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Association of dietary pattern and childhood obesity with cardiovascular disease in patients from Tangail city, Bangladesh

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ABSTRACT

Introduction: Obesity in childhood is a major cause for developing cardiovascular diseases (CVD) at adulthood. The present study was a cross-sectional research aimed to examine the relationship between childhood obesity and dietary pattern with CVD in patients (n=100) from Tangail City, Bangladesh. **Methods:** Dietary patterns, laboratory tests, demographic, and anthropometric interrelated data were measured in patients with stroke and heart attack from five hospitals. The research also used 24-hour recall method and a food frequency questionnaire for assessing daily energy and macronutrient intakes. **Results:** Weight (p=0.004), body mass index (BMI) (p=0.001), mid-upper arm circumference (MUAC) (p=0.009), and waist circumference (WC) (p=0.030) was significantly different between males and females whereas lipid profile was not significantly different between genders. There were no significant associations between intakes of red meat, salt, fast food, fish, egg, nuts and seeds with heart attack and stroke. On the contrary, there were significant associations between fried food intake with heart attack and stroke (p=0.080 and p=0.020). The results indicated that there was a significant relationship between carbohydrate (p=0.001), protein (p=0.001), and fat (p=0.001) intakes with the total energy intake of respondents. The findings also showed that there was a significant relationship between carbohydrate (p=0.003), protein (p=0.001), and fat (p=0.001) intakes with body mass index of the respondents. **Conclusion:** CVD diagnosis in adult patients was found to be associated with fried food intake but not with childhood obesity.

Keywords: body mass index, cardiovascular disease, childhood obesity, dietary pattern, lipid profile

INTRODUCTION

Cardiovascular disease (CVD) is considered as the primary reason for mortality in the world, which alone causes 16% of total global death (WHO, 2017). In 2016, CVD was responsible for 31% of all fatalities worldwide, with stroke and heart attack accounting

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for 85% of these deaths (WHO, 2020). Nowadays, CVD is a massive interest in the world of epidemiology and needs more attention to mitigate (Roth *et al.,* 2017). In Bangladesh, most people have little knowledge about CVD (Rahman *et al.,* 2018) and the death rate for CVD has increased rapidly (Karar, Alam & Kim Streatfield, 2009) with 17% of total mortality (Islam, Mohibullah & Paul, 2016). About half of the world's adults are overweight and obese, and obesity is a global risk factor for CVD (including high blood pressure, heart failure, coronary artery disease, sudden cardiac death) and cerebrovascular disease (Koliaki, Liatis & Kokkinos, 2019) due to the accumulation of fat within the arteries and an expanded threat of blood clots (Boffa *et al.,* 2019).

Several factors like family history, high blood pressure, fatty diet, diabetes, smoking (Banks *et al.,* 2019), stress (Steptoe & Kivimaki, 2013), alcohol (Zhang *et al.,* 2021), and lack of physical activity can also induce CVD (Thomas & Princy, 2016). Childhood obesity is a notorious threat to adult obesity and later on to the development of CVD and diabetes. The occurrence of obesity among adolescents and children has increased dramatically over the years and this rate is significant in Bangladeshi children (Raut *et al.,* 2014; Bulbul & Hoque, 2014). Dietary pattern, especially excessive amount of calorie intake, can cause obesity and later CVD (Tedstone, Duval & Peacock, 2020). On the contrary, eating whole grain foods (Seal, 2007), nutritious foods (Grossman *et al.,* 2017), and a low amount of salt (Karppanen & Mervaala, 2006) can diminish the dangers of stroke and heart attack.

A lot of research has been done on diet and its relationship with other lifestyle diseases such as obesity and diabetes in others countries, but there are only a few studies about the relationship of diet and childhood obesity with CVD development in the Bangladeshi context. Even though childhood obesity is a major factor in the development of CVD, and a lot of patients are dying from CVD in Bangladesh, yet information about this disease concerning childhood obesity is scarce. In this context, understanding all aspects of CVD epidemiology are essential. Hence, the authors wanted to elucidate the association of dietary pattern and childhood obesity with cardiovascular disease in patients of Tangail city, Bangladesh.

MATERIALS AND METHODS

Study location and study population

This study was conducted at five private hospitals in Tangail city, Bangladesh. The hospitals were randomly selected from 20 hospitals in Tangail city based on convenient sampling of patients with CVD from Tangail city and nearby villages.

Study design and sample size

This was a cross-sectional descriptive study, conducted at the cardiology department of selected hospitals. A total of 100 eligible participants (patients with a history of chest pain, cardiac arrest, and stroke) agreed to be enrolled in the current research and provided all the required information.

Data collection, verification, and questionnaire design

Data collection was done via face-to-face interviews using structured questionnaires, which were prepared by the research team and validated by an expert team. Anthropometric and biochemical data were collected using different tools and hospital lab reports. The questionnaires were checked each day after interviews and re-checked carefully after completion of all data collection.

Assessment of anthropometric measurements

Height and weight of the respondents were collected using weighing balance and measuring tape. Body mass index (BMI) was classified according to the World Health Organization (WHO) regulations (WHO, 2000). A measuring tape (non-elastic) was used for measurement of waist circumference (WC) and hip circumference. The participants' waist-to-hip ratio (WHR) was calculated as the ratio of WC divided by hip circumference. The mid-upper arm circumference (MUAC) was measured using MUAC tape, where subjects were told to bend their left arm, then the olecranon process and the acromion process were located and marked. The midpoint between these two marks was measured and recorded as the MUAC.

Assessment of biochemical information and dietary patterns

Patients' blood test reports were collected from the hospital's laboratories (n=44). The study used 24-hour recall method and a food frequency questionnaire (FFQ) for assessing data and menu serving size of macronutrients and total energy intakes. Nutrient databases were used to calculate the carbohydrate, protein, fat, and daily energy intakes. Food exchange list was used to see the amount and measurement for each group of food (Cade *et al.,* 2002).

For food grouping, different food items were grouped into 13 groups, which consisted of a total of 37 food objects (Cade *et al.,* 2002; Islam *et al.,* 2021). Participants reviewed the food groups and informed the amount and collected food serving size of each group they have consumed (Islam *et al.,* 2021) according to the food items. Furthermore, serving size was converted into macronutrients using the food exchange list (Islam *et al.,* 2021; Nahar *et al.,* 2013). The calculation of the total serving size per day for each food group was done using the following equation:

Intake of nutrient (carbohydrate, protein, fat) = No. of serving of acceptable daily intake (ADI) × Nutritive values

After that, calculation of energy intake was done according to the USDA guidelines (National Agricultural Library, Baltimore Avenue): carbohydrates=4 kcal/g, protein=4 kcal/g, fat=9 kcal/g.

The study also calculated the dietary requirement of each subject from an equation using a person's body weight and daily exercise factor. Furthermore, a 5-point Likert scale was used to evaluate the patient's dietary information from the 24-hour recall method (very frequent or many times at short intervals, frequent or often, occasionally or infrequent, rarely or not occurring at regular intervals, and not at all).

Ethical consideration

The study was approved by the Ethical Review Committee of Food Technology and Nutritional Science department, Mawlana Bhashani Science and Technology University and Civil Surgeon Office, Tangail with the ethical approval number MBSTU/FTNS/42/2021/02 and CSTANG/SHA-3/MISS/2021/3681(05). Informed consent was obtained from the participants using a short form consent process. The confidentiality of the participants was maintained and will be maintained in the future.

Statistical analysis

Statistical evaluation was carried out with IBM SPSS Statistics for Windows version 25.0 (IBM Corporation, Armonk, New York, USA). Results were expressed as mean±standard deviation (*SD*), range or fraction, and numbers with percentages. Analysis of variance (ANOVA) test and independent sample t-test were applied to determine the difference/comparison in mean values and proportion of the participants'

characteristics. Also, Pearson's correlation was used to determine the linear relationship between continuous variables. Chi-square (χ^2) test was used to determine the association between two categorical variables. A value of $p<0.05$ was considered statistically significant.

RESULTS

Demographic data of the sample

In this research, the information was collected from 100 patients with CVD, from which 55% were males. Table 1 represents the demographic data of the respondents by distribution of their

Table 1. Demographic data of respondents, *n=100*

Variables	*n*	*%*	*Total energy intake (kcal/day) mean±SD*
Gender			
Male	55	55	2479±272
Female	45	45	2384±269
Religion			
Islam	67	67	2439±292
Hinduism	32	32	2428±238
Christianity	1	1	2550±0
Occupation			
Service	14	14	2500±218
Business	41	41	2472±290
Homemaker	45	45	2384±269
Level of education			
Illiterate	17	17	2424±329
Primary (1-5 classes)	15	15	2463±294
Secondary (6-10 classes)	31	31	2395±257
Higher Secondary (11-12 classes)	28	28	2471±264
Graduate (University level)	9	9	2450±250
Education level of spouse			
Illiterate	53	53	2394±284
Primary	19	19	2458±271
Secondary	7	7	2457±226
Higher Secondary	14	14	2557±308
Graduate	7	7	2436±63
Monthly household income (Taka)			
<10000	1	1	2300±0
10000-20000	14	14	2504±247
20000-40000	64	64	2402±283
40000-60000	21	21	2505±254
Food expenditure purpose (Taka)			
<10000	36	36	2378±297
10000-15000	54	54	2468±252
15000-20000	10	10	2480±289
Residential area			
Rural	55	55	2420±259
Sub-urban	22	22	2439±300
Urban	23	23	2474±289

religion, level of education, living areas, and total energy intake.

Anthropometric characteristics of the respondents and comparison between males and females

Table 2 shows the anthropometric characteristics of the participants and comparison between males and females. Age (p=0.842) and weight (p=0.004) was not significantly different between genders. Mean BMI was 27.1±3.0kg/m^2 and was significantly different between males and females. Similarly, the MUAC, WC and WHR of our CVD patients were significantly different between the genders (p=0.009; p=0.030 and p=0.109, respectively).

Table 2. Anthropometry, energy intake and lipid profile of respondents

Variables	*mean±SD*	*p*
Age (years)†		
Males	52.0±11.5	0.842
Females	49.0±12.4	
All	51.0±11.9	
Weight (kg)†		
Males	71.7±10.4	0.004
Females	63.1±9.9	
All	67.4±10.9	
Height (m)†		
Males	1.6±0.05	0.173
Females	1.6±0.07	
All	1.6±0.07	
BMI (kg/m^2)†		
Males	27.6±2.9	0.001
Females	26.5±3.1	
All	27.1±3.0	
MUAC (cm)†		
Males	32.4±2.0	0.009
Females	31.3±2.2	
All	31.9±2.2	
WC (cm)†		
Males	98.7±8.4	0.030
Females	92.3±11.5	
All	95.5±10.4	
WHR†		
Males	0.99±0.06	0.109
Females	0.96±0.07	
All	0.98±0.07	
Total Energy Intake (kcal/day)†		
Males	2479±272	-
Females	2384±268	
All	2436±272	
LDL-C (mmol/L)‡		
Males	7.9±0.7	0.471
Females	7.6±0.8	
All	7.8±0.8	
HDL-C (mmol/L)‡		
Males	2.7±0.4	0.796
Females	2.7±0.6	
All	2.7±0.5	
TAG (mmol/L)‡		
Males	13.8±1.2	0.675
Females	14.0±1.6	
All	13.9±1.4	
TC (mmol/L)‡		
Males	14.6±1.6	0.932
Females	14.6±1.2	
All	14.6±1.5	

BMI: body mass index; MUAC: mid-upper arm circumference; WC: waist circumference; WHR: waist-hip ratio; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; TAG: triacyl glyceride; TC: total cholesterol.

Data are presented as mean±*SD* and significance level of all variables was considered by two sample *t*-test when $p<0.05$ between males and females.

†n=100; ‡n=44

Biochemical and clinical data of the respondents

Table 2 also describes the biochemical and clinical data of the respondents. LDL-cholesterol and HDL-cholesterol, triacyl glyceride (TAG) and plasma total cholesterol (TC) did not show statistical significance between the genders.

Association of different food items with heart attack and stroke

Table 3 shows the association of different food items that are related to heart attack and stroke. It was found that there was not enough evidence to suggest an association between the intakes of red meat (p=0.820), salt (p=0.830), fast food (p=0.580), fish (p=0.890), egg (p=0.440), nuts and seeds (p=0.990) with heart attack of our patients. On the other hand, there was enough evidence to suggest an association between the intakes of soft drink (p=0.080) and fried food (p=0.080) with heart attack of CVD patients.

It was found that there was not enough evidence to suggest an association between the intakes of red meat (p=1.000), fast food (p=0.160), salt (p=0.670), fish (p=0.890), egg (p=0.810), nuts and seeds (p=0.890) in patients with stroke. On the other hand, there was enough evidence to suggest an association between the intakes of soft drink (p=0.100) and fried food (p=0.020) towards patients with stroke.

Association between childhood obesity with adulthood BMI, heart attack, and stroke

Table 4 illustrates the association between childhood obesity with adulthood BMI, heart attack, and stroke. The p-values between childhood obesity and adulthood BMI, proneness to heart attack and stroke were not statistically significant.

Relationships between macronutrient intakes with total energy intake and BMI of CVD patients

Table 5 represents the dietary patterns of the respondents. All macronutrients were highly significant in correlation with total energy intake and BMI at a 95% significance. The results indicated that there was a significant relationship between carbohydrate (p=0.001), protein (p=0.001), and fat (p=0.001) intakes with the total energy intake of respondents. The findings also showed that there was a significant relationship between carbohydrate (p=0.003), protein (p=0.001), and fat (p=0.001) intakes with BMI of the respondents.

DISCUSSION

Childhood obesity has been reported as the leading cause for the development of CVD in the future. The present research was focused on the relationship of obesity in childhood and dietary intake with CVD in later life. It was found that the total energy intake of male respondents was slightly higher than female respondents; and the energy intake of Christians was slightly higher than Muslims and Hindus. It was also noticed that servicemen needed more energy than businessmen and homemakers.

In this study, the respondents' age and height was not significantly different between males and females, but was significant (p=0.004) in the case of weight. Similarly, BMI (p=0.001), MUAC (p=0.009), and WC (p=0.030) was significantly different between males and females, but not WHR (p=0.109). It was observed that low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, TAG, and TC in CVD patients did not show statistical significance between males and females. Most of the CVD respondents were overweight

Table 3. Associations of different food items with heart attack and stroke

Food intake	*Total (n, %)*	*Heart attack*		χ^2	*p*
		Yes (n, %)	*No (n, %)*		
Red meat					
Very frequently	28	17	11	0.387	0.820
Frequently	56	30	26		
Occasionally	16	9	7		
Total	100	56	44		
Soft drink					
Frequently	9	5	4	6.800	0.080
Occasionally	29	11	18		
Rarely	31	22	9		
Not at all	31	18	13		
Total	100	56	44		
Salt					
Frequently	31	18	13	0.078	0.830
Not at all	69	38	31		
Total	100	56	44		
Fast food					
Frequently	7	5	2	1.900	0.580
Occasionally	30	14	16		
Rarely	31	18	13		
Not at all	32	19	13		
Total	100	56	44		
Fried food					
Very frequently	4	4	0	8.300	0.080
Frequently	16	7	9		
Occasionally	11	6	5		
Rarely	17	6	11		
Not at all	52	33	19		
Total	100	56	44		
Fish					
Very frequently	28	15	13	0.238	0.890
Frequently	55	32	23		
Occasionally	17	9	8		
Total	100	56	44		
Egg					
Very Frequently	19	13	6	2.700	0.440
Frequently	60	34	26		
Occasionally	19	8	11		
Rarely	2	1	1		
Total	100	56	44		
Nuts and seeds					
Very frequently	26	15	11	0.268	0.990
Frequently	12	6	6		
Occasionally	24	14	10		
Rarely	18	10	8		
Not at all	20	11	9		
Total	100	56	44		

Table 3. Associations of different food items with heart attack and stroke *(continued)*

Food intake	*Total (n, %)*	*Stroke*		χ^2	*p*
		Yes (n, %)	No (n, %)		
Red Meat					
Very frequently	28	14	14	0.000	1.000
Frequently	56	28	28		
Occasionally	16	8	8		
Total	100	50	50		
Soft drink					
Very frequently	9	4	5	6.200	0.100
Occasionally	29	20	9		
Rarely	31	12	19		
Not at all	31	14	17		
Total	100	50	50		
Salt					
Frequently	31	14	17	0.420	0.670
Not at all	69	36	33		
Total	100	50	50		
Fast food					
Very frequently	7	2	5	5.200	0.160
Occasionally	30	19	11		
Rarely	31	12	19		
Not at all	32	17	15		
Total	100	50	50		
Fried food					
Very frequently	4	0	4	11.800	0.020
Frequently	16	9	7		
Occasionally	11	7	4		
Rarely	17	13	4		
Not at all	52	21	31		
Total	100	50	50		
Fish					
Very frequently	28	15	13	0.240	0.890
Frequently	55	32	23		
Occasionally	17	9	8		
Total	100	56	44		
Egg					
Very frequently	19	8	11	0.950	0.810
Frequently	60	30	30		
Occasionally	19	11	8		
Rarely	2	1	1		
Total	100	50	50		
Nuts and seeds					
Very frequently	26	14	12	1.200	0.890
Frequently	12	6	6		
Occasionally	24	12	12		
Rarely	18	10	8		
Not at all	20	8	12		
Total	100	50	50		

Chi-square test was carried out, with $p<0.05$ considered as statistically significant.

Table 4. Association between childhood obesity with adulthood BMI, heart attack, and stroke

Adulthood	*Overweight and obesity at Childhood*			χ^2	*p*
	Total (n, %)	*Yes (n, %)*	*No (n, %)*		
BMI (kg/m^2)					
<25	15	11	4	1.400	0.500
25-30	70	46	24		
>30	15	8	7		
Total	100	65	35		
Heart attack					
No	44	28	16	0.835	0.064
Yes	56	37	19		
Total	100	65	35		
Stroke					
No	50	34	16	0.675	0.396
Yes	50	31	19		
Total		65	100		

BMI: body mass index
Chi-square test was carried out, with $p<0.05$ considered as statistically significant.

at their early life and also overweight and obese presently, affected by stroke and heart attack; but this result was not statistically significant. Previous research has observed that childhood obesity is associated with heart attack and stroke in later life (Raut *et al.,* 2014; Bulbul & Hoque, 2014).

The high amount of salt and red meat intakes can lead to stroke and heart attack, while the opposite can reduce CVD (Karppanen & Mervaala, 2006). Also, previous study revealed that a Western dietary pattern (like soft drinks, fast foods, beer and liquor, and deep-fried snacks) (Sichieri, 2002; Fung, 2001) was

Table 5. Relationships between macronutrient intakes with total energy intake and BMI of CVD patients, *n*=100

Variables	*mean±SD*	*Range*	*Total energy intake*		*BMI*	
			r	*P*	*r*	*P*
Carbohydrate (g/d)	397.9±43.7	288-473	0.290	0.001	0.296	0.003
Carbohydrate (kcal/d)	1590.8±173.7	1152-1892				
Carbohydrate (% total energy)	64.7±1.7	61-68				
Protein (g/d)	98.8±10.5	76-126	0.360	0.001	0.363	0.001
Protein (kcal/d)	395.4±42.4	304-524				
Protein (% total energy)	16.2±0.5	15-17				
Fat (g/d)	52.8±6.9	40-71	0.350	0.001	0.347	0.001
Fat (kcal/d)	475.1±62.1	360-639				
Fat (% total energy)	19.3±1.6	17-24				

BMI: body mass index
Data are presented as mean±standard deviation and range.
The correlations are significant at $p<0.05$ tested by Pearson's correlation test.

found to be significantly associated with overweight and BMI (Naja *et al.,* 2015; Naja *et al.,* 2011).

All macronutrients were highly significant with total energy intake and BMI at a 95% level of significance. The results indicated that there was a significant relationship between carbohydrate (p=0.001), protein (p=0.001), and fat (p=0.001) intakes with the total energy intake of respondents. These results also showed that there was significant relationship between carbohydrate (p=0.003), protein (p=0.001), and fat (p=0.001) intakes with the BMI of respondents. Some previous research reported that overweight was significantly (p<0.05) associated with protein intake (Scaglioni *et al.,* 2000). However, a significant interaction between carbohydrate intake and obesity is apparent (Martinez *et al.,* 2003), and higher BMI is associated with a direct relationship with dietary fat quality (Javardi *et al.,* 2020).

CONCLUSION

It is concluded that weight (p=0.004), body mass index (BMI) (p=0.001), mid-upper arm circumference (MUAC) (p=0.009), and waist circumference (WC) (p=0.030) was significantly different between males and females whereas lipid profile was not significantly different between genders. CVD diagnosis in adult patients was found to be associated with fried food intake but not with childhood obesity. We opine that childhood obesity remains one of the major causes of CVD in later life, even though not significant in the current study, but dietary patterns were significantly related with CVD in adulthood.

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Authors' contributions

Linkon KMMR, responsible for supervision and design of the research, and protocol development; Meem NES, Noory SH, Hossain MH, participated in data collection, data curation, data analysis; Nitu RM, Islam MF, Shyfullah M, Jalil S, Esrafil M, contributed in methodology, reviewing and referencing; Alim MA, responsible for methodology, manuscript writing, reviewing and editing.

Conflicts of interest

The authors declare that they have no conflict of interest.

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