ORIGINAL ARTICLE

Balitagrow Plus Application Usage to Improve Children's Nutritional Status

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ABSTRACT

Introduction: This study was conducted in Rambigundam Village, Rambipuji, Jember, one of the five stunting areas in Jember, with cases ≥40%. Previous studies evaluated the BalitAgrow© application for parents and cadres of children under five. However, existing programs, such as posyandu and other routine activities, mainly focus on children under five, while preschool-aged children receive less intervention and growth monitoring. Therefore, it is necessary to evaluate the effectiveness of the updated BalitAgrow Plus© application, which covers all child age groups. This study aimed to determine the effectiveness of BalitAgrow Plus© in improving children's nutritional status. **Methods:** This cross-sectional study collected data on nutritional status before and after eight weeks of assistance/intervention using the application. There were control (non-users), active-assistance, and passive-assistance (users of the app) groups with the same proportion of 7 respondents per category in each sub-village (there were 5). Data were coded then analyzed using Microsoft Excel and SPSS software with Wilcoxon Signed-Rank and Kruskal-Wallis's test. **Results:** Through this study, there was no significant difference for pre- and post-nutritional status among three groups of intervention ($p > 0.05$). However, there was an increased trend in the growth of the respondent. **Conclusion:** To summarize, while application assistance did not particularly target the initiatives to enhance children's nutritional status, it is hoped that this program will create more awareness about stimulating children's growth.
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INTRODUCTION

Child malnutrition remains an issue worldwide, especially in middle-low-income countries [1]. Stunting is one of the major nutrition problems in Indonesia. According to the SSGI (Indonesian Nutrition Status Survey) in 2022, the prevalence of stunting in Indonesia is relatively high (21.6%), and efforts are needed to reduce it every year to achieve the 2024 target of 14% [2]. Jember Regency is the first contributor to stunting in East Java[3]. In particular, Rambigundam Village, Rambipuji, Jember, is one of the five stunting locations in Jember with over 40% cases.

Efforts to improve the quality of nutrition can be carried out with a holistic approach, starting from primordial, primary, and secondary to tertiary preventive measures. In previous studies, we have evaluated the efficacy of the BalitAgrow© application for parents and cadres of children under five. The study showed that Balitagrow© in virtual Posyandu program effectively maintained children's growth and development in pandemic era [4, 5]. Balitagrow is an android-based application that can be download from the 'Google Playstore'. This application was developed by the Public Health Department of UNEJ Medical Faculty, including features such as nutrition status, real-time food record followed by monthly resume report, nutritional food recipe, Nutritional-need calculator and nutrition-related education videos. Throughout the study, it was brought to our attention that the available programs, such as "posyandu" or other regular activities, were still focused on children under five, so the preschool age received less intervention and monitoring of their growth.

Ongoing undernutrition can result in short and long-term effects in children, including increased risk of infections, risk of non-communicable disease, failure to reach physical developmental milestones, decreased

cognitive, and decreased learning capacity. It will reduce their productivity in the long term [6]. Undernutrition also reduces immunological capacity to defend against diseases and recurrent infections, and may reduce and deprive the body from essential nutrients. This leads to the dismal growth of children which adversely affect child's mental and physical development also learning capacity in future life [7]. Thus, it is necessary to verify the effectiveness of this app, which has already evolved into BalitAgrow Plus© (covering all child age groups). This study aimed to determine how well the BalitAgrow Plus© application may enhance children's nutritional status.

MATERIALS AND METHODS

This community-based participatory research (CBPR) collected data on nutritional status before and after eight weeks of assistance/intervention using the BalitAgrow Plus© application, throughout the month of July and August 2023. This study's population is all children registered in Rambigundam Village (Satrean, Krajan Lor, Krajan Kidul, Gayam, and Dukushiae), Rambipuji, Jember Regency.

There were three groups, control (non-users), active-assistance, and passive-assistance (users of the app) groups. Each respondent in the group was selected by the inclusion criteria. In the control groups, respondents who were not exposed/introduced to the Balitagrow Plus© application, were mothers who had a child in the age of 36-72 m.o. (pre-school age), and were willing to be the subject of the research, and allow their child to be measured for their weight and height. The passive and active group were included by the same criteria, but the difference was they were both introduced with the application. Moreover, respondents who were willing to be assisted everyday regarding the use of the application will be included in the active group. Each group has the same proportion of 7 respondents (quota sampling, whereas the respondents were recommended by the cadres in the area) in each sub-village (there were 5), so, the overall sample size was 105 respondents. Respondents would be excluded if they were not able to be contacted/ was not willing for the second measurement of nutritional status after 8 eight weeks.

The independent variable was the assistance/ intervention using the application, while the dependent variable was nutritional status (weight-for-age, height-for-age, weight-for-length/height for children under five years old, and BMI-for-age for children above five years old). The nutritional status is categorized into ordinal data with the criteria within normal limits if the Z score is between +/-1 SD or 5-95% using percentile. We evaluated the nutritional status of the subject after 8 weeks in concordance with previous reference stating 4-8 weeks of intervention may cause significant results [8, 9].After eight weeks of active assistance in the active group, the weight and height of each child in all groups were remeasured.

Several factors may also exert an effect (i.e., potential confounding factors) based on the characteristics of the respondents that were collected, e.g., age, occupation, level of education, and income of the parents. The factors were described in each group through the use of frequency and percentage and the groups were matched as much as possible to reduce confounding effects of these factors.

Data were coded then analyzed using Microsoft Excel and SPSS software with Wilcoxon Signed-Rank test to compare pre- and post-nutritional status in each intervention group, then analyzed using Kruskal-Wallis's test to compare pre- and post-nutritional status in three groups of intervention. This study was approved by Research Ethics Committee from Faculty of Medicine, University of Jember No. 1748/H25.1.11/KE/2023.

RESULTS

This study was conducted in Rambigundam Village, Jember. A total of 105 respondents were initially enrolled and assigned equally into three groups: active-assistance, passive-assistance, and non-user groups, with 35 respondents in each group. Baseline height and weight measurements were obtained before the intervention. During the study period, two children from the passive-assistance group moved out of the study area and were no longer covered by the local posyandu; therefore, post-intervention data were available for 33 respondents in this group.

The characteristics of respondents and their parents are presented in Table I. Most mothers were aged 26–35 years (63.8%), worked as housewives (83.8%), and had completed senior high school (60.0%). Similarly, most fathers were aged 26–35 years (45.7%), worked as entrepreneurs (46.7%), and had completed senior high school (51.4%). Most households had an income below the minimum wage (74.3%). The sex distribution of children was relatively balanced, with 50 males (47.6%) and 55 females (52.4%). Most respondents were aged 36–60 months (80.0%). At baseline, 38.1% of children were wasted based on weight-for-height, 63.8% had short stature based on height-for-age, and 59.0% were underweight based on weight-for-age.

The comparison of nutritional status among the three intervention groups is shown in Table II. There were no significant differences between the active-assistance, passive-assistance, and non-user groups in weight-for-height, weight-for-age, or height-for-age, either before or after the intervention ($p > 0.05$). This indicates that the nutritional status distribution was comparable across groups at baseline and remained statistically similar after the intervention.

Table I: The Characteristics of Fathers, Mothers, and Respondents

Characteristics	Active		Passive		Non-User		Total	
	n	%	n	%	n	%	n	%
Respondents' mothers								
Age (years)								
17-25	5	14.3	0	0.0	7	20.0	12	11.4
26-35	26	74.3	23	65.7	19	54.3	68	63.8
36-45	3	8.6	11	31.4	9	25.7	23	22.9
>45	1	2.9	1	2.9	0	0.0	2	1.9
Occupation								
Housewives	33	94.3	29	82.9	26	74.3	88	83.8
Employees/laborers	2	5.7	3	8.6	5	14.3	10	9.5
Entrepreneurs	0	0.0	2	5.7	2	5.7	4	3.8
Teachers	0	0.0	1	2.9	2	5.7	3	2.9
Education								
No school	0	0.0	1	2.9	0	0.0	1	1.0
Elementary school	4	11.4	7	20.0	6	17.1	17	16.2
Junior high school	3	8.6	5	14.3	8	22.9	16	15.2
Senior high school	26	74.3	19	54.3	18	51.4	63	60.0
Diploma	1	2.9	1	2.9	1	2.9	3	2.9
Bachelor's	1	2.9	2	5.7	2	5.7	5	4.8
Respondents' fathers								
Age (years)								
17-25	0	0.0	1	2.9	4	11.4	5	4.8
26-35	19	54.3	15	42.9	14	40.0	48	45.7
36-45	13	37.1	17	48.6	13	37.1	43	41.0
>45	3	8.6	2	5.7	4	11.4	9	8.6
Occupation								
Sellers	2	5.7	2	5.7	4	11.4	8	7.6
Employees/laborers	8	22.9	9	25.7	12	34.3	29	27.6
Entrepreneurs	21	60.0	17	48.6	11	31.4	49	46.7
Teachers	0	0.0	0	0.0	1	2.9	1	1.0
Farmers	0	0.0	3	8.6	4	11.4	7	6.7
Security	0	0.0	2	5.7	0	0.0	2	1.9
Drivers	2	5.7	1	2.9	3	8.6	6	5.7
Military	0	0.0	1	2.9	0	0.0	1	1.0
BUMN employees	1	2.9	0	0.0	0	0.0	1	1.0
No data	1	2.9	0	0.0	0	0.0	1	1.0
Education								
No school	0	0.0	1	2.9	0	0.0	1	1.0
Elementary school	4	11.4	4	11.4	6	17.1	14	13.3
Junior high school	9	25.7	12	34.3	10	28.6	31	29.5
Senior high school	21	60.0	18	51.4	15	42.9	54	51.4
Diploma	0	0.0	0	0.0	2	5.7	2	1.9
Bachelor's	1	2.9	0	0.0	2	5.7	3	2.9
Income								
Under minimum wage	28	80.0	27	77.1	23	65.7	78	74.3
Upper minimum wage	6	17.1	7	20.0	12	34.3	25	23.8
No data	1	2.9	1	2.9	0	0.0	2	1.9

CONTINUE.....

Table I: The Characteristics of Fathers, Mothers, and Respondents

Characteristics	Active		Passive		Non-User		Total	
	n	%	n	%	n	%	n	%
Respondents								
Sex								
Male	16	45.7	18	51.4	16	45.7	50	47.6
Female	19	54.3	17	48.6	19	54.3	55	52.4
Age (months)								
36-60	30	85.7	28	80.0	26	74.3	84	80.0
>60	5	14.3	7	20.0	9	25.7	21	20.0
Nutritional status pre-intervention								
Weight-for-height								
Obesity	4	11.4	2	5.7	3	8.6	9	8.6
Normal	18	51.4	19	54.3	20	57.1	57	53.3
Wasted	13	37.1	14	40.0	12	34.3	39	38.1
Height-for-age								
Tall stature	0	0.0	0	0.0	1	2.9	1	1.0
Normal	10	28.6	16	45.7	11	31.4	37	35.2
Short stature	25	71.4	19	54.3	23	65.7	67	63.8
Weight-for-age								
Overweight	0	0.0	2	5.7	1	2.9	3	2.9
Normal	14	40.0	12	34.3	14	40.0	40	38.1
Underweight	21	60.0	21	60.0	20	57.1	62	59.0

Each group n=35.
Data were shown in amount of respondent and percentage within each group.

Table II: Comparison of pre- and post-nutritional status among three groups of intervention

	Kruskal-Wallis Test					
	WFH Pretest	WFH Posttest	WFA Pretest	WFA Posttest	HFA Pretest	HFA Posttest
Asymp. Sig.	0,690	0,843	0,946	0,977	0,335	0,707

WFH weight-for-height; WFA weight-for-age; HFA height-for-age.
Three groups consist of active, passive and non-user, each group n=35.
Using the Kruskal-Wallis test, p-value is significant if <0.05.

Within-group comparisons of pre- and post-intervention nutritional status are presented in Table III. Most indicators showed no significant changes after the intervention in all three groups ($p > 0.05$). However, height-for-age in the active-assistance group showed a significant pre- to post-intervention difference ($p = 0.014$), suggesting a potential improvement in linear growth among children who received active assistance through the application. No significant changes were observed in the passive-assistance or non-user groups.

Changes in body weight and length/height after the intervention are summarized in Table IV. Although the Kruskal-Wallis test showed no significant difference in nutritional status among the three groups, an overall growth trend was observed. Weight gain was reported in 61.0% of the active-assistance group, 57.1% of the passive-assistance group, and 82.8% of the non-user group. Increased length/height was observed in 71.4% of the active-assistance group,

Table III: Comparison of pre- and post-nutritional status in each intervention group

Wilcoxon Signed-Rank test	Pre-post WFH	Pre-post HFA	Pre-post WFA
	p-value		
Active	1,000	**0,014**	0,317
Passive	0,527	0,157	0,564
Non-user	0,317	0,257	1,000

WFH weight-for-height; WFA weight-for-age; HFA height-for-age.
Each group n=35.
Using the Wilcoxon Signed-Rank test, p-value is significant if <0.05 and is shown in bold.

Table IV: Weight and length/height after intervention

Categories	Active		Passive		Non-user	
	n	%	n	%	n	%
Weight						
Weight gain	21	61.0	20	57.1	29	82.8
Constant weight	8	22.9	7	20.0	3	8.6
Weight loss	6	17.1	8	22.9	3	8.6
Length/height						
Increased length/height	25	71.4	21	60.0	23	65.7
Constant length/height	10	28.6	14	40.0	12	34.3
Decreased length/height	0	0.0	0	0.0	0	0.0

Each group n=35.
Data were shown in amount of respondent and percentage within each group.

60.0% of the passive-assistance group, and 65.7% of the non-user group. No respondents experienced decreased length/height during the study period.

Overall, the intervention did not produce statistically significant differences in nutritional status between groups. However, the significant change in height-for-age within the active-assistance group and the observed increase in length/height suggest that active assistance using the BalitAgrow Plus© application may have potential value in supporting child growth monitoring and health promotion.

DISCUSSION

Through this study, there was no significant difference for pre- and post-nutritional status among three groups of intervention based on the Kruskal-Wallis's test (Table 2). However, in this study, there was an increased trend in the growth of the respondent as shown in Table IV. Another study conducted in Arkadelphia, USA, found similar results, where a 7-week nutrition intervention resulted in no significant difference in BMI in the control and intervention groups but there was significant increase in children's knowledge as indicated by increased score on the questionnaire [10]. This finding is similar to another study conducted using the first version of the BalitAgrow© application, which found that the use of this application helped improve parents' knowledge of the types of body-building nutrients, types of fast food, types of food sources of animal protein, and types of energy substances for the body, which was characterized by an increase score for completing the questionnaire from 8.8% of parents who scored low to 2.9% at post-treatment [4]. Still, this result is different from the study conducted by Slusser, et al, which showed a significant difference in BMI after intensive intervention for 3 months [11].

Pre-intervention nutritional status was dominated by short stature (63.8%) and underweight (59%). This result may be due to several risk factors. Multifactorial factors, including direct and indirect factors can affect nutrition status. Direct factors focus on daily nutrition intake and infectious diseases, mostly tuberculosis. Less nutrition intake especially for children under five (CUF) has short impact that may increase morbidity. If this nutrition problem is chronic, it will affect cognitive function, and children with lack of nutrition in early life has risk of infected disease [12, 13]. Indirect factors such as beliefs, education level, knowledge level, working mothers, family economic status, nutritional access, culture, and environment influence nutritional status in children [13]. Different socio-cultural condition in different areas will affect how they feed their children [14]. Research conducted in Jakarta concluded that a mother's education less than nine years and mother's employment status has a significant relationship with children's linear growth[15]. However, maternal employment status does not always show a significant relationship. Other studies provide different results because it is considered that working mothers do not have much time to pay attention to child nutrition and environment compared to housewives[16]. But, educated mothers do have better knowledge and awareness which will influence the nutritional intake [17, 18]. In general, the odds of undernutrition were higher in parents with lower education level, although not unanimously, and the odds of undernutrition were usually about twice as high for children of parents with the lowest education compared with the highest [19, 20]. At the time of this study, it was found that the education of fathers and mothers was mostly high school/equivalent. Most occupations were housewives for mothers and entrepreneurs for fathers, with household income dominantly under the minimum wage. A high level of education and good economic status increase parents' ability to provide quality care from the prenatal period and thus improve the child's nutritional intake. This is in line with study conducted on 2014 in Adelaide that showed higher education and socioeconomic status are associated with children daily intake [21].

The strength of the study is the usage of this application enable user to monitor easily the growth of children while also receiving recommendation when the nutritional status is under expectation. The duration of the intervention affects the intervention results on changes of respondent's nutritional status [22, 23]. In this study, the insignificant results between pre and post intervention nutritional status may have occurred due to limitations in the intervention time so that no significant

changes could occur during the 8-week treatment period, which in lines with similar study conducted in Northern Ghana on 2021 that showed intervention time period would affect the results of the study [10].

Another limitation is that this application is only based on android phone for the moment. Therefore, for the application itself, it needs to be made available in any platform, not only for the android phone. To reduce the limitation of insignificant intervention, it is also suggested to increase the intervention period for the future study.

CONCLUSION

While application assistance did not particularly target the initiatives to enhance children's nutritional status, it is hoped that this program will create more awareness about stimulating children's growth.

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