Cambridge Clinical Research Facility

NHS
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Metabolic reference measurements in childhood and adolescents

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Background and Aim

The inherited nature of some conditions including obesity, thyroid hormone and growth hormone disorders implies that they may present in childhood (Wells et al, 2003).

Currently, interpretation of physiological studies carried out in children and adolescents with abnormalities in metabolism are limited because of a lack of normal data and often rely on information extrapolated or predicted from measurements carried out in adults

The aim of this study is to recruit participants aged 6-16 years old to provide a dataset of reference measurements for comparison to children with metabolic disorders. All recruitment and measurements took place at the Cambridge CRF.

Methodology

Over 100 healthy participants have been recruited to provide datasets of reference measurements:

1.Body composition using dual energy X-ray absorptiometry (DXA), Air displacement plethysmography by BodPod, and total body water (TBW).

2.Resting energy expenditure (REE) using indirect calorimetry, together with physical activity (Exercise and Actiheart movement monitor).

Metabolic Disorders – Resistance to thyroid hormone (RTH)

Actions of thyroid hormones (TH) are mediated by two receptors (alpha,beta) with differing tissue distribution: Resistance to Thyroid Hormone Alpha predominantly affects the heart, muscle and bone. RTH Beta affects the liver and pituitary. Patients with RTHalpha typically exhibit lower REE with RTHbeta patients having higher REE compared to healthy controls.

Energy expenditure in thyroid hormone disorders differs compared to healthy age matched controls

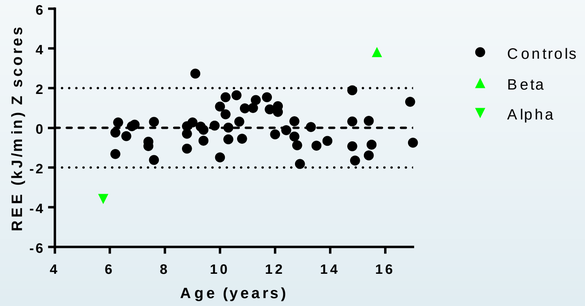

Figure 1. Difference in REE between healthy female controls and two female patients with RTHalpha or RTHbeta.

REE Z scores derived from preliminary multiple regression analysis for the prediction of REE in healthy children. When the regression is applied to children with metabolic disorders, it highlights how far out of a normal range they lie.

Fat mass and REE but not lean mass differ between thyroid hormone disorders and healthy age matched controls

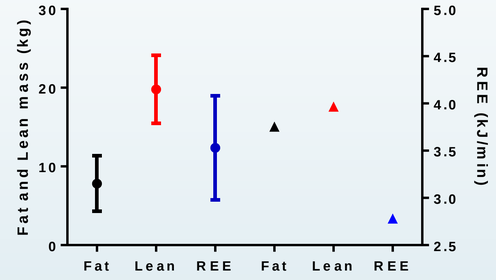

Figure 2. Difference in fat mass, lean mass and REE between healthy age matched male controls (circles) and a patient with a disorder of TH metabolism (triangles).

Typically, lean mass is the primary contribution to variation in REE. In healthy adults, fat mass has a small but significant contribution to the variation in REE (Watson et al, 2014). The patient above presents normal lean mass, high fat mass but a low REE.

Results

Preliminary analysis suggests a trend towards a difference in body composition and REE between healthy age and gender matched participants and three children with metabolic disorders.

Conclusion

This study proves valuable clinically, by illustrating to clinicians how atypical their patient's results lie compared to matched healthy controls. This approach is already being utilised as part of the treatment in patients with metabolic disorders (Watson et al, 2014)

This approach will lead to the further development of new paediatric REE prediction equations and the assignment of standard deviation (Z) scores describing the normal variability of human metabolism.

Reference

Wells JC .Body Composition in childhood: effects of normal growth and disease.*The Proceedings of the Nutrition Society 2003;62(02):521-528*.

Watson LPE, Raymond-Barker P, Moran C et al. An approach to quantifying abnormalities in energy expenditure and lean mass in metabolic disease. *European Journal of Clinical Nutrition 2014;68(2):234-40.*

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