

**Supplementary Table S1.** Comparison of Combined and Standard Protocols \*

|                                      | Standard Protocol (CONTROL)                                                                                                                                                                                                                                           | Combined Protocol (INTERVENTION)                                                                                                                                                                                   |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Eligibility criteria</b>          | Age 6–59 months, MUAC < 12.5 cm and/or oedema (+/++), and clinically uncomplicated (i.e., passes appetite test, no Integrated Management of Childhood Illness (IMCI) <sup>†</sup> <b>Error! Bookmark not defined.</b> danger signs/ no serious medical complications) | Age 6–59 months, MUAC <12.5cm and/or oedema (+/++), and clinically uncomplicated (i.e., passes appetite test, no Integrated Management of Childhood Illness (IMCI) danger signs/ no serious medical complications) |
| <b>Admission criteria</b>            | <b>OTP</b>                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• WHZ &lt; -3</li> </ul> AND/OR                                                                                                                                                                                                |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• MUAC &lt; 11.5 cm</li> </ul> AND/OR                                                                                                                                                                                          |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• Bilateral pitting oedema (+/++)</li> </ul> AND                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• &lt;12.5 cm MUAC</li> </ul> AND/OR                                                                                                                                        |
| <b>Admission criteria</b>            | <ul style="list-style-type: none"> <li>• clinically uncomplicated</li> </ul> <b>SFP</b>                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Bilateral pitting oedema (+/++)</li> </ul> AND                                                                                                                            |
|                                      | <ul style="list-style-type: none"> <li>• Discharged from OTP</li> </ul> AND/OR                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>• clinically uncomplicated</li> </ul>                                                                                                                                       |
|                                      | <ul style="list-style-type: none"> <li>• WHZ &lt; -2.0 to WHZ &gt; -3</li> </ul> AND/OR                                                                                                                                                                               |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• MUAC ≥ 11.5 cm and &lt; 12.5 cm</li> </ul> AND                                                                                                                                                                               |                                                                                                                                                                                                                    |
| <b>Treatment frequency</b>           | <b>OTP</b>                                                                                                                                                                                                                                                            | <b>MUAC &lt;11.5 cm and/or edema (+/++)</b>                                                                                                                                                                        |
|                                      | Weekly                                                                                                                                                                                                                                                                | Weekly                                                                                                                                                                                                             |
|                                      | <b>SFP</b>                                                                                                                                                                                                                                                            | <b>MUAC ≥ 11.5 and &lt; 12.5cm</b>                                                                                                                                                                                 |
|                                      | 14 days                                                                                                                                                                                                                                                               | 14 days                                                                                                                                                                                                            |
| <b>Treatment transition criteria</b> | <ul style="list-style-type: none"> <li>• Child meets OTP ‘recovered’ definition as described below</li> </ul>                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Two consecutive MUAC measurements at or above 11.5 cm</li> </ul> AND                                                                                                      |
|                                      |                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>• No edema</li> </ul>                                                                                                                                                       |
| <b>Dosage</b>                        | <b>OTP</b>                                                                                                                                                                                                                                                            | <b>MUAC &lt; 11.5 cm and/or edema (+/++)</b>                                                                                                                                                                       |
|                                      | RUTF 200 kcal/kg/day                                                                                                                                                                                                                                                  | RUTF 1000 kcal/day (2 sachets/day)                                                                                                                                                                                 |
|                                      | <b>SFP</b>                                                                                                                                                                                                                                                            | <b>MUAC ≥ 11.5 and &lt; 12.5 cm</b>                                                                                                                                                                                |
|                                      | RUSF 500 kcal/day (1 sachet/day)                                                                                                                                                                                                                                      | RUTF 500 kcal/day (1 sachet/day)                                                                                                                                                                                   |
| <b>Recovered</b>                     | <b>OTP</b>                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• Child maintains MUAC ≥ 11.5 cm for two consecutive visits</li> </ul> AND/OR                                                                                                                                                  |                                                                                                                                                                                                                    |
|                                      | <ul style="list-style-type: none"> <li>• WHZ &gt; -3 z-score for two consecutive visits</li> </ul> AND                                                                                                                                                                | <ul style="list-style-type: none"> <li>• ≥ 12.5 cm for 2 consecutive measurements and no edema</li> </ul>                                                                                                          |
|                                      | <ul style="list-style-type: none"> <li>• No edema for two consecutive visits</li> </ul> <b>SFP</b>                                                                                                                                                                    |                                                                                                                                                                                                                    |
|                                      | Child maintains WHZ > -2.0 z-score and/or MUAC ≥ 12.5 cm for a period of two consecutive visits                                                                                                                                                                       |                                                                                                                                                                                                                    |

MUAC, mid-upper arm circumference; IMCI, Integrated Management of Childhood Illness; WHZ, weight-for-height z-score; OTP, outpatient therapeutic program; SFP, supplementary feeding program; RUTF, ready-to-use therapeutic food; RUSF, ready-to-use supplementary food. \* Adapted from Bailey et al. 2018 [27] and Bailey et al. 2020 [35]. <sup>†</sup> Integrated Management of Childhood Illness (IMCI) (revised). 2014. [http://www.who.int/maternal\\_child\\_adolescent/documents/IMCI\\_chartbooklet/en/](http://www.who.int/maternal_child_adolescent/documents/IMCI_chartbooklet/en/) (accessed on 22 March 2021).

**Supplementary Table S2.** Standard ready-to-use therapeutic food dosage table (based on 200 kcal/kg/day using 92 g packets containing 500 kcal) \*

| Child's Weight (kg)   | Packets per Day | Packets per Week |
|-----------------------|-----------------|------------------|
| 4.0 <sup>†</sup> –4.9 | 2               | 14               |
| 5.0–6.9               | 2.5             | 18               |
| 7.0–8.4               | 3               | 21               |
| 8.5–9.4               | 3.5             | 25               |
| 9.5–10.4              | 4               | 28               |
| 10.5–11.9             | 4.5             | 32               |
| ≥12                   | 5               | 35               |

\* Adapted from Bailey et al 2020 [35]. <sup>†</sup> Infants ≥ 6 months and < 4kg are referred to in-patient care.

**Supplementary Table S3.** Relapse, body composition and morbidity at four months post-discharge, by admission category and protocol type (Kenya sample only)

| Intention-to-Treat                         | Group 1<br>MUAC < 11.5 cm and WAZ ≥ -3.0<br>( <i>n</i> = 29) |      |                                            |      | Group 2<br>MUAC 11.5 to < 12.5 cm and<br>WAZ < -3.0 ( <i>n</i> = 140) |      |                                            |      | Group 3<br>MUAC < 11.5 cm and WAZ < -3.0<br>( <i>n</i> = 56) |      |                                            |      |
|--------------------------------------------|--------------------------------------------------------------|------|--------------------------------------------|------|-----------------------------------------------------------------------|------|--------------------------------------------|------|--------------------------------------------------------------|------|--------------------------------------------|------|
|                                            | Combined<br>( <i>N</i> = 6, <i>n</i> = 10)                   |      | Standard<br>( <i>N</i> = 6, <i>n</i> = 19) |      | Combined<br>( <i>N</i> = 6, <i>n</i> = 87)                            |      | Standard<br>( <i>N</i> = 6, <i>n</i> = 53) |      | Combined<br>( <i>N</i> = 6, <i>n</i> = 30)                   |      | Standard<br>( <i>N</i> = 6, <i>n</i> = 26) |      |
|                                            | <i>n</i>                                                     | %    | <i>n</i>                                   | %    | <i>n</i>                                                              | %    | <i>n</i>                                   | %    | <i>n</i>                                                     | %    | <i>n</i>                                   | %    |
| Acute malnutrition status <sup>†</sup>     | 2                                                            | 20   | 5                                          | 26   | 15                                                                    | 17   | 10                                         | 19   | 7                                                            | 23   | 5                                          | 19   |
| Relapse to acute malnutrition <sup>‡</sup> | 1/4                                                          | 25   | 1/10                                       | 10   | 10/68                                                                 | 15   | 6/35                                       | 17   | 1/12                                                         | 8    | 1/13                                       | 8    |
| Illness reported in past week <sup>§</sup> | 2                                                            | 20   | 9                                          | 47   | 21                                                                    | 24   | 12                                         | 23   | 6                                                            | 20   | 8                                          | 31   |
| Hospitalization reported in past 4 months  | 0                                                            | 0    | 1                                          | 5    | 5                                                                     | 6    | 3                                          | 6    | 1                                                            | 3    | 2                                          | 8    |
|                                            | mean                                                         | SD   | mean                                       | SD   | mean                                                                  | SD   | mean                                       | SD   | mean                                                         | SD   | mean                                       | SD   |
| Fat free mass (kg)                         | 6.29                                                         | 0.54 | 6.26                                       | 0.62 | 6.08                                                                  | 0.82 | 6.22                                       | 0.88 | 6.18                                                         | 0.66 | 6.16                                       | 0.70 |
| Fat mass (kg)                              | 2.26                                                         | 0.61 | 2.43                                       | 0.63 | 2.15                                                                  | 0.84 | 2.31                                       | 0.93 | 2.44                                                         | 1.14 | 2.10                                       | 0.77 |

MUAC, mid-upper arm circumference; WAZ, weight-for-age z-score. *N* = number of clusters; *n* = individual children eligible for treatment. <sup>†</sup> At 4-month follow-up visit. <sup>‡</sup> Among those discharged as cured. <sup>§</sup> Data collected on reported diarrhea, vomiting, fever or cough in past week.

**Supplementary Table S4.** Outcomes of children in group 1, unadjusted and adjusted risk ratios

| Intention-to-Treat                 | Group 1 MUAC < 11.5 cm and WAZ ≥ -3.0 ( <i>n</i> = 337) |        |                                              |         |                                                                              |                              |                                  |                              |
|------------------------------------|---------------------------------------------------------|--------|----------------------------------------------|---------|------------------------------------------------------------------------------|------------------------------|----------------------------------|------------------------------|
|                                    | Combined<br>( <i>N</i> = 12, <i>n</i> = 142)            |        | Standard<br>( <i>N</i> = 12, <i>n</i> = 195) |         | Unadjusted Risk Ratio <sup>†</sup>                                           |                              | Adjusted Risk Ratio <sup>†</sup> |                              |
|                                    | <i>n</i>                                                | %      | <i>n</i>                                     | %       | Risk ratio (95% CI)                                                          | <i>p</i> -Value <sup>‡</sup> | Risk ratio (95% CI)              | <i>p</i> -Value <sup>‡</sup> |
| Recovered                          | 25                                                      | 17.6   | 41                                           | 21.0    | 0.84 (0.52, 1.35)                                                            | 0.47                         | 0.87 (0.54, 1.40)                | 0.56                         |
| Died                               | 1                                                       | 0.7    | 2                                            | 1.0     | 0.69 (0.07, 6.45)                                                            | 0.74                         | 0.57 (0.05, 6.55)                | 0.65                         |
| Defaulted                          | 48                                                      | 33.8   | 83                                           | 42.6    | 0.79 (0.57, 1.11)                                                            | 0.18                         | 0.81 (0.58, 1.12)                | 0.20                         |
| Non-recovered <sup>§</sup>         | 46                                                      | 32.4   | 56                                           | 28.7    | 1.13 (0.75, 1.70)                                                            | 0.57                         | 1.16 (0.77, 1.74)                | 0.48                         |
| Transfer-inpatient                 | 7                                                       | 4.9    | 2                                            | 1.0     | 3.20 (0.68, 15.04)                                                           | 0.14                         | 3.13 (0.76–12.96)                | 0.12                         |
| Transfer-new facility              | 6                                                       | 4.2    | 2                                            | 1.0     | 4.12 (0.74, 22.87)                                                           | 0.11                         | 4.08 (0.75, 22.13)               | 0.10                         |
| Early discharge                    | 9                                                       | 6.3    | 9                                            | 4.6     | 1.53 (0.61, 3.80)                                                            | 0.36                         | 1.54 (0.68, 3.45)                | 0.30                         |
|                                    |                                                         |        |                                              |         | Common Language Effect Size statistic<br>(control > intervention) * (95% CI) |                              |                                  |                              |
| Length of stay (days) <sup>a</sup> | 80                                                      | 59, 94 | 94                                           | 85, 108 | 0.63 (0.49, 0.78)                                                            |                              |                                  |                              |

MUAC, mid-upper arm circumference; WAZ, weight-for-age z-score. *N* = number of clusters; *n* = individual children eligible for treatment. <sup>†</sup> Both unadjusted and adjusted results account for the effect of clustering. The adjusted model also includes adjustment for country, age and sex. <sup>‡</sup> Analyses use the Generalized Linear Model, reporting Pearson chi-squared *p*-values. <sup>§</sup> Non-recovered defined as not reaching recovery criteria after 17 weeks in treatment. <sup>a</sup> Length of stay among recovered children only, per global CMAM reporting standards [46]. \* Probability that a randomly selected control length of stay is greater than a randomly selected intervention length of stay.

**Supplementary Table S5. Outcomes of children in group 2, unadjusted and adjusted risk ratios**

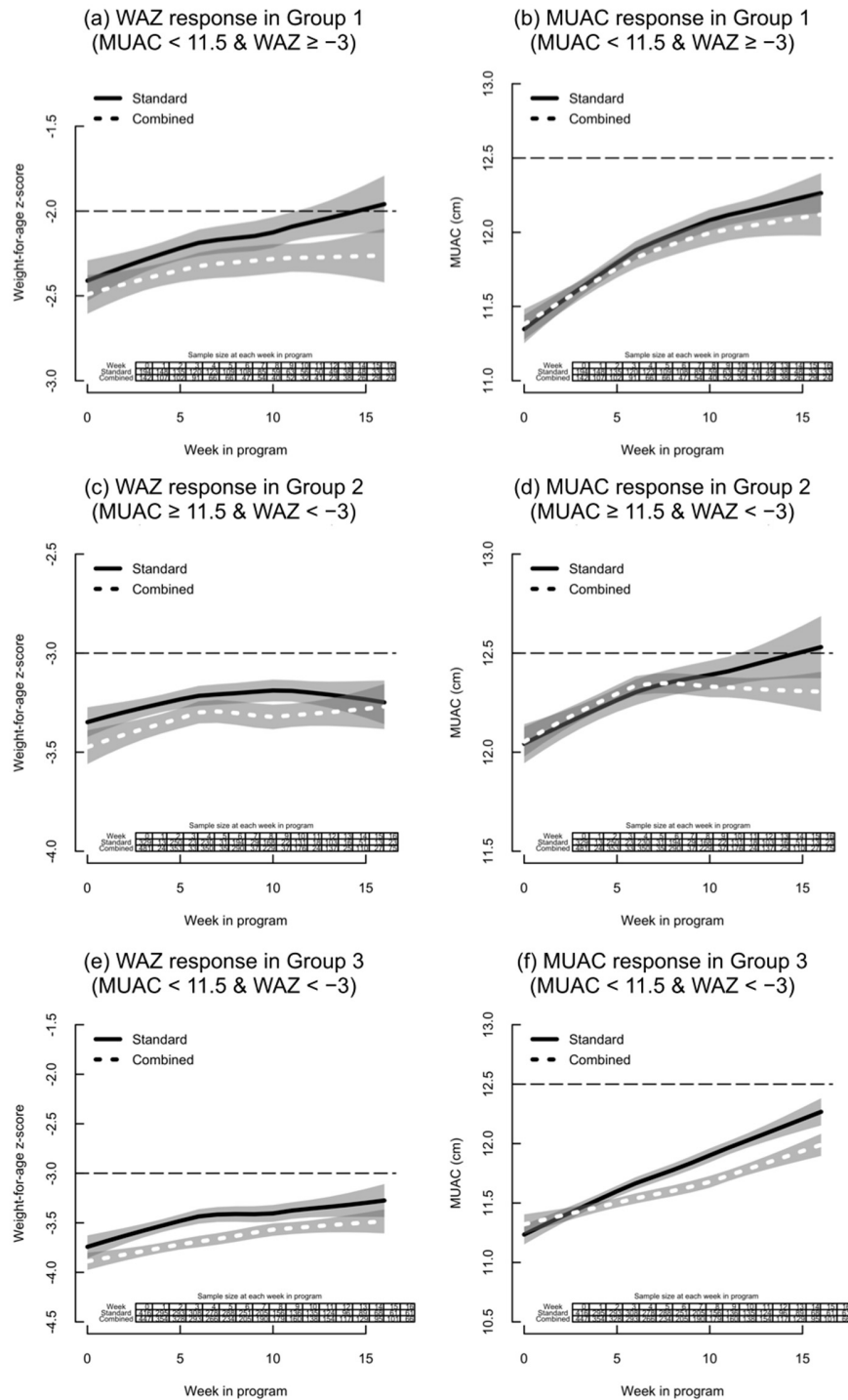
| Intention-to-Treat                 | Group 2 MUAC 11.5 to <12.5cm and WAZ < -3.0 (n=811) |        |                               |                                                                              |                                    |                      |                                  |                      |
|------------------------------------|-----------------------------------------------------|--------|-------------------------------|------------------------------------------------------------------------------|------------------------------------|----------------------|----------------------------------|----------------------|
|                                    | Combined<br>(N = 12, n = 482)                       |        | Standard<br>(N = 12, n = 329) |                                                                              | Unadjusted Risk Ratio <sup>†</sup> |                      | Adjusted Risk Ratio <sup>†</sup> |                      |
|                                    | n                                                   | %      | n                             | %                                                                            | Risk Ratio (95% CI)                | p-Value <sup>‡</sup> | Risk Ratio (95% CI)              | p-Value <sup>‡</sup> |
| Recovered                          | 274                                                 | 56.9   | 163                           | 49.5                                                                         | 1.15 (0.85, 1.55)                  | 0.37                 | 1.18 (0.90, 1.54)                | 0.24                 |
| Died                               | 4                                                   | 0.83   | 3                             | 0.91                                                                         | 0.91 (0.16, 5.25)                  | 0.92                 | 0.75 (0.15, 3.86)                | 0.73                 |
| Defaulted                          | 92                                                  | 19.1   | 79                            | 24.0                                                                         | 0.78 (0.45, 1.37)                  | 0.39                 | 0.78 (0.51, 1.19)                | 0.25                 |
| Non-recovered <sup>§</sup>         | 41                                                  | 8.5    | 28                            | 8.5                                                                          | 1.0 (0.40, 2.50)                   | 1.0                  | 0.82 (0.41, 1.63)                | 0.58                 |
| Transfer-inpatient                 | 5                                                   | 1.0    | 5                             | 1.5                                                                          | 0.68 (0.13, 3.59)                  | 0.65                 | 0.68 (0.14, 3.28)                | 0.63                 |
| Transfer-new facility              | 9                                                   | 1.9    | 6                             | 1.8                                                                          | 0.98 (0.37, 2.60)                  | 0.96                 | 1.06 (0.45, 2.48)                | 0.90                 |
| Early discharge                    | 57                                                  | 11.8   | 45                            | 13.7                                                                         | 0.89 (0.46, 1.72)                  | 0.73                 | 0.95 (0.57, 1.61)                | 0.86                 |
| Median IQR Median IQR              |                                                     |        |                               | Common Language Effect Size Statistic<br>(control > intervention) * (95% CI) |                                    |                      |                                  |                      |
| Length of stay (days) <sup>a</sup> | 57                                                  | 43, 85 | 71                            | 57, 85                                                                       | 0.52 (0.46, 0.58)                  |                      |                                  |                      |

MUAC, mid-upper arm circumference; WAZ, weight-for-age z-score. N = number of clusters; n = individual children eligible for treatment. <sup>†</sup> Both unadjusted and adjusted results account for the effect of clustering. The adjusted model also includes adjustment for country, age and sex. <sup>‡</sup> Analyses use the Generalized Linear Model, reporting Pearson chi-squared p-Values. <sup>§</sup> Non-recovered defined as not reaching recovery criteria after 17 weeks in treatment. <sup>a</sup> Length of stay among recovered children only, per global CMAM reporting standards [46]. \*Probability that a randomly selected control length of stay is greater than a randomly selected intervention length of stay.

**Supplementary Table S6.** Outcomes of children in group 3, unadjusted and adjusted risk ratios

| Intention-to-Treat                 | Group 3 MUAC < 11.5 cm and WAZ < -3.0 ( <i>n</i> = 863) |         |                                              |         |                                                                              |                   |                       |                   |
|------------------------------------|---------------------------------------------------------|---------|----------------------------------------------|---------|------------------------------------------------------------------------------|-------------------|-----------------------|-------------------|
|                                    | Combined<br>( <i>N</i> = 12, <i>n</i> = 447)            |         | Standard<br>( <i>N</i> = 12, <i>n</i> = 416) |         | Unadjusted Risk Ratio †                                                      |                   | Adjusted Risk Ratio † |                   |
|                                    | <i>n</i>                                                | %       | <i>n</i>                                     | %       | Risk ratio (95% CI)                                                          | <i>p</i> -Value ‡ | Risk ratio (95% CI)   | <i>p</i> -Value ‡ |
| Recovered                          | 87                                                      | 19.5    | 57                                           | 13.7    | 1.42 (0.89, 1.95)                                                            | 0.06              | 1.36 (0.90, 1.82)     | 0.07              |
| Died                               | 9                                                       | 2.0     | 7                                            | 1.7     | 1.20 (0.30, 4.78)                                                            | 0.25              | 0.91 (0.36, 2.33)     | 0.85              |
| Defaulted                          | 150                                                     | 33.6    | 188                                          | 45.2    | 0.74 (0.56, 0.98)                                                            | 0.03              | 0.74 (0.57, 0.97)     | 0.03              |
| Non-recovered §                    | 111                                                     | 24.8    | 114                                          | 27.4    | 0.90 (0.70, 1.15)                                                            | 0.40              | 0.91 (0.73, 1.15)     | 0.45              |
| Transfer-inpatient                 | 18                                                      | 4.0     | 11                                           | 2.6     | 1.40 (0.34, 5.69)                                                            | 0.47              | 1.58 (0.38, 6.56)     | 0.53              |
| Transfer-new facility              | 21                                                      | 4.7     | 12                                           | 2.9     | 1.43 (0.64, 3.17)                                                            | 0.38              | 1.51 (0.68, 3.35)     | 0.31              |
| Early discharge                    | 51                                                      | 11.4    | 27                                           | 6.5     | 1.80 (0.95, 3.40)                                                            | 0.07              | 1.95 (1.10, 3.43)     | 0.02              |
|                                    | Median                                                  | IQR     | Median                                       | IQR     | Common Language Effect Size statistic<br>(control > intervention) * (95% CI) |                   |                       |                   |
| Length of stay (days) <sup>a</sup> | 81                                                      | 66, 101 | 94                                           | 71, 108 | 0.56 (0.46, 0.67)                                                            |                   |                       |                   |

MUAC, mid-upper arm circumference; WAZ, weight-for-age z-score. *N* = number of clusters; *n* = individual children eligible for treatment. †Both unadjusted and adjusted results account for the effect of clustering. The adjusted model also includes adjustment for country, age and sex. ‡ Analyses use the Generalized Linear Model, reporting Pearson chi-squared *p*-values. § Non-recovered defined as not reaching recovery criteria after 17 weeks in treatment. <sup>a</sup> Length of stay among recovered children only, per global CMAM reporting standards [46]. \* Probability that a randomly selected control length of stay is greater than a randomly selected intervention length of stay.



**Supplementary Figure S1.** Panel of WAZ and MUAC response among all children by admission group. MUAC, mid-upper arm circumference; WAZ, weight-for-age z-score. (a) WAZ plotted against week in program for Group 1; (b) MUAC plotted against week in program for Group 1; (c) WAZ plotted against week in program for Group 2; (d) MUAC plotted against week in program for Group 2; (e) WAZ plotted against week in program for Group 3; (f) MUAC plotted against week in program for Group 3. The shaded areas represent a 95% confidence band around each curve (i.e., the area between the upper and lower 95% confidence limits is shaded). Overlaps between confidence intervals are more darkly shaded.