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Influence of wheelchair mobility training on sprint performance of amateur wheelchair tennis players

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Abstract: To achieve the purpose of the study was to find out the Influence of wheelchair mobility training on sprint performance of amateur wheelchair tennis players. To fulfill the purpose of the study a convenience sample of twelve participants with physical impairment (N = 24, males) from Coimbatore District, aged from 18 to 30 years old, were invited to participate in the study. using random procedure, they divided into two groups each consist of 12 subjects. All the participants of experimental group underwent eight weeks of wheelchair mobility training along with their usual activities. Outcomes were measured at baseline and after the eight weeks of intervention. The 20 m sprint test was used to test the wheelchair sprint performance, the test was assessed in prior and after the training period and recorded as pre and post test data respectively. The scores were recorded in seconds. The 8-week wheelchair mobility training modules were designed and implemented by following the principles of sports training namely consistency, progression and overload during the entire training phase of the study. The t-test was used to compare the mean. The level of significance was set at $p<0.05$ level of confidence. The eight weeks of wheelchair mobility training program improved the 20 meters sprint performance of the wheelchair tennis players and the results showed that the mobility exercises are able to produce significant improvement on wheelchair sprint performance of the wheelchair tennis players.

Index Terms **– Wheelchair Tennis, Wheelchair Mobility Training and Physical Impairment.**

Introduction

Every disabled person should have a right to live in a world that does not see him or her as handicapped but as a person with a unique set of abilities and life potentials. Children and young people with disabilities continue to be one of the most disadvantaged groups in all our societies. Accepting them is a problem and knowing what-to-do about it is quite a different thing of course is that the children improve and learn at different rates and in different methods.

As per the world report on disability, more than one billion people live with some sort of disability which constitutes about 15% of the world's population, which is higher than the previous WHO estimation of 10% in 1970 (WHO, 2011). Out of which 70 million people are movement disabled and require a wheelchair for locomotion. The report also agrees that the rate of disability is increasing considerably, mainly because the peoples are aging, as a result of increased existences of accidents and due to an rise in chronic health conditions, among the other reasons. In India as per the 2011 census data, 26.81 million people are disabled and this constitutes 2.21% of the total Indian population, out of which 20.28% are movement disabled

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people (Census, 2011). Citing 2002 national sample survey (NSS), the same report points out that there are 10.6 million people with movement disabilities which constitutes to 57.5% of PWDs.

Mobility is a fundamental aspect of health which leads to social integration and individual well-being. Mobility of certain temporarily disabled wheelchair users can be regained by rehabilitation processes and they can be successfully re-integrated into a productive and active life. But most of the lower limb disabled people and aged persons with lower limb incapability depend on wheelchairs for their mobility, for the entire life (van der Woude et al., 1999). For them, independent mobility increases their self-confidence, self-esteem, and happiness levels due to self-reliance. Therefore, the role of value-added assistive systems takes an important place in improving the quality of their life.

Sport is one of the many ways that people with physical impairment can increase physical activity and improve health. It is particularly important in the mobility impairment population because the people most frequently injured are those who are young and otherwise healthy (Ackery et al., 2004).

Wheelchair sport has grown incredibly since 1948 when Sir Ludwig Guttmann organized the first international sports competition for wounded World War II veterans at Stoke Mandeville Hospital in England. What began as a rehabilitation exercise has evolved into one of the world's largest multisport events, the Paralympic Games. There are currently 10 Paralympic sports (summer and winter) that involve competition in the form of wheelchair. These range from individual and team sports involving propulsion, such as wheelchair racing and wheelchair basketball, to non-propulsion wheelchair sports, such as fencing and shooting (Vicky Goosey-Tolfrey, 2010).

Tennis practiced by people with disabilities began to form progress at the primary tournament of its kind, held in l. a. in 1977. Until then, it had been played only individually. After the tournament, people with disabilities started gradually to promote this sport, on various occasions within hospitals and a bit less often at tournaments. Tennis in a wheelchair then expanded to Europe (Netherlands, Germany, France, etc,). The International Wheelchair Tennis Foundation (IWTF) was founded in 1980, with the goal of organizing and promoting tennis during a wheelchair.

Wheelchair tennis in Croatia began to develop in 1990 at the instigation of a couple of amateurs - enthusiasts. A more serious approach and development began only in 1996 after the involvement of professional staff, which was to extend the standard of coaching [Lugonji S (2011]. Wheelchair tennis today is among the foremost popular sports played in wheelchairs. the rationale is that an individual during a wheelchair can play tennis with people without disabilities [Diaper NJ & Goosey-Tolfrey VL (2009)]. Vrdoljak [2013] writes that in tennis, people with disabilities play by an equivalent rules as people without disabilities-the rules specified by the international tennis federation-with only one difference: the ball can bounce twice before an individual during a wheelchair returns it, and therefore the ball can bounce on the bottom just one occasion before an individual without disabilities returns it.

Wheelchair sports propulsion techniques and strategies are complex and involve several factors (Goosey-Tolfrey & Kirk, 2003). Identifying the specific aspects of propulsion related to mechanical efficiency is important both theoretically and practically (De Groot, Veeger, Hollander, & Woude, 2002). Intervention strategies to improve athletes' pushing techniques and mechanical efficiency have been a topic of great interest to sports scientists for many years (Goosey-Tolfrey, 2010). Studies in wheelchair sports are essential to optimizing sports performance (Vanlandewijck, Theisen, & Daly, 2001). It is important to further biomechanical

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and physiological understanding to help determine the optimal benchmarks in efficiency and energy expenditure with regards to wheelchair design, physical conditioning, physical capabilities, and power output parameters (Van de Woude et al., 1988). The specific movements and activities used in wheelchair sports have most commonly been measured using a laboratory ergometer, which fails to address the contribution of the forward momentum of the wheelchair brought by the movement of the trunk and upper body (Moss, Fowler, & Goosey-Tolfrey, 2005). Field testing, rather than traditional laboratory testing, is a more feasible way to get an indication of performance standards (De Groot et al., 2012). Improvement in testing outside of the restricted lab environment has been advanced through the use of telemetry-based velocimeter, enabling researchers to measure wheelchair push velocity in a more realistic environment (Moss, Fowler, & Tolfrey, 2003). Despite the major improvement in general technology, wheelchair propulsion technique is still not very well understood (Van der Woude, Veegar, Dallmeijer, Janssen, & Rozendaal, 2001). There is a need for standardization and consensus for applied measurement strategies, technologies, and methodology in the field of disabled sports (Van der Woude et al., 2001).

MATERIAL AND METHODS

Participants

To achieve the purpose of the study, a convenience sample of twelve participants with physical impairment (N = 24, males) from Coimbatore District, aged from 18 to 30 years old, were invited to participate in the study. using random procedure, they divided into two groups each consist of 12 subjects. Subjects were excluded from the study if they were known to be cognitively impaired, if they had any medical condition that prevented them from exercising. All participants were eligible for inclusion in this study on the basis of their physician's recommendation, as indicated by their diagnosis in their medical record, and determined that they could co-operate with the assessment and exercise procedures and that they could undertake exercise safely. The participants and parents gave their consent to the study and approval was obtained from the ethics committees of the Ramakrishna Mission Vivekananda Educational and Research Institute, Coimbatore. All the participants of experimental group underwent eight weeks of wheelchair mobility training along with their usual activities. Outcomes were measured at baseline and after the eight weeks of intervention. The control group was not administered with specific training program other than their daily routine. The 20 m sprint test was used to test the wheelchair sprint performance, the test was assessed in prior and after the training period and recorded as pre and post test data respectively. The scores were recorded in seconds.

Training Intervention Programme

The 8-week wheelchair mobility training modules were designed and implemented by following the principles of sports training namely consistency, progression and overload during the entire training phase of the study. The well-structured training programme was implemented five days per week for 8 weeks on Mondays, Tuesday, Wednesdays, Thursday and Fridays within the working hours. Supervised exercise training is an important issue in developing skill performance variables among people with physical impairment. In order to train the individuals with physical impairment, the individualized education programme was adopted for better result. A weekly training program is planned to be effective and interesting especially to the individual with physical impairment. Due to the physical impairment, commencement of an activity is occasionally hard and does not have long concentration that gives challenge to the instruction of propulsion of wheelchair mobility training. The program

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is diversified, including activities performed inside and outside and from playing games to active relaxation. Two physical educators trained in wheelchair mobility training for individuals with physical impairment, were assisting the scholar during the entire training program. The training was done for 60 minutes for 5 days in a week, including the stretching & warm-up, wheelchair mobility training to end with cool down exercises. The training was executed by adopting progressive method at a slower pace and increased frequency to aid in the development and maintenance of the acquired skills.

Table – II: Training Schedule of Wheelchair Mobility Training

Day	Training Methods		1st- 4th week		5th - 8th week		Training Time /Total Duration	
			Rep.	Rest (sec)	Rep.	Rest (sec)		
Mon, Tue, Wed, Thu & Friday	Warming Up	Chest Expansion, Alt Chest Expansion, Arm Circles, Neck Rotation, Side Arm Rises.	-	90	-	60	8 min	60 min
	Warm Up Games	Balloon Games, Robbers And Cops, Sharks, Pac Many	2	90	3	60	15 min	
	Mobility Training	Down The Mountain, Park The Car, Through The Gate, Agility, Sprint Slalom Reverse, Two Push Slalom, Half Court Map, Box Command	2	90	3	60	30 min	
	Warm-down	Fingers Relaxation, Arm Loosing	-	-	-	-	7 min	

Statistical analysis

In the present study for the sake of analysis of data, mean and standard deviation of the variables were calculated and statistical t-test was used to compare the mean. The level of significance was set at $p<0.05$ level of confidence. The analysis of data was performed by using Statistical Package for the Social Sciences (SPSS).

RESULTS AND DISCUSSION

Twelve participants were recruited and underwent familiarisation and baseline testing. All participants completed pre-test measurements, they undergone the wheelchair mobility training intervention and post-test measurements after 8 weeks. The training sessions and outcomes were supervised and measured by the investigator along with two qualified physical educators who had five years of experience including three years of working specifically with people with disabilities. After the analysis of the data the obtained results are presented in the following table 1.

TABLE – I: Computation of 't' ratio on 20m Sprint test among amateur wheelchair tennis players of experimental and control group

Test	Pre test ± SD	Post-test ± SD	Mean diff	SD	σ DM	't' ratio
Experimental group	8.54 ± 0.14	7.55 ± 0.19	0.98	0.15	0.04	22.17*
Control group	8.57 ± 0.09	8.56 ± 0.10	0.01	0.07	0.02	0.44

* Significant at 0.05 level *t value 0.05

(1,11) = 2.20

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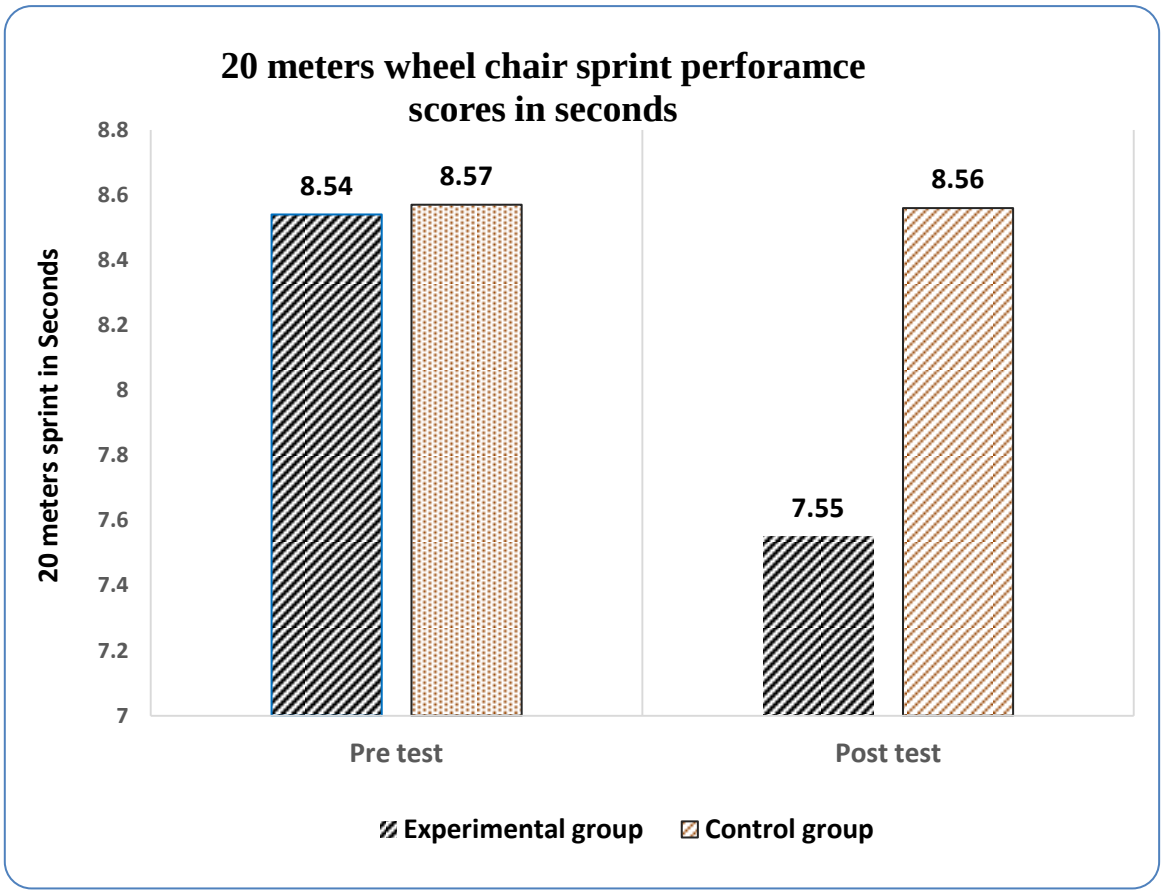
As per table IV, the obtained t - ratio on 20m Sprint test for 22.17 and 0.04 for the experimental group and control group respectively. The experimental group showed the greater t value than the required table value of 2.20 at 0.05 level of confidence, hence it was found to be significant. At the same time the control group showed the t – value of 0.44 is lesser than the table value it was found that there is no significant improvement was found. From the results of the table it was inferred that the experimental group showed significant improvement on 20 meters sprint test of amateur wheelchair tennis players.

FIGURE – I: Bar diagram showing the pre-test and post-test means of experimental and control group on selected 20 meters wheelchair sprint performance of amateur wheelchair tennis players



DISCUSSION

The wheel chair mobility training is specially invented for the wheelchair athletes and the wheelchair tennis game requires the fast movement with wheelchair to all over the playing area. Moreover at least of 20-meters sprint is minimum requirement of the tennis playing to reach the ball successfully. Hence the study implies to access the 20-meter sprint with wheelchair the performance was assessed and computed from pre-test performance to post-test performance the 11.51% improvement was observed. The improvement was significant when compared to the t - ratio obtained from the results of the study. It also inferred that the performance was better than compared to the control group.

Wheelchair maneuvers may include propulsion, starting, stopping, and direction changes of the wheelchair, activities that require explosive strength and speed. The results of

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the study also supported with results obtained from the study conducted by During Wheelchair Basketball practice, players perform bodily efforts to fast movements and quick direction changes, which requires power from the upper limbs (Gorgatti & Bohme, 2002).

Additionally, the movements of the training exercises are dribbling, passing and throwing the ball to the basket; thus, the strength of the upper limbs tends to be more required (Oudejans, Heubers, Ruitenbeek, & Janssen, 2012). Thus, muscle strength and power are determinants and fundamental to success in this sport (Cardoso, 2011).

Our data showed that explosive strength training improved sprint speed by 11.51% for a 20-m distance. Our lower improvement in sprint speed than in the study by Turbanski and Schmidtbleicher (2010) may be related to a shorter training duration and intensity of training. The important factor of this positive results is based on the scientific reason behind the training protocol which includes the repeated movement which develops muscular strength and endurance of the upper extremity. The duration of the explosive strength training is unlikely to have resulted in muscle hypertrophy as in common with heavy resistance training [Haff G, Whitley A, Potteiger JA (2001), Hakkinen K. (1994), & Hakkinen K, Komi PV, Alen M.(1985)]. The neural adaptations such as an increased motor unit synchronization and firing rate may have contributed to the improvement of speed. It is very likely that this development was the result of neural adaptations for a shorter duration of eight weeks.

CONCLUSION

Based on the results of the study it was concluded that the eight weeks of wheelchair mobility training program improved the 20 meters sprint performance of the wheelchair tennis players and the results showed that the mobility exercises are able to produce significant improvement on wheelchair sprint performance of the wheelchair tennis players.

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