



RESEARCH ARTICLE

URL artikel: <http://jurnal.fkmumi.ac.id/index.php/woh/article/view/woh9322>**Changes in the body weight of toddlers after the implementation of Responsive Feeding Plus in the Work Area of Tawiri Community Health Center, Ambon City*****Maria Magdalena Goha¹, Westy Tahapary², Ivin Murfavam³, Prisilia Dina⁴, Abdullah Al Mamun⁵, Vernando Yanry Lameky⁶**^{1,2,3,4,6}Nursing Study Program, Faculty of Health, Christian University of Indonesia, Maluku, Indonesia⁵Center for Multidisciplinary and Contemporary Research (CMCR), Rangpur, BangladeshEmail Corresponding Author(^c): mariegoha@gmail.commariegoha@gmail.com¹, westytahapary99@gmail.com², lvnmurfavam@gmail.com³,
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ABSTRACT

Malnutrition among children under five remains a public health concern, particularly in Maluku, where the prevalence of underweight exceeds the national estimate. This study aimed to compare changes in body weight among underweight children receiving Responsive Feeding Plus (RF Plus) and routine nutrition services in the working area of the Tawiri Community Health Center, Ambon City. A quasi-experimental pretest–posttest control-group design was conducted among 30 children aged 12–59 months recruited through total sampling, with 15 children allocated non-randomly to the RF Plus group and 15 to the control group. RF Plus consisted of three main meals and two energy-dense snacks per day, caregiver education on hunger and satiety cues, responsive feeding without coercion or distraction, and twice-weekly monitoring. Body weight was measured at baseline and after 40 days. Within-group changes were analyzed using the Wilcoxon signed-rank test, while differences in weight change between groups were assessed using the Mann–Whitney test. Mean body weight increased from 10.09±2.05 to 11.42±2.02 kg in the RF Plus group and from 9.95±1.39 to 10.31±1.31 kg in the control group. Mean weight gain was 1.33±0.53 kg (95% CI: 1.04–1.62) in the RF Plus group compared with 0.35±0.22 kg (95% CI: 0.23–0.48) in the control group. The difference in weight change between groups was statistically significant ($p < 0.001$). RF Plus was associated with greater short-term weight gain than routine services among underweight children. However, these findings should be interpreted cautiously because of the small sample size, non-random allocation, potential residual confounding and clustering at the Posyandu level, and short follow-up period.

Keywords: Body weight; caregiver education; responsive feeding; toddlers; underweight

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INTRODUCTION

Malnutrition in early life is associated with growth disorders as well as neurodevelopmental and cognitive consequences that may persist into later stages of life. Suryawan et al. emphasized the neurodevelopmental and cognitive consequences of early-life malnutrition [1]. Arráiz De Fernández et al. similarly reported adverse effects of malnutrition on child neurodevelopment and mental health [2]. These findings underscore the importance of early nutritional intervention and monitoring of measurable child growth outcomes.

Underweight among children under five years of age remains an important nutritional problem in Indonesia. Sihalohe and Sitanggang identified several factors contributing to underweight among children under five years of age at the Belawan Primary Health Center [3]. Syafii et al. reported malnutrition in Kendari City, Southeast Sulawesi [4], while Mahihody and Hinonaung examined factors influencing underweight among children under five years of age in Sangihe Regency [5]. Together, these studies indicate that underweight should be interpreted within the characteristics and context of the local child population.

Feeding practices are a modifiable aspect of caregiving. Bergamini et al., in a systematic review and meta-analysis, examined complementary-feeding caregiver practices in relation to child growth and later overweight/obesity risk [6]. Pérez-Escamilla et al. discussed dietary guidance for children under two years of age within a nurturing-care framework, including developmentally appropriate caregiver–child feeding interactions [7]. These findings provide a rationale for assessing structured and responsive feeding approaches in young children while recognizing that recommendations must be adapted to the child's age and nutritional condition.

International evidence supports the importance of caregiver feeding practices, although the strength of conclusions varies across study designs and populations. Killion et al. found that responsive feeding practices are associated with healthy dietary patterns among low-income caregivers of toddlers [8]. Ní Eidhin et al. identified behavior change techniques used in responsive feeding interventions aimed at preventing childhood obesity [9]. Wang et al. reported in a systematic review and meta-analysis that caregiver-focused interventions can modify feeding practices among preschool children [10]. In addition, Boucheron et al. examined observed feeding behaviors and subsequent child weight and length in a cluster-randomized trial in rural India [11]. Collectively, these studies support the relevance of caregiver feeding behavior while cautioning against direct extrapolation of findings across different populations and nutritional outcomes.

Bimpong et al. reported the relationships among mothers' knowledge and attitudes, complementary feeding practices, and determinants of an adequate diet [12]. Liemen et al. examined maternal knowledge, attitudes, and healthy feeding behavior in relation to the nutritional status of elementary school children [13], whereas Ompusunggu investigated the relationship between mothers' knowledge and attitudes about feeding patterns and the nutritional status of preschool children [14].

Although these studies involved different child age groups and outcomes, they collectively highlight caregiver knowledge, attitudes, and feeding behavior as relevant contextual factors in child nutrition.

Intervention evidence from Indonesia also supports the potential role of nutrition education, although the intervention packages differ from those of RF Plus. Effendy et al. evaluated a nutrition education intervention in Southeast Sulawesi using a cluster-randomized controlled design [15]. Rachmah et al. assessed an educational intervention based on the Theory of Planned Behavior for complementary feeding in a randomized controlled trial [16]. Ali et al. discussed the role of early nutritional interventions in shaping long-term pediatric growth and development outcomes [17]. Differences in intervention content, participant characteristics, and outcomes mean that these findings should be used as contextual evidence rather than as direct evidence of the effectiveness of RF Plus.

The gap examined in this study is the change in weight following the implementation of a structured meal opportunity package, caregiver education, and monitoring of responsive feeding practices in the Tawiri Community Health Center (Puskesmas Tawiri) area. In this study, the term RF Plus refers to a package of three main meals and two energy-dense snacks per day, education on responsive feeding interactions, and monitoring of its implementation; the term does not denote a validated standard protocol. The contribution of this study lies in evaluating this package in community services with a comparator and actual weight measurements, not in claiming that all its components are new concepts. This study aimed to compare weight changes between the RF Plus and routine service groups over 40 days. The hypothesis tested was that there was a difference in weight change between the two groups.

METHOD

The study used a quasi-experimental design with a control group and pre–post measurements. The research was conducted at five Posyandu within the service area of Puskesmas Tawiri, Ambon City, in 2025. Baseline measurement took place on July 29, 2025, and the final measurement on September 7, 2025, with a 40-day interval. The accessible population comprised all children under five who met the eligibility criteria at the study sites and period. Through total sampling, 30 children under five were included, 15 in each of the RF Plus and control groups.

The inclusion criteria were as follows: aged 12–59 months, having a BB/U classification record of <-2 SD at recruitment, residing in the Puskesmas Tawiri service area, and parents or caregivers willing to participate and provide written consent. The exclusion criteria were congenital abnormalities affecting feeding or growth, and severe illness requiring hospitalization. The completeness of follow-up measurements determined the availability of paired data for analysis, not initial eligibility at recruitment. No a priori sample size calculation was performed since the entire accessible population meeting eligibility criteria was recruited. This choice does not guarantee adequate statistical power; therefore, precision and generalizability must be limited. The allocation was non-randomized at the Posyandu level to reduce information contamination between caregivers. Children under five from Posyandu designated as intervention sites received RF Plus, while those from the comparator Posyandu received routine care.

Individual matching was not performed. Both groups used the same eligibility criteria and measurement schedule. Baseline characteristics are presented per group to show the potential for imbalance; this presentation does not imply that the groups are fully equivalent.

The RF Plus group received an intervention package during the observation period. The feeding opportunity component consisted of three main meals and two energy-dense snacks per day. Face-to-face caregiver education included meal schedule arrangement, recognition of hunger and satiety cues, appropriate responses to child signals, positive communication, and the avoidance of coercion and distraction. The caregivers were provided with a companion guide. The term “more frequent” refers to the offered package components; changes in actual meal frequency were not considered as study outcomes because their quantitative measures were not provided.

Package implementation was monitored twice weekly through home or Posyandu visits to assess meal scheduling and responsive feeding practices and to provide reinforcement and feedback. The control group received routine health care and did not receive the RF Plus package during observation. Because details of routine services and exposure to other nutrition interventions were not available in the individual dataset, the effect of additional programs in both groups could not be definitively separated. The main anthropometric outcome analyzed was change in body weight in kilograms ($\Delta BW = \text{final BW} - \text{initial BW}$). Height in centimeters was presented as an additional measure. Body weight was measured using a calibrated digital scale as described in the Methods section. Age was available in rounded months at baseline, while individual dates of birth were not available. Therefore, WAZ was not calculated from the reconstructed date of birth. The nutritional status categories in the source data code were presented descriptively and were not used as the main inferential outcome. The BW/A indicator was not exchanged with BW/H; WHO guidelines for wasting use different contexts for assessment and management [18].

Continuous data are presented as mean $\pm$ standard deviation (SD), while weight change is also summarized with median and first and third quartiles (Q1–Q3). The distribution of ΔBW was assessed using the Shapiro–Wilk test. As the distribution of changes in the control group deviated from normality, within-group changes were analyzed using the Wilcoxon signed-rank test and between-group comparisons using the two-sided Mann–Whitney U test. Differences were calculated with 0.1 kg precision according to weight measurement records [19]. Asymptotic tests accounted for ties, and continuity correction was applied in the Mann–Whitney test. The effect size r was calculated as $|Z|/\sqrt{N}$, with $N=30$. The 95% confidence interval (CI) of the mean change was calculated using the t-distribution and is presented as a descriptive estimate, not as a CI for the median difference. The significance threshold was set at $p<0.05$; values smaller than 0.001 were reported as $p<0.001$. This study was approved by the Health Research Ethics Committee of Universitas Airlangga (approval number: 239/EA/KEPK/2025). The purpose, procedures, and participation in the study were explained to the parents or caregivers, and written consent was obtained prior to participation.

RESULTS

A total of 30 toddlers completed the study, consisting of 15 toddlers in the intervention group and 15 toddlers in the control group. The age ranged from 15 to 55 months, with a mean of 32.6 ± 10.1 months. In addition to the nutritional status category of W/A recorded in the study data, the data present actual anthropometric outcomes in the form of weight and height before and after the study period, as well as changes in body weight between groups.

Table 1. Age distribution of children under five in the working area of Tawiri Community Health Center, Ambon City, 2025

Age group	n	%
1-<2 years	4	13.3
2-<3 years	11	36.7
3-<4 years	12	40
4-<5 years	3	10
Total	30	100

The largest proportion were aged 3-<4 years (12 children; 40.0%), followed by those aged 2-<3 years (11 children; 36.7%). Children aged 1-<2 years accounted for four participants (13.3%), while those aged 4-<5 years represented the smallest proportion (three children; 10.0%). These findings indicate that most participants (76.7%) were between 2 and 4 years of age.

Table 2. Distribution of undernourished children under five by sex in the working area of Tawiri Community Health Center, Ambon City, in 2025 based on respondent characteristic data

Gender	n	%
Female	20	66.7
Male	10	33.3
Total	30	100

Of the 30 children included in the study, 20 (66.7%) were female, and 10 (33.3%) were male. These findings indicate that female children constituted the majority of the study participants, accounting for approximately twice as many as male children.

Table 3. Distribution of nutritional status categories of children under five before the intervention period in the working area of Tawiri Community Health Center, Ambon City, 2025 based on the W/A indicator

Nutritional status	n	%
Undernutrition	29	96.7
Severe malnutrition	1	3.3
Total	30	100

The majority of participants (29 children; 96.7%) were classified as undernourished, while one child (3.3%) was classified as severely malnourished. These findings indicate that all participants had nutritional status classifications below the normal category at baseline, with undernutrition being the predominant classification.

Table 4. Distribution of nutritional status categories of children under five after the study period in the Tawiri Health Center working area, Ambon City, 2025 based on the W/A indicator

Nutritional status	n	%
Undernutrition	17	56.7
Normal	13	43.3
Total	30	100

After a 40-day observation period, 17 children under five (56.7%) were in the undernutrition category, 13 children under five (43.3%) were in the normal category, and no children under five remained in the severe malnutrition category.

Table 5. Changes in actual body weight of toddlers measured on July 29, 2025, and September 7, 2025 (40-day interval) in the RF Plus and control groups at Tawiri Community Health Center, Ambon City, using the Wilcoxon test.

Group	n	BB pre (kg), Mean±SD	BB post (kg), Mean±SD	ΔBB (kg), Mean±SD	<i>p-value</i>
RF Plus	15	10.09±2.05	11.42±2.02	1.33±0.53	<0.001
Control	15	9.95±1.39	10.31±1.31	0.35±0.22	<0.001

Body weight increased in both groups. The intervention group experienced an average increase of 1.33±0.53 kg (95% CI for mean change 1.04–1.62), while the control group increased by 0.35±0.22 kg (95% CI 0.23–0.48). The Wilcoxon test showed significant pre-post changes in both the intervention ($p<0.001$) and control groups ($p<0.001$). Because the primary between-group outcome was ΔBW, the main interpretation was based on the comparison of the magnitude of change, rather than merely the pre-post significance in each group.

Table 6. Changes in actual height of children under five at measurements on July 29, 2025, and September 7, 2025 (40-day interval) in the RF Plus and control groups at Tawiri Community Health Center, Ambon City, using the Wilcoxon test.

Group	n	TB pre (cm), Mean±SD	TB post (cm), Mean±SD	ΔTB (cm), Mean±SD	<i>p-value</i>
RF Plus	15	83.99±9.77	86.13±9.55	2.13±1.12	<0.001
Control	15	86.93±6.57	89.13±6.64	2.20±0.41	<0.001

The increase in body weight was greater in the RF Plus group than in the control group. Comparison of weight change between the groups using the two-sided Mann–Whitney test showed a statistically significant difference ($p<0.001$).

DISCUSSION

The main findings indicate that the RF Plus package is associated with greater weight gain than routine care over 40 days. Increases in both groups show that weight changes can occur during growth and routine care; therefore, the basis for interpretation is the difference in changes between groups. The

large statistical effect size provides an initial signal worth investigating, but does not eliminate the risk of bias due to non-random allocation. Weight gain does not automatically indicate nutritional status recovery without validation of anthropometric indicators according to age and sex.

Biologically, three main meals and two snacks may increase opportunities for children to receive food in portions suited to their eating capacity. Responsive feeding allows caregivers to recognize hunger and satiety cues and respond without coercion. Pérez-Escamilla et al. described dietary guidance for young children within a nurturing care framework [7], while Winahyu highlighted the potential role of responsive feeding in enhancing young children's nutrition [20]. However, energy intake, protein intake, actual meal frequency, appetite, and the quality of caregiver-child communication were not measured as outcomes in this study. Therefore, these mechanisms remain plausible explanations rather than demonstrated mediators of the observed weight gain.

The findings are conceptually consistent with the broader evidence on caregiver influences on children's eating behavior. Schratz et al. described caregiver influences on eating behaviors as a potential target for preventing adverse nutritional outcomes [21]. Ní Eidhin et al. identified behavior change techniques used in responsive feeding interventions [9], and a systematic review and meta-analysis of caregiver feeding interventions reported that such interventions can modify feeding practices among preschool children [22]. These sources support the behavioral rationale for RF Plus; however, differences in populations, intervention objectives, and outcomes mean that they should not be interpreted as direct evidence of RF Plus effectiveness in underweight toddlers.

National evidence also supports interpreting feeding practices within the family and nutritional context. Dwibarto reported an association between meal frequency and the nutritional status of children under five [23]. Shidiqah et al. examined responsive feeding practices, maternal self-efficacy, food diversity, socioeconomic status, and toddler nutritional status [24]. A study in Semarang City examined responsive feeding and its correlation with stunted children and obese/overweight mothers [25]. Larasati et al. investigated maternal responsive feeding and food intake among stunted children aged 2–5 years [26]. Together, these studies indicate that feeding behavior operates alongside multiple child, maternal, dietary, and socioeconomic factors; therefore, observational associations should not be equated with the effect of the RF Plus intervention.

A study examining maternal knowledge and attitudes about responsive feeding reported a relationship with the nutritional status of children under five years old [27]. Another study found that family characteristics and social support were related to maternal responsive feeding behavior [28]. Research among children aged 6–24 months also examined maternal characteristics, history of low birth weight, exclusive breastfeeding, and responsive feeding practices in relation to wasting [29]. These factors were not all measured in the present study; therefore, their contributions to differences in weight change cannot be separated. Consequently, the observed benefit of RF Plus should not be attributed solely to caregiver behavior.

Compared with other experimental studies in Indonesia, the present findings should be considered preliminary because the current design provides less control over bias. Mardani et al. evaluated a nutritional education program for childhood undernutrition in a randomized controlled trial [30]. Rachmah et al. assessed a Theory of Planned Behavior-based educational intervention for complementary feeding [16]. Wahyuni et al. evaluated Taburia fortification combined with maternal nutrition education in children aged 12–24 months [31]. Differences in study design, participant age, intervention components, and follow-up duration prevent direct comparisons of effect sizes across these studies. Çapaş and Ayaz evaluated a home-delivered meal service program in an obesity-focused randomized setting [18]; however, because its target condition differs from underweight, it provides only indirect contextual evidence for structured meal delivery.

Weight gain should not be generalized as evidence of preventing wasting. A systematic review and meta-analysis of intensive infant and young child feeding counseling reported limited evidence for preventing wasting and nutritional edema, with uncertainty regarding underweight outcomes [32]. These findings do not rule out the potential value of interventions that combine structured feeding opportunities and caregiver education; however, they emphasize that improvement in a single anthropometric outcome should not be conflated with recovery from other nutritional conditions.

In community services, the implementation of feeding education should consider food access, caregiving practices, family support, and access to health services. Makwela and Mashaba identified socioeconomic, cultural, caregiver, and health-service determinants of suboptimal complementary feeding practices in low- and middle-income countries [33]. These factors are relevant for designing future evaluations in Maluku, although they were not measured as causal determinants of outcome differences in the present study. For Puskesmas Tawiri, the appropriate implication is to further evaluate the integration of responsive feeding education and growth monitoring into routine services with more comprehensive documentation of implementation and contextual factors.

RF Plus may be considered a complementary component of nutrition services based on individual assessment and should not replace management for children with wasting or clinical conditions requiring specific treatment. The World Health Organization's implementation guidance emphasizes appropriate inpatient and outpatient management of wasting and nutritional edema in children under five [34]. Program expansion should also consider food costs, caregiver time, health worker workload, and service coverage. Baek et al. highlighted the importance of economic evaluation when assessing child nutrition interventions in low- and middle-income countries [35].

The main limitations of this study were the small sample size ($n=30$) and the absence of a priori sample size calculation, which limited the precision and generalizability of the findings. Allocation was non-randomized at the Posyandu level without individual matching, creating potential risks of selection bias, baseline imbalance, and residual confounding factors. In addition, the analysis was performed at the individual level without accounting for possible intra-cluster correlations among participants recruited from the same posyandu. Therefore, the reported p-values and confidence intervals should not

be interpreted as fully accounting for the clustered structure of the data. The predominance of female participants in the overall sample may also limit representativeness, although sex-specific imbalances between groups cannot be determined from the available data. Finally, the use of nonparametric tests addressed distributional assumptions but did not eliminate limitations arising from non-randomized design, potential confounding, or clustering.

CONCLUSIONS AND RECOMMENDATIONS

The implementation of RF Plus for 40 days in the working area of the Tawiri Community Health Center was associated with greater weight gain compared to routine services. The mean change in the RF Plus group was 1.33 ± 0.53 kg and in the control group 0.35 ± 0.22 kg; the comparison of changes showed a significant difference in individual analysis ($U=18.5$; $p<0.001$; $r=0.71$). This finding represents preliminary evidence that should be interpreted in light of the small sample, non-random allocation, uncontrolled intra-cluster correlation, short observation period, and data validation limitations. Health workers may consider providing responsive feeding education alongside nutrition services with individual assessment and monitoring, while caregivers should practice feeding interactions according to hunger and satiety cues without coercion. Further research is recommended using complete age data, validated Z-score indicators, compliance and intake monitoring, and designs and analyses that control for confounders and Posyandu clustering.

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