

# Variations in Body Surface Area of Patients Receiving Chemotherapy Treatment in England

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## INTRODUCTION

Body Surface Area dosing has been used to achieve uniformity in dosing patients receiving chemotherapy treatment, despite numerous limitations<sup>1</sup>. Estimations of costs of chemotherapy treatments partly rely on an assessment of body surface area, with previous studies<sup>2</sup> estimating a mean BSA of 1.79m<sup>2</sup>. Small differences can relate to potential drug wastage and increased cost.

Routine data on the delivery of chemotherapy treatment to patients by NHS hospital trusts in England has been collected through the Systemic Anti-Cancer Therapies (SACT) dataset since April 2012.

Valid height and weight data was available for analysis for 47,812 patients.

## METHODS

Within the SACT dataset, the height and weight of patients starting a regime of chemotherapy is a required data item. These measurements are used to calculate body surface area using the Du Bois method<sup>3</sup> ( $BSA (m^2) = Wt (kg)^{0.425} \times Ht (cm)^{0.725} \times 0.007184$ ).

If a patient started more than one chemotherapy regimen during the reporting period, only their first regimen with a valid height and weight recorded was included. Within the entire SACT dataset, around 30% of patients are currently reported as starting more than one chemotherapy regimen.

SACT data on BSA was compared against BSA from a five year collection of Health Survey for England data to assess differences between those receiving chemotherapy treatment and the general population.

## RESULTS

Analysis shows an overall mean body surface area of 1.83m<sup>2</sup> (95% CI 1.82–1.83). As shown in Figure 1, there are distinct differences when accounting for gender with the mean for women at 1.74m<sup>2</sup> (95% CI 1.73–1.74) compared to a mean of 1.95m<sup>2</sup> (95% CI 1.94–1.95) for men. Further variations were observed when considering age bands of patients, as illustrated in Figure 3.

Variation in mean body surface area by tumour site is noticeable, as summarised in the table in Figure 2. The mean BSA for women with breast cancer was significantly higher than for women with colorectal, lung or ovarian cancer. In men, a higher mean BSA was observed for those with prostate cancer compared to lung or colorectal cancer.

There were noticeable differences in the mean BSA by age and gender, as shown in Figure 3 below. However, considering variations in body surface area by age the Pearson's correlation coefficient showed no correlation between age and BSA for men (-0.09). There was a very small negative correlation between age and BSA for women (-0.16). This is illustrated in Figure 4 below.

A 'T-test' comparing the mean BSA of age and sex stratified samples from the SACT data and Health Survey for England (HSE) data shows a significant difference between males (n= 22,092 p<0.00005) yet there is no significant difference for females (n= 31,080 p=0.2954). BSA in the SACT sample for males is significantly lower than that of the HSE sample. This may suggest for all cancer types that lower BSA is the result of the late detection of cancer in males and the effect the disease has already had before entry into the chemotherapy treatment system.

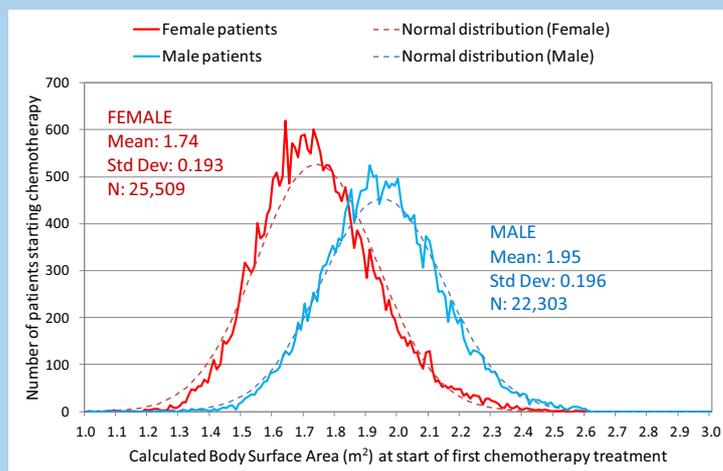


Figure 1: Distribution of body surface area showing variation by gender

		Male	Female
Breast	n	86	10,222
	Mean (CI)	2.00 (1.95, 2.05)	1.78 (1.78, 1.78)
Colorectal	n	4,437	2,896
	Mean (CI)	1.96 (1.95, 1.96)	1.71 (1.71, 1.72)
Lung	n	3,585	2,658
	Mean (CI)	1.92 (1.92, 1.93)	1.69 (1.68, 1.70)
Ovarian	n	-	2,814
	Mean (CI)	-	1.73 (1.72, 1.74)
Prostate	n	1,470	-
	Mean (CI)	1.99 (1.98, 2.00)	-

Figure 2: Variations in mean body surface area by gender and tumour site

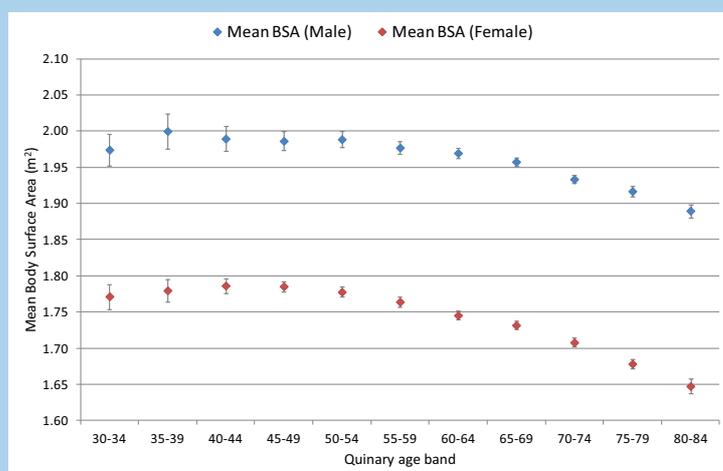


Figure 3: Mean body surface area showing variation by quinary age band (including 95% CI)

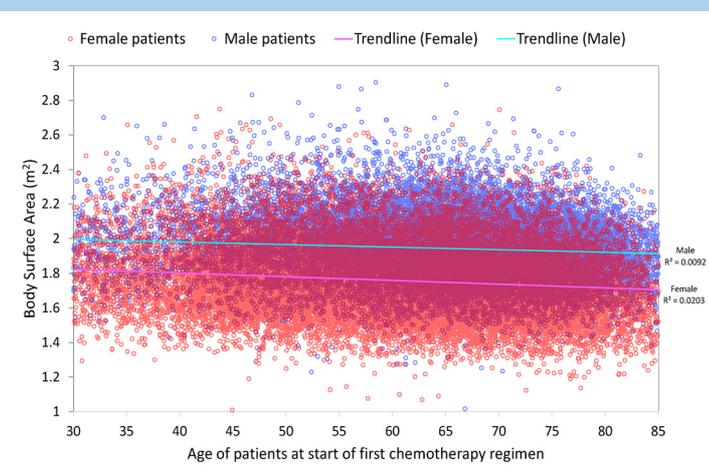


Figure 4: Distribution of body surface area showing variation by gender and age

## DISCUSSION

The SACT dataset is currently part-way through full implementation with over eighty percent of NHS hospital trusts in England submitting data at varying degrees of completeness. Many hospital trusts do not currently submit data for all patient groups. However, the volume of data collected to date proves sufficient for initial baseline analysis and is currently the largest collection of routine chemotherapy data internationally.

## CONCLUSIONS

- There are clear variations in mean BSA by age, gender and diagnostic group of patients receiving chemotherapy treatment in England
- Initial comparison to Health Survey for England data suggests that males receiving chemotherapy show statistically significant differences to the general population
- Further analysis is required to establish whether there is variation between different parts of the country

## REFERENCES

1. "Flat-Fixed Dosing Versus Body Surface Area-Based Dosing of Anticancer Drugs in Adults: Does It Make a Difference?" – Mathijssen et al 2007
2. "The Average Body Surface Area of Adult Cancer Patients in the UK: A Multicentre Retrospective Study" – Sacco et al 2010
3. "A Formula to Estimate the Approximate Surface Area If Height and Weight Be Known" – DuBois D, DuBois EF 1916

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## Metadata

<b>1. What is being measured?</b>	Body Surface Area (BSA) of patients receiving chemotherapy at English NHS hospitals.
<b>2. How is this indicator actually defined?</b>	Body Surface Area is calculated using the Du Bois method: $BSA (m^2) = Wt (kg)^{0.425} \times Ht (cm)^{0.725} \times 0.007184$
<b>3. Who does it measure?</b>	Adult patients receiving chemotherapy at any of the 100 English NHS hospital trusts reporting valid height and weight data as part of the Systemic Anti-Cancer Therapy (SACT) dataset.
<b>4. When does it measure it?</b>	Based on patients starting a chemotherapy regimen between 1 <sup>st</sup> April 2012 and 28 <sup>th</sup> February 2013.
<b>5. Where does the data come from?</b>	Systemic Anti-Cancer Therapy (SACT) dataset <a href="http://www.isb.nhs.uk/documents/isb-1533/amd-63-2010/1533632010quid.pdf">http://www.isb.nhs.uk/documents/isb-1533/amd-63-2010/1533632010quid.pdf</a>
<b>6. How accurate and complete will the data be?</b>	The SACT dataset is part-way through a two year implementation. As such, not all hospitals currently submit data. Those that do submit data may not submit full data for all diagnostic groups, as implementation status of e-prescribing systems varies. The data completion for the height and weight data items varies across the country, with around 42% of records containing valid measurement data.
<b>7. Are there any caveats/warnings/problems?</b>	The high volume of data collected to date provides a valuable starting point for initial baseline analysis. Ongoing data quality work will help to improve the overall validity of data, the completeness in terms of the diagnostic groups reported, and the number of hospitals submitting consistent and comprehensive data.

## References

1. "Flat-Fixed Dosing Versus Body Surface Area-Based Dosing of Anticancer Drugs in Adults: Does It Make a Difference?" – Mathijssen et al 2007  
<http://theoncologist.alphamedpress.org/content/12/8/913.full>
2. "The Average Body Surface Area of Adult Cancer Patients in the UK: A Multicentre Retrospective Study" – Sacco et al 2010  
<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0008933>
3. "A Formula to Estimate the Approximate Surface Area If Height and Weight Be Known" – DuBois D, DuBois EF 1916

## Supporting data tables

Figure 2: Variations in mean body surface area by gender and tumour site

		Male	Female
<b>Breast</b> ICD10: C50	Total number of patients	86	10,222
	Mean BSA (95% CI)	2.00 (1.95, 2.05)	1.78 (1.78, 1.78)
<b>Colorectal</b> ICD10: C18-C20	Total number of patients	4,437	2,896
	Mean BSA (95% CI)	1.96 (1.95, 1.96)	1.71 (1.71, 1.72)
<b>Lung</b> ICD10: C33-C34, C37-C39, C45	Total number of patients	3,585	2,658
	Mean BSA (95% CI)	1.92 (1.92, 1.93)	1.69 (1.68, 1.70)
<b>Ovarian</b> ICD10: C56, C570	Total number of patients	-	2,814
	Mean BSA (95% CI)	-	1.73 (1.72, 1.74)
<b>Prostate</b> ICD10: C61	Total number of patients	1,470	-
	Mean BSA (95% CI)	1.99 (1.98, 2.00)	-

Figure 3: Mean body surface area showing variation by quinary age band (including 95% CI)

	30-34	35-39	40-44	45-49	50-54	55-59
<b>Male</b>	1.97 (1.95 - 2.00)	2.00 (1.98 - 2.02)	1.99 (1.97 - 2.01)	1.99 (1.97 - 2.00)	1.99 (1.98 - 2.00)	1.98 (1.97 - 1.99)
<b>Female</b>	1.77 (1.75 - 1.79)	1.78 (1.76 - 1.80)	1.79 (1.78 - 1.80)	1.79 (1.78 - 1.79)	1.78 (1.77 - 1.78)	1.76 (1.76 - 1.77)

	60-64	65-69	70-74	75-79	80-84
<b>Male</b>	1.97 (1.96 - 1.98)	1.96 (1.95 - 1.96)	1.93 (1.93 - 1.94)	1.92 (1.91 - 1.92)	1.89 (1.88 - 1.90)
<b>Female</b>	1.75 (1.74 - 1.75)	1.73 (1.73 - 1.74)	1.71 (1.70 - 1.71)	1.68 (1.67 - 1.69)	1.65 (1.64 - 1.66)