Changes in body composition using deuterium dilution technique among young children receiving specialized nutritious foods for treatment of moderate acute malnutrition in Sierra Leone

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Background

- Anthropometry indicators mid-upper arm circumference (MUAC) and weight-for-height z-score (WHZ) are currently used to determine recovery from moderate acute malnutrition (MAM)
- Body composition measures of fat mass (FM) and fat-free mass (FFM) give more detail to quality of weight gain and may be important for longer term maintenance of recovery and risk of chronic disease later in life

Objectives

- Investigate the effects of four study foods on changes in FM and FFM among children after 4 weeks of treatment for MAM
- Compare changes in body composition with changes in anthropometric measures MUAC and WHZ

Study Setting and Methods

- This sub-study was nested within a cluster-randomized trial comparing the cost-effectiveness of four specialized nutritious foods (SNF) in treating children 6-59 months with MAM, in Pujehun District, Sierra Leone.
- Children were recruited from 2 of the 7 clinics from each arm (*n*=578).
- Children were screened for MAM (MUAC<11.5cm) and given 14-day rations of one of four study SNFs and instructed to return to clinic every 2 weeks until they recovered (MUAC>=12.5cm) of up to 12 weeks;

Corn-Soy Blend Plus w/ oil (CSB+ w/oil)

Super Cereal Plus w/ amylase (SC+A)

Corn-Soy-Whey Blend w/ oil (CSWB)

Ready-to-Use-Supplementary Food (RUSF)

- FFM and FM assessed at 0 and 4 weeks of treatment using Deuterium Dilution (DD) technique. Sample analysis using calculated hydration factors yielded estimates of FM and FFM.
- Changes in weight, FM, FFM and %FFM (FFM / body weight x 100) and FFM index (FFM kg / height^2) were tabulated overall and by study arm
- Differences in outcomes among arms were assessed using linear regression adjusted for baseline outcome, age, sex, baseline WHZ and wealth quintile
- Pearson correlations were used to compare among the changes in fat mass, fat-free mass, MUAC and WHZ
- Mean changes in FFM, FM and weight were estimated
- 352 subjects were included in the final analysis

Results

At enrollment, descriptive statistics of subjects included in body composition analysis, *n*=352

	Total	CSB+ w/ oil	SC+A	CSWB w/ oil	RUSF	*P*-value[3]
n	352	94	107	75	76	
Age, m	12.24 ± 6.95[1]	11.99 ± 6.40	12.93 ± 7.65	12.38 ± 6.90	11.44 ± 6.67	0.530
Female	199 (57%)[2]	55 (59%)	65 (61%)	40 (53%)	39 (51%)	0.556
Previous SAM	89 (25%)	26 (28%)	28 (26%)	15 (20%)	20 (26%)	0.672
HAZ	-2.75 ± 1.17	-2.77 ± 1.21	-2.74 ± 1.10	-2.87 ± 1.22	-2.62 ± 1.20	0.659
WHZ	-1.71 ± 0.72	-1.64 ± 0.67	-1.78 ± 0.72	-1.84 ± 0.73	-1.57 ± 0.74	0.059
Wealth quintile						<0.001
Lowest	74 (21%)	24 (26%)	12 (11%)	17 (23%)	21 (28%)	
Low	64 (18%)	9 (10%)	18 (17%)	13 (17%)	24 (32%)	
Middle	69 (20%)	21 (22%)	23 (22%)	11 (15%)	14 (18%)	
High	80 (23%)	23 (24%)	23 (22%)	20 (27%)	14 (18%)	
Highest	63 (18%)	17 (18%)	29 (28%)	14 (19%)	3 (4%)	
Recovered within 12 weeks	263 (75%)	70 (74%)	82 (77%)	57 (76%)	54 (70%)	0.772

[1] Mean ± SD, all such values
[2] Frequency (percent), all such values
[3] ANOVA tests were used for continuous variables; chi-square tests were used for categorical
Abbreviations: FFM, fat-free mass; FM, fat mass; CSB+, Corn Soy Blend Plus; CSWB, Corn Soy Whey Blend; HAZ, height-for-age z-score; MUAC, mid-upper arm circumference; RUSF, ready-to-use supplementary food; SAM, severe acute malnutrition; SC+A, Super Cereal plus Amylase; WHZ, weight-for-height z-score

Anthropometric and body composition measures at enrollment and changes after 4 weeks of treatment for MAM, *n*=352

	Total	CSB+ w/ oil	SC+A	CSWB w/ oil	RUSF	*P*-value[2]
n	352	94	107	75	76	
Baseline						
Weight, kg	6.54 ± 0.94[1]	6.54 ± 1.06	6.61 ± 0.95	6.51 ± 0.76	6.47 ± 0.92	0.796
WHZ	-1.71 ± 0.72	-1.64 ± 0.67	-1.78 ± 0.72	-1.84 ± 0.73	-1.57 ± 0.74	0.059
MUAC, cm	11.97 ± 0.27	12.00 ± 0.27	11.99 ± 0.25	11.95 ± 0.27	11.94 ± 0.27	0.316
Total body water, kg	4.17 ± 0.70	4.14 ± 0.65	4.21 ± 0.80	4.18 ± 0.64	4.13 ± 0.70	0.857
FFM, kg	5.26 ± 0.94	5.22 ± 0.87	5.32 ± 1.05	5.27 ± 0.85	5.20 ± 0.93	0.832
FM, kg	1.28 ± 0.50	1.32 ± 0.54	1.29 ± 0.50	1.24 ± 0.51	1.27 ± 0.45	0.762
FFM %	80.33 ± 7.34	80.06 ± 7.04	80.24 ± 7.61	80.89 ± 7.84	80.24 ± 6.90	0.897
FFM index	11.65 ± 1.18	11.64 ± 1.23	11.57 ± 1.19	11.70 ± 1.20	11.74 ± 1.09	0.790
Change after 4 wks[4]						
Weight, kg	0.43 ± 0.39	0.42 ± 0.38	0.46 ± 0.41	0.43 ± 0.39	0.40 ± 0.36	0.793
WHZ[3]	0.30 ± 0.60	0.27 ± 0.59	0.34 ± 0.54	0.41 ± 0.68	0.14 ± 0.60	0.102
MUAC, cm [4]	0.32 ± 0.45	0.29 ± 0.47	0.33 ± 0.40	0.37 ± 0.48	0.28 ± 0.45	0.720
Total body water, kg	0.28 ± 0.45	0.28 ± 0.42	0.26 ± 0.52	0.28 ± 0.46	0.32 ± 0.40	0.881
FFM, kg	0.37 ± 0.57	0.37 ± 0.54	0.35 ± 0.66	0.36 ± 0.57	0.41 ± 0.50	0.895
FM, kg	0.06 ± 0.62	0.06 ± 0.58	0.11 ± 0.69	0.07 ± 0.65	-0.01 ± 0.50	0.627
FFM %	0.35 ± 8.65	0.23 ± 8.12	-0.20 ± 9.43	0.27 ± 9.16	1.38 ± 7.62	0.678
FFM index[5]	0.48 ± 1.30	0.55 ± 1.22	0.47 ± 1.47	0.38 ± 1.25	0.51 ± 1.20	0.922

[1] Mean ± SD, all such values
[2] ANOVA tests used to determine differences among the 4 study arms
[3] *n*=257 due to missing values at 4 weeks
[4] *n*=250 due to missing values at 4 weeks
[5] *n*=234 due to missing values at 4 weeks
Abbreviations: FFM, fat-free mass; FM, fat mass; CSB+, Corn Soy Blend Plus; CSWB, Corn Soy Whey Blend; MUAC, mid-upper arm circumference; RUSF, ready-to-use supplementary food; SC+A, Super Cereal plus Amylase; WHZ, weight-for-height z-score

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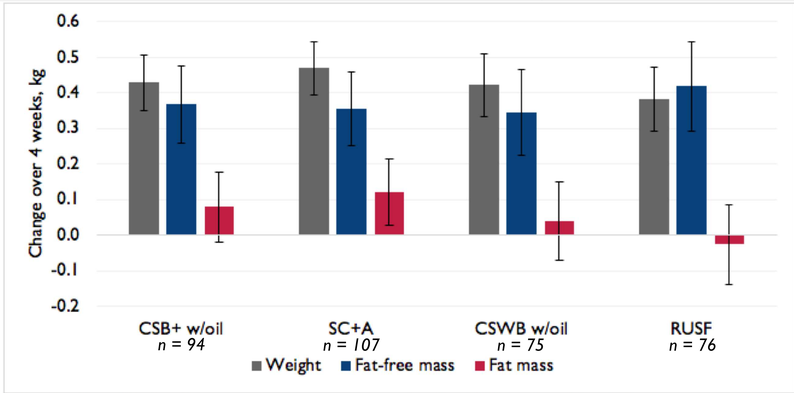
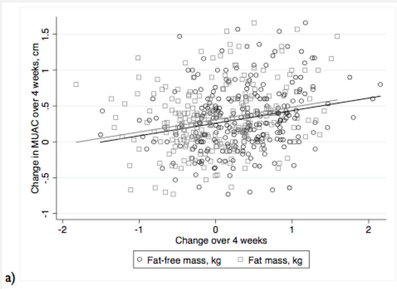
Change in weight, fat-free mass and fat mass by study arm after 4 weeks of treatment for MAM[1], *n*=352



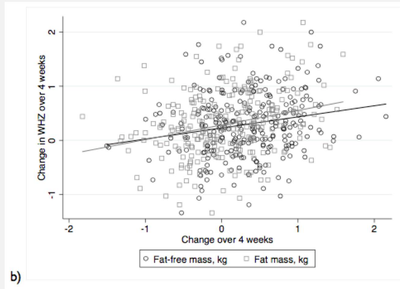
[1] Models adjusted for baseline outcome measure, age, sex, baseline WHZ and wealth quintile
Abbreviations: CSB+, Corn Soy Blend Plus; CSWB, Corn Soy Whey Blend; MAM, moderate acute malnutrition; RUSF, ready-to-use supplementary food; SC+A, Super Cereal plus Amylase

Pearson correlations between changes in:

(a) MUAC and FFM =0.23 or FM=0.23 (*P*<0.001)



(b) WHZ and FFM=0.20 (*P*=0.002), FM=0.27 (*P*<0.001)



Conclusions

1. Statistically different changes in body composition (FM and FFM) among the four study arms were not observed
2. On average, most of the weight gained over the 4 weeks of treatment was FFM (~ 86%)
3. Changes in body composition were weakly correlated with anthropometric measures
4. Children who recovered within 12 weeks of treatment gained significantly more FFM and FM within first 4 weeks of treatment compared with children who did not recover; a similar pattern was seen among children who sustained recovery for 1 month vs those who relapsed (not reported)