Impact of Nutritional Status and Related Factors on Academic Achievement of High School Adolescents, Hlaing Tharyar District, Yangon, Myanmar

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Submitted: 13 June 2022. Accepted: 20 January 2023. Published: 11 February 2023
Volume 31, 2023. pp. 482–496. http://doi.org/10.25133/JPSSv312023.027

Abstract

Chronic malnutrition in adolescents may result in significant academic difficulties. The impact of nutritional status and related factors on the academic achievement of adolescents in high schools in Myanmar was determined. A cross-sectional survey using a self-administered questionnaire on food intake and other factors potentially affecting nutritional status was used to gather information from 301 students aged 13–17. Grade-point averages (GPA) in the previous academic year were also recorded. Most respondents showed average body mass index values, followed by underweight, overweight, and obese. Regarding academic achievement, a GPA of A, B, C, and D was seen in 41.5%, 36.2%, 15.3%, and 7.0% of the respondents, respectively. Nutritional status was significantly associated with academic achievement. Underweight students had a 1.96 times higher likelihood of achieving mediocre grades (C, D) than normal-weight students. Among other factors examined, only the number of meals per day was associated with nutritional status. The duration of the walk to school, the duration of watching or playing games, and the parent's socioeconomic status were associated with academic achievement. The study found an association between nutrition-related factors on levels of academic achievement of adolescent students in the study area.

Keywords

Academic achievement; adolescence; malnutrition; Myanmar; nutrition

Introduction

Adolescence is a transition period involving substantial physical, psychological, and cognitive growth (Mahy et al., 2014). Limitations in their cognitive abilities challenge many adolescents engaged in school activities. To enhance adolescents' physical and intellectual abilities, they should be provided with the appropriate quantity and quality of nourishment (Ogunsile, 2012). Adolescents who are either underweight or overweight have significant difficulties in school, both academically and socially (Dodsworth, 2010). This explanation implies that the nutritional status of adolescents can influence academic achievement.

A large number of adolescents suffer from chronic malnutrition. The prevalence of protein-energy malnutrition is high in almost every country in the region (World Health Organization, 2006). The World Food Programme (2016) stated that Myanmar is still one of the Southeast Asian countries with the highest undernutrition rates. A previous study also reported that the prevalence of malnutrition among adolescents was 20.1% in Dagon Township (Win et al., 2011).

Academic achievement is the outcome or performance of education that indicates the extent to which a student has accomplished specific goals that were the focus of activities in instructional environments (Suvarna & Ganesha-Bhata, 2016). To evaluate if students are gaining sufficient academic knowledge, the teachers must assess the student's knowledge and summarize this assessment into a letter or number (Chiekem, 2015). Some educators have recommended that grades only reflect the students' competencies in a given subject. Grading students in terms of what they know will help teachers provide students and parents specific feedback on which learning areas call for improvement (Fleenor et al., 2011). Moreover, research has demonstrated that grades reflect learning goals which are part of academic performance (Randall & Engelhard, 2010).

Proper nutrition is one of the essential requirements for academic achievement. Students who do not receive appropriate nutrition can become underweight or overweight and suffer from various nutrient deficiencies affecting their academic achievements. Some studies found that low anthropometric measurements are frequently associated with poor academic achievement (Ivanovic & Marambio, 1989). A recent study in India showed that the student populations with the lowest prevalence of stunting achieved the highest grades (Souza et al., 2021). Likewise, a study in Thailand showed that being or becoming overweight during adolescence was significantly associated with poor academic achievement (Mo-suwan et al., 1999).

Many factors may influence the nutritional status of adolescent students; habits of food choices, the amount of food intake, eating behavior, lack of knowledge about nutrition, food availability, the quest for independence and acceptance by peers, socioeconomic status of the student's family, and physical activity affect the nutritional status of students (Ogunsile, 2012). Students consuming a balanced, nutrient-dense diet perform better in participation, social behavior, attendance, and completing their assigned tasks than those who do not eat well (Dodsworth, 2010). These are some reasons students' nutritional status is vital for their academic achievement.

Although several factors, such as intelligence quotient, emotional quotient, and perseverance, play a significant role in determining a child's academic achievement, nutritional status is one

of the main factors potentially impacting academic achievement. Therefore, this study aimed to determine the impact of nutritional status and related factors on the academic achievement of adolescents in high schools in Hlaing Tharyar Township, Yangon, Myanmar.

Materials and methods

Study design

This cross-sectional study was carried out to identify the association between nutritional status and related factors in the academic achievement of adolescents in high schools in Hlaing Tharyar Township, Yangon, Myanmar. Two schools, namely No. (1) and No. (2) Basic Education High Schools, Hlaing Tharyar, were selected in the Northern District of the Yangon metropolitan area. The sample size estimated using $n = (Z^2 \alpha/2 P (1 - P))/ d^2 + 25\%$ of withdrawal issues was 307 participants. Questionnaires were developed and prepared with a code system for each participant and each school. After understanding the study's objectives explained by the researcher, the participants were asked to sign the consent form before measuring their body mass index (BMI) and responding to the questionnaires. Each participant had the right to cancel the consent and withdraw from the study if the participant did not wish to continue.

Inclusion criteria

Secondary school students aged 13–17 years who were willing to participate in this study and able to provide the consent form signed by their parents or guardian were invited.

Exclusion criteria

We excluded students who did not function well enough to respond relevantly to the questionnaires, were severely ill and absent or did not receive approval from their parents or guardians.

Data collection

This study was performed in May 2017 and was based on three components of anthropometric measurements, academic grades, and information provided through self-administered questionnaires. During data collection, regular and closed supervision was performed with the help of school teachers to control possible bias.

Anthropometric measurements

Height and weight for all participants were measured using standard anthropometric methods to calculate the Body Mass Index (BMI) according to the World Health Organization's growth reference for individuals aged 5–19 years (World Health Organization, 2006, 2011). The hip at the widest length of the buttock and the waist circumference at a level midway between the lower rib margin and the iliac crest of the participants were measured using a measuring tape, and the data were used to calculate the waist-to-hip ratio (WHR). A

BMI of 18.5 to < 25 is the healthy weight range for men and women. A moderate WHR of less than 0.9 and 0.85 are for men and women, respectively.

Recording academic grades

Previous year academic grades were retrieved from the comprehensive personal record of each participant. Grade point averages (GPA) were used to reflect academic grades in the two high schools for the 2016–2017 academic year. The GPA-based classification of A, B, C, and D corresponded to 80%–100%, 60%–79%, 40%–59%, and < 40%, respectively. Fair and reasonable grades were considered the percentage of scores < 60 and ≥ 60, respectively.

Self-administered questionnaires

Questionnaires included four sections regarding demographic information, food intake, and factors relating to adolescent nutritional status (knowledge and attitude toward food intake and eating behavior, physical activity, and family socioeconomic status).

Food intake survey

Food frequency questionnaires (FFQs) were applied based on the Asian Food Guide Pyramid to assess the food intake by participants. After the investigator team explained the purpose of this study, all participants were requested to complete their FFQ for 30 days.

Factors related to nutritional status

Participant knowledge of the nutritional status

The questions were developed to assess the participants' knowledge of food intake, food choices, and malnutrition, and there was one correct answer for each question. The questions were developed to address the Go, Glow, and Grow Food groups (Lopez-Madrid et al., 2018). The highest possible total score was 9, and answers were categorized into 'poor level' if the score ranged between 1 and 5 and 'good level' if the score ranged between 6 and 9.

Participant attitude on nutritional status

Questions on food intake and choices were posed to determine the participants' attitudes toward food consumption. The participants showed their degree of agreement by choosing only one answer for each item. Each statement had five-point numerical scales, ranging from strongly agree, agree, neutral, disagree, and strongly disagree. The maximum total score for attitude was 25 and categorized into 'fair attitude' if the score range was 0–16 and 'good attitude' if the score range was 17–25.

Eating behavior, physical activity, and socioeconomic factors of the participants

Items pertaining to participants' knowledge, attitude, and behavior on eating behavior, physical activity, and socioeconomic factors at school during a day or week were surveyed using a food frequency questionnaire and brief questions.

Data analysis

The quantitative data of BMI, waist-to-hip ratio, grade record, FFQ, knowledge, attitude, behavior, physical activity, and socioeconomic status were analyzed using SPSS Version 18.0. Descriptive data were presented as numbers, percentages, and means with standard deviations. Pearson's chi-squared test (χ^2) was used to determine the association between the nutrition-related factors of food intake knowledge, attitude and behavior, physical activity, and socioeconomic status on the academic achievement of adolescents.

Ethical considerations

The study was approved by the ethics committee of the Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand (COA No. MUTM 2017-031-01 issued on July 2017). A permission letter from the Yangon Region education office was received on February 2017 (Sector 8/1218/permission research/2017). Data collection was conducted only after obtaining informed consent from the participants. All data was collected confidentially at each stage of data handling. The data were anonymized using a random identity number at the start of data collection.

Results

General characteristics, anthropometric assessments, and grade point average

The study's sample size was 301 participants from two high schools in Hlaing Tharyar Township. A total of 132 participants (43.9%) were from No. (1) Basic Education High School and 169 (56.1%) were from No. (2) Basic Education High School. Most participants were female (65.1%). The mean age of the participants was 14.43 (range, 13–17) years, with 22.3% aged 13, 21.9% aged 14, 46.8% aged 15, 8.3% aged 16, and 0.7% aged 17. The majority of the recorded BMI values were within the normal range (69.4%). Participants who were underweight, overweight, or obese constituted 22.6%, 4.7%, and 3.3% of the study population, respectively. A total of 211 participants (70.1%) had normal waist-to-hip ratios, while the remaining 90 (29.9%) were at substantially increased risk of metabolic complications. With regard to academic achievement, 41.5% of the students received a grade of A, 36.2% received a grade of B, 15.3% received a grade of C, and 7.0% received a grade of D based on the GPA-based evaluation (Table 1).

Table 1: General Characteristic Anthropometric Assessment and Grade Point Average of Study Participants (n = 307)

Characteristic	Number (%)
Gender	
Male	105 (34.9)
Female	196 (65.1)
Age category (years)	
13	67 (22.3)
14	66 (21.9)

Characteristic	Number (%)
15	141 (46.8)
16	25 (8.3)
17	2 (0.7)
Mean ± SD	14.43 ± 0.95
Body Mass Index (BMI)	
Underweight	68 (22.6)
Normal	209 (69.4)
Overweight	14 (4.7)
Obesity	10 (3.3)
Mean ± SD	17.9 ± 3.52
Waist-hip Ratio	
Normal	211 (70.1)
Risk	90 (29.9)
Mean ± SD	0.84 ± 0.06
Grade point average (GPA)	
Grade A	125 (41.5)
Grade B	109 (36.2)
Grade C	46 (15.3)
Grade D	21 (7.0)
Schools (study sites, *n* = 301)	
B.E.H.S (1), Hlaing Tharyar	132 (43.9)
B.E.H.S (2), Hlaing Tharyar	169 (56.1)

Note: Grades A, B, C, and D corresponded to 80%–100%, 60%–79%, 40%–59%, and < 40%, respectively.

Food intake

Data on the food intake of the participants over the past 30 days was recorded by the FFQ, collated, and presented in Table 2, with poultry (42.25%) and fish (36.5%) being the meat items consumed most frequently. Participants also consumed milk/yogurt (26.9%) and ground nuts (29.9%) as a protein source.

Table 2: Frequency and Percentage of Maximum, Minimum, and Never Consumption of Food During the Previous Month (*n* = 307)

List of Foods	Maximum Consumption *n* (%) Food Frequency	Minimum Consumption *n* (%) Food Frequency	Never Consumption in One Month *n* (%)
Meats			
Beef	34 (11.3) Once per week	2 (0.7) ≥ twice per day	205 (68.1)
Pork	79 (26.2) Once per week	9 (3.0) ≥ twice per day	101 (33.6)
Chicken	127 (42.2) 2–4 times per week	11 (3.7) Once per month	21 (7.0)
Fish	110 (36.5) 2–4 times per week	12 (4.0) ≥ twice per day	13 (4.3)
Egg	97 (32.2) Once per week	18 (6.0) Once per month	8 (2.7)
Prawns	66.9 (22.9) Once per week	8 (2.7) ≥ twice per day	32 (10.6)

List of Foods	Maximum Consumption *n* (%) Food Frequency	Minimum Consumption *n* (%) Food Frequency	Never Consumption in One Month *n* (%)
Dairy products			
Milk/yogurt	81 (26.9) Once per week	13 (4.3) ≥ twice per day	24 (8.0)
Cheese/ Butter	50 (16.6) Once per month	6 (2.0) ≥ twice per day	133 (44.2)
Cereals			
White/sticky rice	296 (98.3) ≥ twice per day	5 (1.7) Once per day	-
Bread	94 (34.2) Once per day	12 (4.0) 2–3 times per month and once per month	13 (4.3)
Fruits			
Banana	78 (25.9) Once per week	21 (7.0) ≥ twice per day	32 (10.6)
Papaya	75 (24.9) Once per week	8 (2.7) ≥ twice per day	54 (17.9)
Drinks			
Soft drinks	110 (36.5) Once per day	8 (2.7) Once per month	2 (0.7)
Vegetables			
Potatoes	116 (38.5) 2–4 times per week	16 (5.3) ≥ twice per day	10 (3.3)
Leafy greens	90 (29.9) 2–4 times per week	5 (1.7) Once per month	3 (1.0)
Pumpkin	64 (21.3) Once per month	3 (1.0) ≥ twice per day	137 (45.5)
Ground nuts	90 (29.9) Once per week	7 (2.3) ≥ twice per day	31 (10.3)

Nutritional status-related factors

There was a statistically significant association between the number of meals per day and the nutritional status (p = .045). Respondents who had ≤ 2 meals per day were more likely to have abnormal BMI than those who had ≥ 3 meals per day (odds ratio [OR] = 1.663, 95% CI [1.010, 2.739]) (Table 3). In addition, although not significant, respondents who categorized into the fair attitude toward food intake tended to have a less normal nutritional status than respondents who rated as having a good attitude. Up to 82.6% of those who did not walk or walked for less than 15 minutes had abnormal BMI. Nearly 27% of the respondents with abnormal BMI were from families with ≥ 7 family members, and 42.4% of the respondents' parents were either dead or divorced.

Table 3: Knowledge, Attitude, Eating Behavior, Physical Activity, and Nutritional Status (n = 307)

Measurement	Nutritional Status		p value	OR (95% CI)
	Abnormal n (%)	Normal n (%)		
Knowledge score				
Poor (1–5)	4 (4.3)	12 (5.7)	.620	0.746
Good (6–9)	88 (95.7)	197 (94.3)		(0.234, 2.378)
Attitude score				
Fair (0–16)	68 (73.9)	141 (67.5)	.263	1.366
Good (17–25)	24 (26.1)	68 (32.5)		(0.790, 2.364)
Eating behavior				
Number of meals per day				
≤ 2 meals	56 (60.9)	101 (48.3)	**.045**	1.663
≥ 3 meals	36 (39.1)	108 (51.7)		(1.010, 2.739)
Skip meal				
Yes	54 (58.7)	111 (53.1)	.370	1.225
No	38 (41.3)	98 (46.9)		(0.764, 2.060)
Skip breakfast				
Yes	36 (39.1)	73 (34.9)	.485	0.835
No	56 (60.9)	136 (65.1)		(0.503, 1.385)
Eating snack				
Yes	89 (96.7)	201 (96.2)	.809	1.181
No	3 (3.3)	8 (3.8)		(0.306, 4.555)
Do Physical activity				
Yes	85 (92.4)	189 (90.4)	.583	1.285
No	7 (7.6)	20 (9.6)		(0.523, 3.154)
Duration of watching or playing games				
≥ 2 hours	47 (51.1)	88 (42.1)	.149	1.436
Not watch and watch < 2 hours	45 (48.9)	121 (57.9)		(0.878, 2.350)
Duration of walk to school				
≥ 15 minutes	16 (17.4)	35 (16.7)	.891	1.047
Not walk and walk < 15 minutes	76 (82.6)	174 (83.3)		(0.546, 2.005)

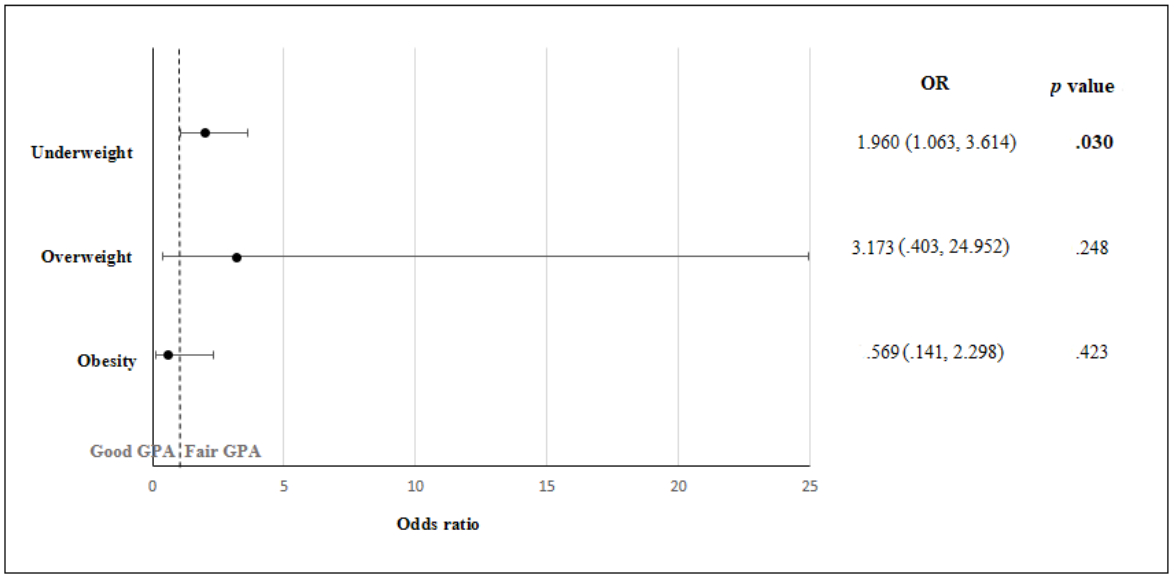
Note: Pearson correlation is significant at $p < .05$

Factors related to academic achievement

Nutritional status and academic achievement

Underweight participants were 1.96 times more likely to receive fair grades (C, D) than those who were normal-weight (OR = 1.960, 95% CI [1.063, 3.614], p = .030). However, there was no association between overweight/obesity and academic achievement (Figure 1).

Figure 1: Association Between Nutritional Status and Academic Achievement Compared to Normal Status (*n* = 307).

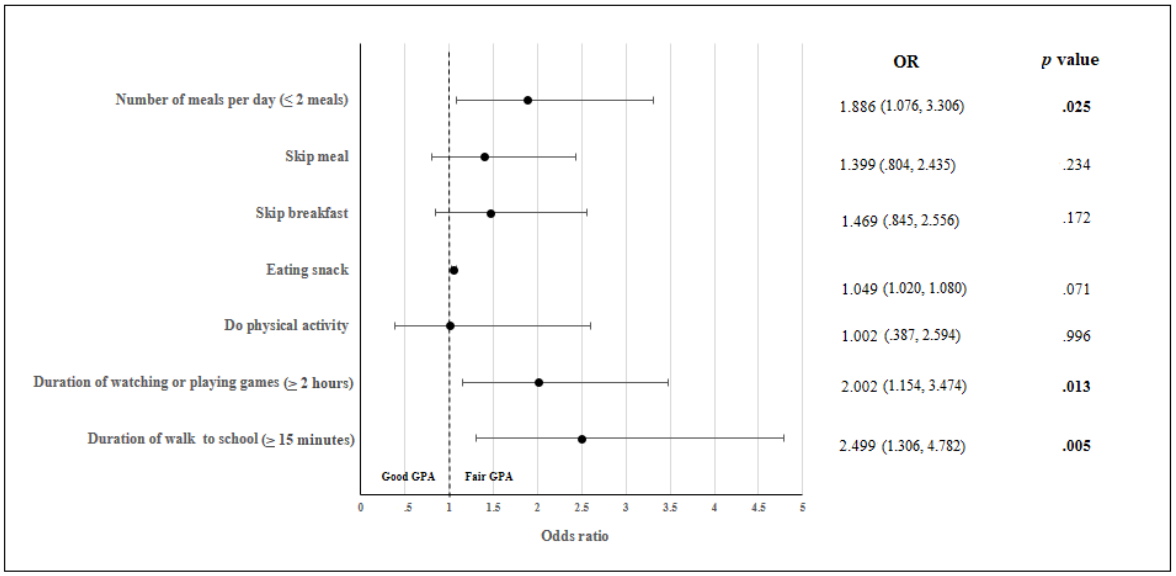


Note: GPA = Grade Point Average, Good GPA = Grade A or B, Fair GPA = Grade C or D; Pearson correlation is significant at p < .05.

Eating behavior, physical activity, and academic achievement

A statistically significant association between the number of meals per day and academic achievement was observed (Figure 2; *p* = .025). Participants who had ≤ 2 meals per day were 1.886 times more likely to have a 'fair' GPA rating than those who had ≥ 3 meals per day (OR = 1.886, 95% CI [1.076, 3.306]). Nearly 62% of the participants who skipped a meal were scored as 'fair' in the GPA, while only 38.3% of those who did not skip a meal were scored as 'fair' in the GPA. No association was identified between physical activity and academic achievement.

Figure 2: Eating Behavior, Physical Activity, and Academic Achievement (*n* = 307).



Note: GPA = Grade Point Average, Good GPA = Grade A or B, Fair GPA = Grade C or D; Pearson correlation is significant at p < .05.

Meanwhile, there was a statistically significant association between the duration of watching or playing games and academic achievement (p = .013). Participants who watched and played games for ≥ 2 hours were more likely to be categorized as 'fair' in the GPA compared with those who did not watch and play games or who watched and played games for < 2 hours (OR = 2.002, 95% CI [1.154, 3.474]).

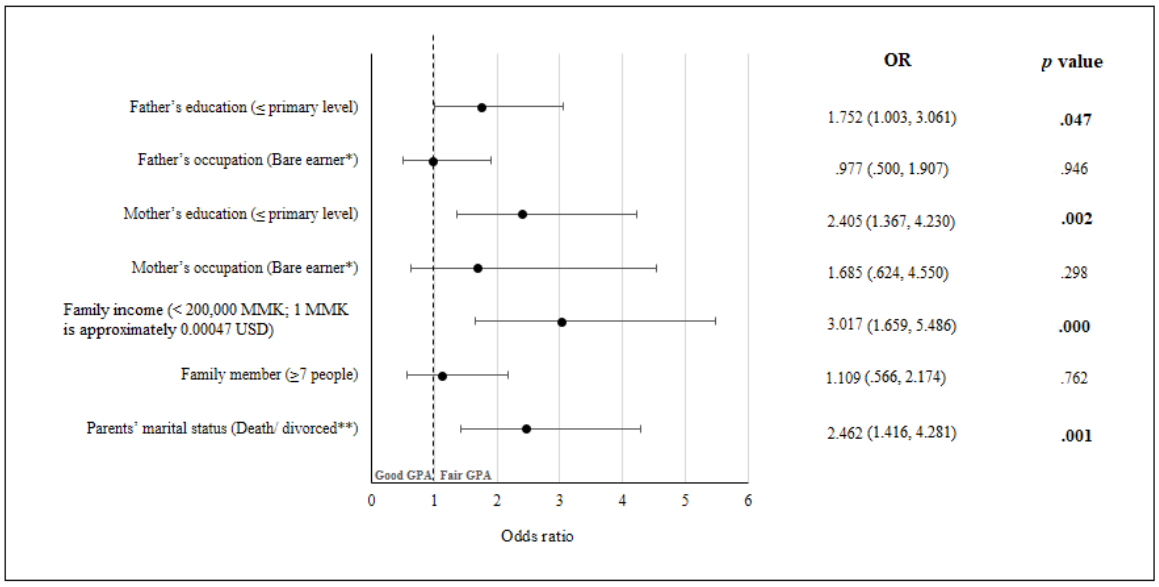
Our study also revealed a statistically significant association between the duration of the walk to school and academic achievement (p = .005). Participants who walked for ≥ 15 minutes to school were 2.499 times more likely to receive a 'fair' GPA than those who did not walk and who walked < 15 minutes (OR = 2.499, 95% CI [1.306, 4.782]).

Socioeconomic factors and academic achievement

There was an association between the father's (p = .047) and mother's (p = .002) education and academic achievement of the participant. Participants whose fathers or mothers had less or just primary education level were more likely to receive a 'fair' GPA compared with those whose fathers or mothers had at least or more than middle or higher education level (OR = 1.752, 95% CI [1.003, 3.061] and OR = 2.405, 95% CI [1.367, 4.230], respectively).

A clear association between family income and academic achievement was observed (p < .001). Participants whose families had an income of < MMK 200,000 (≈ USD 47) were 3.017 times more likely to receive a 'fair' GPA than those whose families had an income of ≥ MMK 200,000 (≈ USD 47) (OR = 3.017, 95% CI [1.659, 5.486]). There was also a clear association between the parent's marital status and academic achievement (p = .001); participants whose parents were either dead or divorced were more likely to receive a 'fair' GPA than those whose parents were alive and in a relationship (OR = 2.462, 95% CI [1.416, 4.281]) (Figure 3).

Figure 3: Association Between Socioeconomic Factors and Academic Achievement (n = 307)



*Note: GPA = Grade point average, Good GPA = Grade A or B, Fair GPA = Grade C or D; *jobless, **one/both dead, divorced; Pearson correlation is significant at p < .05.*

Discussion

This study investigated factors related to the nutritional status of adolescents in two basic education high schools in Hlaing Tharyar in the Yangon metropolitan area of Myanmar. There was no association between demographic factors (gender, age, waist-to-hip ratio, schools) and nutritional status. Regarding the intake frequency of food items, we showed that chicken was the most commonly consumed food item, followed by fish, vegetables, and soft drinks. Meat, eggs, dairy products, fruits, and nuts were less frequently consumed (Table 2). Respondents from this study ate various types of food items. However, a balanced diet is critical to intellectual and physical development (Food and Agriculture Organization, 2015). According to our observations, the participants' food intakes were sometimes not met by their daily diet. A previous study found that adolescents who do not have a balanced diet may exhibit various degrees of malnutrition with implications on health and academic development (Ogunsile, 2012).

A study of knowledge on nutrition, attitude toward nutrition, and nutritional practices are critical to understanding the development of a community. This study did not find any association between the level of nutrition knowledge and attitude and nutritional status. Surprisingly, respondents with a good knowledge level presented abnormal BMIs, up to 95.7%. However, only up to 73.9% of the respondents with a fair attitude toward nutrition had abnormal BMIs. When looking further into eating behavior, more than 60% of the respondents who had ≤ 2 meals per day were more likely to have abnormal BMIs than those who had ≥ 3 meals per day (39.1%; Table 3). A reasonable frequency of meals is vital to secure a steady energy distribution throughout the day, especially for adolescents (Siega-Riz et al., 1998). A previous study found that those with the lowest meal frequency had inadequate energy intake but higher fat mass (Würbach et al., 2009). An inverse relationship between meal frequency and overweight and obesity in adolescents has been identified (Franko et al., 2008). Another study found that increasing meal frequency may be conducive to reducing BMI (Mota et al., 2008).

Many studies have found an association between physical activity and nutritional status (Goyal et al., 2011; Kotian et al., 2010; Kumar et al., 2007). Although walking to school was the most common physical activity performed by the participants, our study failed to find any association between physical activity and nutritional status. Thus, in this study, eating lower than three meals per day appeared to be the most substantial influencing factor concerning abnormal nutritional status. However, a good level of knowledge and attitude toward food intake and consuming a healthy and proper diet are still crucial to ensuring a normal nutritional status.

There was no association between skipping a meal, skipping breakfast, or eating a snack and nutritional status. However, we revealed that more than half of the participants (54.8%) skipped a meal daily. The main reasons provided for skipping a meal were 'not having enough time to have a meal' (30.6%), 'did not like the food available' (16.9%), and 'having the habit of skipping a meal' (9.6%). In addition, 8% of the respondents skipped a meal when they were in a particular emotional state (happy, sad, excited, anxious, etc.), and 2.7% also skipped a meal to keep weight. Almost 40% of the respondents skipped breakfast, and 96.7% ate a snack during the day. A habit of skipping meals could lead to essential nutrient deficiencies. Moreover, the habit of eating snacks could result in raised calorie and fat intake. These eating behaviors could affect nutritional status and health (Das & Sahoo, 2011) (Figure 2). The

findings from this study might be beneficial for implementing intervention strategies that could reduce skipping meals and provide healthy snacks to adolescents.

This study identified no association between socioeconomic factors and nutritional status. This finding was inconsistent with previous results (Das & Sahoo, 2011; Gurung & Sapkota, 2010; Paracha et al., 2016). This finding might be explained by the low cost of living that allows purchasing of healthy foods.

We identified a statistically significant association between nutritional status and academic achievement. Underweight respondents were more likely to receive Grades C and D than those with normal weight (p = .030) (Figure 1). Previous studies have reported that low anthropometric measurements are frequently associated with poor academic achievement (Ivanovic & Marambio, 1989; Keeley & Fox, 2009). This finding might be because underweight students may have various nutrient deficiencies, affecting their academic achievements. Meanwhile, in our study, there was no relationship between being overweight or obese and academic achievement. This finding differed from a previous study in Thailand, which mentioned that overweight students were more likely to have low GPAs than normal-weight students (Mo-suwan et al., 1999).

Our study found a significant association between consumed daily meals and academic achievement (p = .025). Respondents who had ≤ 2 meals per day were more prone to receive a 'fair' GPA than those who had ≥ 3 meals per day (Figure 2). We speculate that inadequate nutrition could cause low energy levels among those affected, and the lack of ability to concentrate would be reflected in the low scores on their tests. This result was consistent with a previous study reporting that students who did not eat well performed worse in participation, social behavior, attendance, and ability to complete assigned tasks than those who ate well. One study stated that the academic achievement of adolescents is associated with a daily intake of three regular meals (Kim et al., 2003). Another study found that children with a lower dietary intake had lower academic achievements than those with adequate dietary intakes (Kleinman et al., 2002).

We found an association between the duration of the walk to school and academic achievement (p = .005). Respondents who walked ≥ 15 minutes to school were more likely to receive a 'fair' GPA than those who did not walk or walked < 15 minutes (Figure 2). This finding might be explained by the possibility that walking distance to school makes students tired after reaching the school and renders them lagging in the classroom and private studies. This finding was consistent with a previous study (Mhiliwa, 2015) that reported that a long walk to school affected the student's performance compared to living close to the school environment.

This study also showed that most respondents (80.7%) watched or played games. More than 44% of the students spent more than 2 hours per day on such activities, and only 9% played less than 1 hour per day. Respondents who watched and played games for ≥ 2 hours were more likely to receive a 'fair' GPA than those who did not watch and play games or did it for < 2 hours (Figure 2). Students who spend most of their free time watching or playing games might have less study time. A previous study reported a similar result: those who watched television for > 2 hours per day had lower academic achievement than those who watched television for < 2 hours (Sharma et al., 2017). Instead of game playing and watching, individuals aged 5–17 years should spend at least 60 minutes per day performing a physical activity of moderate-to-vigorous intensity according to the Myanmar Clinical Practice Guidelines for the Management of Obesity (Latt et al., 2011).

An association between the father's or mother's education and the student's academic achievement was observed. Respondents whose fathers or mothers had less than or only primary education level fell were more prone to receive a 'fair' GPA than those whose fathers had at least or more than middle or higher education level (Figure 3). There were also statistically significant associations between high family income, parents' marital status, and good academic achievement (p = .000). Respondents whose parents were dead or divorced scored more 'fair' GPAs than those whose parents were alive. We assume that parents who had higher education and higher income and who are both alive might be able to support a better-quality life for their children and invest more in their children's education. These findings were supported by a previous study (Paracha et al., 2016). The significant limitation of our study is only used a chi-squared test to determine the association between nutrition-related factors. Regression analysis should be performed to control for covariates and confounders and determine the variables most influential. This limitation would affect the discussion and the conclusion in a significant way. It also noted that only two schools selected in this study would influence the interpretation of results variability, which may lead to bias. The opinions of specific groups could skew the results.

Conclusions

This study noticed the impact of nutritional status and its related factors on the academic achievement of adolescents. This realization includes the number of meals per day, the duration of watching or playing games, the duration of the walk to school, parent education, family income, and the parents' marital status. In order to explore the specific nutrients requirement of adolescents in further detail, weighed dietary records or 24-hour recalls may also be combined. Researchers could use research results to apply for further study to get more specific details of the problem. Schools may consider providing more meals and physical activities to students. Education academic officers should provide the proper nutritional knowledge to students and parents. This evidence-based would assist the policymakers in Myanmar in designing health and nutrition policies related to promoting adolescents' nutritional status. It would also aid the development of new strategies to improve the health of children and adolescents and reduce the burden of nutrition-related problems in public. Further study on nutrition adequacy would be helpful.

Acknowledgments

We acknowledge those who participated in this study and would also like to thank Beth Taylor from Enago Academy for editing a draft of this manuscript.

References

Chiekem, E. (2015). Grading practice as valid measures of academic achievement of secondary schools students for National Development. *Journal of Education and Practice, 6*(26), 24–28. https://iiste.org/Journals/index.php/JEP/article/view/25707

Das, S., & Sahoo, H. (2011). An investigation into factors affecting child undernutrition in Madhya Pradesh. *The Anthropologist, 13*(3), 227–233. https://doi.org/10.1080/09720073.2011.11891201

Dodsworth, L. M. (2010). *Student nutrition and academic achievement* [Master's thesis, St. John Fisher University]. Digital Commons. https://fisherpub.sjf.edu/mathcs_etd_masters/96/

Fleenor, A., Lamb, S., Anton, Stinson, J. T., & Donen, T. (2011). The grades game. *Principal Leadership*, *11*(6), 48–52. https://eric.ed.gov/?id=EJ916326

Food and Agriculture Organization. (2015). *Myanmar - Food and Nutrition Security Profiles*. https://www.fao.org/3/at700e/at700e.pdf

Franko, D. L., Striegel-Moore, R. H., Thompson, D., Affenito, S. G., Schreiber, G. B., Daniels, S. R., & Crawford, P. B. (2008). The relationship between meal frequency and body mass index in black and white adolescent girls: More is less. *International Journal of Obesity, 32*(1), 23–29. https://doi.org/10.1038/sj.ijo.0803654

Goyal, J. P., Kumar, N., Parmar, I., Shah, V.B., & Patel, B. (2011). Determinants of overweight and obesity in affluent adolescent in Surat City, South Gujarat region, India. *Indian Journal of Community Medicine, 36*(4), 296–300. https://doi.org/10.4103/0970-0218.91418

Gurung, C. K., & Sapkota, V. P. (2010). Prevalence and predictors of underweight, stunting and wasting in under-five children. *Journal of Nepal Health Research Council, 7*(2), 120–126. https://doi.org/10.33314/jnhrc.v0i0.206

Ivanovic, D., & Marambio, M. (1989). Nutrition and Education I. Educational achievement and anthropometric parameters of children elementary and high school graduates. *Nutrition Reports International, 39*(5), 983–993. https://agris.fao.org/agris-search/search.do?recordID=US8922828

Keeley, T. J. H., & Fox, K. R. (2009). The impact of physical activity and fitness on academic achievement and cognitive performance in children. *International Review of Sport and Exercise Psychology, 2*(2), 198–214. https://doi.org/10.1080/17509840903233822

Kim, H.-Y. P., Frongillo, E. A., Han, S.-S., Oh, S.-Y., Kim, W.-K., Jang, Y.-A., Won, H.-S., Lee, H.-S., & Kim, S.-H. (2003). Academic performance of Korean children is associated with dietary behaviors and physical status. *Asia Pacific Clinical Nutrition*, *12*(2), 186–192. https://apjcn.nhri.org.tw/server/APJCN/12/2/186.pdf

Kleinman, R. E., Hall, S., Green, H., Korzec-Ramirez, D., Patton, K., Pagano, M. E., & Murphy, J. M. (2002). Diet, breakfast, and academic performance in children. *Annals of Nutrition and Metabolism, 46*(S1), 24–30. https://doi.org/10.1159/000066399

Kotian, M. S., Kumar, G., & Kotian. S. S. (2010). Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. *Indian Journal of Community Medicine, 35*(1), 176–178. https://doi.org/10.4103/0970-0218.62587

Kumar, S., Mahabalaraju, D. K., & Anuroopa, M. S. (2007). Prevalence of obesity and its influencing factor among affluent school children of Davangere city. *Indian Journal of Community Medicine, 32*(1), 15–17. https://doi.org/10.4103/0970-0218.53384

Latt, T. S., Ko, K., Aye, T. T., Thidar, A., & Khin, E. E. (2011). A summary of the Myanmar clinical practice guidelines for the management of obesity. *Journal of the ASEAN Federation of Endocrine Societies, 26*(2), 105–109. https://www.asean-endocrinejournal.org/index.php/JAFES/article/view/78

Lopez-Madrid, M. M., Acuin, C. C. S., Orense, C. L., Duante, C. A., Tan, R. C. A., & Capanzana, M. V. (2018). Awareness of and adherence to the food based dietary guidelines among household meal planners in the Philippines. *Philippine Journal of Science, 147*(3), 523–535. https://philjournalsci.dost.gov.ph/home-1/78-vol-147-no-3-september-2018/821-awareness-of-and-adherence-to-the-food-based-dietary-guidelines-among-household-meal-planners-in-the-philippines

Mahy, C. E. V., Moses, L. J., & Kliegel, M. (2014). The development of prospective memory in children: An executive framework. *Developmental Review, 34*(4), 305–326. http://dx.doi.org/10.1016/j.dr.2014.08.001

Mhiliwa, J. A. (2015). *The effects of school distance on students' academic performance: A case of community secondary schools in Makambako Town Council* [Master's thesis]. The Open University of Tanzania. http://repository.out.ac.tz/1296

Mo-suwan, L., Lebel, L., Puetpaiboon, A., & Junjana, C. (1999). School performance and weight status of children and young adolescents in a transitional society in Thailand. *International Journal* of *Obesity, 23*(3), 272–277. https://doi.org/10.1038/sj.ijo.0800808

Mota, J., Fidalgo, F., Silva, R., Ribeiro, J. C., Santos, R., Carvalho, J., & Santos, M. P. (2008). Relationships between physical activity, obesity and meal frequency in adolescents. *Annals of Human Biology, 35*(1), 1–10. https://doi.org/10.1080/03014460701779617

Ogunsile, S. E. (2012). The effect of dietary pattern and body mass index on the academic performance of in-school adolescents. *International Education Studies, 5*(6), 65–72. https://doi.org/10.5539/ies.v5n6p65

Paracha, P. I., Bakht, S. Paracha, S.I., Vriesekoop, F., Alam, I., ud Din, Z., & Ullah, N. (2016). Nutritional status, dietary and physical activities of adolescents in public and private schools of Karachi, Pakistan. *Obesity Research – Open Journal, 3*(2), 30–39. http://dx.doi.org/10.17140/OROJ-3-125

Randall, J., & Engelhard, G. (2010). Examining the grading practices of teachers. *Teaching* and *Teacher Education, 26*(7), 1372–1380. https://psycnet.apa.org/doi/10.1016/j.tate.2010.03.008

Sharma, B., Cosme Chavez, R., Jeong, A. S., & Nam, E. W. (2017). Television viewing and its association with sedentary behaviors, self-rated heath and academic performance among secondary school students in Peru. *International Journal of Environmental Research and Public Health, 14*(4), Article 383. https://doi.org/10.3390/ijerph14040383

Siega-Riz, A. M., Popkin, B. M., & Carson, T. (1998). Trends in breakfast consumption for children in the United States from 1965-1991. *The American Journal of Clinical Nutrition, 67*(4), 748S–756S. https://doi.org/10.1093/ajcn/67.4.748S

Souza, S. H. D., Shetty, P., & Shetty, G. B. (2021). Nutritional status of mid-day meal program on government and private school students: A comparative study. *International Journal of Community Medicine and Public Health, 8*(10), 4982–4986. https://doi.org/10.18203/2394-6040.ijcmph20213806

Suvarna, V. D., & Ganesha-Bhata, H. S. (2016). A study on academic achievement and personality of secondary school students. *Research in Pedagogy, 6*(1), 99–108. https://doi.org/10.17810/2015.27

Win, N., Hongrailert, N., & Silabutra, J. (2011). Factors related to overweight middle school children in Dagon Township, Yangon Division, Union of Myanmar. *Journal of Health Research*, *25*(3), 111–115. https://he01.tci-thaijo.org/index.php/jhealthres/article/view/81153

World Food Programme. (2016, April). *Nutrition: WFP Myanmar*. https://cdn.wfp.org/wfp.org/publications/WFPMYA_Nutrition_Apr16.pdf?_ga=2.245199365.1092956120.1588587743-814911489.1588587743

World Health Organization. (2006, March). *Adolescent nutrition: A review of the situation in selected South-East Asian Countries* [SEA-NUT-163]. WHO Regional Office for South-East Asia. https://apps.who.int/iris/handle/10665/204764

World Health Organization. (2011, May 16). *Waist circumference and waist-hip ratio: Report of a WHO Expert Consultation*. https://www.who.int/publications/i/item/9789241501491

Würbach, A., Zellner, K., & Kromeyer-Hauschild, K. (2009). Meal patterns among children and adolescents and their associations with weight status and parental characteristics. *Public Health Nutrition, 12*(8), 1115–1121. http://dx.doi.org/10.1017/S1368980009004996