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STRIDE REGULATION AT THE APPROACH PHASE OF LONG JUMP IN VISUALLY IMPAIRED (F13) ATHLETES

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The present work studied whether visually impaired (VI) class F13 long jumpers showed at the approach run the same pattern of variability in footfall placement across trials as their non-VI counterparts. The long jump finalists (men and women), of the IBSA 2009 European Athletics Championship were recorded. VI long jumpers demonstrated an initial ascending variability followed by a descending one suggesting some type of regulation. This control emerged on the 5th and 4th stride prior to take-off and at a mean distance of 8.8±1.9m and 8.3±2.6m from the take-off board for men and women respectively. TBD variability reached a maximum value of 30.0±18.9cm and 25.2± 14.4cm and was finally reduced to 7.73cm (± 6.65cm) and 8.2± 2.6cm for males and females respectively. The striding pattern observed was similar to that reported in the literature for non-VI athletes.

KEY WORDS: Long jump, stride regulation, visually impaired.

INTRODUCTION: The approach phase and the technical skill of placing the take-off foot on the board with accuracy, speed and right technique during a long jump constitutes a demanding task for the performer. The successful completion of this task depends heavily on the constancy of the run up distance, number of strides and the ability of the athlete to reach maximal controllable horizontal velocity in a similar fashion across all tries. Many studies using a vast range of performers (elite, high class, skilled, unskilled, novices) (Berg & Mark 2005; Berg, Wade & Greer, 1994; Bradshow 2005; Hay, 1988; Hay & Koh 1988; Scott, Li & Davids, 1997) suggested that the final fraction of the long jump's run-up is visually regulated and that this regulation constitutes an ever-present element of the event's performance.
Long jump is one of the events of the International Blind Sport Association (IBSA) and Paralympics competition programme and among the ones that attract a large number of high level competitors. Competing athletes are classified in three distinct categories according to their respective visual impairment (F11, F12 & F13). Visually impaired (VI) athletes participating in class F13 have visual acuity of above 2/60 up to visual acuity of 6/60 and/or visual field of more than 5 degrees and less than 20 degrees (IBSA 2009). Visual acuity of 2/60 or 6/60 means that the person cannot see, at a distance of 2 or 6 meters, the object which a person with normal eyesight would be able to see at 60 meters. The long jump event in this category (F13) is performed according to the relevant IAAF competition rules applied for non-VI impaired athletes (IBSA 2009). The assimilation between non VI and VI long jumping provided us with the reasoning for conducting the present study. The purpose of the present study was to report if class F13 VI long jumpers demonstrate step length regulation in the approach run as reported in main literature for their non VI counterparts.

METHODS: The four finalists of the men's long jump and the six finalist of the women's long jump (class F13), of the International Blind Sport Association (IBSA) 2009 European Athletics Championship were recorded during the competition. The set up of the experimental procedure was according to the protocols described by most of the visual regulation studies so far (Berg & Mark 2005; Berg, Wade & Greer, 1994; Bradshow 2005; Hay, 1988; Hay & Koh 1988; Scott, Li & Davids, 1997). Forty (40) 1.0 meter zones were established on the runway and were designated by white markers placed at 1m intervals on either side of the runway and parallel to its long axis. This was to enable calculation of the horizontal distance between the toe and take-off board (toe-board distance). The approach phase of each long jump was recorded using a high definition digital video camera (SONY HDR-SR10) operating

at 50 frames/second. The camera was manually panned to allow the whole of each subject's run-up to be recorded. The panned camera was positioned at a distance of 15m from the midline of the runway and elevated at a height of 5m so that the markers on both sides of the runway were visible. In total, 55 run-ups were analysed.
To determine the toe-board distances (TBD) for each foot placement of each athlete's run-up, the videos collected from the panning camera were transferred to a personal computer for kinematic analysis using the APAS 2010 (ARIEL DYNAMICS) software. A five-point model was used and included the toe during the support phase and the four markers which surrounded the foot at ground contact. TBD was calculated according to the method described by Chow 1987 and adapted by Hay and Koh (1988). This procedure required initially the designation of the toe-marker distance by projecting the position of the toe onto a line between the two near markers that had been digitized. TBD was calculated by the addition of the toe-marker distance and the marker-take off board distance. The validity of the procedure for calculating the toe-board distance was assessed by recording running shoes placed at known distances along the runway. The TBD of the running shoe was then calculated using the same method as described above. The comparison of the actual shoe distance with the digitized one showed an error of ± 1 cm which was considered acceptable for the purposes of the study (Berg et al., 1994; Berg & Mark, 2005; Hay, 1988). Descriptive statistics were used in order to calculate the mean and SD of TBD at each support phase across trials.

RESULTS: As shown on Figure 1, male athletes demonstrated an initial ascending mean SD of TBD reaching a maximum value of 30.0 cm (± 18.85cm) on the 6th support phase (i.e. 5th stride from the board) and at a mean distance of 8.81m (± 1.88m) from the take-off board. Similarly, female athletes as well reached a maximum TBD value of 25.21 cm (± 14.37cm) on the 5th support phase (i.e. 4th stride from the board) and at a mean distance of 8.30m (± 2.59m) from the take-off board. Following the point of TBD when SDmax was achieved, a descending trend was recorded for the remaining strides until the take-off board where the mean SD of TBD across trials was finally reduced to 7.73cm (± 6.65cm) and 8.23cm (± 2.55 cm) for males and females respectively.

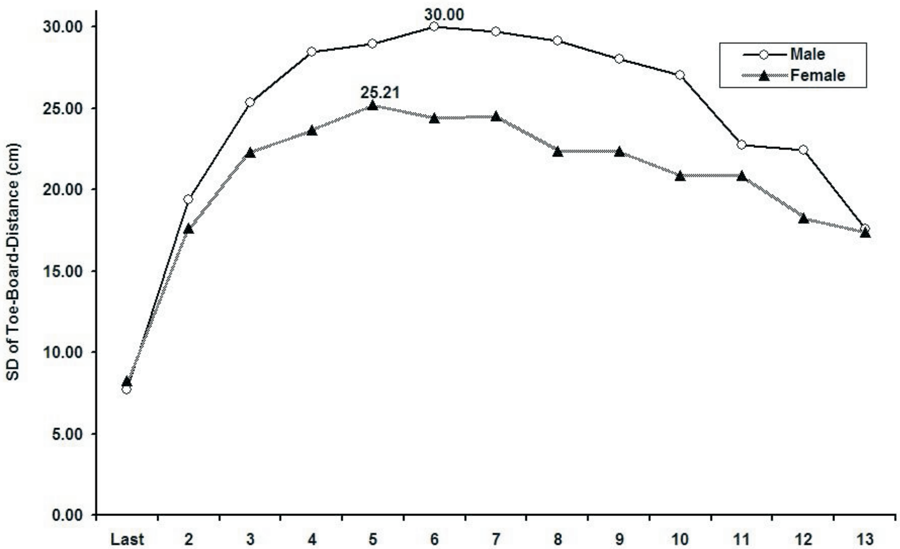

Figure 1: Mean SD of toe-board distance (cm) at each support phase for male and female (class F13) long jumpers.

DISCUSSION: All the studies investigating the regulation of the strides at the approach phase of a long jump have demonstrated that all the athletes, irrespective of their expertise, display an ascending-descending trend of variability for foot placement over trials (Berg & Greer 1995; Bradshow 2005; Hay 1988; Hay & Koh 1988; Galloway & Connor 1999; Scott et al., 1997). The maximum SD (SDmax) of TBD is considered to be a measure of the consistency of the stereotyped segment of the approach run. The value recorded at the present study is similar to the SDmax of TBD reported in several studies (37cm in Lee et al., 1982; 33-36cm in Galloway & Connor 1999; 22cm in Hay & Koh 1988; 23cm in Hay 1988) for non-VI athletes.
The descending pattern of variability found in this study was also comparable to the one reported in most studies where it has been reported to commence as an average on the 4th to 5th stride from the board and at a mean distance of 7.48m to 10.0m from the take-off point (Hay 1988; Berg, Wade & Greer 1995; Bradshow and Aisbett 2005). This decrease is presumed to reflect the replacement of the stereotyped gait pattern with one that is based on jumpers' visually perceived relationship to the take off board (Lee et al., 1982; Hay and Koh, 1988; Berg et al., 1994). However, since the athletes participating at the current study were VI, the nature of the perception guiding them to perform this type of regulation much earlier than their vision allows, should be of a different origin. Furthermore, the average SD of TBD recorded for the take-off stride demonstrates an accuracy of foot placement on the board comparable with elite level non-VI athletes (6-12cm, Hay & Koh 1988; 4-6cm, Hay 1988).

CONCLUSION: A comparison of the data from the current study with those reported on other studies, suggests that VI (class F13) athletes demonstrate a level of consistency in their run-up comparable to high level non-VI athletes and that a regulation is present as it happens to their non-VI counterparts. A question is raised as to how VI athletes manage to regulate their stride pattern in a similar fashion to their non-VI counterparts, despite the fact that visual information is limited. The absence of well established theory to guide our discussion led us to adopt the multisensory tau hypothesis of Berg and Mark (2005) and the possibility that kinaesthesia allows them to perceive their position relative to the approaching target. Further research is required in order to build a strong theoretical background to support future researchers examining VI long jumpers.

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