Are certain body proportions better for certain track and field events including the sprints and long distance?

"You have a runner's body". What exactly does this mean? Do runners have certain physical characteristics that are seen throughout various runners? I want to see whether there really is a so-called runner's body, yet I am faced with a challenge. What exactly defines a runner? Someone that occasionally runs around the neighborhood? Or someone that runs repeats or trains for a marathon on a daily basis? I decided to narrow it down to my teammates on the ıck and field team. I have split the top three distance runners (5k) and the top three short distance runners (100 meters and 200 meters) into two groups.

Limited data

The 100 and 200-meter sprints are brief and explosive events while the 5,000 meters is a prolonged and endurance event. It only makes sense that either the sprinter or the distance runner would benefit from a specific body type in order to succeed in the race. One can simply watch the Olympics to determine that most of the sprinters or distance runners share some physical characteristics. It is not very difficult to distinguish between the two of them since sprinters usually appear muscular and built while the distance runners seem very lean and thin.

Rationale for the investigation

There are various reasons that these two runners have different body types. Starting with the sprinter, one can see that they are muscular all around. Since the sprinter will be running for a short amount of time at a very high speed, larger muscles help the sprinter produce force.[1] Sprinters are known to have powerful arms, quads, calves, backs, and chests in order to come out of the blocks with as much explosive force as possible.[2] A sprinter also has strong core muscles since it allows him or her to maintain stability and control trunk rotation while moving straight towards the finish line.[3] It is important to prevent inefficient side-to-side movement and therefore core muscle strength is essential.[4] In order for the legs to keep moving quickly towards the finish line, a strong upper body is necessary since the legs only move as fast as the arms pump.[5] Powerful arms can help the sprinters maintain their proper stride and rhythm as fatigue sets in.[6] As a result of these large muscles throughout the whole body, which allow the sprinter to run with more power, they carry more muscle than long distance runners.[7] Compared to other athletes, sprinters tend to be of average weight and height.[8] Although long legs provide the sprinter with a longer stride, they can also make it harder to accelerate and therefore there is no specific leg length required for a sprinter.[9] Consequently, arm length is not a very significant

A+ Introduction and background information

[1] Kay Tang and Demand Media, "The Physical Difference Between Long Distance Runners & Sprinters" *Live Healthy*, accessed February 20th, 2014, http://livehealthy.chron.com/physical-difference-between-long-distance-runners-sprinters-4549.html

[2] Ibid.

[3] David Csonka, "Sprinter & Marathon Runners' Bodies", *Naturally Engineered*, August 13, 2012, http://www.naturallyengineered.com/sprinter-and-marathon-runners-bodies-comparing-trends-in-olympic-athletes over-time-infographic/

[4] Ibid.

[5] Jeff Gordon, "Do Sprinters Work Out Their Upper Bodies?", *LIVESTRONG.COM*, accessed February 20th, 2014, http://www.livestrong.com/article/546032-do-sprinters-work-out-their-upper-bodies/

[6] Ibid.

[7] Scott Amato, ""The Physical Difference Between Long Distance Runners & Sprinters", *LIVESTRONG.com*, updated September 27, 2013, http://www.livestrong.com/article/550102-the-physical-difference-between-long-distance-runners-sprinters/

[8] David Csonka, "Sprinter & Marathon Runners' Bodies", *Naturally Engineered*, August 13, 2012, http://www.naturallyengineered.com/sprinter-and-marathon-runners-bodies-comparing-trends-in-olympic-athletes over-time-infographic/

[9] Ibid.

In bibliography

factor.[10] The importance lies in how muscular the arms and legs are and whether the runner is able to use them as a tool for acceleration. Therefore, it is essential that sprinters have fast twitching fibers, which are fibers in muscles that react instantly and are very fast; however, they quickly run out of power.[11] Through training, these fibers naturally become big and heavy.[12] In addition to the difference in training, genes also play a role due to the fact that elite sprinters are born with more fast twitching fibers than slow twitching ones.[13]

In comparison to sprinters, long distance runners tend to have more slow-twitch fibers, which are not as reactive and speedy as the fast-twitch fibers; however, they can work non-stop for a long time.[14] In addition, they allow the muscles to stay slim and light, which is important since distance runners need to carry as little weight as possible.[15] They need to carry their muscles and fat for longer periods of time and therefore it is essential to have less body and muscle weight; therefore, distance runners tend to be more lean and slender.[16] They develop long and lean muscles, especially in the lower body.[17] It is therefore beneficial to be smaller and lighter as a long distance runner since one carries less muscle to weight one down.

In order to determine whether these characteristics seen in elite sprinters and long distance runners are present in high school runners, I recorded the body proportions of my teammates. Table 1 shows the top three sprinters, including myself, and the top three distance runners on my team and their body proportions.

Personal engagement

Table 1

	Height (cm)	Weight (kg)	Calves circ. (cm)	Quads circ. (cm)	Arm length (cm)	Biceps circ. (cm)	Leg length (cm)	Chest circ. (cm)
Sprinters								
1	168.9	58.01	36.1	57.6	69.4	26.8	107.2	75.8
2	170.8	59.56	39.4	59.3	73.9	29.0	105.2	77.3
3	180.3	58.97	34.2	58.0	78.3	26.4	111.3	70.2

Good use of table to organize data.

[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Ibid.
[14] Ibid.
[15] Ibid.
[16] Ibid.
[17] Scott Amato, ""The Physical Difference Between Long Distance Runners & Sprinters", *LIVESTRONG.com*, updated September 27, 2013, http://www.livestrong.com/article/550102-the-physical-difference-between-long-distance-runners-sprinters/

Distance Runners								
1	162.7	45.95	31.2	47.4	67.9	21.6	105.3	66.8
2	158.8	55.84	33.8	51.2	68.0	25.3	105.7	72.0
3	162.6	44.86	30.2	44.9	68.5	23.5	106.0	67.7

Discussed limitations of data.

Before starting to analyze the data, it is necessary to take into account the biases that come with the measurements. Sprinters 1 and 2 are seniors while Sprinter 1 is a freshman Distance runners 1 and 3 are sophomores and Distance Runner 2 is a junior. In addition, Sprinters 2 and 3 are from African American descent and according to research studies, African Americans have distinct body patterns that allow them to naturally run faster.[18] Sprinters 2 and 3 are also basketball players. In addition, distance runner 2 was a gymnast, who tends to be shorter and more muscular than distance runners.[19]

To start, we can find the mean measurements for each of the categories in order to compare the sprinters to the distance runners. Below is the math behind the average height, followed by Table 2 with the rest of the averages.

Average Height:

Sprinters

$$\frac{168.9 \text{ cm} + 170.8 \text{ cm} + 180.3 \text{ cm}}{3} = 173.3 \text{ cm}$$

Distance Runners

$$\frac{162.7 \text{ cm} + 158.8 \text{ cm} + 162.6 \text{ cm}}{3} = 161.4 \text{ cm}$$

Table 2

Average	Sprinters	Distance Runners
Height (cm)	173.3	161.4
Weight (kg)	58.84	48.88
Calves circ. (cm)	36.6	31.7
Quads circ. (cm)	58.3	47.9
Arm length (cm)	73.9	68.1
Biceps circ. (cm)	27.4	23.5

Good use of tables to show data.

[18] Karen Rowan, "Scientists Theorize Why Black Athletes Run Faster", *livescience*, July 13, 2012, February 22, 2013, http://www.livescience.com/10716-scientists-theorize-black-athletes-run-fastest.html

[19] Matthew Potak, "How to Build a Gymnast Body", *LIVESTRONG.COM*, September 21, 2013, http://www.livestrong.com/article/192324-how-to-build-a-gymnast-body/

Leg length (cm)	108.0	105.6
Chest circ. (cm)	74.3	68.2

D+

In average, the sprinters were about 11 cm taller than the long distance runners. This corresponds to the fact that it is beneficial for long distance runners to be shorter in order to carry less fat and muscle to pull them down. This is supported by the fact that sprinters weight about 10 kg more than the long distance runners. This weight relates back to the heavier muscles in the sprinters. The sprinter's calves were 4.9 cm bigger, the quads about 10.4 cm, the biceps 3.9 cm, and the chest 6.1 cm. The sprinter's arms were about 5.8 cm bigger and the legs about 2.4 cm.

However, all of the sprinters were taller than the long distance runners and therefore it has to be taken into account that they naturally weight more due to their height. Therefore, one has to examine the ratio between weight and height in order to see if sprinters truly do weight more.

Sprinter 1:

Weight: $\frac{58.01 \text{ kg}}{} = 0.34$
Height 168.9 cm

Sprinter 2:

$\frac{59.56 \text{ kg}}{} = 0.35$
170.8 cm

Sprinter 3: ← B - Representation of fractions.

$\frac{58.97 \text{ kg}}{} = 0.33$
180.3 cm

Distance R. 1:

Weight: $\frac{45.95 \text{ kg}}{} = 0.28$
Height 162.7 cm

Distance R. 2:

$\frac{55.84 \text{ kg}}{} = 0.35$
158.8 cm

Distance R. 3:

$\frac{44.86 \text{ kg}}{} = 0.28$
162.6 cm

Average Sprinters:

Weight: $\frac{58.84 \text{ kg}}{} = 0.34$
Height 173.3 cm

Average Distance Runners:

$\frac{48.88 \text{ kg}}{} = 0.30$
161.4 cm

If a sprinter and a distance runner would have the same height, the sprinter would be heavier than the distance runner. This is supported by the weight to height ratio. For example, if a distance runner were 173.3 cm tall, he would weigh 51.99 kg (173.3 x 0.30), 6.85 kg less than the sprinter. If a sprinter would be 161.4 cm tall, he would weigh 54.88 (161.4 x 0.34). This proves how sprinters carry more weight than long distance runners due to more muscle weight. However, Distance Runner 2 has an extremely high ratio. The reason for this distance runner to have such a high ratio is because she was previously involved in gymnastics where powerful muscles are necessary for the sport.

D+ Good analysis.

Therefore, this runner might potentially skew the data results of the long distance runners, since she has some body proportions of a gymnast, which is related to those of a sprinter. By taking her measurements out of the ratio (see below), we can see that the ratio is even more different between the two types of runners.

Average Sprinters	**Average Long Distance Runners 1 and 3**
Weight: 58.84 kg = 0.34	(45.95 kg + 44.86 kg) / 2 = 0.28
Height 173.3 cm	(162.7 cm + 162.6 cm) / 2

In order to prove my analysis, I compared the above ratio to elite runners.

Sprinter: Usain Bolt	**Marathoner: Stephen Kiprotich**
Weight: 94 kg = 0.48	Weight: 56 kg= 0.44
Height 195 cm	Height 127 cm

These two elite runners show similar ratios to the ones in my research. If Usain Bolt was 127 cm tall, he would weight 60 kg (127 x 0.44), and if Stephen Kiprotich was 195 cm tall, he would weigh 85.8 kg. Moreover, this shows how sprinters carry more weight than long distance runners.

According to my results, the sprinters also have longer legs than the distance runners. However, it is necessary to take into consideration that the sprinters are taller than the distance runners. Therefore, it is necessary to examine the ratio between leg length and height.

Average Sprinter:	**Average Distance Runner:**
Leg Length: 108.0 cm = 0.62	105.6 cm = 0.65
Height 173.3 cm	161.4 cm

These ratios show how distance runners tend to have slightly longer legs than sprinters, which is supported by the research studies mentioned earlier, stating that marathoners tend to have long and lean muscles especially in the lower body. However, it is important to remember that leg muscle is a more prominent distinction between the two runners rather than leg length. There is a clear distinction between calves and quad size between the two types of runners, which is important to notice since sprinters need this leg muscle in order to propel themselves forward with as much strength as possible.

More analyses

Similarly to leg length, it is important to find the ratio between height and arm length.

Average Sprinter:	**Average Distance Runner:**
Arm Length: 73.9 cm = 0.43	68.1 cm = 0.42
Height 173.3 cm	161.4 cm

There seems to be no great difference between arm lengths in sprinters and distance runners. This proves how arm length is not a key component in the difference between the two runners.

Now, lets determine whether sprinters really do have bigger quads and calves than long distance runners by creating a quad circumference to leg length and calves circumference to leg length ratio. However, just by looking at the data we can see that Long Distance runner 2 is an outlier again. This distance runner has much stronger muscles than the other two distance

runners due to the fact that she used to be a gymnast and needed more powerful muscles to perform all her stunts. Therefore, I am going to determine the following ratios with and without Distance Runner 2.

Average Sprinters

Calves Circ.: $\frac{36.6 \text{ cm}}{108.0 \text{ cm}} = 0.34$

Average Distance Runners

$\frac{31.7 \text{ cm}}{105.6 \text{ cm}} = 0.30$

Average Sprinters

Calves Circ.: $\frac{36.6 \text{ cm}}{108.0 \text{ cm}} = 0.34$

Average Distance Runners 1 and 3

$\frac{(31.2 \text{ cm} + 30.3 \text{ cm}) / 2}{(105.3 \text{ cm} + 106.0 \text{ cm}) / 2} = 0.29$

If the sprinters and distance runners had the same leg length, the sprinters would have bigger calf muscle due to the fact that they run on their toes and need this muscle to create as much force as possible. Taking out Distance Runner 2, due to the fact that gymnasts have larger calves, the difference in ratios is even more prominent.

Average Sprinters

Quad Circ.: $\frac{58.3 \text{ cm}}{108.0 \text{ cm}} = .54$

Average Distance Runners

$\frac{47.9 \text{ cm}}{105.6 \text{ cm}} = 0.45$

Average Sprinters

Quad Circ.: $\frac{58.3 \text{ cm}}{108.0 \text{ cm}} = .54$

Average Distance Runners 1 and 3

$\frac{(47.4 \text{ cm} + 44.9 \text{ cm}) / 2}{(105.3 \text{ cm} + 106.0 \text{ cm}) / 2} = .44$

Similarly to the calves, sprinters have larger quads than distance runners. Next, one can examine the ratio between arm length and bicep circumference to see if sprinters really do have more muscle on their arms.

Average Sprinters

Bicep Circ.: $\frac{27.4 \text{ cm}}{73.9 \text{ cm}} = .37$

Average Distance Runners

$\frac{23.5 \text{ cm}}{68.1 \text{ cm}} = .35$

Average Sprinters

Bicep Circ.: $\frac{27.4 \text{ cm}}{73.9 \text{ cm}} = .37$

Average Distance Runners 1 and 3

$\frac{(21.6 \text{ cm} + 23.5 \text{ cm}) / 2}{(67.9 \text{ cm} + 68.5 \text{ cm}) / 2} = .33$

Student does a good job in comparing different parts of the body

In the ratios above, distance runner 2 makes a big difference. Due to the fact that gymnasts need to constantly pull themselves up, they develop very strong arms. Therefore, when not taking distance runner 2 into consideration, sprinters have much larger biceps than long distance runners.

Knowing that there are some key differences in body proportions between the top three sprinters and long distance runners on my team, I decided to talk to my coaches about my findings. I suggested measuring the body proportions of three of the new additions to the team. I chose three girls that have never run or participated in a sport before due to the fact that this would create bias. Table 3 shows the measurements of the three girls.

C+ Good - more data.

Table 3

	Height	Weight (kg)	Calves circ.	Quads circ.	Arm length	Biceps circ.	Leg length	Chest circ.
1	166.3	50.26	31.5	48.5	69.8	24.2	106.7	70.1
2	163.5	54.43	33.2	55.3	67.7	24.0	105.1	73.4
3	158.0	51.71	30.3	45.5	71.0	25.4	105.1	68.7

In order to determine which body types these girls have and, therefore, which event they would most likely be able to succeed in, it is necessary to compare their body proportions to the top three sprinters and marathoners. However, there are many events in track and field such as mid-distance and field events and therefore a new runner could potentially be neither a sprinter nor a distance runner. Now, in order to compare the body proportions, one can first compare the ratios between the new runners and the established ratios for the sprinters and long distance runners.

New Runner 1

Let's take the New Runner 1 and determine the key ratios to determine whether this runner is a sprinter or long distance runner.

Weight: $\frac{50.26 \text{ kg}}{\text{Height } 166.3 \text{ cm}} = .30$

Calves: $\frac{31.5 \text{ cm}}{\text{Leg Length } 106.7 \text{ cm}} = .30$

Quads: $\frac{48.5 \text{ cm}}{\text{Leg Length } 106.7 \text{ cm}} = .45$

Biceps Circ.: $\frac{24.2 \text{ cm}}{\text{Arm length } 69.8 \text{ cm}} = .35$

According to earlier results, this runner fits the average weight to height ratio of a long distance runner. She has the same calves circ. to leg length and quads circ. to leg length ratio as the average long distance runner as well. Lastly, the bicep to arm length ratio is also the same as the long distance runners'. In conclusion, New Runner 1 has the body proportions of a long distance runner, since weight to height, calves circ. to leg length, quad circ. to leg length, and bicep circ. to arm length ratios are the same. However, it important to take into consideration that this runner has never participated in a sport before and could potentially develop stronger muscles needed by sprinters.

Student analyses the findings.

New Runner 2

Weight: 54.43 kg = .33
Height 163.5 cm

Calves: 33.8 cm = .32
Leg Length 105.1 cm

Quads: 55.3 cm = .53
Leg Length 105.1 cm

Bicep Circ.: 24.0 cm = .35
Arm length 67.7 cm

This runner's weight to height ratio and quad circ. to leg length ratio are very close to the average sprinters' ratios. The calves circumference to leg length ratio is in between the average sprinter's and long distance runner's ratio; however, when taking Distance Runner 2 out of the distance runner's average, due to larger muscles, the new runner's ratio is closer to the average sprinter's ratio. Lastly, this new runner has the arms of a long distance runner. However, taking Distance Runner 2 out of the equation once again, this new runner's arms are a bit larger than the average distance runner's arms. In conclusion, this runner has potential to become a sprinter since the weight to height and quad circ. to leg length ratios are similar to those of a sprinter. Even though this runner has the arms of a long distance runner, with exercise these arms will only become larger.

New Runner 3

Weight: 51.71 kg = .33
Height 158.0 cm

Calves circ.: 30.3 cm = .29
Leg length 105.1 cm

Quads: 45.5 cm = .43
Leg Length 105.1 cm

Bicep Circ: $\frac{25.4 \text{ cm}}{} = .36$
Arm length 71.0 cm

This runner's leg muscles are clearly those of a long distance runner. This runner seems to have very small leg muscles; however, the weight to height ratio seems to be similar to the average sprinter's ratio. Lastly, the bicep circ. to arm length ratio is in between the sprinter's and long distance runner's ratio. To conclude, this runner could either develop stronger leg muscles and become a sprinter or get in shape and become a long distance runner. In my opinion, this runner would be a more successful long distance runner since the leg muscles are not very strong and with some long distance training this runner could bring the weight to height ratio closer to that of a long distance runner.

Standard Deviation

Besides comparing the ratios, standard deviation can be used to further classify the three new runners as either sprinters or long distance runners. (Below is the formula for standard deviation)[20]

$$\sqrt{\frac{\Sigma(X - \bar{X})^2}{(n - 1)}}$$

B - Why n-1?

where:

X = each score
$\bar{X}$ = the mean or average
n = the number of values
Σ means we sum across the values

Below is an example of how one would find the standard deviation of the height for both sprinters and long distance runners, followed by a table including all standard deviations for the body proportions.

Height

Sprinters

$$\sqrt{\frac{((168.9 - 173.3) + (170.8 - 173.3) + (180.3 - 173.3))^2}{3}} = 4.99$$

[20] "Descriptive Statistics", *Research Methods Knowledge Base*, accessed February 24th, 2014, http://www.socialresearchmethods.net/kb/statdesc.php

Distance

$$\sqrt{\frac{((162.7 - 161.4) + (158.8 - 161.4) + (162.6 - 161.4))^2}{3}} = 1.81$$

Table 4

Standard Deviation	Sprinters	Distance Runners
Height (cm)	4.99	1.81
Weight (kg)	.64	4.94
Calves circ. (cm)	2.15	1.52
Quads circ. (cm)	.73	2.60
Biceps circ. (cm)	1.14	1.51
Leg length (cm)	2.54	.29
Chest circ. (cm)	3.06	2.27

New Runner 1

In order to determine in ~~which~~ standard deviation this runner's height is, one can do the following:

Average Sprinter's height:
173.3 cm – 4.97 = 168.33 cm – 4.97 = 163.36 cm
Average Distance R. height:
161.4 cm + 1.81 = 163.21 cm + 1.81 = 165.02 cm + 1.81 = 166.83 cm

It can be interpreted that this runner's height is in the second standard deviation for average sprinter's height and in the third standard deviation for the average distance runner's height. However, earlier it was determined that this runner is most likely a long distance runner and therefore this runner is tall compared to the other long distance runners.

The standard deviations for the rest of the body proportions are as followed:

Average Sprinter's weight:
58.84 kg – (.64 x 14) = 49.88 kg
Average Distance R. weight:
48.88 kg + 4.94 = 53.82 kg

B - Difficult to follow reasoning - how does this help to reach the conclusion?

Average Sprinter's leg calves circ.:
36.6 cm – 2.14 = 34.46 cm – 2.14 = 32.32 cm – 2.14 = 30.18 cm

Average Distance R. leg calves circ.:
31.7 cm – 1.52 = 30.18 cm

Average Sprinter's quad circ.:
58.0 cm – (.73 x 14) = 47.78 cm
Average Distance R. quad circ:
47.9 cm + 2.60 = 50.2 cm

Average Sprinter's bicep circ.:
27.4 cm – (1.14 x 3) = 23.89 cm
Average Distance R. bicep circ:
23.5 cm + 1.51 = 25.01 cm

Average Sprinter's chest circ.:
74.3 cm – 3.06 = 71.24 cm
Average Distance R. chest circ:
68.2 cm + 2.36 = 70.56 cm

D - The student attempts to use another mathematical process of comparing the data but the results are not clear.

The calculations show that the new runner is in the first standard deviation of the long distance runners for the calves, quad, bicep, and chest circumference, and weight. Both the ratios and the standard deviations show how this runner will most likely become a long distance runner. It looks like our team has a new distance runner.

Why?

New Runner 2

Average Sprinter's heights:
173.3 cm – 4.97 = 168.33 cm – 4.97 = 163.36 cm
Average Distance heights:
161.4 cm + 1.81 = 163.21 cm + 1.81 = 165.02 cm

Average Sprinter's weight:
58.84 kg – (.64 x 7) = 54.37 kg
Average Distance R. weight:
48.88 kg + 4.94 = 53.82 + 4.94 = 58.76 kg

Average Sprinter's leg calves circ.:
36.6 cm – 2.14 = 34.46 cm – 2.14 = 32.32 cm
Average Distance R. leg calves circ.:
31.7 cm + 1.52 = 33.22 cm + 1.52 = 34.74 cm

Average Sprinter's quad circ.:
58.0 cm – (.73 x 4) = 55.08 cm
Average Distance R. quad circ:
47.9 cm + (2.60 x 3) = 55.7 cm

Average Sprinter's bicep circ.:
27.4 cm – (1.14 x 3) = 23.98 cm
Average Distance R. bicep circ:
23.5 cm + 1.51 = 25.01 cm

Average Sprinter's chest circ.:
74.3 cm – 3.06 = 71.24 cm
Average Distance R. chest circ:
68.2 cm + (2.36 x 3) = 75.28 cm

It was established that this runner would most likely become a sprinter; however, this runner has some body proportions of a long distance runner. As seen with the standard deviations, this runner would be a very light sprinter since she is in the second standard deviation for the long distance runners and in the seventh for the sprinters. In addition, this runner has smaller quads since they are in the third standard deviation for the distance runners and in the fourth for the sprinters. The biceps are also smaller since they are in the first standard deviation for the long distance runners and in the third for the sprinter. However, the chest is in the first standard deviation of the sprinters'.

In conclusion, due to the fact that the ratios of the new runner are more similar to the sprinter ratios, this runner has potential to develop stronger muscles and become closer to the sprinter's standard deviations. Therefore, through sprinting workouts, this runner has the capacity to grow more muscle and have more characteristics of a sprinter. It looks like we have a potential sprinter on the team!

New Runner 3

Average Sprinter's heights:
173.3 cm – (4.97 x 4) = 154.14 cm
Average Distance heights:
161.4 cm - 1.81 = 159.59 cm – 1.81 = 157.78 cm

Average Sprinter's weight:
58.84 kg – (.64 x 12) = 51.16 kg
Average Distance R. weight:
48.88 kg + 4.94 = 53.82 kg

Average Sprinter's leg calves circ.:
36.6 cm – (2.14 x 3) = 30.18 cm
Average Distance R. leg calves circ.:
31.7 cm - 1.52 = 30.18 cm

Average Sprinter's quad circ.:
58.0 cm – (.73 x 19) = 44.13 cm

Average Distance R. quad circ:
47.9 cm - 2.60 = 45.3 cm

Average Sprinter's bicep circ.:
27.4 cm – 1.14 = 26.26 cm – 1.14 = 25.12 cm
Average Distance R. bicep circ:
23.5 cm + 1.51 = 25.01 cm + 1.51 = 26.52 cm

Average Sprinter's chest circ.:
74.3 cm – (3.06 x 2) = 68.18 cm
Average Distance R. chest circ:
68.2 cm + 2.36 = 70.56 cm

It was established that this runner could either develop stronger leg muscles and become a sprinter or get in shape and become a long distance runner. The standard deviations suggest that this runner has the body proportions of a long distance runner. The weight, calves circ., quad circ., and chest circ. are all in the first standard deviation and the height and biceps are in the second standard deviation for the long distance runners. This reinforces my opinion that this runner would be a more successful long distance runner since the leg muscles are not very strong and with some long distance training this runner could bring the weight to height ratio closer to the long distance runner ratio.

Good point.

Conclusion

Based on the top three sprinters and top three long distance runners on my team, I was able to find similar body proportions for each type of running. I discovered that sprinters tend to carry more weight due to their bigger muscles seen all over the body including arms, legs, and chest. By finding out these ratios, I was able to place three new runners as either sprinters or long distance runners. However, I only had three runners to compare in this research, which limits the reliability of the results. A larger sample size would be more beneficial to have more reliable comparisons. If this research were conducted again, it would be advantageous to compare freshman sprinters to freshman distance runners, sophomore sprinters to sophomore distance runners, etc., since age can also affect body proportions.

This research can be compared to runners all around in world in order to determine similarities or differences in body proportions. Maybe some countries have sprinters and distance runner whose body proportions differ from the runners on my track and field team. In addition, it would be interesting to compare the body proportions between Olympic sprinters and between Olympic marathoners in order to determine which body proportions lead to the best performance. However, it is important to remember that there are a lot of aspects to running performance besides body proportions. Heritage, diet, mental strength, and motivation are all some of the aspects which can play a role in someone's running career. Lastly, this research can be extended to other sports such as gymnastics or swimming in order to determine which body proportions are better for certain events.

Student reflects on exploration.

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