Criterion Validity of Whole Body Surface Area Equations: A Comparison Using 3D Scanning

Nathan D. DANIELL*[a], Tim OLDS[b, c], Grant TOMKINSON[b]
[a]ErgoLab, Mawson Institute, University of South Australia
[b]School of Health Sciences, University of South Australia
[c]Samsom Institute, University of South Australia

Abstract

Measurements of whole body surface area (WBSA) have important applications in numerous fields including clinical medicine, biomechanics, and sports science. Currently WBSA is most often estimated using predictive equations due to the complex and time consuming methods required for direct measurements. As a result, many different predictive equations have emerged. The aim of this study was to identify whether there were significant and meaningful differences between WBSA measurements taken using a whole-body three-dimensional (3D) scanner (criterion measure) and the estimates derived from each of the WBSA equations identified from a systematic review. The study also aimed to determine whether differences varied according to BMI, sex or athletic status (using rowers as a comparison population). The systematic review identified 15 WBSA equations derived for Western adult populations which have been published since 1900. For this study, WBSA was measured on 1732 subjects using the Vitus Smart 3D scanner. This included 1452 subjects (753 males, 699 females) aged 18-30 years from the general population and 280 rowers (161 males, 119 females) aged 18-54 years. Mixed design ANOVAs determined whether the differences between the measured and equation-predicted values varied systematically with BMI category, sex or athletic status. Bland-Altman analysis was also used to identify the systematic error (bias) and random error (standard deviation of the differences).With a few exceptions, the equations were quite accurate (bias ≤2%) and precise (standard deviation of the differences 1.5-3.0%). Body mass index had a substantial impact on the accuracy and precision of WBSA equations. Significant differences were also identified for sex and athletic status, although the magnitude of these differences was minimal. Care must be taken when deciding which equation to use when estimating WBSA.

Keywords: 3D scanning, body surface area, anthropometry

* Nathan Daniell,
M1-08D, Mawson Institute, Mawson Lakes Campus, University of South Australia,
Mawson Lakes Boulevard, Mawson Lakes, South Australia, 5095, Australia,
Telephone: +61 8 8302 3647 , Fax: +61 8 8302 5639 , Email: nathan.daniell@unisa.edu.au