**A Semi-Mechanistic Model for Quantification of Lean Body Weight**

**Sarayut Janmahasatian**, **Stephen B Duffull**, **Susan Ash**, **Leigh C Ward**, **Nuala M Byrne**, **Bruce Green**

1. School of Pharmacy, University of Queensland, Brisbane, Australia; 2. School of Public Health, Queensland University of Technology, Brisbane, Australia; 3. Department of Biochemistry and Molecular Biology, University of Queensland, Brisbane, Australia; 4. School of Human Movement Studies, Queensland University of Technology, Brisbane, Australia; 5. Center for Drug Development Science, University of California San Francisco, Washington DC, USA

**Introduction**

- Measures of body composition, such as Lean Body Weight (LBW), have been recommended to scale drug dosing in patients who are obese [1]
- The current estimate of LBW [2] has been shown to be inconsistent at extremes of body size [3]
- Fat free mass (FFM) can be measured using dual energy X-ray absorptiometry (DXA). LBW cannot be measured experimentally.
- LBW differs from FFM by < 3-5%. FFM unlike LBW excludes lipids in cellular membranes. Generally FFM and LBW are considered interchangeable.

**Aim**

- To develop a semi-mechanistic model for predicting FFM from subject characteristics in a population that includes extremes of size

**Model Building**

- Two datasets were available: (1) an index dataset used for model building and (2) an evaluation data set used for external evaluation.
- The index data set had 2 response measures: bioimpedance (Z) and FFM (kg) – see Table 1 for demographics
- Four models were built
  i. Semi-mechanistic model to predict Z from subject characteristics
  ii. Empirical model to predict Z from subject characteristics
  iii. Semi-mechanistic model to predict FFM from Z
  iv. Empirical model to predict FFM from subject characteristics
- Models (ii) and (iv) were used to assess predictive loss associated with assuming a priori the model form for the semi-mechanistic models

**Results**

- Final model to predict FFM [combining models (i) and (iii)]
  \[
  \text{FFM} = \frac{9.27 \times 10^2 \times \text{weight}}{6.68 \times 10^4 + 216 \times \text{BMI}}
  \]
- The information loss for the semi-mechanistic model for Z was 6%, and for the semi-mechanistic model for FFM was 26%
- Results of external evaluation (Fig. 1)

**Conclusions**

- A semi-mechanistic model has been developed to predict FFM (and therefore LBW) from easily accessible patient characteristics. This model has been prospectively evaluated and shown to have good predictive performance.