BJMB
Brazilian Journal of Motor Behavior

Research Article

Symmetric analysis in a wheelchair basketball player during an incremental intermittent test: a case study

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https://doi.org/10.20338/bjmb.v18i1.383

HIGHLIGHTS
- Wheelchair propelling is often assumed as symmetric.
- The cycle time of the right and left segments were similar throughout the increments.
- The participant had a constant propulsive frequency along with the test.

ABBREVIATIONS

WB	Wheelchair basketball
PF	Propulsion frequency
RP	Recovery Phases
CT	Cycle time
RCT	Right cycle time
LCT	Left cycle time
RRPT	Right recovery phase time
LRPT	Left recovery phase time
%RCT	Percentage of right cycle time
%LCT	Percentage of left cycle time
IR	Interquartile range

PUBLICATION DATA
Received 31 07 2023
Accepted 12 10 2023
Published 27 04 2024

BACKGROUND: Wheelchair basketball (WB) is a sport aimed at people with permanent disabilities in the lower limbs, with a functional classification system that allows the inclusion of various levels of injury from 1 to 4.5. Thus, it is natural that there is an increase in the search for greater sports performance which is related to physiological and kinematic analyses.
AIM: The present study aimed to compare the symmetry of temporal kinematic variables in the different zones of effort intensity during an incremental intermittent field test.
METHOD: The sample consisted of 1 male player aged (27 years), with spinal cord injury, with more than 5 years of gaming experience. The player performed the incremental field Yo-Yo Test - IR1 and the linear kinematics of the propulsive cycle was estimated.
RESULTS: The results indicated that wheelchair propulsion is a symmetrical movement, although some asymmetries seem to be perceived qualitatively, but without a statistically significant difference.
CONCLUSION: It was found that despite the injury to the right shoulder, there is symmetry in terms of wheelchair propulsion.

KEYWORDS: Kinematics | Intermittent incremental test | Basketball | Wheelchair users

INTRODUCTION

Wheelchair basketball (WB) is a sport practiced by people with permanent physical disability in the lower limbs (e.g., spinal cord injury) [1]. Due to the inequality between the players during the games a subdivision is carried out among the participants, allowing the inclusion of various levels of disabilities [2]. The functional classification system of each player according to their movements and skills presents scores ranging from 1.0 to 4.5 as determined by the International Wheelchair Basketball Federation, 20103. These aspects make the modality one of the most practiced sports among Paralympic athletes [3,4]. The evolution of WB is noticed in biomechanical research on wheelchair propulsion cycle time and symmetry [4–6]. Functional classes (i.e., 1.0 to 4.5) are associated with biomechanical changes and adjustments. According to previous studies the lower the class, the greater the kinematic limiting factors (e.g., trunk flexion for motion control) [7,8].

Wheelchair propulsion is described as a bilateral, simultaneous and repetitive movement of the upper extremities [9,10]. It is considered a cyclic movement, which begins with the moment the hand comes into contact with the rim and ends at the immediate instant before bringing the hand back closer to the rim [5]. Propulsion efficiency is determined by hand coupling at the beginning and end of the propulsion stage, thrust angle, shoulder position at the beginning and end of movement, and standardization of recovery [11]. Through a symmetry measurement, it is possible to evaluate the wheelchair player to obtain a better performance regarding the range of motion and energy savings during the propulsion [12,13], which are associated with both the player's technique and efficiency of, considering the intraindividual variability of propulsive patterns (e.g., semicircular) [5,12].

The presence of symmetry helps to obtain better performance [14], on the other hand, asymmetries can be detrimental to performance or mainly expose athletes to a greater risk of injury [15]. Biomechanical parameters, incidence of injuries, patterns of use differences between the dominant and non-dominant sides can make it difficult to propel the wheelchair in a straight line, as well as lead to excessive metabolic and cardiopulmonary demands [14-16].

Therefore, to perform better during a game, it is necessary to understand the behavior of symmetry or asymmetry in the movements inherent to the wheelchair basketball game, so that there is an appropriate training prescription according to the level of amplitude that the wheelchair user presents in the demands offered by the game. From this perspective, the study aimed to compare the symmetry of kinematic variables in different effort intensity zones during the Yo-Yo intermittent incremental field test, as it is a commonly used test [17]. A symmetrical profile on both sides during the wheelchair propulsion phases along with the increments was hypothesized. The findings could help researchers and trainers better understand kinematic adaptations due to individual characteristics and task constraints during a commonly used training test.

METHODS

Participants

A 27-year-old male, 180 cm of height, 55.79 kg of body mass, 16.20% of body fat and triceps, subscapular, suprailiac, abdominal skinfold measurements (mm) as 9.4 ± 0.20, 15.8 ± 0.10, 14.5 ± 0.20, 28.4 ± 0.30 and Σ = 68.10, and more than five years of training. Participant was affected with acquired physical disability (i.e., spinal cord injury), with legibility T12 -L1 and Functional Classification 3.0had. The athlete performed three training sessions during the week lasting three hours each session. The training was divided into cardiorespiratory (30 min), strength and mobility training (1 h), and technical and tactical training (1h and 30 min). Before the experiment, the participant provided a written informed consent to participate in this study and a brief interview verified the absence of injuries and diseases. This study was approved by the institutional review board (opinion number: 2.928.218) according to the Helsinki Declaration.

The test was carried out in an adjustable basketball wheelchair, with a dry weight of 15kg, height 68cm, seat depth 51cm, backrest height 27.5cm and width 38cm. The Levorin Way-back wheels had a frontal distance of 38cm, with a diameter of 62cm and 36Lbs/in^2 of working pressure.

Data collection procedures: field tests

The Yo-Yo intermittent test consists of a 10 m displacement between the start, turn and finish line, at a progressively incremental speed controlled by signals via beep (Yo-Yo Test, Ruval Enterprise®). Between each stage of the test, the participant has an active rest consisting of a 5m run in 10s. The test can be run at two different levels, with different speeds (levels 1 and 2). When the participant could not reach the starting line in time, or when he reached volitional exhaustion, the distance covered was recorded and represented the result of the test [18].

Figure 1. Yo-Yo Intermittent Recovery Test (Yo-Yo test).

The test was performed on an indoor court, starting with a brief 10-minute low-intensity warm-up simulating the first 4 displacement sessions of the test, followed by a 15-minute passive rest before the test [19]. The test consisted of a 10 m run with active rest and a 5 m run in 10s. As described in Table 1, the Yo-Yo Test intermittent recovery test consisted of: (i) Stage 1 - at a speed of 10 km.h^{-1} with a displacement (round trip) of 10 m each, totaling 20 m traveled; (ii) Stage 2 - at the speed of 12 km.h^{-1} with a displacement (round trip) of 10 m each, totaling 20 m traveled; (iii) Stage 3 - at the speed of 13 km.h^{-1} with two displacements (round trip) of 10 m each, totaling 40 m traveled, so successively until the evaluated reach exhaustion.

Table 1. Yo-Yo incremental intermittent test protocol - IR1.

Stage	Speed km.h^{-1}	Displacement (2 x 10m)	Divided distance (m)	Accumulated distance (m)
1	10	1	20	20
2	12	1	20	40
3	13	2	40	80
4	13.5	3	60	140
5	14	4	80	220
6	14.5	8	160	380
7	15	8	160	540
8	15.5	8	160	700
9	16	8	160	860
10	16.5	8	160	1020
11	17	8	160	1180
12	17.5	8	160	1340
13	18	8	160	1500
14	18.5	8	160	1660
15	19	8	160	1820

Kinematic analysis

The analysis was made at each final stage of the test until the volitional exhaustion of the wheelchair user, preceded by a three-dimensional inertial central marker (Functional Assessment of Biomechanics System – FAB, Biosyn Systems INC., Canada). It consists of a number of electronic sensors and a data collection unit *Handheld or Desk Top Receiver* to be located near the evaluation point. For each segment of the body there is a specific electronic sensor (figure 2), identified with the name of the region (segment) to be placed, in this way, the electronic sensors were placed in the segments of the wheelchair user as follows [20]:

• Head sensor: Occipital;
• Trunk sensor: Thoracic between T10 and T11;
• Sense of the pelvis: Lumbar L5 and Sacrum S1;
• Right and left arm sensor: Lateral part of the biceps above the elbow;
• Right and left forearm sensor: Dorsal side of the wrist just above the styloid of the ulna.

To demarcate the increase in speed there was a light-emitting diode that was activated every one minute, which was synchronized with an increase in speed according to the FAB's own video recording (100 Hz). Spatio-temporal variables were measured throughout the incremental test, such as:

• Propulsion frequency (PF): number of propulsion cycles (starts at the instant the hand comes into contact with the rim and ends at the instant before the next contact of the hand with the rim) per unit time;
• Time between Recovery Phases (RPT): interval time between non-propulsive moments.
• Cycle time (CT): propulsion frequency time adding the recovery phase;
• Normalized time per phase of the cycle: phase times as a percentage of the total time.

Statistical analysis

For cinematographic data, descriptive statistics were performed with expressions in mean, standard deviation, median and interquartile range between the right and left side. All statistical analyzes will be performed using the Statistical Package for the Social Sciences – SPSS (SPSS version 22, IBM Corporation, Armonk, New York).

Figure 2. Positioning of central inertia sensors.

RESULTS

Temporal parameters

The number of cycles per stage (cycle number), propulsive frequency (PF), mean and standard deviation of the left and right limbs of the following variables: right and left cycle time (RCT/ LCT), right and left recovery phase time (RRPT/LRPT) and percentage of right and left cycle time (%RCT/ %LCT) were reported in Table 2. The participant had a constant propulsive frequency during the test. The time between the recovery phase was regular, this resulted in a constant and symmetrical cycle time, despite presenting an inflammation in the right shoulder (bursitis), which could be an influence on the symmetry of the athlete during the propulsion of the wheelchair.

Table 2. Propulsive frequency (PF), cycle time (CT), time between recovery phases (RT), percentage of cycle time (% CT) from the right (R) and left (L) upper extremities, Median, Interquartile Range (IR)

Stage	1º Stage		2º Stage		3º Stage		4º Stage		5º Stage	
	Average ± SD	Median ± IR	Average ± SD	Median ± IR	Average ± SD	Median ± IR	Average ± SD	Median ± IR	Average ± SD	Median ± IR
Nº Cycle	**4**		**3**		**4**		**5**		**5**	
PF	0.06		0.05		0.06		0.08		0.08	
CT (R)	0.70±0.06	0.70±0.04	0.67±0.06	0.68±0.04	0.64±0.04	0.64±0.02	0.57±0.02	0.57±0.04	0.53±0.02	0.52±0.03
CT (L)	0.71±0.05		0.64±0.05	0.64±0.03	0.66±0.04	0.66±0.03	0.56±0.02	0.55±0.03	0.52±0.02	
RT (R)	0.59±0.05	0.57±0.04	0.50±0.01	0.50±0.04	0.52±0.01	0.50±0.04	0.38±0.01	0.37±0.03	0.41±0.02	0.40±0.03
RT (L)	0.58±0.05	0.58±0.03	0.47±0.03	0.46±0.03	0.53±0.05	0.46±0.03	0.40±0.04	0.42±0.03	0.43±0.02	0.45±0.03
%TC (R)	68.28	--	58.18	--	67.12		72.10		63.32	
%TC (L)	69.57	--	58.18	--	65.39		70.21		62.38	
	6º Stage		**7º Stage**		**8º Stage**		**9º Stage**		**10º Stage**	
	Average ± SD	**Median ± IR**	**Average ± SD**	**Median ± IR**	**Average ± SD**	**Median ± IR**	**Average ± SD**	**Median ± IR**	**Average ± SD**	**Median ± IR**
Nº Cycle	5		5		5		6		6	
PF	0.08		0.08		0.08		0.10		0.10	
CT (R)	0.53±0.02	0.51±0.03	0.51±0.03	0.50±0.03	0.51±0.05	0.50±0.03	0.51±0.06	0.51±0.03	0.49±0.05	0.48±0.04
CT (L)	0.53±0.04	0.52±0.03	0.57±0.07	0.57±0.03	0.50±0.02	0.49±0.03	0.57±0.02	0.58±0.03	0.53±0.05	0.56±0.04
RT (R)	0.38±0.07	0.37±0.04	0.38±0.03	0.38±0.03	0.31±0.10	0.29±0.03	0.34±0.05	0.34±0.04	0.29±0.10	0.28±0.03
RT (L)	0.40±0.03	0.41±0.03	0.43±0.03	0.44±0.03	0.35±0.03	0.37±0.03	0.38±0.07	0.39±0.03	0.37±0.03	0.38±0.03
%TC (R)	73.35	--	74.19	--	59.06	--	61.53	--	54.02	--
%TC (L)	74.39	--	71.68	--	68.12	--	77.18	--	58.79	--

DISCUSSION

The present study aimed to compare the symmetry of temporal kinematic variables in the different zones of effort intensity during an incremental intermittent field test. The results indicated that wheelchair propulsion is a symmetrical movement, although some asymmetries seem to be perceived qualitatively, but without a statistically significant difference, corroborating our hypothesis. Our findings differ from the results found by Goosey-Tolfrey and Campbell [23], who found asymmetries in some research participants, indicating a preference for the right upper limb [17], who found asymmetries in some research participants. Manual propulsion for wheelchairs is assumed to be a symmetrical movement, the propulsive instants present an amplitude and a phase so that the phenomena are symmetrical concomitantly [24,10]. The logicalness for this assumption is that any asymmetry, ordered with the decoupled nature of the wheels, would hinder a linear propulsion [25]. Corrections resulting from the direction can lead to increased energy cost and other unfavorable effects (e.g., movement compensation) [10].

According to Vegter [26], experienced wheelchair users possibly have symmetrical propulsion mechanics over time and the more trained the athlete, the greater the symmetry during wheelchair propulsion [17], In the present study, the athlete had already been practicing the modality for more than five years. Among the studies that analyzed dissimilarities in the mechanics of propulsion, there was consensus regarding the presence of symmetry. Some studies showed significant symmetry [17], as spatio-temporal variables [19], and others have significant differences from side to side (i.e., left, right). The results of the present study agree with the literature, obtaining spatio-temporal values similar to previous research. Studies such as Soltau [11] denote that low levels of symmetry can subsist during manual wheelchair propulsion and these levels can add in the graded condition when the demand at the upper end is increased. Despite the fairly uniform changes during wheelchair propulsion, the participant developed kinematic solutions to stay in the test.

The consistent change of the research participant was regarding the range of motion of flexion and elbow extension during the incremental intermittent test, which is in agreement with the study by Soltau [11]. The para athlete demonstrated discrepancy between the angle of the right and left elbow during the recovery phase. According to Goosey-Tolfrey and Campbell [23], a possible explanation for this was that, although the elbow flexion angles were the same duration, the point at which each upper limb (i.e., right and left) flexed may have varied, since before the recovery phase, during the propulsive phase, the point at which each hand made initial contact with the hand rim could have varied. Certainly, this would have an effect on the angle of the elbow, as when the hand follows the rim through the pressure arc, the elbow extends. Thus, the results agree with the studies presented by Su [26], where it was addressed that both the right arm and the left arm have the same power, but some of the arms may present smaller movements due to the force exerted by the requested limb.

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During the incremental test, data from the 1st stage at 10Km/h are close to the Soltau study in the spatio-temporal variables of the TC at a fast and graduated level, as well as the %TC in stages 2 and 10 (12 km/h and 16.5 km /h) respectively. Hurd et al (2008) [28] studied lateral differences in temporal variables to standard manual propulsion in different environments and showed similar magnitudes of differences to those in the current study, however. The differences found, although not significant, may have occurred due to the difference between the dominant and non-dominant side and the exhaustion of the research participant during the intermittent incremental test. It is noteworthy that the lack of consensus regarding differences in symmetry may be due to differences between sample sizes and statistical methods.

Forward progression in wheelchair basketball refers to the direct advance of the team towards the opposing basket during offense. This movement is crucial for creating scoring opportunities and overcoming the opposing defense. It involves efficient wheelchair propulsion, team coordination and synchronization, strategic use of court space, adaptation to the opposing defense, precise mid-range and long-range shooting, speed, and agility. Specific training is crucial to develop these fundamental skills.

As recommendation, further analyses should include different functional classification and wheelchair players' specialties to identify if asymmetries would be observed due to different intensities of effort in a field training test. Moreover, the inclusion of more detailed biomechanical analyses would allow coaches and researchers to clear understand how wheelchair players organize their technique at training different zones to achieve the task goal, improving performance and reducing the risk of injuries.

CONCLUSION

The athlete presented kinematical symmetry regarding wheelchair propelling. It was noted that low levels of symmetry can be perceived during manual wheelchair propulsion, which can be accentuated when the demand on the upper extremity is increased. Despite uniform changes during wheelchair propulsion, the participant developed several kinematic solutions to achieve the test goal.

REFERENCES

1. Goosey-Tolfrey VL. Physiological profiles of elite wheelchair basketball players in preparation for the 2000 Paralympic Games. *Adapt Phys Act Q*. 2005;22(1):57-66. 1. doi: 10.1123/apaq.22.1.57
2. Molik B, Kosmol A, Morgulec-Adamowicz N, et al. Comparison of aerobic performance testing protocols in elite male wheelchair basketball players. *J Hum Kinet*. 2017;60(1):243-254. doi: 10.1515/hukin-2017-0140

3. International Wheelchair Basketball Federation IWBF classification for wheelchair basketball. 2021. (available online at: www.iwbf.org; accessed on 20.04.2023)
4. Francis J, Owen A, Peters DM. A new reliable performance analysis template for quantifying action variables in elite men's wheelchair basketball. *Front Psychol*. 2019;10:16. doi: 10.3389/fpsyg.2019.00016
5. Brown DD, Knowlton RG, Hamill J, Schneider TL, Hetzler RK. Physiological and biomechanical differences between wheelchair-dependent and able-bodied subjects during wheelchair ergometry. *Eur J Appl Physiol Occup Physiol*. 1990;60:179-182. doi: 10.1007/BF00839155
6. Chow JW, Levy CE. Wheelchair propulsion biomechanics and wheelers' quality of life: an exploratory review. *Disabil Rehabil Assist Technol*. 2011;6(5):365-377. doi: 10.3109/17483107.2010.525290
7. Symonds A, Barbareschi G, Taylor S, Holloway C. A systematic review: the influence of real time feedback on wheelchair propulsion biomechanics. *Disabil Rehabil Assist Technol*. 2018;13(1):47-53. doi: 10.1080/17483107.2016.1278472
8. Menezes-Reis R, Ribeiro VB, Tourinho Filho H. Respostas fisiológicas ao exercício físico em atletas cadeirantes com lesão medular. *Conscientiae saúde*. 2015;14(1):161-168. 1. doi:10.5585/ConsSaude.v14n1.5216
9. Collins EG, Gater D, Kiratli J, Butler J, Hanson K, Langbein WE. Energy cost of physical activities in persons with spinal cord injury. *Med Sci Sport Exerc*. 2010;42(4):691-700. doi: 10.1249/MSS.0b013e3181bb902f
10. Shimada SD, Robertson RN, Bonninger ML, Cooper RA. Kinematic characterization of wheelchair propulsion. *J Rehabil Res Dev*. 1998;35(2):210-218.
11. Soltau SL, Slowik JS, Requejo PS, Mulroy SJ, Neptune RR. An Investigation of Bilateral Symmetry During Manual Wheelchair Propulsion. *Front Bioeng Biotechnol*. 2015;3:86. Published 2015 Jun 11. doi:10.3389/fbioe.2015.00086
12. Cooper RA, De Luigi AJ. Adaptive sports technology and biomechanics: wheelchairs. *Pm&r*. 2014;6(8):S31-S39. doi: 10.1016/j.pmrj.2014.05.020
13. Cooper RA, DiGiovine CP, Boninger ML, Shimada SD, Koontz AM, Baldwin MA. Filter frequency selection for manual wheelchair biomechanics. *J Rehabil Res Dev*. 2002;39(3).
14. Bergamini E, Morelli F, Marchetti F, Vannozzi G, Polidori L, Paradisi F, et al. Wheelchair Propulsion Biomechanics in Junior Basketball Players: A Method for the Evaluation of the Efficacy of a Specific Training Program. *Biomed Res Int*. 2015;2015:275965. doi:10.1155/2015/275965
15. Heishman A, Daub B, Miller R, Brown B, Freitas E, Bemben M. Countermovement jump inter-limb asymmetries in collegiate basketball players. *Sports*. 2019;7(5):103. doi:10.3390/sports7050103
16. Brassart F, Faupin A, Hays A, Bakatchina S, Alberca I, Watelain E, et al. Upper limb cranking asymmetry during a Wingate anaerobic test in wheelchair basketball players. *Scand J Med Sci Sports.* 2023;33(8):1473-1485. doi:10.1111/sms.14376
17. Ferreira da Silva CMA, de Sá KSG, Bauermann A, Borges M, de Castro Amorin M, Rossato M, et al. Wheelchair skill tests in wheelchair Basketball: A systematic review. *PLoS One*. 2022;17(12):e0276946. doi: 10.1371/journal.pone.0276946
18. Rodgers MM, Keyser RE, Gardner ER, Russell PJ, Gorman PH. Influence of trunk flexion on biomechanics of wheelchair propulsion. *J Rehabil Res Dev*. 2000;37(3):283-295.
19. Nunome H, Doyo W, Sakurai S, Ikegmai Y, Yabe K. A kinematic study of the upper-limb motion of wheelchair basketball shooting in tetraplegic adults. *J Rehabil Res Dev*. 2002;39(1).
20. Yanci J, Granados C, Otero M, et al. Sprint, agility, strength and endurance capacity in wheelchair basketball players. *Biol Sport*. 2015;32(1):71-78. doi: 10.5604/20831862.1127285
21. Tachibana K, Mutsuzaki H, Shimizu Y, Doi T, Hotta K, Wadano Y. Influence of functional classification on skill tests in elite female wheelchair basketball athletes. *Medicina (B Aires)*. 2019;55(11):740. doi: 10.3390/medicina55110740
22. Pérez R, Costa Ú, Torrent M, Solana J, Opisso E, Cáceres C, et al. Upper limb portable motion analysis system based on inertial technology for neurorehabilitation purposes. *Sensors*. 2010;10(12):10733-10751. doi: 10.3390/s101210733
23. Goosey VL. Symmetry of the elbow kinematics during racing wheelchair propulsion. *Ergonomics*. 1998;41(12):1810-1820. doi: 10.1080/001401398185983
24. Hernandez V, Gorce P, Rezzoug N. Evaluation and validation of musculoskeletal force feasible set indices: Application to manual wheelchair propulsion. *J Biomech*. 2018;68:70-77. doi: 10.1016/j.jbiomech.2017.12.012
25. De Groot S, Veeger DH, Hollander AP, Van der Woude LH. Wheelchair propulsion technique and mechanical efficiency after 3 wk of practice. *Med Sci Sports Exerc*. 2002;34(5):756-766. doi: 10.1097/00005768-200205000-00005
26. Vegter RJK, Lamoth CJ, De Groot S, Veeger DHEJ, Van der Woude LH V. Variability in bimanual wheelchair propulsion: consistency of two instrumented wheels during handrim wheelchair propulsion on a motor driven treadmill. *J Neuroeng Rehabil*. 2013;10:1-12. doi: 10.1186/1743-0003-10-9
27. Su FC, Chou YL, Lu JW, Lai KA. Three-dimensional kinematics in wheelchair propulsion. *J Biomech*. 1992;25(7):732.
28. Hurd WJ, Morrow MM, Kaufman KR, An KN. Biomechanic evaluation of upper-extremity symmetry during manual wheelchair propulsion over varied terrain. *Arch Phys Med Rehabil.* 2008;89(10):1996-2002. doi:10.1016/j.apmr.2008.03.020

Citation: de Jesus K, Nascimento LS, de Jesus K. (2024). Symmetric analysis in a wheelchair basketball player during an incremental intermittent test: a case study. *Brazilian Journal of Motor Behavior*, 18(1): e383.
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Funding: This research received no specific grant from any funding agency.
Competing interests: The authors have declared that no competing interests exist.
DOI: https://doi.org/10.20338/bjmb.v18i1.383