

Validity of the motor coordination assessment battery for wheelchair users

Validez de la batería de evaluación de la coordinación motora para usuario de silla de ruedas

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Abstract. The aim of this study was to establish the scientific authenticity, in terms of validity, of a Motor Coordination Assessment Battery for Wheelchair Users - BACMoC. The elaboration of the instrument was carried out through bibliographic review followed by brainstorm, which allowed the choice of preliminary tests that composed the instrument. The instrument validity was verified through its Content and Appearance through the Delphi method, with consultation to a Board of Expert Evaluators - QPA. The QPA initially consisted of 40 evaluators, all with MSc or Ph.D. degree, characterized as follows: being in the age group of young and mature adults ($\bar{X} = 52.75 \pm 6.29$ years); 100% of them with a degree in Physical Education and linked to Paralympic sport, with extensive experience in the sector ($\bar{X} = 29.5 \pm 6.85$ years). The final BACMoC version consists of five tests designed to assess the four existing types of coordination: fine motor coordination; specific motor coordination; gross motor coordination and general motor coordination. At the end of the objectivity determination process, agreement index of 98.4% was reached in the third round, with Cronbach's alpha coefficient value of 1.0, which denotes perfect statistical reliability.

Keywords: Coordination Impairment; Wheelchair; Motor Skill; Para-Athletes;

Resumen. El objetivo del presente estudio es establecer la autenticidad científica, en términos de validez de una Batería de Evaluación de la Coordinación Motora para Usuarios de Silla de Ruedas – BECMoC (por su sigla en portugués). La elaboración del instrumento se realizó a través de revisión bibliográfica seguida de *brainstorm*, que permitió elegir las pruebas que formaron parte de forma preliminar. La validez del instrumento fue verificada a través de su Contenido y Apariencia, por medio del método Delphi, consultando un Equipo de Peritos Autorizados – EPA. El EPA fue constituido inicialmente por 40 evaluadores, todos magísteres o doctores, así caracterizados: están en la franja de adulto joven y maduro ($\bar{X} = 52,75 \pm 6,29$ años); todos tienen graduación en Educación Física y vínculo con el deporte paralímpico, con bastante experiencia en el sector ($\bar{X} = 29,5 \pm 6,85$ años). La versión final del BACMoC está compuesta por cinco pruebas que se destinan a evaluar los cuatro tipos de coordinación existentes: coordinación motora fina; coordinación motora específica; coordinación motora gruesa y coordinación motora general. Al final del proceso de determinación de la objetividad, se llegó a un índice de concordancia de 98,4% en la tercera ronda, con un coeficiente α de Cronbach de 1,0, lo que denota una confiabilidad estadísticamente perfecta.

Palabras claves: Deficiencia de Coordinación; Sillas de Ruedas; Destreza Motora; Paratleta;

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Introduction

According to data from the National Health Survey conducted by the Brazilian Institute of Geography and Statistics, there are approximately 17.3 million people in Brazil with at least one type of disability, whether hearing, motor, visual or mental/intellectual (Institute Brazilian Geography and Statistics, 2021). People with disabilities are those with long-term physical, mental, intellectual or sensory impairment, which, in interaction with one or more barriers, can impair their full and effective participation in society on equal terms with other people (Brazil, 2015). There are different types of disabilities, and each type has different behavioral specificities and social factors.

In this context, the use of wheelchair stands out, a necessary tool for approximately 75 million people worldwide, according to estimates of the World Health Organization (World Health Organization, 2019). These tools are important to increase the mobility and the autonomy of people with disabilities, being essential for most wheelchair users, as it is a form of moving around independently (Abdulghani et al., 2020; Larraga-García et al., 2019).

Another way to develop the autonomy of people with

disabilities is the practice of sports, which provides several benefits for health and individual well-being, with remarkable value in the context of social inclusion and integration, and may promote social inclusion. The practice began with the intention of being a recreational and therapeutic activity, constituting one of the credible alternatives of playful or competitive participation for people with disabilities, presenting properties for high-performance sports and the Paralympic games as basic means for the dissemination of achievements, being the main singular scenario to support the practice of sports by people with disabilities (D'elia et al., 2021; Pullen & Silk, 2019).

Adapted sports activities and Paralympic sports are not restricted only to the Paralympic Games, which is the largest high-performance sports competition for athletes with disabilities, but are represented in the various events organized by the International Paralympic Committee, confederations and federations linked to it, including athletes with various disabilities such as physical, visual or intellectual, being manifested and practiced at different levels of performance, whether in school, leisure or high performance (Cardoso et al., 2020; Marques, 2016)

In the practice of sporting activities, one of the most

important components, whether at competitive level or as leisure, is the Motor Coordination, which is also indispensable for various functional and intentional tasks in people's lives, in physical and leisure activities (Lima et al., 2019).

Motor coordination is presented as the ability to more efficiently use skeletal muscles, resulting in a more practical and economical global action, and can be defined as the ability to perform motor activities, including fundamental movement patterns and fine motor skills necessary to manage daily tasks (Ma et al., 2021; Santana et al., 2019).

Currently, motor coordination is subdivided into four categories: General Motor Coordination, which is responsible for the individual to be able to master his/her own body and control all movements; Specific Motor Coordination, materialized by the control of specific movements to perform a specific type of activity, such as kicking a ball or participating in a basketball game; Gross Motor Coordination, which mainly involves large muscle groups and can be developed from the practice of physical activities. Finally, Fine Motor Coordination, which is related to activities that require high precision, involving smaller muscles (Logan et al., 2018). These categories are particularly visible in sports for people with disabilities.

As wheelchair athletes who participate in wheelchair sporting events constitute the majority of Paralympic competitors, wheelchair sports are those that have been modified according to the abilities of athletes with lower limb and trunk disabilities (Sasadai et al., 2020). According to Li et al. (2020), there is a strong relationship between motor coordination and physical activity. Motor coordination skills are essential in the practice of a physical or sporting activity, and the higher a person's level of physical activity, the better his/her motor coordination (Moura et al., 2022; Mejia & Pérez, 2021; Guillamón et al., 2020; De Gregorio et al., 2019;). Thus, there is need to correctly assess motor coordination to better understand it, as there is lack of studies on wheelchair users related to motor coordination.

In order to fill the knowledge gaps presented above, this study aims to develop a validated instrument to assess motor coordination in wheelchair users. Studies such those carried out by Frechette et al. (2020); Dekkers et al. (2020); Worobey et al. (2020); Paulisso et al. (2020) have used validation methods, which suggests the effectiveness of this method, even if they were not properly used to validate a similar tool.

This instrument will enable assessing the motor coordination of wheelchair users, to support accurate decision-making about this population group. This requires an instrument that provides sufficiently reliable, valid and objective data (Thomas et al., 2012).

Validity is the degree of veracity of the test result or measurement. That is, once reproducible, the test result precisely reflects what it was intended to test. The same authors establish that this criterion can be determined in four ways: logic, content, criterion and construct (Pineda-

Espejel et al., 2019). Due to its adequacy, for the proposal of this study, validity by content and appearance will be used.

Therefore, the aim of the study was to establish the scientific authenticity in terms of validity (content and appearance) of a motor coordination assessment battery for wheelchair users.

Methodology

The proposal for the elaboration of a Motor Coordination Assessment Battery for Wheelchair Users – BACMoC was preliminarily performed, it is a qualitative study.

For the elaboration of the battery, with the specification of its constituent tests, a literature review was initially used, from which a discussion based on the Brainstorming methodology was held (Daugherty et al, 2021) with the work and research group - QTP Paralympic Sport, basically reaching three measurement instruments to be used: the Bruininks-Oseretsky Motor Proficiency test – 2nd Edition, translated and validated for the Brazilian population (Fernandes, 2019); the “Beck” battery of skill tests for Brazilian wheelchair rugby athletes validated by Gorla et al., (2011) and the wheelchair test developed by Hollins (2017).

The establishment of the Battery validity was carried out in October 2021, using the Delphi method through a Google form, in consultation with a Board of Expert Evaluators - QPA composed of experts in the field. The instrument used can be accessed on the link: <https://forms.gle/c8sRAsyUJj4H3fXT>.

For readers who want to have access to this article in its physical form (paper).

The present work meets the standards for conducting research with human beings, in accordance with guidelines established by the Declaration of Helsinki (2008) and by Resolution 466 of December 2012 of the National Health Council (CNS), Brazil, being approved by the Ethics Committee of the University of the State of Pará – UEPa under CAAE No. 51930821.2.0000.5174, through protocol No. 5.012.266 of October 1, 2021.

The Delphi method follows a flowchart based on the following steps (Barrios et al., 2021; Vida & Lluçh., 2019):

- 1) Preparation Phase: consists of preparing the instrument that will be submitted to the group for consideration;
- 2) Consultation Phase: The battery to be validated will be sent via the internet to a group of experts in the field to carry out the consultation based on answers to questions in the first questionnaire; there will be a new entry, in which the new questions and evaluation items of the second questionnaire will be prepared. Normally, 2 to 4 rounds are needed to increase the convergence of opinions, and thus reach a consensual opinion;
- 3) Consensus Phase: researchers must define that consensus was reached, finally reaching the validation of the battery that allows assessing the motor coordination of wheelchair users.

Delphi is a method that is still little used in Brazil, but its effectiveness has been consolidated in order to allow scientists to assess the proposed study object more intensively (Lima et al., 2020).

For Lima et al (2020), the method allows studying different aspects regarding the creation and validation of data collection instruments, being therefore, fundamental dimensions for the development of society, established by the scheme shown in Figure 1:

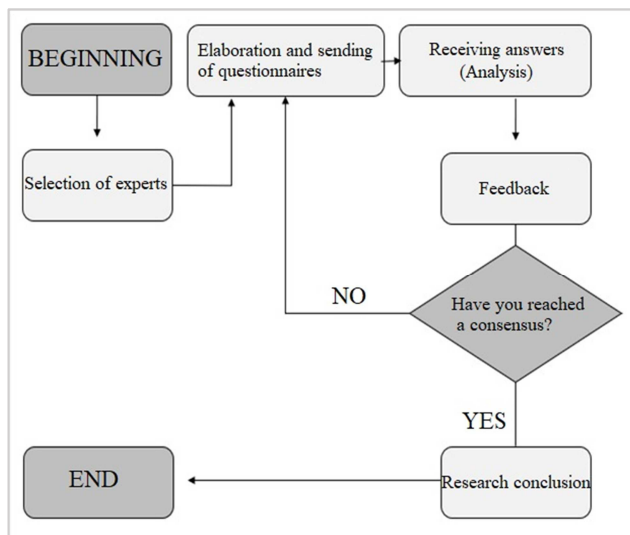


Figure 1. Delphi flowchart. Adapted from: Lima et al (2020).

Results

The instrument validity was verified through its content and appearance using the Delphi method, by consulting a Board of Expert Evaluators - QPA (Lima et al., 2020).

For the QPA, around 40 professionals were initially invited, all with MSc or Ph.D. degree, characterized as follows: being in the age group of young and mature adults ($\bar{X} = 52.75 \pm 6.29$ years); 100% of them with a degree in Physical Education and linked to Paralympic sport, with extensive experience in the sector ($\bar{X} = 29.5 \pm 6.85$ years).

Of the 40 guests, 18 responded to the assessment instrument, with the following characteristics: 61.5% with Ph.D. degree, 23.1% with MSc. degree and 15.4% with specialization degree.

As previously mentioned, the instrument validity was verified by its content and appearance through the Delphi method, with reference to the QPA constituted and characterized as previously presented.

Table 1. Delphi results

Sending	Sent	Returns	% of Agreement 1 st Question	% of Agreement 2 nd question	Average	Cronbach's alpha coefficient
1 st	19	18	72.4%	43.3%	57.85%	0.43
2 nd	15	14	92.9%	72.7%	82%	0.60
3 rd	14	14	100%	96.7%	98.4%	1.00

Source: The Author (2021).

The validity determination instrument was sent, for the QPA assessment according to the phases of the electronic Delphi, and the result was presented in table 1.

Inferential statistics were performed using the chi-square test to verify the difference between the prevalences in the categorical variables. To determine the validity of the responses obtained by the Delphi method, from the structured group of experts, Cronbach's alpha coefficient was used (Kitamura et al., 2021).

The same method was used in other studies, and although studies such as those carried out by Barros and Triani (2019) were not properly used to validate a similar tool; Mohammadi & Azizi (2019); Couto & Melo (2019), used the common Delphi method or the INTERNET for validations within the sports context, which suggests the effectiveness of the method for such validations.

After calculating the Cronbach's alpha coefficient, it was found that in the third round, the result obtained was 1.0, showing perfect reliability, demonstrating the consistency of the motor coordination assessment battery for wheelchair users.

The final validated BACMoC version can be observed in table 2.

Table 2. Final form of the Motor Coordination Assessment Battery for Wheelchair Users – BACMoC

Type of Motor Coordination Assessed	Tests Used
Fine Motor Skill Specific	Fine Motor Coordination
General	Oculomanual Accuracy
Gross Motor Skill General	Explosive Force
	Agility
	Travel Speed

Final form of the Motor Coordination Assessment Battery for Wheelchair Users – BACMoC.

The tests indicated in table 2 can be described as follows:

- Speed of Displacement: This test consists of measuring the ability to displace in speed. A route of 20 meters is used.

The evaluator is positioned at the end of the route and an assistant is positioned at the beginning to give the signal that corresponds to the wheelchair user's exit. The reference point for the test is the passage of the front pair of wheels of the chair, so, when the pair of front wheels passes the line, the assistant who has his arm raised, lowers it to signal the evaluator to start counting the time with the stopwatch (the only one with the stopwatch). The wheelchair user then moves at speed and when he passes the final line, the timer will be stopped. The time in seconds is computed and there are two valid trials in the test.

- Explosive Force: This is the test that aims to measure the ability of wheelchair users to make long-distance passes.

The participant was positioned at the back line of the court and must perform the long-distance pass with the greatest possible force, using the pass performed during the game situation. On the sides of the court, spaces are

demarcated every two meters with cones that are the reference zones for the test score. Zones are numbered with a ratio scale (1) starting from number one. The score for the zone where the ball touches the ground is the result of the execution. There are three runs on each of the two attempts. The sum on each trial is the test result.

- **Oculomanual Precision:** In this test, a target is drawn on the wall, whose distance from the evaluated subject is five meters. At each meter from the subject to the wall, a line is passed, separating spaces whose values range from a point in the first part in front of the subject to the center of the target, which is 10 points. The target's height from the ground is 1.15 m. The test consists of performing passes (Using a basketball) to the target to quantify the score and the pass that the wheelchair user uses on the court must be used in the test. In each test attempt (two in all) there are three executions. The sum of the points obtained in each attempt is the result of the test.

- **Agility:** Through a circuit with a 10m U-shaped design, wheelchair users must go through the end in the opposite direction, in the shortest possible time, totaling 20m.

- **Fine Motor Coordination:** The first part of the test will be to draw a continuous line within the course and the second a circle cutout. Outline a continuous line within the course: The task is described as follows: while the subject is seated in a chair in front of a table, he/she receives a sheet of white paper size 21.00 cm x 14.85 cm, containing the drawing of the route and a pencil. The activity consists of starting and ending the route with a continuous line within the delimited space. There is no stipulated time, however common sense must be used. The evaluation procedure takes place by verifying the accuracy and continuity of the line from start to finish within the delimited space. Cut out a circle: The task is described as follows: the initial action is to position the subject sitting in a chair in front of a table, hand him a sheet of white paper size 21.00 cm x 14.85 cm, containing the drawing of a circle with a diameter of 6 cm and age-appropriate scissors. The activity consists of cutting the circle as accurately as possible. It is not necessary to time the task, but rationality in the face of time is important. And the procedure for evaluating is done by a judgment of the accuracy of the cut.

Discussion

Regarding the content and appearance validity according to data obtained in the QPA with 98.4% agreement in the 3rd round, confirmed by the Cronbach's alpha coefficient value of 1.0 (Statistically Perfect) in the third round, a result that corroborates the Cronbach's alpha value with other studies, although they were not properly used to validate a similar tool such as that of Navarro et al. (2020), in which the Cronbach's alpha value was 0.864, it was evidenced that the evaluated test shows great consistency and it is a self-administered test that can be reliably used in

clinical research.

In another study where the Cronbach's alpha value was 0.981 to determine internal consistency, it demonstrated reliability in the validity of the test used (Roman et al., 2020). In the study by Aunola et al. (2020), the internal consistency for the total scale was excellent, with Cronbach's alpha value of 0.90. In this way Rodríguez et al. (2019); Cossio-Bolaños et al. (2019) also demonstrated the validity of their studies through the result of Cronbach's Alpha.

In the study by Da Silva et al. (2020), the Cronbach's alpha value was 0.88, demonstrating that the questionnaire is valid, reliable and can be used as alternative to assess individuals with upper limb dysfunction related to orthopedic and traumatic injuries. Nyongesa et al. (2020) obtained Cronbach's alpha value of 0.82, which suggests that it is internally consistent. Tavares et al. (2020) obtained Cronbach's alpha value of 0.89, demonstrating reliability and adequate validity to assess the mobility of hospitalized elderly patients.

In comparison with results presented in other studies, the first part of this research presented very robust and reliable data, confirmed by the Cronbach's alpha coefficient value of 1.0 (Statistically Perfect) in the third round.

The Delphi method has been used in other studies; although not properly used to validate a similar tool, they used the common Delphi method or INTERNET for validations within the sports context, which suggests the effectiveness of the method for such validations, studies such as those by Barros & Triani (2019) carried out with an online questionnaire; Mohammadi & Azizi (2019) performed with a physical questionnaire and Couto & Melo (2019) performed with a physical questionnaire.

Conclusion

The aim of the study was to establish the validity (Content and Appearance) of a motor coordination assessment battery for wheelchair users, attended in a robust and fairly consistent manner: Content and Appearance Validity with 98.4% agreement, confirmed by the Cronbach's alpha coefficient value of 1.0 (Statistically Perfect) in the third round.

Therefore, BACMoC is a valid option to assess the motor coordination of wheelchair users, whether they are Parathletes or not.

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References

Abdulghani, M. M., Al-Aubidy, K. M., Ali, M. M., & Hamarsheh, Q. J. (2020). Wheelchair Neuro Fuzzy Control and Tracking System Based on Voice Recognition. *Sensors*,

- 20(10), 2872.
- Aunola, K., Sorkkila, M., & Tolvanen, A. (2020). Validity of the Finnish version of the Parental Burnout Assessment (PBA). *Scandinavian Journal of Psychology*, 61(5), 714-722.
- Barrios, M., Guilera, G., Nuño, L., & Gómez-Benito, J. (2021). Consensus in the delphi method: What makes a decision change?. *Technological Forecasting and Social Change*, 163, 120484.
- Barroso, J. B., de Araujo Silva, C. L., dos Reis Façanha, C. C., Gomes, C. R. M., & Materko, W. (2019). Comparação entre diferentes compassos de dobras cutâneas para estimativa da gordura corporal relativa. *Revista Brasileira de Nutrição Esportiva*, 13(80), 543-549.
- Barros, G., & da Silva Triani, F. (2019). A utilização de recursos tecnológicos por professores de Educação Física do município do Rio de Janeiro. *Motrivivência*, 31(58), 1-17.
- Brasil, C. D. D. (2015). Lei nº 13.146, de 6 de julho de 2015. Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). *Diário Oficial da União*, 43.
- Cardoso, V. D., Haiachi, M. D. C., Dos Santos, A. C. A., Canuto, S. C. M., & Nicoletti, L. P. (2020). Brazilian paralympic sport initiation: The road from Rio to Los Angeles.
- Carver, J., Ganus, A., Ivey, J. M., Plummer, T., & Eubank, A. (2016). The impact of mobility assistive technology devices on participation for individuals with disabilities. *Disability and Rehabilitation: Assistive Technology*, 11(6), 468-477.
- Couto, L. C., & Melo, T. A. (2019). Efeitos do treinamento resistido na capacidade funcional de pacientes com DPOC hospitalizados: revisão sistemática. *Revista Pesquisa em Fisioterapia*, 9(4), 563-571.
- Cossio-Bolaños, M. A., Vidal-Espinoza, R., Sulla-Torres, J., Luarte-Rocha, C. E., Pacheco-Carrillo, J., & Gomez-Campos, R. (2019). Validity, reliability, and percentiles of a questionnaire measuring activity levels in adolescents living at moderate altitude in Peru. *Retos*.
- Dos Santos Barros, G., & da Silva Triani, F. (2019). A utilização de recursos tecnológicos por professores de Educação Física do município do Rio de Janeiro. *Motrivivência*, 31(58), 1-17
- Daugherty, K. K., Lebovitz, L., & DiVall, M. V. (2021). Educational research and scholarship—Brainstorming, developing, and publishing together as teams. *Currents in Pharmacy Teaching and Learning*.
- Da Silva, N. C., Chaves, T. C., Dos Santos, J. B., Sugano, R. M. M., Barbosa, R. I., Marcolino, A. M., ... & Fonseca, M. C. R. (2020). Reliability, validity and responsiveness of Brazilian version of Quick DASH. *Musculoskeletal Science and Practice*, 48, 102163.
- Dekkers, L. M., Janssen, A. J., Donders, A. R. T., Nijhuis-van der Sanden, M. W., & de Swart, B. J. (2020). Construct Validity of the Observable Movement Quality Scale in Pediatrics: Hypothesis Testing of a Formative Measurement Model. *Physical therapy*, 100(2), 346-358.
- De Gregorio, M. V., Pérez, L. M. R., & Moro, M. I. B. (2019). Análisis de las relaciones entre la baja competencia motriz y los problemas de atención e hiperactividad en la edad escolar. Analysis of the relationships between low motor competence and attention and hyperactivity problems in school age. *Retos*, 36, 625-632.
- D'Elia, F. (2021). Inclusion in physical and sport education for special movement needs. *J. Hum. Sport Exerc*, 16, 781-787
- Fernandes, M. C. C. (2019). Tradução e adaptação transcultural para uso no Brasil do teste de proficiência motora Bruininks-Oseretsky (BOT 2). 1 recurso online (191 p.). Tese (doutorado) - Universidade Estadual de Campinas, Faculdade de Ciências Médicas, Campinas, SP.
- Frechette, M. L., Abou, L., Rice, L. A., & Sosnoff, J. J. (2020). The validity, reliability, and sensitivity of a smartphone-based seated postural control assessment in wheelchair users: a pilot study. *Frontiers in sports and active living*, 2.
- Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2013). Compreendendo o desenvolvimento motor: bebês, crianças, adolescentes e adultos. AMGH Editora.
- Gomes, A. S., & Gomes, C. R. A. (2019). Classificação dos tipos de pesquisa em Informática na Educação. Jaques, Patrícia Augustin; Pimentel, Mariano; Siqueira; Sean; Bittencourt, Ig.(Org.) Metodologia de Pesquisa em Informática na Educação: Concepção da Pesquisa. Porto Alegre: SBC.
- Goodway, J. D., Ozmun, J. C., & Gallahue, D. L. (2019). Understanding motor development: Infants, children, adolescents, adults. Jones & Bartlett Learning.
- Gorla, J. I., de Araújo, P. F., & Rodrigues, J. L. (2010). Avaliação motora em educação física: teste ktk. Phorte Editora LTDA.
- Gorla, J. I., Costa e Silva, A. D. A., Costa, L. T., & Campos, L. F. C. C. D. (2011). Validação da bateria " Beck" de testes de habilidades para atletas brasileiros de " rugby" em cadeira de rodas. *Revista Brasileira de Educação Física e Esporte*, 25(3), 473-486.
- Guillamón, A. R., Canto, E. G., & García, H. M. (2020). Análisis de la coordinación motriz global en escolares según género, edad y nivel de actividad física. *Retos: nuevas tendencias en educación física, deporte y recreación*, (38), 95-101.
- Hollins, R., Hoffmann, S., Sanders, N., & Dwyer, D. (2017). The development and evaluation of a fitness test for wheelchair-based court sports. *Journal of Science and Medicine in Sport*, 20, 28.
- Instituto Brasileiro de Geografia e Estatística, IBGE.(2021). Pesquisa Nacional de Saúde 2019 Ciclos de vida: Brasil. Coordenação de Trabalho e Rendimento. Rio de Janeiro. Disponível em: <https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=2101846>
- Kitamura, S., Otaka, Y., Murayama, Y., Ushizawa, K., Narita, Y., Nakatsukasa, N., ... & Sakata, S. (2021). Reliability and Validity of a New Transfer Assessment Form for Stroke Patients. *PM&R*, 13(3), 282-288.
- Larraga-García, B., Lozano-Berrio, V., Gutiérrez, Á., Gil-Agudo, Á., & Del-Ama, A. J. (2019). A systematic methodology to analyze the impact of hand-rim wheelchair propulsion on the upper limb. *Sensors*, 19(21), 4643.
- Li, Y. C., Chirico, D., Graham, J. D., Kwan, M. Y., & Cairney, J. (2020). Motor coordination and moderate-to-vigorous physical activity in emerging adults: Mediating effect of physical self-concept. *International Journal of Environmental Research and Public Health*, 17(11), 3748.
- Lima, R. A., Bugge, A., Ersbøll, A. K., Stodden, D. F., & Andersen, L. B. (2019). The longitudinal relationship between motor competence and measures of fatness and fitness from childhood into adolescence ☆. *Jornal de pediatria*, 95, 482-488.
- Lima, S. F., Nunes, E. C., & de Souza, R. F. (2020). O método delphi e a validação de pesquisa na educação: um estudo com professores de ciências dos anos iniciais atuantes em salas

- multisseriadas na Amazônia. *Complexitas—Revista de Filosofia Temática*, 4(1), 50-56.
- Logan, S. W., Ross, S. M., Chee, K., Stodden, D. F., & Robinson, L. E. (2018). Fundamental motor skills: A systematic review of terminology. *Journal of sports sciences*, 36(7), 781-796.
- Ma, J., Lander, N., Eyre, E. L., Barnett, L. M., Essiet, I. A., & Duncan, M. J. (2021). It's not just what you do but the way you do it: a systematic review of process evaluation of interventions to improve gross motor competence. *Sports Medicine*, 1-23.
- Marques, R. F. R. (2016). A contribuição dos Jogos Paralímpicos para a promoção da inclusão social: o discurso midiático como um obstáculo. *Revista USP*, (108), 87-96.
- Mejía, N., & Pérez, B. Z. (2021). Estructura interna de la coordinación motriz de los movimientos de pies en ataque del baloncesto (Internal structure of the motor coordination of foot movements in attack of basketball). *Retos*, 42, 813-820.
- Mohammadi, M., & Azizi, B. (2019). Determining the effect of educational characteristics of sports coaches in their ability (a case study of sport coaches in hamadan province). *Humanidades & Inovação*, 6(13), 77-88.
- Moura, O. M., Marinho, D. A., Morais, J. E., Pinto, M. P., Faíl, L. B., & Neiva, H. P. (2022). Learn-to-swim program in a school context for a twelve-week period enhance aquatic skills and motor coordination in Brazilian children. *Retos: nuevas tendencias en educación física, deporte y recreación*, (43), 316-324.
- Navarro-Flores, E., de Bengoa Vallejo, R. B., Losa-Iglesias, M. E., Palomo-López, P., Calvo-Lobo, C., López-López, D., ... & Romero-Morales, C. (2020). The reliability, validity, and sensitivity of the Edmonton Frail Scale (EFS) in older adults with foot disorders. *Aging (Albany NY)*, 12(24), 24623.
- Nyongesa, M. K., Mwangi, P., Koot, H. M., Cuijpers, P., Newton, C. R., & Abubakar, A. (2020). The reliability, validity and factorial structure of the Swahili version of the 7-item generalized anxiety disorder scale (GAD-7) among adults living with HIV from Kilifi, Kenya. *Annals of general psychiatry*, 19(1), 1-10.
- Neto, F. R. (2020). *Manual de Avaliação Motora EDM III*. Florianópolis: EDM;
- Paulisso, D. C., Cruz, D., Allegretti, A. L. C., Schein, R. M., Costa, J. D., Campos, L. C., & Schmeler, M. R. (2020). Cross-Cultural Adaptation and Face Validity of the Functional Mobility Assessment into Brazilian Portuguese. *Occupational therapy international*, 2020.
- Pineda-Espejel, H. A., López Gaspar, I., Guimaraes, A. C., Martínez Zavala, S., Morquecho-Sánchez, R., Morales-Sánchez, V., & Dantas, E. H. (2019). Psychometric properties of a Spanish version of the basic needs satisfaction in sports scale. *Frontiers in psychology*, 10, 2816.
- Pullen, E., & Silk, M. (2020). Gender, technology and the ablenational Paralympic body politic. *Cultural Studies*, 34(3), 466-488.
- Rodríguez, G. A. R., Hernandez, L., & Triana, N. V. (2019). Validación de un cuestionario para evaluar valores personales y sociales en jóvenes deportistas. *Retos: nuevas tendencias en educación física, deporte y recreación*, (36), 152-158.
- Roman, N., Miclaus, R., Repanovici, A., & Nicolau, C. (2020). Equal Opportunities for Stroke Survivors' Rehabilitation: A Study on the Validity of the Upper Extremity Fugl-Meyer Assessment Scale Translated and Adapted into Romanian. *Medicina*, 56(8), 409.
- Santana, A. K., dos Santos, C. S. S., de Sousa, V. G. S., & Costa, M. J. M. (2019). Análise da coordenação motora e equilíbrio de crianças do ensino infantil de uma escola pública de Teresina-PI. *BIOMOTRIZ*, 13(1).
- Sasadai, J., Maeda, N., Shimizu, R., Kobayashi, T., Sakai, S., Komiyama, M., & Urabe, Y. (2020). Analysis of team-sport wheelchair falls during the Rio 2016 Summer Paralympic Games: a video-based cross-sectional observational study. *BMJ open*, 10(3), e033088.
- Tavares, L. S., Moreno, N. A., de Aquino, B. G., Costa, L. F., Giacomassi, I. W. S., Simões, M. D. S. M. P., & Lunardi, A. C. (2020). Reliability, validity, interpretability and responsiveness of the DEMMI mobility index for Brazilian older hospitalized patients. *Plos one*, 15(3), e0230047.
- Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2012). *Métodos de pesquisa em atividade física*. Artmed Editora.
- Vasquez, S. G., D'Innocenzo, M. E., Pearlman, J., Zigler, C., Mendez, Y. G., Rozen, P., ... & Praptoraharjo, I. (2020). Wheelchair user's voice: a pilot study in Indonesia. *bioRxiv*.
- Vidal, F. J. L., & Lluch, A. C. (2019). Diseño y validación mediante Método Delphi de un cuestionario para conocer las características de la actividad física en personas mayores que viven en residencias. *Retos: nuevas tendencias en educación física, deporte y recreación*, (36), 515-520.
- Whiting, W. C. (2018). *Dynamic Human Anatomy*. Human Kinetics.
- Worobey, L. A., Rigot, S. K., Boninger, M. L., Huzinec, R., Sung, J. H., DiGiovine, K., & Rice, L. A. (2020). Concurrent validity and reliability of the transfer assessment instrument questionnaire as a self-assessment measure. *Archives of rehabilitation research and clinical translation*, 2(4), 100088.
- World Health Organization. (2019). *Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019*, World Health Organization, Geneva, Switzerland, 22–23 August 2019. Volume 1.
- World Health Organization. (2015). *Wheelchair service training package for managers*. Geneva: WHO.
- World Health Organization. (2017). *Wheelchair service training of trainers package*. Geneva: WHO.