Chapter 3

METHODOLOGY

3.1 Experimental design

The main purpose of this study was to establish the reliability and validity of the speed jump test developed. The reliability was established by test-retest method where the experiment was divided into two sessions conducted over two alternate days with one day of rest in between. The speed jump measurement obtained during the first session was then compared to the one obtained in the second session by calculating the Cronbach's alpha coefficient and Pearson Product Moment correlation coefficient. Student's t-Test were used to compare the mean of the results obtained in both the sessions.

During the first session, the subjects’ height and weight were measured first when they came in. Rules and regulations and methodology of all the tests were explained to them and the subjects were also made aware of their rights in participating and withdrawing from the tests and the risks associated with all the tests. Instructions of all the tests were given and demonstrations were also conducted. They were also required to have a feel in performing all the tests. Before they started the tests, they went through their normal warm-up routine consisting of jogging for five minutes and various stretches for upper body, lower body and core muscles. They were then tested on the 40-meter dash test, followed by the maximal
countermovement vertical jump test before the speed jump test. The tests in the first session were arranged in the above sequence to optimize the subjects’ performance by providing resemblance to mimic the activity they are used to in training where sprinting bouts are incorporated in their normal warm-up routine. As for speed jump test, the vertical jump score was needed in order to calculate the 80% value and thus it had to be conducted only after the maximal countermovement vertical jump test had been performed.

During the second session, the subjects started the session by performing their normal warm-up routine. In addition to this, they were required to perform 3-4 sprint drills to mimic the situations in the first session. They were then tested on the speed jump test, followed by the countermovement drop jump test (drop jump for height) and lastly the bounce drop jump test (drop jump for height and contact time). All the tests were performed in an indoor facility that could accommodate two basketball courts.

In each and every test, one practice trial and three trials were given and corrections were made if necessary before the subjects started the tests. All the queries were also answered and the subjects began the tests only after they were sure of the proper techniques in performing all the tests. The best results for each test were used for further analysis.

3.2 Subjects

Twenty-one subjects, ages between 13-15 years, from a junior basketball development program team based in Chung Hua High School, Kuala Lumpur volunteered to be the subjects in this study. This study was conducted upon an
agreement between the coach of the team, who was seeking help to test his players and the author who needed subjects during that particular time. The players based in this center were students from Kuala Lumpur area but were not restricted to Chung Hwa High School students. Their average age, body mass and height were $14.3 \pm 0.7$ years, $63 \pm 15.2$ kg and $175.1 \pm 5.1$cm respectively. Their training age ranged from one to four years and they were then divided into two groups, that of a more-experienced training group who had been training for more than two years and a lesser-experienced training group who had been training for less than two years. Subjects' characteristics including those of the higher and lower training age groups are depicted in table 3.1. They trained thrice weekly for two hours per session that consisted of fundamental movements and fundamental skills training.

Table 3.1 Basic characteristics data for all the subjects. $> 2$ tr yrs refers to subjects that have been training for more than two years whereas $< 2$ tr yrs refers to subjects that have been training for less than two years.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects</td>
<td>14.3 (0.7)</td>
<td>175.1 (5.1)</td>
<td>63 (15.2)</td>
</tr>
<tr>
<td>$&gt; 2$ tr yrs</td>
<td>14.6 (0.5)</td>
<td>174.36 (4.1)</td>
<td>59.6 (8.2)</td>
</tr>
<tr>
<td>$&lt; 2$ tr yrs</td>
<td>13.9 (0.7)</td>
<td>175.9 (6.1)</td>
<td>66.7 (20.3)</td>
</tr>
</tbody>
</table>

Note: Mean (SD).
Since most of the subjects didn’t have a good command of English or Malay language, they requested that the test instructions be conveyed in Mandarin, which is the mother tongue for most of them.

Several steps were taken as precaution to ensure that all the subjects were clear of all the rules and regulations and understood all the instructions for the tests. All the information were conveyed in the language they preferred; demonstrations were conducted for all the tests involved; practice trials were conducted before each and every tests; the subjects were allowed to have a feel in performing the tests during demonstration; corrections were made before they started all the tests, even during the practice trials; subjects were encouraged to ask questions and their queries were answered as clearly as possible.

3.3 Testing Procedures

This section will elaborate in detail all the tests that had been conducted including the maximal countermovement vertical jump with arm swing, speed jump test, 40-meter dash test, countermovement drop jump test and the bounce drop jump test. These tests were performed in an indoor facility that could accommodate two basketball courts.

3.3.1 Maximal Countermovement Vertical Jump Test

The maximal countermovement jump was performed using a vane/slat apparatus (Vertec, U.S.A.). Each vane in the Vertec apparatus is separated by half an inch. To perform the test, the subjects’ standing reach height was measured first by having the subjects standing flat-footed sideways to the apparatus and reaching vertically with their preferred hand. Subjects’ preferred hand should touch their ears
and the apparatus was adjusted so that the subjects’ hands would touch the lowest vane. The apparatus would then be adjusted again by increasing the lowest vane by 10 inches.

The subjects were then asked to drop into a squat position at the level and speed they preferred, from which they would immediately jump up as high as possible with an arm swing. At the peak of the jump, the subjects would move the vanes out of the way. The vertical jump score would be determined by adding 10 inches to the total vanes displaced. If the subject were able to displace all the vanes in the practice trials, then an initial adjustment of 10 inches would be increased to 15 or 20 inches and the vertical jump score would be determined by adding 15 or 20 inches to the total vanes displaced depending on the initial adjustment. The subjects had 1 practice trial and 3 trials. The trial with the best result or score was used for further analysis.

3.3.2 Speed Jump Test

The speed jump test was performed using the Vertec apparatus and the Newtest Powertimer Jump Test System consisting of the Powertimer clock, a contact mat and a connection unit. The Powertimer clock (figure 3.1) served the function of collection, recording, computation and output of measured data. The contact mat was a 120cm x 87cm mat (figure 3.2) with a sensitive switch timer capable of measuring time in contact and off contact with the mat. The connection unit had terminals, to which the respective measurement equipment and printer were connected (Figure 3.3).
Figure 3.1  The Powertimer clock that served the function of collection, recording, computation and output of measured data.

Figure 3.2  Contact mat with a sensitive switch timer capable of measuring time in contact and off contact with the mat.
Figure 3.3 The two views of the connection unit. The upper figure (a) shows the terminals that are connected to the Powertimer clock, printer and switches. The lower diagram (b) shows terminals connected to the photocells, contact mat and other equipments that are not used in this study.
The Speed Jump test basically required the subjects to jump upwards and touch a target set at the pre-determined height repeatedly for five times on a contact mat. Firstly, a bar was placed on the Vertec apparatus as the target for the Speed Jump test. Then the 80% value was computed from the maximum countermovement jump height score. The bar placed on the Vertec apparatus was then adjusted to the subject’s 80% vertical jump height. The contact mat was connected to the jump terminal with the Powertimer clock attached to the Powertimer terminal.

Subjects began in a standing position at the edge of the contact mat. They then took one step onto the contact mat and immediately jumped up to the predetermined 80% jump height and touched the bar. Subjects were allowed to utilize an arm swing during jumping. Upon landing, the subjects jumped up again as fast as possible to touch the same target. These procedures were repeated for 5 times. Figure 3.4 shows the sequence of movements during the Speed Jump Test. The contact mat together with the timer measured the contact time for each and every jump. Each subject had 1 practice trial and 3 testing trials. The measured contact time was then used to generate the speed jump index using the equation as follows:

\[ SJ_{in} = n(\text{80}\% \text{ VJH}) / Ct \]

\[ equation \ 3.1 \]

Where:

- \( SJ_{in} = \text{Speed jump index} \)
- \( 80\% \text{ VJH} = \text{the calculated 80}\% \text{ vertical jump height (cm)} \)
- \( Ct = \text{total contact time for last 4 jumps (s)} \)
- \( n = \text{reactive jump repetitions (first jump is not a reactive jump)} \)
The speed jump index generated was used for further statistical analysis including reliability, validity and correlative analysis with other speed strength test. In this case, the trial with the highest speed jump index would be selected.
Figure 3.4  The sequence of movements of the speed jump test. The subject begins at the edge of the mat, step into the mat and immediately jumps towards the predetermined height and touches the bar. This process of a, b, c and d is repeated for five repetitions continuously.
3.3.3 40m Dash Test

The 40-meter dash test was performed in an indoor facility. The starting and finishing lines were marked with adhesive tape and were visible to all the subjects. Three photoelectric sensors (photocells) attached to three tripods were placed at the starting line, the 10-meter mark and the finishing line at the end of the 40-meter mark. The equipments used are depicted in figure 3.5.

Figure 3.5 Equipments used in the 40-meter dash test. The photocell sensor is seen attached to the tripods. The connection unit is sitting next in the middle and the Powertimer clock is sitting at the right of the connection unit.
Subjects were required to start from the starting line in a standing start position. No crouch start was allowed in this test to eliminate the variations caused by different starting techniques. The subjects would start whenever they were ready and the photocell sensor at the starting line would sense the subjects' first movement to initiate the running of time. This procedure was imposed to eliminate the reaction time variability. Subjects were required to sprint as fast as possible through to the 40-meter finishing line and not to slow down before passing the finishing gate. Each subject had 1 practice trial and 3 test trials and the best time measured by the three photoelectric sensors placed at the beginning, 10-meter and the 40-meter were used for further analysis.

3.3.4 Countermovement Drop Jump Test

Countermovement drop jump test is also known as drop jump for height. This test is performed by having the subjects to drop from a 40cm bench and immediately jump up reactively as high as possible. The key here is to jump as high as possible or in other words, to jump for maximal vertical distance. This dropping and jumping movement is done with arms akimbo to eliminate any contributions from arm swing.

The equipments used in this study were a 25cm height bench and Newtest Powertimer jumping system consisting of the connection unit, Powertimer clock and the contact mat. As usual, the Powertimer clock was connected to the clock terminal at the connection unit whereas the contact mat was connected to the jump terminal. Schmidtbleicher (2001) suggested it is advisable for the adolescent to perform the drop jump only at a height lower than 40cm due to the high risks of getting injured in performing this type of activity. A dropping height of 25cm was selected in this
study because our pilot study revealed that the subjects were not able to perform drop jump from a 32cm bench. This may be due to the fact that subjects were all 13-15 years old adolescence and were not well conditioned. Besides, they have never performed any forms of drop jumping exercise before and might be lacking in techniques and body coordination to perform this test.

The subjects began this test by standing on the 25cm bench and took one front step in the air and then dropped down from the bench. Upon landing, the subjects were instructed to jump as high as possible or to jump for maximal vertical distance. Attention was paid to ensure that the subjects actually dropped down and not stepped down or jumped down from the 25cm height bench and with arms akimbo. The flight time measured would then used to generate the jump height using the formula below:

\[ H = \frac{2gt}{8} \]  

*equation 3.2*

Where,

- \( H \) = height of rise of the center of gravity (meter)
- \( g \) = acceleration of gravity (9.81ms\(^{-2}\))
- \( t \) = flight time (second)
- \( 2 \) = constant

Feedbacks were provided to the subjects after each trial. This procedure has been reported to be valid for measuring jump height only when the body position is the same at the instants of takeoff and landing. Any deviation from this position will result in a higher flight time and subsequently a higher jump height (Young, Pryor
and Wilson, 1995; Young Wilson, Pryor, 1999). Therefore, the subjects were instructed to land in a fully extended position before flexing at the hips, knees and ankles to attenuate the impact. Any trial that deviated from this landing position would be disallowed. The error in jump associated with this procedure has been reported to be 2% based on cinematographical analysis (Komi & Bosco, 1978) and has been described previously (Young et al, 1995).

3.3.5 **Bounce Drop Jump Test**

The bounce drop jump test is often called drop jump for height and time (DJ-H/t). This test is performed almost in the same way as the countermovement drop jump test. The only difference is the subjects were instructed to jump for maximum height and minimum ground contact time instead of just jump for maximum height. The height jumped (cm), contact time (s) and the height/contact time index (cm/s) would be displayed and feedback would be provided to the subjects after each trial so that they could determine the optimum combination of height and contact time to produce the highest height/contact time ratio. The jump height was calculated using the same formula with the countermovement drop jump test. The measurement of interest in this test was the reactive strength index, represented by the ratio of jump height to contact time.

The best score achieved would be retained for further analysis. Due to the relatively short contact times and the need to quickly attenuate the eccentric force, this test was considered to be a more reflective measure of reactive strength ability (Young et al., 1995; Young et al., 1999)
3.4 Statistical Analysis

The establishment of reliability involves three statistical methods with different analytical goal. The intraclass correlation coefficient was calculated using the Cronbach's alpha coefficient. The interclass correlation coefficient was calculated using the Pearson's correlation coefficient to indicate the degree of relative reliability which is the ability of the test to consistently distinguish between individuals in a particular population and the Student's $t$-Test was used to detect systematic bias. Pearson Product Moment correlation coefficient was also used to study the relationship between the speed jump test and various speed strength measures including leg speed, leg power and reactive strength, to understand the nature of this type of movement and to establish predictive validity. The Student's $t$-Test was then used again in the known group difference analysis to study if the speed jump test was able to distinguish between a group of adolescent basketball players that had been training for more than two years and a group that had been training for less than two years.