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## Altered energy metabolism in anorexia nervosa

Janice Russell<sup>a, b, \*</sup>, Louise A. Baur<sup>c</sup>, Peter J.V. Beumont<sup>a</sup>,  
Suzanne Byrnes<sup>a, b</sup>, Gaby Gross<sup>a</sup>, Stephen Touyz<sup>d</sup>, Suzanne  
Abraham<sup>b, e</sup>, Stephan Zipfel<sup>f</sup>

<sup>a</sup> Department of Psychological Medicine, University of Sydney, Sydney, NSW 2006, Australia

<sup>b</sup> Eating Disorders Unit, Northside Clinic, 2 Greenwich Rd, Greenwich, NSW 2065, Australia

<sup>c</sup> Department of Paediatrics and Child Health, University of Sydney, Sydney, NSW 2006, Australia

<sup>d</sup> Department of Psychology, University of Sydney, Sydney, NSW 2006, Australia

<sup>e</sup> Department of Obstetrics and Gynaecology, University of Sydney, Sydney, NSW 2006, Australia

<sup>f</sup> Department of Psychology, Department of General, Internal and Psychosomatic Medicine, University of Heidelberg, Heidelberg, Germany

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### Abstract

Optimal nutritional rehabilitation of anorexia nervosa requires more information concerning actual energy and substrate requirements. To this end, indirect calorimetry was performed in female patients ( $n=34$ , age  $20.9\pm 1.2$  yr, body mass index [BMI]  $15.6\pm 0.2$  kg/m<sup>2</sup>; mean $\pm$ SEM) soon after commencement of refeeding and at the time of discharge from hospital ( $n=18$ , BMI  $19.0\pm 0.3$  kg/m<sup>2</sup>). Healthy female controls ( $n=18$ , age  $24.6\pm 1.3$  yr, BMI  $21.6\pm 0.6$  kg/m<sup>2</sup>) were also tested. Resting energy expenditure (REE) and respiratory quotient (RQ) were measured in the fasting state, followed by diet-induced thermogenesis (DIT) and RQ over a 4 h period following a 100 g oral glucose load. Compared with post-refeeding patients and controls, pre-refeeding patients had a high basal RQ and a low REE, with a paradoxically higher DIT ( $13.2\pm 0.9\%$  of REE vs  $8.3\pm 1.2\%$  and  $8.6\pm 0.9\%$  in post-refeeding patients and controls, respectively). RQ values in pre-refeeding patients exceeded unity following the glucose load, probably reflecting net lipogenesis, whereas in the post-refeeding patients, post-glucose RQ was similar to that of controls, suggesting premature curtailment of lipogenesis. These data demonstrate energy wasting in emaciated patients with anorexia nervosa. Biological repair processes could account for disproportionate energy loss early in refeeding and there may be some later impediment to full restoration of fat stores. © 2000 Elsevier Science Ltd. All rights reserved.

\* Corresponding author. Address to Northside Clinic. Tel.: +61-2-9433-3555; fax: +61-2-9433-3599.  
E-mail address: jrussell1@mail.usyd.edu.au (J. Russell).

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## **1. Introduction**

In NSW, Australia it has been estimated that 400 new cases of anorexia nervosa are diagnosed each year and that at any one time at least 2000 people are suffering from its effects (Beumont et al., 1995; Lucas et al., 1991). This parallels the experience in North America where Lucas et al. (1991) demonstrated anorexia nervosa to be the third most common chronic medical illness in girls aged 15 to 19 yr. As 50% of patients relapse in the 12 months following weight gain (Hsu et al., 1979), nutritional rehabilitation may appear to be a futile and expensive exercise, at least in the short term. Nevertheless, it has been demonstrated that patients do not recover fully unless weight is restored to near normal levels (Russell and Byrnes, 1998). Hence, nutritional rehabilitation must be as efficient as possible. The refeeding of anorexia nervosa patients can be frustrating even to experienced clinical teams and poor compliance is usually blamed for this even when patients claim to have been fully cooperative. In one study using food records, it was found that caloric requirements in anorexia nervosa following weight restoration were increased for a period of six months (Kaye et al., 1986).

Little is known about the changes that occur in energy and substrate requirements over the course of refeeding in anorexia nervosa patients. The doubly labelled water technique has been used in two studies (Casper et al., 1991; Pirke et al., 1991) to measure total daily energy expenditure (TDEE) in chronic but stable low weight patients; TDEE was found to be similar to that of normal controls despite modestly reduced levels of resting energy expenditure (REE). This finding was attributed to increased levels of exercise in the anorexic patients. In another study, no differences in REE or TDEE were found between normal controls and patients who were weight recovered for six months or more (Platte et al., 1994). The third component of TDEE is diet induced thermogenesis (DIT) and no differences were reported between chronic anorexia nervosa patients and controls in the studies of Pirke et al. (1991) and Casper et al. (1991).

Substrate utilisation has been measured by the use of respiratory quotient (RQ) which is the rate of CO<sub>2</sub> production divided by O<sub>2</sub> utilisation (VCO<sub>2</sub>/VO<sub>2</sub>). This is determined by the nutritional state of the subject and the substrate mix ingested. Following ingestion of glucose, RQ approaches 1.0 in healthy weight subjects consuming a normal diet; this RQ reflects the oxidation of glucose. Following ingestion of fat, RQ approaches 0.70 (due to fat oxidation) and after a normal mixed meal, the RQ is approximately 0.83. The RQ in a fasting state is higher in low weight refeeding anorexia nervosa patients than in normal weight controls and may exceed unity following a glucose load (Vaisman et al., 1991; Kubata et al., 1993; Krahn et al., 1993).

The aim of this study was to measure REE, post glucose diet induced thermogen-

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