The Gammarana Intervention Succeeded in Restraining the Increase in Stunting during the COVID 19 Pandemic in Enrekang, South Sulawesi

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Keywords: Stunting, COVID-19, Nutrition Intervention.

Abstract: Enrekang is the district with the highest prevalence of stunting in South Sulawesi. The Indonesian government designated pilots for a stunting prevention convergence intervention project, called *Gammarana*. The purpose of this study is to evaluate the impact of the program on stunting prevention duringthe COVID19 pandemic. The method is quasi-experimental. The intervention group was given macronutrientsupplements, micronutrient supplements, child feeding education and natural interventions. The control groupwas given natural intervention (IFA-S, Antenatal Care and Growth Monitoring). The intervention group waslocated in 30 villages and the control group was 30 villages with similar socio-demography. Intervention for6 months. Results, stunting in the intervention group increased from 18.7% to 20.1% or 1.4%, while stuntingin the comparison group increased from 16.4% to 19.51% or 3.1%. Overall stunting increased from 17.7% to19.9% or 2.1%. The results of the Wilcoxon test showed that there was no change in stunting in the intervention group (p=0.293) while in the comparison group it increased significantly (p=0.048) as well as overall (p=0.016). Conclusion, The *Gammarana* intervention was able to restrain the rate of increase in the prevalence of stunting during the COVID-19 Pandemic.

1 INTRODUCTION

Stunting has become a serious public health problem in Indonesia. This is addressed on a regional basis, especially in areas with a stunting prevalence of >20%. The Indonesian government, especially South Sulawesi, has established a focus area for stunting prevention, one of which is the Enrekang District. This district had a stunting prevalence of 48% in 2019, before the COVID-19 pandemic spread (Kemenkes, 2018).

The problem at present is that there are no results of an extensive, population-scale impact evaluation of the intervention. This is required, because the track record of sustainable interventions, is very useful to be refined. The experience of a broad community-based intervention is one of the potential lessons learned from the experience that is very well imitated (Haselow, Stormer și Pries, 2016),(Hossain *et al.*, 2017a)

The absence of efficacy studies of stunting prevention interventions in Indonesia is due to the absence of specific and sensitive nutrition intervention packages designed in the perspective of evaluation studies but generally designed and implemented in the perspective of program orientation alone. Several programs are implemented as routine activities and their impact on stunting reduction has not been specifically measured. Routine program packages such as folic acid supplementation for pregnant women and adolescent girls,

Sirajuddin, ., Sirajuddin, S., Thaha, A., Razak, A., Ansariadi, ., Thaha, R., Junadi, P. and Ali, P.
The Gammarana Intervention Succeeded in Restraining the Increase in Stunting during the COVID 19 Pandemic in Enrekang, South Sulawesi.
DOI: 10.5220/0010760000003235
In *Proceedings of the 3rd International Conference on Social Determinants of Health (ICSDH 2021)*, pages 195-203
ISBN: 978-989-758-542-5

supplementary food supplementation for chronically deficient pregnant women, high-dose vitamin A supplementation for children aged five years, salt iodization in endemic goitre areas, regulation of mother's milk, surveillance for monitoring the growth of children under five, and basic immunization packages for children under five and pregnant women. On the other hand, sensitive intervention packages for both the agricultural and environmental sectors have also been carried out throughout Indonesia. (Beal *et al.*, 2018),(Aryastami *et al.*, 2017), (Prawirohartono, Nurdiati și Hakimi, 2016).

Although the intervention package has been carried out on a massive scale, there are very few study reports that examine its impact on stunting reduction. This fact needs to be explained as a result through the evaluation of a large-scale stunting prevention intervention program. The Government of Enrekang Regency, South Sulawesi, has made a pilot project of a comprehensive stunting prevention approach involving a sensitive and specific approach at the village level. Thirty villages were targeted for intervention with an estimated stunting number of 2230 children and 120 pregnant women in 2020, (Jeon *et al.*, 2019),(Haselow, Stormer și Pries, 2016).

Based on the evidence base of other studies on the impact of micronutrient supplementation, macronutrients and nutritional literacy that are aligned with improvements in environmental sanitation, theoretically stunting will decrease by around 4% per year. All of the above studies were carried out under normal conditions(S. *et al.*,2016),(Olney *et al.*, 2018),(Gelli *et al.*, 2018). The results of the above study were then adopted as the basis for implementing stunting prevention interventions in Enrekang Regency, which is called the local term Gammarana.

Gammarana, is a unique innovation in the stunting prevention program, because it is based on evidence from previous randomized studies, but also when the new normal system was implemented in Indonesia. Can this intervention package provide an alternative to stunting prevention, when pressure from external environmental factors due to the COVID-19 pandemic is increasing (Pérez-Escamilla, Cunningham și Moran, 2020)? Access and services were stopped in a direct form, but eventually, adaptation was carried out so that stunting did not increase further. (Akseer *et al.*, 2020). This evaluation study aims to analyze the impact of Gammarana on stunting prevention in Enrekang district when the COVID-19 pandemic has not ended.

2 METHODS

This study is quasi-experimental, investigating the impact of Gammarna on stunting

2.1 Study Design

This study was conducted in 60 villages, 30 villages as the intervention group and 30 villages as the comparison group. The comparison villages had the same characteristics (7 indicators) in aspects of food security (p=0.111), agricultural land area ratio (p=0.317), access to clean water (p=0.154), latrine status, family planning (p=0.545), basic immunization (p= 0.999), exclusive breastfeeding (p=0.999), and growth monitoring (p=0.317) and health insurance (p=0.999), these are presented in other study reports (1). The duration of this study was 180 days, baseline and endline measured stunting status, while the comparison of confounding variables was controlled by selecting similar villages. (Sirajuddin *et al.*, 2021)

The intervention village was selected based on the consideration of high stunting prevalence and has been designated by the Enrekang district government as a stunting focus village, while the comparison village was chosen intentionally by the researchers with the criteria, geographically being in one sub-district, having similarities in 7 indicators to control for confounding variables.

Another similarity between the two groups is natural intervention, namely folic acid supplementation for pregnant women, adolescent girls, basic immunization for children under five, supplementaryfeeding for pregnant women, chronic lack of energy, and growth monitoring. The difference with the intervention group is the *Gammarana* intervention component.

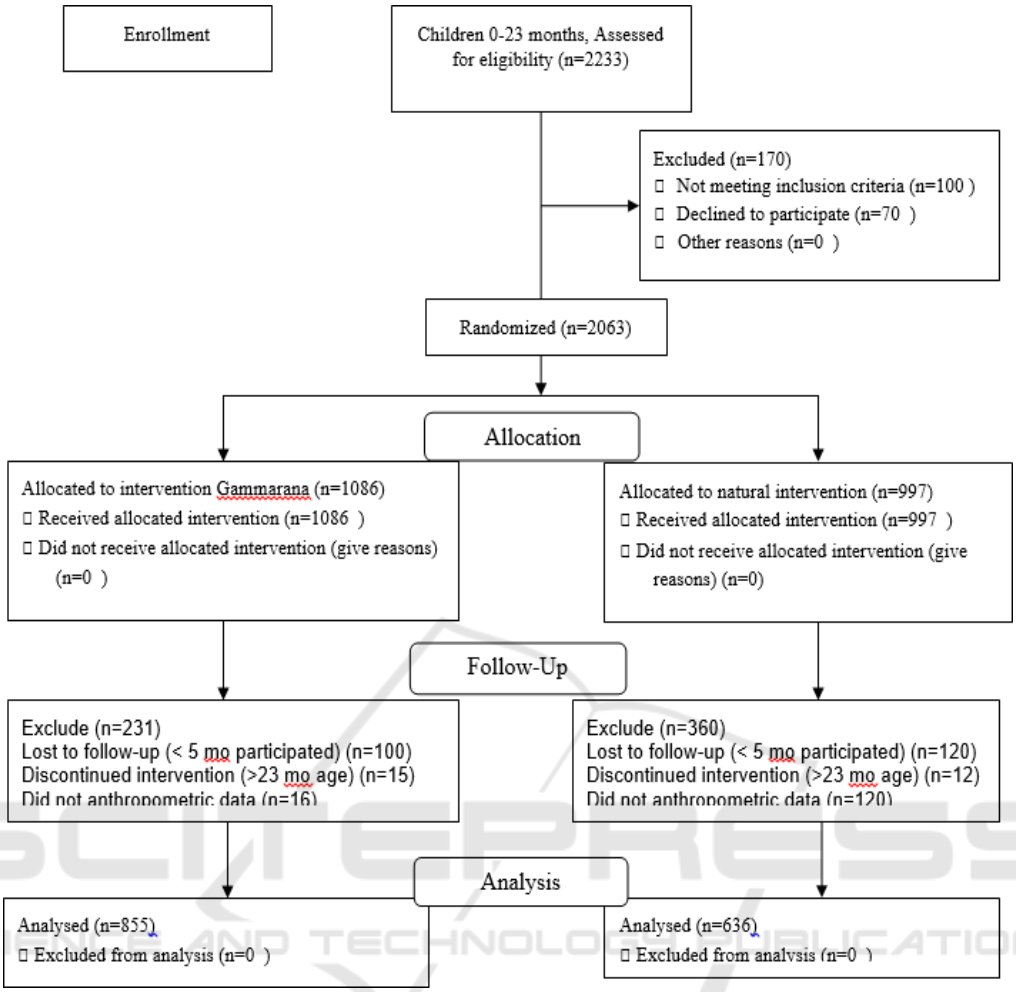

Figure 1. The Sample enrolled and finally analysed

2.2 Participants

2.2.1 Pregnant

Pregnant participants as targets who were given protein supplementation, and *Moringa* capsules. Pregnant is known based on the results of amenorrhea history followed by a urine test. If it is declared positive for pregnancy, then deregister as a subject. This is done by the Midwife of the Health Center. The total number of pregnant was 200 in the intervention village and 100 in the comparison village. Of this number who gave birth in the period August 2020 to February 2021, 30 in the Intervention Village and 30 in the Comparison Village. This pregnant participant was registered because the pregnancy outcome in the form of birth height was the primary outcome variable in this study.

2.2.2 Child 0-23 Months

Children aged 0-23 months were enrolled as subjects in this study. An 855 out of 1086 in the intervention village and 636 out of 997 in the comparison village. Excluded children with birth defects, adopted children from outside the region, down syndrome, caregivers who did not participate in Gammarana, did not record anthropometry (weight and height) at the beginning and end of the program. Determination of age based on birth certificate documents, calculated in the full month method.

Table 1: Characteristic of the Subject Intervention and Control

	Mean	SD	Mean	SD	Mean	SD	
Food security compositescores	3.83	1.34	4.20	1.27	4.02	1.31	0.111
The ratio of land foragriculture	0.16	0.32	0.08	0.06	0.12	0.23	0.317
The ratio of food production	0.07	0.03	0.08	0.04	0.07	0.04	0.393
The ratio of poverty quantile1	0.06	0.03	0.05	0.02	0.06	0.03	0.034
Food Security Index	57.96	11.04	61.12	9.33	59.54	10.26	0.531
Access latrine (%)	91.36	9.20	89.20	10.54	90.28	9.87	0.321
Access water treated (%)	94.78	5.79	92.98	12.74	93.88	9.85	0.154
Family Planning (%)	18.34	16.53	26.52	23.76	22.43	20.71	0.545
Delivery in health facilities(%)	80.19	21.71	81.63	30.16	80.91	26.06	0.691
Basic immunization (%)	96.87	5.62	97.68	5.19	97.28	5.38	0.999
Exclusive breastfeeding (%)	93.20	10.16	93.40	7.66	93.30	8.92	0.999
Growth monitoring (%)	94.51	8.67	96.97	3.21	95.74	6.60	0.317
Health insurance Access (%)	47.65	10.64	50.98	11.15	49.32	10.93	0.999

2.3 The Component of Gammarana

Their Component of intervention was *Taburia* supplementation, *Moringa* extract capsule supplementation, protein supplementation and nutrition education. This was only given to the *Taburia* is given to all children aged 6-23 months, the response dose is 1 sachet / 2 days/child. How to give, prepare children's food, separate 1/3 part, shake the taburia, tear the package and sprinkle it on 1/3 of the preparing the *Taburia*, continue to be breastfed for those who are still breastfed. The total number of sachets for each child is 90 sachets for 180 days, One sachet = 1 g.

Provision *Taburia* to children is carried out by skilled caregivers, through demonstrations and simulations, guided by nutritionists, carried out by skilled caregivers. Each village has 1 nutritionist specifically for the Intervention village, while the comparison village has no nutritionists in the village. The nutritional contribution of each sachet (1 g) to the Recommended Daily Allowance (RDA) (%) for pregnant, age of 19-30 years, trimester 2, vitaminsand minerals is vitamin A (13.90), Bi1 (35,71), B2 (31.25), B3 (34.72), B6 (26.32), B12 (22.22), folic acid (25.00), vitamin C (35.29), pantothenic acid (50.00), Vitamin D3 (33.33), Vitamin E (400), Vitamin K (36,36), Iodine (227,27), Iron (74,07), and Zn (41,67) and selenium (68,97). *Taburia* has been registered at the Center for Drugand Food Control No SD 171250351, and LPPOM MUI: 01251097470214.

Intervention village, while the natural intervention was not only given to the comparison village group but also the intervention village.

2.3.1 *Taburia* Suplementation

separated food, mix well, try to consume this mixture for <30 minutes, should not be mixed with soupy foods and drinks, wash hands before and after.

2.3.2 Moringa Extract Capsule

Moringa extract capsules (MEC) were taken every pregnancy, the response dose is 1 capsule per day during pregnancy. The contribution of RDA (%) Vitamin A (0.19), Vitamin E (2.93), Vitamin C (2,55), Iron (2,00), Zinc (0,01) and selenium (0.24). The MEC has been registered at the Center for Drug and Food Control No TR203339021.

2.3.3 *Proten* Supplementation

Proten supplementation (PR) is given to all pregnant. The response doses are one sachet every 2 days. The method of preparation is to dissolve the PR powder in warm or cold water according to the tastes of pregnant women, 200 ml of water. Drink immediately < 30 minutes after preparation. The entire contents of one sachet are made for one serving, cannot be divided into two or more. Leftovers that are not used should not be saved for the next gift but must open a new bag. a sachet 52 g.

Table 2: The impact of nutrition intervention on reducing stunting

Group	NutritionalStatus	aselinen(%)	ndlinen(%)	Deltan(%)	Wilcoxon Test *P-Value*
Intervention	Stunting	160 (18,7)	172 (20.1)	1.4	0.293
	Normal	695 (81,3)	683 (79.9)		
	Total	855 (100)	855 (100)		
Control	Stunting	104(16.4)	124(19.5)	3.1	0.048*
	Normal	532(83.6)	512(80.5)		
	Total	636 (100)	636(100)		
Total	Stunting	264 (17.7)	296 (19.9)	2.1	0.036*
	Normal	1227 (82.3)	1195(80.1)		
	Total	1491 (100)	1491 (100)		
Mann-Whitney P-Value		0,238	0,767		

*=significant <0,05, differences before –after for control (natural intervention) and across group

The provision of PR is carried out by pregnant after skillfully preparing, guided by nutritionists in each village. Nutritional contributions to the RDA (%) of pregnant are energy (17.50), fat (14.86), protein (27.4), carbohydrates (17), sodium (23.33), calcium (24.89), vitamin A (1.90) B1 (117.14), B2 (29.38), B3 (19,19), B5 (43.33), B6 (120.53), B7(2.6), Vitamin C (38.82), Selenium (75.86). and Iron (22.22.) and Zinc (16.67). It is also given to children aged 12-23 months who have not gained weight. The response doses is sachet/day (25 g) dissolved in 100 ml of cold or warm water. Giving is carried out by skilled caregivers, guided by nutritionists. Nutritionalcontributions to the RDA of pregnant are energy (32,59), fat (22.22), protein (33.33), carbohydrates (31.63), sodium (23.33), vitamin A (4,28), B1 (328), B2 (156) , B3 (31.67), B5 (130), B6 (458), B7(3.31), Vitamin C (82.50), Selenium (122). and Iron (85,71). PR has been registered with BPOM No: 862513022005.

2.3.4 Biscuits for Children

Biscuits for children (BFC) were given to children aged 6-23 months in both groups. The duration of administration was divided into two, namely wasting toddlers <-2SD median WHO Anthro 2006 was given for 1 month. Meanwhile, if wasting <-3SD is given indefinitely until the nutritional status of the WHZ score is at least -2SD. The response dose for each administration is the age of 6-11 months given 8 pieces (80 g) per day, 12-23 months of age given 12 pieces (120 g) per day. Energy 160 kcal, 3.2-4.8 g protein, 4-7.2 g fat. Enriched with 11 vitamins (A, D, E, K, B1, B2, B5, B3, B16, B12) and 7 kinds of minerals (Iron, Iodine, Zn, Calcium, Sodium and Phosphorus. The provision of BFC is accompanied by nutrition education by nutrition workers at the Public Health Centres in the comparison villages and by volunteer nutritionists in the intervention villages.

2.3.5 Biscuits for Pregnant

The Biscuit for Pregnant (BFP), given to pregnant. in both groups. The dose of administration is 2 pieces/day for the first trimester, and 3 pieces daily @ 20 g or 60 g / day for the second and third trimesters. Energy 270 kcal, 6 g protein, 12 g fat. Enriched with 10 vitamins (A, D, E, K, B1, B2, B3, B16, B12) and 7 kinds of minerals (Iron, Iodine, Zn, Calcium, Sodium and Phosphorus.

The duration of administration of BFP without chronic energy deficiency (upper arm circumference > 23.5 cm) is for 1 month, while for pregnant women, upper arm circumference < 23.5 cm, is given during pregnancy until it reaches >= 23.5 cm. Another provision for the provision of biscuits to pregnant women is that the provision of complete food remains the main reference, while this package is only a supplement.

2.3.6 Growth Monitoring

Growth monitoring (GM) is carried out once a month. Measurement of body weight using an accuracy of 0.1 kg. Measurement of height using length board to the nearest 0.1 cm. Measurements were taken at the beginning and end of the intervention in both groups. Enumerators who carry out measurements have been trained in anthropometric techniques and are declared eligible to carry out according to their competencies.

The measurement results are inputted into the Big of Nutrition Surveillance Indonesia Data at each location, according to the month of measurement. The z-score was calculated using the WHO Anthro 2006 application. Extreme values + 6 SD were excluded from the analysis. The index used is BAZ, HAZ and WHZ.

2.3.7 Iron Folic Acid Supplementation

Iron Folic Acid supplement (IFA-S), given to pregnant. Dosage response for prevention 90 tablets during pregnancy. The contribution of folic acid and iron respectively 60 mg (10%) and 0.25 mg (1%) to Recommended Daily Allowance (RDA) of Indonesia.

2.3.8 Basic Immunization

Basic immunization (BI) provision for infants younger than 24 hours. It giving hepatitis B immunization (HB-0). 1 month age giving Bacille Calmette Guerin (BCG) and Poliomyelitis 1. Infants aged 2 months giving of vaccine Diphtheria-Tetanus-Pertussis (DPT) Haemophilus influenzae type b (Hib1), poliomyelitis-2, and Rotavirus. Infants aged 3 months: DPT-HB-Hib 2 and poliomyelitis 3. Infants aged 4 months: DPT-HB-Hib 3, poliomyelitis 4.

2.3.9 Nutrition Education

Nutrition education (NE) is given to the caregivers, by nutritionists in each village. The material given is related to breast milk and complementary foods for breastfeeding. Education is carried out twice a month for 6 months, through home visits. Educational guide, compiled and provided to every nutritionist.

2.4 Outcomes

Primary outcomes are the number and percentage of stunting before and after the intervention, in *Gammarana* and Comparative villages. Stunting is known from the Z value of the 2006 WHO Reference LAZ score. Values <-2 SD are called stunting. This calculation uses the WHO Anthro 2005 software version 3.2.2. Biologically implausible values LAZ -6<LAZ>+5 and were excluded from the analysis.

The prevalence of stunting in this study was calculated before and after the intervention for the same subject (dependent). If the subject did not complete the data at the beginning and at the end, then he was excluded from the analysis. Analysis of stunting changes using a paired test approach.

2.5 Sample Size

A total of 2333 children were enrolled, 170 were excluded because their height was not measured at the beginning of the screening so that the remaining 2063 were. These were then divided into two groups, namely intervention 1086 and control 997. In the intervention group, 231 were excluded because the age was more than 23 months at the end of the program. did the final measurement, because they did not undergo the intervention for 5 months. In the control group, 362 were excluded due to incomplete anthropometry and out of the area. The final sample size in the intervention group was 855 and in the control group was 636.

2.6 Randomisation

Randomization, carried out at the level of selection of the comparison village, after being selected, all children in the village are registered as subjects and then screened for age and willingness to participate. In the intervention village, no randomization was carried out because this village was selected from all villages with the highest prevalence of stunting in the Enrekang District of 30 so that there were 30 intervention villages and 30 comparison villages. Allocation concealment mechanism was not done, because controlling the mobility of subjects between villages was not feasible.

2.7 Statistical Method

Stunting efficacy was tested from ordinal data on stunting status before and after the intervention in both groups. Test the normality of the data with the Kolmogorov Test p = 0.000, so the Wilcoxon test was used. Conversion from LAZ values to categorical data follows, the following criteria: Stunting if the LAZ value is <-2 SD, and Normal if >=-2 SD. There are only 2 categories, namely stunting and normal. Data analysis with SPSS 16.0. This study was recognized by the Hasanuddin University Ethics Committee and registered with The Registry for International Development Impact Evaluations (5.24.2021).

3 RESULTS

During this 6-month study, the number of children under five who intervened was 1086 in locus villages, 997 in non-locus villages. The coverage of children changes every month, duo to the number of births and leave over the age of 23 months do not compare. Investigate of stunting efficacy interventions only took place on children who were intervened for 6 months, excluded children who did not reach the 6-month intervention. Does not reach because the age is past 23 months and or the age has not reached 6 months. The number of eligible children is 855 in Gammarana village and 636 in Non-Gammarana

village (Figure:1)

The findings of this study show that in the intervention group there was no change in stunting proportion although increased by 1.4%. On the other hand, in the control group, it was found that there was a significant increase in stunting at (p=0.048) is 3.1%. Due to this high increase, overall it is known that the increase is 2.1% (p=0.036) (Table 2). Of course, this finding proves that if there is an intervention, the increase in stunting can be prevented, although the reduction is still difficult to achieve because thisstudy used a two-paired sample, not an independent sample.

If the phenomenon is like this, then the effectiveness of prevention in newborns is required. If children were born from mothers who covered in the Gammarana were able to reduce stunting, the stunting population will decrease significantly. The decline in this intervention is a decrease that is triggered by the absence of new cases and vice versa, newborns tend to have good nutritional status or are not stunted.

4 DISCUSSION

The result of this study is that the *Gammarana* intervention succeeded in restraining the rate of stunting increase in the intervention village because it only increased by 2.1% while in the comparison village is increased by 3%. Unable to reduce stunting, due to various factors that are thought to be indirectly related to the condition of the COVID-19 pandemic, in which access to basic health services was delayed for several months before finally reopening at the end of 2020 on a limited basis.

There are two approaches used in many studies, namely independent samples and paired samples. If the change in stunting is calculated based on the free sample, then the design is cross-sectional twice at the beginning and end. This has the advantage that changes in the percentage of stunting are very dynamic, especially in a small population. The population will change according to the distribution of birth age and stunting prevention efficacy. If the efficacy is good and the birth rate is high, a real reduction in stunting occurs even in a very short time.

The study in this study uses a paired sample model so that the direction of change in stunting will focus more on delaying new cases due to interventions in subjects who have not been stunted effectively or not. In stunted subjects, the ability to get out of this zone is very difficult. This is related to the line of height growth in children does not apply throughout the year.

The experience of various studies in testing the efficacy of stunting prevention through RCT studies shows that if the intervention goes well, the reduction is estimated to be >4% per year. Of course, the intervention runs in a period of between 4-6 years. This is a child's life cycle as a period of growth and development. The difference with this study is that here, it is a pilot program that continues to be developed (Hossain *et al.*, 2017b).

Similar studies to this study in Burkina Faso (Lanou *et al.*, 2019), (Fadnes *et al.*, 2016) and (Muhoozi *et al.*, 2018), where there was no decrease in stunting after the intervention, but also no increase in stunting. On the one hand, this provides an advantage because there is no increase in stunting cases. This phenomenon is interesting to discuss because various possibilities are unique to be discussed. The first is that stunting rehabilitation is very difficult, due to the accumulation of nutritional deficiencies that have an impact on the ability to absorb nutrients in the digestive tract. This is associated with stunting as an indication of chronic, not an acute deficiency. On the other hand, inflammation increases demand but decreases appetite. Recovery must be gradual and requires patience on the part of the caregiver.

In addition, the studies reported by (Olney *et al.*, 2018), (Gelli *et al.*, 2017), succeeded in reducing stunting, because they not only managed to prevent new cases but managed to rehabilitate stunting to normal. This is especially found in cases of stunting, the threshold difference between normal and mild stunting, and the majority of the age is < 12 months. This age still can increase in height between 10-23 cm for one year, if nutritional intake meets the RDA. A micronutrient enrichment base intervention with maximal adherence control and coverage will find results like this.

The limitation is that the coverage and adherence to the intervention package are not optimal due to the irregular supply of materials, which is caused by the refocusing of the budget due to the pandemic. However, this does not reduce the quantity and quality of interventions at the end of the program, because coverage can be maximized. This causes some intervention packages to be given after the program ends and after the follow-up program which was not reported in this study.

The generalizability of this study is that *Gammarana* can be replicated with noted improvements in the timely mechanism of micro and macronutrient packet administration. One way is that Gammarana is continued in the second year in the Enrekang districts and others in South Sulawesi. The

interpretation of the results of this study is that stunting prevention must be evidence-based and *Gammarana* provides a way out for the use of macronutrient, micronutrient supplementation and nutrition education intervention packages controlled by nutritionists through home visits as educators.

The evidence in this study is consistent with the results of studies in Burundi (Leroy, Olney și Ruel, 2018), Bangladesh (Mridha *et al.*, 2016), Tanzania (Locks *et al.*, 2016), Burkina Faso (Lanou *et al.*, 2019), Mali (Adubra *et al.*, 2019), Uganda (Carroll *et al.*, 2017). Although these studies are known to differ from those of studies in Guatemala (Olney *et al.*, 2018), Bangladesh (Shafique *et al.*, 2016), Malawi (Gelli *et al.*, 2018), Phipipina (Kandpal *et al.*, 2016) and Ghana (Kandpal *et al.*, 2016), these differences are not the main substance that renders the results of these studies inapplicable. Each community group has different determinants, so that modifications are only needed on the context and mechanism side, but do not differ on the underline side of the intervention package. The strategy to overcome the differences in context mechanism side, but do not differ on the underline side of the intervention package. The strategy to overcome the differences in context and mechanism in each social unit of society is by analyzing the right situation when the initial design of the intervention control the implementation process with an up to date approach. (Mirzoev *et al.*, 2016), (Jeon *et al.*, 2019), (Lacouture *et al.*, 2015). It takes consistency and focuses from program implementation. This can be done with the cooperation of stakeholders as practitioners and academics as independent reviewers who are free of conflicts of interest.

5 CONCLUSIONS

Gammarana can suppress the rate of stunting increase during the COVID-19 pandemic so that it can be replicated in new areas.

ACKNOWLEDGEMENTS

Thank you, to the government of Enrekang District, Faculty of Public Health Hasanuddin University and Health Polytechnic of Makassar.

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