Comparison of anthropometric characteristics and physical performance measures between Division I and Division II volleyball players in the State of Kuwait

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Introduction:

It is very desirable for coaches and sport scientists to predict with a high degree of probability whether or not a player in any given sport will achieve success as an athlete (27). Anthropometric and physical performance characteristics have been shown to be key factors for predicting successful performance in many sports, including volleyball (2, 12, 17, 19, 30). Volleyball requires that players repeatedly perform short bouts of high-intensity activities, such as jumping, spiking, blocking, digging, and sprinting, in order to fulfill the technical and tactical requisites for high level performance (6, 9, 10, 14, 16, 20, 25, 32). Thus, for the game of volleyball, technical and tactical skills, anthropometric characteristics, and physical performance abilities have been recognized as important factors contributing to success at all levels of competition (2, 6, 13, 15, 20, 25, 26, 30).

Several studies have demonstrated that players competing at higher levels of competition are taller, have less body fat and have better individual physical performance abilities than players at lower levels of competition (7, 8, 28, 29). Smith et al. (28) examined the differences in physiological, physical and performance characteristics between national-level and college-level volleyball players for the purpose of identifying key characteristics for developing a long-term national program. The Smith et al. (28) study

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revealed that national level players have significantly higher blocking and spiking jumps, VO_2max, and 20-m sprint speed than do volleyball players at lower levels of competition. Similarly, Gabbett et al. (9) investigated the physiological and anthropometric characteristics of junior volleyball players competing at national, state, and novice levels. Significant differences were found between the players in terms of height, standing reach height, body fat %, lower-body muscular power, agility, and estimated maximal aerobic power, with the physiological and anthropometric characteristics of players generally being better with higher competitive levels (10). Forthomme et al. (8) conducted a study to determine if there was a difference between anthropometric variables, physical performance scores and ball velocity during volleyball spikes for first-division (N1) and second division (N2) players. Only spiked ball velocity and vertical jump height differed between the N1 and N2 players (8). There is also evidence supporting the notion that anthropometric and physical performance variables differentiate international volleyball players from national and regional level volleyball players.

Based upon a growing body of research literature asserting that anthropometric and physical performance variables can differentiate between levels of volleyball playing abilities, sport scientists and volleyball coaches are beginning to incorporate anthropometric assessment and physical performance testing into the process of identifying volleyball player's talent (6, 10, 13, 25, 28, 30). However, the practice of using anthropometric assessment and physical performance testing to identify volleyball talent in Kuwait is not well utilized. This is primarily because there is little or no published data on the anthropometric characteristics and physical performance test scores of players at the various levels of volleyball competition in Kuwait. Therefore, the purpose of the present study is to address the dearth of data on male volleyball players in the state of Kuwait by assessing,

analyzing and comparing selected anthropometric variables and physical performance abilities between two groups: Kuwaiti male Division I and Division II volleyball players. The Al-arabi club won the 2013-2014 Kuwait championship for Division I while the Al-yarmook club also won the 2013-2014 championship for division II. By comparing anthropometric variables and performance test scores for players from two teams representing very different levels of volleyball success, insight into the contribution of anthropometric variables and performance test outcomes on volleyball performance success will be possible. A second purpose of the present study is to compare obtained data on Kuwait volleyball players with the descriptive data published for international and national level male volleyball players from other countries.

Taken together, the two purposes for the current study could be used to help Kuwaiti volleyball coaches identify the anthropometric characteristics and physical performance capabilities necessary for achieving higher levels of volleyball success. Such information could be used in the selection of future volleyball players, as well as for planning training programs to improve the performance of Kuwait volleyball players.

Hypotheses:

Two hypotheses were tested. First, there will be significant differences in the anthropometric variables between the Division I players and the Division II players. Second, the physical performance capabilities will be significantly higher for the Division I players compared to the Division II players. Descriptive statistics for the anthropometric and performance variables for the Kuwaiti Division I and II players will be compared to available data on other male, national and international volleyball players in the discussion section of this manuscript, but specific hypotheses will not be tested.

Keywords: volleyball; performance; strength training; spiked ball velocity; radar gun; Myotest.

Methods:

Subjects:

A total of 29 Kuwaiti male volleyball players

participated in the study. Of these 29 players, 16 were division one (N1) players from Al-arabi Sporting Club, and 13 were division two (N2) players from Al-yarmook Sporting Club. The Al-arabi D1 and Al-yarmook D2 were the two highest divisions of volleyball in Kuwait for the 2013-2014 season; however, to date objective criteria have not been used to distinguish between these two divisions. As part of the process of determining physical and physiological characteristics that could be used to evaluate Kuwaiti volleyball players, the top teams from D1 and D2 were tested. Similarly, Forthomme et al. (8) have also contrasted D1 and D2 volleyball player performance. If performance on the selected tests is found to differ between the top D1 and D2 teams, support for using performance tests to evaluate players will result. In addition, by testing the top D1 and D2 teams, norms for level of play for Kuwaiti volleyball players can be developed.

The authors of the present study used Forthomme et al.'s study (8) as a framework for the following reasons; a) no other published data compares D1 to D2; b) Forthomme et al. (8) also studied the highest D1 and D2 teams; c) the anthropometric characteristics reported in Forthomme et al.'s study (8) were similar to those reported in the present study; d) the Belgian players were male, as in our study; and e) not many researchers have assessed the same variables that were measured in the current study.

Procedures:

All testing was conducted indoors at the Al-kuwait Sporting Club in the state of Kuwait in August 2014 following the 2013-2014 championship.

The first testing session included study familiarization followed by data collection for the anthropometric measurements, agility T-test, 1 repetition maximum testing (1RM), and counter movement jump (CMJ) test. The 5-m, 10-m, and 20-m sprint tests, along with spiked ball velocity with the coach toss were completed during the second session, which took place 48 hours after the first testing session. All players performed 10-15 minutes of warm-up activities before participating in the physical performance testing.

Anthropometric Measures:

Each participant's height was measured barefoot and recorded to the nearest 0.1 cm. Their body weight was measured using a medical scale (Detecto's ProHealth 6129 with height measurement rod), and recorded to the nearest 0.01kg. Body mass index (BMI) was calculated using the following formula: body weight (kg) / [height (m)]^2 (18).

Body-fat percentage (BF%) was measured using the Skinfold Caliper methodology following the procedures described by Norton et al. (21) using a Lafayette Skinfold Caliper, the skinfold thickness was measured at seven sites: biceps, triceps, subscapular, supraspinal, abdominal, thigh, and calf on the right side of the body. Standing reach stature was measured using a yardstick vertical jump device (Swift Performance Equipment, NSW, Australia). Players were instructed to stand with feet flat on the ground, extend their arm and hand, and mark the standing reach stature.

Physical Performance Measures:

After a self-selected 10 minute warm-up period, a battery of physical performance tests was administered. The participants were instructed to give maximal effort for each of the performance tests.

Agility T-test:

In terms of agility, volleyball players frequently move quickly forward and backward, and change direction during a game (10). The agility T-test requires players to move through a T-shaped pattern as quickly as possible. The agility T-test is a valid and reliable measure of agility performance with a reliability of 0.90 (95% confidence interval) (23). For this study, three cones (B, C, and D) were placed 4.57 m apart to form the top of the T and the bottom cone (A) of the T was placed 9.14 m yards from the middle cone, forming the top of the T. The player and the principal investigator/timer acknowledged their readiness by the player yelling, “Ready," and the principal investigator yelling, "Ready" in return. The principal investigator started the stopwatch at the player’s first starting movement, and the player ran as fast as possible through the agility T-test cones. Players began with both feet behind the starting

point at cone A. Each player was instructed to sprint forward 9.14 m to point B and touched the cone with the right hand. The player then shuffled to the left 4.57 m and touched cone C with the left hand. Players then shuffled to the right 9.14 m and touched cone D with the right hand. They then shuffled to the left 4.57 m back to point B cone and touched the cone with the left hand. The players finally ran backward as quickly as possible and returned to the finishing line at point A. The principal investigator stopped the stopwatch when the player broke the plane of the finish line at cone A (1, 24). Each player performed 3 testing trials, with a recovery period of 3 minutes between each trial. The times for each trial were recorded to the nearest one-hundredth of a second, but only the best trial was used for analysis.

1 Repetition Maximum (1RM):

Each player lay supine on a bench, with hips and shoulder blades in contact with the bench and feet flat on the floor. With a grip slightly wider than shoulder width, the bar was lowered to the chest and pushed upward until the arms were fully extended.

A light warm-up set of 10 repetitions was performed using a 20 kg weight. This was followed by 6 – 8 repetitions of approximately 30-40% of the estimated 1 repetition maximum (1RM), which was based on the basis of recent training history. A 3-minute stretching routine for the shoulders and chest was performed, followed by a 6 additional repetitions on the bench press at a weight corresponding to 60% of the estimated 1 repetition maximum (1RM). The player then rested for 3-4 minutes before attempting his 1 repetition maximum (1RM). If the 1 repetition maximum (1RM) was successful, the player rested for five minutes before attempting a bench press using a resistance that had been increased by 2-5%. Conversely, the resistance was decreased by 2-5% if the lift was not successful. The test was recorded as the maximum weight (kg) that could be lifted with one repetition. The lift was terminated if the player raised his foot off the bench during the movement, bounced the bar off the chest, or

extended the arms unevenly. The absolute 1 repetition maximum (1RM) was recorded in kilograms (kg), and the 1RM relative bench press was calculated as 1RM/ (bodyweight) (5).

Countermovement Vertical Jump Test:

Volleyball players must possess high levels of lower body muscular power during blocking, spiking, and serving (10). In order to measure lower body muscular power, a Myotest device was used. Players carried a belt around their lower trunk, on which a Myotest wireless device was placed (safely attached to a belt) (Figure 1).

Figure 1. A Myotest device attached to a belt around the trunk

All players were required to perform 5 vertical jumps (CMJ). Prior to each test session, players warmed up by jogging for 5 minutes and stretching the upper and lower extremity muscles for 5 minutes. The principal investigator explained how to perform the jumps and players practiced the jumps until they had successfully learned them (as judged by the principal investigator). For the countermovement jump (CMJ), players started from an upright standing position with hands placed on their hips (Figure 2); they then quickly flexed their knees (90 degrees). Following the audio signal of the device, the players performed the jump as high as possible, and landed with affable flexion (up to 110 degrees) in the articulations of the knee. Finally, they returned to the starting standing position, while waiting for the new sound signal from the device, when the specified jump technique was repeated. If the principal investigator

determined that a jump was incorrectly performed, the player was asked to repeat it. At the end of the protocol, the Myotest device software automatically processed the mean values of analyzed variables (3, 4).

Figure 2. Starting position for the CMJ test

Vertical Jump Height Estimation:

The Myotest device (5.4 X 10.2 X 11.1 cm; weight: 58g) contains a 3D inertial accelerometer (± 8 g), which allows vertical acceleration to be recorded at a sampling frequency of 500Hz. The device is typically attached to a large (8.5cm) Velcro elastic belt. The manufacturer recommends that the device be fixed at about hip level on the left side of the body. Accelerometric data from the tests were stored and subsequently downloaded for jump height calculations (using Myotest PRO Software version 1.0). The software automatically integrates the acceleration recording to obtain vertical velocity; jump height was estimated using two different calculation methods (4).

5-m, 10-m and 20-m Sprints:

Volleyball players need to move rapidly to position themselves for both attack and defense (10). Thus, players' running speed was measured with 5-m, 10-m, and 20-m sprints. The three distances were marked on the gymnasium floor. Each player assumed the starting position by lowering his center of gravity and leaning slightly forward. The players and the principal investigator/timer

acknowledged readiness by the players yelling, “Ready," and the principal investigator yelling, "Ready" in return. The principal investigator started the stopwatch at the player’s first starting movement, and the player ran as fast as possible to the 5-m distance finish line. The principal investigator stopped the timer stopwatch when the player broke the plane of the finish line. The same procedure was performed with the 10-m and 20-m distances. Each player performed three maximal effort sprints of 5-m with a recovery period of 30 seconds between each trial. Each of the three maximal effort 10m sprints was followed by a 1 minute recovery period. The three maximal effort 20-m sprints were followed with 2 minute recovery periods. The times for each sprint were recorded to the nearest one-hundredth of a second, but only the best sprint at each distance was used for analysis (1).

Spiked Ball Velocity (SBV):

The spike is one of the most critical skills in the game of volleyball. Therefore, in order to be successful in this sport, players must consistently generate high ball velocity during the volleyball spike (7). Ball velocity was measured using a Stalker Sport2® radar gun (SRG) calibrated by the manufacturer to allow for small projectile tracking, reducing the validation time from 0.125 to 0.038 sec and increasing the center frequency of the tracking filters from 1,664 to 3,170 Hz (7).

Spiked Ball Velocity with Coach Toss:

After 20 minutes of rest, the ball velocity of a simulated volleyball spike with the coach toss was measured using the same radar gun, which was calibrated to measure spike speed (7). The players spiked a ball that was tossed by the coach. The coach was standing in the center (position 3) and was instructed to toss the ball on the same side from which the player performed the volleyball spikes. Then, a Stalker Sport2® radar gun (SRG) was positioned on a stand set 3 meters behind the participant, 1 meter lateral, and 3 meters high, angled so the volleyball spike would pass in front of the SRG’s beam (7). The player was instructed to hit the tossed volleyball with maximum force and speed using his dominant arm. Each

player was instructed to perform 5 standardized spikes (an approach followed by a vertical jump) at maximal intensity with a 1-minute rest period between trials. All spikes were performed from position 4 and players had to hit balls toward a delimited target zone (diagonal). Opposite directionality (position 2) was used for left-handed spikes. Only the highest spiked ball velocity (km/h) from the successive spike trials for each player was used for data analysis.

Statistical Analyses:

After the data were collected, statistical analyses were conducted using SPSS (Statistical Package for Social Science, Version 14.0) software. Descriptive statistics were used to identify mean, standard deviation for all variables. In addition, an independent t-test was used to determine significant differences between the two teams' anthropometric and the physical performance characteristics. The level of significance was set at $p = 0.05$ level of probability.

Results:

Table 1 compares the means for a number of anthropometric for the two teams' players in the present study. The mean age, and standard deviation for (N1) volleyball players, and (N2) volleyball players group were 24 ± 3.2, and 21.1 ± 2.7 years, respectively. The mean height and weight and standard deviations for the N1 and N2 volleyball players were 186.3 ± 5.6 cm, and 75.1 ± 9.9 kg, and 181.1 ± 4.7 cm, and 71.1 ± 9.7 kg, respectively. The mean body mass indices, calculated by dividing body weight in kilograms by body height in meters squared, for the N1 and N2 volleyball players were 23.1 ± 2.7, and 21.6 ± 2.7, respectively. The mean body fat percentage and standard deviation obtained from the 7-site skinfold thickness tests for the N1 and N2 volleyball players were 9.5 ± 1.9%, and 13.5 ± 2.9%, respectively. The mean standing reach heights and standard deviation for the N1 and N2 volleyball players were 240 ± 6.1 cm, and 235 ± 5.5 cm, respectively.

Using independent t-tests, statistically significant results were only identified for age ($p = .009$), height ($p = .006$), body fat percentage ($p = .006$), and strength training hours per

week (p = .002), as presented in Table 1. These results partially support the hypothesis that there are significant differences in the anthropometric variables between the Division I players and the Division II players. Three of the 6 variables assessed for the two teams were significantly different.

Table (1)
Descriptive Variables for Kuwaiti Male Volleyball Players from Al-arabi First Division (N1) and Al-yarmook Second Division (N2)

Variable	First Division (N1)	Second Division (N2)	P-values
Age (y)	24 ± 3.2	21.1 ± 2.7	.009*
Height (cm)	186.3 ± 5.6	181.1 ± 4.7	.006*
Weight (kg)	75.1 ± 9.9	71.1 ± 9.7	.54
Body Mass Index BMI (kg/m²)	23.1 ± 2.7	21.6 ± 2.7	.31
Body Fat Percentage (BF %)	9.5 ± 1.9	13.5 ± 2.9	.006*
Standing Reach Height (cm)	240 ± 6.1	235 ± 5.5	.09

Note**. ***Statistically Significant ($p < 0.05$). Gender: male

A comparison of physical performance measures for Kuwaiti male volleyball players in the N1and N2 teams are presented in Table 2. For the mean spiked ball velocities and standard deviation with the coach toss (SBV) were 23.8 ± 2.9 m-s, and 20.1 ± 2.4 m-s, respectively. The mean countermovement vertical jump (CMJ) heights and standard deviations for the N1 and N2 volleyball players were 52.1 ± 4.3 cm, and 49.1 ± 3.3 cm, respectively. The mean 5-m sprint speeds and standard deviations for the N1 and N2 volleyball players were 1.21 ± 0.1 sec, and 1.39 ± 0.7 sec, respectively. The mean 10-m sprint speeds and standard deviations for the N1and N2 volleyball players were 1.99 ± 0.1 sec, and 2.03 ± 0.3 sec, respectively. The mean 20-m sprint speeds and standard deviations for N1 and N2 volleyball players were 3.22 ± 0.2 sec, and, 3.28 ± 0.4 sec, respectively. The mean agility T-test times and standard deviation for the N1 and N2 volleyball players were 10.6 ± .8 sec, and 10.8 ± .5 sec, respectively. The mean 1 repetition maximum (1RM) weights and standard deviations for the N1 and N2 volleyball players were 57.9 ± 14.8 kg, and 53.6 ± 12.6 kg, respectively. The mean

strength training hours per week and standard deviation for the N1 and N2 volleyball players were 0.35 ± 0.7 h, and 0.15 ± 0.5 h, respectively.

Using independent t-tests, statistically significant results were only identified for spiked ball velocity with the coach toss (p = .009), 5-m sprint (p = .007), 1 repetition maximum (p = .007), and strength training hours per week (p = .002) as presented in Table 2. These results partially support the hypothesis that the physical performance capabilities for the Division I players will be significantly higher than the values observed for the Division II players. Four of the 8 variables assessed for the two teams were significantly different.

Table (2)
Comparison of Physical Performance Measures of Kuwaiti Male Volleyball Players from Al-arabi First Division (N1) and Al-yarmook Second Division (N2)

Variable	First Division (N1)	Second Division (N2)	P
Spiked ball velocity (SBV) (m-s)	23.8 ± 2.9	20.1 ± 2.4	.009*
Countermovement Vertical Jump (CMJ) (cm)	52.1 ± 4.3	49.1 ± 3.3	.44
5-m Sprint (sec)	1.21 ± 0.1	1.39 ± 0.7	.007*
10-m Sprint (sec)	1.99 ± 0.1	2.03 ± 0.3	.32
20-m Sprint (sec)	3.22 ± 0.2	3.28 ± 0.4	.18
Agility T-test (sec)	10.6 ± .8	10.8 ± .5	.14
1 repetition maximum (1RM) (kg)	57.9 ± 14.8	53.6 ± 12.6	.07*
Strength training per week (h)	0.35 ± 0.7	0.15 ± 0.5	.002*

**Note. ***Statistically Significant ($p < 0.05$). Gender: male

Discussion:

Anthropometric characteristics and physical performance abilities have been shown to be key factors for predicting successful performance in many sports, including volleyball (2, 12, 17, 19, 30). To our knowledge, the present study is the first to investigate the anthropometric characteristics and physical performance abilities of Kuwaiti male volleyball players from a first division team (Al-arabi, N1) and a

second division team (Al-yarmook, N2).

As expected, the results of the current study demonstrate that significant group differences exist in some of the anthropometric variables. The Al-arabi (N1) players were significantly older than the Al-yarmook (N2) players (Table 1). It appears that Al-arabi (N1) volleyball players are significantly taller ($p > 0.05$) and slightly heavier than the Al-yarmook (N2) volleyball players (Table 1). Since the N1 players were also significantly older, it is possible that age-related growth and maturation might account for some of the differences. Another contributing factor for the differences in anthropometric variables for the two groups may be differences in training time between the two groups. The time spent in strength training per week was significantly great for the N1 players (Table 2). Since weight training has been shown to stimulate muscle hypertrophy, the increased strength training time observed for the N2 players would result in greater training loads with more associated muscle hypertrophy, contributing to a higher body weight (26). The statistically lower body fat percentage for the N1 players compared to the N2 players further supports the speculation that the better anthropometric profile exhibited by the N1 players than the N2 players partially reflects training differences. Our findings are in agreement with previous studies, which demonstrate that players competing at higher levels of competition are taller and possess less body fat percentages than do players at lower levels of competition (7, 8, 28, 29). However, a comparison of the strength training per week reveals significant differences between Al-arabi (N1) players and Al-yarmook (N2) players with no significant differences, but higher standing reach, for Al-arabi (N1) players (Table 1). These differences may be due to differences in training and/or selection of individuals for the Al-arabi (N1) team who possess more desirable characteristics as a

consequence of genetic and nutritional factors.

Forthomme et al. (8) compared the anthropometric characteristics of Belgian first division (N1) and second division (N2) volleyball players (Table 3). The results revealed that first division (N1) volleyball players were older (26/21y), taller (193.9/191.1cm), heavier (89.5/85kg), and possessed higher body mass index (23.8/23.2) than second division (N2) volleyball players, respectively (Table 3). Compared to the Belgian volleyball players, the Al-arabi (N1) volleyball players were younger than the Belgian (N1) players, and the Al-yarmook (N2) volleyball players were comparable with the Belgian (N2) players (8); Both Al-arabi (N1) and Al-yarmook (N2) volleyball players were shorter and lighter when compared to the Belgian (N1) and (N2) volleyball players (Table 3). The height and weight differences between the Kuwaiti volleyball players and the Belgian volleyball players in the Forthomme et al. (8) study could be explained by genetic, environmental, behavioral, cultural, and nutritional factors. The body mass index of the Al-arabi (N1) volleyball players was almost the same when compared to the Belgian (N1) volleyball players. However, the body mass indexes of the Al-yarmook (N2) players were slightly lower than the Belgian (N2) volleyball players. The authors of the present study used Forthomme et al.'s study (8) as a reference because the anthropometric characteristics were similar, and they both used highest D1 and D2 teams.

Table (3)
Comparison of Anthropometric Characteristics between Kuwaiti Male Volleyball Players of First Division (N1) and Second Division (N2), and the Belgian First Division (N1) and Second Division (N2) Volleyball players of Forthomme et al. (8)

Variable	Present study N1	Present study N2	Forthomme et al. (8) N1	Forthomme et al. (8) N2
Age (y)	24 ± 3.2	22.1 ± 2.7	26.1 ± 5.4	21 ± 3.04
Height (cm)	186.3 ± 5.6	181.1 ± 4.7	193.9 ± 2.8	191.1 ± 5.6
Weight (kg)	75.1 ± 9.9	71.1 ± 9.7	89.5 ± 6.3	85 ± 5.7
Body Mass Index BMI (kg/m^2)	23.1 ± 2.7	21.6 ± 2.7	23.8 ± 1.5	23.2 ± 3.6
Body Fat Percentage (BF %)	9.5 ± 1.9	13.5 ± 2.9	-	-
Standing Reach Height (cm)	240 ± 6.1	233 ± 5.5	-	-

Note. Gender: male

In addition to the expectation that there would be differences in the anthropometric characteristics of Kuwaiti N1 and N2 male volleyball players, the results from the current study support the expectation that male Kuwaiti N1 players have higher performance test scores than N2 players. As seen in Table 2, the spiked ball velocity (SBV) of the Al-arabi (N1) volleyball players was significantly higher than for the Al-yarmook (N2) volleyball players. Also, the comparison of the countermovement vertical jump (CMJ) sores revealed that Al-arabi (N1) volleyball players had slightly higher values than did the Al-yarmook (N2) volleyball players, but the difference was not statistically significant. Despite the fact that Al-arabi (N1) volleyball players were faster than the Al-yarmook (N2) volleyball players during the 5-m, 10-m, 20-m sprints,

and the agility T-test, only the 5-m sprint time was statistically significantly lower for the Al-arabi (N1) players (Table 2). Perhaps the lack of difference in 10m, 20m sprint time, and agility T-test times reflects the specifics of volleyball. The distances that a volleyball player needs to cover in the course of a volleyball match are typically less than 5-m, so it is reasonable to assume that sprint speeds over a distance of less than 5-m would differentiate between volleyball playing ability.

In addition, the 1 repetition maximum (1RM) scores for the Al-arabi (N1) volleyball players were significantly higher than for the Al-yarmook (N2) volleyball players (Table 2). This result can probably be explained by the differences in training and playing time for the two levels of competitors, although it is also possible that individual capabilities might be a contributing factor.

Evidence in support of the role of training in the development of high level male volleyball competitors should come as welcome information for the volleyball coach. This information should be used to drive volleyball coaches to plan and implement specific physical training programs as well as nutritional interventions to develop volleyball specific characteristics and abilities.

Although other researchers have examined volleyball performance in male players at different levels of competition, only Forthomme et al. (8) study, on Belgian volleyball players, reported values for SBV, CMJ height, and strength training per week three variables assessed in the current study. Table 4 indicates that the SBV values for both the Al-arabi (N1) and Al-yarmook (N2) volleyball players were slower than for the Belgian (N1) and (N2) players (Table 4). In addition, the countermovement vertical jump (CMJ) heights of Al-arabi (N1) and Al-yarmook (N2) volleyball players were lower than both (N1) and (N2) Belgian volleyball players (Table 4). Moreover, both Al-arabi (N1) and Al-yarmook (N2) volleyball players spent less time in terms of strength training per week when compared to the Belgian (N1) and (N2) volleyball players (8); see Table 4.

Table (4)
Selected Performance Measures for First Division (N1) and Second Division (N2) Kuwaiti Male Volleyball Players and the First Division (N1) and Second Division (N2) Belgian Volleyball Players in Forthomme et al. (8)

Variable	Present Study N1	Present Study N2	Forthomme et al. (8) N1	Forthomme et al. (8) N2
Spiked ball velocity (SBV) (m-s)	23.8 ± 2.9	20.1 ± 2.4	28.1 ± 3.1	25.1 ± 3.4
Countermovement Vertical Jump (CMJ) (cm)	52.1 ± 4.3	49.1 ± 3.3	56.5 ± 4.6	51.2 ± 2.3
Strength training per week (h)	0.35 ± 0.7	0.15 ± 0.5	2.1 ± 1.5	0.25 ± 0.7

Note. Gender: male

Although some of the disparity in SBV and CMJ height may reflect genetic differences, it is likely that the differences reflect differences in training programs and competitive schedules for Kuwait and Belgium. Male Belgian volleyball players have been competing internationally for many years, while Kuwaiti international level volleyball involvement is much more recent phenomenon. Consequently, the thoughtful application of the sport sciences to the training of male Kuwaiti volleyball players could significantly contribute to the increased competitive success of Kuwaiti teams.

Conclusions:

On the basis of the outcomes of the present study, the following conclusions can be drawn:

1. Relative to anthropometric variables, significant differences were found between Al-arabi (N1) and Al-yarmook (N2) volleyball players in age, height, and body fat percentage. The number of strength training hours per week was also significantly different.
2. Relative to physical performance variables,

significant differences were found between Al-arabi (N1) and Al-yarmook (N2) volleyball players in spiked ball velocity (SBV), 5-m sprint, and 1 repetition maximum (1RM).

3. Although age-related growth and maturation may explain some of the observed differences, a more likely explanation is the difference in training time. With increased attention to the application of sport science to training male volleyball players, Kuwaiti volleyball coaches could affect significant improvement in volleyball play in Kuwait.

Practical Applications:

The present study is the first to concurrently investigate the anthropometric and physical performance measures of two teams of Kuwaiti male volleyball players with considerably different success records. These results provide a starting point for the establishment of norms for NI and N2 level for Kuwaiti male players and could be used as a reference for improving Kuwaiti male volleyball player's first division (N1) and second division (N2) through future studies.

While norms for anthropometric and performance variables may provide insight for the processes of talent identification and player selection, the current study also provides evidence in support of the role of training time in the development of successful male volleyball players and to design training programs for maximizing volleyball players' performance. Therefore, the results of the current study should provide encouragement to coaches who want to improve the ability of individual players as well as the entire team. Spending time and energy on the design and implementation of training programs and nutritional support programs will be helpful in elevating the play of volleyball team member.

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