ORIGINAL RESEARCH

Chrononutrition Behaviour of Dhaka City School Children and Its Effect on Their Weight Gain: A Cross-sectional Analytical Study

Abu Torab MA Rahim[1], Shamima Akther[2], Sanjida Nur-A Afrin[3], Sazia Mahmood[4], Mahbuba Kawser[5]

Received on: 20 March 2024; *Accepted on:* 12 April 2024; *Published on:* 30 April 2024

Abstract

Aim and background: Many recent studies identified increasing trends in the prevalence of overweight and obesity among children and adolescents in Bangladesh. Multiple factors were identified as attributes to this phenomenon. One of the underlying causes of the increasing prevalence of obesity and overweight among urban school children is assumed to be the high consumption frequency of energy-dense fast food available on the school premises. Studies addressing the role of fast foods (FF) intake behaviour of school-going children on their increasing weight gain are very scanty. The present study was undertaken to find out the causal association between the chrononutrition behaviour of fast food consumption and childhood overweight and obesity.

Materials and methods: A total of 246 students aged 11–18 years from 4 selected schools in Dhaka city were studied using a cross-sectional data collection technique. Along with socioeconomic and anthropometric variables, a pre-tested structured questionnaire was used to collect the consumption frequency of snacking and types of snack foods, as well as snacking time for frequent eaters per day. The association of chrononutrition behaviour (type, frequency, volume, and snacking time) of fast food consumption with overweight and obesity of children were explored by an appropriate statistical tools.

Results: Screening of the children resulted in 26.02% of them being overweight while 7.32% of them were obese on body mass index (BMI) Z-score. Most of them belonged to higher-income families. About 42% of them consumed commercial snack foods at least one time per day. The BMI Z-score of them significantly correlated with their frequently eaten snack foods ($p = 0.048$) and eating out behaviour ($p = 0.016$). Body mass index of the children was also influenced significantly by parents' education ($p = 0.002$) and nutritional knowledge ($p = 0.000$). Two times snack eaters per day showed higher BMI-score than one-time eaters.

Conclusion: The findings denote an association between chrononutrition behaviour of snacking among Dhaka school children with their higher BMI Z-score.

Keywords: Body mass index Z-score, Chrononutrition, Obesity, Snacking, Urban school children.

The British Journal of Translational Global Health (2024): 10.5005/bjotgh-11016-0006

Introduction

Despite being the 41st largest country in GDP world ranking and 31st largest by purchasing power parity (PPP) Bangladesh is suffering from a double burden of malnutrition.[1] The prevalence rates of the double burden of malnutrition at the household level have been found at 4.10% (urban: 5.57%, rural: 3.51%).[2] On the other hand, pooled prevalence rates of overweight and obesity among children and adolescents were 7.0% (95% CI, 5.0–10.0) and 6.0% (95% CI, 4.0–8.0) respectively.[3] A systematic review of the literature on childhood obesity by Banik and Rahman[4] revealed that prevalence rates of overweight and obesity are higher in urban people compared to rural people living in Bangladesh. Due to rapid changes in food consumption behaviour among Bangladeshi urban people, the prevalence of obesity and overweight is alarmingly increasing thereby indicating a visible nutrition transition.

Multiple factors such as rapid urbanisation, unhealthy dietary practices, obese and overweight parents, increasing sedentary activity, etc., were identified as the main attributes of the emerging overweight and obesity problem among them. A recent study identified family income >50,000 per month [adjusted odds ratio (AOR) = 3.07, $p = 0.001$], no physical activity (AOR = 38.3, $p = 0.004$), more than 4 hours of sedentary activities (AOR = 4.84, $p = 0.02$), regular consumption of fast food (AOR = 3.05, $p = 0.042$) are risk factors associated with childhood overweight/obesity.[5] Moreover, a positive energy balance over a considerable period among the children is related to their obesity.[6] The children of overweight parents having limited exercise and high levels of sedentary activities lead also to obesity among school-aged children in urban cities.

[1–5]Institute of Nutrition and Food Science, University of Dhaka, Dhaka, Bangladesh

Corresponding Author: Abu Torab MA Rahim, Institute of Nutrition and Food Science, University of Dhaka, Dhaka, Bangladesh, Phone: +8801718485554, e-mail: torabrahim@gmail.com

How to cite this article: Rahim ATMA, Akther S, Nur-A Afrin S, *et al*. Chrononutrition Behaviour of Dhaka City School Children and Its Effect on Their Weight Gain: A Cross-sectional Analytical Study. Br J Transl Glob Health 2024;1(1):9–14.

Source of support: Nil

Conflict of interest: Dr Abu Torab MA Rahim is associated as the Editorial Board member of this journal and this manuscript was subjected to this journal's standard review procedures, with this peer review handled independently of this editorial board member and his research group.

Children get their energy from their usual primary meals (3 or 4 times a day). However, they get their excess energy from snacking, i.e., eating small amounts of food between meals. Intake of excess amount energy depends on their intake frequency and quality of snacking. Our previous studies revealed that urban consumers usually treat traditional snack foods (TSF) similarly to Western type fast foods (FF).[7,8] Both types of foods, TSF and FF, are being consumed either in snacking or in the main meal, particularly in lunch. Rahim et al.,[7] analysed locally available FFs and found them rich in energy, fat, cholesterol, and sodium but low in total dietary fibre. We have also identified in our previous study that the frequent consumers of TSF and FF belonged to middle-class to rich families and increasing family income was significantly associated with frequent fast food consumption.[9]

In addition to known effects of childhood overweight and obesity, recent research disclosed that the mammalian circadian clock (CC) at the molecular, physiological, and behavioural levels highlights that the timing of food intake can impact weight gain and increased adiposity as reviewed by Davis et al.[10] It is worth noting that circadian rhythms (CRs) are biological cycles that run approximately every 24 hours analogous to a clock and they regulate essential functions viz., sleep, metabolism, hormone release, etc.[11] Since the metabolic processes are governed by CC, mis-timed meals can cause circadian disruption. Food intake pattern aligns with CC rhythms causes optimal homeostasis of metabolic processes. On the other hand, food intake pattern misaligns with CC rhythms causing circadian disruption and thereby resulting in dysregulation of metabolic processes that is assumed to be a root cause of metabolic disorders.[10]

Chrononutrition deals with the relationship between temporal eating patterns, circadian rhythms, and metabolic health. It encompasses a wide range of eating behaviours, including the clock time of the first and last food/beverage intake, eating window, eating frequency, eating volume, late-night eating, etc.[12] Aligning the time of food intake with the body's CC can have a significant impact on overall health, particularly obesity.[13] There are only few studies[7–9] available on FF and TSF consumption frequency and food quality by Bangladeshi urban people. However, researches regarding the chrononutrition behaviour of Bangladeshi school children on their weight gain is absent. The present study, therefore, seeks an investigation on chrononutrition features of FF and TSF consumption behaviour of school-aged children on their weight gain phenomenon. Finding any correlation between snacking habit, snacking frequency, food volume, and snacking time with the index of obesity and overweight will disclose an association of child chrononutrition behaviour with their overweight and obesity.

Materials and Methods

Study Design

A cross-sectional observational study was conducted among 11–18-year old school children in affluent areas of Dhaka city, where commercial FF and TSF are available in the school premises or in the vicinity of the school.

Sample Size Calculation

We have modelled sample size calculations using the prevalence of obesity in English medium schools which was reported as 20.5%.[14] A sample size of 250 was estimated basis on 95% confidence interval, a level of desired precision at 0.05, and a 21% prevalence of obesity. Considering design effect and non-responsiveness, a total of 736 students were screened for overweight and obesity. The screening was conducted by physical appearance followed by an anthropometric assessment to identify probable study participants. After scrutinisation with the sample selection criteria (Monthly family income > 30,000 BDT), a total of 246 parents gave their consent to participate in the interview procedure along with their child.

Sampling Protocol

Two affluent areas from the public perception's point of view, Dhanmondi and Lalmatia, were selected for locating desired schools. Schools, which have FF/TSF shops or vendors in or outside of the premises were selected for sample collection. Ten (10) schools were approached with written applications. However, only four school management authority (two in Dhanmondi and two in Lalmatia) gave their consent to conduct the survey. A number of children for the screening procedure varied for each school depending on the number of students per class.

Data Collection Procedure

A semi-structured questionnaire was developed with specific and relevant questions for the interviewee and pretested in a 10% similar sample from a different area that are not included in the final count. The final SI was developed by incorporating the outcomes of the pretesting survey. The SI also contained socio-demographic and anthropometric measurement formats. The SI was self-administered and the names of respondents were not indicated for ethical reasons. Data was collected before the onset of the COVID-19 pandemic.

Data Analysis

After data entry, coding, editing, and cleaning, the analysis of data into descriptive (per cent, mean, standard deviation), compared mean (ANOVA), and correlation and regression (bivariate and multivariate) statistics were done by SPSS (20.0) package program. Nutritional status was calculated by BMI Z-score (Epi-info 16.0 version).

Results

Table 1 describes the sociodemographic, economic, and anthropometric features of the school children and their families. The majority of the study participants (80.5%) were girls aged between 11 and 16 years of age and belonged to relatively small families (≤ 5 members). Most of their parents were postgraduates, respondents mothers were housewives (51.6%) and indicated a family income of more than 50K Taka (79.3%) thereby majority of them belonged to high-income groups.

The table also showed per cent distribution of BMI Z-score of the school children to denote that 78% of them were overweight (> +1SD) while 22% of them were obese (> +2SD). However, the mean BMI Z-score of these two groups were 1.52 ± 0.345 and 2.19 ± 0.20 respectively. The average BMI Z-score of all studied children was found as 1.23 ± 0.82. However, when calculated for the prevalence of overweight and obesity among all screened children it revealed 26.02% (192/738*100) and 7.32% (54/738*100) respectively.

Snaking behaviour of the school children in the present study showed that close to half (47.2%) of them had snacks frequently and

Table 1: Sociodemographic, economic, and anthropometric features of the school children and their family

Parameters	*% (No.)*
Age (years)	
11.0–13.0	47.2 (116)
13.1–16.0	35.8 (88)
16.1–18.0	17.1 (42)
Gender	
Boy	19.5 (48)
Girl	80.5 (198)
Parity	
1–2 children	51.6 (129)
≥3	48.4 (121)
Family size	
≤5 members	89.4 (220)
>5 members	10.6 (26)
Parent's education	
≤HSC	19.5 (48)
Graduate	31.3 (77)
≥Postgraduate	49.2 (121)
Parent's occupation	
General services	19.2 (47)
Technical services	16.2 (40)
Business	13.0 (32)
Housewife	51.6 (127)
Monthly HH income (Tk)*	
Middle (<50,000)	20.7 (51)
Higher (≥50,000)	79.3 (191)
Anthropometry (BMI Z-score)**	
Overweight (> + 1SD)	1.52 ± 0.35
Mean BMI (±SD)	47.9 (23)
Boys	85.4 (167)
Girls	78.0 (192)
Total	
Obese (> + 2SD)	
Mean BMI (±SD)	2.19 ± 0.20
Boys	52.1 (25)
Girls	14.6 (29)
Total	22.0 (54)
Average prevalence of overweight	1.23 ± 0.82

*1 Taka ~ 82 $; **WHO Growth reference (5–19 years); Overweight > +1 SD (equivalent to BMI 25 kg/m^2 at 19 yrs.); Obesity > +2 SD (equivalent to BMI 30 kg/m^2 at 19 yrs.); Thinness < −2 SD; Severe thinness < −3 SD

more than half (52.8%) had them occasionally (Table 2). Snaking volume depicted that almost 95% of them take light foods and the rest take heavy foods. Out of 116 children, who frequently took snacks, 61.2% (n = 71/116) of them took different FF at least 1-time per day and 30.2% were found to take snacks 3–4 times per week. On the other hand, among 130 children, who occasionally took FF, 59.2% of them took these foods at least once in a week. Since eating time is important in chrononutrition behaviour, it has been found that 59.3% of everyday eaters (total n = 81) ate these foods once in the morning at their school premises from the commercial vendors. While 40.7% of them were two time eaters–first one in the morning during school time and the other one before or at evening dinner (Table 2).

Table 2: Snaking behaviour of the school children

Parameters	*% (No.)*
Snacking habit	
Frequently	47.2 (116)
Occasionally	52.8 (130)
Snack volume	
Light	95.5 (235)
Heavy	4.5 (11)
Frequency of snacking	
Frequent	
1 time/day	41.4 (48)
2 times/day	28.5 (33)
3–4 times/week	21.5 (25)
Do not count	8.6 (10)
Total	116
Occasional	
1 time/week	59.2 (77)
2 times/week	18.5 (24)
Do not count	22.3 (29)
Total	130
Snacking time in a day (n = 81)	
Only morning eater	59.3 (48)
Morning + Evening eater	40.7 (33)

Table 3: Consumption profile of FF and TSK by the children during snacking

	Multiple responses	
Name of FF and TSF eaten	*n*	*Percent*
Frequently eaten (n = 19)		
French fry	204	6.50%
Fried chicken	188	6.00%
Soft drink	172	5.50%
Sandwich	161	5.10%
Samucha	158	5.00%
Fuchka	156	5.00%
Chips	144	4.60%
Burger	142	4.50%
Pizza	140	4.50%
Bread	136	4.30%
Singara	133	4.20%
Cake	126	4.00%
Nuggets	124	4.00%
Dalpuri	123	3.90%
Roll	114	3.60%
Kebab	114	3.60%
Cookies	110	3.50%
Chicken ball	101	3.20%
Pastry	96	3.10%
Less frequently eaten (n = 11)		
Kimapuri	72	2.30%
Milk shake	63	2.00%

(Contd...)

Table 3: *(Contd...)*

	Multiple responses	
Name of FF and TSF eaten	*n*	*Percent*
Patties	59	1.90%
Hotdog	60	1.90%
Chapati	59	1.90%
Saundesh	38	1.20%
Doi/curd	44	1.40%
Rashogolla	31	1.00%
Kalojam	26	0.80%
Chamcham	20	0.60%
Yogurt ghol	20	0.60%
Total citation of all foods	3134	100%

Table 3 shows the consumption profile of the types of FF and TSK by the children during snacking presented as citation percentage. The total citation of all food was 3134. Among the most eaten foods, French fries were taken by the highest number of children ($n = 204$; citation = 6.5%). On the other hand, traditional snack food, Yogurt ghol was consumed by the least number of children ($n = 20$; citation = 0.60%).

Bivariate analysis showed the correlation of sociodemographic variables with the BMI Z-Score of the children (Table 4). From the table, it is observed that family size of the respondents, occupation of parents, and monthly family income did not have a significant effect on the BMI Z-score children. The rest of the variables were found to be significantly correlated with the BMI z-score of the children. On the other hand, except for snacking times in a day, an association of chrononutrition behaviour of the children with their BMI Z-Score were found statistically significant (Table 5). However, two times eaters, both morning and before evening showed a higher BMI Z-score (1.81 ± 0.092) than one-time eaters in the morning (1.72 ± 0.630).

The role of individual FF and TSF on children's BMI was evaluated by the association of volume and intake frequency by bivariate and multivariate regression tests and presented in Table 6. Multivariate linear regression model R^2 denoted around 28.6% variation in the dependent variable i.e., BMI (kg/m^2) that was accounted for by the independent variables (consumption of chips, dalpuri, soft drinks, chicken ball, and fuchka). Body mass index is predicted to increase by 28% when chips are eaten by one unit (packet), holding all other variables constant. Similarly, all other frequently eaten foods positively influenced the BMI levels of the children, thus BMI is to increase by 25, 23, 21, 19, and 16% by consuming one unit of soft drink, dal puri, chicken ball, fuchka (one plate) and roll respectively, holding all the variables constant. However, kebab, samucha and nuggets are not significant in the multivariate model though they were significant in the bivariate model.

Discussion

Our previous studies depicted that urban dweller in Bangladesh, especially the young generation, have accepted fast-food culture with open arms because of their different taste, convenience, and pleasant eating environment and as a fashionable new eating out trend.[7–9] A recent study found that the overweight (36%)

Table 4: Association of sociodemographic features with BMI Z-score

	Frequency distribution		BMI Z-score	
Variables	*%*	*n**	*(Mean ± SD)*	*Statistical test*
Age distribution (year)				
11–13	47.2	116	1.29 ± 0.67	
14–16	35.8	88	1.46 ± 0.78	$f = 20.561$ $p = 0.000$*
17–18	17.1	42	0.56 ± 0.92	
Gender				
Boy	19.5	48	1.98 ± 0.42	$t = 8.016$
Girl	80.5	198	1.04 ± 0.78	$p = 0.000$*
Classes				
Six	28.8	71	1.28 ± 0.68	$f = 7.110$
Seven	29.3	72	1.20 ± 0.77	$p = 0.000$*
Eight	11.4	28	1.80 ± 0.58	
Nine	13.4	33	1.23 ± 0.81	
Ten	17.1	42	0.79 ± 1.0	
Family size				
3 members	8.5	21	1. 45 ± 0.722	$f = 0.996$
4–5 members	80.9	199	1.19 ± 0.82	$p = 0.371$
> 6 members	10.6	26	1.29 ± 0.88	
Parent's education				
SSC–HSC	19.5	48	1.56 ± 0.70	$t = 3.175$
Graduate and above	80.5	198	1.15 ± 0.82	$p = 0.002$*
Occupation				
Job holder/Self employed	48.4	119	1.13 ± 0.82	$t = -1.694$ $p = 0.091$
Housewife	51.6	127	1.31 ± 0. 81	
Monthly family income (BDT)**				
<50,0000	20.7	51	1.22 ± 0.74	$t = -0.063$
≥50,000	79.3	195	1.23 ± 0.84	$p = 0.950$

*$n = 246$; **1US$ = 82 BDT (at the time of interview)

Table 5: Association of chrononutrition behaviour with BMI Z-score

Chrononutrition parameters	*Frequency*		*BMI Z-Score*	*Significance level*
	%	*n**	*Mean ± SD*	
Habit of snacking				
Frequently	47.2	116	1.33 ± 0.79	$p = 0.048$**
Occasionally	52.8	130	1.13 ± 0.83	
Volume of snacking				
Light	95.5	235	1.40 ± 0.76	$p = 0.004$**
Heavy	4.5	11	1.80 ± 0.84	
Frequency of snacking				
Frequently	47.2	116	1.33 ± 0.79	$p = 0.048$**
Occasionally	52.8	130	1.13 ± 0.83	
Time of snacking in a day ($n = 81$)				
Morning eater (1 time/day)	59.3	48	1.72 ± 0.630	$p = 0.720$
Morning + evening eater (2 times/day)	40.7	33	1.81 ± 0.092	

*$n = 246$; **$p < 0.05$ (statistically significant)

Table 6: Regression analysis to identify snack foods related to BMI-score

	Bivariate linear regression			*Multivariate linear regression model*		
Food items	*β*	*95% CI,*	*p-value*	*β*	*95% CI,*	*p-value*
Dalpuri	0.483	(0.287–679)	0.000*	0.420	(0.242–599)	0.000*
Fuchka	0.318	(0.108–527)	0.003*	0.379	(0.191–567)	0.000*
Soft drinks	0.327	(0.107–507)	0.000*	0.352	(0.163–552)	0.001*
Chips	0.499	(0.300–647)	0.001*	0.349	(0.158–541)	0.000*
Roll	0.270	(0.067–473)	0.009*	0.225	(0.037–413)	0.019*
Chicken ball	0.303	(0.098–508)	0.004*	0.214	(0.019–409)	0.032*
Samocha	0.250	(0.038–462)	0.021*	0.117	(0.082–317)	0.248
Kebab	0.235	(0.031–439)	0.024*	0.094	(0.094–283)	0.325
Nuggets	0.438	(0.240–636)	0.000*	0.173	(0.030–377)	0.095
R^2	–			0.286		
SE	–			0.6897		
Constant				1.289		

*$p < 0.05$; Multiple regression includes all variables with $p < 0.05$ in bivariate model

and obesity (25.3%) prevalence among private school children of 9–14 years of age in Dhaka city indicate a fast-increasing trend of obesity among urban school children of economically solvent families.[15] However, in reality, both overweight and/or obese as well as underweight children coexist in both urban and rural school children (6–15 years) of Bangladesh.[16] Another recent study revealed that rural children are still showing a high prevalence of stunting (25%), underweight (32%), and wasting (29%) respectively revealing urban-rural disparities in socioeconomic coadditions.[17]

From nutritional quality point of view, the majority of the FF and TSF consumed by the studied children are energy-dense, low fibre and high-salt food as revealed in our earlier studies.[7–9] Not surprisingly higher snacking frequency (SF) and eating frequency (EF) were associated with higher risks of overweight and abdominal obesity as reported for Japanese children.[18]

Numerous studies suggest that mealtimes can influence physiological processes, including sleep/wake cycle, hormone levels, obesity, and metabolic syndrome.[19] The findings of the current study could be an indication of the effect of child chrononutrition behaviour that might lead to misaligned CC thereby leading to overweight and obesity. An Indian study found similar results and suggested that the lengthening of the daily feeding time may be a factor in the development of metabolic disorders.[20] Another recent study observed a significant association between BMI and eating window, evening latency, evening eating, and night eating among college students during COVID-19 pandemic.[21]

Conclusion

Chrononutrition encompasses the studies of biological rhythms or circadian cycles of living organisms and its adaptation to foods and its ingestion time. So wide 'eating window' may cause misaligned CR leading to metabolic syndromes like overweight and obesity. In recent years, numerous studies have highlighted how feeding times and frequency can influence circadian rhythms. With this note, the present study seems worthy to chalk future studies in depicting the role of chrononutrition behaviour among school children with their health profile.

Acknowledgement

The study was conducted partially by the Ministry of Science and Technology, GoB Funds and partially by the University of Dhaka Research Fund.

Author Contributions

ATMAR: Conceptualised, deigned, supervised, analysed and wrote the manuscript; SA: Conducted the study, analysed data, and drafted the manuscript; SNA: Analysed data and organised the final manuscript; SM: Participated in field data collection; MK: Performed the statistical analysis of the data.

Orcid

Abu Torab MA Rahim https://orcid.org/0009-0007-0196-8127

References

1. World Economic League Table (WELT), 10th edition. London, Cebr, 2018, p. 55.
2. Anik AI, Rahman MM, Rahman MM, et al. Double burden of malnutrition at household level: A comparative study among Bangladesh, Nepal, Pakistan, and Myanmar. PloS one 2019;14(8):e0221274. DOI: 10.1371/journal.pone.0221274.
3. Biswas T, Garnett SP, Pervin S, et al. The prevalence of underweight, overweight and obesity in Bangladeshi adults: Data from a national survey. PloS one 2017;12(5):e0177395. DOI: 10.1371/journal.pone.0177395.
4. Banik S, Rahman M. Prevalence of overweight and obesity in Bangladesh: A systematic review of the literature. Curr Obes Rep 2018;7(4):247–253. DOI: 10.1007/s13679-018-0323-x.
5. Alam MM, Hawlader MD, Wahab A, et al. Determinants of overweight and obesity among urban school-going children and adolescents: A case-control study in Bangladesh. Int J Adolesc Med Health 2021;33(1). DOI: 10.1515/ijamh-2018-0034.
6. Hossain MO, Zannat IA, Begum SU, et al. Risk factors for overweight and obesity among children and adolescents in Bangladesh: A hospital based study. Bangladesh J Child Health 2019;43(1):9–14. DOI: 10.3329/bjch.v43i1.41210.
7. Rahim AT, Islam M, Ara G, et al. Commercial fast food and traditional snack food of Bangladesh: II. Content of proximate nutrients, sodium,

potassium, dietary fiber and energy. Bangladesh Journal of Nutrition 2002;15:79–89.
8. Meher-un-Nessa, Rahim ATMA, Shaheen N, et al. Commercial fast food and traditional snack food of Bangladesh: I. Content of cholesterol and triacylglycerol. Bangladesh J Nutr 2002;15:62–70.
9. Rahim ATMA, Moushumi S, Khan N. Consumption behaviour and nutrient quality of fast foods: Development of a healthy eating index for Bangladeshi consumers. South Asian J Pop Health 2008;1:137–147.
10. Davis R, Rogers M, Coates AM, et al. The impact of meal timing on risk of weight gain and development of obesity: A review of the current evidence and opportunities for dietary intervention. Curr Diab Rep 2022;22(4):147–155. DOI: 10.1007/s11892-022-01457-0.
11. Arble DM, Bass J, Laposky AD, et al. Circadian timing of food intake contributes to weight gain. Obesity 2009;17(11):2100–2102. DOI: 10.1038/oby.2009.264.
12. Wang L, Chan V, Allman-Farinelli M, et al. The association between diet quality and chrononutritional patterns in young adults. Eur J Nutri 2024:1. DOI: 10.1007/s00394-024-03353-7.
13. Almoosawi S, Vingeliene S, Karagounis LG, et al. Chrono-nutrition: A review of current evidence from observational studies on global trends in time-of-day of energy intake and its association with obesity. Proc Nutr Soc 2016;75(4):487–500. DOI: 10.1017/S0029665116000306.
14. Rahman SMM, Kabir I, Bhuyan MAH, et al. Prevalence and determinants of childhood obesity in Dhaka City. Bangladesh Medi Res Council Bulletin 2019;45(2):68–80. DOI: 10.3329/bmrcb.v45i2.42534.
15. Hossain MT, Luies SK, Biswas T. Prevalence and factors associated with overweight and obesity among primary school children (9–14 years) in a selected area of Dhaka, Bangladesh: A cross-sectional study. Indian J Community Med 2020;45(4):429–434. DOI: 10.4103/ijcm.IJCM_466_19.
16. Bulbul T, Hoque M. Prevalence of childhood obesity and overweight in Bangladesh: Findings from a countrywide epidemiological study. BMC pediatrics 2014;14:86. DOI: 10.1186/1471-2431-14-86.
17. Kamruzzaman M, Rahman SA, Akter S, et al. The anthropometric assessment of body composition and nutritional status in children aged 2–15 years: A cross-sectional study from three districts in Bangladesh. PloS one 2021;16(9):e0257055. DOI: 10.1371/journal.pone.0257055.
18. Murakami K, Livingstone MB, Masayasu S, et al. Eating patterns in a nationwide sample of Japanese aged 1–79 years from MINNADE study: Eating frequency, clock time for eating, time spent on eating and variability of eating patterns. Public Health Nutr 2022;25(6):1515–1527. DOI: 10.1017/S1368980021000975.
19. McKenna H, van der Horst GT, Reiss I, et al. Clinical chronobiology: A timely consideration in critical care medicine. Crit Care 2018;22:124. DOI: 10.1186/s13054-018-2041-x.
20. Adafer R, Messaadi W, Meddahi M, et al. Food timing, circadian rhythm and chrononutrition: A systematic review of time-restricted eating's effects on human health. Nutrients 2020;12(12):3770. DOI: 10.3390/nu12123770.
21. Juliana N, Teng NI, Hairudin KF, et al. Chrononutrition behavior during the COVID-19 pandemic and its relationship with body weight among college students. Front Nutr 2023;10:1079069. DOI: 10.3389/fnut.2023.1079069.