avaliação ou reabilitação do membro superior.

Palavras-chave: Destreza motora. Desempenho psicomotor. Lateralidade funcional.

INTRODUCTION

The achievement of autonomy and functional independence in activities of daily living (ADLs) is directly linked to the ability of the hand function to manipulate objects of different shapes, sizes and textures[1] through gross and fine motor skills, dexterity[2], motor coordination and manual preference. Manual dexterity (MD) consists of a rapid motor coordination activity, involving a fine or gross voluntary action of movements developed through training, learning and experience with the use of the hand in conjunction with the arm, under conditions of speed and dexterity[3]. The measurement of MD in the rehabilitation environment provides verification of changes in fine motor performance, supports the establishment of therapeutic goals and objectives, as well as the planning of restorative behaviors, and allows the investigation of the effects caused by the therapeutic intervention.

Several manual function assessment instruments, of foreign origin, are highlighted in the literature as being reliable, according to their psychometric properties, and are used in Brazilian research and clinical practices. These include the Box and Block Test, the Minessota Dexterity Test, the Jebsen Taylor Hand Function Test (JTHFT) and the Finger Dexterity Test, among others. However, not all of them present standardized performance for the Brazilian population, thus compromising the reliability of the comparisons evaluative.

The JTHFT was developed in 1969 by Jebsen and collaborators aiming to provide a method for evaluating manual function in daily activities through the use of standardized tasks that are based on the daily reality and that present an objective measurement. For the standardization of the instrument, the authors evaluated 300 North American individuals, aged 29 to 94 years, of both genders, without clinical abnormalities in the upper limbs, in the seven proposed tasks: writing, turning cards, stacking checkers, simulated feeding, lifting small objects, and moving large, light and heavy objects. The data presented by the authors correspond to the mean values and standard deviations of two age groups (20-59 and 60-94 years) condensed according to gender and the hand (dominant or non-dominant) used[4,5].

A cross-cultural adaptation and validation study of the test was carried out for the Italian population with a group of 320 healthy individuals of both genders, to determine manual function performance parameters for the test. The analysis and presentation of the data occurred from the stratification of the sample into age groups: a) 6 to 19 years - 42 males (m) and 44 females (f); b) 20-29 years (39m and 33f); c) 30-39 years (16m and 17f); d) 40-49 years (16m and 30f); e) 50 to 59 years (16m and 22f); and f) 60-87 years (20m and 25f). During the cultural adaptation process, some adjustments to the test were

discussed, such as the exchange of the American penny for the Italian cent and the development of new phrases with 24 letters. Variables such as education level and handgrip strength were verified by the authors as factors that influenced the speed of writing[6].

In Brazil, the psychometric properties of the JTHFT were verified in 40 stroke patients, presenting excellent internal consistency and inter and intra-rater reliabilities[7]. Other studies also aimed to measure the positivity of the JTHFT sensitivity for the Brazilian population in adolescents with autism spectrum disorder[8], diabetic individuals[1], children with Down syndrome[9], patients with muscular dystrophy[10], stroke patients[7,11] and children with cerebral palsy[12]. Considering the need to provide normative data that can serve as a reference for the manual dexterity performance of the Brazilian population through the JTHFT evaluation, for its clinical and scientific applicability, this study sought to characterize the data referring to Brazilian children, young people and adults.

METHODOLOGY

Participants of the study were 360 healthy children, adolescents and adults, without neurological or orthopedic impairments in the upper limbs that could cause functional impairment in the performance of the tasks, of both genders, aged between 6 and 49 years. The 178 male and 182 female participants, were divided into six investigation groups: G1: aged 6-10 years; G2: 11-15 years; G3: 16-19 years; G4: 20-29 years; G5: 30-39 years and G6: 40-49 years. Each group was composed of 60 individuals, 30 of each gender, with the exception of G3, which was composed of 32 women and 28 men. The number of sample participants was based on the same number of individuals that made up the group evaluated by the authors in the original study of 1969[5].

The Dutch Handedness Inventory[14] was used to check for manual dominance. This is an instrument that identifies the individual's manual preference and intensity, using 10 tasks such as: holding the pencil to draw; holding the toothbrush; unscrewing the cap of a bottle; throwing a ball; giving the cards from a deck; picking up a racket; opening the lid of a box; holding a spoon; erasing with an eraser; and opening a door with a key. In each task, the hand used for the performance is verified and a value is assigned. The task receives a score of -1 when the individual demonstrates performing the activity with the left hand, 0 when demonstrating its performance with either hand, or +1 when using the right hand for its realization. From the sum of the scores in the inventory, the individual can be classified as left handed when the sum totals a value between -10 and -3, ambidextrous when achieving a final score between -3 and +3 or right handed when the final sum value is from +3 to +10.

Subsequently, the JTHFT was applied, in which the evaluator guided the

sequential execution of the tasks through demonstration and verbal guidance in each of the seven requested actions. All tasks were performed with both hands, always starting with the non-dominant hand, with the handling of the materials being allowed prior to the execution of the task. The tasks were performed with the specific material from the kit that accompanies the test, imported for conducting research. The execution time for each task was measured in seconds (s) using a stopwatch. The description of the tasks and collection procedures is detailed below:

(1) Writing - The participant was provided with a pen and blank paper where he/she had to copy a sentence consisting of 24 letters. A card with the described phrase was presented, with the writing side facing downwards and, upon the evaluator's command, the card was turned over and the participant started writing. The writing time was timed from the word "start", until the pen lifted at the end of the sentence, and then the item was repeated with the dominant hand with a new sentence. The phrases proposed were "Our Brazil is a great country" and "The Brazilian is very excited".

(2) Turning Cards - Five cards were arranged vertically, in a horizontal line on the table in front of the participant, with a distance of approximately 5 centimeters (cm) between them. The participant had to turn the cards with the hand crossed from the orientation of the appraiser, that is, if the non-dominant hand is the left, the appraiser had to start the task from the extreme right, going to the extreme left and vice versa. The time was measured from the word "start", until the last card was turned. Then, the item was repeated with the dominant hand.

(3) Lifting small objects - An empty can was placed directly in front of the subject, 5 cm from the front edge of the table. Horizontally, two paper clips, two bottle caps (normal size) and two 5 cent coins were placed, to the left or to the right of the can, with a distance of 5 cm between each one. The participant had to take each object individually and place it in the can, on the extreme left or right, in the opposite direction. The time was measured from the word "start" until the sound of the last object was heard hitting the inside of the can. Then the item was repeated with the dominant hand and the objects aligned with their corresponding ones.

(4) Simulated feeding - Five beans were placed in front of the subject approximately 12 cm from the edge of the table, oriented to the left or right of the center, according to the hand to be used. An empty can was placed in the center and the subject was provided with a teaspoon. The participant had to scoop up one bean at a time and place it inside the can. The time was measured from the

word "start" until the last bean had hit the bottom of the can. The item was then repeated using the dominant hand.

(5) Stacking checkers - Four red wooden checkers were placed in front of the participant, approximately 12 cm from the front edge of the table, oriented from the center, two on each side. The individual had to place one piece on top of the other, on the extreme right or left, depending on the hand used, in the opposite direction. The time was measured from the word "start" until the fourth piece made contact with the other pieces. Then the test was repeated with the dominant hand.

(6) Lifting large, lightweight objects - Five empty cans were placed in front of a plate attached to the counter approximately 12 cm from the front edge of the table. The cans were spaced at a distance of approximately 5 cm. The participant needed to move the cans from the front of the plate to behind it, from the extreme right or left to the opposite direction depending on the hand used. The time was measured from the word "start" until the fifth can had been moved, with the items then repeated using the dominant hand.

(7) Lifting large, heavy objects - Five heavy cans were placed in front of a plate attached to the counter approximately 12 cm from the front edge of the table. The cans were

spaced at a distance of approximately 5 cm. The participant needed to move the cans from the front of the plate to behind it, from the extreme right or left to the opposite direction depending on the hand used. The time was measured from the word "start" until the fifth can had been moved, with the items then repeated using the dominant hand.

Data were collected from regular schools, religious communities and a university in the metropolitan region of São Paulo. Each evaluation took place individually, in a room reserved by the collaborating institution, in the morning and afternoon periods, according to availability. All researchers received training for the test prior to the data collection.

This study was approved under CAAE 45606715.4.0000.0084 and authorization number 1.131.752. All participants signed the consent form, which explained the confidentiality and anonymity of the data, as well as the right to withdraw from the study at any time, according to the recommendations of the National Research Ethics Commission.

For analysis of the results, the distribution of the times observed for the accomplishment of each task, performed using the DH and NDH, was tested for normality. As the data did not demonstrate normality, non-parametric analysis of variance was decided upon, using the Kruskal-Wallis test. The Minitab statistical software was used for the data analysis,

considering a significance level of $p \leq .05$ to compare the results for the dominant and non-dominant hands.

RESULTS

Among the 360 participants, 332 presented dominance in the right hand, 20 members in the left hand and 8 were classified as ambidextrous. Ambidextrous individuals were placed in the right hand dominant group, as this was the predominant group in the sample. The data were grouped according to gender, for each task, in the six age groups, with values referring to means and standard deviation for all measures, being presented in four tables with the results for the dominant hand/male gender (Table 1); dominant hand/female gender (Table 2); non-dominant hand/male gender (Table 3) and non-dominant hand/female gender (Table 4). The values represented in the tables correspond to the time, measured in seconds, to carry out the test tasks.

Table 1. Test results for the dominant hand/male gender

JTHFT Tasks	Parameters MEN 6 to 49 years - DOMINANT Hand					
	06-10 years	11-15 years	16-19 years	20-29 years	30-39 years	40-49 years
Writing	39.3±15.4	19.4±9.7	11.9±2.1	10.8±2.1	11.4±2.3	10.9±2.1
Turning cards	5.3±1.8	3.7±0.6	3.5±1.0	3.6±0.7	4.0±1.1	3.6±0.7
Small objects	6.8±1.2	5.9±0.5	5.5±0.8	5.4±0.7	5.6±0.9	5.6±0.9
Simulated feeding	15.1±5.1	9.4±2.2	8.3±1.6	7.8±2.1	7.7±1.4	7.7±1.9
Stacking Checkers	4.5±1.0	3.4±0.7	2.8±0.4	2.8±0.4	3.0±0.7	2.8±0.6
Large and light objects	3.9±1.0	3.0±0.6	2.8±0.4	2.5±0.3	2.7±0.5	2.5±0.4
Large and heavy objects	4.2±1.1	3.1±0.6	2.8±0.5	2.7±0.5	2.9±0.5	2.7±0.4

Source: Research data.

Table 2. Test results for the dominant hand/female gender

JTHFT Tasks	Parameters WOMEN 6 to 49 years - DOMINANT Hand					
	06-10 years	11-15 years	16-19 years	20-29 years	30-39 years	40-49 years
Writing	40.0±19.7	16.2±4.4	12.4±2.7	11.3±2.8	11.1±1.8	11.4±2.0
Turning cards	5.5±1.4	3.9±0.7	3.8±0.7	3.5±0.6	4.0±0.5	3.8±0.6
Small objects	7.2±1.1	6.1±1.2	5.6±0.7	5.4±0.7	5.7±0.9	5.4±0.7
Simulate feeding	15.1±4.8	9.8±2.5	8.7±2.2	8.0±1.5	7.7±1.4	8.0±1.3
Stacking Checkers	4.5±1.2	3.5±0.7	3.1±0.5	2.8±0.6	3.0±0.5	2.8±0.6
Large and light objects	3.7±0.7	3.2±0.5	2.9±0.4	2.9±0.4	2.9±0.4	2.9±0.4
Large and heavy objects	4.6±1.2	3.6±0.5	3.2±0.4	3.0±0.4	3.1±0.4	3.0±0.4

Source: Research data.

Table 3. Test results for the non-dominant hand/male gender

JTHFT Tasks	Parameters MEN 6 to 49 years – NON-DOMINANT Hand					
	06 -10 years	11-15 years	16-19 years	20-29 years	30-39 years	40-49 years
Writing	79.4±29.0	40.9±14.9	32.4±9.6	25.9±5.9	31.0±11.5	26.0±5.7
Turning cards	5.8±1.7	4.0±0.9	3.9±0.9	4.0±0.9	4.4±1.1	4.0±0.9
Small objects	7.6±1.9	6.2±0.9	6.1±1.0	5.9±0.8	6.0±1.2	5.9±0.8
Simulate feeding	21.2±7.0	12.5±3.7	10.3±2.8	9.7±2.6	9.7±2.8	10.0±3.0
Stacking Checkers	5.0±1.1	3.6±0.6	3.4±0.6	3.1±0.7	3.5±0.6	3.1±0.6
Large and light objects	4.1±0.9	3.1±0.6	3.0±0.6	2.8±0.4	2.9±0.5	2.8±0.5
Large and heavy objects	5.4±1.6	3.5±0.9	3.2±0.6	2.9±0.5	3.0±0.5	2.9±0.5

Source: Research data.

Table 4. Test results for the non-dominant hand/female gender

JTHFT Tasks	Parameters WOMEN 6 to 49 years – NON-DOMINANT Hand					
	06-10 years	11-15 years	16-19 years	20-29 years	30-39 years	40-49 years
Writing	78.9±28.9	37.8±7.4	34.2±9.0	28.0±5.0	27.5±8.2	27.8±6.3
Turning cards	6.3±2.0	4.7±1.0	4.3±0.8	4.6±2.0	4.4±0.8	4.3±1.0
Small objects	8.0±1.7	6.7±1.1	6.5±1.0	5.8±0.6	6.4±1.1	6.7±2.2
Simulate feeding	18.6±5.5	11.9±3.3	10.9±2.4	10.2±1.8	11.5±3.2	10.3±2.3
Stacking Checkers	5.6±1.1	4.3±1.0	3.8±0.6	3.2±0.6	3.5±0.5	3.3±0.6
Large and light objects	4.2±0.9	3.6±0.7	3.2±0.5	3.0±0.4	3.1±0.3	3.0±0.4
Large and heavy objects	5.3±1.4	4.1±0.8	3.6±0.4	3.3±0.4	3.3±0.4	3.4±0.4

Source: Research data

In the comparison between the DH and NDH, superior performance was observed for the DH, with a significant difference for the sum of the seven tasks, in both genders (*p*=.001).

DISCUSSION

The development of motor skills may be dependent on some factors, such as laterality, gender and age[14]. Concerning laterality and the resulting functional asymmetries, the literature reveals that left-handed people are not as lateralized as right-handed people and present, when compared to these, superior performance in many tasks, such as those that involve fine manual dexterity. The sample studied here did not allow comparison between right-handed and left-handed people, due to the low percentile of left-handed people,

however, future studies may contemplate this investigation.

Research on laterality has been the focus of scholars that are interested in manual functions, as well as investigations in cases of ambidexterity and manual asymmetries. There are indications of increasing consistency in the right hand preference with age, however, there is still no clear explanation for this, with this fact possibly being the result of social interactions and adaptation to a "right-oriented" world[15].

Strong correlations between fine motor coordination and handwriting legibility were found in a study that revealed that the precision of hand manipulation skills affects handwriting, demonstrating the relevance of fine motor skills stimulation programs during the school phase[16].

Writing skills are acquired through repetition of sequenced movements, practiced to achieve the desired automation. In the execution of the first JTHFT task, it was observed that, as the age increased, the time to complete the writing task decreased. It was noticed that the time necessary to perform the other tasks also decreased with increasing age. A similar result was previously highlighted in a study involving children and adolescents, aged between 7 and 15 years, with typical development and with Down syndrome. The individuals without developmental changes presented progressive changes related to manual dexterity, which may reflect a process of organization and maturation[17].

The age range studied by the authors of the original article[5] was between 20 and 94 years, with results grouped in the 20-59 and 60-94 age groups, considering the differences in performance between the DH and NDH. The data presented here follow the same line of reasoning, however, with divisions of the age groups into six groups, including participants under 20 years of age. Among the groups, the age group that needed more time to perform all the tasks was G1: 6-10 years, which can be justified by the motor learning period that characterizes this stage of development. Even so, the JTHFT was easy to apply with all ages, as the seven tasks are functional and aroused the interest of the participants.

From a search in the databases it was found that the literature on the use of the JTHFT in Brazil is still scarce, and that the instrument's evaluation parameters for other populations have not been updated. This finding emphasizes the importance of the continuity of studies in the area, such as translation into Portuguese, comparison between genders, expansion to other age groups and adaptations for people with specific clinical conditions, to control the evolution of therapies that aim to improve the gain in dexterity and manual coordination in different areas such as neurology, orthopedics and sports physiotherapy.

Because it is one of the oldest and most efficient motor dexterity assessment tools, the JTHFT is frequently used in the assessment of functional capacity, however, it is composed of unilateral tasks only. Some scholars warn that the test disregards proximal movement along with the palmar function and that, due to "unusual" tasks, it has little relation to activities of daily living (ADLs)[18]. However, other authors consider that the JTHFT provides an assessment based on movements related to ADLs, in addition to being easy to instruct, quick to apply and of low cost[7].

The test tasks, although performed for unilateral evaluation, involve writing, manipulating objects such as coins, paper clips, small and large pieces, with different weights, thus resembling functional handling and selective motor activities. The functionality can be observed from the ease with which the tasks are understood by the subject, of any age. The

International Classification of Functionality (ICF), in its mobility chapter, considers as fine use of the hand (code d440) the act of "performing the coordinated actions of handling objects, picking up, manipulating and releasing them using one's hand, fingers and thumb, such as required to lift coins off a table or turn a dial or knob"[19].

Considering the benefits and objectivity of the test, the JTHFT should be studied and used in Brazil so that its application is made possible with children, youths, adults and older adults that need a quantified assessment of the manipulative function. The availability of standardized hand function data for the Brazilian population, based on an internationally recognized testing model addresses an existing gap regarding instruments for assessing fine motor skills based on various tasks and helps professionals in the area of functional recovery to have updated reference parameters for the age group studied. Some limitations can be highlighted for this study, such as the non-probabilistic sampling and the absence of data for the over 50 years age group, however, the methodological design followed the model presented by the authors of the original test.

CONCLUSIONS

With this study, it was possible to identify performance parameters for the JTHFT for Brazilian children, adolescents and adults in the 6 to 49 years age group.

Updating the data in different cultural contexts will allow the definition of parameters that can be compared with those of the present study to observe whether there was a change in the pattern of dexterity related to the technological context. In addition, the data generated here may serve to support research on manual dexterity in diverse populations, with typical or atypical development, in intervention programs focused on improving this skill. Accordingly, it can be said that the proposed objective was achieved, since it was possible to standardize the pattern of motor dexterity measured by the JTHFT in the studied groups.

The practical applications of the JTHFT with standardized data for the Brazilian population may contribute to better knowledge and planning of therapeutic activities for the areas of health and education, favoring the recovery of manual function in people with neurological, orthopedic or rheumatological diagnoses in different life cycles.

REFERENCES

1. Lima K, Freitas PB. Avaliação da função manual e da força de preensão palmar máxima em indivíduos com diabetes mellitus. Fisioter. Pesqui. 2012; 19(4):375-80.

2. Elui VMC, Goia DN, Ricci FPFM, Fonseca MCRF. Reliability of the ELUI Upper Extremity Functionality Test. Acta Fisiátr. 2014; 21:101-6.

3. Oliveira CC, Neto JLC, Tudella E. Manual Dexterity of Children and Adolescents with Down Syndrome: Systematic Review of the Literature. J Genet Syndr Gene Ther. 2016; 7(305). doi: 10.4172/2157-7412.1000305

4. Takla, MKN; Mahmoud, EAK; El-Latif, NA. Jebsen Taylor Hand Function test: Gender, dominance, and age differences in healthy Egyptian population. Bulletin of Faculty of Physical Therapy, 2018; 23(2):85-93. doi: 10.4103/bfpt.bfpt_11_18

5. Jebsen RH, Taylor N, Trieschmann RB, Trotter MJ, Howard LA. An Objective and Standardized test of Hand Function. Arch Phys Med Rehabil. 1969; 50(6).

6. Culicchia G, Nobilia M, Asturi M, Santilli V, Paoloni M, Santis R, et al. Cross-cultural adaptation and validation of the Jebsen-Taylor Hand Function Test in an Italian population. Rehabil Res Pract. 2016. Article ID 8970917. doi: 10.1155/2016/8970917

7. Ferreiro K, Santos RD, Conforto A. Psychometric properties of the Portuguese version of the Jebsen-Taylor test for adults with mild hemiparesis. Rev. Bras. Fisioter. 2010; 14(5): 377-82.

8. Angélico, SS, Quintas, RHR, Blascovi-Assis, SM. Evaluation of Manual Dexterity of Teenagers with Autistic Spectrum Disorder: Comparison among Validated Tests. International Journal for Innovation Education and Research. 2019; 7(8):308-318. doi: 10.31686/ijier.Vol7.Iss8.1680

9. Rufino LA, Blascovi-Assis SM, Souza AB, Verginassi G, Cymrot R. Avaliação da destreza manual em pessoas com síndrome de Down: comparação entre teste caixa e blocos, Minnesota e Jebsen-Taylor. Fisioter Bras. 2016; 17(3):188-96.

10. Artilheiro MC, Cardoso de Sá CS, Fávero FM, Wutzki HC; Dutra de Resende MB, Caromano FA, et al. Hand Function in Muscular Dystrophies: Relationship between Performance of Upper Limb and Jebsen-Taylor Tests. Percept Mot Skills. 2017; 124(2):441-52.

11. Oliveira MC, Magalhães Demartino A, Cardoso Rodrigues L, Pinheiro Gomes R, Michaelsen SM. The activity assessment instruments of the upper limbs do contemplate the most accomplished tasks at home by people with hemiparesis? Cad. Bras. Ter. Ocup. 2018; 26(4):809-28.

12. Brandão MB, Mancini MC, Ferre CL, Figueiredo PRP, Oliveira RHS, Gonçalves SC, et al. Does Dosage Matter? A Pilot Study of Hand-Arm Bimanual Intensive Training (HABIT) Dose and Dosing Schedule in Children with Unilateral Cerebral Palsy. Phys Occup Ther Pediatr. 2018; 38(3):227-43.

13. Reedman SE, Beagley S, Sakzewski L, Boyd RN. The Jebsen Taylor Test of Hand Function: A Pilot Test–Retest Reliability Study in Typically Developing Children. Physical & Occupational Therapy In Pediatrics, 2016;36(3):292-304, doi: 10.3109/01942638.2015.1040576

14. Freitas C, Botelho Ml, Vasconcelos O. Preferência lateral e coordenação motora. Motri. 2014; 10(2):11-24. http://dx.doi.org/10.6063/motricidade.10(2).1245.

15. Rodrigues PC, Vasconcelos MO, Barreiros JM. Desenvolvimento da Assimetria Manual. RPCD. 2010; 10(1):230-41.

16. Seo SM. The effect of fine motor skills on handwriting legibility in preschool age children. J Phys Ther Sci. 2018; 30(2):324-27. doi:10.1589/jpts.30.324

17. Guimarães R, Blascovi-Assis SM. Uso do teste caixa e blocos na avaliação de destreza manual em crianças e jovens com síndrome de Down. Rev Ter Ocup Univ Sao Paulo. 2012; 23(1): 98-106.

18. Michaelsen SM, Ovando AC, Natalio MA, Mazo, GZ, Rodrigues LC. Avaliação da capacidade funcional dos membros superiores por utilização do TEMPA: Valores de referência, efeito da idade, gênero, dominância e relação com a destreza. Motricidade. 2011; 7(2): 47-55.

19. OMS. Organização Mundial da Saúde. Como usar a CIF: um manual prático para o uso da Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF). Versão preliminar para discussão. Genebra: OMS; Outubro de 2013. Available at: http://www.fsp.usp.br/cbcd/wp-content/uploads/2015/11/Manual-Pra%CC%81tico-da-CIF.pdf Accessed on 15/11/2020