# CHAPTER I

## INTRODUCTION

The standard sprint hurdle race is 110 meters (m) for male (1). The basic technique of the hurdle race, like most other athletic events, requires both speed and skill for the performing athlete to compete in the race with the best result (2). Additional requirement are flexibility and rhythm which considered as the most important of all technique. The overall performance objective of the hurdle race is to cross over the obstacles, which are ten hurdles, effectively with maximal velocity and to cover the race distance within the shortest time (3). To achieve this main objective, the hurdler depends largely on his ability to maintain proper body orientation and horizontal velocity of the center of mass (CM), especially during going over each of the ten hurdles (4).

A basic hurdle run during each hurdle clearance comprises of the hurdle step, and the three interhurdle steps which are landing step, recovery step, and preparatory step (5). The lead leg plays a crucial role that influences the hurdler's performance during each hurdle step. After take off, the lead leg initiates and controls the body to clear the hurdle and lands first to begin the next interhurdle step (6). From previous studies concerning hurdling performance, several variables were derived from biomechanical analysis, such as vertical and horizontal velocities, takeoff and landing distance, and the body's CM displacement, and were used to determine the level of hurdler's performance (3, 4, 5, 7).

Mean horizontal velocity of HS were used to determined level of performance of the athletes (4, 5). Salo et al. (4) found that the county level male hurdlers performed with longer takeoff distance and greater mean horizontal velocity than the club level male hurdlers, which indicated the different skill level of male hurdlers. A low CM parabola path was the proper characteristics of the CM trajectory used by high-level hurdlers during crossing over the hurdle (3, 4, 5, 7). The less in CM lift and clearance height associated with having the highest point of CM prior to the hurdle indicated the lower CM parabola path (4, 5). The angular velocity and angular displacement of lower extremities were also used to determine performance of the athletes (4). Salo et al. (4) found that male hurdlers had greater mean maximal angular velocity of the trail hip flexion and less values of minimum hip flexion angle of the lead leg than female hurdlers, which indicated that male hurdlers were able to cross the hurdle faster, had greater trunk flexion, and were able to raise their lead leg more than female hurdlers, thus provided the male hurdlers the lower CM parabola path. Maximal angle of trunk and lead leg and time to reach maximal angle of trunk and lead leg may be used to indicate the ability of the athletes. However, details concerning maximal trunk flexion, maximal hip flexion, maximal knee extension, and time to reach these of maximal angle are still limited.

The male's 110 m hurdle event requires high precision for the athletes to alternate steps consistently while being able to clear the barriers safely, therefore the ability to control body movement during the hurdle step may be used to determine the performance of the athletes. Therefore, for this study, it was surmised that the athletes with high-level of performance would be able to control their body orientation better than the athletes classified as an amateur-level during hurdle step.

From the previous results of the South East Asian games (SEA games) (8), Thailand has been recognized as one of the leading countries topping the medal tally, including the success of the Thai Athletics Association. The continued success of Thai athletes in getting several gold medals, especially from the male sprint hurdle race, indicates a potential for our achievement at higher levels of international sport events such as the Asian Games or even the Olympics Games. However, biomechanical research concerning the performance of Thai athletes during a hurdle race is still limited.

Professional athletes and their coaches are continuously seeking the best available tools to improve their training and performance. The analysis of the body mechanics performed by highly skilled athletes such as elite level hurdlers may provide useful information for the hurdlers at lower level to learn about proper technique. However, movement assessments should be made easy to use during training sessions. A video camera operating at the rate of 25 frames per second has been used in previous studies to analyze the athlete's performance during a professional level hurdling race (4, 7). In addition, the lead leg movement, which requires to crossover the hurdle without rotation, primarily occurs in the sagittal plane of motion. Similarly, the motion of the trunk presents in the sagittal plane during leaning forward (2). Therefore, for the present study, a two-dimensional (2-D) measurement was considered to be an appropriate choice for answering the problems that occur primarily in the sagittal plane and provide satisfactory results for the kinematics of the trunk, hip, and knee joints (9, 10).

Currently, basic coaching guidance for Thai sprint hurdle provided mostly rough guide about movement of whole body, however, detail information regarding

the kinematics of the lead leg and its relation to the body remains scarce. Therefore, the purpose of this study was to examine the kinematic differences in hurdling performance of male sprint hurdlers with different skill levels using 2-D video analysis. The results of the study may provide additional information for Thai hurdlers about their currently used techniques and may help them improve their performances. Furthermore, this study was in accordance with the national policy of the Sport Authority of Thailand to pursuit of sporting excellence for both athletes and coaches (11).

**Purpose of the study**

1. To describe the movement patterns of the trunk and lead leg during the hurdle step of Thai male sprint hurdlers with high level (HI) and amateur level (AM) of performance in terms of horizontal velocity, takeoff and landing distances, CM parabola path, and joint displacement angles of the trunk and lower extremities.
2. To determine if differences exist in the movement patterns of the trunk and lead leg during the hurdle step between Thai male hurdlers with different level of performance (high level versus amateur level).



**Research question and hypothesis of the study**

Research question

Were there distinguishable skill level differences for the kinematics used to generate horizontal velocity, movements of the trunk and lead leg, and CM parabola path between high-level (HI) and amateur-level (AM) hurdlers during the hurdle step?

Hypothesis

When comparing between male sprint hurdlers with HI and AM, there would be differences in

- Mean horizontal velocity
- Takeoff distance
- Landing distance
- Body kinematics of trunk and lead leg including
    - Maximal trunk flexion and time to maximal trunk flexion
    - Maximal hip flexion and time to maximal hip flexion
    - Maximal knee extension and time to maximal knee extension
- CM parabola path including
    - CM lift
    - Clearance height
    - Horizontal displacement of peak of CM parabola path to the hurdle

**Advantages of the study**

The knowledge derived from the present study may provide useful information for the Thai hurdlers of different levels of performance to develop more efficient technique and improve their performance. The amateur-level hurdlers could learn about developing their basic techniques in order to achieve similar technique as the high-level hurdlers. The high-level hurdlers could improve their performance as the international level hurdlers of other countries and have potential to compete in the higher level of international sport events such as the Asian Games or the Olympics

Games. Furthermore, hurdling coaches could use kinematics data to apply to their training program in order to train the basic technique of hurdling, which could be helpful in developing proper mechanics of the body for newly-trained hurdlers. In addition, the results of the study will be useful for future research considering the training effects of hurdling drills based on kinematic data.