



# Power and endurance in Hong Kong professional football players

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## Abstract

**Background:** The purpose of this study was to investigate the power and endurance characteristics of Hong Kong professional football players. Training recommendations can be deduced based on the comparison between Hong Kong and international football players.

**Methods:** Eighty-eight Hong Kong professional football players (height,  $177.2 \pm 6.4$  cm; weight,  $70.6 \pm 7.6$  kg; age,  $25.6 \pm 5.0$  years) in the first division league participated in a battery of tests, which included: (1) height, (2) weight, (3) countermovement jump, (4) 30-m sprinting, and (5) Yo-Yo Intermittent Recovery Test Level 2.

**Results:** Compared with the test results of the first division players in other countries as reported in the literature (Norway, France, and Scandinavian countries), Hong Kong players were shorter in height (0.1–2.1%), lighter in weight (5.5–8.3%), fair in vertical jump height (–4.8–17%), slower in acceleration (4.2–5.1%) and maximum speed (3–14.2%), and had poorer aerobic and anaerobic endurance (22.9%).

**Conclusion:** The present study suggests that Hong Kong football players (or players with similar physique and ability) need to improve their power and endurance.

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**Keywords:** endurance; field test; fitness; football; power

## Introduction

Football is the most popular sport in the world with 260 million football players in the world.<sup>1</sup> Football performance is composed of technical, tactical, physiological, and mental areas.<sup>2</sup> Physical fitness is one of the most important elements that affect football team performance because of the high physical demand in the real match situations.<sup>2,3</sup> Football players have to perform many activities with explosive power. A sprint bout occurs every 90 seconds which lasts for 2–4

seconds. It constitutes 1–11% of the running distance covered in a football match.<sup>2</sup> Players also have to perform 150–250 intense movements in a match, such as tackles, heading, cutting, and sprinting.<sup>2</sup> Furthermore, forceful muscle contractions to maintain body balance and control of the ball against defensive pressure (i.e., body contact situation) is also a situation that commonly occurs during a football match.<sup>2</sup> In the endurance context, each player has to complete a distance of 8–12 km in a match, and the average work intensity is between 80% and 90% of the maximal heart rate.<sup>2</sup> Hence, power and endurance are the key fitness elements for players to perform well for the aforementioned activities in a football match.

Football players at the professional level usually have better physical abilities compared with semiprofessional or amateur players, probably because of the higher physical demand in a professional football match. Cometti et al<sup>4</sup> found that

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professional players differ from amateurs in terms of knee flexor muscle strength and short-distance sprinting speed. Top tier players were also found to have more high-speed run distance during a match than moderate-class players in the match analysis.<sup>5</sup> Previous studies have shown that players at a higher playing level had better aerobic and anaerobic performance in terms of Yo-Yo Intermittent Recovery Test performance.<sup>5,6</sup> These studies indicated that lower limb muscle strength and power, speed, and aerobic and anaerobic endurance are critical to distinguish the players' physical performance at different playing levels.

It is important for teams at lower playing levels to know their players' physical weaknesses compared with players at a higher playing level. Hence, suitable training focusing on particular weaknesses can be offered. The purpose of the current study was to determine the power and endurance characteristics of Hong Kong professional football players or players with similar physique for strength and conditioning specialists to design suitable training programs.

## Materials and methods

### Study design

Three fitness tests were done on Hong Kong professional football players: (1) countermovement jump (CMJ), (2) 30-m sprint, and (3) Yo-Yo Intermittent Recovery Test Level 2 (YYIR2). These tests represent the lower limb power, speed, and endurance of football players and were used in chosen previous studies.<sup>4,7–9</sup> Height and weight were measured to represent the demographic characteristics. The tests were done on an artificial turf at the end of the preseason period. A 24-hour to 48-hour rest period was offered to the participants prior to the test day. All procedures described in this study were approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethical Review. Informed signed consent was provided by each participant before the study started.

### Participants

Eighty-eight Hong Kong professional football players participated in a battery of fitness test (height,  $177.2 \pm 6.4$  cm; weight,  $70.6 \pm 7.6$  kg; age,  $25.6 \pm 5.0$  years). Only individuals aged 18–35 years who played in the first division football league in Hong Kong were included. This was the highest level league in Hong Kong, and it has been renamed as Hong Kong Premier League since the 2014 season. Individuals were excluded if they had any injury or disease affecting their physical performance on the test day. These participants were trained at 5–7 sessions/wk during the preseason period (4–6 field sessions and 1–3 weight training session in the gym). Each field training session consisted of 10 minutes of warm up, 30 minutes technical and tactical training, 30 minutes simulated competition, 30 minutes fitness training, and 10 minutes of cool down. Each weight training session was about 90 minutes in length, and included upper limb, lower limb, and core exercises.

### Procedure

All measurements of participants were taken on the same day in the following sequence: height, weight, CMJ, 30-m sprint, and YYIR2. Each participant performed warm-up exercises for 15 minutes, including slow jogging, dynamic stretch, and static stretch, prior to all the tests.

**CMJ.** An electronic jump mat (Smartjump; Fusion Sport, Queensland, Australia) was used to measure the maximum height of the CMJ. The participants were instructed to squat down quickly and jump up immediately and explosively with arm swing. No prior step was made prior to the jump. Three trials were conducted, and the best trial was used for analysis. Each trial was separated by at least 5 minutes of rest to enhance full recovery. Using a jump mat to test CMJ was proven to have a high test–retest reliability ( $r = 0.99$ ).<sup>10</sup> Peak power was calculated from the CMJ result using the following formula:  $60.7 \times [\text{jump height (cm)}] + 45.3 \times [\text{body mass (kg)}] - 2055$ .<sup>11</sup>

**30-m sprint.** The participants were instructed to sprint through a 30-m distance with their maximum effort. Time was recorded using an infrared speed gate (Smartspeed; Fusion Sport) placed at the start, as well as a 10-m, 20-m, and 30-m location. Each trial was separated by a 10-minute rest to enhance full recovery. High reliability was reported in previous studies for 10-m, 20-m, and 30-m sprint (intraclass correlation coefficient  $> 0.91$ ).<sup>12,13</sup>

**YYIR2.** YYIR2 determines an individual's ability to recover from repeated exercise with a high contribution from both aerobic and anaerobic systems.<sup>7</sup> Thus, this test represents both the aerobic and anaerobic energy systems turnover during intense exercise.<sup>7,8</sup> The protocol is an incremental shuttle run interspersed with active recovery. The test consists of many bouts of  $2 \times 20$  m shuttle runs at increasing speeds, interspersed with a 10-second period to cover  $2 \times 5$ -m distance. Participants were verbally instructed prior to the familiarisation. Three bouts of familiarisation were given to these players. A 10-minute rest was given before the test started. The test was terminated when the participant was unable to maintain the required running speed. The total running distance covered in the test reflects the endurance performance. The test–retest coefficient of variance for the YYIR2 test has been reported as 9.6%.<sup>14</sup>

### Statistical analysis

Data were analyzed using SPSS version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). The data were presented as mean and standard deviation. The mean difference of each variable between Hong Kong players and international players from previous studies is presented as a percentage.

For the CMJ performance, adjustment was made on the data from the study of Cometti et al.<sup>4</sup> owing to the difference in jumping technique. Akimbo position (arm on waist) was used by French players,<sup>4</sup> whereas arm swing was allowed for

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