Research Report

Anthropometric measurements and performance profile of the 70th UAAP season athletes of the University of Santo Tomas

Josephine Joy Reyes, MPE

ABSTRACT

Objective. Determine the anthropometric measurements and performance profile of the collegiate and junior athletes of the University of Santo Tomas who participated in the 70th UAAP season. ***Methods.*** Two hundred fifty one eligible players (95 males, 84 females, 45 boys and 27 girls) of 13 sporting events of the UAAP performed the sports-specific physiological testing. The following general fitness and physiological tests were measured: anthropometric measurements, low back and hamstring flexibility, local muscular strength and endurance, maximal oxygen uptake (VO_2max), motor ability and sports-specific tests. Descriptive anthropometric and performance profile of athletes were calculated using means and standard deviations by gender and sport. ***Results.*** Mean age of participants were 15.0 $\pm$ 0.75 y/o for boys, 13.42 $\pm$ 1.2 y/o for girls, 20.05 $\pm$ 1.74 y/o for senior male athletes, and 19.69 $\pm$ 1.9 y/o for senior female athletes. Anthropometric measurements revealed a morphology in athletes across different sports. Findings in the general physiological data to performance showed the following results: predicted VO2max values from the 20-meter progressive shuttle run test (MSFT) was high in football males (54.0 $\pm$ 4.6 ml O2/kg/min) and females (43.5 $\pm$ 3.4 ml O2/kg/min); flexibility test was high among taekwondo boys (33. 8 $\pm$ 8.1 cm), taekwondo males (33.2 + 7.8 cm), and football females (35.1 $\pm$ 4.4 cm); Football males and females dominated the 2-min sit-up test with 88.2 $\pm$ 23.7 repetitions and 78.5 $\pm$ 26 repetitions, respectively. In the vertical jump test, basketball players generated a jump height of 73.5 $\pm$ 5.6 cm in males and 52.1 $\pm$ 3.5 cm in females. Results of the agility and speed tests cannot be compared across all sports because sports-specific testing protocols were used. ***Conclusion.*** Results of this study provide baseline and reference data that can be used to make guided decisions in training athletes so that appropriate identification and training programs be designed to improve individual performances.

Keywords: anthropometry, physical fitness, multi-stage fitness test (non-MeSH), performance evaluation

INTRODUCTION

One big challenge that continually faces coaches is the assessment of the performance level of their athletes both in training and in competition. Sport-scientific monitoring and evaluation of athletic performance is of great significance in order that training programs may answer the different needs of athletes. Being motivated to achieve training and competition goals is not enough. Athletes and their coaches need appropriate feedback to let them understand their progress. Testing of athletes with a focus on the crucial aspects of measurement and evaluation provide objectivity to elements of performance that are usually more kinesthetic or cognitive to coaches.[1] Physiological testing is commonly used to assess the overall fitness level of the athletes and to set guidelines for individualized training.[2] An athlete's anthropometric and physical characteristics may represent important prerequisites for successful participation in any given sport.[3]

Several studies have examined the anthropometric and physiological profile of athletes in general.[3,4] However, there is a dearth in published researches on collegiate athletes which were not even made available as references for the present study, especially in the Philippines. Thus, there is a need to conduct related studies at the secondary and tertiary

(school) levels that may contribute to better training programs leading to championships for local athletes and coaches.

One such collegiate athletic program where sport scientific monitoring and evaluation would be of great value is that of the University of Santo Tomas (UST) Varsity Sports Program. UST has been participating actively in the University Athletic Association of the Philippines (UAAP) since its establishment in 1938[5]. Out of the eight (8) member universities (namely the Adamson University, Ateneo de Manila University, Far Eastern University, De La Salle University, National University, University of the East, University of the Philippines and the University of Santo Tomas), all located in Metro Manila, UST has been the consistent overall champion in the seniors division in the following years: 1958, 1960-1964, 1967, 1970, 1975-1976, 1979, 1982, 1983-1985, 1987-1996, 1998-2006.[5] This overall championship is awarded to the school with the highest point total in the different UAAP events. [5] For the 70th UAAP season (academic year 2007-2008) the conduct of the sporting events (men and women/ senior and junior divisions) were distributed into two (2) semesters: Basketball, Beach Volleyball, Chess, Judo, Swimming, Table Tennis, Taekwondo conducted in first semester; and Athletics, Badminton, Baseball, Football, Lawn Tennis, Softball, and Volleyball during the second semester.

The number of championships won may be overwhelming but factors leading to these facts and figures are unknown. Further, the pattern of victories may seem to be consistent but the sustainability of being the overall champion in the years to come may be uncertain. Thus, sports-specific tests conducted routinely and objectively as part of the mandatory monitoring and evaluation of athletic teams are very important.

Therefore, this study was conducted to determine the anthropometric measurements and performance profile of collegiate and junior athletes of the University of Santo Tomas who actively participated in the 70th UAAP season.

METHODOLOGY

Research Design

This exploratory research utilized the descriptive study design with the objective of establishing anthropometric measurements and performance tests profile of the UST athletes in the 70th UAAP season. The sports events (totaling 10), divisions (junior and senior) and gender (male and female) were the variables considered within each of the following parameters measured and tested: height (cm), weight (kg), arm span (cm), skinfold measurements at 9 sites, low back and hamstring flexibility, local muscular strength and endurance (1st and 2nd min sit-ups), 20-meter progressive shuttle run test (MSFT), vertical jump, medicine ball throw, sports specific agility and sprint tests.

Subjects

All UST varsity athletes for the collegiate and junior divisions who were eligible to participate in the UAAP Season 70 were recruited for this study. Those with conditions that would preclude performance of any of the physiologic tests were excluded from the study.

Among the team divisions (juniors and seniors) in thirteen (13) events invited to participate, only ten (10) teams agreed to take part in the actual tests and measurements conducted. These were: Athletics (Juniors), Badminton (Juniors), Basketball (Seniors and Juniors), Baseball (Seniors), Judo (Seniors), Football (Seniors), Lawn Tennis (Seniors), Swimming (Seniors and Juniors), Taekwondo (Seniors and Juniors) and Volleyball (Girls) teams. A total of two hundred fifty one (251) athletes comprised of 95 males, 84 females from the senior division, and 45 boys and 27 girls from the junior division completed the sports-specific battery of tests.

Testing Procedures

Prior to actual testing, an orientation was done to each team regarding the objectives of the test and the procedures to be conducted, after which, consent forms were distributed and collected. The test protocol was approved by the Research Ethics Committee of the College of Rehabilitation Sciences. Sports-specific measurements were conducted during the scheduled training and each team completed the assessments on 2 sessions following a rest period between test days.

The following anthropometric measurements and performance tests were used in this study:

1. anthropometric measurements - height (cm), arm span (cm) and weight (kg) taken using a Detecto weighing scale with stadiometer and skinfold measurements were taken at 9 sites[6]

using a Lange caliper and BF % calculated using the Lifesize program; [6]

2. Low back and hamstring flexibility was assessed using the sit and reach test.[7]
3. Local muscular strength and endurance were recorded using the maximal number of correct sit-ups done in the 1st and 2nd minute until exhaustion [8]
4. Maximal oxygen uptake (VO_2max) was indirectly estimated using a multi-stage 20-m progressive shuttle run test.[9]
5. Heart rates were monitored using a pulsemeter (Polar) before and after the test run.
6. Motor ability and sports-specific tests such as agility tests (Illinois, t-test, hexagon, 505), sprint tests (10m, 20m, 60m and base sprints) using timing gate lights,[10] vertical jump using a yardstick device[10], and upper body strength test using medicine ball throw and overhead throw were also measured.

Data Analysis

Descriptive statistics were used to provide the fitness profile for each parameter that was measured. The mean ± SD were calculated for each sport.

RESULTS

A total of 251 athletes were assessed in this study. Age range of the junior athletes was 15.0 ± 0.75 years old for boys and 13.42 ± 1.2 years old for girls. The mean age range of senior athletes was 20.05 ± 1.74 years old for males and 19.69 ± 1.9 years old for females.

Descriptive anthropometric profiles, performance profiles, and determined anthropometric and performance profiles are shown in Tables 1-3, respectively.

Table 1. **Descriptive anthropometric profile of athletes (Mean ± SD) by gender and sport**

SPORT	(n)	HEIGHT (cm)	WEIGHT (kg)	ARM SPAN (cm)	BF %
Athletics					
Juniors (Boys)	15	167.4 ± 5.7	58.9 ± 11.1	130.0 ± 72.8	12.5 ± 7.7
Badminton					
Seniors (Males)	8	165.6 ± 7.4	62.2 ± 8.8		14.7 ± 6.7
(Females)	6	154.6 ± 6.3	58.7 ± 6.3		24.5 ± 1.6
Basketball					
Juniors (Boys)	12	176.6 ± 7.5	70.7 ± 16.6	181.0 ± 7.5	18.4 ± 6.3
Seniors (Males)	15	184.0 ± 8.3	81.1 ± 8.0	191.8 ± 9.7	14.0 ± 4.7
(Females)	17	163.0 ± 8.7	57.9 ± 9.0	165.9 ± 9.6	24.2 ± 3.1
Football					
Seniors (Males)	18	167.8 ± 4.9	62.6 ± 6.4		11.6 ± 3.5
(Females)	22	156.2 ± 5.2	53.9 ±7.5		27.1 ± 3.4
Judo					
Seniors (Males)	7	170.0 ± 8.2	55.0 ± 38.6	178.2 ±11.7	23.6 ± 12.0
(Females)	9	155.0 ± 6.0	57.0 ±10.8	157.1 ± 7.5	25.3 ± 4.0
Lawn Tennis					
Seniors (Males)	10	171.3 ± 7.0	65.0 ± 8.0	174.7 ± 7.9	14.42 ± 4.1
(Females)	9	154.5 ± 5.8	49.4 ± 7.0	157.2 ± 6.5	23.3 ± 3.8
Swimming					
Juniors (Boys)	9				17.3 ± 7.1
(Girls)	12				23.4 ± 4.0
Seniors (Males)	8	166.8 ± 5.8	64.7 ± 5.2	174.9 ± 6.5	19.9 ± 6.2
(Females)	11	160.1 ± 2.8	55.2 ± 7.3	164.5 ± 5.6	23.8 ± 3.7
Taekwondo					
Juniors (Boys)	9				15.3 ± 7.0
Seniors (Males)	13				19.2 ± 9.5
(Females)	10				22.7 ± 5.6
Volleyball					
Juniors (Girls)	15	164.0 ± 9.1	54.1 ± 7.2	165 ± 9.7	22.5 ± 3.1

Table 2a. **Performance profile of athletes (Mean ± SD) by gender and sport**

SPORT	Sit & Reach Test (cm)	1st min sit-ups test	2nd min sit-ups test	Upper body strength test	Vertical jump (cm)	20-m shuttle run test (pred. VO_2max)	Agility tests	Speed tests (sec)
Athletics								
Juniors (Boys)	33.6±5.2	40.2±11.4	19.4±11.8		69.0±11.6	48.1±5.3		*(60 m sprint)* 8.1 ± 0.7
Badminton								
Seniors							*(Hexagon test)*	*(10 m sprint)*
(Males)	29.8±11.6	38.6 ± 5.5	26.3±14.0		67.9±6.7	45.9±5.9	15.4 ± 1.1	2.4 ± 0.1
(Females)	28.0±5.3	35.4 ± 8.2	24.8±15.8		47.4±2.1	39.3±1.4	15.7±1.2	2.6 ± 0.1
Baseball				*(med ball throw)*				*(1-base sprint)* 4.2 ± 0.3
Seniors(Males)	29.7±8.7	36.8 ± 5.0	13.6 ± 10.6	11.0 ±1.5	64.6±6.8			*(2-base sprint)* 8.1±0.4
Basketball				*(med ball throw)*			*(t-test)*	*(20 m sprint)*
Juniors (Boys)	30.5 ± 4.3	46.3 ± 8.8					10.8±0.7	3.7 ± 0.5
Seniors(Males)	29.4±10.2	42.0±12.0	29.3±11.4	38.6±12.0	73.5±5.6	47.5±5.0	10.8±0.4	3.7 ± 0.1
(Females)	33.6± 6.6	45.3 ± 9.0	28.4 ± 16.9	34.1± 11.5	52.1 ±3.5	41.8±4.1	11.2±0.5	4.1 ± 0.2
Football							*(Illinois Agility Test)*	*(20 m sprint)*
Seniors(Males)	33.2 ± 5.0	53.2 ± 8.2	35.0±15.5		63.4 ±6.5	54.0±4.6	15.6 ± 0.4	3.7 ± 0.1
(Females)	35.1 ± 4.4	41.7 ± 8.4	36.8 ±17.6		44.2± 5.1	43.5±3.4	17.4 ± 0.5	4.1 ± 0.1
Judo								
Seniors(Males)	32.8 ± 9.7	36.3±13.4	10.1±18.2					*(10 m sprint)* 2.6 ± 0.1
(Females)	30.8 ± 5.9	32.7 ± 7.7				19.3±2.8		2.6 ± 1.0
Swimming								
Juniors (Boys)	22.1 ± 5.4	30.7±11.1	13.6±11.1					
(Girls)	28.1 ± 8.0	36.7 ± 6.5	27.8±14.5					
Seniors(Males)	25.0 ± 6.9	37.6 ± 9.5	27.8±11.7					
(Females)	37.1 ± 4.2	36.7 ± 5.1	28.4 ± 8.7					
Taekwondo					*counter movement jump*		*(Hexagon test)*	*(10 m sprint)*
Juniors (Boys)	33. 8±8.1				.39 ± .13		11.67±3.0	2.4 ± 0.1
Seniors(Males)	33.2 ± 7.8	54.1± 9.1	28.0±17.5		.44 ± .08	45.9±6.8	11.84±1.5	2.4 ± 0.7
(Females)	33.8±10.3	42.0±11.6	34.4 ± 7.6		.28 ± .08	37.5±10.8	10.87±3.3	2.4 ± 0.6
Volleyball				*(med ball throw)*			*(505 Agility test)*	*(10 m sprint)*
Juniors (Girls)	30.9 ± 7.3	42.9± 5.5	29.2 ± 10.9	3.1 ± 0.4	54.9 ± 4.7	42.6 ± 3.4	2.7 ± 0.1	2.7 ± 0.1
Lawn Tennis				*(Overhead throw)*				*(10 m sprint)*
Seniors(Males)	21.7 ± 8.1	39.1 ± 9.2	17.7±17.4	6.9 ± 0.7	63.4 ±9.0	49.8±3.9		2.5 ± 0.1
(Females)	26.7± 7.8	31.3 ± 5.6	19.0 ± 13.6	5.5 ± 0.6	39.9 ±3.5	36.2±5.1		2.8 ± 0.1

Table 2b. **Performance profile of Lawn tennis athletes on Agility tests**

Lawn Tennis	*(Sideways Movement Agility forehand)*	*(Acceleration Sideways-right)*	*(Acceleration Forward-right)*	*(Repeated-Effort Agility test)*
Seniors(Males)	2.9 ± 0.3	2.6 ± 0.1	2.1 ± 0.2	18.1 ± 0.7
(Females)	3.4 ± 0.2	3.0 ± 0.1	2.6 ± 0.2	22.0 ± 0.6

Table 3. **Determined anthropometric and performance profile of the UST athletes in the 70th UAAP season**

	Mean ± SD	SPORT
Height (cm)	184.0 ± 8.3 cm 163.0 ± 8.7 cm 176.6 ± 7.5 cm 164.0 ± 9.1 cm	Basketball (Males) Basketball (Females) Basketball (Boys) Volleyball (Girls)
Weight (kg)	81.1 ± 8.0 kg 58.7 ± 6.3 kg 70.7 ± 16.6 kg 54.1 + 7.2 kg	Basketball (Males) Badminton (Females) Basketball (Boys) Volleyball (Girls)
Arm span (cm)	191.8 + 9.7 cm 165.9 + 9.6 cm 181.0 + 7.5 cm 165 + 9.7 cm	Basketball (Males) Basketball (Females) Basketball (Boys) Volleyball (Girls)
Body fat (%)	11.6 + 3.5 22.7 + 5.6 12.5 + 7.7 22.5 + 3.1	Football (Males) Taekwondo (Females) Athletics (Boys) Volleyball (Girls)
Sit and Reach (cm)	33. 8 + 8.1 cm 37.1 + 4.2 cm 33. 8 + 8.1 cm 30.9 + 7.3 cm	Taekwondo (Males) Swimming (Females) Taekwondo (Boys) Volleyball (Girls)
1st min situps	54.1 + 9.1 reps 45.3 + 9.0 reps 46.3 + 8.8 reps 42.9 + 5.5 reps	Taekwondo (Males) Basketball (Females) Basketball (Boys) Volleyball (Girls)
2nd min situps	35.0 ± 15.5 reps 36.8 ± 17.6 reps 29.3 ± 11.4 reps 29.2 ± 10.9 reps	Football (Males) Football (Females) Basketball (Boys) Volleyball (Girls)
Vertical jump (cm)	73.5 ± 5.6 cm 52.1 ± 3.5 cm 69.0 ±11.6 cm 54.9 ± 4.7 cm	Basketball (Males) Basketball (Females) Athletics (Boys) Volleyball (Girls)
10 meter sprint test	2.4 ± 0.1 secs 2.4 ± 0.6 secs 2.4 + 0.1 secs 2.7 + 0.1 secs	Badminton (Males) Taekwondo (Females) Taekwondo (Boys) Volleyball (Girls)
20 meter sprint test	3.7 + 0.1 secs 4.1 + 0.1 secs 3.7 + 0.5 secs	Football (Males) Basketball (Males) Football (Females) Basketball (Boys)
20-meter shuttle run test	54.0 ± 4.6 ml O2/kg/min 43.5 ± 3.4 ml O2/kg/min 48.1 ± 5.3 ml O2/kg/min 42.6 ± 3.4 ml O2/kg/min	Football (Males) Football (Females) Athletics (Boys) Volleyball (Girls)

DISCUSSION

The purpose of this study was to determine the anthropometric measurements and performance profile of the UST athletes in the 70th UAAP season. A total of two hundred fifty one (251) players from different sporting events were included in this study and underwent a sports-specific battery of fitness and physiologic assessments. Measurements of muscular strength, local muscular endurance, flexibility, aerobic fitness, speed, agility, and anthropometric measurements (height, weight, arm span, and body fat percentage) were obtained. The mean age range of male players was 20.05 $\pm$ 1.74; for female 19.69 $\pm$ 1.9; for boys 15.0 $\pm$ 0.75 and for girls was 13.42 $\pm$ 1.2.

To our knowledge, this study has provided the most comprehensive profiling of collegiate and junior athletes in the Philippines to date. The descriptive anthropometric profile of athletes is shown in Table 1. As expected, the study indicated anthropometric mean differences across all sports. Basketball players appeared to be the tallest and heaviest while football players were relatively the shortest among males. Recent research on elite male basketball players has illustrated the development of the trend toward an increase in height and the variation in height and weight for positional play in basketball.[11,12] In a similar study, anthropometric differences were also found among the young football players in accordance with their different playing positions where goalkeepers are the tallest while the midfielders are the shortest.[13] In terms of body composition, male Football displayed the lowest body fat percentage. Body composition is an important physical component for football. According to the study of Reilly (1996), excess body fat makes the body move constantly against gravity and it is an unnecessary load for footballers.[14] Likewise, low body fat percentage among female taekwondo players was also obtained. A study of Markovic et al (2005) showed that Croatian elite female taekwondo athletes had lower average body fat percentage than female physical education students[15]. Similar results by another study also showed that majority of female athletes from various sports had lower average body fat percentage.[16]

The performance profile of athletes by Gender and Sport is presented in Table 2a. The study showed that female swimmers and male taekwondo players obtained the highest score in the flexibility test. Results for the flexibility test with male taekwondo subjects were similar with those of Thompson and Vinueza,[17] and Heller et al.[18] In this study, the leg splits test was applied along with a sit-and-reach test. Since the majority of techniques performed with Taekwondo are done with legs at full range of motion, it is expected that a more specific test, like the one that measures the range of motion of the hip joints, likewise be a more valid instrument. Moreover, athletes whose sports are characterized by various movements in extreme ranges of motion tend to score high in flexibility.[7,17]

In terms of local muscular strength and endurance, the male taekwondo players and female basketball players obtained the highest mean repetition in the 1st minute sit-up test scores. As indicated in the study of Toskovic et al (2004)[19], the mean performance of male taekwondo practitioners ranked higher in the maximum number of sit-ups in 1 minute. This was attributed to significant training adaptations and specific demands associated with performance. On the other hand, male and female football players attained the highest mean repetition in the 2nd minute sit-up test. This result can be interpreted as the effect of the exercises and conditioning experienced in the pre-season preparation training period.

Results of the agility and speed tests cannot be compared across all sports in this study because different sports-specific testing protocols were used in this particular component.

The mean vertical jump height was recorded highest among male and female basketball players in this study. Basketball has become a more physically demanding sport, with an emphasis being placed on movements being performed at high intensity. McClay et al. (1994) identified a typical list of basketball movements through a notational analysis study, which included running, cutting, turning, jump shot take-off and landing, lay-up takeoff and landing and vertical jump take-off and landing. [20]

With respect to the measurement of endurance using the 20-meter progressive shuttle run test, we can briefly state that it determines the aerobic capacity of the athletes. It also measures how an athlete can tolerate fatigue during training and competition and plays a major role during the recovery process.[23] According to Tamer (1995),

the shuttle run test was utilized to measure maximum oxygen consumption VO 2max and defined in ml/kg/min.[24] In the study of Grant et al. (1995) and Leger et al (1988), the Multistage Fitness Test shuttle run appears to be a valid [25,9,26] and reliable indicator of VO_2max (Leger et al. 1988; Sproule et al. 1993),[26,27] although it may slightly underestimate VO_2max as assessed on a treadmill (Grant et al. 1995; Sproule et al. 1993).[25,27] Findings indicated in this study show that male and female Football players achieved high aerobic power in terms of estimated VO_2 max values since a good aerobic capacity is necessary in this sport to endure long matches. Moreover, athletes in endurance sports tend to have a high level of aerobic power. [16,24,28,29]

In addition, examination of the fitness and physiological profile of university athletes may provide a basis for specific training programs and provide the athlete with information on where training may be directed or to compensate for areas where the athlete may be below average in their specific sport. Also, fitness profiles may be used for comparing athletes of similar sports and skill levels.

CONCLUSION

The importance of anthropometric measurements and performance test data obtained from a study such as this is proven to be of value in providing a good baseline and reference as part of the scientific monitoring and assessment of athletic teams. In addition, examination of the fitness and physiological profile of university athletes may provide a basis for specific training programs and provide the athletes, coaches and support staff with information on where training may be directed or to compensate for areas where the athlete may be below average in their specific sport. It also enabled different anthropometric characteristics and performance profiles across all sports identified, comparing athletes of similar sports and skill levels' so that appropriate identification and training programs be designed to improve individual performances.

Additional research is needed to investigate to what extent the results of this study reflect better selection process in identifying future talents to the teams.

Corresponding Author:
Josephine Joy Reyes
College of Rehabilitation Sciences
CRS Faculty Room, 2nd Floor Medicine Building,
University of Santo Tomas
Espana, Manila
1008 Philippines
Email: jbreyez@mnl.ust.edu.ph
Phone: +63920-9035260
Fax: +632-7409713

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