


Effect of Buffalo Milk Consumption on the Growth of 10 to 12 years Old Schoolgirls in Magdalena, Laguna, Philippines

Nutrition and Metabolic Insights
Volume 16: 1–5
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DOI: 10.1177/11786388231151355



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ABSTRACT

BACKGROUND: Milk contains essential nutrients that help can improve the growth and development of adolescent girls.

OBJECTIVES: The study determined the effect of milk consumption on the nutritional status of schoolgirls ages 10 to 12 years old in Magdalena, Laguna, Philippines.

METHODOLOGY: A quasi-experimental study design was used to determine the impact of daily consumption of 200 ml buffalo milk on the prevalence of undernutrition among the 57 schoolgirl participants before and after 160 days. One sample *t*-test and paired *t*-test were used to compare the actual and expected total increment and monthly changes in the height and body mass index (BMI) of the participants, while a one-way analysis of variance was used to compare the actual total changes in height and BMI by age. Factors that are correlated with these measurements were identified based on Spearman's correlation coefficients.

RESULTS: The percentage of stunting (31.6%–22.8%) and thinness (21.1%–15.8%) decreased after the milk feeding. Significant differences were observed in the means of total actual and expected changes in height ($P < .00$) and BMI ($P < .00$). While there were significant differences in the means of actual and expected monthly changes in height every month, this was only observed in the first 2 months for BMI. Only the mean actual changes in height had significant differences when compared by age ($P = .04$). Lastly, the age and education of the father were found to be correlated with the height of the schoolgirls.

CONCLUSION: Buffalo milk consumption can improve the growth outcomes of schoolgirls

KEYWORDS: Adolescence, body mass index, buffalo milk, linear growth

RECEIVED: November 29, 2022. **ACCEPTED:** December 29, 2022.

TYPE: Original Research

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The authors would like to thank the Philippine Carabao Center, National Nutrition Council-Department of Health, and the Department of Science and Technology – Science Education (DOST-SEI) through its Accelerated Science and Technology Human Resource Development Program (ASTHRDP) for funding this study.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Introduction

Optimal nutrition is essential in the adolescence phase as rapid biological growth and development happen during this period,^{1,2} particularly among adolescent girls who often have greater nutritional deficit compared to males.^{3,4} Adolescence is considered the second window of opportunity, and failing to invest in adolescent-focused initiatives would jeopardize earlier investments in maternal and child health.^{5–7}

In the Philippines, the prevalence of stunting among female adolescents ages 10 to 12 years old is 22.7% while the prevalence of wasting/thinness is 10.8%.⁸ Stunting among adolescent girls can result in adverse reproductive outcomes in the future. Women with low stature have higher risks of having complications during delivery, including prolonged labor and cesarean delivery. On the other hand, low absolute weight increases the

risk of poor pregnancy outcomes such as preterm delivery and having a baby born of low birth weight.⁹ Adolescent girls with low body mass tend to have lower bone mass in early adulthood, which can lead to postmenopausal osteoporosis.¹⁰

While many factors such as age, socioeconomic status, and parental age and education can affect the growth and development of adolescents,^{11–13} milk consumption has been found to improve the linear growth and body mass index (BMI) of adolescents.^{14,15} Based on the seventh Philippine National Nutrition Survey data, the mean energy intake from milk is significantly associated with the nutritional status of Filipino adolescents. However, the milk intake among this age group is low.¹⁶ This could be used as an opportunity to improve the existing state of undernutrition among adolescents in the country, particularly among females.



Hence, for this study, we explored the impact of milk consumption on the nutritional status of schoolgirls ages 10 to 12 years old in Magdalena, Laguna, Philippines, and the factors associated with their linear growth and BMI. Specifically, the study aimed to determine the prevalence of stunting and thinness in schoolgirls before and after milk feeding. It also compared the actual and expected total increment and monthly changes in height and BMI of the schoolgirls, as well as the actual changes of these anthropometric measurements by age. Lastly, it identified the factors correlated with the height and BMI of the 10 to 12 years old schoolgirls.

Methodology

Study design

A quasi-experimental study design was conducted to determine the impact of consumption of 200 ml locally produced buffalo milk for 160 days on the height and BMI of schoolgirls in 2 selected public elementary schools in Magdalena, Laguna, Philippines. Schoolgirls who are 10 to 12 years old, and have normal/stunted and normal/thin nutritional status using 2007 WHO Growth Reference¹⁷ for height-for-age and BMI-for-age, respectively. Only those who gave their assent and whose parents signed the informed consent to participate were included in the study. Those who have lactose intolerance per confirmation of a physician were excluded from the study.

The buffalo milk used for this study was subjected to nutrient analysis. The analysis used separate pooled milk samples from three batches of production in Magdalena, Laguna, Philippines. Every 100ml of buffalo milk was estimated to contain: 114 calories, 5.29 g carbohydrates, 4.69 g protein, 8.18 g fat, 44.35 retinol equivalents (RE) vitamin A, 134.86 mg calcium, 0.60mg iron, 5.76 mg magnesium, and 120.14 phosphorus.

Sampling

There were 193 schoolgirls aged 10 to 12 years old enrolled in the selected schools; one had a history of lactose intolerance and was therefore excluded from the study. The rest were invited to participate in the study and among the invited students, 5 refused to participate. Of the 187 who agreed to participate, 5 were identified as obese and 10 were overweight. Participants were identified from the 172 eligible schoolgirls who have signed informed consent.

A minimum number of 57 participants was required to observe an anticipated proportion of 50% with a 90% confidence level and a margin of error of 9%. The estimated minimum sample size was adjusted for a population of 172. A buffer of 1 schoolchild participant was allowed in consideration of the available budget. Hence, 58 participants were randomly selected among eligible schoolgirls. However, 1

participant discontinued participating in the study during the 160 days feeding period.

Data collection

The data collection was conducted from July 2018 to December 2018. A structured questionnaire was used to collect data on the sociodemographic profile of the participants such as household size, parental age and education, and monthly family income. On the other hand, the anthropometric measurements were taken by a nutritionist following a standard protocol at baseline and the end of every month in the designated place in the schools for the duration of the study. A stadiometer (SECA 213, Hamburg, Germany) and a digital floor scale (SECA 813, Hamburg, Germany) were used to measure the height and weight of the participants, respectively. Before weighing, the scale was calibrated and measurements were taken twice to ensure the precision and accuracy of the data. The average of the 2 measurements was calculated, recorded to the nearest 100g, and considered as the final measurement.

Data analysis

Only the data of those who finished the study were included in the data analysis. The data on weight and height were used to compute the BMI (kg/m^2) of the participants. Those who suffered from stunting and thinness were identified based on the 2007 WHO Growth Reference for height-for-age and BMI-for-age for 5 to 19 years old, respectively. Stunting among the schoolgirls was defined as those whose height is more than 2 standard deviations below the median height-for-age of the growth reference. On the other hand, thinness among the schoolgirls was defined as those whose BMI is more than 2 standard deviations below the median height-for-age of the growth reference. The actual changes in the height and BMI of the participants were based on the monthly anthropometric measurements while the expected changes in anthropometric measurements were also based on the said growth reference.

Descriptive statistics such as frequencies and percentages were used to describe the prevalence of stunting and thinness among the participants before and after the milk feeding for 160 days. On the other hand, a one-sample *t*-test was used to compare the actual and expected total incremental change in height, and the difference in height after 160 days period (baseline and endline), whereas the paired *t*-test was used to compare the actual and expected monthly incremental changes in anthropometric measurements (height and BMI), and the total incremental change in BMI of the participants. One-way analysis of variance (ANOVA) was also used to compare the actual changes in height and BMI of the participants by age. Lastly, the sociodemographic factors that are correlated with the height and BMI of the participants were identified based on Spearman's correlation coefficients. The data in this study were

Table 1. Frequency and percentage of malnutrition among 10 to 12 years old schoolgirls before and after 160 days milk feeding (n=57).

VARIABLE	BASELINE		ENDLINE	
	FREQUENCY	%	FREQUENCY	%
Stunted	18	31.6	13	22.8
Thin	12	21.1	9	15.8

analyzed using the Statistical Package for Social Science (SPSS) version 17.0.

Ethical consideration

The study protocol was reviewed and approved (No. 2017-520-01) by University of the Philippines Manila Research Ethics Board (UPMREB), and was done in accordance with the guidelines set in the Helsinki Declaration. Written assent and informed consent were also sought from the schoolgirls and their parents before the data collection, respectively.

Results

Around one-third of the participants were stunted while about 1 in every 5 participants were thin at the baseline of the study. These numbers were reduced to 22.8% for stunting and 15.8% at the endline (Table 1).

Significant differences were observed between the means of actual and expected total incremental change per month in height and BMI and the means of actual and expected change in height after 160 days period (Table 2).

The means of actual and expected monthly changes in height (i.e., 0.5cm \pm 0.03cm) were significantly different ($p < 0.00$). Highest mean increase in height was observed during the first month (1.12cm \pm 0.61cm). This is followed by a slightly lower mean increase in height in the second measurement of 0.72cm \pm 0.5cm. The mean increase in height on the third and fourth months were 0.92cm \pm 0.6cm and 0.68cm \pm 0.58cm. The last mean increase in height of the schoolgirls on the fifth month was 0.76cm \pm 0.55cm (Figure 1).

There were also significant differences observed in the means of actual and expected monthly changes in BMI (i.e., 0.06kg/m² \pm 0.01kg/m²) until the second month of milk feeding. No significant differences were observed in the subsequent months. The actual means of changes in BMI of the schoolgirls in the first two measurements were 0.24 kg/m² \pm 0.36 kg/m² ($p < 0.00$) and 0.16kg/m² \pm 0.38 kg/m² ($p = 0.03$) (Figure 2).

The study also revealed that there were significant differences in the means of actual changes in height of the participants when compared by age. On the other hand, no significant differences in the means of actual changes in BMI of the participants when compared by age (Table 3).

Furthermore, findings showed that the fathers' age and education are correlated with the participant's height. There was a

weak negative correlation between the age of the father and the height of the participants at baseline while there is a weak positive correlation between the educational attainment of the father and the height of the participants at baseline. No significant relationship was found between sociodemographic factors and the BMI of the participants (Table 4).

Discussion

The study found that the prevalence of stunting and thinning among the participants were reduced after the intervention. Improved rates of height and BMI increase were also observed when compared to what was expected rates of height and BMI changes among the participants. Moreover, while the rate of height increase varies by age, no significant differences were observed in the BMI changes when compared between the ages of the schoolgirls.

While both the prevalence of stunting and thinness among the participants at baseline and endline were still higher compared to the national estimates,⁸ the findings indicate that buffalo milk feeding may decrease the prevalence of undernutrition among schoolgirls. Previous observational studies also found similar findings to this study wherein significantly lower the prevalence of stunting and underweight were observed among adolescents who consumed dairy products than those who did not.^{18,19}

A higher velocity of the change in anthropometric measurements (ie, height, weight, and BMI) was also observed in previous milk intervention trials.^{20,21} Dor et al²² suggest that milk consumption stimulates the growth of adolescents, thereby protecting them from having short stature. Milk contains nutrients such as protein, essential minerals, and vitamins which are essential for growth. Adolescents who consume milk are more likely to meet their requirements for these nutrients. Milk consumption can also lead to higher serum insulin-like growth factor-1,¹⁵ which is a hormone that mainly regulates linear growth.¹⁴

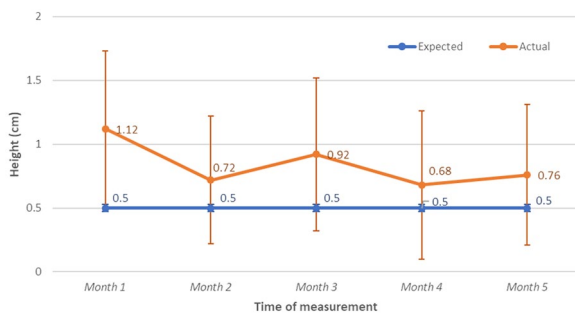
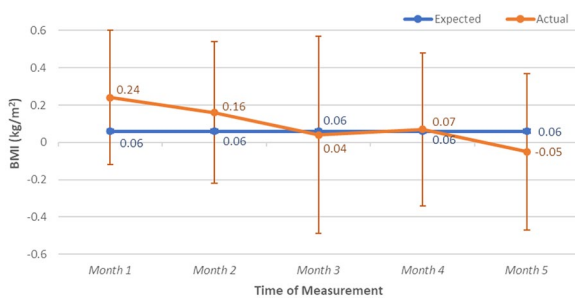
Furthermore, the study showed that there were significant differences in the mean changes in height of the schoolgirls when compared by age. This is perhaps due to the growth spurt that happens at this age, peaking at 12 years old among girls. Hence, the rate of skeletal growth or increase in height is highest at this age.²³

Lastly, among the sociodemographic characteristics investigated in the study, only the father's age and educational attainment were found to have correlations with the height of the schoolgirls. While maternal age and education are more commonly cited as important contributing factors to the nutritional status of the children,²⁴⁻²⁷ some have also found a significant relationship between paternal age and education and linear growth as well as BMI among adolescent girls,^{13,28} as what was found in this study. Perhaps, the father being the head of the family, a common setting in Filipino households, had more influence on decisions made at the household level that dictates

Table 2. Comparison of the actual and expected increment changes in anthropometric measurements of 10 to 12 years old schoolgirls (n=57).

VARIABLE	WHO		ACTUAL		P-VALUE ^A
	MEAN	SD	MEAN	SD	
Height					
Total Incremental Change Per Month	0.51	0.04	0.84	0.21	.00 ^{ab}
Difference in height (160 days period)	2.54	0.19	4.20	1.03	.00 ^{ab}
BMI					
Total Incremental Change Per Month	0.06	0.01	0.09	0.10	.01 [*]

*Significant at $P < .05$; a = paired sample *t*-test; b = 1 sample *t*-test.

**Figure 1.** Comparison of the actual and expected monthly changes in the height of 10–12 years old schoolgirls (n = 57).**Figure 2.** Comparison of the actual and expected monthly changes in the BMI of 10–12 years old schoolgirls (n = 57).

the nutrition of the schoolgirls. These results highlight the importance of human capital investments in improving the nutritional status of adolescent girls. Nutrition initiatives for schoolgirls in the study area should target household heads who are young and with low educational attainment.

The study provides evidence of the stimulating effect of the consumption of locally produced buffalo milk on the linear growth and BMI of Filipino schoolgirls. However, due to the nature of the study design (i.e., lack of control group), the causal effect of buffalo milk consumption on the nutritional status of the study population cannot be established. Hence, continued research is needed to provide concrete evidence linking buffalo milk consumption and nutritional status among schoolgirls. For future studies, researchers can build on the study findings by conducting studies with a randomized controlled trial research design on the beneficial effect of buffalo milk consumption on the

Table 3. Comparison of the actual changes in anthropometric measurements of 10 to 12 years old schoolgirls, by age.

AGE	MEAN	SD	P-VALUE
Height			
10	4.57	0.88	.04 [*]
11	4.05	1.05	
12	3.44	1.07	
BMI			
10	0.39	0.53	.37
11	0.48	0.57	
12	0.78	0.52	

*Significant at $P < .05$.

Table 4. Factors correlated with the height and BMI of the 10 to 12 years old schoolgirls.

VARIABLE	HEIGHT	BMI
Household size	-0.1757	0.1003
Age of father	-0.2751 [*]	0.0281
Age of mother	-0.0717	0.0039
Education of father	0.2808 [*]	-0.1447
Education of mother	0.1156	-0.1211
Monthly family income	0.1938	0.1162

*Significant at $P < .05$.

nutritional status of adolescent girls as well as other nutritionally vulnerable groups.

Inclusion of other outcome variables such as mid-upper arm circumference, waist-hip ratio, and biochemical parameters like serum protein levels may be relevant for these studies. Furthermore, it could also be interesting to compare the outcomes among those who consumed cow, and goat milks.

Conclusion

Findings revealed that the percentages of schoolgirls in Magdalena, Laguna who suffers from stunting and thinness

decreased after the milk feeding for 160 days. There were also significant differences in the means of total actual and expected changes per month in height and BMI of the schoolgirls. Moreover, significant differences were also observed in the means of actual height per month of the participants. This was also observed in the BMI of the schoolgirls but only in the first 2 months of intervention. Furthermore, there were significant differences in the mean changes in height of the schoolgirls when compared by age, but none in BMI changes by age. Additionally, the age and educational attainment of the father was found to be correlated with the height of the schoolgirls. These findings suggest that buffalo milk consumption can improve the linear growth and BMI of schoolgirls and that adolescent-focused nutrition initiatives in the area should target those who belong to a household headed by young and with low educational attainment fathers. However, further studies are needed to establish the beneficial effect of buffalo milk consumption on the nutritional status of adolescent girls.

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