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Letter to the Editor

A Quick and Reliable Mental Formula to Calculate the BSA of a Patient

A patient's body surface area (BSA) is used throughout healthcare settings, but it usually requires a calculator due to involvement of the calculations (1). The BSA is used for an array of purposes such as determining metabolic demand, medication dosages, sizes of mechanical replacement devices (e.g., cardiac valves), and blood perfusion flows for adequate blood flow during cardiac surgery (1).

Much of the purposes for BSA are for quick medical treatments. For example, when a patient suffers cardiac arrest and needs emergent cardiopulmonary bypass (CPB) support to address the underlying causes of the cardiac arrest, the perfusionist must know the patient's BSA so they can provide enough blood flow, delivering adequate oxygen supply to the patient. Much critical time before initiating CPB is used getting the heart–lung machine ready to initiate CPB. The perfusionist also needs to make sure they are ready with proper medications and disposable devices for CPB.

Because of these requirements, the perfusionist does not usually have much downtime to take out a calculator to determine the BSA and find out what an adequate blood flow is required during CPB. After calculating BSA, the perfusionist can use a cardiac index (C.I.) between 1.8 and 2.4 L/min/m^2 to multiply by the BSA to determine the required blood flow during CPB (2). Since this situation refers to emergent cardiac surgery, the perfusionist can simply use a C.I. of 2 L/min/m^2 multiplied by the BSA to quickly reference what the average required CPB blood flow should be. Because this calculation is required, having quick access to an accurate BSA is a useful information when valuable time is not devoted to computing the BSA on a calculator.

MATERIALS AND METHODS

Some popular formulas to calculate BSA are Mosteller, DuBois and DuBois, Haycock, Gehan and George, and Boyd (1). For this paper, all heights will be in centimeters, and all weights will be in kilograms. The following are various formulas for BSA (3–5):

$$\text{Mosteller (3): BSA} = \text{square root of } [(\text{height} \times \text{weight})/3600]$$

$$\text{DuBois and DuBois (4): BSA} = 0.007184 \times \text{height}^{0.725} \times \text{weight}^{0.425}$$

$$\text{Haycock (5): BSA} = 0.024265 \times \text{weight}^{0.5378} \times \text{height}^{0.3964}$$

$$\text{Gehan and George (5): BSA} = 0.0235 \times \text{weight}^{0.51456} \times \text{height}^{0.42246}$$

$$\text{Boyd (5): BSA} = 0.03330 \times \text{weight}^{(0.6157-0.0188\ \times\ \log10(\text{weight})} \times \text{height}^{0.3}$$

These formulas are very involved and are almost impossible to calculate mentally, and they are time-consuming to calculate. Valuable time takes away from adequately taking care of a patient, whether it be with CPB or other healthcare treatments that use BSA. With an effort to make better use of critical healthcare time, the Pelletier formula for BSA can be used.

$$\text{Pelletier formula: BSA} = (\text{height} + \text{weight} – 60)/100$$

Another way to show the Pelletier formula is

$$\text{Pelletier formula: BSA} = (\text{height} + \text{weight} – 60)$$

and then move the decimal point two places to the left.

RESULTS

To show accuracy and comparison of the Pelletier formula, Table 1 is shown. This table used values for short, average, and tall individuals, and it used values for underweight, average, overweight, and obese individuals for each height category. The average height of individuals used was 175.3 cm (6). The height for short individuals used was 147.3 cm and the height for tall individuals used was 193.0 cm (6). The weights for underweight, average, overweight, and obese are different for each height category, and are noted in Table 1 (7).

The data were used for each formula, and Table 1 shows the BSA for each category when using the Mosteller,

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Table 1. A reference of various BSA formula results compared to the Pelletier Formula and the averages of the other BSA formulas

	cm kg	BSA (m^2) Mosteller Formula	DuBois and DuBois Formula	Haycock Formula	Gehan and George Formula	Boyd Formula	Pelletier Formula	Average BSA (Excluding Pelletier)
Short Underweight	147.3 39.1	1.26	1.27	1.26	1.28	1.27	1.26	1.27
Short Average Weight	147.3 46.8	1.38	1.37	1.39	1.40	1.41	1.34	1.39
Short Overweight	147.3 58.4	1.55	1.51	1.56	1.57	1.59	1.46	1.56
Short Obese	147.3 74.8	1.75	1.68	1.79	1.78	1.82	1.62	1.76
Average Height Underweight	175.3 55.9	1.65	1.68	1.64	1.65	1.64	1.71	1.65
Average Height Average Weight	175.3 68.9	1.83	1.84	1.83	1.84	1.84	1.84	1.84
Average Height Overweight	175.3 83.0	2.01	1.99	2.03	2.03	2.03	1.98	2.02
Average Height Obese	175.3 105.9	2.27	2.21	2.31	2.30	2.32	2.21	2.28
Tall Underweight	193.0 68.6	1.92	1.97	1.90	1.91	1.88	2.02	1.92
Tall Average Weight	193.0 80.2	2.07	2.10	2.07	2.07	2.05	2.13	2.07
Tall Overweight	193.0 100.7	2.32	2.32	2.33	2.33	2.32	2.34	2.33
Tall Obese	193.0 128.6	2.63	2.57	2.66	2.64	2.65	2.62	2.63

DuBois and DuBois, Haycock, Gehan and George, Boyd, Pelletier, and average of all BSA formulas excluding the Pelletier formula. The results in Table 1 show large similarities between the Pelletier formula and the other formulas. For average height and average weight, the Pelletier formula yields the exact BSA as the average of all other BSA formulas.

The largest discrepancy between the Pelletier formula and the average of all the other BSA formulas was an 8% difference with the short and obese category, showing a difference of .14 m^2. The second largest difference was the short and overweight category, showing a difference of .10 m^2 (a 6% difference). The rest of the results only had differences between .7 and .0 (between 3% and 0% difference).

DISCUSSION

The results listed in Table 1 show that the Pelletier formula provides the same or very similar BSA results as other more complicated BSA equations. The Pelletier BSA formula is a quicker and reliable mental formula that saves crucial time during critical healthcare situations, such as emergent cardiac surgery. The Pelletier formula allows for quicker responses with any treatment where BSA is required.

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