Assessing the effect of using Rice-Mongo Crunchies (RMC) as complementary food in Malnutrition Feeding programs

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Abstract. Overcoming malnutrition in all its forms (including undernutrition, micronutrient deficiencies, overweight and obesity) is more than securing enough food for survival; especially what children eat – they must also be nutritious. This study documented the effects of feeding the DOST-PINOY complementary food to malnourished kids ranging from 14 months to 54 months, non-school age children. Four barangays in the city with the highest incidence of malnutrition (based on 2016 data) became recipients of the study during a four-year consecutive period. The children were categorized as severely underweight or underweight children. The feeding program used Rice-Mongo crunches (RMC), which was fed continuously for 120 days. The results showed an increase in the weight gained during the four months of feeding with RMC. Furthermore, there was a significant difference in weights during the 1st, 2nd, 3rd and 4th months of feeding against the initial weights. The increase in weight varied between 0.20-0.800 kg as observed per child per month. At the end of the 4th month of feeding, the total weight gained varied from 0.3 kg to 2.8 kg per child.

1. Introduction

Good nutrition allows children to survive, grow, develop, learn, play, participate and contribute, however, malnutrition robs children of their future and leaves their young lives hanging in the balance. According to the World Health Organization[1], malnutrition is still one of the most common nutritional disorders in developing countries and it remains one of the most common causes of morbidity and mortality among children worldwide. “Malnutrition is a complex issue, but it is the main cause of death and disease in the world,” says Dr. Francesco Branca, Director of the Department of Nutrition for Health and Development at the World Health Organization (WHO). And according to him, dysfunctional global food systems are fueling soaring levels of malnutrition and causing a world health crisis. He further said that more must be done to ensure that people have enough to eat and access to the right foods[2].

According to the UNICEF[3] Report in 2019, globally, at least 1 in 3 children under 5 is not growing well due to malnutrition in its more visible forms: stunting, wasting and overweight. A child who is underweight may be stunted, wasted, or both. According to the study conducted by Martorell et al.[4], it is paramount that these conditions be addressed during the first one thousand days of life as they are found to be the critical period of child development.
Access to the right kind of foods has prompted several government agencies around the globe to create various feeding programs, complementary foods and, protocols to address this threat to its populace, however, even with good intentions and discovery of highly nutritious foods, these programs and their food products are not accepted, implemented or have not reached the target individuals. It is important that these food products must also be accepted by the target individuals.

In the report from the National Center for Health Statistics[5] in the USA, covering the period of 2015–2018, it found out that in children aged 2–11 years, the average percentage of calories consumed from fast food was 11.4%, which is considered unhealthy foods. Even in less developed countries, this trend is observed as well, according to the article “The Junk Food Generation---A multi-country survey of the influence of television advertisements on children” [6] conducted in 2002, revealed that 40 per cent of parents and 63 per cent of children in the Philippines believe fast food to be fit for frequent consumption. Studies and surveys conducted reveal that advertisements are targeting children and promoting unhealthy foods [7]. Thus junk foods are not shunned, junk foods dominate the market, that even very young children e.g. 9 months are given this type of food specially in urban and rural areas where the residents live below poverty line, and kids won’t even eat vegetables cause they prefer junk foods. This was observed during the conduct of the study and with interviews with health workers as additional reasons for malnutrition. Thus, access to a highly nutritious food which visually resembles these junk foods in form and taste can have success in the fight against malnutrition.

The DOST-PINOY [8] complementary food, PINOY stands for Package of Intervention for the Improvement of Nutrition of Young children, specifically the Rice-Mongo crunchies (RMC) had been developed by the Food and Nutrition Council Research Institute of the Philippines as part of its initiatives to lessen or address the malnutrition issues of the country. But it is not widely available in the whole country as only a few accepted to be implementers/ manufacturers of these products. Its effects (has been verified) but its acceptance in the communities as a solution to address malnutrition has not been fully accounted for, thus this particular study has been undertaken. In addition, innovation on these product is ongoing in terms of increasing its nutrient content and use of other indigenous materials readily found in the local area.

There has been food formulations [9], mung bean puffed infant rice cereals, specially for weaning, that used rice and mung bean as ingredients for complementary foods, but none in the form of chips designed to visually resemble the usual “junk food chips” in the market. There are also complementary foods in powdered form to be diluted in water. Thus, in what ever form it may be, targeting specific ages groups of children, innovations on complementary foods is important so that it will accepted and accessible to both malnourished and healthy children.

2. Methodology

Two methods are outlined, first is the basic procedure for making the RMC and the second is the conduct of the assessment of the effect of using RMC on the weight of individual malnourished kids.

2.1 RMC procedure

The process begun with removing visible dirt from rice, the mango or mung bean were washed and dried under the sun; and then separately milled; both milled rice and mango were mixed with water, forming a dough-like mixture. The flattened dough was then steamed, afterwards while partially cooled down it was fed into an extruder to form strips, which were then cut into bite sizes and dried in a convection oven. The dried product was deep fried for a few seconds, cooled and then packed.

2.2 Assessment

As part of its methodology, before conducting this study, consultative meeting with key agencies, stakeholders and beneficiaries were done. The local government, the ‘barangay’ through a barangay council resolution allows its subjects to take part in this research and extension. A signing of a Memorandum of Agreement by the Barangay Captain, College president of state college (DNSC), the city Mayor and the Department of Science and Technology (DOST) Regional head was also done before the conduct of the study.
A total of four barangays namely: Brgy Cagangohan, Brgy. San Vicente, Brgy. JP Laurel and Brgy. New Visayas agreed to participate in this research and extension program, in a period of four years. A total of 52 children became recipients/study subjects of this study. A pre-selection of the recipients/study subjects were chosen by the Barangay Health Workers (BHW) in-charge in each respective barangay since they monitor the status of malnourished kids in their respective barangays. The BHW are main partners of the researchers in the conduct of the study.

The recipients belong to poor or very poor families which cannot afford to provide extra food sources but the basic needs, and the kids are classified as either underweight to severely underweight, or normal in weight but stunted in growth according to WHO standards. The study subjects are non-school age children to minimize others external factors that might contribute to increase in weight/height since school children may become recipients of other feeding programs. An informed consent was also signed by the parents/guardians of each child, a document attesting to their consent and commitment to the study. Prior to the start of the research, a pre-weighing of each child was done to determine initial weights and heights (baseline data).

Each child was fed with Rice-Mongo crunches (RMC) cheese flavor, shown in Figure 1. It contains 580 calories and 8g protein per 100g; this provides 31.8% of recommended energy and nutrient intake (RENI) for energy and 14.3% for protein of 1 to 3’ year-old children. The feeding was continuous for 120 days or four months, where one pack per day of RMC is consumed. This one pack (30 g) can be consumed one time or divided into small servings as snacks for the child, provided it should be consumed within that day.

Weighing was done every month to monitor weight and height increments, and a weekly assessment of problems encountered during the feeding period was also done. A general monthly feedback assessment was also undertaken. The DOST-FNRI [8] protocol was followed in the conduct of the study.

![Figure 1. Rice-Mongo raw materials to final product (Moritos)](image)

2.2 Statistical tools
The data obtained was statistically analyzed using the SPSS tool, a paired t-test to determine significant difference between initial weights and weights per month; likewise, its height differences.

3. Results and Discussion
A total of fifty-two (52) children were the recipients/study subjects of the research project for the last four years. Sixteen during its first year (Brgy, Cagangohan); on the 2nd year, eleven (from Brgy. San Vicente and Cagangohan); during the 3rd year: four(4) from Brgy Cagangohan and eleven (11) (from Brgy. JP Laurel) and on its 4th year: ten ( from Brgy. New Visayas). Table 1 shows the summary of results with the respective interpretation based on WHO standards.

It was generally observed during the past four years of the study that there was an increase in the weight gained during the 1st, 2nd, 3rd and 4th months of feeding. However, it is in the 3rd and 4th months that a higher significant difference is noted against the initial weights. The normal growth rate is in the
range of 0.15-0.20 kg weight gained per month per child according to the WHO Child Growth standards.

Table 1. Summary of results obtained for year 1, 2, 3 and 4 for weight changes and there interpretations.

| No of kids | Initial AGE OF CHILD, in months | Gender | Initial weight in kg | Initial status | Weight after four months, (Blue color only 3 months) | Total weight gained, kg | INTERPRETATION OF RESULTS Based on WHO standards |
|------------|---------------------------------|--------|----------------------|----------------|-----------------------------------------------|------------------------|-----------------------------------------------|
|            |                                 |        |                      |                |                                               |                        | Age vs weight | Age vs Height | Weight vs Height |
| 1          | 10                              | F      | 8                    | n              | 8.6                                           | 0.6                    | Normal        | Normal         | Normal         |
| 2          | 10                              | F      | 6.5                  | uw             | 8                                             | 1.5                    | Normal        | Normal         | Normal         |
| 3          | 18                              | F      | 8                    | uw             | 8.8                                           | 0.8                    | Normal        | Normal         | Normal         |
| 4          | 26                              | F      | 7.8                  | suw            | 8.8                                           | 1.0                    | Normal        | Normal         | Normal         |
| 5          | 32                              | F      | 10.4                 | n              | 11.5                                          | 1.1                    | Normal        | Normal         | Normal         |
| 6          | 33                              | F      | 10.3                 | uw             | 11.7                                          | 1.4                    | Normal        | Normal         | Normal         |
| 7          | 10                              | M      | 7.8                  | n              | 8.4                                           | 0.6                    | Normal        | Normal         | Normal         |
| 8          | 21                              | M      | 7.7                  | suw            | 8.4                                           | 0.7                    | suw           | Normal         | Normal         |
| 9          | 21                              | M      | 9.2                  | n              | 10.2                                          | 1.0                    | Normal        | Normal         | Normal         |
| 10         | 22                              | M      | 11.5                 | N              | 13                                            | 1.5                    | Normal        | Normal         | Normal         |
| 11         | 24                              | M      | 9.5                  | uw             | 11.4                                          | 1.9                    | Normal        | Normal         | Normal         |
| 12         | 26                              | M      | 10.2                 | n              | 11.5                                          | 1.3                    | Normal        | Normal         | Normal         |
| 13         | 28                              | M      | 9.9                  | uw             | 11.8                                          | 1.9                    | Normal        | Normal         | Normal         |
| 14         | 30                              | M      | 9.4                  | suw            | 10.7                                          | 1.3                    | Underweight   | Normal         | Normal         |
| 15         | 35                              | M      | 10.8                 | uw             | 11.9                                          | 1.1                    | Normal        | Normal         | Normal         |
| 16         | 42                              | M      | 11.4                 | uw             | 12.5                                          | 1.1                    | Normal        | Normal         | Normal         |
| 17         | 15                              | M      | 7.7                  | uw             | 10                                            | 2.3                    | Normal        | Normal         | Normal         |
| 18         | 19                              | F      | 8                    | uw             | 10.5                                          | 2.5                    | Normal        | Normal         | Normal         |
| 19         | 23                              | F      | 8.4                  | uw             | 10.8                                          | 2.4                    | Normal        | stunted (ss)  | severely normal |
| 20         | 24                              | M      | 8.7                  | uw             | 10.5                                          | 1.8                    | Normal        | normal         | normal         |
| 21         | 25                              | F      | 8.8                  | uw             | 10.4                                          | 1.6                    | Normal        | normal         | normal         |
| 22         | 27                              | F      | 8.6                  | uw             | 10                                            | 1.4                    | Underweight   | s             | normal         |
| 23         | 32                              | F      | 9.2                  | uw             | 10.5                                          | 1.3                    | Underweight   | s             | normal         |
| 24         | 33                              | F      | 10                  | uw             | 10.5                                          | 0.5                    | Underweight   | s             | normal         |
| 25         | 36                              | M      | 9                    | suw            | 10.2                                          | 1.2                    | suw           | ss             | normal         |
| 26         | 38                              | M      | 10.4                 | uw             | 11.4                                          | 1.0                    | Underweight   | s             | normal         |
| 27         | 38                              | F      | 10                  | uw             | 10.8                                          | 0.8                    | Normal        | normal         | normal         |
| 28         | 28                              | M      | 6.8                  | suw            | 7.9                                           | 1.1                    | suw           | ss             | wasted         |
| 29         | 36                              | F      | 7.9                  | suw            | 8.8                                           | 0.9                    | suw           | ss             | wasted         |
| 30         | 50                              | M      | 10.9                 | suw            | 11.7                                          | 0.8                    | suw           | ss             | wasted         |
| 31         | 32                              | M      | 9.8                  | suw            | 10.6                                          | 0.8                    | Underweight   | ss             | wasted         |
| 32         | 18                              | F      | 7.6                  | suw            | 7.9                                           | 0.3                    | Underweight   | ss             | wasted         |
| 33         | 18                              | M      | 7.8                  | uw             | 9.1                                           | 1.3                    | Underweight   | ss             | normal         |
| 34         | 28                              | M      | 9.9                  | uw             | 11.4                                          | 1.5                    | Normal        | s             | normal         |
| 35         | 14                              | F      | 7                    | uw             | 8.6                                           | 1.6                    | Normal        | normal         | normal         |
| 36         | 54                              | M      | 13                  | uw             | 14.8                                          | 1.8                    | Normal        | normal         | normal         |
| 37         | 28                              | M      | 9.3                  | uw             | 11.6                                          | 2.3                    | Normal        | s             | normal         |
| 38         | 51                              | F      | 11.3                 | uw             | 14.1                                          | 2.8                    | Normal        | s             | normal         |
| 39         | 41                              | M      | 11                  | uw             | 12.9                                          | 1.9                    | Normal        | s             | normal         |
| 40         | 47                              | M      | 10.8                 | suw            | 12.7                                          | 1.9                    | Underweight   | ss             | normal         |
| 41         | 43                              | M      | 11.1                 | uw             | 13                                            | 1.9                    | Normal        | normal         | normal         |
| 42         | 34                              | M      | 10.1                 | uw             | 11.8                                          | 1.7                    | Normal        | s             | normal         |
| 43         | 25                              | M      | 10.2                 | N              | 10.6                                          | 0.4                    | Normal        | s             | normal         |
| 44         | 14                              | M      | 8.1                  | suw            | 8.4                                           | 0.3                    | Underweight   | normal         | normal         |
| 45         | 27                              | F      | 8.1                  | suw            | 8.8                                           | 0.7                    | suw           | normal         | wasted         |
| 46         | 14                              | M      | 9.9                  | N              | 9.4                                           | 0.4                    | Normal        | normal         | normal         |
| 47         | 46                              | M      | 11.9                 | uw             | 12.3                                          | 0.3                    | Underweight   | s             | normal         |
| 48         | 39                              | M      | 8.4                  | suw            | 8.6                                           | 0.2                    | suw           | ss             | wasted         |
| 49         | 18                              | M      | 7.4                  | suw            | 8                                             | 0.6                    | suw           | ss             | wasted         |
| 50         | 45                              | M      | 11.6                 | uw             | 11.7                                          | 0.1                    | Underweight   | s             | normal         |
| 51         | 20                              | F      | 7.9                  | uw             | 8.7                                           | 0.8                    | Underweight   | normal         | normal         |
| 52         | 14                              | M      | 7.8                  | uw             | 8.6                                           | 0.8                    | Normal        | normal         | wasted         |
3.1 Brgy. Cagangohan

The result of this study has shown that an average increase of 0.20-0.475 kg was observed per child per month. At the end of the 4th month of feeding, a range of 0.6-1.9 kg was gained per child as shown in Table 1. Out of the 16 children, thirteen were now considered as having a normal weight, an 81.25% success rate. Furthermore, the remaining three (children no. 4, 8 and 14) shown in Figure 2 have gained significant increase in their weights, although they have not obtained the normal weight for their respective ages. This may be attributed to the fact that one child had been sick and the others were teething during the feeding period, and all three had really small weights classified as severely underweight from their initial weighing. However, as attested by their mothers and health workers in the barangay, these children have since then gained more appetite in eating and seems to be healthier now compared to before the feeding program was commenced.

![Figure 2](image-url)

**Figure 2.** Changes in weight for 16 children recipients from Brgy. Cagangohan

3.2 Brgy. San Vicente

There were a total of eleven (11) children recipients in the second year (2018) of implementation of this study; only 3 from Brgy. San Vicente, while eight (8) from Brgy. Cagangohan. Although, there were more than three children considered malnourished from this barangay, only three, were willing to participate, the rest came from Brgy. Cagangohan, those who did not reach normal status and new ones who were considered malnourished.

There was an increase in the weight gained during the four months of feeding, same as observed in the previous year as shown in Figure 3. The result of this study has shown that an increase of 0.10-0.800 kg was observed per child per month. At the end of the 4th month of feeding, a range of 0.5-2.5 kg was gained per child.

Out of the 11 children, five were now considered as having a normal weight, five were still underweight and one severe underweight. These results may be attributed to the fact that some children had been sick, and the others were teething during the feeding period. One child had a congenital disease. Two kids were really slow/picky in eating. Also, as shown in Table 1, comparing age versus height after feeding, majority of the children are stunted but they are not classified as “wasted” per weight versus height standard interpretation.
Figure 3. Weight changes during the 2nd year of study from Brgy. San Vicente and Cagangohan

3.3 Brgy. JP Laurel

The data obtained revealed that there was an increase in the weight gained during the four months of feeding with RMC as shown in Figure 4. These changes in weight were significantly different based on statistical analysis using the SPSS software and paired t-test analysis, as shown in Table 2. This implied that feeding with RMC affected the weight of the malnourished kids.

Figure 4. Data obtained during the 3rd year of the study from Brgy JP Laurel only

As shown in Table 1, varying increase of 0.20-0.800 kg was observed per child per month. At the end of the 4th month of feeding, the total weight gained varied from 0.3 kg to 2.8 kg per child. Out of the 11 children, eight, were now considered as having a normal weight while three were still...
underweight. Sadly, comparing age vs height, most are either stunted or severely stunted, only two kids obtained the “normal status”. Feeding may have contributed to increase in height but not enough to reach ideal height for their age. But when comparing their height vs their weight, only one was considered “wasted” and the rest are normal.

Table 2. T-test results for comparison of the weights of 11 respondents using SPSS tool.

| Pair  | Initial – 1st month | Mean  | Std. Deviation | df  | Sig. (2-tailed) |
|-------|---------------------|-------|----------------|-----|----------------|
| Pair 1| initial             | -0.44545 | 0.12933         | 10  | 0.000          |
| Pair 2| initial             | -0.70000 | 0.30984         | 10  | 0.000          |
| Pair 3| initial             | -1.13636 | 0.57493         | 10  | 0.000          |
| Pair 4| initial             | -1.72727 | 0.62144         | 10  | 0.000          |

3.4 Barangay New Visayas
Ten(10) children where the recipients during the fourth year of this study in 2020. The data obtained revealed that there was an increase in the weight gained during the three months of feeding with RMC as shown in Table 1 and Figure 5. Moreover, there was a significant difference in weights during the 1st, 2nd and 3rd months of feeding against the initial weights. The data obtained was only for three months because of the COVID-19 lockdown, the BHW were not able to get the 4th month weights and heights of the kids. The continuous feeding for four months however was completed, since March 30 was the last day of feeding, and the complete lockdown was on the first week of April 2020.

As shown in Table 1, varying increase of 0.10-0.500 kg was observed per child per month. At the end of the 3rd month of feeding, the total weight gained varied from 0.1 kg to 0.8 kg per child. Using the SPSS software and paired t-test analysis, p-values of 0.000-0.010 (α=0.05), as shown in Table 3, were obtained when comparing the initial weight against the first, second and third months of feeding. This implied that feeding with RMC affected the weight of the malnourished kids. And based on WHO standards, this increases in weight per month exceeds normal weight gained.

Out of the 10 children, only three reached the considered normal weight while four were underweight and three severely underweight. These results may be attributed to the fact that some children were severely underweight from the initial weighing, and based on observation, their parents means of income are very deficient, and won’t be able to give rich protein foods. Since, these are complementary foods, without parents providing basic nutritious food intake, these RMC are not sufficient to give them “normal” weight nor reach normal heights.

Likewise, since data for the fourth month is not available, these interpretations are not final statements for the effect of feeding the RMC. It has been observed for the past three years of feeding that it is in the fourth months that a very distinct effect is shown on the weight gain of malnourished kids. The researchers can only presume that based on previous results, a weight gain was obtained.

Furthermore, based on the data obtained for changes in height, it was also observed that there were changes in height noted during the feeding period. Statistical analysis showed that there were significant differences during the three-month feeding period compared to their initial heights.

Sadly, comparing age vs height, some are either stunted or severely stunted, only five kids obtained the “normal status”. Feeding may have contributed to increase in height but not enough to reach ideal height for their age. And when comparing their height vs their weight, six gained “normal status”, three were “wasted” and one “severely wasted”. 
3.5 On-going developments
The researchers are currently developing an enhanced RMC that has higher nutrient content. The addition of corn flour to the main ingredients has also been explored since its cost is less than rice and initial findings have shown that it brings out unique attributes to the final product. Also, RMC with squash flour, or banana flour is being explored, likewise, addition of ‘Malunggay leaves’ or horse radish leaves, or adding turmeric, both acting as flavoring and increase nutritive values for the RMC are also being studied. These new innovations will not only target malnourished kids but also young kids and teenagers as an alternative to eating junk foods.

4. Conclusion
Based on the findings of the study, the following conclusions are drawn: Feeding with RMC increased the weights of malnourished children during the 120 days of feeding period; significant differences among the weights from first to fourth month vs initial weights was observed; the significant difference in weight implied that feeding with RMC affected the weights of malnourished kids and even to a degree increased their respective height; and lastly, continue developing these products and recommend them to be used in feeding programs to minimized if not eliminate malnutrition and make them accessible to children and young people alike as an alternative to junk foods.
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