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Anthropometry Profile and Muscle Strength of Archery Athletes' Arms in DKI Jakarta

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Abstract:
This study aimed to determine the anthropometric profiles and muscle strength of archery athletes at the Center for Student Training (PPLM) at DKI Jakarta. This research was conducted in August 2017; data retrieval was conducted on August 16, 2017, and took place at the Laboratory Somatokinetika Faculty of Sport Science, Universitas Negeri Jakarta, Jl. Pemuda No. 10 Rawamangun, East Jakarta. Data collection used a descriptive method with a survey technique using test and measurement. Samples totalled 32 subjects with total sampling technique. The instruments used in this research were stadiometer, scales, anthropometer, seat anthropometer or seat-height gauge, meter, and push-and-pull dynamometer. Statistical techniques were used to calculate the highest and lowest value of each test item; to determine the range or range of the difference between the highest and lowest values; and to determine the median, mode, and standard deviation of the overall value of each test that in the study. We found a correlation between shoulder width and height, which is supported by literature asserting that a person's height can be roughly calculated from the person's arm span.
Correlation between shoulder width and height could influence muscle strength the playing style of athletes at the Center for Student Training (PPLM)at DKI Jakarta.

Keywords: *Profile, anthropometry, arm muscle strength, archery athletes.*

1.Introduction

Sports achievement is not something that comes by chance or is easily attained. The highest achievements in every sport are closely related to the amount of preparatory effort made by the athletes. The work done by these athletes may be include exercise, but not all athletes doing the same exercises have the same potential to become champions, and which ones succeed can depend on the training processes they undergo.

In DKI Jakarta, one of the sport branches that joined in the Student Training Center (PPLM) program is archery. With the PPLM, archery athletes who hold the status of student can run more technical and physical programmed exercises and participate in regional, national, or international championships. The Multi-Event Championship is attended by student athletes during the National Student Sports Week, which is a national interprovincial sports event for undergraduate and diploma university students in Indonesia. Good student athletes continue to be nurtured in training camps like PPLM and others. In this and other sports, good physical conditioning can be fundamental and must be attained by athletes to achieve maximum performance, including accuracy in target sports such as archery.

In archery, certain anthropometric measures such as height and weight are not considered critical, but that does not mean that no measurements are important. Other factors do relate to success in the sport, including the measure of certain body parts, such as arm spans, sitting height, and shoulder widths—which are especially useful in determining the specification of the tools suitable for each individual athlete—and of certain physical factors that affect optimal performance, such as endurance, strength, and flexibility (Hume & Stewart, 2018). Conditioning within the limits of an individual athlete's own maximum ability can improve performance, as technical factors (e.g., aim, distance) will usually improve only when the athlete has achieved at least the minimum level of physical condition required for the particular sport. To achieve optimal performance, competitive athletes should properly and regularly perform exercises appropriate for the sport in which they compete.

1.1. Profile

Profiles can be interpreted as the personal data of a person, such as identity details (e.g., name, date of birth) or other descriptive details such as address, place of birth, school, career, hobby, or others. The profile is often associated with facts included specifically to clarify, disambiguate, or elucidate some aspect of the subject. Profiles have the function and purpose of providing information and to clarify perceptions of something that exists. In this study, "profile" refers to the state of archery athletes in PPLM DKI Jakarta, viewed in terms of anthropometry and arm muscle strength.

1.2. Anthropometry

Anthropometry, the scientific study of the measurements and proportions of the human body, is useful for recording the structure of a person's body. With respect to sports, anthropometric data can be used to identify which sports best suit particular athlete's physique. Certain body structures and physical abilities are ideal for different types of sports (Hawes & Sovak, 1994; Hume & Stewart, 2018). Anthropometry can help coaches sort beginners into the sports most likely to suit various players' abilities and strengths, as well as help advanced athletes maximize their achievement and condition.

In some sports, anthropometry is a highly regarded tool, since their rules for competition may require classifications among the entrants (e.g., weight classes, age brackets) as being predetermined criteria. But in one branch of sports accuracy, the archery sport, there is no established criteria (Batlle, Carr, & Brown, 2015). Anthropometry is a term used for a branch of science that deals specifically with the application of human body measurements, forms, proportions, composition and maturity (Rahardian, 2008). The word comes from the Greek *anthros*, meaning human, and *metrein,* meaning to measure—thus, it means literally to measure humans (Kerk, 2012). So, it can be said that anthropometry is the study of the measurement of the dimensions of the human body (size, weight, volume, length, etc.).

Static anthropometric measurements are easier to do than dynamic anthropometric measurements. Therefore, static anthropometric measurements have more frequent uses and applications. Some of the static anthropometric measurements used in this study, as follows.

1.2.1. Height

Height is the vertical distance from floor to the top of the head. Under normal circumstances, height increases with age, with full growth typically peaking in the late teens to early twenties for males and slightly earlier for females (Panero & Zelnik, 2014). Human skeletal bone is a building block that gives the body its shape. Bone grows because of the bone growth layer at the *epiphysis*, at the end of a long bone, and the *diaphysis*, or the shaft of the long bone form (Paterson, 1929). The degree of maturity or bone growth is characterized by the unity of epiphysis and diaphysis; the distalis epiphyses typically unite between the ages of 17 and 19 years, whereas the epiphyses lateralis typically unite between the ages of 19 and 20 years (Isidori & Benetton, 2015). The height gauge is the stadiometer or height meter.Displayed in figure 1.

1.2.2. Weight

Weight is the simplest and most easily measured parameter of growth. Technically, body weight is a measure of the force exerted by gravity on the body. Humans are weighed in a state of minimal clothing without any accessories such as keys or cell phones. Body volume, a figure calculated by knowing a person's height and weight, is often used to estimate the level of a person's health or nutrition. Body weight is actually determined by the amount of fluids, fat, protein, and minerals present in the human body (± 60%). Body weight is also affected by age, physical activity, and body temperature. Body weight is most commonly expressed in kilograms (kg). Displayed in figure 2.

1.2.3. Arm Span

Arm span, sometime called "wingspan", is the distance from the tip of the middle finger of one arm to the other when the two arms are extended arms parallel to the ground at shoulder height. Measurements can be made using a calibrated ruler, Campbell calliper, or stadiometer.Displayed in figure 3.

1.2.4. Sitting Height

The seated or sitting height is the vertical distance from a flat seat to the top of the head—that is, a measure of the length of the upper body, which includes the buttocks, spine length, neck, and the head. Sitting height gauges are anthropometer chairs or sliding callipers.Displayed in figure 4.

1.2.5. Shoulder Width

The shoulder lies between the back and neck and is at the back (dorsal) of the body. The shoulder width is the horizontal distance between the upper arms, and can be measured using a calliper. We used the Campbell calliper 20, a tool often used as well for measuring the width or thickness of the torso breadths such as acromial, transverse chest, and others (Setyobroto, 1993).Displayed in figure 5.

1.2.6. Arm Muscle Strength

In many sports, strength is one of the most important elements for achieving the optimum results. In addition, strength is also useful for facilitating learning techniques and preventing injuries in sports. Strength is an important element in

the human body. According to Nurhasan (2005), strength is the ability of a group of muscles to withstand the maximum load, while Bompa and Haff (2009) defined strength as the ability of muscles and nerves to cope with internal and external loads. Both state that strength is an important component in improving a person's overall physical condition and their ability to exert physical pressure.

Almost every technical activity in archery takes strength—especially in the arm muscles. The muscle strength of the arm is to exert maximum force to perform contractions or movement (Sounthornwiboon, Srichaisawat, & Sriprasertpap, 2015). Strength plays a significant role and is the basis of all components of the physical conditions that support the success of archery; with greater strength, an archer will be able to retract and stretch the greater bowto make the darts go faster. By having good arm muscle strength, an athlete can perform activities well without experiencing significant fatigue. The tool we used to measure arm muscle strength was a pull-and-push dynamometer.Displayed in figure 6.

2. Archery Athletes at PPLM DKI Jakarta

Athletes in the sport of archery can be described as those who use bows to send projectiles (darts or arrows) toward targets, with higher points for greater aiming accuracy to archery either in an exercise or an archery game (Damiri, 1990). One of the efforts of the Indonesian government in the effort to develop sports achievement is to set up sports coaching centres such as the Student Training Center (PPLM), which currently exist in various provinces in Indonesia. The Center for Student Sports and Training (PPLM) is a forum for the development of sports achievements in universities based on existing resources such as students, scientists, trainers and various support such as science and technology, laboratories, infrastructure and facilities (KEMENPORA, 2011).

3. Methods

This study, performed in 2017, aimed to find the anthropometry profile and arm muscle strength of archery athletes at the Student Training Center (PPLM) of DKI Jakarta. The anthropometric tests included height, weight, arm span, sitting height, and shoulder width, as well as pull and push tests for arm muscle strength.

The method used in this research was the descriptive method with a survey technique, using test measurements of anthropometric conditions and muscle strengths. The study population was archery athletes at the Student Training Center (PPLM) in DKI Jakarta: 32 people total (24 men and 8 women). The sampling technique in this research was based on a total sampling technique, which is when all the members of a population are included in the sample. We tested all the archery athletes (32) at the Student Training Center (PPLM) in DKI Jakarta in 2017.

3.1. Height

To measure our subjects' height using a stadiometer, we followed these steps: (1) asked the person to remove footwear and headwear; (2) had the person stand up straight, looking straight ahead, with soles on the pedestal; (3) lowered the sliding extension until it rested on top of the skull (not the hair); and (4) recorded the results designated by measuring rods in units of centimetres (cm).

3.2. Weight

To measure our subjects' weight using scales, we followed these steps: (1) asked the person to remove footwear, watches, and outerwear (e.g., jackets, hats), empty pockets of heavy objects (e.g., keys, cell phones); (2) adjusted the scaling needle scales until they were parallel to the zero kilograms (0 kg); (3) asked the person to climb onto the scales and stand in the centre of the platform, looking straight ahead; and (4) recorded the results indicated by the scoring needle in kilograms (kg).

3.3. Arm Span

To measure our subjects' arm span using a calliper, we followed these steps: (1) asked the person to sit up straight on the ground, looking straight ahead, with legs folded; (2) asked the person to extend both arms out to the sides and parallel to the ground; (3) measured the distance from the tip of the middle finger of one hand to the tip of the middle finger of the other hand, keeping the calliper tool parallel to the ground (and the subject's arms); and (4) recorded the dimension in centimetres (cm).

3.4. Sitting Height

To measure our subjects' sitting height using a sliding calliper, we followed these steps: (1) asked the person to sit up straight, looking straight ahead, and both knees forward and bent and hands placed on thighs, which should be parallel to the floor; (2) measured the vertical distance from the pedestal to the top of the head; and (3) recorded the result of the number designated by the meter in centimetres (cm).

3.5. Shoulder Width

To measure our subjects' shoulder width using a calliper, we followed these steps: (1) asked the person to sit up straight; (2) measured between the upper right shoulder and the upper left shoulder; and (3) recorded the dimension measurement in centimetres (cm).

3.6. Arm Muscle Strength

To measure our subjects' arm muscle strength width using a pull-and-push dynamometer, we followed these steps: (1) asked the person to stand upright, legs shoulder-width apart, and look straight ahead; (2) asked the person to grip the dynamometer handles with both hands in front of the chest, with forearms held at shoulder height and parallel to the ground; (3) asked the person to pull the two handles as far apart as possible; (4) recorded the pull strength in kilograms per square metre (kg/m^2); (5) asked the person to push the two handles as close together as possible; and (6) recorded the push strength in kilograms per square metre (kg/m^2).

4. Results

After data collection was done, the results were calculated based on statistical techniques. The raw data was obtained from the prepared and processed samples for which data descriptions were presented to make it easier to read and analyse them.

We processed the data to determine the highest and lowest value and the average, median, mode, range, and standard deviation of each of these variables: height, weight, arm span, sitting height, shoulder width, and arm muscle strength. The complete data appears in Table 1.Displayed in table 1.

Table 1 shows the results, including the lowest values, the highest values, median, median, mode, range, and standard deviation of each of the variables: height, weight, arm span, sitting height, shoulder width, and arm muscle strength of the 10 archery athletes at the Archery Student Training Center PPLM) of DKI Jakarta.

- Height (in cm). The lowest was 145.8. The highest value was 175.8. The average value was 162.7. The median was 162.3. The mode was 163. The range was 30. The standard deviation was 8.8.
- Weight (in kg). The lowest value was 47.5. The highest value was 76. The average value was 61.09. The median was 53.5. The mode was 51.5. The range was 28.5. The standard deviation was 9.2.
- Arm span (in cm). The lowest value was 151. The highest value was 179.5. The average value was 167.7. The median was 167.7. The mode was 168. The range of 28.5. The standard deviation was 9.8.
- Sitting height (in cm). The lowest value was 78.4. The highest value was 92. The average value was 85.2. The median was 84. The mode was 83. The range was 13.6. The standard deviation was 4.5.
- Shoulder width (in cm). The lowest value was 30. The highest value was 39.5. The average value was 34.5. The median was 35. The mode was 35. The range was 9.5. The standard deviation was 2.5.
- Arm muscle strength (in kg/m^2). The lowest value was 16. The highest value is 41. The average was 26.2. The median was 25.5. The mode was 25.5. The range was 25. The standard deviation was 8.4.

5. Discussion

5.1. Measurements

- Height. The tallest of all the archery athletes at PPLM at DKI Jakarta was 175.8 cm, and the shortest was 145.8 cm. The average height was 162.2 cm, with a median of 162.3 cm, a mode of 163 cm, and a range 30 cm.
- Weight. The heaviest of all the archery athletes at PPLM DKI at was 71 kg, and the lightest was 47.5 kg. The average weight was 58.3 kg, with a median of 53.5 kg, a mode of 51.5 kg, and a range 23.5 kg.
- Arm span. The longest arm span for archers at PPLM DKI Jakarta was 179.5 cm, and the shortest was 151 cm. The average span was 166.9 cm, with a median of 167.7 cm, a mode of 168 cm, and a range of 28.5 cm.
- Sitting height. The tallest sitting height of all the archery athletes at PPLM DKI Jakarta was 92 cm, and the shortest was 78.4 cm. The average sitting height was 85.1 cm, with a median of 84 cm, a mode of 83 cm, and a range of 13.6 cm.
- Shoulder width. The widest shoulders of all archery athletes at PPLM DKI Jakarta measured 39.5 cm, and the narrowest measured 30.8 cm. The average shoulder width was 35.1 cm, with a median of 35 cm, a mode of 35 cm, and a range 8.7 cm.
- Arm muscle strength. The greatest arm muscle strength of all the archery athletes at PPLM at DKI Jakarta was 41 cm, and the least was 16 cm. The average arm muscle strength was 25.5 cm, with a median of 25.5 cm, a mode of 25.5 cm, and a range of 8.4 cm.

5.2. Significance

We found a correlation between shoulder width and height, which is supported by literature asserting that a person's height can be roughly calculated from the person's arm span **(**Capderou & Zelter, 2011).

6. Conclusion

When comparing 32 archery athletes at the Center for Student Training (PPLM) at DKI Jakarta. We found a correlation between shoulder width and height. These correlation could influence muscle strength the playing style of athletes at the Center for Student Training (PPLM) at DKI Jakarta.

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Appendix

Variables	Value					
	Height (cm)	Weight (kg)	Arm Span (cm)	Sitting Height (cm)	Shoulder Width (cm)	Arm Muscle Strength (kg/m2)
Lowest Value	14.58	47.5	151	78.4	30	16
Highest score	175.8	76	179.5	92	39.5	41
Average	162.7	61.09	167.7	85.2	34.5	26.2
Median	162.3	53.5	167.7	84	35	25.5
Modus	163	51.5	168	83	35	25.5
Range	30	28.5	28.5	13.6	9.5	25
Standard deviation	8.8	9.2	9.8	4.5	2.5	8.4

Figure 1: Stadiometer Device Used To Measure Human Height.

Figure 2: Scales Used To Weigh Humans.

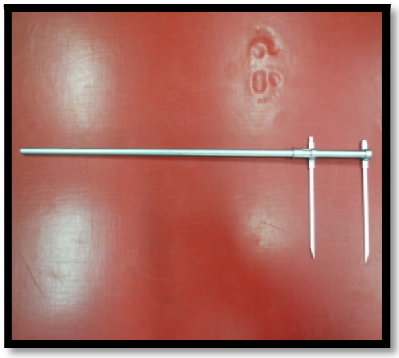

Figure 3: Measuring arm span using a Campbell calliper.

Figure 4: Measuring sitting height.

Figure 5: Measuring shoulder width with a calliper.

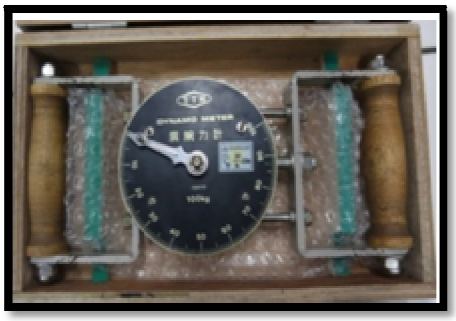

Figure 6: Pull-And-Push Dynamometer for Measuring Arm Muscle Strength.