THE ANTHROPOMETRIC CHARACTERISTICS 
AND PHYSICAL FITNESS PROFILE
OF THE NATIONAL HONG KONG WATER POLO TEAM PLAYERS

BY

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13000853

AN HONOURS PROJECT SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ARTS
IN
PHYSICAL EDUCATION AND RECREATION MANAGEMENT (HONOURS)

HONG KONG BAPTIST UNIVERSITY

April, 2015
HONG KONG BAPTIST UNIVERSITY

24th April 2015

We hereby recommend that the Honor’s Project by Dr. Huang Ya Jun Wendy entitled “THE ANTHROPOMETRIC CHARATERISTIC AND PHYSICAL FITNESS PROFILE OF THE NATIONAL HONG KONG WATER POLO TEAM PLAYERS” be accepted in partial fulfillment of the requirements for the Bachelor of Arts Honours Degree in Physical Education and Recreation Management.

__________________                 ___________________
Dr. Huang Ya Jun, Wendy             Prof. Cheung Siu Yin
Chief Adviser                        Second Reader
DECLARATION

I hereby declare that this honour project, "THE ANTHROPOMETRIC CHARACTERISTIC AND PHYSICAL FITNESS PROFILE OF THE OFFICIAL HONG KONG WATER POLO TEAM PLAYERS", represents my own work and had not been previously submitted to this or other institution for a degree, diploma or other qualification. Citations from the other authors have been appropriately referenced.

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Tsang Shun Kin

24th April, 2015
Acknowledgment

I would like to take this opportunity to express my deepest and most sincere gratitude to my supervisor to Dr. Huang Ya Jun, Wendy, for her valuable advice and guidance throughout the completion of my honour project. Her kindness, patient and understanding have encouraged me to strive to do better in my work.

I would also like to express my appreciation towards the National Hong Kong Water Polo Team members for graciously agreeing to participate in the project to contribute to science.

In addition, I would like to give thanks to Prof. Cheung Siu Yin for taking the time to serve as the second reader of my work. Next, I would also like to give thanks to Dr. Louie Hung Tak, Lobo for giving me his professional advice on this honour project. Special thanks goes to Mr. Binh Quach,
technician of the laboratory of Dr. Stephen Hui Research Centre for Physical Recreation and Wellness of Hong Kong Baptist University, for providing the necessary equipment needed to complete the study.

Finally, I would like to say thank you to Miss. Liu Yu Ching for giving me helpful suggestions and support throughout the past months that has made this project possible.

________________________

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ABSTRACT

The purpose of this study is to gather and evaluate the anthropometric and physical fitness profile of the National Hong Kong water polo players. The sample of subjects consisted of 20 male water polo players (between the ages 17 to 23; height of 177.8±6.139 cm, and weight of 74.26 ± 8.70 kg).

In this study, different anthropometric, body composition measurements and specific fitness tests were used to collect data from the subjects. The anthropometric measurements were compared within the different positions to determine whether there are position specific differences in the anthropometric and physical fitness of water polo players.

The measurements of the players’ anthropometric measurements and their results of specific fitness tests were compared with data of various other national water polo teams. The results showed there is a position-specific
anthropometric characteristic, body composition in water polo players.

In addition the study found that there were general differences among the various national water polo teams. It was found that there is a significant difference in general physical characteristics between the “Asian” and “non-Asian” teams. Results show that there are differences to players’ anthropometric measurements and physical fitness that is affected by the ethnicity of the player.
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Chapter 1

INTRODUCTION

Statement of Problem

The Hong Kong Water Polo team has for years had the honor to be invited to compete at the Asian Games (Asiad). The pancontinental multi-sport event held once every four years among athletes from all over Asia is deemed as Asia’s Olympics.

Unfortunately Hong Kong Water Polo team’s performance at the prestigious Asiad has been poor throughout the years.

In the 2006 Doha Asian Games and 2010 Guangzhou Asian Games, the Hong Kong team came in last. And most recently in 2014 Incheon Asian Games, out of 7 teams, the Hong Kong team continued to come in last.

The trend of poor performance suggests there are
inadequacies in the selection process of players and/or errors in the training approach taken in the past. Yet no research has been conducted on the local team to identify missteps. However in the general field of water polo, studies have always been rather limited, despite the sport’s rich history of being the oldest team sport of the Olympic games (Smith, 1998).

Scholars have in particular found there is a lack in studies, which go into finding out the anthropometric and physical fitness profile of professional water polo players (Ferragut, 2011).

It has also been reported, little study has been conducted in the area of water polo as it is not one of the most popular sports in the world such as football or basketball therefore it is difficult to find an appropriate sample of subjects (Kondric, 2012). Others have suggested there have been relatively less studies conducted on the particular sport as there are difficulties related to data collection in water
(Platanou, 2005).

Purpose of Study

By developing the anthropometric and physical fitness profile of this lower ranking but professional Hong Kong Water Polo team, the results can be compared to other elite national water polo teams. Thus shed light on where the local team is lacking in when it comes to the physical and physiological demands of the sport.

The aim of the present study was to reach two goals:

1. To develop an anthropometric and physical fitness profile of the professional male Hong Kong Water Polo players in the year 2015.

2. To investigate the rank of the national Hong Kong Water Polo Team through conducting a comparison between the local team with other elite national water polo teams. The
comparison looks at the anthropometric and physiological differences between the statistics of the overall teams and the difference between all playing positions.

Significance of the Study

The pioneer study of Hong Kong Water polo players will allow coaches or other interested parties to gain more insight of the sports general physiological demands.

Only by understanding the physical and physiological demands of a sport can it help people facilitate the development of more appropriate and targeted training program for optimal physical preparation of athletes (Aziz et al., 2002).

The results of the study can also serve, as the basis of what future research will stem from. The study could facilitate in future studies hoping to conduct long term
profiling of the Official Hong Kong Water Polo Team. Long term tracking pinpoints ‘rewarding genetic traits’ that determine what makes up a successful water polo player (Lozovina & Pavičić, 2012).

Long term profiling can indicate the possible unbeficial genetic traits and shift the Asian Hong Kong team towards developing what is deemed the desirable traits in an effort to increase the success of the local water polo team.

Definition of Key Terms

For the purpose of better understanding the content of the study, frequently used technical terms will be defined in the following section

1. Anthropometry

Anthropometry is popularly used in areas such as physical education, sports science, physical activity and
biomedical sciences. It is defined as the scientific study of the measurements of size, weight and proportions of the human body.

Examples of anthropometric techniques include the skinfold fat, circumference, diameter measurements (Reilly et al., 1990).

2. Anthropometric measurements

Anthropometric measurements are a set of noninvasive, quantitative techniques for determining an individual’s height, weight and lengths, breadth or width, circumferences or girths, depths and skinfolds (Jonas, 2005).

All measurements are external dimensions of the body used to determine an individual’s body type and suitability for a desired activity, sport, or position played in the sport (Anderson, Hall, & Martin, 2004).
3. Body composition

Body composition provides detailed information regarding an individual’s muscle, fat, and bone mass. Measurements of body composition can provide a reliable means of determining the amount of weight that an individual may safely gain or lose (Anderson & Parr, 2008).

4. Physical fitness

Physical fitness is a set of attributes that people have or have achieved. Being physically fit has been defined as the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies (Kilgore & Rippetoe, 2007).

Hypothesis

Firstly, it is hypothesized that on average the Hong Kong water polo players’ anthropometric characteristics in BMI,
height, arm span, and weight will be lower than of non-Asian elite water polo players.

The hypothesis has been based on the Aziz et al. (2002), the study has found that the average Singaporean (Asian) national water polo player is typically 8 cm shorter and 15 kg lighter than the elite non-Asian water polo players.

Secondly, it is hypothesized the fitness level of the local water polo players will be lower than other national teams. It is predicted that local water polo players will have lower VO2 max levels and have slower swimming speed.

The second hypothesis was made based on Smith, (1998)’s finding which has recorded on average national water polo players train 4 to 6 hours per day, 6 days per week.

Yet the Hong Kong water polo players train on average 2.5 hours per day 6 days a week. It is also worth mentioning, in
order to qualify as a national Hong Kong Water Polo Player, players are only required to reach an attendance rate of 80%.

In a face-to-face interview, the current head coach of the Hong Kong Water Polo Team reported, most players only satisfy the basic attendance requirements (G. Zhou, personal communication January 02, 2015). It can thus be deduced that on average players generally train 5 days a week. Therefore Hong Kong water polo players train significantly less than other national players. As a result it makes it unlikely for them to obtain the same high level of VO2 max and fast swimming speed other national water polo’s have been recorded with.

Delimitations

1. Hong Kong water polo players who made the 2014 – 2015 male national teams qualify as subjects for the study.

2. Data was collected in the university laboratory or at Wan chai swimming pool with the specific measuring devices
3. Only specific physical fitness tests can be selected for testing the water polo players.

4. The anthropometric test and fitness swimming speed test must be separated to different days and different places.

5. All subjects were aged 17-22.

Limitations

1. No attempt was made to control the subjects’ diet, rest and immediate psychological condition, factors that might have affected their performance.

2. The subjects may need to attend regular training. However, no control was possible to restrict subjects during training.

3. During testing, the effort of the subjects is uncontrollable and their performance may be reduced by the low motivation.
Chapter 2

Review of Literature

Water polo has often been coined as a complex team sport. Kondric (2012), has figuratively describes water polo as a combination of two sports that is both handball and swimming.

Water polo unlike many other sports categorized as an intermittent sport. It is thus conclusive the sport requires extensive research-based study on its physical and physiological demand.

In short this multi-dimensional sport is a physically demanding contact team sport that requires the high development of anthropometrical characteristics such as having high levels of muscle power to hit, block, push and hold throughout the play (Smith, 1998; Ferragut et al., 2011).
It also requires high intensity bursts of sprinting, interspersed with short periods of low to moderate intensity swimming (Aleksandrovic et al., 2011) and water treading.

Furthermore, Petric (1991), a study focused on calculating the total distance covered by the water polo players within a game, has found that the mean distance players of lower level competitions would reach was about 500 to 1000 meters. In higher-level competitions, players may reach up to 1500 to 1800 meters per game. Subsequently makes the sport an aerobic-anaerobic activity that requires a high physiological demand from the three energy systems (Aziz et al., 2002).

It has been found that the complex nature of the sport reflects through different playing position. The physical and physiological demand of each position is vastly different. The recent studies continue to conclude there is a need for more position-specific research approaches (Frenkl et al., 2001; Aleksandrovic et al., 2011; Melchiorri et al., 2010).
Researches such as Melchiorri et al. (2010) and Lozovina et al. (2009) have found out that there were no particular correlation when it came to comparing water polo players by nation to nation. With the various amount of players it is difficult to standardize one nation’s Olympic water polo team to compare it to another.

However there has been a lot of evidence to suggest certain body proportion, water polo players tend to have. According to Kondric et al. (2012), a study with 110 water polo players aged between 17 to 18 years of age, has found out that water polo players generally have larger shoulders and thinner waists. As for Goalkeepers and Wings players, it was found they tended to have lower skinfold result, BMI and muscle mass than Center. It was concluded in the study that the results reflected that there is a specific physical profile in different playing positions.

Similar conclusions echoed in earlier studies using
similar samples of subjects (Vila et al., 2010).

General differences in the **Anthropometric characteristics**

Of water polo players according to playing position

Anthropometric characteristics is the measurement of age, height, weight, body composition and so on that is used to determine an individuals’ body type and suitability for a desired activity, sport, or position played in the sport (Jonas, 2005).

It has long been established that an athlete’s physical body, in other words certain anthropometric dimensions, reflecting the body shape, proportionality and composition, play a significant role in determining the potential for success in a sport (Uljevis, 2013). Recent study of Kyrolainen et al. (2010) also supports this finding and concludes body composition is significantly correlated with physical fitness.
Ferragut et al. (2011) collected and studied the anthropometry difference of different water polo positions among 19 elite Spanish players, and has found that Centers generally have higher body masses, BMIs, larger waists, chest girths and muscle masses compare to the Wings. It also found that Wings tended to have shorter leg length compared to the Points and therefore concluded different positions have their own specific anthropometric characteristics.

Study done by Kondric et al. (2012), aimed to investigate the status and differences between five playing positions (Goalkeepers, Centers, Drivers, Wings and Points) in anthropometric measures and some specific physical fitness variables in high-level junior water polo players. After analyzing the collected data, Kondric et al. (2012) found out that Goalkeepers and Wings have a lower skinfold result than Centers, but there’s no significant difference in any of the body fat percentage measures between the Points, Divers and Center.
A study on the Singaporean national water polo team highlights there is a need for more studies on water polo players of Asian ethnicities.

The study found that Singaporean water polo players were more petite in size than compared to other ethnicities. Demonstrating a possibility there may be general anthropometric differences in water polo players depending on particular ethnicities.

General differences in the **Physical fitness**

**Of water polo players according to playing position**

In a recent investigation Melchiorri et al. (2010) analyzed blood lactate and game activity among elite male water polo players and found 7.7±1.0 mmol/l of blood lactate concentration, but with enormous differences among playing positions. In short, the mean match blood-lactate concentrations for Centers, Points, and Field Players (Drivers and Wings) were (mmol /l) 11.2 ± 1.0, 6.7 ± 0.9, and 5.3 ±
0.9, respectively, indicating the different physiological backgrounds of the water polo game for each playing position.

According to Kondric et al. (2012), there are three major swimming tests to test the physical fitness of the water polo players, which is 25m, 100m and 400m. The 25m swimming test is used to test the specific explosive power; the 100m swimming test is an anaerobic test to measure their endurance of the explosive power; the 400m swimming test is to measure their cardiovascular endurance.

The study found that there were significant differences within the playing positions in some of the swimming test, for instance the Points achieved the best results in the 25m and 400m.

Platanou (2009), a study that collected the VO2 max of the national Greek water polo team through direct measured in a laboratory, has found that there is a significant difference
among different positions.

VO2 max is an important method to measure the fitness level of the athletes because a fitter athlete is supposed to require a higher VO2 max value which can increase their endurance and let them to reach a higher intensely level during the competition (French & Long, 2012).

Centers and points were recorded with the highest VO2 max at >87 mL/(kg·min). Wings were recorded at >80 mL/(kg·min), drivers were recorded at >74 mL/(kg·min) and goalkeepers were recorded at >64 mL/(kg·min).

Summary

Past research points to the fact that water polo players should have position specific differences when it comes to the ideal anthropometrics characteristic and body composition measurements.
However the available research has also highlighted that the previous studies mainly focus on the “western” water polo teams and lack of research on “Asian” water polo teams.

Aziz et al. (2002) is currently the only study that has studied professional Asian water polo players, namely the Singaporean team. And in Hong Kong, there are currently no studies on water polo players.

The only study on an Asian ethnicity national team, Aziz et al. (2002), has found that there are obvious differences among the non-asian and Asian national teams. The study highlights that is a need to go into more in-depth research to identity whether there is a different ideal anthropometric and physical fitness level ‘Asian’ players should be reaching, instead of reaching the current standard of the largely western norm.
Chapter 3

Method

Sample of Selection

The Hong Kong Water Polo Players: Refers to the 2014 – 2015 rules and regulations set by the Hong Kong Amateur Swimming Association. To qualify as an athlete on the Hong Kong Water Polo team, one must obtain a monthly attendance rate of over 80%. Next, each individual needs to train in water polo for at least 2 hours per session, 5 days a week, with an additional 1 hour gym training session 3 times a week.

Twenty official male national water polo team members aged 17-23, volunteered to participate in this study. The subjects were all invited from the Hong Kong Water Polo Team. 5 out of 20 are secondary school representatives, 12 out of 20 are university representatives and the remaining are workers of society. When the 20 subjects are divided by playing positions,
(n=3) players are the Points, (n=4) are Centers, (n=2) are Goalkeepers, (n=6) are Wings, (n=5) are Drivers.

13 out of the 20 subjects were the representatives of Hong Kong China in the 2014 Asian Olympic Games in Incheon, South Korea. Before data collection, all participants and coaches were clearly informed of the purpose, benefit of this study and some possible risks related to the tests. Before doing the tests, Physical Activity readiness Questionnaire (PAR-Q) and consent forms were informed to each of the participants and collected with signatures from their guardians.

Measurements

The measurements were categorized into three parts:

(1) Anthropometric measurements

(2) Body Compositions

(3) Specified fitness tests
Anthropometric Measurements

Height

The heights of the subjects were measured by a wall-mounted stadio-meter. The height measurements were assessed to the nearest 0.1 cm. Subjects were required to be barefoot, to stand still and to have their back against the wall (Eston & Reilly, 2001).

Weight

The electronic weighing scale was used to record the body weights of the Hong Kong water polo players. To measure the body weight to the nearest 0.1 cm, subjects were informed to dress in minimal clothing, during weight measuring subjects need to take off their shoes and personal belongings. Body weight was narrowed to the nearest 0.3 kg without shoes and light clothing (Eston & Reilly, 2001).
**Body mass index (BMI)**

The Body mass index was calculated as weight divided by height squared [kg/m2] (Pinero et al., 2010).

**Skinfold thickness measurements**

Skinfold thickness was measured on the right side of the body to the nearest 0.1 mm with a skinfold caliper (Moreno et al., 2002). Measurements were taken on the right side of the body with two sites [see Figure (a)] and [Figure (b)]. All participants were measured shirtless. For all the skinfold thickness measurements, the technical errors of measurement were smaller than 1 mm and reliability is greater than 95% (Moreno et al., 2003).
a.) Triceps skinfold. [See Figure (a)]

The subjects were asked to maintain a relaxing standing position with the left arm slightly lowered by their side. The right shoulder was relaxed and the arms were maintained at a 90 degrees elbow flexion. The measurement was taken at the midpoint of the acromion process of scapula and the olecranon process of the elbow joint (Moreno et al., 2003).

b.) Subscapular skinfold. [See Figure (b)]

The subjects were asked to maintain a relaxing standing position with both arms handling by the sides. The measure was done 15-20 mm below the end of the scapula and 45 degrees to the lateral side of the body (Moreno et al., 2003).

Arm span measurement:

Arm span is the horizontal distance between the tip of the middle fingers, with the arm extended laterally and at shoulder level. To measure the arm span, subject were requested to stand near the wall with their back straight,
eyes looks forward, both arms abducted to 90 degrees, while elbows and wrists should be extended and the palms facing directly forward. Readings was taken to the nearest 0.1 cm. Arm span was measured by a flexible steel tape from the end of the middle finger from one hand to the end of the middle finger on the other hand (Hossain, 2011).

Measurements of the girth of arm relaxed, arm flexed and tensed, forearm, waist, chest, thigh, mid-thigh, calf and ankle girth:

Arm girth relaxed:

A measuring tape was used during the girth measurement. The subject’s right arms were relaxed and hanging by the side and the arm was measured at the level of the mid-acromiale-radiale. The measuring tape was perpendicular with the long axis of the humerus [See in figure (a)] (Norton & Olds, 1996).
Arm girth flexed and tensed:

To measure the maximum girth of the right upper arm, the subject was asked to maintain a sagittal plan, the right arm was raised to a horizontal position with the forearm to the upper arm about 45 degrees. The subject was told to contract his bicep muscle until it’s fully tensed.

The tape was firmly wrapped around the arm, yet it did not restrict blood flow when the measurement was taken. The measuring tape was also adjusted around the arm to find out the point of maximal girth [See in figure (b)] (Norton & Olds, 1996).
Forearm girth:

A flexible metal tape was used to measure the subjects' maximum girth. The subject was asked to stand in a frontal plane and hold their palm up while relaxing their muscle at the same time. The tape was firmly wrapped around the arm, yet it did not restrict blood flow when the measurement was taken. The tape was adjusted around the forearm region in order to find the point of maximal girth [See in figure (c)] (Norton & Olds, 1996).
Waist girth:

The waist girth measurement was taken in the narrowest waist level. The narrowest waist level was near the mid-point of the lowest rid and the top of the iliac crest (Pouliot et al., 1994). The tape was adjusted in order make sure it was not too loose or too tight across the waist. The tape was also adjusted around arm in order to find out the level of the smallest waist girth [See in figure (d)] (Norton & Olds, 1996).
Chest girth:

The chest girth was measured at the middle of the sternum. The subject was asked to stand straight and breath normally until the measurement was taken. The tape was adjusted in order make sure it was not too loose or too tight across the chest. [See in figure (e)] (Norton & Olds, 1996).
Gluteal Thigh girth:

The gluteal thigh girth is taken 1 cm below the gluteal line or fold horizontally with the long axis of the thigh. The subject stands erect with equal weight separated on both legs. The tape was adjusted in order make sure it was not too loose or too tight across the arm. The tape was also placed horizontally around the top of thigh [See in figure (f)] (Norton & Olds, 1996).

Mid-thigh:

The subject stands erect with equal weight separated on both legs. The tape was placed on the right thigh at the midway between trochanterion and tibial laterale. The tape was
adjusted in order make sure it was not too loose or too tight across the thigh. The tape was also placed horizontally around the top of thigh [See in figure (g)] (Norton & Olds, 1996).

Calf girth:

The calf girth measurement is taken at the level of the largest circumference of the right calf. The subject stands erect with equal weight separated on both legs. Tape was adjusted in order to find the maximal girth of the calf. [See in figure (h)] (Norton & Olds, 1996).
Ankle girth:

This measurement was taken at the narrowest point of the superior to the sphyriontibiale. The tape was adjusted up and down find the narrowest point. Tape was placed horizontally across the calf. It was also adjusted in order to ensure it was not too lose or too tightly wrapped around the leg. [See in figure (i)] (Norton & Olds, 1996).
(2) Body Composition

Percentage Body fat measurement:

The body fat measurements of the subjects were done by the (TANITA Body Composition analyzer TBF-410). Subjects were informed to take off their shoes and socks. Personal information like sex, age and height were inputted into the machine to calculate the body fat percentage. Normal mode was chosen and 0.5kg of clothing weight was deducted during the measurement. Subject was asked to stand on the footpad with their eyes looking forward and back straight. The results were printed out when the measurement is done.

(3) Specified Fitness Test

Swimming tests of 25m, 100m and 400m water polo front crawl:

The specific fitness test is divided into three swimming tests, which is 25m, 100m and 400m. The 25m swimming test is used to test the specific explosive power; the 100m swimming
test is an anaerobic test to measure their endurance of the explosive power; the 400m swimming test is to measure their cardiovascular endurance (Kondric et al., 2012).

The subject were instruct to swim as fast as possible, a standardized 15 minutes warm up and cool down period was given to all subjects. The test was done in a standard 50m swimming pool with depth 2.1 m and the water temperature between 26°C-28 °C.

To measuring to the nearest .01 second, the time was measured by a standard digital stopwatch. To increase the motivation of subjects, information of the results was given to the subjects immediately (Dopsaj et al., 2007).

Goalkeepers were excluded from completing the 100 and 400 meter swimming test, because goalkeepers don’t need high levels of swimming cardiovascular endurance (Kondric et al., 2012).
Indirect maximum oxygen uptake (VO2max)

The Cooper’s 12 minute run test (Cooper, 1968) is a method used to measure the indirect maximum oxygen uptake (VO2max). This fitness test was found by Dr. Cooper that there’s a very high significant correlation between the distance they can run (or walk) in 12 minutes and their VO2 max value (Das, 2013).

The subjects were given a warm up period to prevent injury and the test was done in a standard 400 meter track. During the experiment day, the experimental subjects was asked to run or walk as many laps as possible within 12 minutes, a name tag sticker will was given to each subject, so when the trial ends they should stick the name tag on the spot they stopped. Before the test started, the subjects were asked to stand on the starting line to prepare. After precisely 12 minutes subjects have to stop immediately and stick their stickers on the ground.

Then total distance in meter covered after 12 minutes
by the experimental subjects were recorded. VO2 max was predicted by using the following formula (Das, 2013):

\[
\text{VO2 max (ml/kg/min) = (22.351 x distance covered in kilometers) - 11.288}
\]

Procedures

In this study, different test and measurements were used to collect data from the subjects. In each component, different tests and measurement were arranged for data collecting.

There were ten parts of tests and measurements, (1) body height and weight, (2) body fat percentage (percentage of body fat measure by using BIA device), (4) Skinfold of triceps and subscapular, (5) swimming tests of 25m, 100m and 400m, (6) indirect maximum oxygen uptake (VO2max) (7) measurements of the girth of arm relaxed, arm flexed and tensed, forearm, waist, chest, thigh, mid-thigh, calf and ankle (8) Arm Span. All lab
tests were held in Dr. Stephen Hui Research Center of Physical Recreation and Wellness and the fitness test was held in the Wan Chai Swimming Pool at 27 Harbour Road in Wan Chai.

For the lab test, the subjects (n=20) was taken the anthropometry components test first, then body composition was measured by the BIA device, after that the Skinfold of triceps and subscapular, body fat percentage measurement, arm span, measurement of the girth of arm relaxed, arm tensed, forearm, waist, chest, gluteal, thigh, calf and ankle measurement was performed.

The fitness test was arranged on a separate day. Before starting the fitness test, a warm up period was given to the subjects to prevent injuries, the fitness tests includes the swimming tests of 25m, 100m, 400m, all this swimming tests was done in the Wan Chai Swimming Pool at 27 Harbour Road in Wan Chai.
The 12 minutes VO2max test was also done at the wan chai sports ground but on a separate day to ensure candidate were well rested.

Method of Analysis

All collected data were reported as the mean and standard deviation. The Statistical Package for the Social Science 16.0 for windows (SPSS 16.0) software was used to analyze the mean and standard deviation of variables. Also the descriptive statistics of the one-way analysis variance (ANOVA) and the Bonferroni of the Post Hoc Test are calculated by the SPSS. By running the ANOVA, the results will help to determine whether there is a statistically significant difference between each playing position, but the goalkeeper position is not included in the ANOVA and Post Hoc Test because of the lack of subjects. If the significant difference is below 0.05, then the variables of anthropometry measurements have a
statistically significant difference between the points, centers, drivers and wings.
Chapter 4

RESULTS

The anthropometric characteristics and fitness profile test results of the male Hong Kong water polo team members are summarized in the following chapter. Key findings have been presented through 4 sections: (a) Background Information, (b) Anthropometric Measurement, (c) Body Composition and (d) Physical Fitness Tests.

a) Background information

Table 1

<table>
<thead>
<tr>
<th>Different positions</th>
<th>Number of subjects</th>
<th>years of experience (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>3</td>
<td>6.67 ± 2.1</td>
</tr>
<tr>
<td>Center</td>
<td>4</td>
<td>4.75 ± 2.4</td>
</tr>
<tr>
<td>Driver</td>
<td>5</td>
<td>6.00 ± 2.0</td>
</tr>
<tr>
<td>Wing</td>
<td>6</td>
<td>5.50 ± 2.6</td>
</tr>
<tr>
<td>Goalkeeper</td>
<td>2</td>
<td>7.00 ± 1.4</td>
</tr>
</tbody>
</table>
The position with the highest number of subjects is the Wing, while the position with the lowest amount of subjects is the Goal Keeper.

Goal Keepers on average have 7 years of experience, making them the most experienced. Point players are a close second to goalies, as the mean number of years stands at 6.67 years. Centers have the least amount of experience with the average having played water polo for 4.75 years of experience.

Table 2

The overall anthropometric characteristics and body composition of the Hong Kong national water polo team (n=20)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>20.25 ± 1.65</td>
<td>17-23</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177.8 ± 6.14</td>
<td>164.5-194</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>74.26 ± 8.70</td>
<td>56.5-88.5</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>17.02 ± 4.77</td>
<td>8.5-31.4</td>
</tr>
</tbody>
</table>
b) Anthropometric measurement

Table 3

Anthropometric characteristics of participations by playing positions (n=18) (Mean ± SD)

<table>
<thead>
<tr>
<th>Positions</th>
<th>Point (n=3)</th>
<th>Center (n=4)</th>
<th>Driver (n=5)</th>
<th>Wing (n=6)</th>
<th>Goalkeeper (n=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>185.0 ± 10.8</td>
<td>179.0 ± 3.7</td>
<td>175.9 ± 2.6</td>
<td>174.6 ± 5.5</td>
<td>178.5 ± 4.9</td>
</tr>
<tr>
<td>TS (mm)</td>
<td>12.4 ± 1.4</td>
<td>13.2 ± 3.9</td>
<td>9.4 ± 2.3</td>
<td>8.8 ± 2.2</td>
<td>11.7 ± 4.0</td>
</tr>
<tr>
<td>SS (mm)</td>
<td>9.5 ± 1.0</td>
<td>14.3 ± 5.6</td>
<td>8.0 ± 1.1</td>
<td>9.1 ± 1.1</td>
<td>9.8 ± 2.2</td>
</tr>
<tr>
<td>AS (cm)</td>
<td>188.9 ± 14.2</td>
<td>181.9 ± 4.1</td>
<td>178.8 ± 3.4</td>
<td>177.6 ± 7.3</td>
<td>184.1 ± 8.9</td>
</tr>
<tr>
<td>AR (cm)</td>
<td>32.1 ± 2.6</td>
<td>32.3 ± 1.2</td>
<td>30.5 ± 1.1</td>
<td>29.2 ± 1.9</td>
<td>30.7 ± 2.4</td>
</tr>
<tr>
<td>AF&amp;T (cm)</td>
<td>35.9 ± 2.1</td>
<td>36.5 ± 0.4</td>
<td>34.1 ± 1.0</td>
<td>33.3 ± 1.7</td>
<td>34.1 ± 1.6</td>
</tr>
<tr>
<td>Forearm (cm)</td>
<td>29.1 ± 1.1</td>
<td>27.9 ± 1.2</td>
<td>27.9 ± 0.7</td>
<td>26.7 ± 1.7</td>
<td>26.0 ± 1.4</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>83.9 ± 1.0</td>
<td>86.2 ± 5.2</td>
<td>75.8 ± 5.3</td>
<td>75.4 ± 5.8</td>
<td>74.1 ± 2.6</td>
</tr>
<tr>
<td>Chest (cm)</td>
<td>104.8 ± 2.2</td>
<td>107.6 ± 6.9</td>
<td>96.7 ± 3.3</td>
<td>95.8 ± 4.2</td>
<td>96.1 ± 3.2</td>
</tr>
<tr>
<td>Gluteal (cm)</td>
<td>55.0 ± 1.7</td>
<td>59.4 ± 2.1</td>
<td>54.2 ± 3.0</td>
<td>54.2 ± 2.4</td>
<td>55.8 ± 3.9</td>
</tr>
<tr>
<td>Thigh (cm)</td>
<td>48.1 ± 1.9</td>
<td>51.9 ± 6.0</td>
<td>48.0 ± 2.7</td>
<td>50.1 ± 1.9</td>
<td>48.4 ± 2.2</td>
</tr>
<tr>
<td>Calf (cm)</td>
<td>38.4 ± 1.6</td>
<td>38.3 ± 1.9</td>
<td>37.4 ± 1.6</td>
<td>37.3 ± 2.6</td>
<td>36.9 ± 1.3</td>
</tr>
<tr>
<td>Ankle (cm)</td>
<td>25.5 ± 1.6</td>
<td>23.8 ± 0.9</td>
<td>23.6 ± 1.3</td>
<td>23.3 ± 1.5</td>
<td>23.6 ± 0.6</td>
</tr>
</tbody>
</table>

The TS is Triceps skinfold (cm), SS is Subscapular skinfold (mm), AS is Arm Span (cm), AR is Arm Girth Relaxed (cm) and AF&T is Arm Girth Flexed & Tensed (cm).

a. Center Vs Driver (p=0.028)
b. Center Vs Wing \( (p=0.026) \)

c. Center Vs Wing \( (p=0.033) \)

d. Center Vs Driver \( (p=0.017) \)

e. Center Vs Wing \( (p=0.007) \)

f. Center Vs Driver \( (p=0.004) \)

g. Center Vs Wing \( (p=0.034) \)

The one-way analysis variance (ANOVA) and the Post Hoc Test of the anthropometry measurements of different positions \( (n=18) \), which includes points, centers, drivers and wings (excludes goal keepers).

Significant differences were found in the Subscapular skinfold, arm girth flexed and tensed, Waist girth, chest girth and gluteal girth.

Centers had higher subscapular skinfold and Gluteal girth than Driver \( (F=4.235, \ p = 0.025) \), \( (F=4.438, \ p = 0.022) \). Also, Centers had a higher Arm Girth Flexed & Tensed, Waist girth
and Chest girth than Wings \((F=4.934, p = 0.015)\), \((F=5.299, p = 0.012)\), \((F=7.633, p = 0.003)\).
c) Body composition

Table 4

Body compositions of participations by playing positions
(n=18) (Mean ± SD)

<table>
<thead>
<tr>
<th>Positions</th>
<th>Point (n=3)</th>
<th>Center (n=4)</th>
<th>Driver (n=5)</th>
<th>Wing (n=6)</th>
<th>Goalkeeper (n=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.5 ± 1.4</td>
<td>82.2 ± 5.1</td>
<td>69.9 ± 2.6</td>
<td>66.8 ± 5.9</td>
<td>73.6 ± 5.7</td>
</tr>
<tr>
<td>BMI</td>
<td>25.4 ± 2.8</td>
<td>25.8 ± 2.8</td>
<td>22.4 ± 1.3</td>
<td>21.8 ± 0.9</td>
<td>23.1 ± 0.5</td>
</tr>
<tr>
<td>BF(%)</td>
<td>16.3 ± 0.6</td>
<td>21.2 ± 7.1</td>
<td>17.8 ± 1.8</td>
<td>13.4 ± 4.3</td>
<td>18.7 ± 3.8</td>
</tr>
<tr>
<td>FM (kg)</td>
<td>14.1 ± 0.5</td>
<td>17.6 ± 6.9</td>
<td>12.4 ± 1.2</td>
<td>10.4 ± 4.2</td>
<td>13.9 ± 3.8</td>
</tr>
<tr>
<td>FFM (kg)</td>
<td>72.3 ± 1.5</td>
<td>64.5 ± 4.8</td>
<td>57.5 ± 2.6</td>
<td>57.2 ± 5.5</td>
<td>59.7 ± 1.8</td>
</tr>
</tbody>
</table>

The BMI is Body Mass Index, BF (%) is Body Fat Percentage, FM (kg) is Fat Mass (kg), FFM (kg) is Fat Free Mass (kg).

a. Point Vs Driver (p=0.001)
b. Point Vs Wing (p=0.000)
c. Center Vs Driver (p=0.006)
d. Center Vs Wing (p=0.038)

e. Point Vs Driver (p=0.002)

f. Point Vs Wing (p=0.001)

There is a statistically significant difference between group means. The Weight, BMI and the fat free mass were all below 0.05. Therefore, those variables of body compositions have a statistically significant difference between the points, centers, drivers and wings.

Points had greater weight and Fat Free Mass (kg) than Driver (F=18.938, p = 0.000), (F=10.732, p = 0.001). Also, Center had a higher Body Mass Index than Wing (F=5.004, p = 0.015). However, Wing had a lower weight and Fat Free Mass (kg) than points, (F=18.938, p = 0.000), (F=10.732, p = 0.001).
**d) Physical Fitness Tests**

Table 5

**Specified physical fitness tests of participations by playing positions (n=18) (Mean ± SD)**

<table>
<thead>
<tr>
<th>Positions (n=20)</th>
<th>Point (n=3)</th>
<th>Center (n=4)</th>
<th>Driver (n=5)</th>
<th>Wing (n=6)</th>
<th>Goalkeeper (n=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2max</td>
<td>51.3 ± 3.1</td>
<td>51.8 ± 1.3</td>
<td>50.6 ± 2.4</td>
<td>55.5 ± 3.2</td>
<td>43.0 ± 1.4</td>
</tr>
<tr>
<td>25m/s</td>
<td>11.7 ± 0.5</td>
<td>12.2 ± 0.2</td>
<td>11.9 ± 0.4</td>
<td>11.5 ± 0.3</td>
<td>12.9 ± 0.6</td>
</tr>
<tr>
<td>100m/s</td>
<td>58.8 ± 1.7</td>
<td>58.6 ± 1.0</td>
<td>61.5 ± 2.2</td>
<td>57.3 ± 2.7</td>
<td>/</td>
</tr>
<tr>
<td>400m/s</td>
<td>297.7 ± 6.1</td>
<td>301.1 ± 4.2</td>
<td>303.8 ± 6.4</td>
<td>285.1 ± 9.8</td>
<td>/</td>
</tr>
</tbody>
</table>

- **a. Center Vs Driver (p=0.021)**
- **b. Driver Vs Wing (p=0.048)**
- **c. Driver Vs Wing (p=0.029)**
- **d. Center Vs Wing (p=0.028)**
- **e. Driver Vs Wing (p=0.006)**

There is a statistically significant difference between the VO2max, 100 meter swimming test and the 400 meter swimming test were all below 0.05.
Centers had higher VO2max than Driver ($F=5.057, p = 0.014$). However, Driver had a slower swimming speed of the 100 and 400 meter front crawl swimming than Wing ($F=3.806, p = 0.035$), ($F=6.874, p = 0.004$). Also, Center had a slower swimming speed of the 400 meter front crawl swimming than Wing too ($F=6.874, p = 0.004$).
DISCUSSIONS AND CONCLUSIONS

This aim of study is to evaluate the anthropometric and physical fitness profile of the Official Hong Kong water polo players. Key findings will be presenting through 3 sections in the following chapter: (a) Discussion, (b) Conclusion, and (c) Recommendations for Further Studies.

Discussion

This discussion chapter is divided into three aspects; including (1) Anthropometric Measurements, (2) Body composition, and (3) Physical fitness tests.

(1) Anthropometric Measurements

After conducted the ANOVA test and post hoc test to analyze the data between Centers and Wings of the Hong Kong water polo players, the results showed that Centers have a significant difference among the BMI value, body mass, subscapular
In addition, the body mass, BMI value, waist girth and gluteal girth of the Centers was significant higher and larger than the Wings.

The results coincides with Ferragut et al. (2011), that found in elite Spanish water polo players, Centers had the tendency to have higher body mass, larger skinfold, BMI, larger waist, chest girth and muscle mass than compared to Wings. Both the current study and Ferragut et al. (2011) thus reflect there is a position-specific anthropometric characteristic in different playing positions even in the Hong Kong water polo team.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean±SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>22.5±7.2</td>
<td>16.1-38.6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.5±3.9</td>
<td>172.5-185.5</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>71.0±8.4</td>
<td>61.2-90.5</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>13.7±3.8</td>
<td>8.0-23.0</td>
</tr>
</tbody>
</table>
Aziz et al. (2002) found that Singaporean water polo players were more petite in size when compared to non-Asian ethnicities teams. The comparison showed similar results when the Hong Kong water polo teams overall physical characteristics were compared to the Singaporeans.

The mean height of the Singaporean water polo players was recorded to be on average 178.5±3.9 cm, while similarly the Hong Kong water polo players were on average 177.8±6.1 cm tall.

In terms of weight the two teams also showed comparable results. The Hong Kong team was recorded to be 74.3±8.7 (kg) on average, thus making the Hong Kong team only slightly heavier than the on average 71.0±8.4. (kg) Singaporeans.

Smith, (1998) provides a collection of data regarding different top western national teams has found the Greek national team (n=20), was found to have a mean height of 184.2cm, while the mean body mass is 88.1kg; Canada national team (n=28),
the mean of the team height was recorded at 182.91cm, the mean body mass was 79.89kg; UC Berkeley varsity team (n=25), the mean of the team height was 186.5cm, the mean body mass was 86.1kg.

The body height and size of the western teams are significantly taller and larger than the Hong Kong and Singaporean team. It shows there are a significant difference in general physical characteristics between the “Asian” and “non-Asian ethnicity” teams.

The Hong Kong water polo team has similar traits with the Singaporean water polo team. It is an indication that Asian water polo players have a similar physical characteristic. Thus indicating Asian water polo players may have a different set of ‘ideal’ water polo anthropometric characteristic than what has been indicated in the past. As other than (Aziz et al, 2002) the Singaporean and the current Hong Kong water polo study, no other studies on ‘ideal’ anthropometric
measurements have been conducted using ‘elite Asian’ water polo players. Suggesting previously studies and conclusions drawn from the western norm.

(2) Body composition

After analyzing the data of the Hong Kong water polo players with the post hoc test, found out that in terms of weight, there was a significant different between Point Vs. Driver (p=0.001), Point Vs. Wing (p=0.000) and Center Vs. Driver (p=0.006). There was not a significant difference when it comes to the Centre and Wing within the Hong Kong Water Polo Players. However the Points tended to have a significant difference when compared to the Driver and Wings. It shows out there’s a position specific in the Hong Kong water polo team.

There’s no significant difference in the skinfold result between the Centers and Wings, but Center vs. Driver (p=0.028)
has a significant difference between the Subscapular Skinfold. In addition there is no significant difference any of the body fat percentage measures between the Points, Divers and Centers in the Hong Kong water polo team. Kondric et al. (2012) also found similar results in his study, it this shows that the Hong Kong water polo team have a similar position specific difference with the Western water polo teams.

Kondric et al. (2012), investigated differences between five playing positions in anthropometric measures and some specific physical fitness variables in high-level junior (17 to 18 years of age) water polo players. After analyzing the collected data, Kondric et al. (2012) found out that Center has a larger body mass compare to Wings, Wings have a lower skinfold result than Centers, but there’s no significant difference in any of the body fat percentage measures between the Points, Divers and Centers.

The comparison indicates that the Hong Kong water polo team
has correlating differences to the non-Asian teams in terms of the differences between anthropometric measurements between the various playing positions.

(3) Physical fitness tests

In the Hong Kong water polo team, numerous differences were found between the playing positions in the physical fitness tests of the VO2 max result. The points, center and drivers got the similar VO2 max values.

Wings have been found to have the highest VO2 max; the goalkeepers were the lowest. There is also a significant difference of VO2 max between the Center Vs Driver ($p=0.021$) and Driver vs. Wing ($p=0.048$).

The testing method of indirect VO2 max measurement of the Hong Kong team may not be the best testing method, because the testing method of VO2 max should be more relative to game
movement performance (Holmer, 1972), but due to the limited resource, the cooper test were selected for the VO2 max collection.

The VO2 max of the Hong Kong water polo team was compared with other elite national teams, such as the French national water polo team (Platanou, 2009). The study showed the French national team (n=31) through direct measured during free swimming and there's a significant difference among different positions. Centers and points got the highest VO2 max as about >70, wings are about >66, drivers are about >62 and goalkeepers are about >52. VO2 max is an important method to measure the fitness level of the athletes (French & Long, 2012).

When the VO2max of the Hong Kong team was compared with the French national team, it was found that the local team had a lower level of VO2 max.

The cause of the low VO2 max of the Hong Kong team may be
the lack of training, as the French national water polo national team’s trains for six day a week for two section a day each section for two hours, but the Hong Kong team only trains for four to five days a week with one section a day for two hours. The vast difference in training duration, suggests the Hong Kong water polo team will need to increase training time in order to increase the level of the teams VO2max.

Kondric et al. (2012) investigates 110 high level junior water polo players, found out that there were significant differences in playing positions in the swimming tests, Points have the best results of 25m and 400m swimming, drivers were the second best in 25m and 400m, but there’s no significant post-hoc difference among the 100 meter swimming test. But in the Hong Kong team, Wings were recorded with the best result in all swimming tests; Drivers have been found to have the poorest results in the 100m and 400m swimming tests.
In addition there's a significance difference between positions with the post-hoc test, Driver vs. Wing \((p=0.029)\) in the 100 meter swimming, Center vs. Wing \((p=0.028)\) and Driver vs. Wing \((p=0.006)\) within the 400m swimming test. It shows there's a significant difference in playing positions in the swimming ability in the Hong Kong team.

Conclusion

The results showed that Centers has a significant difference among the BMI value, body mass, subscapular skinfold, waist and chest girth compare to the wings, reflecting there is a position-specific anthropometric characteristic in different playing positions even in the Hong Kong water polo team.

The body height and size of the western teams are significantly taller and larger than the Hong Kong team. It shows there are a significant difference in general physical characteristics between the “Asian” and “non-Asian ethnicity”
teams.

The Hong Kong water polo team has similar traits with the Singaporean water polo team. It is an indication that Asian water polo players have a similar physical characteristic.

The body mass of Centers doesn’t have a significant different compare to the Wings within the Hong Kong team water polo players, but the Points has a significant difference comparing to the Driver and Wings. It shows out there’s a position specific in the Hong Kong water polo team.

When the VO2max of the Hong Kong team was compared with the French national team, it was found that the local team had a much lower level of VO2 max. The cause of the low VO2 max of the Hong Kong team may the lack of training.

The data of the anthropometric and physical fitness profile of the Official Hong Kong water polo player provides useful
scientific information is useful for the well-development of the Hong Kong water polo team. Moreover, the reference can also work as a standard for selecting and training the water polo players with a new or modify effective training program in order to develop the Hong Kong water polo team to a higher level. To improve the Hong Kong water polo team, they should increase the training specificity. The training format and motions should be closely related to competition situation (Smith, 1998). They may need to increase the intensity and training period to reach a higher level physical fitness, such as using overload training, due to their low VO2 max result after comparing with other national teams.
Recommendations for Further Studies

1. Pre-season period is the best time to undergo the investigation, which could minimize the uncontrollable variables like competition and injury that would be affected the testing schedule.

2. Muscles power and strengthen of upper and lower extremities can be included since they are good indicators of better performance.
REFERENCES


Department of Sport and Exercise Science, The University of Auckland, Auckland, New Zealand, Sports Med, 26(5), 317-34.


Zhou claimed that many of his students only reached 80% in attendance rate (personal communication, October 21, 2014)
APPENDIC

Informed Consent for Hong Kong Team Water Polo Players

The purpose of this fitness testing and data collecting is to evaluate the Anthropometric Characteristics and Physical Fitness Profile of the Official Hong Kong Water Polo Team Players, the tests includes anthropometric measurement, body composition, specialized swimming ability and skill related muscular fitness measurements.

I understand that I am responsible for monitoring my own condition throughout the tests, and should any unusual symptoms occur, I will cease my participation and inform the instructor.

In signing this consent form, I, ______________________ (Name of Participant), affirm that I have read this form in its entirety and that I understand the description of the testing procedures and the risks and discomforts, and having had an opportunity to ask questions that have been answered to my satisfaction.

________________________   ______________________
(Signature of participant)   (Date)

________________________   ______________________
(Person administering tests)  (Date)
香港水球隊運動員體能測試參加者同意書

閣下正被邀請參與一個關於香港水球運動員測量的研究，其研究目的是收集運動員身體素質的資料。其資料可能將會有助於日後選材及訓練之用。

研究包括以下測試：
- 皮下脂肪
- 身體脂肪百分比
- VO2max最大耗氧量
- 游泳速度：
  1) 25米自由式
  3) 100米自由式
  4) 400米自由式
- 量度：
  1) 臂周
  2) 臂長
  3) 前臂圍
  4) 腰圍
  5) 胸圍
  6) 臀部周圍
  7) 大腿圍
  8) 小腿周圍
  9) 腳踝周圍

當進行測試時，可能會潛在不適和危險。當參加者在研究期間有任何不適，應立即通知有關研究人員。如需要額外藥物治療，有關費用將由參加者負責。若進行研究中參加者有任何受傷，將不會獲得任何金錢上的賠償。參加者是義務參與是項研究，若參加者於中途退出，將不需承擔任何懲罰。

本人（參加者姓名正楷）________________________________已閱覽內附註的計劃測試內容，並願意參與此測試計劃。本人已明白參與測試所帶來的潛在風險及對身體可能造成的不適；本人明白有關研究人員將保密處理所有測試結果，而有關資料則只作評核和研究之用。本人知道有權隨時作出查詢，甚至終止測試。

本人聲明健康及體能良好，適宜參加上述活動。如果本人因自己的疏忽或健康體能欠佳，而引致於參加這項活動時傷亡，主辦人員無須負責。

_________________________________________  (實驗對象簽署)  ____________________________  (日期)

_________________________________________  (研究人員簽署)  ____________________________  (日期)
Physical Activity Readiness Questionnaire (PAR-Q)

PAR-Q is designed to help you. For most people physical activity should not pose any problem or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable for them. Common sense is your best guide when you answer these questions. Please read the following questions carefully and answer each one honestly: check YES or NO.

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
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</table>

I, _________________________ (Name of Participant), have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

_____________________________________  _____________________________
(Signature of participant)  (Date)
體能活動適應能力問卷 (PAR-Q)

經常進行體能活動不但有益身心，而且樂趣無窮，因此，愈來愈多人開始每天多做運動。對大部分人來說，多做運動是很安全的。不過，有些人則應在增加運動量前，先行徵詢醫生的意見。

在進行測試之前，請回答以下7題問題。普通常識是回答這些問題的最佳指引。請仔細閱讀下列問題，然後誠實回答：

請答「是」或「否」。

<table>
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<th>是</th>
<th>否</th>
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<tr>
<td>□ □</td>
<td>1. 醫生曾否說過你的心臟有問題，以及只可進行醫生建議的體能活動？</td>
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<tr>
<td>□ □</td>
<td>2. 你進行體能活動時會否感到胸口痛？</td>
<td></td>
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<tr>
<td>□ □</td>
<td>3. 過去一個月內，你曾否在沒有進行體能活動時也感到胸口痛？</td>
<td></td>
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<td>□ □</td>
<td>4. 你曾否因感到暈眩而失去平衡，或曾否失去知覺？</td>
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<td>□ □</td>
<td>5. 你的骨骼或關節 (例如脊骨、膝蓋或髖關節) 是否有毛病，且會因改變體能活動而惡化？</td>
<td></td>
</tr>
<tr>
<td>□ □</td>
<td>6. 醫生現時是否有開血壓或心臟藥物 (例如water pills) 給你服用？</td>
<td></td>
</tr>
<tr>
<td>□ □</td>
<td>7. 是否有其他理由令你不應進行體能活動？</td>
<td></td>
</tr>
</tbody>
</table>

*如果在上述問卷中有一個或以上「是」的答案，即表示參加者的身體狀況可能不適合參加有關活動。

本人 _______________ (姓名) 已閱悉，明白並填妥本問卷。本人的問題亦已得到圓滿解答。

___________________  ____________________
(實驗對象簽署)  (日期)
Data Collection Form

Name: _________________ (Chi)  Date of Birth: _______________
_________________ (Eng)  Age: _______________
Weight: ____________ kg
Height: ____________ cm
Experience of water polo:
0-2 / 3-4 / 5-6 / 7-8 / 9-10 / 11 or above years
Position: Point / Driver / Wing / Center / Goalkeeper

Anthropometry

Skinfold:
- Triceps:  Trial1_______ Trial2_______ Trial 3_______ Average_______ (mm)
- Calf:  Trial1_______ Trial2_______ Trial 3_______ Average___
(mm)

Width:
- Arm span:  Trial1_______ Trial 2_______ Average_______ (cm)

Circumference:
1. Arm girth relaxed:  Trial1_______ Trial 2_______ Largest
__________(cm)
2. Arm girth flexed & tensed: Trial1_______ Trial 2_______ Smallest
_______(cm)
3. Forearm girth:  Trial1_______ Trial 2_______ Average_______ (cm)
4. Waist girth:  Trial1_______ Trial 2_______ Average_______ (cm)
5. Chest girth:  Trial1_______ Trial 2_______ Average_______ (cm)
6. Gluteal girth:  Trial1_______ Trial 2_______ Average_______(cm)
7. Thigh girth:  Trial1_______ Trial 2_______ Average_______(cm)
8. Calf girth:  Trial1_______ Trial 2_______ Average_______(cm)
9. Ankle girth:  Trial1_______ Trial 2_______ Average_______(cm)
Body Composition

Percentage body Fat: _______________%
Fat mass: ____________ (kg)
Fat Free mass: ____________ (kg)

Physical Fitness

Indirect VO2 max from Cooper’s 12 minute run test
VO2 max (ml/kg/min) = (22.351 x distance covered in kilometers) -11.288
Distance: ________________
Estimated oxygen uptake: ________________ml/kg/min

Swimming Test:
1. 25m(s): Time:_____________ (s)
2. 100m(s): Time:_____________ (s)
3. 400m(s): Time:_____________ (s)