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Carbonated Beverage Consumption Pattern and Their Association with Body Weight Among Adults – A Cross-Sectional Study

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Abstract –

Background: The Epidemic rise in obesity has become a serious public health concern with disrupted dietary habits, among which carbonated drinks are brought to attention by being high in calories and low in nutritional value. Unlike solid food, carbonated drinks are liquid calories, which are less effective on the hunger hormone and promote satiety. Therefore, a lack of satiety leads to an increased calorie intake of solid foods, leading to a doubled calorie intake and increasing risk of weight gain. ***Objective:*** The objective of this research is to gain a better understanding of the consumption of carbonated drinks, which causes obesity in the adult population. By raising awareness about the harmful effects of carbonated drink consumption, we aim to help people recognise their physical body status and guide them towards a "better me."***Methods:*** The cross-sectional study was conducted on 406 individuals ranging in age from 18 to 59 years. To analyse the consumption of carbonated drinks and its effects on satiety and obesity. The data was collected using a structured questionnaire in which there were demographic details and anthropometric assessments, and their knowledge, attitude, and practice regarding carbonated beverages and their physical body status were assessed using an Omron Kadara Body scanner. Furthermore, descriptive Statistical analysis methods and correlational analysis were used for data analysis to compare the independent variable with dependent variables. ***Results:*** The sample includes 406 individuals ranging from age 18-59 years. Among females, 53.6%, and males, 46.3%, among which 77.6% of males had been exposed to carbonated drinks as children, and 60% of them complained of weight gain, of which 60.6% of males and 45.8% of females had self-introduced the drinks. 63% were ignorant of the ingredients of carbonated drinks and failed to read the nutritional information on the label, and 70.2% are addicted to them because they consume them during meals, 54.4% tried to stop but failed, but they are significantly reducing their excess weight and are willing to stop obesity soon, and 93% think that more public education about the health risks of carbonated drinks is necessary. ***Conclusion:*** In summary, knowledge regarding carbonated drinks suggested that participants are well aware of the negative effects of carbonated drinks, and there is a significant gap between this awareness and their actual behaviour. An understanding is required to successfully support public health concerns around the consumption of carbonated beverages.

Keywords: Obesity, Carbonated drinks, Body Mass Index (BMI), Physical body status.

1. INTRODUCTION

Carbonated drinks are consumed for their taste and convenience; however, they are high in calories due to added sugar and have low nutritional value, significantly contributing to weight gain (Kim, J.-M et al., 2021). Although effective approaches exist to raise awareness and educate people about the alarming adverse health effects of carbonated drink consumption, consumption patterns and dietary habits remain unaddressed across various age groups. Children and adolescents have adaptable minds that enable them to form dietary habits; early exposure to carbonated drinks can lead to lifelong behaviours that jeopardize their health. Their overall health (Miller et al., 2022). It is estimated that worldwide, 446 million adults, or 8.9% of the global population, consume carbonated drinks at a rate exceeding 7 servings per week (Lara-Castor et al., 2023). Carbonated drinks contain sugar, artificial sweeteners, and phosphoric acid, which can contribute to insulin resistance, obesity, and other metabolic disorders (Chen, L et al., 2020). Furthermore, marketing strategies for carbonated drinks focus on influencing youth through deceptive advertising that promotes the idea of replenishing energy and hydration, thereby swaying their preferences away from healthier choices (Marx et al., 2021).

The major concerns about the association between these beverages and weight are well documented; there is limited focus on the product and implications of consumption patterns, including behavioural tendencies and knowledge gaps, particularly among young and middle-aged adults in an organized environment.

This study aims to evaluate the relationship between the consumption of carbonated drinks and the risk of obesity by analysing demographic variables, body composition using an Omron Karada body scanner, and knowledge, attitude, and practice regarding dietary habits and the consumption of carbonated drinks. This study will provide valuable insights into improving public health strategies by evaluating these factors regarding the

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consumption of carbonated drinks and obesity-related parameters.

RESEARCH METHODOLOGY

The cross-sectional study aimed to evaluate dietary habits, anthropometric measurements, and body composition using the Omron Karada body scanner, as well as participants' knowledge, attitudes, and practices regarding carbonated drink consumption and obesity risk. Data collection took place over three months at three research sites, involving 406 participants who consented to take part in the study. Inclusion criteria required participants to be between the ages of 18 and 59, while those with pre-existing medical conditions were excluded. A structured questionnaire assessed participants' knowledge, attitudes, and practices related to carbonated drink consumption and obesity risk. The evaluation focused on demographics, anthropometric data, body analysis, and participants' knowledge, attitudes, behaviours, and practices. Descriptive Statistical analysis was conducted to gain deeper insights into the findings. Data collection involved a validated questionnaire assessing demographics, KAP, and body analysis. Statistical analyses included descriptive statistics (mean ± SD).

RESULTS AND DISCUSSION

1. Demographic Distribution of Respondents

Table 1 shows that the study participants included 188 males (46.3%) and 218 females (53.6%). Among these, the majority of male participants (38.8%) are in the 26 to 35 age group, while most female participants (44.5%) are between 18 and 25 years old. Moreover, 54.3% of men and 39.4% of women have obtained a graduate-level education, followed by post-graduate level males at 21.2% and females at 25.6%. Surprisingly, very few participants held a PhD, among which 2.1% were males and 0.9% were females. Looking forward to employment status, among which 44.6% of males and 22.0% of females were employed, while the students were predominantly female at 33% compared to males at 21.2%. Homemakers were exclusively female at 35.7%, whereas 29.7% of males were entrepreneurs compared to females at 3.6%. The proportion of daily wage earners was slightly higher among females at 5.5%, whereas males were at 4.2%. The findings show the distribution of demographic characteristics between the male and female populations of the study.

Table 1 Demographic Distribution of Respondents

Parameters	Response options	Male		Female	
		Frequency (n=188)	Percentage (%)	Frequency (n=218)	Percentage (%)
Age group	18 - 25 years	72	38.3	97	44.5
	26 – 35 years	73	38.8	35	16.0
	36 – 59 years	43	22.8	86	39.4
Education Level	Ph.D.	04	02.1	02	0.9
	Post graduate	40	21.2	56	25.6
	Graduate	106	56.3	86	39.4
	Higher secondary	24	12.7	48	22.0
	Secondary	14	07.4	26	11.9
Employment status	Employed	84	44.6	48	22.0
	Students	40	21.2	72	33.0
	Homemakers	-	-	78	35.7
	Entrepreneur	56	29.7	08	03.6
	Daily wager	08	04.2	12	05.5

2. Dietary and Health Patterns

Table 2 presents the findings on meal frequency among participants in a study of 406 individuals, including 188 males and 218 females. Most males (50%) reported eating three meals a day, while 47.8% reported consuming two meals. Only a small percentage (2.1%) indicated having four meals, and none reported having five meals. Among males, 49.5% follow the three-meal pattern, while 33.9% eat two meals daily. In contrast, 13.7% of females reported having four meals, and 2.7% reported five meals. This suggests that while the three-meal-a-day pattern is the most common overall, a higher percentage of women reported having four or more meals compared to men. These differences can be influenced by employment status, which suggests that the homemakers are females only.

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Table 2 Dietary and Health Pattern

Parameters	Response options	Male		Female	
		Frequency (n=188)	Percentage (%)	Frequency (n=188)	Percentage (%)
Meal frequency	2 meals 3 meals 4 meals 5 meals	90 94 04 -	47.8 50 2.1 -	74 108 30 06	33.9 49.5 13.7 2.7

3. Carbonated drinks consumption pattern

Table 3 shows that carbonated drinks were introduced at an early stage of life. Among the 406 respondents (188 males and 218 females), the study investigates the age of introduction, sources of influence, and frequency of consumption of carbonated drinks. The majority of males (77.6%) and females (65.1%) were introduced to carbonated drinks during childhood, while 22.3% of males and 33.9% of females were introduced during adolescence. Only 0.9% of females reported being introduced to such drinks in adulthood. Regarding sources of influence, 60.6% of males and 45.8% of females reported that they self-initiated their consumption of carbonated drinks. In 18.6% of males and 22% of females, parental guidance played a role in their introduction to these drinks, while friends influenced 20.2% of males and 11.9% of females. Additionally, 20.1% of females were influenced by relatives, compared to just 1.06% of males.

In terms of frequency of consumption, most males (60.6%) and females (42.2%) consume carbonated drinks once a week. Roughly 8.5% of males and 7.3% of females reported daily consumption, which is relatively low. Furthermore, 14.6% of females consume them once every two weeks, while 8.5% of males do the same. Monthly consumption is reported by 13.8% of males and 13.7% of females.

It is worth noting that 22% of females and 8.5% of males drink carbonated drinks infrequently, suggesting a higher tendency for females to restrict their consumption. Gender-based differences were revealed in these factors of early exposure, influences, and consumption of carbonated drinks, informing dietary behaviours with implications for health interventions.

Table 3 Carbonated drinks consumption pattern

Parameters	Response options	Male		Female	
		Frequency (n=188)	Percentage (%)	Frequency (n=188)	Percentage (%)
Age of introduction of carbonated drinks	Childhood Teenage Adulthood	146 42 -	77.6 22.3 -	142 74 02	65.1 33.9 0.9
Source of influence	Self-introduced Parents Friends Relatives	114 35 38 02	60.6 18.6 20.2 1.06	100 48 26 44	45.8 22.0 11.9 20.1
Consumption frequency	Daily Weekly Once in a 2 weeks Monthly Rarely	16 114 16 26 16	8.5 60.6 8.5 13.8 8.5	16 92 32 30 48	7.3 42.2 14.6 13.7 22.0

Table 4 Anthropometric assessment and Body analysis

Table 4 presents the height and BMI distribution of 406 respondents (188 males and 218 females). The average height for male participants is 169.6 cm (SD = 9.47), while for females it is 154.2 cm (SD = 9.46). As shown in the bar graph of BMI distribution, most respondents report their weight falling within the normal and overweight ranges. Sixty-six male participants are categorised as having a normal BMI, whereas 84 are classified as overweight. In comparison, 70 females have a normal BMI, and 58 are overweight. A small percentage of males (8) and females (24) are underweight. The rates of obesity are particularly striking, with 22 males and 32 females classified as Obese I. Additionally, six males are classified as Obese II, while no females fall into this category. This variation may indicate differences in dietary habits, physical activity, or metabolic factors that influence body composition. These findings highlight the gender differences in BMI distribution, where a comparatively higher proportion of males are overweight, while fewer females are classified as underweight or Obese I.

Parameters	Male Frequency (n=188)		Female Frequency (n=218)	
	Average	Standard Deviation	Average	Standard Deviation

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Height (cm)	169.6	9.47	154.2	9.46
Weight (kg)	74.3	15.64	63.4	15.39

Figure 1: Gender-based distribution of body mass index

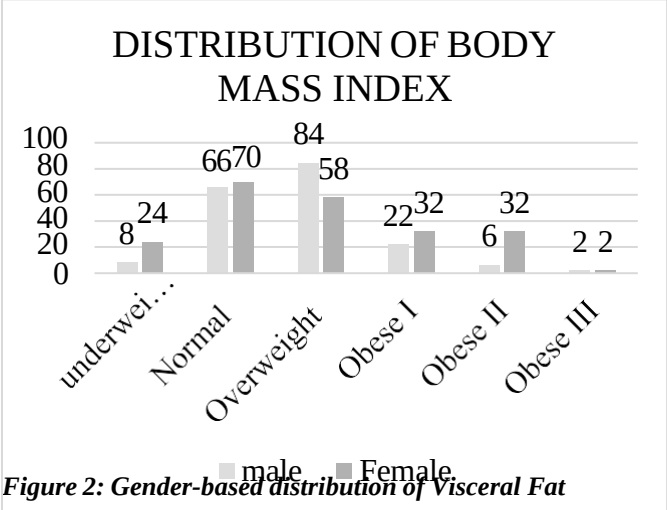


Figure 2: Gender-based distribution of Visceral Fat

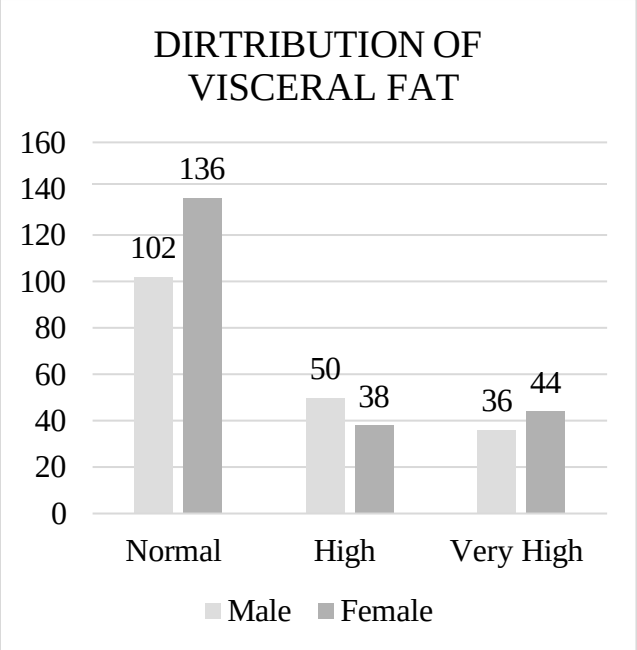
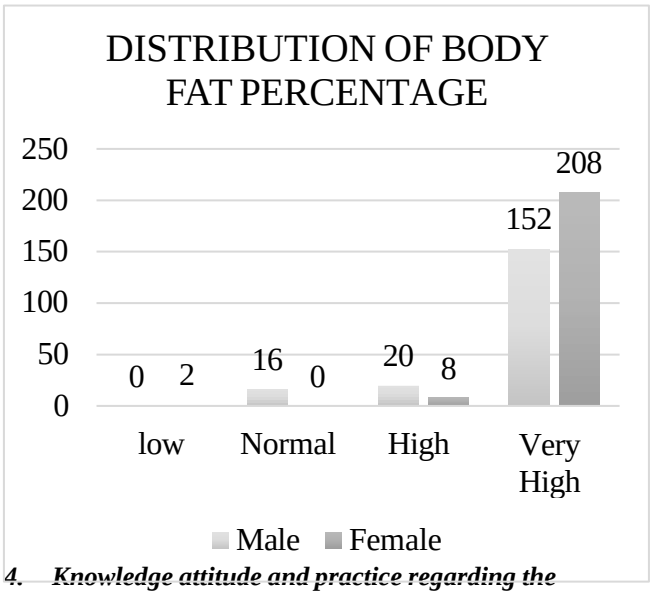


Figure 3: Gender-based distribution of Body fat percentage



4. Knowledge attitude and practice regarding the consumption of carbonated drinks

Table 5, which discusses knowledge among participants regarding the consumption of carbonated drinks, suggests that 91.5% could recognize carbonated drinks, but only 36.6% were aware of their ingredients. However, this study found that the lack of awareness about the ingredients present in carbonated drinks, such as sugar and their alternatives with additives, is a major contributor to the higher consumption of carbonated drinks.

Table 5 Knowledge regarding consumption of carbonated drinks

Knowledge Question	**Frequency (n=404) Correct answers**	**Percentage (%)**
Which of the following is a carbonated drink?	370	91.5
Do you know the ingredients of carbonated drinks?	148	36.6
The calories in carbonated drinks come from which ingredient?	382	94.5
Is long term effect of carbonated drink consumption?	402	99.5
What gives bubbles to soda	386	95.5

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Table 6 depicts the attitude towards carbonated drinks by the participants, showing that 70.5% disagreed with the idea that daily consumption of carbonated drinks is healthy, and 70.2% of them considered carbonated drinks to be addictive. Surprisingly, 37.6% believe that carbonated drinks can cause weight gain, while only 36.1% strongly agree that they read nutritional labels and consider them to be important.

Table 6 Attitude regarding consumption of carbonated drinks

Attitude Questions	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Daily carbonated drinks consumption is healthy.	04 (0.9)	04 (0.9)	18 (4.4)	90 (22.2)	285 (70.5)
Carbonated drinks cause weight gain.	152 (37.6)	66 (16.3)	60 (14.8)	108 (26.7)	18 (4.4)
It is important to read nutritional label of soda	146 (36.1)	94 (23.2)	144 (35.6)	18 (4.4)	02 (0.2)
Diet or low-calorie carbonated drinks is a healthier alternative to regular carbonated drinks.	164 (40.5)	98 (24.2)	96 (23.7)	26 (6.4)	20 (4.9)
Carbonated drinks are addictive	284 (70.2)	82 (20.2)	22 (5.4)	08 (1.9)	08 (1.9)
It is important to have healthy weight.	366 (90.5)	50 (12.3)	08 (1.9)	04 (0.9)	06 (1.4)

*values are in parenthesis in percentage (%)

Table 7 highlights the responses to the practice- related questions and gives deep insights into how often the participants consume carbonated drinks and whether they are even aware of the health risks that are attached to carbonated drinks. A significant 66.8% of the people consumed soda along with their meals, which might lead to high-calorie consumption. Nonetheless, 60.1% of participants reported concern about weight gain. However, only 30.6% had received any theoretical education on the dangers of carbonated drinks, reflecting a lack of public health knowledge. Encouragingly, most (87.1%) said they would try to decrease their consumption of carbonated drinks to prevent obesity and the health risks associated with being overweight, and 93% thought there was a need for more public education about health. They said they would consume fewer carbonated beverages if they were to prevent obesity, and 93% said there should be greater efforts to educate the public about the health risks associated with carbonated beverages. Although they were aware of the public health problem, it didn't change their diet, as 54.4% of the respondents were unsuccessful in taking carbonated drinks off their diet, and 45.5% successfully eliminated carbonated drinks. These results indicate a gap in knowledge on healthy eating habits, which could encourage the design of more directed educational campaigns and intervention strategies that build healthier habits and reduce the risk for obesity.

Table 7 Practice regarding consumption of carbonated drinks

Practice Question	**Yes**	**No**
Do you consume soda during meal	270 (66.8)	134 (33.1)
Are you concern about your weight gain?	242 (60.1)	162 (39.9)
Have you received any education about potential risk of carbonated drinks	124 (30.6)	280 (69.3)
Are you willing to reduce your consumption of carbonated drinks to prevent obesity?	352 (87.1)	52 (12.8)
Do you think that there should be more public education on the health	376 (93)	28 (6.9)

risks of consuming carbonated drinks?		
Were you successful to eliminate carbonated drinks?	184 (45.5)	220(54.4)

*Values are in parenthesis in percentage (%)

CONCLUSION

The study evaluated the widespread prevalence of carbonated drink consumption and its association with dietary habits, body composition, and the risk of obesity. Despite participants being aware of the negative effects of carbonated drinks, there was a significant gap between their knowledge and actual behaviour. The results indicated that carbonated drinks had been marketed effectively, particularly to younger generations, making them appealing. Furthermore, a significant correlation was found between body composition, BMI, body fat percentage, and visceral fat, emphasizing the need for dietary interventions to reduce excessive calorie intake from these beverages. Public health policies should focus on enhancing nutritional labelling, enforcing strict regulations on the sugar content in carbonated drinks, and promoting healthier alternatives. Additionally, further research could examine interventions, awareness, and behaviour changes within the younger generation. Future studies could adopt a longitudinal perspective to assess the before and after effects of carbonated drink consumption and its relation to obesity-related complications.

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Conflict of interest: There are no conflicts of interest

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