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Kinematical Analysis Of Hundred Meters (100m) Sprinters Of Elite And Sub Elite Level In Pakistan

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ABSTRACT

The objective of this research was to kinematic analysis of Split times across 100-m sprint performance level. Experimental study conducted through a research national player of Pakistan. Kinovea Software; 0.8.15 was used to find out the respondent about the statement. Results show that athlete performance was associated with a relatively long stride length, horizontal positioning of the foot close to the CoM at the ground contact, minimal braking phase, high vertical ground reaction forces, minimal vertical displacement of the CoM, as well as with high angular and horizontal velocities of his swinging leg.

INTRODUCTION

The 100m race is one of the most historical races along with the marathon. Introduced to the Olympic Games in 1896 for the first modern Olympiad (held in Athens, Greece), it is believed to be the modern equivalent of the ancient sprint race, named "stadion". "Stadion", was a common race in ancient Greece and a part of the Ancient Olympic Games. Moreover, it was one of the five major sports of the ancient Pentathlon and the most prestigious event of the Ancient Games. Adapted in Latin and later in English as "stadium", the name derives from the fact that an athlete had to run the perimeter of the ancient stadium, which was approximately 180m.In the first modern Olympic Games, the 100m winner was the American runner Thomas Burke who finished his sprint with a time of 12 seconds. At those Games the lanes were separated by ropes and each runner had his own unique style of starting and running. That changed a few years later, in 1920, as athletes shared for the first time a similar style of running by using the starting blocks.

The start: The starting blocks consist of two adjustable footplates attached to a rigid frame. Races commence with the firing of the gun. The starting commands are "On your marks" and "Set". Once all athletes are in the set position, the starter's gun is fired, officially starting the race. For the 100 m, all competitors are lined up side-by-side. False starts: According to the IAAF rules, "An athlete, after assuming a full and final set position, shall not commence his starting motion until after receiving the report of the gun, or approved starting apparatus. If, in the judgment of the Starter or Recallers, he does so any earlier, it shall be deemed a false start. The finish: The first athlete whose torso reaches the vertical plane of the closest edge of the finish line is the winner. To ensure that the sprinter's torso triggers the timing impulse at the finish line rather than an arm, foot, or other body part, a double Photocell is commonly used. Times are only recorded by an electronic timing system when both of these Photocells are simultaneously blocked. Photo finish systems are also used at some track and field events.

Reaction: The goal of the reaction phase is to react to the gun as quickly as possible without sacrificing the 2nd phase (block clearance). The most important mechanics of reaction is to clear your head of all thoughts except for triggering your hands to be split free (forward/backward) by the sound of the gun. Reaction is important because it sets the pace, the intention to perform, and mentally affects the confidence level of the athlete at the beginning of the race. Block clearance: The goal of the block clearance is to eject from the blocks with the proper mechanics to successfully set up the rest of YOUR race. The technique is to eject from the blocks pushing through your heels using your gluten muscles, with a forward lean, and head down. The importance of the block clearance is that it will set up the rhythm, and execution of the remaining phases. Drive phase: In the drive phase you need come out of the blocks staying low, with your body at a 45-degree angle, with good triple extension in the ankles, knees, and hips. Apply as much force as possible into the ground and drive your arms and legs as fast you can. At the 10-meter mark, transition into the acceleration phase. Acceleration phase: In the acceleration phase, you are pushing your hips forward and applying force into the ground. On ground contact, your feet should push back against the track. Keep your head in line with your body and your eyes are transitioning from looking down to looking up toward the finish line. Get tall with your knees up.

Top speed: This is your max velocity phase, where you should be at full speed. Some athletes can transition early and be at full speed at the 40-meter mark; others reach it at the 50-meter mark. Your body should be upright and standing tall, with no forward or backward lean. You'll only be able to run in this phase for around two to three seconds. Speed maintenance: From your top speed you'll then transition into the speed maintenance phase. Don't try to run faster or you might tighten up. All you want to do is to maintain your current speed. Some athletes can start this phase at the 60-meter mark, others at the 70-meter mark. Maintain proper form to avoid slowing any more than you have to in the final 10 or 20 meters. Keep your knees high and move your legs quickly and lightly. Also, drive your arms harder as you push through the final meters of the race. Finish: You want to stay relaxed until you reach the finish line. Lean forward with your shoulders and chest at the final two meters before the finish line. This will push your body forward, getting it over the finish line fractions of a section faster. This may not seem like much, but it can be the difference between being on the podium and watching from the stands. Also, do not let up until you've completely crossed the line. Treat the finish line as something you run through not something you run to.

Starting Phase: The initial phase of sprinting is known as the starting block phase, where the sprinter is in contact with the blocks. This phase has the greatest amount of ground contact time, or the total time in which the feet are in contact with the ground or blocks. This is when force production is the greatest. With the rear leg producing force for only 45 percent of the contact time, the front leg is believed to be of more importance at the start. Stride length and stride frequency are not factors in this phase because the sprinter is not moving.

Acceleration Phase: Once the sprinter takes off from the blocks, they begin to accelerate by increasing stride length and stride frequency. The length of this phase can be anywhere from 30 to 50 meters among top sprinters during a 100-meter race. During acceleration, the time in which the foot is in contact with the ground is relatively long in order to generate high levels of force, but decreases as the sprinter achieves maximum running speed. Constant Speed Phase: The constant speed phase can be submaximal, maximal or supramaximal and is characterized by both the stride length and stride frequency remaining the same over a period of time. This phase is generally achieved between the 60 to 80 meter mark in men and 50 to 70 meter mark in women. In principle, the top sprinters can sustain this phase over a distance of 10 to 20 meters. The difference between elite and sub-elite sprinters is the frequency of stride, demonstrating that it is more important than the length of the stride.

Deceleration Phase: The last phase is categorized by a decrease in sprinting speed, usually occurring between the 80 and 100-meter mark in top sprinters. Velocity begins to decrease on a scale of .5 to 1.5 meters per second and is caused by central and peripheral fatigue. The decrease in speed is mainly caused by a decrease in stride frequency, as stride length and ground contact time is increased when compared to the third sprinting phase.

Statement of the problem

The purpose of this study was to kinematic analysis of Split times across 100-m sprint performance level. It was an effort to know, kinematic analysis the approach during attempt the 100m sprint.

Objectives of the study

- To view the kinematic analysis of Split times across 100-m sprint performance level.
- To view the factor effecting the athletes during 100m sprint.

Significance of study

Result of this study identifies the key parameters which play role during 100m sprint. These results can be used by coaches and players to identify their own strengths and weakness.

Limitation of the study

This study was limited to the national level athletes of Pakistan.

Definition of key terms

100m sprint: The 100 meters is a sprint race in track and field competitions. The shortest common outdoor running distance, it is one of the most popular and prestigious events in the sport of athletics.

Kinovea: Kenova is a video player for sport analysis. It provides a set of tools to capture, slow down, study, compare, annotate and measure technical performances.

LITERATURE REVIEW

In the last four years Usain Bolt improved the world record in the 100 m sprint three times, from 9.74 s to 9.58 s. Over the last 40 years this record has been revised up to thirteen times from 9.95 s to 9.58 s. The improvement equals 0.37 s (from 1968 to 2009) which is an increase in performance of 3.72%. By comparison, during the same time period, the 200 m world record was revised six times from 19.83 s to 19.19 s what amounts to 3.33 %.

Sprinting speed is defined with the frequency and the length of strides [1-5]. These parameters are mutually dependent with their optimal ratio enabling maximal sprinting speed. The increase of speed can be achieved by increased length or frequency of strides. The increase of both parameters simultaneously is quite difficult due to mutual dependency. Therefore an increase in one factor will result in an improvement in sprint velocity, as long as the other factor does not undergo a proportionately similar or larger decrease [6]. Increased frequency results in shorter stride length and vice versa. Therefore the increase in stride length must be directly proportional with the decrease of stride frequency, especially at the beginning of the race – the initial acceleration phase [7]. This relationship is individually conditioned with the processes of neuro-muscular regulation of movement, morphological characteristics, motor abilities and energy substrates [8-13].

According to [6,14] research investigating the relative importance of developing a long stride length or a high stride rate has been inconsistent across published data. [1,14,15] suggested that SF was a more important contributor to the velocity increase in sprint performance, where [4][16-18] stated that SL was a more significant variable. However, it is not clear how those two kinematic parameters interact with each other across the entire distance of 100 m in order to accurately identify different phases of the sprint race. No data exist on how world class sprinters manipulate stride frequency and stride length in order to reach optimal efficiency of the sprint run.

The purpose of this investigation was to compare and determine the relevance of the morphological characteristics and variability of running speed parameters (stride length and stride frequency) between Usain Bolt's three best 100 m performances. Based on this, an attempt was made to define which factors determine the performance of Usain Bolt's sprint and, therefore, distinguish him from other sprinters.

The presented reasoning leads to the following hypotheses: the stride length is the main factor that determines the increase of running speed in particular 10 m sections of the entire 100 m distance. Knowledge of the relative influence of stride length or stride frequency on maximal running speed would be of great value to coaches and provide a basis for developing specifically designed training protocols for maximum speed development.

Usain Bolt is one of the greatest athletes in the history of athletics. He is the winner of eight Olympic gold medals, as well as the world record holder in the 100 m (9.58 s), 200 m (19.19 s), and 4 x 100 m relay (36.84 s). During the 12th International Association of Athletics Federations (IAAF) World Championships in Berlin in 2009, he established a new 100 m world record with a tailwind of 0.9 m/s, beating his previous world record by 0.11 s that had been set in 2008. Specifically, his 100 m world record was one of the most remarkable achievements in sprinting and was the largest improvement in the 100 m world record yet observed [19]. Recently, at the 15th IAAF World Championships in Beijing, 2015, Bolt managed to maintain his world titles in the 100 m, 200 m, and 4 x 100 m relay despite participating in few competitions prior to the Championships due to injury.

Bolt's performance has been a subject of numerous media analyses, debates, and discussions, as well as biomechanical investigations. Research literature has attempted to explain Bolt's performance using spatio-temporal parameters

[19,20] mathematical and biomechanical models [19][21-23], as well as anthropometrical characteristics [20,24]. There has also been attempts to estimate Bolt's 100 m sprinting potential [22,25] with a general consensus that he could have run below 9.5 s if only his reaction time had been better and under optimal environmental conditions (i.e., tailwind and high altitude), thus agreeing with the prediction by [26] that humans can run 100 m in 9.48 s. However, kinematic data of Bolt running in competition are rare, and a more detailed investigation for Bolt's whole-body kinematics could assist in verifying some of the numerous theories of his sprinting success.

When Bolt set his current 9.58 s world record, his fastest 20-m section time was 1.61 s, reflecting mean velocity of 12.42 m/s [19]. This value is the highest absolute velocity ever reached by a sprinter during a 100 m race, and the fastest mean velocity (10.60 m/s) over that race distance. Bolt's superior sprinting performance has been attributed to a strong acceleration phase, higher maximal velocity, advantageous power generation ability, and impressively long strides associated with his physical built [19,21].

Bolt participated in the IAAF World Challenge Zagreb 2011, Croatia. Our team of scientists had the opportunity to further study the fastest sprinter in the world. The specific aim was to investigate the kinematic parameters associated with Bolt's maximal sprint velocity during the men 100 m finals.

Humans can engage in many different actions called ‘‘explosive’’ as jumping, kicking and throwing. Common features of explosive movements are the short duration and high angular velocities. In Athletics, the most explosive kind of action is the ‘‘starting block phase’’ (the time when the sprinter is in contact with the blocks) of a 60 or 100 m sprint. The aim of this phase is to create the greatest horizontal velocity of the center of mass (CM) at the clearing block (VCMclear). Indeed, many studies [9,10,27] have clearly shown that better performances on 100 m are obtained for higher VCMclear and thus depend on the ability of the sprinter to create a great impulse in the shortest time. To understand this ability, some works were interested in the transformation of joint rotations into the desired translation [28,29]. They hypothesised that the centre of mass (CM) translation of multi-joint system is due to the transformation of the joint's rotations into the desired translation.

This transformation during push-off action has been studied during squat jump exercise [28][30-32], during skating [29] during the first steps of sprinting [33] and during the starting block phase [34] suggested that to reach high velocity of the center of mass at the clearing block, a greater peak ankle joint moment and power is necessary.

However, all these studies, about joint moment and joint power, used 2D kinematical analysis and restricted their investigations to lower limbs. To understand the contribution of each segment in the transformation of segmental rotation to the translational movement of the CM during the sprint start, the use of a whole body 3D model is essential to have some information about the influence of the movement in the three planes.

The aim of the present study was to measure the joint angular velocity (JAV) and the kinetic energy (KE) of the different segments in elite sprinters using a 3D kinematic analysis of the whole body. This study will respect the joint coordinate system and hypothesized that JAV and KE of the different segments shall explain the contribution of each segment in the transformation of segmental rotations to the translational movement.

Importance of stride length and stride frequency to the velocity curve of the 100 meters is well documented in the sport science literature (MURASE et al., 1976; [1,4,5,35,36]. However, it is not clear how these kinematic parameters affect the different phases of a sprint race. Little is known about how sprinters manipulate their stride patterns during the phases of acceleration, maximum velocity, and deceleration to reach optimal efficiency. Moreover, there is the question as to whether the phase structure of the 100 meters is the same for athletes of different levels of performance.

This is an important theme for research as information in this area will promote the understanding of the biomechanics of sprinting and provide a basis for developing training protocols that are specifically designed for individual athletes.

The purpose of this study was to determine the relevance of the variability of the main kinematic parameters between athletes of different performance levels in the 100 meters and then verify their influence on the phases of the race and technical efficiency.

Data obtained for a group of “average” sprinters was collected and compared with published data for elite sprinters to understand the relationships between stride length and frequency, and then running velocity, and to determine the phase structure for each group. To draw conclusions and make recommendations it was necessary to observe the changes in velocity and estimate the proportionate effects of stride length and stride frequency by measuring both variables and computing their influence using appropriate statistics.

Male weightlifting is a sport with a long history dating back to being included in the first Olympic Games in 1896. This sport is based on dynamic strength and power, in which two different movements (Snatch and Clean & Jerk) are performed sequentially. The final rank is determined on the total result of the heaviest successful lifts of the two movements. In weightlifting, athletes use their reasonable technique, physical, functional and psychological traits to lift a barbell of maximal weight. Of all weight classes in Olympic weightlifting, only the 69-kg is the category common to both genders. The 69-kg class, which is identified as the category with the greatest depth of lifters from top to bottom is representative of national caliber performance in snatch. The performance pattern of snatch technique requires the barbell to be lifted from the floor to a straight-arm overhead position in a continuous action. In the past four Olympic Games (2004, 2008, 2012, and 2016) Chinese male athletes have won the gold medals in the 69-kg class which provides an adequate ground for our investigation.

The technique of top-elite athletes represents the best performance, and can be considered as excellent technical model or a reference that should be achieved. Previous studies of snatch performance focused mainly on the differences in adult female weightlifters, between adult and adolescent males and between genders. They analyzed the kinematic and kinetic parameters by two or three-dimensional methods. However, the lack of data regarding the stability of snatch technique raises questions regarding the appropriateness of using the specific assistant exercises for improving the success of the snatch lift. Furthermore, no study was found within the literature that compared the snatch performances between top elite and sub-elite (lower level athletes) male weightlifters in 69-kg category. Therefore, the purpose of our study was to highlight the differences of technical characteristics between top-elite and sub-elite male weightlifters, to summarize the technical features of top-elite athletes, and to provide valuable information for lower level lifters and coaches to integrate into training and competition.

It was hypothesized that under the condition without considering weight nuances of top-elite and sub-elite weightlifters, the comparative analysis of snatch performances in the 69-kg category would reveal the technical discrepancy between the two levels.

The crowning of the 100-m sprint champion remains a hallmark of each Olympic Games, and the winners are “the world’s fastest humans.” The dramatic world record progression since the first modern Olympics has been driven by advancing training methodology and deliberate practice, combined with key improvements in running surfaces and footwear. Because sprint running is a core capacity that underlies performance in many sports, there is a voluminous body of scientific literature devoted to sprint training. The vast majority of sprint-related training interventions have reported positive effects on sprinting capabilities, leading to the assumption that sprinting performance is easily improved with a variety of methods. In contrast, observations of elite athletes over time show a very different reality, one where most annual within-athlete performance differences are lower than typical variation, the smallest worthwhile change, and the influence of external conditions (wind, temperature, altitude, timing methods/procedures, etc.). Plausible explanations for this mismatch between published science and observed practice are publication bias in favor of positive findings and subject training status bias, with most experimental data coming from studies of untrained or moderately trained performers.

In contrast to the many descriptive studies of world-class endurance athletes no studies of world-class sprinters to date have described the varying training components (modality, duration, intensity, resting periods, session rate, etc.) across the annual cycle. It is fair to say that positive developments in sprint training methods employed by world-class athletes have not been driven by sports scientists. Publicly available “recipe books” and training guides based upon the practical experience and intuition of world-leading sprint coaches, and also governing body documents from acknowledged athletics federations, have become important and popular sources of best practice training information and framework development for the international sprint community. We believe combining data sources from available research evidence and results-proven practice provides a valid point of departure for outlining state-of-the-art sprint training recommendations and for generation of new hypotheses to be tested in future research. The objective of this review is therefore to integrate scientific and best practice literature regarding the training and development of elite sprint performance. Although the present review is anchored in athletics and competitive 100-m sprinting, most of the content is also relevant for other sports where linear sprints frequently occur.

Their lower performing counterparts. Table 1 displays and overview of observed split times as a function of 100-m sprint performance level and can be used to identify individual strengths and weaknesses across the varying phases.

Power, technique, and sprint-specific endurance are considered key underlying determinants of 100-m sprint performance. A very strong relationship exists between maximal horizontal power output and sprint performance; the shorter the sprint distance is, the higher the association with maximal horizontal power output. Power output demand in sprinting increases exponentially with velocity. Reported that step averaged maximal horizontal power output in male and female world-class sprinters was 30.3 ± 2.5 and 24.5 ± 4.2 W kg− 1 , respectively, typically reached after ~ 1 s of sprinting. The highest individual values for men and women were 36.1 and 29.3 W kg− 1 respectively, representing current upper limits in humans.

Although the basic principles of sprinting are relatively simple and governed by the laws of motion, the way an athlete solves the mechanical constraints and utilizes the degrees of freedom within these constraints is far more complex. A review of research literature shows that the following kinematic variables have received the most attention: Spatio-temporal variables (e.g., step length, step rate, contact time, flight/aerial time): Segment configuration at touchdown and lift-off: Lower-limb segment velocities immediately prior to touchdown or during ground contact: Front- and back-side mechanics.

Indeed, sprint mechanical variables are entangled, and no single variable is associated with better performance. Because kinetics and kinematics are entwined, athletes cannot apply sprinting mechanics that they are not adequately predisposed to. For more information regarding the sprint running technique, we refer to previously published biomechanical analyses (e.g.).

Sprint-specific endurance refers to the deceleration phase of the sprint. The velocity decline is typically accompanied by a reduction in step rate. Sprint related fatigue is attributed to disturbances in the central nervous system and peripheral factors within the skeletal muscles. Available research indicates that leg stiffness, which influences elastic energy storage, is particularly crucial for sprint-specific endurance. Sprint-specific endurance is also determined by instantaneous energy delivery. Estimated from accumulated oxygen deficit measures, the relative anaerobic energy system contribution (from stored adenosine triphosphate, stored phosphocreatine, and anaerobic glycolysis) is about 80% for 100-m sprint.

In elite team handball, shooting on goal is one of the most important aspects of the game. For a shot to be successful, it requires maximum ball velocity and precision as well as an element of surprise for the defensive players and goalkeeper. But what factors influence maximal ball velocity and precision in a handball throw, and what kind of training should be undertaken to increase ball velocity and precision to optimize the throw? [37] reported that 67% of ball velocity at ball release can be explained by the summation effects from the velocity of elbow extension and internal rotation at the shoulder. Jo¨ris and colleagues [38] showed that a high ball velocity depends on an optimal proximal-to-distal sequence, but [39] revised this thesis based on their results with French handball players: maximal linear speed of the shoulder occurred after maximal linear speed of the elbow. Wagner and colleagues [40] measured the kinematics of the upward jumping throw performed by handball players of varying skill. They found that the main reason why top players produced higher ball velocities than less proficient players was the velocity of the shoulder, especially shoulder flexion, together with elbow extension and ulnar deviation at the wrist. When summarizing the results of these studies, it is clear that it is important to optimize the movement of the throwing arm, in particular the velocity of the shoulder, elbow, and wrist.

It is usual for handball-specific training to be used to optimize the throw in handball. Trainers provide instructions and corrective feedback. They plan handball-specific strength training by throwing with a lighter/heavier, smaller/larger ball or with an additional weight or training under game-specific conditions (e.g. against one or more defensive players or with one or more offensive players).

To determine the training that is most appropriate to optimize ball velocity and precision for the handball throw, it is important to know the standard at which the athlete performs. For low-performance athletes, it is important to keep the conditions as constant as possible to stabilize the movement pattern and to avoid neural overload [41]. In contrast, for high-performance athletes, it is important to vary the movement pattern to ensure adequate reaction to changing conditions and therefore to stabilize the movement. At the elite standard, it is often necessary to develop training methods that offer athletes the possibility to improve their performance further. Therefore, we chose a method that offers an athlete individual optimization of certain movement patterns in contrast to the theory of imitating the movement of a model to improve performance. We selected a variable training method based on the variability of practice hypothesis [41] and a differential training method modelled on differential learning [42]. Comparing these training methods for the handball throw would be useful because little research has been conducted on the acquisition of team handball skills, apart from a few studies on variable practice [43-45] and differential training.

The Variability of Practice theory predicts that practicing a variety of movement outcomes with the same program (i.e., by using a variety of parameters) will provide a widely based set of experiences upon which a rule or schema can be built" [44]. For throw training in handball, the desired schema defined by invariant elements should involve experience of as many different combinations of parameters as possible that require changes in variant features within a class of skills to optimize the movement. The athlete must learn how to alter his or her schema to achieve a particular outcome in different conditions. That is, following Schmidt (1975, 1976, 1988), for various starting situations (X) and result conceptions (Z), the appropriate parameters (Y) must be measured. For throw training in handball, Roth (1989) recommends varying the following programme parameters: action speed and overall duration, fast or slow throw execution, jump assistance or handicaps, overall force, and changing the throw strength or spatial parameters such as point of release or release angle. Therefore, we used lighter or heavier, smaller or larger sport devices to vary the parameter of absolute force, special training devices to vary the parameter of movement duration, and the participants were required to throw with different foot positions, release angles, and different points of release during variable training.

In addition to variation of the programme parameters, the arrangement and sequence of the exercises relative to contextual interference effects can also play a role in the success of learning. Lee and Magill (1983) reported that serial or random practice was more effective than blocked practice for success in a retention test. Similar results were reported by Shea and Morgan (1979), Shea and colleagues [46], and Wulf and Lee (1993). In a serial or random practice condition, different exercises (e.g. A, B, C, and D) are performed one at a time either in a specific sequence or in a completely random order. With blocked training, exercise A is repeated several times before moving on to exercise B, then exercise C, and finally exercise D. To optimize the variable training, it was important to establish either a serial or a random practice schedule. Therefore, we first arranged the exercises for variable training under methodical standpoints and then randomized them.

Learning may take the form of a phase-transition process that involves stabilization of the required pattern as an attractive state of the coordination dynamics" [47]. This phase transition – that is, the change in movement pattern from one to another stable state – was demonstrated experimentally using rhythmic finger movements [48,49] and transformed into a mathematical model [50] by calculating the relative phase between the two involved fingers. The most important finding in this experiment was that by changing a control parameter in line with the movement frequency starting from a certain critical frequency, the fluctuations increase and system changes are self-organized. In this case, it is not arbitrary; rather, the change is from one stable state (attractor; anti-phase ¼ 1808) to another, whereby the second attractor (in-phase ¼ 08) is more attractive. This effect can be recognized also with complex movements when a newly learned movement pattern reverts to an old movement pattern during competition. By increasing movement velocity (i.e. altering the control parameter), the system becomes unstable and change is self-organized to the more attractive attractor.

The ability to change from a bi-stable to a tri-stable regime of pattern dynamics has been shown by Zanone and Kelso (1992a, 1992b, 1997). Participants with bi-stable dynamics, with a stable behaviour at 08 and 1808, were assigned to practise a 908-phase. After 5 days of training, a new attractor (the standard deviation of 908 relative phase decreased) existed, whereby the stability of this new attractor depended on the pre-existing attractors, according to Zanone and Kostrubiec (2004). Furthermore, the symmetry pattern (2708 phase) of the to-be-learned pattern became an attractor state too, although such a pattern had never been practised, which could be interpreted as a transfer within an effector system. Whether a transfer between effector systems is also possible was tested by Kelso and Zanone (2001). They observed that the practised 908 phase of a rhythmic arm movement also became a stable state for the leg and vice versa, although the legs did not practise such a pattern. This could be interpreted as a transfer of learning across two effector systems.

Coordination training in handball demands varying movement parameters over a sufficiently wide range [51] focusing mainly on destabilization of an existing attractor and the building of a new movement pattern. The differences are selected such that the expected values lie within the chosen extreme values (principle of interpolation; cf. Figure 1). In this context, Scho¨llhorn (2000) speaks of the differential learning approach. According to Scho¨llhorn (2000), practicing with different exercises also offers the ability to react continuously to new situations in a rapid and appropriate way.

Variations in the movement pattern of the handball throw [37,39,40] and the principles of movement variability in general [52,53] in the context of the handball throw, result in the variations and differences listed in Figure 2. These possible variations serve as a basis for the conception of the individual training units. For the differential training approach, the principle of contextual interference was also used. In previous studies of variable [43,54,55] and differential [56,57] training, only low performance participants were used and the duration of the training was temporally limited. Therefore, the aim of this study was to conduct a comprehensive temporal, effective, and practical training study that would offer athletes the opportunity to increase their performance, and to analyze the effects by measuring kinematics and quality parameters.

To evaluate possible improvements after completing this training, we analyzed a world-class athlete with similar anthropometric characteristics to a training participant for comparison. In this context, it was of interest to establish if the movement pattern of the training participant approximated that of the world-class athlete. That is, can the difference between the actual and desired value of a certain model be reduced? The training programme should involve three different phases. In the first phase, preferable differentiated exercises should allow the system the possibility to optimize self-organization of a movement pattern. This movement pattern could be a new one or a stabilized old one with the positive effect of an increasing movement quality. In the second training phase, the dynamic of the movement should be improved by changing the external conditions as well as increasing ball velocity. Since in this phase both external and internal forces will vary during the movement, this training allows the athlete to improve the internal forces to optimize the movement. In this context, Bernstein (1967) speaks of the highest stage of movement coordination that can only be realized by top-class athletes. In the final training phase, the contents of the preceding training phases should be combined to increase the chances of improving performance.

METHODOLOGY

It is necessary to develop appropriate design to complete this study or research successfully. The present research included following thing which were consider as research design. The research procedure is about the methodology of research. This chapter gave the complete understanding about the methodology that have been used to complete this research.

Participants

Athletes was selected for this study from different universities of Lahore, Pakistan.

Experimental Protocol

The participants was give 10 minutes to do a warm-up related to event. Every player was permitted to practice related to event for becoming familiar with the test environment. Players have to try perform at maximum level. Cameras & stop watch was used to analyze sprint.

Camera set-up

First camera (Sony HDR-HE9) was placed 5.03 meters away from the subject in such a way that it become perpendicular to the sagittal plane to accurately record the motion of subjects on the sagittal plane, height of the lens will kept at 1.00 meters from the ground height, it also aided in precise measure of different joint angles. On the frontal side, second camera was placed behind the player to record accuracy. Third camera was used to measure the velocity & accuracy. To analyze and digitize the recorded videotapes, motion analysis system (Kinovea Software; 0.8.15) will used.

Statistical Analysis

Descriptive analysis statistics was used to describe the data and nature of the data obtained on the samples of the study. Pearson's Product Moment Correlation was used to evaluate the various relationships of the selected variables. All statistical analysis will carried out in SPSS 22.0

RESULTS

This chapter includes the results of the study that came after the data analysis.

Table: 1 Sprinter	100 m(s)	30 m(s)	60 m(s)	80 m(s)	30-60 m(s)	60-80 m(s)	80-100 m(s)	60-100 m(s)
Ali Ahmad	10.34	4.06	6.71	8.47	2.65	1.76	1.87	3.63
Farhan Shah	10.50	4.11	6.77	8.58	2.66	1.81	1.92	3.73
M. Laeeq Naveed	10.55	4.08	6.76	8.59	2.68	1.83	1.96	3.79
Abdullah	10.60	4.13	6.81	8.63	2.68	1.82	1.97	3.73
Muhammad Shafiq	10.66	4.10	6.80	8.66	2.70	1.86	2.00	3.86

Table 1: Split times across 100-m sprint performance level

Table 1 displays and overview of observed split times as a function of 100-m sprint performance level and can be used to identify individual strengths and weaknesses across the varying phases. Ali Ahmad cover the 100m sprint distance into a 10.34s, 30m distance cover into a 4.06s, 60m distance cover into a 6.71s, 80m distance cover into a 8.47s, Ali Ahmad cover total distance into 10.34s, in between 30-60m distance cover 2.65s, 60-80m distance cover 1.76s and 80-100m distance cover into a 1.87s. Farhan Shah cover the 100m sprint distance into a 10.50s, 30m distance cover into a 4.11s, 60m distance cover into a 6.77s, 80m distance cover into a 8.58s, Farhan Shah cover total distance into 10.50s, in between 30-60m distance cover 2.66s, 60-80m distance cover 1.81s and 80-100m distance cover into a 1.92s. M. Laeeq Naveed cover the 100m sprint distance into a 10.55s, 30m distance cover into a 4.08s, 60m distance cover into a 6.76s, 80m distance cover into a 8.59s, M. Laeeq Naveed cover total distance into 10.55s, in between 30-60m distance cover 2.68s, 60-80m distance cover 1.83s and 80-100m distance cover into a 1.96s.

Abdullah cover the 100m sprint distance into a 10.60s, 30m distance cover into a 4.13s, 60m distance cover into a 6.81s, 80m distance cover into a 8.63s, Abdullah cover total distance into 10.60s, in between 30-60m distance cover 2.68s, 60-80m distance cover 1.82s and 80-100m distance cover into a 1.97s. Muhammad Shafiq cover the 100m sprint distance into a 10.66s, 30m distance cover into a 4.10s, 60m distance cover into a 6.80s, 80m distance cover into a 8.66s, Muhammad Shafiq cover total distance into 10.66s, in between 30-60m distance cover 2.70s, 60-80m distance cover 1.86s and 80-100m distance cover into a 2.00s.

SUMMARY

The purpose of this study was to kinematic analysis of Split times across 100-m sprint performance level. It was an effort to know, kinematic analysis the approach during attempt the 100m sprint. To view the kinematic analysis of Split times across 100-m sprint performance level. To view the factor effecting the athletes during 100m sprint. Result of this study identifies the key parameters which play role during 100m sprint. These results can be used by coaches and players to identify their own strengths and weakness. This study was limited to the national level athletes of Pakistan. Kinovea is a video player for sport analysis. It provides a set of tools to capture, slow down, study, compare, annotate and measure technical performances. Athletes was selected for this study from different universities of Lahore, Pakistan. First camera (Sony HDR-HE9) was placed 5.03 meters away from the subject in such a way that it become perpendicular to the sagittal plane to accurately record the motion of subjects on the sagittal plane, height of the lens will kept at 1.00 meters from the ground height, it also aided in precise measure of different joint angles. On the frontal side, second camera was placed behind the player to record accuracy. Third camera was used to measure the velocity & accuracy. To analyze and digitize the recorded videotapes, motion analysis system (Kinovea Software; 0.8.15) will used. Descriptive analysis statistics was used to describe the data and nature of the data obtained on the samples of the study. Pearson's Product Moment Correlation was used to evaluate the various relationships of the selected variables. All statistical analysis will carried out in SPSS 22.0

Discussion

Table 1 displays and overview of observed split times as a function of 100-m sprint performance level and can be used to identify individual strengths and weaknesses across the varying phases. Ali Ahmad cover the 100m sprint distance into a 10.34s, 30m distance cover into a 4.06s, 60m distance cover into a 6.71s, 80m distance cover into a 8.47s, Ali Ahmad cover total distance into 10.34s, in between 30-60m distance cover 2.65s, 60-80m distance cover 1.76s and 80-100m distance cover into a 1.87s. Farhan Shah cover the 100m sprint distance into a 10.50s, 30m distance cover into a 4.11s, 60m distance cover into a 6.77s, 80m distance cover into a 8.58s, Farhan Shah cover total distance into 10.50s, in between 30-60m distance cover 2.66s, 60-80m distance cover 1.81s and 80-100m distance cover into a 1.92s. M. Laeeq Naveed cover the 100m sprint distance into a 10.55s, 30m distance cover into a 4.08s, 60m distance cover into a 6.76s, 80m distance cover into a 8.59s, M. Laeeq Naveed cover total distance into 10.55s, in between 30-60m distance cover 2.68s, 60-80m distance cover 1.83s and 80-100m distance cover into a 1.96s.

Abdullah cover the 100m sprint distance into a 10.60s, 30m distance cover into a 4.13s, 60m distance cover into a 6.81s, 80m distance cover into a 8.63s, Abdullah cover total distance into 10.60s, in between 30-60m distance cover 2.68s, 60-80m distance cover 1.82s and 80-100m distance cover into a 1.97s. Muhammad Shafiq cover the 100m sprint distance into a 10.66s, 30m distance cover into a 4.10s, 60m distance cover into a 6.80s, 80m distance cover into a 8.66s, Muhammad Shafiq cover total distance into 10.66s, in between 30-60m distance cover 2.70s, 60-80m distance cover 1.86s and 80-100m distance cover into a 2.00s.

Conclusion

It can be concluded that athlete performance was associated with a relatively long stride length, horizontal positioning of the foot close to the CoM at the ground contact, minimal braking phase, high vertical ground reaction forces, minimal vertical displacement of the CoM, as well as with high angular and horizontal velocities of his swinging leg. A more extensive analysis including all the sprinting phases (i.e., starting block, acceleration, speed-maintenance, and deceleration) can be suggested to researcher. Also suggested to be a resulting combination of anthropometrical characteristics, coordinated motor abilities, power generation capacities, and effective running technique.

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