Nutritional adequacy and accuracy in long-stay critically ill patients as measured by indirect calorimetry

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Introduction

Nutritional optimisation is recognised as having significant impact on clinical and functional outcomes of critically ill patients (1). Clinical recommendations suggest use of indirect calorimetry guided nutrition in the intensive care unit (ICU) (2), and a recent systematic review demonstrated improved outcomes from its use (3). The COVID-19 pandemic has seen a greater proportion of patients with prolonged critical illness, a cohort for whom nutritional optimisation is a key unmet need (4).

This service evaluation assessed rates of over and underfeeding in a tertiary centre ICU and how these relate to markers of catabolism and persistent critical illness.

Methodology

Serial measurements of REE (resting energy expenditure) and RQ (respiratory quotient) by indirect calorimetry were performed using Q-NRG+ device (COSMED, Rome, Italy).

Nutritional intake and estimations of requirements were recorded concurrently together with routine clinical observations, and markers of critical illness, catabolism and over or underfeeding ($PaCO_2$, insulin use, urea-creatinine-ratio, CRP, Hb, SOFA-score).
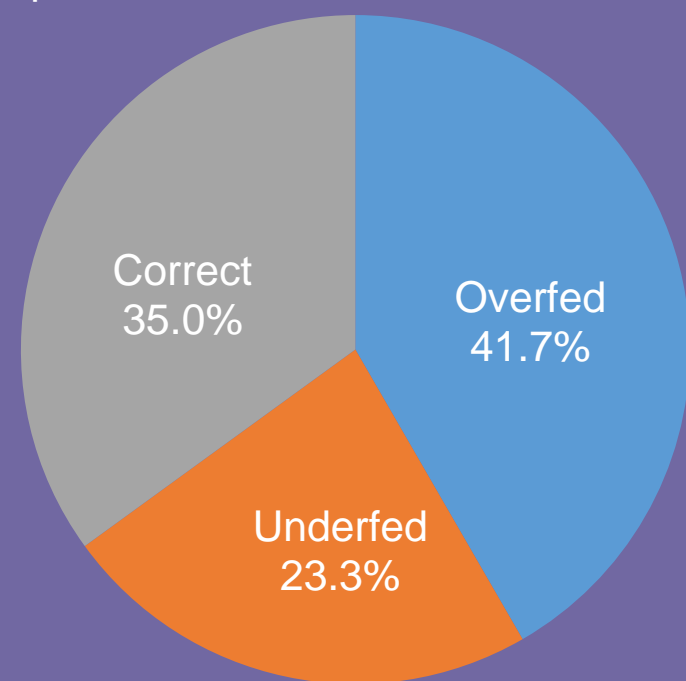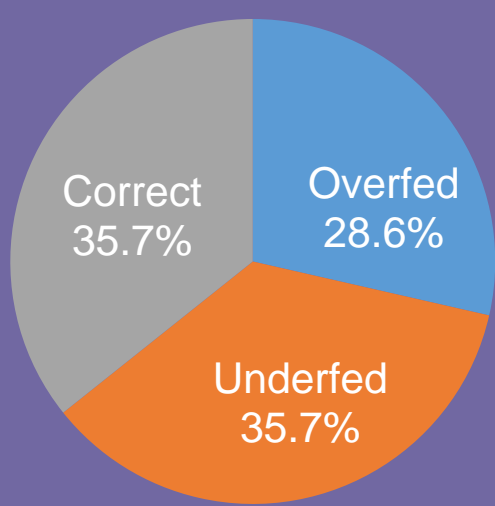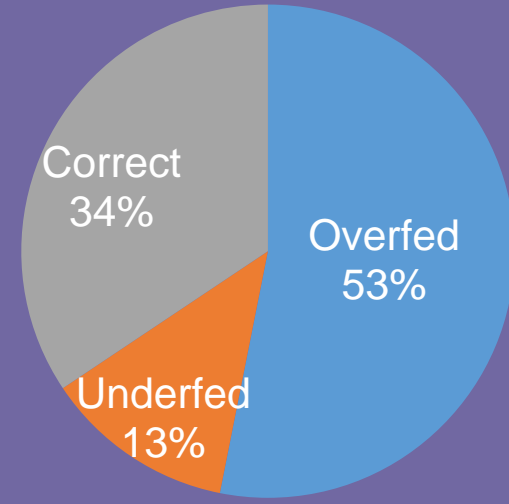

Figure 1: : Proportion of measurements of REE demonstrating overfeeding (actual intake >110% of REE), underfeeding (actual intake <85% of REE), or correct intake (actual intake 85-110% of REE). a. all patients. b. patients with BMI≥30 c. patient with BMI <30
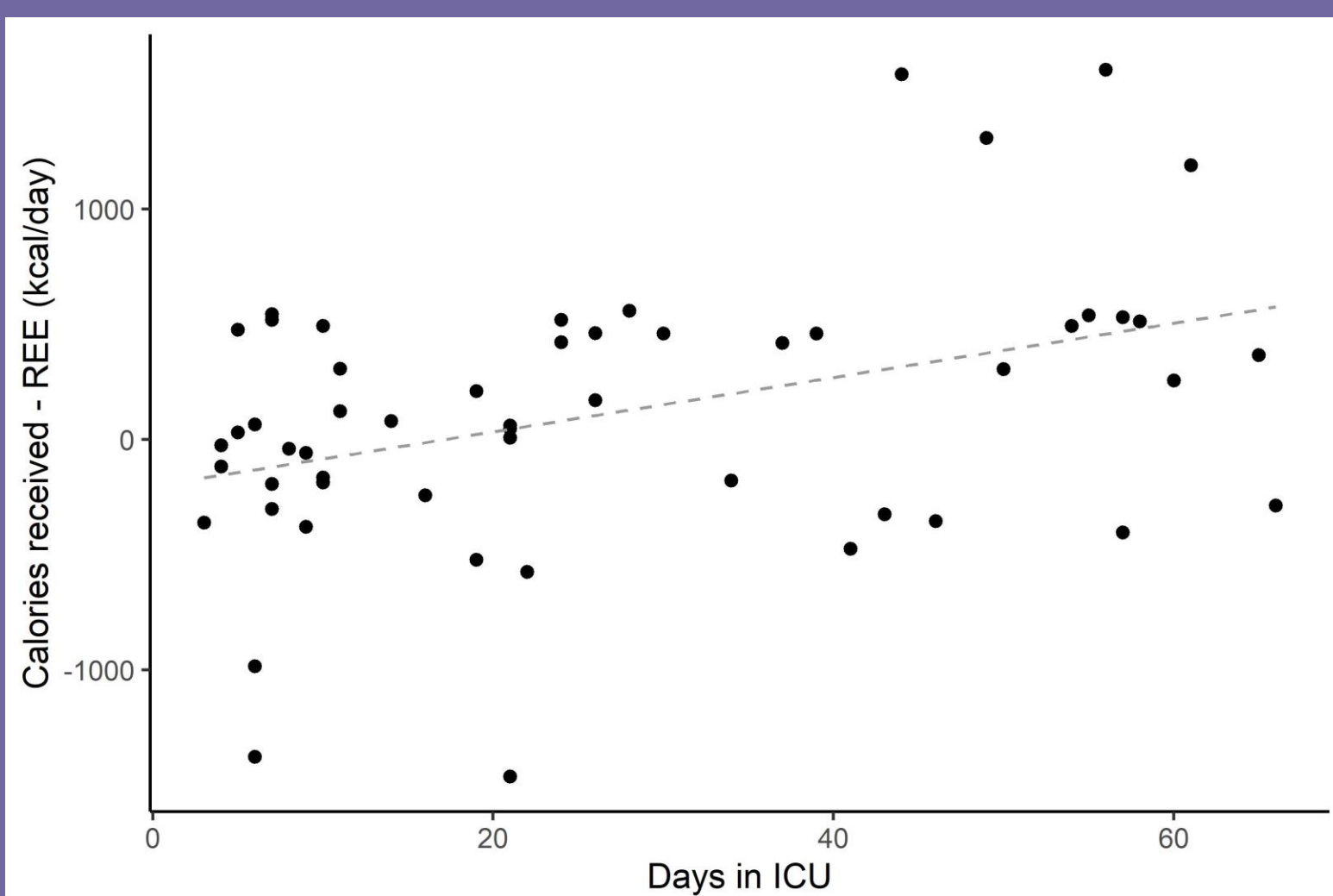

Figure 2: Daily calorie surplus or deficit vs. day of ICU admission, calculated as difference between nutrition actually received (kcal/day) and REE (kcal/day). Linear regression analysis shown by dashed line, (R^2 0.159, p<0.005).

Results

Across 30 patients, REE was lower than formula-based predicted energy requirements, mean 1586 (IQR 1322-1892) kcal/day vs. 1889 (IQR 1755-2084) kcal/day , including when standardized to ideal body weight, 24.2 (IQR 20.0-28.1) kcal/day/kg IBW vs. 29.1 (IQR 25.4-33.1) kcal/day, p<0.001.

41.8% of measurements showed overfeeding (actual calorie intake >110% of REE), and 23.3% showed underfeeding (actual calorie intake <85% of REE). Median calorie surplus in those overfed was +494kcal/day (IQR 420-540), and in those underfed, median calorie deficit was -497kcal/day (IQR -636--365).

Obese patients (n=15) were underfed (median difference -32kcal/day) compared to non-obese patients (n=15), who were on average overfed (median difference +234kcal/day), p=0.021, demonstrated in Figure 1.

Overfeeding was also associated with greater length of ICU admission (R^2 0.159, p<0.005), Figure 2. Mean duration of ICU admission at time of measurement was 26.8 days (IQR 9-43.8). Median day of ICU admission in overfed patients was 39 days (IQR 24-56), and in underfed patients 21.5 (IQR 7.5-45.25).

Examining this relationship further, individual REE values were weakly related to days of ICU admission (R^2= 0.088, p=0.029), as shown in Figure 3. However, there was no significant association between calorie surplus or deficit, and other markers of overfeeding $PaCO_2$, insulin use, urea-creatinine-ratio.
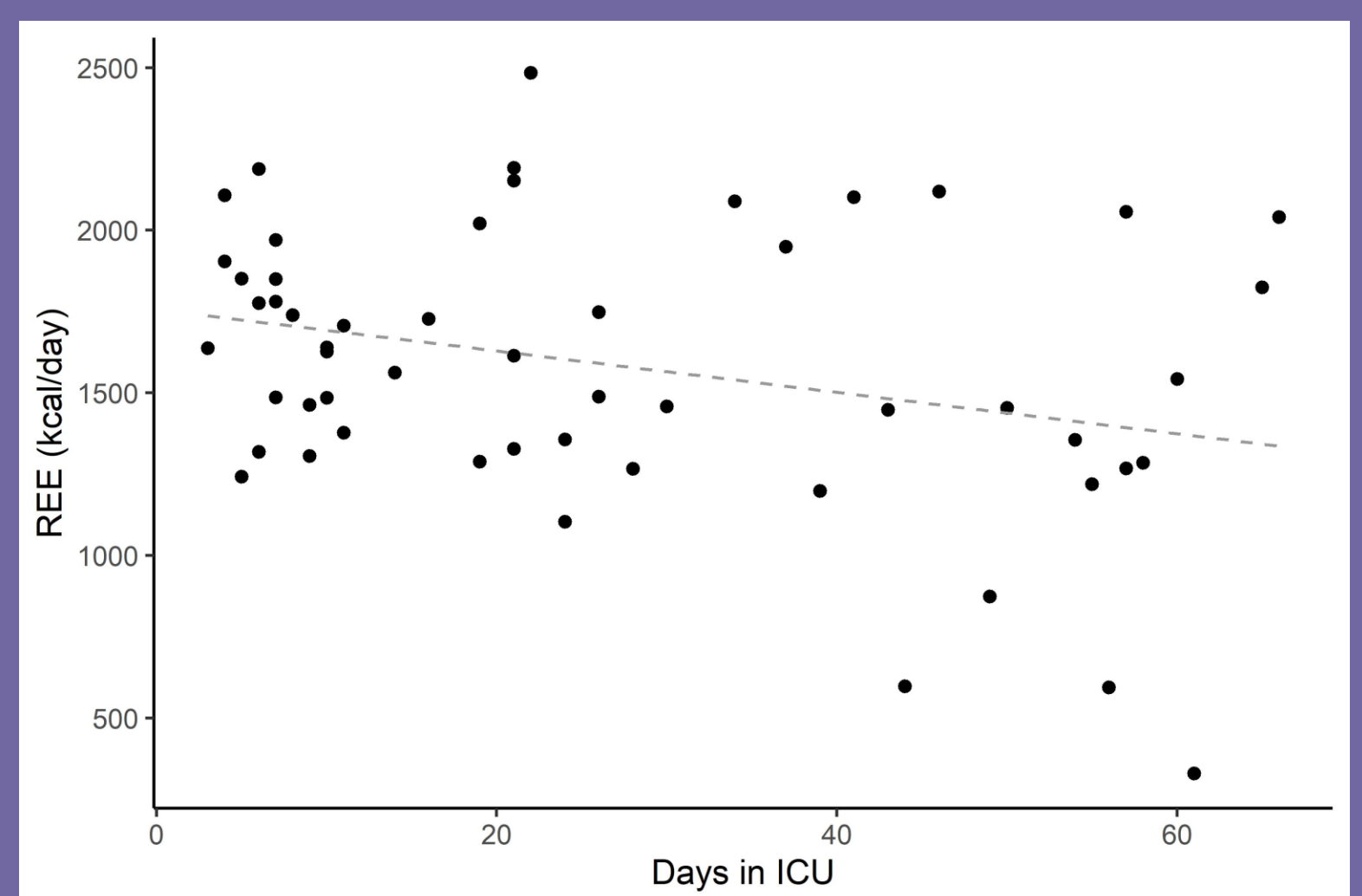

Figure 3: REE measured (kcal/day) vs. days of ICU admission, linear regression shown by dashed line (R^2= 0.088, p=0.029).

Conclusion

This service evaluation recorded measurements of REE and RQ in critically ill patients with high lengths of ICU stay (up to 66 days).

We observed increased rates of overfeeding with increased duration of ICU admission, and increased overfeeding in non-obese patients. Clinicians should be mindful of this trend towards overfeeding in non-obese and prolonged ICU stay patients given harms associated (5).

References

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