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Kinematical Technical Performance of the Wheelchair Push in the 100 Meters Race for Disabled Runners Athletics

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Abstract: This research aims to identify the most important kinematical variables associated with wheelchair push in 100 meters race for disabled men athletics runners. Research sample of three runners has been selected intentionally from the republic athletics championship. The race included the start-up phase and then starting phase increasing speed until the finish line. Results indicated that 100 meters runners using wheelchairs need longer distance and more time to reach their maximum speed.

Key words: Kinematical Technical Performance % Wheelchair Push % 100 Meters Race % Disabled Runners Athletics

INTRODUCTION

The track and field competitions are competitive because it help the players to show their capabilities of high performance with high efficiency and in particular contest 100 meter chair where one of the ex-speed in which the rider tries to finish the race in the least time possible, so the athletic depends on either increasing frequency of his step or increasing the stride length [1], in this contest, frequency step represents here the number of pushing wheelchair and striking wheelchair along [batch] is the length of step. This competition has special requirements must be met for the rider to reach the highest possible level of athlete [2], from those requirements the training level of the elements of power, speed and endurance of the player.

The world has witnessed in recent times that the technical performance of the 100 meter wheelchair is subjected to continuous changes and developments through the planning process including a scientific manner using modern technical tools which work to improve the properties of pushing and preventing injuries through the application of research findings in mechanical sport using wheelchairs, which plays an important role in training and analysis of motor performance to determine the factors affecting the performance in order to reach the most appropriate solutions to the problems of mobility through what is extracted from the useful scientific information in the field of training in order to achieve the best possible kinesthetic achievement [3, 4].

Thus, the analysis of the stages of the sprints is the basis as a way to assess the strengths and a remedy to weaknesses as a measure to motor performance objective criterion that can build on it in live performance skills for any kinetic skill from the standpoint of biomechanical, where the motor performance is a dynamic complex system of motor actions based on the optimal use of the potential goal-oriented motor activity, where speed is dependent on the movement of body parts. The speed of skills performance depends on speed of its constituent motor performances that lead to access higher level [5, 6]. As a result of the speed performance of pushing wheelchairs by the arms and overlapping stages during the 100 meter race, coach cannot identify shortcomings in the technical performance of the pushing. Chow *et al*. [7] compared international and Egyptian times recorded in similar races to the one under study, they detected that international personal times recorded by disabled men in 100 m wheelchairs race were 14.85 s, 15.01 s, 16.10 s, 16.80 s, with an arithmetic average 15.69 s and the Egyptian times were17.80 s, 19.30 s, 19.70 s with an average of 18.93 s. So, it is clear how much the delay of times of Egypt.

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This study aims to analyze the 100 m wheelchair racers for the analysis of mobility in order to identify the most important variables associated with kinematical variable associated with performance of pushing wheelchairs in 100 m race of disabled Egyptian contestants.

MATERIALS AND METHODS

Curriculum and Research Sample: The researcher used the descriptive method using a single set of runners from disabled athletics men set and participants in the championship of the republic, November 2009. Research sample of three contestants was intentionally selected from all participants in the 100 m wheelchair race.

The basic Study

Playground Equipment

Based on the results of previous studies and given the extent of the delay of Egyptian times compared to the international times, distance of 100 meters has been divided to 5 sections of probability predicted decrease or increase distances of the race stages for the Egyptian contestants, first section of a length of 15 meters, the second section of a length of 15 meters. For studying phase of increasing speed, a camera was placed in front of the middle of each section; also 3 cameras were used to determine the distance of maximum speed and end stage of the race for members of the research sample. The third camera was placed in the middle of the third section, length of 15 meters, which starts from a distance of 30 meters from the line start of the race until the 45meters. The fourth camera was in mid-fourth section with a length of 20 meters starting from 45 meters to 65 meters and then was fifth camera in the middle of the fifth section length of 35 meters from 65 meters until the end of the 100 meters.

Implement and Record Attempts: Filming attempts was carried out according to data recording steps mentioned above on 23November, 2009. The researcher took into account that players perform their attempts in the best form, emphasizing on the importance of giving constant instructions for players concerning skill performance.

RESULTS AND DISCUSSION

Through the results of Table 1, it is clear that the contestants (members of the research sample for the 100 m wheelchairs race) have reached their speed maximum 9.18 m/s, 8.82 m/s, 7.78 m/s, respectively, at distances 83.38 m, 89.2 m, 84.6 m from the start line of the race, that the phase to keep the maximum speed was 1.478 m, respectively, for the first rider and 1.41 m, for the second rider and 1.24 meters for the third rider and despite the importance of this stage, it is indicated by prior studies [7-9] that when the arrival of rider to the maximum speed, the technique may retards and the runner becomes unable to implement the performance by the required relaxation and he is also unable to remain steadfast on the motor unit for maximum speed and given to the small values of distances to keep the maximum speed for members of the research sample, this indicates that there is no special training to develop with maximum speed and

Table 1: Mean and standard deviation of the speed of each wheel's center of gravity 0.16/s, the highest value speed, the number of strikes achieved for displacements for each rider as far as sections within a distance of 100 m

Variables	Distances	The first 15 meters	The second 15 meters	The third 15 meters	The fourth 20 meters	The fifth 35 meters
The first contestant	Average speed	2.50	3.92	4.65	5.18	8.26
	Top Speed	3.65	4.69	5.19	5.50	9.18
	Place	15	24.09	38.21	52.11	83.38
	Number of strikes	10	9	9	10	8
The second contestant	Average speed	2.11	3.21	3.74	4.61	7.73
	Top Speed	3.45	4.18	4.72	5.57	8.82
	Place	6.43	23.62	40.38	47.43	89.2
	Number of strikes	11	8	9	7	5
The third contestant	Average speed	2.61	3.76	3.92	4.06	6.90
	Top Speed	4.52	4.19	4.88	4.82	7.78
	Place	15	23	45	46.36	84.6
	Number of strikes	10	8	11	11	10

Table 2: The arithmetic mean and standard deviation of the speed of the wheel for each transition 0.16 s ,displacement each stroke, the speed of displacement, the time of the strike, the movement time of resilience of the sample individuals together through the sections of sections 100 m

Variables	Distances	The first 15 meters	The second 15 meters	The third 15 meters	The fourth 20 meters	The fifth 35 meters
Speed transition for	Mean	2.4	3.7	4.1	4.6	7.6
the second wheel	Std. deviation	0.36	0.48	0.48	0.56	0.68
Displacement distance meter	Mean	1.20	1.69	1.60	2.16	4.16
	Std. deviation	0.18	0.08	0.13	0.32	0.73
Second time displacement	Mean	0.49	0.46	0.61	0.46	0.56
	Std. deviation	0.01	0.05	0.36	0.07	0.12
Speed displacement m/s	Mean	2.74	3.67	3.70	4.74	7.44
	Std. deviation	0.31	0.44	0.22	0.54	0.74
The time of the strike/s	Mean	0.26	0.20	0.20	0.20	0.21
	Std. deviation	0.01	0.02	0.03	0.01	0.05
Time movement of resilience/s	Mean	0.21	0.27	0.20	0.24	0.36
	Std. deviation	0.05	0.05	0.03	0.05	0.1
Number of pushings	Mean	1.3	8.33	9.66	9.33	7.66
	Std. deviation	0.57	0.57	1.15	2.08	2.51

Table 3: Analysis of variance between sections divided by 100 m [15 m first, second, third, fourth and 20 m, 35 m, the last] of the sample individuals together to speed variable displacement

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	39.43	4	9.85	40.93*
	Within groups	2.40	10	0.24	
	Contrast	41.84	14		

Function at the level of significance 0.05

of increasing distance to keep the contestants members appointed by the search, as it did slight non-significant drop in the rate of speed, with an arithmetic mean of the speed of the medium of the contestants through a distance of 100 m (5.00 m/s, 4.37 m/s, 4.35 m/s, respectively).

This is consistent with prior study [7] indicating that wheelchairs runners often need to greater time and longer distance to reach the maximum speed and also stated that the personal times of 100 m, to the category of T54 for a sample of examined men were 14.85 s, 15.01 s, 16.10 s, 6.80 s with arithmetic average of 15.69 s, citing the small size of the mass of the muscle groups involved in pushing the wheelchair compared with normal, which have a greater impact in increasing the 100 m time of wheelchairs racing.

Through the results of Table 1, the members of the research sample possessed the stage of having increasing and continuing speed throughout a distance of 100 meters, which is considered as confirmed by previous studies [10-12] that the phase of increasing speed is considered one of the main pillars in the stages of the 100 m race and that the longer this phase with the increase in value of the maximum speed has led to improve the digital standard. The speed of the runner depends on one of the factors either stride length or reluctance to racing speed, which is similar to the length of the displacement distance resulting from each batch of the chair and the time it takes for the distances that displacements during the 100 m wheelchair race under discussion [1].

As confirmed by the results of Tables 2 and 3, there are significant differences between all the sections of sections of the race at the speed of displacement with the except of second and third 15 meters and significance was from the first section to the last section. This is also confirmed by the results of Tables 4 and 5 of the existence of significant differences between all sections of the race to the length of the displacement distance and the final 35 meters was the largest section of the race which increased the length of the displacement distance, which indicates that the contestants made their maximum effort whenever they approached the finish line. This is consistent with what shown by Table 1 that all the values of maximum speed have emerged after 83 m meaning within section 35 m for the whole sample. This is due to that the amount of self incapability in the first stage is large and therefore, the effort is greater to overcome this incapability. During the last 35 m section, inertia gets smaller and hence the effort required will be less.

Table 4: Analysis of variance between sections divided by 100 m of the sample individuals together for a variable length of the displacement distance

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	16.39	4	4.09	29.29*
	Within groups	1.3	10	0.14	
	Contrast	17.7	14		

Function at the level of significance 0.05

Table 5: Analysis of variance between sections divided by 100 me of the sample individuals together for a variable time displacement

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	0.05	4	0.01	0.44*
	Within groups	0.31	10	0.03	
	Contrast	0.36	14		

Function at the level of significance 0.05

Table 6: Analysis of variance between the 100 meters sections for members of the research sample for a variable time of the strike

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	0.01	4	0.002	2.29*
	Within groups	0.01	10	0.001	
	Contrast	0.02	14		

Function at the level of significance 0.05

Table 7: Analysis of variance between the 100 meters sections of the research sample for a variable time of resilience movement

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	0.04	4	0.01	30.38*
	Within groups	0.04	10	0.003	
	Contrast	0.07	14		

Function at the level of significance 0.05

Results of Table 6 show that there was no significant differences in the displacement time between the 100 m distance sections, which indicates that the sample individuals may have relied on increasing the length of the displacement distance resulting from the pushing of wheelchair moving by hands to increase the speed of displacement and they did not depend on time displacement, resulting in an increase in the amount of transitional speed to the competitors during the race distance and this agreed with the results of Tables 7 and 8. Also, this fits with results of other study [13] that the stride length is a sign of the speed of running and that the greater the length of the step the faster running, as the stride length represents [for competitions for moving wheelchairs] displacement distance that has been made to push wheelchair hands.

A previous research [14] studied the importance of studying the advantages and characteristics of pushing with hands to the edge of the wheelchair during studying the speed of the displacement distance, where the stop of speed the displacement distance depends on the technical performance which was defined in another study [15] as a symmetry of power between the right side and left side during the pushing. Another work [16] added that the better the results of the technical performance of pushing (strike) improved mechanical efficiency push, the greater the efficiency of mechanical improvement in the time of pushing increased and improved recurrence of pushing which indicates a good training for the competitor. Also, the technical performance of the pushing depends on two factors: the time of pushing and time of movement resilience of pushing.

Through Table 8, it is clear that there is no significant differences between sections of the 100 m race to the time of the strike (pushing), indicating that members of the research sample had a fixed performance to the times of pushing depending on the lack of differences between sections of the 100 m to the time of pushing, as evidenced by also the adoption of the members of the research sample in the time of pushing resilience to pushing a

Table 8: Analysis of variance between the 100 meters sections of the research sample for a variable the transition speed variable for each 0.16 seconds

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Sections divided by 100 m	Between groups	43.96	4	10.9	39.07*
	Within groups	2.76	10	0.027	
	Contrast	46.72	14		

Function at the level of significance 0.05

Table 9: Analysis of variance for the number of pushings between members of the sample divided by distances of 100 m

Race distances	Variation Source	Squares Sum	Freedom Degrees	Squares Average	Value "f"
Number of pushings	Between groups	10.1	2	5.06	2.11*
	Within groups	28.8	12	2.4	
	Contrast	38.9	14		

Function at the level of significance 0.05

second factor affecting the technical performance of the pushing and that emerges from the results of Table 9 that there are significant differences between the sections of the race to the time of resilience movement. Significance was recorded for the section of the final 35 m distance. This is contrary to what was confirmed by previous studies [8, 17] that the time of connecting hands with the wheel when pushing (the speed of the strike) should be reduced, in line with increasing time of movement of resilience compared to normal runners who minimize the base time to increase speed.

The results of Table 9 show the lack of significant differences between sections of 100 m, to the frequency of pushing (frequency) where the relative stability of the repetition of the number of pushing through the various stages of the race and this shows that the runners of wheelchairs sample are individuals maintain their fixed pushing throughout the race did not rely on increasing the rate of frequency to increase the speed of the running and this is consistent with the results of Table 7 that there was no significant differences in the time of the displacement distance between the sections of the 100 m race and this is in line with the results of confirmed by prior study [7] of the stability of the frequency of pushing, which shows the change of the kinematical factors which influence the movement of pushing, depending on the increase in the length of the displacement distance and not on the number of pushing (frequency) to increase the speed of the running throughout the race according to the requirements of each stage of the race.

This is consistent with what was confirmed by prior study [18] that the rider should increases both the length of the distance of the stride and its frequency during the running until a specific speed and then a factor increases over the other factor. So, training must be designed to stabilize the frequency of pushing (frequency) of the wheelchair with the change in the kinematical values of variables that causes the movement of pushing and in accordance with the requirements of each stage of the race.

After studying the previous kinematical variables in the speed of running of wheelchairs in question, it is clear how the agreement between them and the results of Table 9 that there are significant differences at the level of 0.05 between the sections of the 100 m race, in the average speed of the running wheelchair (transitional speed of the wheel per 0.16 s) of the contestants together. Significance was achieved in the last section of the race and there was no difference in the amount of speed between sections at the second 15 m and the third 15 meters and the fourth 20 meters, where it may be due to the small values of a unit of measurement of the contest and the value is much less than the significance of the statistic differences, where the time value of their importance in practice, as a result of the race may be determined on 0.001 of a second. This is consistent with other study [11] that speed of runner is not going to a fixed rhythm from the start of the race until the end which may be due to that when a difference in the amount of speed between the various stages of the race may be the result of changes in the resistance when the runner push [7].

CONCLUSION

- The existence of various technical stages of the 100 m wheelchair race for members of the research sample, including the start-up phase and the starting point and then increasing speed until the finish line.
- The difference in the rate of speed and direction of the significance between 100 m race sections indicates the continuity of the increasing speed phase along the race.

- 100 m wheelchairs runners need longer distance and time for greater access to their maximum speed.
- The arrival of the three contestants of the research sample to their speed maximum, reaching values of 9.18 m/s, 8.82 m/s, 7.78 m/s at distances 83.38 m, 89.2 m, 84.6 m, respectively from the start line of the race.
- The average length of displacement distances of the three contestants during the first 15 m; the second 15 m; the third15 m ; the fourth 20 m and the fifth 35 m were 1.20 m, 1.69 m, 1.60 m, 2.16 m, 4.16 m, respectively. while the displacement speed recorded 2.74 m/s - 3.67 m/s -3.70 m/s - 4.74 m/s - 7.44 m/s, respectively.
- Members of the research sample depended on the increasing of the length of the displacement distance with frequency factor pushing throughout the race distance in order to increase the average speed of the wheelchairs which indicates that the 100 meter race for wheelchairs is within the speed rhythm races.
- The average number of strikes recorded for the three contestants were10.33 strikes in the first 15 m, 8.33 strikes in the second 15 m ; 9.66 in the third 15 m; 9.33 strikes in the fourth 20 m and 7.66 in the final strike.

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