

神經性厭食病人的身體組成 —— 隨治療、決定因素和方法而轉變

Body composition in anorexia nervosa – changes with treatment, determinants and techniques

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Body fat, total body water and totally body nitrogen were estimated twice before and after refeeding in 32 patients with anorexia nervosa. Body composition was estimated once in 29 normal controls using the techniques of anthropometry, impedance and IVNCA. The influence of weight gain and other variables, ie psychological status, biochemical parameters, exercise and dietary composition, on protein repletion was examined. Methods of assessment of body composition were compared. The results demonstrated that in anorexia nervosa patients, protein was more completely replenished than fat when patients had reached 85% of average body weight for height and age. Weight gain was the only determinant of protein gain. There was no correlation with psychological, biochemical or exercise status nor with dietary composition. Direct methods, ie deuterium dilution and IVNCA, were shown to be preferable in determination of body composition in anorexia nervosa.

Introduction

In serious medical illness, eg chronic renal failure, sepsis, AIDS and cancer, protein depletion occurs and is adversely related to prognosis¹. Nutritional rehabilitation in these conditions results in preferential repletion of fat¹⁵. A similar interpretation of data obtained from famine victims and from the seminal starvation studies of Keys et al.¹⁰ has been made with anorexia nervosa being assumed to be comparable^{14,16}. As nitrogen was only measured directly in the latter study, and in a small number of subjects, the situation here remains unclear.

The aims of this study were three: firstly to examine the body composition changes in anorexia nervosa following treatment, secondly to examine the determinants of protein repletion and thirdly to compare values obtained by direct and indirect techniques.

Patients and methods

The subjects were 32 female patients who fulfilled current diagnostic criteria from anorexia nervosa (DSM-IV-R, 1987). They had no other illnesses and gave informed consent. The controls were 29 healthy female volunteers. Patients were treated in a multidisciplinary inpatient refeeding programme consisting of cognitive-behavioural and psychotherapeutic elements. An exercise component was included which was contingent upon weight gain and compliance. The refeeding diet was balanced with respect to nutritional recommendations and adjusted so as to ensure a weight gain of 1 kg a week. Body composition was assessed in the low weight patients in the second week of hospitalization and prior to discharge after attainment of 85% of average weight for height and age. Controls were assessed on one occasion only.

Techniques

The following procedures were performed for assessment of body composition:

- 1 Anthropometry from sum of biceps, triceps, suprascapular and surailiac skinfold thickness to estimate percentage body fat^{4,5}.
- 2 Bio-electrical impedance (BIA) for estimation of % body fat and lean body mass¹².
- 3 Deuterium dilution for measurement of total body water³.
- 4 In vivo neutron capture analysis using Californium 252 as the neutron source.²

Other determinants assessed were: (i) Psychological status initially and the change following refeeding using the Beck Depression Inventory⁹, Spielberger State and Trait Anxiety Inventories¹⁸, Eating Attitudes Test⁶ and the Eating Disorders Inventory⁷. (ii) Biochemistry assessed by plasma levels of those parameters responsive to short-term changes in nutritional status, eg alkaline phosphatase, transferrin, retinol binding prealbumin and creatinine clearance^{8,11,13}. (iii) Mean weekly exercise score (aerobic, nonaerobic and total) as ascertained by diary and weekly interview). (iv) Mean daily dietary composition as ascertained by food logs and interview with nutritionist.

Comparison of techniques

Values obtained for fat and lean body mass by four different methods involving direct and indirect techniques, as shown in Table 1, were compared.

Statistics

Significance of changes was assessed by repeated measures

Table 1. Abbreviations and methods used to calculate body composition components.

Component and abbreviation	Method or equation used for calculation
TBW=total body water	Measured by D ₂ O (litres)
ECW=extracellular water	Measured by bromide
ICW=intracellular water	TBW - extracellular water
TBN=Total body nitrogen	Measured IVNAA (grams)
TBP=Total body protein	Protein=0.625 x nitrogen
Total body minerals	Minerals=0.0622 x (TBW/0.732)
Total body glycogen	Glycogen=0.0091 x (TBW/0.732)
Total body carbohydrate	same as glycogen
LBM=lean body mass	LBM(Kg)=total body (kg)- Fat(kg)
FFM=fat free mass	Same as LBM
TBF=total body fat	4 methods used (see below)
Estimated fat from:	
(1) Skinfold anthropometry	Measuring skinfold thickness
(2) Impedance	Bioimpedance
(3) Total body water	Total body (kg) - (TBW/0.732)
(4) Four-compartment model	Body (kg)-(water+protein+minerals+glycogen)

ANOVA. Correlations between nitrogen repletion, weight gain and these determinants were assessed by factor analysis based on a Pearson's correlation matrix.

Results

Changes in body composition are shown in Tables 2 and 3.

Table 2. Body composition of controls and anorexia nervosa patients before and after refeeding (mean ± SD).

	Controls (n=29)	Anorexia Nervosa Patients (n=32)	
		Before refeeding	After refeeding
Age (years)	23.2 ± 5.4	18.8 ± 4.1 ^a	
Height (cm)	164 ± 6.2	165 ± 5.7	
Weight (kg)	57.8 ± 7.3	41.9 ± 4.9	51.9 ± 4.4 ^{a,b}
BMI (kg/m ²)	21.6 ± 2.7	15.4 ± 1.3	19.0 ± 1.2 ^{a,b}
LBM (kg)	42.2 ± 4.2	35.4 ± 3.4	39.7 ± 3.6 ^{a,b}
Fat:			
Weight (kg)	15.6 ± 4.3	6.5 ± 2.6	12.2 ± 2.4 ^{a,b}
%of weight	26.6 ± 4.6	15.2 ± 5.0	23.4 ± 3.8 ^{a,b}
Nitrogen:			
Weight (kg)	1.53 ± 0.18	1.15 ± 0.17	1.37 ± 0.16 ^{a,b}
% of weight	2.65 ± 0.21	2.74 ± 0.19	2.63 ± 0.21 ^b
Index	1.01 ± 0.111	0.74 ± 0.107	0.88 ± 0.82 ^{a,b}
Grams per kg lean body mass	36.5 ± 3.0	32.5 ± 3.0	34.4 ± 2.5 ^{a,b}

^a=different from controls, P <0.001, ANOVA (DF=1.59)

^b=different from before refeeding P <0.001, repeated measures ANOVA (DF=1.31)

Table 3. Depletion of fat and nitrogen before and after refeeding.

	Anorexia nervosa patients		
	%Depletion compared to controls		%Increase
	Before refeeding	After refeeding	
Fat	58.4%	21.8%	87.7%
Nitrogen	24.5%	10.6%	18.4%

There were no significant correlations between increase in nitrogen and psychological status, biochemical changes, mean weekly exercise scores and dietary composition. The

only significant determinant of nitrogen gain was weight gain. In anorexia nervosa patients but not in controls, there was a discrepancy between body fat as measured by indirect (eg anthropometry and impedance) techniques compared to those which included more direct (eg deuterium dilution and IVNCA) methods (as shown in Table 4).

Table 4. Comparison of body composition by direct and indirect methods of estimation expressed in kg of total body weight.

	Controls (kg)	Before refeeding (kg)	After refeeding (kg)
Total body	60.3	41.9	51.9
Total body water (TBW)	33.2	28.3	32.2
Total body protein (TBP)	9.9	7.2	8.5
Total body minerals	2.8	2.4	2.7
Total body carbohydrates	0.41	0.35	0.40
Lean body mass (LBM):			
from skinfolds	43.3	35.4	39.7
from total body water	45.3	38.6	44.0
from 4 compartment model	46.3	38.2	43.9
Total body fat (TBF):			
from skinfold	17.0	6.6	12.2
from impedance	17.5	6.2	11.6
from total TBW	15.0	3.4	8.1
from 4 compartment model	13.9	3.6	8.2

Discussion

In patients with anorexia nervosa, protein is replenished effectively and more completely than is fat. The absence of pathological processes impairing protein repletion distinguishes anorexia nervosa from medical illness in which protein loss occurs. Increased physical activity may add to this effect. Weight gain is the only determinant of nitrogen gain. Direct methods of measurement of body composition are preferable as these techniques do not rely on the use of constants derived from normal subjects^{16,17}. Weight restoration is the essential component of treatment in anorexia nervosa.

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