

The Impact of Animal Source food (ASF) on the Growth of Malnourished Children in Bachok, Kelantan: Randomized Controlled Intervention Trial

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Abstract

Objective: The aim of this study was to evaluate the effect of Animal Source Food on the growth of Malaysian malnourished children in Bachok Kelantan.

Method: A six months Animal Source Food (ASF) intervention trial was carried out with 90 malnourished children, aged 2-10 years, from food insecure households in Bachok, Malaysian. Children were randomized into three groups: Milk Group (n=30) consumed two boxes of 250 ml milk daily over the study period, Egg Group (n=30) received two eggs daily and Control Group (n=30) children who did not receive any food intervention. Anthropometric data were collected at baseline, after 3 and 6 months of the intervention trial.

Results: Over the 6 months study period there was a significant increase in children's height for all groups (Milk Group; 3.62 cm; p<0.001, Egg Group; 3.51 cm, p<0.001, Control Group; 2.55 cm, p<0.001), weight (Milk Group; 1.72 kg; p<0.001, Egg Group; 1.67 kg, p<0.001, Control Group; 0.87 kg, p<0.001), and mid upper arm circumference (MUAC) (Milk Group; 0.80 cm; p<0.001, Egg Group; 0.78 cm, p<0.001, Control Group; 0.31 cm; p=0.023).

Conclusion: The impact of the intervention was positive but the effectiveness was not large enough to define a success of the intervention program.

Keywords: Malnutrition; Intervention; Milk; Eggs; Bachok

Introduction

Limited availability, accessibility and intake of Animal Source Foods (ASF) at a household level and lack of knowledge about their value in the diet and health contribute to poor diet quality [1-3]. It has been shown that households spending more money on non-grain food such as animal source food are preventing their children from being stunted [4].

In affluent countries, strict vegetarian diets, and fear of red meat dictated by spiritual and health beliefs, contribute to micronutrient deficiencies and affect the function of an increasing number of children [2,5,6]. The Nutrition Collaborative Research Support Program (NCRSP) reported strong statistical associations between the intake of Animal Source Foods (ASFs) and better growth, cognitive function, activity, pregnancy outcome and morbidity in three parallel longitudinal observational studies in different ecologic and cultural parts of the world, Egypt, Kenya and Mexico [7-9].

It is well established that foods of domestic animal origin make a major contribution to the diet [10]. Parents who fear to serve eggs and red meat to their children (to control the cholesterol level) are actually keeping them away from the densest sources of proteins, minerals, and vitamins. Such rich sources could help promote growth, bridge the nutrient gap, strengthen the body, and improve the child's immunity to diseases [11].

Different studies have shown that animal source foods (ASF) have a positive impact on weight gain and lean body mass [6-9]. In Kenya, school children were given milk and meat for 21 months. The outcomes measured were rates of change or increase during the intervention in cognitive function, growth, physical activity and behavior and micronutrient status [6].

In another study, where milk and meat were given to the Kenyan school children for 23 months. Children in the meat and milk group gained 30-80% and 40% respectively, more mid-upper-arm muscle area than their peers in the control group [12]. Younger children in the highest quartile of dairy intake had higher Body Mass Index (BMI) than those in the lowest two quartiles [13].

On the other hand, some of the studies did not support the association between consumption of food of animal origin and physical growth of the child [14,15]. In Indonesian study, where milk consumption showed a significant negative association with a child being classified as underweight or stunted but no with wasted children, while the consumption of meat/poultry and eggs did not show any significant impact on all the z scores [14].

The aim of the study is to evaluate the effectiveness of Animal Source Food (ASF) intervention program on the growth of undernourished children.

Materials and Methods

This intervention program was part of a comprehensive study (two-

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phase study) in which we have assessed the household food insecurity level among low income households and nutritional status of the children living in north east of Malaysia (first phase). In the second phase a six months an Animal Source Food (ASF) intervention trial was carried out with 90 malnourished children, aged 2-10 years, from food insecure households in Bachok, Malaysia (April -October 2011). Children were stratified and simply randomized into three groups: Milk group (M), 30 children consumed two carton of 250 ml milk each daily over the study period; Egg group (E), 30 children received two eggs daily; Control group (C). Anthropometric data were collected at baseline and after 3 and 6 months of the trial.

Study subjects and location

The intervention was delivered at the household level targeting 90 children aged 2 to 10 years who were mildly or significantly malnourished from eight Mukems (administrative units in each district) in Bachok District namely Tawang, Perupok, Telong, Melawi, Gunung, TanjungPauh, Repek, Mahligai, and Bekelam. The basic strategy of this intervention program is premised on the simple nutrition concept that a healthy child gains weight every month. Based on this theme, a basic animal based food (milk and eggs) were provided to the malnourished children and periodic anthropometric measurements (PRE, POST1 and POST2) were conducted. We excluded children with allergy to cows' milk, lactose intolerance, severe food allergy, and other severe chronic diseases.

Parents were informed of the study protocol, and each child was included after written consent was presented to his/her proxy.

Sampling design

The targeted malnourish children were stratified for sex (Male/Female), age (≥ 2 to ≤ 6 years / <6 to ≤ 10 years) and nutritional status (stunting; Height for Age Z score < -1 , underweight; Weight for Age Z score < -1 and wasting; Weight for Height Z score < -1), and all the targeted subjects were randomly allocated (simple random method) into three groups; control group, milk group and the egg group.

Food items distribution

Before supplying the food items, the research team along with the community leaders conducted home visits to the targeted households in order to explain to the parents the objectives and benefits of the project as well as the anticipated outcomes. The research team handed over written guidelines and special forms for monitoring and evaluation and parents were guided to fill up these forms.

Monitoring tools

The monitoring procedure for the intervention program was throughout the intervention program and its function is to ensure that people receive the food items at the correct level (safe and compliant with programs guidelines) over an appropriate period of time and also to ensure coverage of those at highest risk another important role is that monitoring reduce recurring costs.

Record keeping

We have developed different records for monitoring purposes:

- Lists of our subjects with all information such as name address and contact number.
- Distribution forms which include the date and time of distribution and the signature of the receiver.

- Compliance records were provided to the mothers (proxies) of the targeted children in order to record the daily compliance toward milk and eggs.
- Two weeks health recalls were distributed to monitor any changes which may encounter the study during the intervention and hinder the growth of the child such as diarrhea, vomiting and other serious complications.
- Anthropometric measuring reports to record all the measurements at the three levels of assessments: (PRE, POST1 and POST2)

Anthropometry measurements

The anthropometry data gathered from participants included height, weight and MUAC Height: Subjects' height was measured using a portable height rod with a horizontal head board attachment- SECA body meter. Participants removed their shoes, stood as tall and straight as possible with their head level and their shoulders and upper arms relaxed. The vertical distance between the standing surface and the top of their head was measured at the maximum point of inhalation. The measurement was repeated two times to a precision of 0.1 cm and a mean value calculated [16].

Weight: Weight were obtained using a SECA digital weighing scale (to the nearest 0.1 kg) Scale. The child should stand unassisted in the center of the scale and be asked to look straight ahead in a relaxed standing position. Minimal clothing and no shoes or socks should be worn by the child during the weighing. Preferably, the weighing should be done after the bladder is emptied and before a meal. The weight measurement should be recorded to the nearest 100 gram (0.1 kg) [16]. After weighing, the scale weight should return to zero position. The age of the child was calculated in months from their birth date to the day of data collection.

The age, weight and height of the children were translated into three indices height - age, (HAZ), weight - age (WAZ) and weight - height (WHZ) by using the Epi. Info 3.5.1, U.S. Centers for Disease Control and Prevention, Atlanta, GA, USA. Measurements on Mid-upper arm circumference for the child were carried out using a flexible measuring tape.

Data analysis

All analyses were conducted using the Statistical Package for the Social Sciences statistical software package version 16.0 (SPSS Inc., Chicago, IL, USA).

To evaluate the impact of the intervention, the groups were compared before the intervention, after three months of the intervention, and at the end of the intervention. Repeated Measures ANOVA was used to detect any univariate differences in height, weight and MUAC measurements within the group changes (PRE, POST1 and POST2). Bonferroni corrections were used and statistical significance was accepted at 0.05.

Results

Anthropometric status

The average of height and weight of all the children was 113.62 ± 12.00 cm and 18.84 ± 4.28 kg respectively. The mean differences of weight, height and MUAC in the Milk group were slightly higher than

other groups, but none of these differences was significant (Table 1). The mean HAZ, WAZ, and WHZ were all negative, suggesting a generally poor nutritional status of all the children in the study. Among the children, the stunted children (significant and mild) were (84.4%) and the underweight (significant and mild) were (92.3%), while the wasted (significant and mild) were (35.1%). The present study did not report any significant difference in weight for age, height for age and weight for height z scores of the children between any of the groups, therefore no adjustment of the nutritional status is required while performing the outcome analyses.

One-way repeated measures ANOVA analysis

The examination of the results of three mean height for PRE, POST1 and POST2 intervention suggested that there was significant difference of mean height within the control group, milk group and the egg group based on time ($F=640.22$, $p<0.001$, correction as per

Huynh-Feldt). The paired t test showed a significant difference in pair 1 (PRE intervention and POST1 intervention; mean difference= -1.04, 95% CI; -1.22, -0.86; $p<0.001$), pair 2 (PRE intervention and POST2 intervention; mean difference= -2.55, 95% CI; -2.93, -2.18; $p<0.001$), and pair 3 (POST1 intervention and POST 2 intervention); mean difference= -1.51, 95% CI; -1.82, -1.20; $p<0.001$). For the milk group, paired t tests suggested significant differences in pair 1 PRE intervention and POST1 intervention; mean difference= -2.07, 95% CI; -2.40, -1.75; $p<0.001$), pair 2 (PRE intervention and POST2 intervention; mean difference = -3.62, 95% CI; -4.11, -3.12; $p<0.001$), and pair 3 (POST1 intervention and POST 2 intervention; mean difference = -1.54, 95% CI; -1.90, -1.18; $p<0.001$). For the egg group, there was a substantial and significant increase in mean height at all the three time intervals. The most substantial increase in height seen in milk group (3.62 cm) followed by the egg group (3.51 cm) (Table 2).

For the changes in weight, there were increases in mean weight over

Variables	Total		Control		Milk		Egg		F	P-Value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean (SD)		
Height		113.62 ± 12.0		113.76 ± 11.7		114.69 ± 12.73		112.41 ± 12.32	0.323	0.725 ^A
Weight		18.84 ± 4.28		18.51 ± 3.89		19.12 ± 4.31		18.90 ± 4.73	0.155	0.857 ^A
MUAC		16.24 ± 1.57		16.01 ± 1.40		16.17 ± 1.4		16.54 ± 1.83	0.898	0.411 ^A
H/A z score		-1.67 ± 0.86		-1.58 ± 0.72		-1.46 ± 0.62		-1.96 ± 1.12	2.759	0.069 ^A
Significant Stunting	23(25.5)		6(6.7)		5(5.6)		12(13.3)			0.22 ^F
Mild Stunting	53(58.9)		18(20)		21(23.3)		14(15.6)			
Normal	14(15.6)		6(6.7)		4(4.4)		4(4.4)			
W/A z score		-1.65 ± 0.53		-1.7 ± 0.49		-1.6 ± 0.34		-1.65 ± 0.71	0.3	0.742 ^A
Significant Underweight	23(25.6)		10(11.1)		2(2.2)		11(12.2)			<0.001 ^F
Mild Underweight	60(66.7)		19(21.1)		28(31.10)		13(14.4)			
Normal	7(7.8)		1(1.1)		0(0.0)		6(6.7)			
W/H z score		-0.81 ± 0.72		-0.92 ± 0.64		-0.84 ± 0.77		-0.67 ± 0.74	0.917	0.404 ^A
Significant Wasting	4(4.4)		1(1.1)		2(2.2)		1(1.1)			0.76 ^F
Mild Wasting	33(36.6)		13(14.4)		9(10)		11(12.2)			
Normal	53(58.9)		16(17.8)		19(21.1)		18(20)			

SD: Standard Deviation

^AIndependent t, ^FPearson Chi-Square Test., F Fisher exact test.

Significantly underweight/stunting/wasting (Moderate + Severe) Z score: <-2 SD

Mildly underweight/stunting/wasting: Z score ≤ -2 SD ≤ x < -1 SD

Normal: Z score -1 SD ≤ x ≤ 2 SD.

Table 1: Anthropometric characteristics of children in the Control group, Milk group and Egg group.

Comparison	Control Group		Milk Group		Egg Group	
	MD (95% C.I.)	p-Value [*]	MD (95% C.I.)	p-Value [*]	MD (95% C.I.)	p-Value [*]
Height(cm)						
Pre-Post1	-1.04(-1.22, -0.86)	<0.001	-2.07(-2.40, -1.75)	<0.001	-2.31(-2.71, -1.91)	<0.001
Post1-Post2	-1.51(-1.82, -1.20)	<0.001	-1.54(-1.90, -1.18)	<.001	-1.20(-1.42, -0.97)	<0.001
Pre-Post2	-2.55(-2.93, -2.18)	<0.001	-3.62 (-4.11, -3.12)	<0.001	-3.51(-3.87, -3.87)	<0.001
Weight(kg)						
Pre-Post1	-0.49 (-0.70, -0.28)	<0.001	-1.11(-1.44, -0.77)	<0.001	-1.01(-1.40, -0.62)	<0.001
Post1-Post2	-0.37 (-0.62, -0.12)	0.002	-0.61(-0.82, -0.39)	<0.001	-0.65(-0.98, -0.33)	<0.001
Pre-Post2	-0.87 (-1.21, -0.47)	<0.001	-1.72(-2.11, -1.32)	<0.001	-1.67(-2.27, -1.07)	<0.001
MUAC(cm)						
Pre-Post1	-0.12 (-0.37, 0.12)	0.632	-0.47 (-0.7, -0.25)	<0.001	-0.58(-0.85, -0.31)	<0.001
Post1-Post2	-0.19 (-0.30, -0.07)	0.001	-0.33 (-0.55, -0.10)	0.002	-0.20(-0.41, 0.07)	0.061
Pre-Post2	-0.31 (-0.59, -0.036)	0.023	-0.80 (-1.08, -0.52)	< 0.001	-0.78(-1.17, -0.39)	<0.001

One – way Repeated Measures ANOVA within group analysis was applied followed by Pairwise Comparison with confidence interval adjustment.

MD = Mean Difference.

^{*}Pairwise comparison with Bonferroni to correct the level of significance.

Table 2: Comparison of Height, Weight and MUAC within each intervention groups based on time (Time Effect).

time in each group, with the least increase seen in the control group. Moreover, for the other two experimental groups the gain in weight increased substantially from time one to time two ($p < 0.001$) as well as from time two to time three ($p < 0.001$). The milk group reported the most substantial gain in weight (1.72 kg),

The multiple comparisons of the pairs show that the average MUAC of children in the control group increases substantially from POST1 to POST 2 ($p = 0.001$) following a minimal increase from PRE – POST1 ($p = 0.623$). In the milk group, the increments in mean MUAC from PRE – POST1 ($p < 0.001$) and from POST1 – POST 2 ($p = 0.002$) were substantial and significant.

Multiple comparisons within the egg group showed significant difference in pair1 (PRE-POST1); -0.58, 95% CI; -0.85, -0.31; $p < 0.001$) and pair2 (PRE - POST2 -0.87, 95% CI; -1.17, -0.39; $p < 0.001$) while pair 3 (POST1- POS 2); the mean difference was not significant; -0.20, 95% CI; -0.41, 0.07; $p = 0.061$). The milk group also reported the highest increment in MUAC, followed by the egg group then, come the control group in the third place.

Discussion

Height gain

Various studies targeting school-age children who have a low intake of milk and other dairy products showed that the addition of milk to the diet increased linear growth and reduced stunting. These results were observed in Malaysia and in Japan using school feeding programs. In both studies, rapid growth in height was noted [17,18]. Another important evidence was reported in a longitudinal study of 92 Japanese children, which indicated that greater height and weight gain among children who drank more milk over a period of three years [19]. Likely, the same positive association was reported with the consumption of eggs in an Iranian study in which eggs were introduced to the breakfast of Iranian Qashqa'i tribes resulting in a significant increase in height when compared with the control group [20]. The expenditures and consumption of animal source foods were related to reduction in the prevalence of stunting [2] and it's believed that this association not only because of the protein and the caloric contents of these foods, but the benefit refer to the ASFs potential to provide enough iron, calcium, and zinc [21].

However, not all studies have found an effect. For example, a study involving several thousand children from 28 areas in England and Scotland found no difference in height increase between those who had access to free school milk for one school year and those who did not [15].

Weight changes

At the within-group effect level, our results showed significant positive changes in the weight of the children in the experimental groups and in the control group. At this level of analysis, our results are consistent with those of a Kenyan study in which the children in the milk group gained 0.4 kg more weight than those in the control group. In the Iranian study in which eggs were introduced to the children's breakfast, the weight gain was 0.74 kg after a year of intervention.

Our findings are consistent with that of a Chinese study in which 757 girls aged 10 years were recruited for a two-year milk intervention trial, their results reported a significant increase in weight over the study period [22,23]. Consistent with our results, Salehi and his colleagues reported a significant gain in weight when eggs were included in the breakfast meal of Iranian Qashqa'i children during a 12-month intervention program [20].

Interestingly, evidence from a Malaysian study in which Chen (1989) evaluated the impact of a school milk program indicated a reduction in the prevalence of protein-energy malnutrition in terms of underweight (15.3% to 8.6%), stunting (16.3% to 8.3%), and wasting (2.6% to 1.7%) from the beginning of the school feeding program until two years later [17]. The difference in the magnitude of reduction in the protein-energy malnutrition between Chen's and our study is attributed to four reasons; first, the former was conducted at the school level whereas the latter was at the household level. An earlier level of intervention (school level) provides a better opportunity to monitor and follow up compared with intervention at the household level because of social barriers that the researchers might encounter when dealing with a family. Second, the intervention of the other study was conducted over a two-year period, which was longer than the duration of our intervention. Third, at the household level, sharing of milk among the household members is possible, especially for the younger siblings; no such limitation exists at the school level. Finally, the statistical analysis of the other study depended on categorical data using the chi-squared test, whereas in our study, the statistical analysis was based on numerical continuous data via one-way repeated measures ANOVA, which is a more powerful statistical tool.

Negligible difference was found in weight gain between the milk (1.71 kg) and the egg (1.67 kg) groups. To some extent, this observation disagrees with the findings of other studies, which proved that milk and milk isolates (whey) may result in greater food intake suppression compared with egg albumin [23].

Before the intervention, our advice to the mothers was to give the milk to the targeted child after the meal to prevent loss of appetite for the daily meals. However, many of the mothers said that their children had less appetite for the usual meals, especially rice, a staple food in Malaysia. This observation might be valid given the evidence from studies that examined the effects of high-protein diets on energy expenditure, subsequent energy intake, and weight loss compared with lower protein diets. Such studies showed that protein was more satiating than carbohydrate or fat [24,25], which suggests that a modest increase in protein, at the expense of other macronutrients, may promote satiety and facilitate weight loss through reduced energy consumption [26-28].

MUAC changes

The mean differences were significant when the effect of the time factor was tested. The increase in the MUAC of the children in the milk and egg groups were nearly double that in the control group. Our result was consistent with other trials in which they use milk [29] and egg [20]. In the former study, the meat group showed the steepest rate of increase (almost double) in the size of the mid-arm muscle area (indicative of lean body mass), and the milk group showed the next greatest improvement. In the latter study, the increase in the MUAC of children who ate one egg daily was nearly double that in the control group (0.8 and 0.42 cm, respectively) during a 12-month trial. The association between milk consumption and the increase in the size of muscle areas might be an effect of protein isolates, which provide the raw materials needed to synthesize proteins, thus increasing lean muscle mass and protecting muscles against catabolic breakdown during physical activities [30].

In conclusion, the impact of the intervention program was positive, but it did not meet our expectations. The reason for the unexpected results might be the small sample size, the wide age range of the children in our study (2 to 10 years), and the aspects that could not have been explored with the available data using the randomized design

because of the limited number of undernourished children from the first phase of the study. In one of the key studies that focused on age differences in the relationship between supplement intake and growth rates, Schroeder et al. (1995) reported that the gain in length during the first three years of life showed the greatest benefit in the first year. Between the ages of three and seven, nutritional supplementation had no significant impact on linear growth [31]. This finding might be the same in our case, resulting in an insignificant increase of linear growth in our trial in which the mean age of the children was 88 months.

Another crucial factor which might hinder the efficacy of the intervention program is the compliance rate for the experimental groups. The compliance rate was correlated with the growth of the child in terms of linear growth, weight and MUAC (Data not shown) at both the levels of the intervention and it was clear that the gaining in the up mentioned parameters in the first level of the study was better than the second level in harmony with the compliance rate which consider as important constrain in any intervention [32]. The compliance rate might be influenced by the appetite of the children to the food supplementation, where various mothers expressed the reluctance of the children because they feel bored of eating or drinking the same type of food for six months, which for them is a relatively long period.

Conclusion and Recommendations

The results of the study showed positive impact of the intervention trial in term of growth among undernourished children from food insecure household in north east Malaysia. These findings provide better pathway in designing program and food intervention for future studies. An integrated program of food supplements and nutritional education based on strong and a propitiate study design and longer duration of intervention can be advice to reduce the prevalence of malnutrition among children in low income and rural communities

One of the major limitations of the study, that it doesn't include baseline measure of dietary intake which can be used to determine the deficits of calories and nutrients in the population. On the basis of this information, the supplementation to be provided by the food ration is determined.

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