




Biomechanical analysis of start and acceleration of 100 meters sprint running with selected disabilities in Indonesian Physical Impairment Athletes

Udin Muhammad Hafid¹, Agus Kristiyanto², Fadilah Umar²

¹Sports Science, University of Sebelas Maret, Surakarta, Indonesia. ²Department of Sports Science, Postgraduate Program, University of Sebelas Maret, Surakarta, Indonesia.

Abstract

This study aims to: 1) find out whether variable start has a contribution to athletes with physical impairment in the 100-meter race, and 2) to find out the contribution of acceleration for athletes with physical impairment in the 100-meter race. A quantitative approach was used for this study in which the sprint performance of four elite Paralympic athletes was measured over time. The data source in this study focuses on the analysis of running start and acceleration of 100-meter running in athletes with physical impairment national paralympic. The data used are primary and secondary data. Quantitative data analysis includes digital video analysis of each athlete's set position, initial acceleration phase, and maximum sprint running speed phase. Based on the results of the research, the results obtained were that: 1) the athlete was able to affect the performance of the Indonesian Physical Impairment Athlete in the 100 Meter number. 2) Acceleration is able to affect the performance of the 100 Meter Run in Physical Impairment Athlete National Paralympic Committee Indonesia. The suggestion from this study is that athletes with physical impairment in the 100 m running race must be able to prepare themselves in the race process. In addition, coaches are expected to be able to prepare training programs to support athletes' achievements.

Received:
June 01, 2024

Accepted:
June 28, 2024

Online Published:
July 01, 2024

Keywords:
Acceleration, 100-meter run,
physical impairment athlete, start.

Introduction

Sport is a life activity that is not underestimated by society in general (Burhaein, 2017). Sports trains the body both physically and spiritually because doing sports will make our bodies healthy (Riskasdes Ministry of Health of the Republic of Indonesia, 2019). Sport can be interpreted in the Javanese language, namely, if it means practicing and sport means physical (Arifin, 2017). The development of sports in Indonesia is progressing very rapidly and supports achievements for the nation's progress (Burhaein, 2017). Sport requires commitment in its development which is carried out in totality so that it cannot be done instantaneously, management needs to be systematic and continuous (Priyono, 2012). Fostering sports in totality and commitment produces good sports achievements (Iso-Ahola, 2018).

Sports development is carried out scientifically from talent scouting to the coaching process making it appear

measurable to lead to sporting achievements to increase the dignity and honor of the nation (Effendi, 2016). Sports development has been regulated in Law No. 3 of 2005 concerning the National Sports system developed through educational sports, recreational sports and achievement sports (Nopiyanto et al., 2019). Educational sports are carried out both in formal and non-formal channels, recreational sports develop people's awareness of healthy living, and achievement sports are specifically for achieving achievements (Firdaus, 2011).

Sports cover very broad dimensions and are able to penetrate all elements of society, in this case minority communities who can be called people with disabilities (Purna et al., 2020). People with disabilities have long-term physical, mental and intellectual limitations so that they experience obstacles in fully participating in society based on equal human rights (Wijayanti et al., 2016). There are equal opportunities in sports for people with disabilities to excel in sports (Shofana & Supriyanto,

✉ U. M. Hafid, e-mail: udinmuhammadhafid@student.uns.ac.id

To Cite: Hafid, U. M., Kristiyanto, A., & Umar, A. (2024). Biomechanical analysis of start and acceleration of 100 meters sprint running with selected disabilities in Indonesian Physical Impairment Athletes. *Adv Health Exerc*, 4(2), 69-79.

2022). Because society has different views about people with disabilities, this raises many questions because they are considered a burden. Through sports achievements, it is hoped that society's view of people with disabilities will change in a more positive direction. According to Law No. 3 of 2005 concerning the National Sports System, it is stated that special activities for people with disabilities are carried out according to the condition of a person's physical abnormalities, which leads to coaching and is directed towards improving health, self-confidence, towards achieving achievements (Ministry of Youth and Sports, 2010). The role of people with disabilities is not new, because it is based on a disability that the person with a disability can overcome by excelling in the world of sports.

The very rapid development of disability sports has produced athletes who are able to compete in several events, one of which is the Provincial Paralympic Week (PEPARPOV) at the provincial level (Ita et al., 2021). In athletics, it is part of the competition. According to Purnomo & Dapan (2011) athletics is a physical activity that uses basic movements dynamically and harmoniously to improve an athlete's motor skills, consisting of running, jumping and throwing. Sports for people with disabilities in athletics cannot take place without a platform. So that the formation of an organization for people with disabilities in Indonesia called the National Paralympic Committee of Indonesia (NPC). The NPC is a forum for sports for people with disabilities in Indonesia which has the authority to coordinate and develop any and all sporting activities for national and international achievements and clarify the status that there are organizations that accommodate people with disabilities. One of the sports branches overseen by the NPC is athletics competitions which include the 100 m dash. Disabled people have the right to become 100 M athletes and have the right to receive support from various parties

This research examines the effect of starting and acceleration on the physical improvement of athletes with disabilities in the 100 meters race. Basically, a start is a preliminary movement carried out with three signals, namely "Ready", Ready" and "Yes/Sound of gun". The squat start is done by crouching which is intended to get maximum encouragement when starting to run. To maximize the push of the legs on the track, they are assisted with a foot brace or block board, a squat starting aid is called a startbock, while acceleration is an acceleration movement carried out by an athlete sprinting from a stationary position on the start line and slowly increasing the speed to reach the

finish line. Starting and acceleration movements for physical improvement athletes are important movements for winning. The existence of physical impairment athletes departs from athletes with disabilities who are considered to be a manifestation of a complex phenomenon that reflects the interaction between the characteristics of a person's body which requires support from various elements, such as support from parents and from the surrounding community (Kaplan et al., 2015).

This research is a biomechanical analysis that examines Biomechanics. Basically, biomechanical factors for each technique have similarities depending on the use of the technique and the muscle styles possessed by each athlete. In the book A.V.HIL states that, where the ability to produce muscle force is divided into contractile and elastic elements (unified parameter model) with the most commonly used version being the three-component Hill model (Ghildiyal, 2015). This model consists of elements contractile and two elastic elements: a series elastic element and a parallel elastic element. Mathematical relationships are required for each element in the muscle model so that the force exerted by the muscle in the simulation model can be defined throughout the simulation muscle length, muscle speed and muscle activation. States that muscle strength depends on muscle kinematics. Muscle kinematics, including arm and muscle-tendon moment length.

Previous research entitled "Study of the Implementation of the Indonesian National Paralympic Committee's Athletic Training Program for Central Java Province towards PAPERNAS XVI Papua 2021 during the Covid-19 Pandemic" shows that the start is a preliminary movement carried out by athletes running 100 M in preparation before stepping on the starting line in 100 M race, while acceleration is the acceleration of the athlete's movement to reach the finish line quickly, which is adjusted to the disability classification of the running athlete. Start and acceleration in the 100 m race have an important role because start and acceleration are the initial movements that influence the 100 m runner to start the movement from the start line to the finish line in the shortest time. The lack of information and knowledge regarding starting and acceleration analysis of disabled athletes has resulted in minimal information in coaching 100 M athletes, so it is not appropriate if the starting movements and acceleration of disabled athletes are the same as normal athletes. To prove this problem, it is necessary to carry out an in-depth analytical study in a research.

Apart from that, research by Sari & Suripto (2021) related to Biomechanics, found that the acceleration movements of the hands and feet were in the "appropriate" criteria so that they were relevant to the start and acceleration used. Apart from that, athletes fall into the criteria of almost matching because of discrepancies that occur in one or two points. Most athletes do not apply this point, so it becomes an obstacle to acceleration. Researchers took research on running starts and acceleration of the 100 meters run among Indonesian National Paralympic Committee Physical Impairment Athletes because starting and acceleration are basic movements that must be mastered by athletes from all groups. Starting and accelerating are the keys for athletes to win the competition, so it is important to carry out a thorough analysis to determine whether starting and accelerating are effective or not for physically impaired athletes in the 100 m race.

The importance of this research is that increasing knowledge about the 100 meters race will become a more in-depth reference for students regarding the competition for physically impaired athletes in the 100 m race.

Method

A quantitative approach was used for this study in which the sprint performance of four elite Paralympic athletes was measured over time. The advantage of using a mixed methods approach is that it supports combining quantitative data to gain a personal impression of each athlete's sprint performance over a year of training. Bartlett (2007) suggests that this approach is suitable for coaches, athletes, physiotherapists and performance analysts working

with athletes as well as movement coordination researchers.

The data source in this study focused on analyzing the running start and acceleration of the 100 meters run in physically impaired athletes from the Indonesian National Paralympic Committee. In this research, data was obtained by researchers through observation and interviews. In this case, researchers find informants to investigate sources of information. Before informants are determined, researchers must adjust to the informant criteria. Qualitative research informants are research informants who understand research subject information. The selected informants must have criteria so that the information obtained is useful for the research being carried out. With this data, it is hoped that researchers can determine the analysis of running starts and acceleration of the 100 meters run in athletes with physical impairment at the Indonesian National Paralympic Committee.

Sugiyono (2019) stated that quantitative research methods are used to examine certain populations and samples, collecting data using research instruments and analyzing the data in the form of quantitative data which aims to test the hypothesis that has been formulated.

Data analysis technique the data analysis used in this research includes several aspects as follows.

Data Analysis

Quantitative data analysis includes digital video analysis of each athlete's set position, initial acceleration phase, and maximum sprint speed phase. The potential for IM™ training to influence performance is presented as a subjective report by the athletes themselves.

Table 1

Summary of variability results for all participants.

Participants & Classes	Biomechanics of Defined Positions	Initial Acceleration Steps 1, 2, & 3 to 10m	Max Speed 30m-40m
1 (T43)	Most of the variability in the posterior knee and anterior hip seeks optimal compression with the prosthesis as it leaves block	The key to fast stride length is timing is the key focal length for the second stride trainer (prosthetic leg)	Stride length is the main focus for coaches
2 (T13)	Most of the variability in the arm suggests he is looking for a more balanced and rhythmic way out of the blocks	A short first step stride and a longer frequency, both primary focuses are key to running for trainer performance	Step frequency is the main focus for trainers
3 (T37)	Variability in both ankles, both knees and back hip to find a more economical way out of the blocks	Consistency in stride length, stride length, and key frequency are key performance focus areas for coaches	Step frequency is the main focus for trainers

Sprint Performance Analysis

Sprint performance analysis consists of four steps: Selection of the kinematic variables most useful to the coach, analysis of digital video clips of each athlete's performance to generate data related to the selected kinematic variables, determination of the reliability of the analysis process and presentation of the results in descriptive graphs that support the visual identification of variability during four testing periods.

Selection of Kinematic Variables

The deterministic model for sprinting presented in Chapter Two is commonly used by sprint coaches to identify the important role of stride length and stride frequency in sprint performance. The selection of variables such as these that can be observed by trainers who have no technology or low levels of technology is consistent with the movement observation process described in the professional teaching/training literature (Abendroth-Smith, 1996). Because communicating the results of this research to coaches was a priority for this study, it was decided to select variables that had direct meaning to them.

Clip Video Analysis

Video clips of each athlete's entire test run were initially stored on the camera's hard drive. After each testing session, the camera used to record each athlete's sprint performance during the initial acceleration phase (block start up to 10 m) was connected via a USB cable to a laptop computer. The video clips are then downloaded to the laptop with another copy made to an external hard drive. Using Dartfish ProSuite software version 4.0.9.0, each clip from each test was labeled (e.g. Participant 1 initial acceleration phase, Test 1, Trial 1). Video clips stored on the laptop were used to complete the analysis. The following is a summary of the process.

Separate sessions were scheduled to work on video clips from each test session. For example, the process has been completed for all participants' performances on Test 1 before the process begins for the Test 2 performance, and so on. Although sprint analysis usually takes the value of the fastest trial (Sinamo et al., 2022), it was decided to analyze both trials in each test session to obtain enough data to see trends across the training year. Coaches specifically requested that tryouts be limited to two to minimize the impact on their athletes and their training sessions. A summary of the comparison results is presented in Table 2.

Table 2

Percentage of agreement between initial analysis and reanalysis of all variables.

Kinematic Variables Measured	Level of agreement with Analysis 1
1 st Step	96.4%
2 nd Step	95.6%
Average stride length (3 rd atep to 10m)	95.8%
Time at 5m	94.9%
Time at 10m	93.1%
Speed on 5m	92.4%
Speed on 10m	91.1%
Acceleration on 10m	90.7%
Average stride length (30-40m)	96.7%
Time (30-40m)	97.2%
Average speed (30-40m)	95.1%
Acceleration (30-40m)	92.3%
Total Agreement Level	94.4%

Data reduction

The data reduction stage was carried out to reduce the data obtained in the field. In this research, the data from interviews, observations and documentation that have been collected are then summarized, removing unnecessary ones and focusing on matters related to the analysis of running starts and acceleration of the 100 meters run in physically impaired athletes at the Indonesian National Paralympic Committee.

Presentation of data

Presenting the material in this research by explaining the research results obtained through narrative text so that researchers can present the material systematically and substantively. So in this case the researcher presents data by selecting data that is in accordance with the research analysis of running starts and acceleration of the 100 meter run in athletes with physical impairment at the Indonesian National Paralympic Committee.

Concluding Drawing

Researchers draw conclusions that are supported by valid and consistent evidence when researchers return to the field to collect data, so that the conclusions presented are reasonable conclusions.

Results

This research is research that examines the biomechanical analysis of running starts and acceleration of the 100 meters run in Indonesian Physical Impairment National Paralympic Committee athletes. The results of this research are adjusted to the research formulation and objectives. The level of agreement is a percentage adjusted for the comparison between the initial analysis and reanalysis. The standard for an acceptable level of agreement is set at 90%, namely as follows. With the level of agreement in table 2, namely 94.4%, it can be concluded that the data used already has relevant comparisons between objects so that they can be compared from a biomechanical point of view. The measurement results of athlete achievements are in the following table.

Based on the results of data processing, it shows that all athletes have run 100 meters with increasing time, indicating a decrease in speed as time or laps are increased. Achievement of an achievement in the sport of running 100 meters is influenced by the start and acceleration produced, so the details of the influence of the start and acceleration are as follows.

Contribution of the Start for Athletes with Physical Impairment in the 100m Race

Achievement of a short time in a running competition is influenced by the starting position which is also influenced by the position and muscle strength which differ between one athlete and another. This research

examines the effect of starting and acceleration on the physical improvement of athletes with disabilities in the 100 meter race. Basically, a start is a preliminary movement carried out with three signals, namely "Ready", Ready" and "Yes/Sound of gun". The squat start is done by crouching which is intended to get maximum encouragement when starting to run. Researchers use start blocks to maximize leg push on the track. Starting and accelerating movements in physically impaired athletes are important movements for winning. The existence of physical impairment athletes departs from athletes with disabilities who are considered to be a manifestation of a complex phenomenon that reflects the interaction between the characteristics of a person's body which requires support from various elements, such as support from parents and from the surrounding community. Researchers carried out an analysis of the starting movement on the start block to obtain analysis results which were then analyzed through Table 3.

Table 4 shows that there is a difference in the length of the starting stride which is getting shorter along with the fatigue obtained from the laps carried out so that it has an impact on the athlete's time achievement. The shorter the stride length that is reached when starting, the weaker the acceleration achieved will be. The starting position taken determines the extent to which the runner can find the best starting position so as to contribute to the running speed he will create. If we look at the start, the frequency of explosive power when jumping from the start block is as follows.

Table 3
Results of 100 meter speed measurements for Indonesian Physical Impairment Athletes.

Names	Time (seconds)		
	1	2	3
Partin	12.64	13.39	13.11
Karisma Evi	16.06	16.68	17.13
Yusuf Fikri Albar	12.40	12.60	12.69
Devi Kumala Sari	15.97	16.01	16.54
Viqi Dian Maulana	13.91	14.40	14.27
Bejo Suprpto	13.77	14.14	13.61
<i>Amount</i>	84.75	87.22	87.35
<i>Average</i>	14.13	14.54	14.56
<i>Total number</i>		259.32	
<i>Total Average</i>		14.41	

Table 4

Stride length results at the 100 meter start for Indonesian Physical Impairment Athletes.

Names	Stride Length at Start (m)		
	1	2	3
Partin	1.4	1.2	1.1
Karisma Evi	1.3	1.1	1.3
Yusuf Fikri Albar	1.5	0.8	1.4
Devi Kumala Sari	0.8	1.4	1.2
Viqi Dian Maulana	0.8	1.3	1.1
Bejo Suprpto	1.3	1.4	0.9
<i>Amount</i>	8.1	7.2	7
<i>Average</i>	1.35	1.20	1.14
<i>Total number</i>		22.3	
<i>Total Average</i>		1.239	

Table 5

Results of stride speed at the start of 100 meters for Indonesian Physical Impairment Athletes.

Names	Movement Speed Frequency (sec)		
	1	2	3
Partin	0.26	0.16	0.20
Karisma Evi	0.50	0.40	0.40
Yusuf Fikri Albar	0.70	0.64	0.64
Devi Kumala Sari	0.94	0.84	0.88
Viqi Dian Maulana	1.14	1.08	0.94
Bejo Suprpto	1.38	1.58	1.70
<i>Amount</i>	4.92	4.70	4.76
<i>Average</i>	0.82	0.78	0.79
<i>Total number</i>		14.38	
<i>Total Average</i>		0.80	

Table 6

Recapitulation of starts from Indonesian 100 Meter Physical Impairment Athletes.

Names	Step (m)			Speed (sec)			Time (Second)		
	1	2	3	1	2	3	1	2	3
Partin	1.4	1.2	1.1	0.26	0.16	0.20	12.64	13.39	13.11
Karisma Evi	1.3	1.1	1.3	0.50	0.40	0.40	16.06	16.68	17.13
Yusuf Fikri Albar	1.5	0.8	1.4	0.70	0.64	0.64	12.40	12.60	12.69
Devi Kumala Sari	0.8	1.4	1.2	0.94	0.84	0.88	15.97	16.01	16.54
Viqi Dian Maulana	0.8	1.3	1.1	1.14	1.08	0.94	13.91	14.40	14.27
Bejo Suprpto	1.3	1.4	0.9	1.38	1.58	1.70	13.77	14.14	13.61
<i>Amount</i>	8.1	7.2	7	4.92	4.70	4.76	84.75	87.22	87.35
<i>Average</i>	1.35	1.20	1.14	0.82	0.78	0.79	14.13	14.54	14.56
<i>Total number</i>		22.3			14.38			259.32	
<i>Total Average</i>		1.239			0.80			14.41	

Table 5 shows that the jumping speed at the start shows the highest number during the first attempt compared to the second or third running attempts, thus showing the influence of the starting jumping power per second on the results of reaching the finish line for the six athletes who were tested. Based on the biomechanical analysis used, the starting position will influence the distance covered by the six athletes being tested.

Table 6 shows that the steps and speed when jumping from the start block show that the first lap has a longer stride with a higher speed when reaching the jump. The combination of a longer stride with a higher speed when jumping from the start block will be proportional to the short time needed to reach the finish. This is shown by the average steps achieved by athletes when jumping from the start block as far as 1.35 meters with a jumping speed of 0.82 seconds so that they can reach the finish line in an average time of just 84.75 seconds. This shows that there is an influence from the start carried out on reaching the finish line in the shortest time.

Contribution of Acceleration for Physical Impairment Athletes in the 100 m Running Race

Achievement in running competitions is also influenced by the presence of stable and maintained acceleration in each competition session. This research also examines the acceleration of physical improvement in athletes with disabilities in the 100 meters running race. Acceleration is needed because there are four stages or phases in the 100 meters sprint, namely reaction time and reaction speed, acceleration (acceleration), basic running speed and endurance speed. In a 100 meters sprint, runners typically experience acceleration,

maintenance, and deceleration from start to finish. This shows that acceleration is an important component in supporting the performance of running athletes. Researchers used analysis of the consistency of footsteps and the time required for each period from the start to the finish line so that the furthest steps with the fastest time were measured during the three laps carried out. The results of the average time calculation carried out are as follows.

Table 7 shows that there is a difference in stride length during acceleration from the start to the finish line, which also becomes shorter along with the fatigue obtained from the lap and the distance of 100 meters covered, thus having an impact on the athlete's time achieved. The shorter the stride length that is reached when running from start to finish, the weaker the acceleration achieved will be.

The time span during running from second to second also shows a real contribution between speed in running and the effectiveness of the time created when running to the finish line. If viewed from the acceleration carried out, the frequency of explosive power when running to the finish line based on biomechanical analysis is as follows.

Table 8 shows that the acceleration speed during the running process shows the shortest number during the first attempt compared to the second or third running attempts, thus showing the influence of acceleration during running on the results of reaching the finish line for the six athletes who were tested. Based on the biomechanical analysis used to measure acceleration, the acceleration when reaching the finish line can be seen in the following table.

Table 7
Results of stride length in 100 meter acceleration for Indonesian Physical Impairment Athletes.

Names	Stride Length During Acceleration (m)		
	1	2	3
Partin	0.4	0.2	0.1
Karisma Evi	0.2	0.2	0.3
Yusuf Fikri Albar	0.5	0.3	0.2
Devi Kumala Sari	0.3	0.2	0.3
Viqi Dian Maulana	0.4	0.3	0.1
Bejo Suprpto	0.4	0.5	0.3
<i>Amount</i>	2.2	1.7	1.3
<i>Average</i>	0.37	0.28	0.22
<i>Total number</i>		5.2	
<i>Total Average</i>		1.73	

Table 8

Results of stride speed at the start of 100 meters for Indonesian Physical Impairment Athletes.

Names	Movement Speed Frequency (sec)		
	1	2	3
Partin	0.3	0.6	1.1
Karisma Evi	0.2	0.4	0.4
Yusuf Fikri Albar	0.4	0.6	0.6
Devi Kumala Sari	0.6	0.4	0.8
Viqi Dian Maulana	0.2	0.8	0.9
Bejo Suprpto	0.3	0.8	0.4
<i>Amount</i>	2.0	3.6	4.2
<i>Average</i>	0.33	0.6	0.7
<i>Total number</i>		9.8	
<i>Total Average</i>		3.26	

Table 9

Recapitulation of starts from Indonesian 100 Meter Physical Impairment Athletes.

Names	Step (m)			Speed (sec)			Time (Second)		
	1	2	3	1	2	3	1	2	3
Partin	0.4	0.2	0.1	0.3	0.6	1.1	12.64	13.39	13.11
Karisma Evi	0.2	0.2	0.3	0.2	0.4	0.4	16.06	16.68	17.13
Yusuf Fikri Albar	0.5	0.3	0.2	0.4	0.6	0.6	12.40	12.60	12.69
Devi Kumala Sari	0.3	0.2	0.3	0.6	0.4	0.8	15.97	16.01	16.54
Viqi Dian Maulana	0.4	0.3	0.1	0.2	0.8	0.9	13.91	14.40	14.27
Bejo Suprpto	0.4	0.5	0.3	0.3	0.8	0.4	13.77	14.14	13.61
<i>Amount</i>	2.2	1.7	1.3	2.0	3.6	4.2	84.75	87.22	87.35
<i>Average</i>	0.37	0.28	0.22	0.33	0.6	0.7	14.13	14.54	14.56
<i>Total number</i>		5.2			9.8			259.32	
<i>Total Average</i>		1.73			3.26			14.41	

Table 9 shows that the steps and speed when accelerating towards the finish line show that the first lap has more long steps with higher speed when reaching the jump when accelerating. The combination of longer steps with a higher speed when running to the finish line will be comparable to the short time needed to reach the finish line. This is shown by the average steps achieved by athletes when running a distance of 0.37 meters with a jump speed of 0.33 seconds so that they can reach the finish line in an average time of 84.75 seconds. This shows the influence of acceleration on reaching the finish line to achieve victory.

Discussion

Based on the research results, it was found that the start made by athletes was able to influence the performance of Indonesian Physical Impairment Athletes in the 100 Meters. This is obtained from the steps when starting

and the speed when jumping from the start block showing figures that are in sync with the first lap and are in line with the time achieved during the first lap. Based on the research results, it was found that the farther the athlete's steps, the faster the time when reaching the finish line. This can be seen from the steps achieved by the six participants which showed a figure of 1.35 and was the highest compared to the second and third rounds. This high jump resulted in a short time to reach the finish line, namely only 84.75 seconds and was the shortest recorded time compared to the second and third rounds. This shows that the jump distance when starting will also contribute to the time achieved by Indonesian Physical Impairment runners in the 100 Meters. The short time achieved in a running competition is influenced by the starting position which is also influenced by the position and muscle strength which differ between one athlete and another. This research examines the effect of starting and acceleration

on the physical improvement of athletes with disabilities in the 100 meters race. Basically, a start is a preliminary movement carried out with three signals, namely "Ready", Ready" and "Yes/Sound of gun". The squat start is done by crouching which is intended to get maximum encouragement when starting to run.

Running is a process of moving the body from one point to another with relative physical conditions and balanced arm movements and steps (Sinamo et al., 2022). In this way, perfect running movements and techniques are achieved. Running, also known as sprinting, is very popular among sports spectators so balance is required when jumping from the starting block. The seemingly simple skill of sprinting actually relies on an athlete's ability to combine the movements of the legs, arms, torso, and so on into a smoothly coordinated whole (McGinnis, 2013). This coordination also includes long jumps when stepping on the start block so that coordination is needed in order to achieve the fastest time to reach the finish line. We must consider aspects of human anatomy, such as height, stride frequency, stride length, speed, energy production, somatotype, anthropometry, strength and muscle fiber composition, when analyzing such events. This kind of coordination is needed to achieve better performance. Simple running skills actually depend on an athlete's ability to combine movements of the legs, arms, body and so on in a smoothly coordinated manner.

The jump achieved when starting is one of the components for achieving achievement. This is related to physical activity which is a priority to stimulate physical growth in balance with spiritual development so as to create balance within oneself. Emotionality is also an aspect that is developed in physical education. Jumping at the start can be a medium for Indonesian Physical Impairment athletes in the 100 Meters as a means to improve the development of movement skills, physical skills, knowledge, thinking, appreciation (attitude, intellectual, emotional, spiritual, social) as well as getting used to a healthy lifestyle that leads to balance between stimulating growth and development in the national education system. This is due to a jump in the starting movement on the start block. The influencing factor for stride length is power. Good power needs to be synchronized with the running movement, so that the ability to use power is technique and to get a stable stride length for a long time, special endurance is needed. The frequency of steps is influenced by the ability to coordinate movements, the better the coordination of movements, the better the

frequency of steps taken, the frequency of steps carried out for a long time requires special endurance. Good coordination is influenced by whether the running movement technique is effective in its implementation so that these components influence each other's sprint performance.

According to Comyns (2022) what is important in sprinting is to reach the highest and smoothest speed as quickly as possible and this can only be done if the step rhythm starts from the start of the run, continuing gradually in all running positions. The ability to carry out movements smoothly in each stage of the 100 meters run is the key to achieving success in achieving the best performance. The explosion started from the explosiveness created by a long jump when starting on the start block. The competition that seeks the champion is not held conventionally and is a theoretical study, but includes physical, mental, intellectual, emotional and social elements. Learning activities should have a didactic-methodical meaning, so that the objectives of the competition are achieved through the activities carried out.

The research results also show that apart from the jump distance, the success of the start is also influenced by the time achieved by the athlete in making the maximum jump. This is shown by the average steps achieved by athletes when jumping from the start block as far as 1.35 meters with a jumping speed of 0.82 seconds so that they can reach the finish line in an average time of just 84.75 seconds. This shows that there is an influence from the start carried out on reaching the finish line in the shortest time. This is supported by the opinion of In physics, speed is defined as distance per unit time, while physiologically speed can be defined as the ability to carry out movements in a unit of time based on ease of movement, nervous system processes and muscle equipment. Based on the definition above, speed in the 100m run is the ability to reach the target in the shortest time. The speed in question is the athlete's ability to jump in the shortest possible time so that the speed in reaching the finish line is more effective. This is also related to acyclic speed, this speed is limited by factors related to the speed of movement of each muscle within the muscle. It is mainly the static energy and its contrasting speed that determines the speed of movement. These two factors in turn depend on muscle viscosity and tone. In addition, external factors influence: the antagonistic action of the muscle and the associated stretching, the onset and onset of muscle action, the length of the lever and the mass to be moved (load-force ratio). Factors

limiting efficiency are dynamic power (fast force), anthropometric size (lever-to-body ratio), and mass (load-to-force ratio).

Related to this, the energy created by athletes when jumping is related to the pushing movement carried out. The goal of the drive phase is to leave the start block and prepare to make the first running step. The technical characteristics of this pushing movement phase include that the body is straightened and lifted when both feet press firmly on the start block. Both hands are lifted from the ground at the same time and then swung alternately. The back leg pushes hard or briefly, the front leg pushes slightly less strongly but lasts a long time. The hind legs are swung forward quickly while the body leans forward. The knees and hips are both fully straightened at the end of the push. To create a more effective time for jumping, a starting position is needed that can support the jump. The technical characteristics of the 'ready' signal position include, the knees are pressed to the back, the knees of the front leg are in a position that forms a right angle (90°), the knees of the back leg form an angle between 120° – 140°, the waist is slightly raised higher than the shoulders, the body leans slightly forward and the shoulders are slightly further forward than both hands.

The effectiveness of timing when jumping also refers to the increased performance of the Indonesian National Paralympic Committee Physical Impairment Athletes. Increasing achievement can be done through training that focuses on developing movement skills, physical skills, knowledge, thinking, appreciation (attitude, intellectual, emotional, spiritual, social) as well as getting used to a healthy lifestyle that leads to a balance between stimulating growth and development in the career training system. 100 meters from the Indonesian National Paralympic Committee Physical Impairment Athlete. Training also focuses on teaching basic movement skills, games and physical techniques and strategies, to encourage values (sportsmanship, honesty, cooperation, etc.) and to get used to a healthy lifestyle. Teaching in class is not carried out conventionally, which is theoretical in nature, but includes physical, mental, intellectual, emotional and social elements. Learning activities should have a didactic-methodical meaning, so that the training objectives are through the activities carried out. This is related to optimizing the time given when making a jump when starting from the start block.

Factors limiting efficiency are dynamic power (fast force), anthropometric size (lever-to-body ratio), and mass (load-to-force ratio). Physical preparation in

general and in particular can increase overall speed. Specific speed is the ability to perform an exercise or skill at a specific speed, usually very high. Specific speeds are speeds that apply separately in each specific sport. In physics, speed is defined as distance per unit time, while physiologically speed can be defined as the ability to carry out movements in a unit of time based on ease of movement, nervous system processes and muscle equipment. Based on the definition above, speed in the 100m run is the ability to reach the target in the shortest time. All of this is created by consistency in stepping forward.

Apart from footsteps, the time or frequency of movement speed achieved when accelerating also affects the athlete's speed in reaching the finish line. This is reinforced by the opinion of Sari and Suropto et al., (2022) that sprinting is maximum speed, expending all energy and running speed from the start to reaching the finish line, measured in units of time. To achieve good running results, a runner must have good technique, strength and speed over a distance of 100 meters. This power and speed will be achieved if the resulting time can be made as effective as possible. Simple running skills actually depend on an athlete's ability to combine movements of the legs, arms, body and so on in a smoothly coordinated manner (McGinnis, 2013).

Conclusion

Based on the research results, the start made by athletes was able to influence the performance of Indonesian Physical Impairment Athletes in the 100 Meters. This was obtained from the steps when starting and the speed when jumping from the start block, showing synchronized numbers during the round. This can be seen from the steps achieved by the six participants which showed a number of 1.35 and was the highest compared to the second and third rounds. This high jump resulted in a short time to reach the finish line, namely only 84.75 seconds and was the shortest recorded time compared to the second and third rounds. The research results also show that apart from the jump distance, the success of the start is also influenced by the time achieved by the athlete in making the maximum jump.

Apart from that, acceleration can influence the 100 meters running performance of Indonesian National Paralympic Committee Physical Impairment Athletes. This can be seen from the steps achieved by the six participants which showed a figure of approximately 0.37 meters per step in sprinting and was the highest compared to the second and third rounds. Stability in

maintaining speed also produces the most appropriate consistency to reach the finish line and record the shortest time compared to the second and third rounds. The presence of acceleration in the form of longer and more consistent footsteps shows that there is optimization of consistent footsteps to achieve maximum speed. Therefore, physically impaired athletes in the 100 m race must be able to prepare themselves for the competition process so that they are ready to receive input from efforts to improve their performance well. If you still don't understand, you can ask fellow athletes to get maximum results.

References

- Arifin, S. (2017). Peran Guru Pendidikan Jasmani Dalam Pembentukan Pendidikan Karakter Peserta Didik. *Multilateral Jurnal Pendidikan Jasmani Dan Olahraga*, 16(1), 78–92.
- Bartlett, R. (2007). Movement coordination and movement variability. *Sports Biomechanics*, 6(2), 119–120.
- Burhaein, E. (2017). Aktivitas Fisik Olahraga untuk Pertumbuhan dan Perkembangan Siswa SD. *Indonesian Journal of Primary Education*, 1(1), 51–58.
- Effendi, H. (2016). Peranan psikologi olahraga dalam meningkatkan prestasi atlet. *Nusantara: Jurnal Ilmu Pengetahuan Sosial*, 1(1).
- Firdaus, K. (2011). Evaluasi Program Pembinaan Olahraga Tennis Lapangan di Kota Padang. *Jurnal Media Ilmu Keolahragaan Indonesia*, 1(2), 127–132.
- Ghildiyal, R. (2015). Role of Sports in the Development of an Individual and Role of Psychology in Sports. *Mens Sana Monographs*, 13(1), 165.
- Iso-Ahola, S. E. (2018). Intrapersonal and interpersonal factors in athletic performance. *Scandinavian Journal of Medicine & Science in Sports*, 5(4), 191–199.
- Ita, S., Kusuma, M. J., Womsiwor, D., Qomarrullah, R., Putra, M. F. P., Kurdi, Putra, I. P. E. W., Ibrahim, Syam, M. S., Hasan, B., & Rumbewas, S. T. (2021). *Master plan pembinaan prestasi olahraga disabilitas papua*. Wineka Media.
- Kaplan, R. M., Spittel, M. L., & David, D. H. (2015). *Population Health: Behavioral and Social Science Insights* (Issue No. 15-0002). AHRQPublication.
- Ministry of Youth and Sports. 2010. Strategic Plan of the Ministry of Youth and Sports 2010-2014. Jakarta: Ministry of Youth and Sports.
- McGinnis, P. M. (2013). Biomechanics of sport and exercise. Human Kinetics.
- Nopiyanto, Y. E., Syafril, S., & Sihombing, S. (2019). Hubungan Panjang Tungkai Dan Daya Ledak Otot Tungkai Dengan Hasil Lari Sprint 100 Meter. *Kinestetik: Jurnal Ilmiah Pendidikan Jasmani*, 3(2), 256–261.
- Priyono, B. (2012). Pengembangan Pembangunan Industri Keolahragaan Berdasarkan Pendekatan Pengaturan Manajemen Pengelolaan Kegiatan Olahraga. *Jurnal Media Ilmu Keolahragaan Indonesia*, 2(2), 112–123.
- Purna, S. K., Kardiyanto, D. W., & Angga, P. D. (2020). *Kerangka pembinaan olahraga disabilitas*. Zifatama Jawa.
- Purnomo, E., & Depan. (2011). Gerak Dasar Atletik. Alfamedia.
- Riskedes Kemenkes RI. (2019). *Laporan Hasil Riset Kesehatan Dasar 2018* (pp. 1–674). Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI.
- Sari, S. D., & Suropto, A. W. (2021). Profil Kondisi Fisik Atlet Lari Jarak Jauh Klub Atletik Bima Cepu Kabupaten Blora. *Indonesian Journal for Physical Education and Sport*, 2(1), 398–402.
- Shofana, N., & Supriyanto, A. (2022). Manajemen Sarana Dan Prasarana Dalam Pemenuhan Aksesibilitas Bagi Penyandang Disabilitas Di Perguruan Tinggi. *Jurnal Manajemen Pendidikan*, 13(1), 26–35.
- Sinamo, G. H., Yendrizal, Mardela, R., & Oktavianus, I. (2022). Kontribusi Daya Ledak Otot Tungkai Dan Kecepatan Reaksi Terhadap Kemampuan Lari 100m Atlet PASI Kota Padang. *Gladiator*, 2(2), 58–72.
- Solomonow, M. (2018). Ligaments: a source of work-related musculoskeletal disorders. *Journal of Electromyography and Kinesiology*, 14(1), 49–60.
- Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabet.
- Susanti, R., Sidik, D. Z., Hendrayana, Y., & Wibowo, R. (2022). Latihan Pliometrik dalam Meningkatkan Komponen Fisik: A Systematic Review. *Journal of Sport Science and Education*, 6(2), 156–171.
- Wijayanti, D. G. S., Soegiyanto, & Nasuka. (2016). Pembinaan olahraga untuk penyandang disabilitas di National Paralympic Committee Salatiga. *Journal of Physical Education and Sport*, 5(1), 17–23.