



# MARSDEN

A Complete Guide to Body Surface Area

A Marsden Weighing Group Guide

[www.marsden-weighing.co.uk](http://www.marsden-weighing.co.uk)



## In this white paper:

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## Introduction

Body Surface Area (BSA) is the measure of surface area for the human body. In many cases, BSA is a better indicator of mass than body weight as it's less affected by abnormal adipose (fat) mass.

BSA is widely used by NHS DEXA scanners to help calculate body composition and dosages for anti cancer agents. In fact, it is an important way to calculate dosages for many medicines.

According to Lack and Taylor (1997), "BSA is recommended as the principal basis for drug dosage as the rate of metabolism or redistribution of a drug is proportional to metabolic rate, which in turn reflects heat losses, which as for any warm object, are generally proportional to surface area. Many measurements of organ size, fluid compartment volumes and assays of blood concentration of drugs correlate well with BSA."

<http://www.wellnesstradingpost.com/docs/herb-ref-guide/reference/online-references-used/Child-drug-dosage-by-Br.J.Anaesth.-1997-Lack-601-5.pdf>

A person's Body Surface Area is often a major factor to consider when determining the cause of treatment and drug dosages. According to Frazier and Price (1998), "Dosing based on body surface area (BSA) is generally used in an effort to normalise drug concentrations. This is because it is well recognised that measures of many physiologic parameters that are responsible for drug disposition, including renal function and energy expenditure, can be normalised by use of BSA."

<https://www.ncbi.nlm.nih.gov/pubmed/9686387>

Over the years, a series of formulae to simplify the process have been developed. The results of each formula varies considerably, so questions have been raised as to whether the choice of a particular formula is safe and valid for patients.

Many studies have justified that BSA can provide an exact fit with the people it examines.



# Timeline of BSA & Formulas



1850

1879

Meeh formulated the first available BSA formula.

$$0.1053 \times W^{2/3}$$

1916

DuBois published their formula - introducing height as a variable.

$$0.007184 \times W^{0.425} \times H^{0.725}$$

1935

Boyd publishes alternative BSA formula - for infants and children

$$0.000320 \times (W \times 1000)^{0.7285 - 0.0188 \times \log_{10}(W \times 1000)} \times H^{0.3}$$

1968

Fujimoto 3 stage formula

$$0.008883 \times W^{0.444} \times H^{0.663}$$

1970

Gehan & George's BSA formula

$$0.0235 \times W^{0.51456} \times H^{0.42246}$$

1978

Haycock publish alternative BSA formula.

1987

Mosteller publishes 'simplified' Body Surface Area calculation.

$$\sqrt{(W \times H / 3600)}$$

$$0.024265 \times W^{0.5378} \times H^{0.3964}$$

2000

Shuter & Aslani's revisited DeBois formula

$$0.00949 \times W^{0.441} \times H^{0.655}$$

2010

Schlich's alternative BSA formula

men:  $0.000579479 \times W^{0.38} \times H^{1.24}$   
 women:  $0.000975482 \times W^{0.46} \times H^{1.08}$

2017





## Which formula is best?

The effectiveness of each formula has been debated by medical professionals over time.

The DuBois formula has been the standardised formula in western cultures and has been since its inception.

In 2003, the Japanese were keen to find out which formula was most effective - in part due to inconsistencies between western BSA and their own Fujimoto formula. They compared various BSA formulas, before concluding the DuBois method was the best fit.

According to Kouno et al "The BSA calculated for all heights and body weights using the Fujimoto formula, ranged between 0.7% and 4.8% less than those calculated by the DuBois formula. The western formula showed larger discrepancies than the Fujimoto and DuBois formula.

"The DuBois formula, which is the western standard formula, is validated to a greater extent and its accuracy has been confirmed more than others, including the Fujimoto formula."

<https://pdfs.semanticscholar.org/a9e8/f32a3a324eb-45897725679f46bfec5f7be5c.pdf>



# How is BSA used?

## In medication dosages

Moore (1909) was first to recognise the importance of BSA in this regard, saying that “starting dosage in reference to body weight is not only inaccurate but rests entirely on the wrong principle. (It should be) proportionately to body surface, or in other words, proportionately to the two thirds power of their weight.”

<http://www.wellnesstradingpost.com/docs/herb-ref-guide/reference/online-references-used/Child-drug-dosage-by-Br.J.Anaesth.-1997-Lack-601-5.pdf>

## In chemotherapy

BSA is used to calculate dosages in chemotherapy. Here, it was chosen ahead of weight for two reasons. BSA has been demonstrated to provide a more accurate comparison of activity and toxicity for certain drugs. Second, BSA can be closely correlated with cardiac output, which determines blood flow to the liver and kidney.

<http://eguideline.guidelinecentral.com/i/132815-chemotherapy-weight-based-dosing/2>

## Calculating drug dosage for obese patients

When considering cancer patients with obesity, Griggs JJ et al (2012) said, “Reduced (drug) dosages may result in poorer disease-free and overall survival rates for obese patients”, hence the need to take into account the body surface area prior to delivering the medication - and that there must be a correlation between the two entities.

<http://ascopubs.org/doi/full/10.1200/jco.2011.39.9436>

However, research by Dr Caterina Fontanella, MD, a trainee in medical oncology from the University of Udine (Italy) has suggested this currently doesn't happen enough - with a cap on the medication dosage, when BSA exceeds a certain amount.

“Obese patients may have a BSA of more 2.0m<sup>2</sup>, but the chemotherapy dose they receive will not reflect this. It is a very common practice in these patients for fear of overdosing, but of course it means that they will often receive a relatively lower quantity of chemotherapy,” Dr Fontanella said. “In my opinion, a deeper understanding of chemotherapy metabolism and distribution in patients with high BMI and with increased adipose tissue is needed.”

<https://medicalxpress.com/news/2014-03-obesity-diabetes-adverse-effects-cancer.html#jCp>

The close links between weight, BMI and BSA have shown that knowledge of all three is required for the ideal care of the patient. The role of the I-300 range therefore, provides medical staff with access to all these measurements in one device.



## Other uses of BSA

Knowing a patient's BSA is not only useful for calculating medication dosages, but can also determine whether certain treatments may need to be accelerated or stopped altogether.

If a child has burn injuries which cover more than 60% of their body surface area, experts have said that they should be immediately transferred to a specialist burn centre for treatment.

Previous studies have found that a figure of 62% of body surface area is the critical mortality threshold for child burn victims.

<http://bit.ly/2tWyGpV>

There has also been links found between a higher BSA and atrial fibrillation (the most common heart rhythm disorder). Research presented at EuroPrevent 2017 found that women with a BSA between 1.82-3.02 m<sup>2</sup> (the highest BSA band) had three times the risk of the condition, than those in the smallest bracket.

<https://www.sciencedaily.com/releases/2017/04/170407090136.html>

### Things to take into account before using BSA

Specific nursing responsibilities related to using BSA to determine drug dosages can vary among health care institutions; however, the nurse always needs to be able to assess that the medication dose prescribed is safe for the patient. Therefore, the nurse needs to know how to calculate the BSA, how to calculate dosages based on BSA, and how to assess prescriber orders based on BSA.

<http://bit.ly/2tBIXIz>

With the BSA calculation function now available on some Marsden weighing scales, it means that a much simpler process can be followed to calculate BSA. BMI and weight information can also be collected from the patient at the same time.

### BSA calculation on a weighing scale

A Body Surface Area (BSA) function has been added to a new range of Marsden weighing scales - believed to be a world first. The function uses the DuBois formula to calculate BSA.

This can improve processes as it means a patient's BSA can be taken at the same time as weight and BMI measurements. This information can then be added to the medical record at the same time, meaning the administration process is accelerated. As only one device is needed, medical costs can be saved too.

It also improves patient care. Their time can be saved, meaning their visit to the practice is kept to a minimum. Because a patient should be familiar with weighing scales, they are less likely to feel uncomfortable when the BSA reading is taken.



# Recommended Weighing Scales

M-125



Class III Approved Column Scale  
250kg capacity  
100g graduations  
Hold, Tare, BMI, BSA

M-225



Class III Approved Chair Scale  
250kg capacity  
100g graduations  
Hold, Tare, BMI, BSA

M-545



Class III Approved Floor Scale  
250kg capacity  
100g graduations  
Hold, Tare, BMI, BSA

M-565



Slimming Scale\*  
250kg/39st capacity  
200g/0.5lb graduations  
Hold, Tare, BMI, BSA  
\*not medically approved







Accuracy Assured


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