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## Research Article

# Association Between Simple Carbohydrate Content in Breakfast Meal and Fat Mass among Adult Saudi Females

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## Abstract

**Background and Objective:** The amount and quality of macronutrients intake at breakfast do have a great effect on body weight. So, this study was aimed to investigate the association between simple carbohydrate intake during breakfast with increased fat mass among young Saudi females at Princess Nourah University (Riyadh, Saudi Arabia). **Materials and Methods:** Body composition was analyzed in 84 participants. Quantitative and qualitative assessment of simple carbohydrate intake during breakfast were conducted using 24 h dietary recall over 3 days and a food frequency questionnaire, respectively. Statistical tests were applied to assess difference between normal fat mass and high fat mass groups, while Pearson test evaluated the association between different parameters. **Results:** A very high percentage of participants had high fat mass (60.7%). However, no significant difference in calorie intake was reported between normal fat mass group (1422.04 Kcal/day) and high fat mass group (1384.40 Kcal/day). Similarly, no difference in breakfast consumption between the 2 groups were observed. However, high fat mass group consumption of carbohydrates was significantly less during breakfast compared to the low fat mass group ( $p = 0.05$ ). **Conclusion:** This study concluded that the consumption of simple carbohydrates during breakfast was not associated with increased calories intake or body fat mass percentage among young Saudi females.

**Key words:** Breakfast, fat mass, simple carbohydrate, adult female, macronutrient dietary, calories intake

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

It has been reported that daily consumption of breakfast helps to reduce body weight, but this effect is dependent on the composition of the breakfast<sup>1</sup>. Indeed, the type and amount of carbohydrates contained in a breakfast influences both post-prandial glycemia and insulinemia<sup>2</sup>. Moreover, it is well documented that high glycemic index foods causes a rapid fluctuation in glucose and insulin levels, which is disadvantageous for health<sup>3</sup>. Furthermore, high carbohydrate diet has been demonstrated to reduce fatty acid oxidation as a result of the inhibition of long-chain fatty acid entry into the mitochondria<sup>4</sup>. On the other hand, breakfast composition can affect insulin sensitivity when meals are consumed during lunch and this is known as the "second meal effect"<sup>5</sup>. Interestingly, the low glycemic index breakfast reduces insulin demand in the subsequent meal<sup>6</sup>. Moreover, energy intake throughout the day is affected by breakfast with a meal made up of high protein and low carbohydrate providing maximum satiety and daylong minimum energy consumption<sup>7</sup>. In addition, intake of simple carbohydrates during breakfast is associated with an increase in hunger and fatigue<sup>8</sup>. Furthermore, food intake is suggested to be affected by variety of hormones including gut peptides such as; cholecystokinin and ghrelin, which are recognized appetite regulators. In addition, food drive has been demonstrated to be influenced by blood glucose and insulin levels. Thus, meals containing low glycemic index showed a positive impact on appetite-related hormones throughout the day inducing lower levels of insulin and higher cholecystokinin that can promote weight loss by reducing food intake<sup>9,10</sup>. At epidemiological level, this could be reflected in the existing correlation between post-prandial hyperinsulinemia and metabolic syndrome. In fact, as several studies supported, the impact of glycemic load on increased risk of developing type 2 diabetes (T2DM) and overweight<sup>11,12</sup>.

In Saudi Arabia, prevalence of obesity among adults is very high (28.7%) and women are more affected compared to men<sup>13</sup>. World Health Organization (WHO) has proven that 63% of global deaths were due to non-communicable diseases<sup>14</sup>. In fact, current lifestyle pattern of Saudi population is considerably different in comparison to how it was decades ago. Dietary habits of Saudi population are characterized by high amount of intake of sugars and fats with a corresponding decrease in intake of vegetables. Furthermore, a study showed that female adolescents consume large amounts of caloric dense foods<sup>15</sup>. Recently, Alqahtani *et al.*<sup>16</sup> reported that both normal and obese Saudi female university students consumed about the same total calorie intake per day. However, fat and

sugar intake were higher in the obese students group. Thus, based on evidence of parallel increased prevalence of obesity and carbohydrate intake in Saudi Arabia, it is hypothesized that intake of simple sugars mainly during breakfast might lead to increased body fat mass percentage among Saudi women. Therefore, this study was designed to assess simple carbohydrate intake during breakfast and its possible association to fat mass among young Saudi female adults.

## MATERIALS AND METHODS

**Study design and participants:** Across-sectional study was carried out at the College of Health and Rehabilitation Science in Princess Nourah University (PNU) in Riyadh. It was conducted from January-March, 2018, after obtaining the ethical approval (Number H-01-R-059/18-0018) from the Institutional Review Board of PNU. A total of 102 participants (aged 19-24 years) were recruited in response to advertisement about the study. Exclusion criteria included the following: being pregnant, breast feeding, on a diet or using a medication that affects body weight at the time of the study, suffering from any disease that influences dietary intake such as celiac disease, diabetes and thyroid diseases. All subjects provided written informed consent. Participants were treated according to the principles of Helsinki declaration and data were kept anonymous.

**Dietary intake assessment:** Quantitative data on daily food intake by participants was collected using 24 h dietary recall. It included the 3 main meals, drinks and snacks in between meals. Data was collected throughout the week for 3 non-consecutive days, 2 week days and 1 weekend day<sup>17</sup>. Calculation of carbohydrates (g), protein (g), fats (g) and daily energy intake (Kcal) were completed from the recorded foods using the National Nutrient Database for Standard Reference Release<sup>18</sup>.

Qualitative data focused mainly on frequency and types of carbohydrate consumed during breakfast. Thus, data was collected using Food Frequency Questionnaire (FFQ) for breakfast. This FFQ included the following food items: cereals and bread, rice and pasta, biscuit and cookies, fruits, soft drinks, sweets and sugary drinks. In this study, the breakfast was considered as the first meal eaten between 6 am and 12 pm and it should contain macro-nutrients (carbohydrate- protein-fat) to be counted as the first meal.

**Anthropometric measurements:** To acquire accurate data of body measurement, participants were asked to wear light

clothes and take off shoes before measuring their height and weight. Height was measured using a standard measuring scale to the nearest 0.1 cm and waist circumference was obtained using body measuring tape to the nearest 0.1 cm. Height and waist circumference measurements were then introduced to the body composition analyzer (seca mBCA 515) to calculate fat mass percentage, body mass index (BMI) and visceral fat. Participants were afterwards classified based on the WHO<sup>19</sup> guidelines. Underweight: <18.50 kg m<sup>-2</sup>, Normal: 18.50-24.99 kg m<sup>-2</sup>, overweight ≥25.00 kg m<sup>-2</sup> and obese ≥30.00 kg m<sup>-2</sup>. Classification was also made based on standardized cut off points of fat mass percentage where values ranging from 9-<32 and ≥32% were considered as normal and high fat percentage, respectively<sup>20</sup>.

**Statistical analysis:** All incomplete data was removed before processing and analysis (n = 18). Descriptive statistics were used to understand the pattern of simple carbohydrate consumption during breakfast and total energy intake. Analytical statistical tests that included Pearson correlation, Fisher's exact test and t-test were used to find the association between simple carbohydrate consumption during breakfast and fat mass percentage. Z-test for proportion was used to assess the difference in percentage between the groups. A difference was considered significant at a p<0.05. All statistical analyses were performed using SPSS software (Version 24).

## RESULTS

**Main characteristics of the studied population:** Complete data collected from 84 young female adults were included in this analysis. The socio-demographic characteristics showed a very homogenous sample as all participants were single,

female college students between the ages of 19-24 years. They were grouped according to their fat mass percentage, with the high fat mass percentage group representing 60.7% of total population while normal fat mass percentage group represented 39.3% only (Table 1).

**Energy and nutrients intake:** The energy and nutrient intake are presented as mean±SD in Table 2. In general, both groups (normal and high fat mass) consumed on average, almost the same daily amount of calories and macro-nutrients (1422.04 vs. 1384.40 Kcal, respectively, p>0.05). Surprisingly, the normal fat mass group consumed more simple carbohydrates during breakfast (17.9 vs. 13.9 g, respectively, p = 0.05) compared to high fat mass group.

**Frequency of breakfast consumption:** In terms of frequency of breakfast consumption, 39.4% of the normal fat mass group consumed breakfast 3-5 times per week, while in the corresponding high fat mass group, it was only 29.4%, this difference was significant (p<0.05) (Table 3).

**Frequency of consumption of carbohydrates containing foods during breakfast:** Data in Fig. 1 showed that bread was the most consumed food item during breakfast in both groups.

Table 1: Main characteristics of the studied population (n = 84)

Parameters	(n=84) (%)
Age (year) (Mean±SD)	20±2.5
<b>Marital status</b>	
Single	100
Married	0
Divorced/widow	0
<b>Fat mass (%)</b>	
Normal (9-<32%)	39.3
High (≥32%)	60.7

Table 2: Energy and nutrients intake during 24 h and during breakfast in normal fat mass group and high fat mass group

Parameters	Total population (n = 84)	Normal fat mass (%) group (n = 33)	High fat mass (%) group (n = 51)	p-value
<b>24 h</b>				
Calories (Kcal)	1398.5±409.9	1422.00±318.4	1384.4±462.7	0.66
Carbohydrate (g)	184.1±58.5	187.50±49.6	182.1±64.2	0.66
Protein (g)	55.8±18.1	52.80±13.9	57.3±20.2	0.22
Fat (g)	51.1±17.1	53.13±13.5	50.4±19.3	0.39
<b>Breakfast</b>				
Calories (Kcal)	268.2±114.1	272.00±93.1	259.2±125.4	0.59
Total calorie intake (%)	20.3±9.2	20.00±8.1	20.0±10.9	0.99
Carbohydrate (g)	38.3±18.2	39.80±14.7	35.4±17.2	0.21
Simple carbohydrate (g)	15.5±8.6	17.50±7.9	13.9±8.60	0.05
Total carbohydrate intake (%)	41.6±21.8	46.30±20.8	39.4±22.5	0.15
Protein (g)	10.5±5.8	9.50±4.5	10.9±6.60	0.24
Fat (g)	8.9±4.7	8.60±3.6	9.0±5.30	0.65

Calorie and macronutrients intake were calculated from 24 h recall of three non-consecutive days. Results are presented as mean±SD. Normal fat mass percentage group = Fat mass percentage ranges 9-31%, High fat mass percentage group = Fat mass percent ≥32%. The p-value is calculated using t-test to assess the difference between the two groups

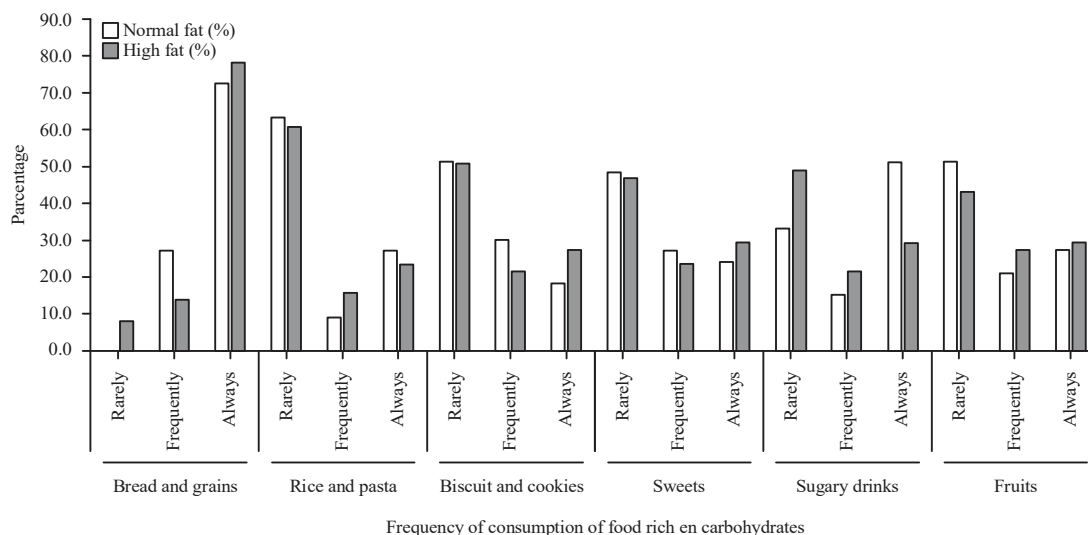


Fig. 1: Frequency of carbohydrates containing foods consumption during breakfast among normal fat mass group and high fat mass group of participants (n = 84)

Data are presented as percentage of each group. Normal fat mass percentage group ranges is 9-31%; High fat mass percentage group is 32%

Table 3: Frequency of breakfast consumption in normal fat mass group and high fat mass group

Parameters	Total population (n = 84)	Normal fat mass (%) group (n = 33)	High fat mass (%) group (n = 51)	p-value
Always	39.3	39.4	39.2	<0.05
3-5 times/ week	33.1	39.4	29.4	<0.05
1-2 times/week	23.9	18.2	27.5	<0.05
Never	3.7	3.0	3.9	<0.05
Total (%)	100.0	100.0	100.0	

Results are presented in percentage of respective group. Normal fat mass percentage group = Fat mass percentage ranges 9-31%, High fat mass percentage group = Fat mass percentage  $\geq 32\%$ . The p-value is calculated using Z-test for proportion

Frequency of consumption as indicated by “always” for biscuits and cookies, sweet and fruits were high in fat mass group. In contrast, percentage of participants in normal fat group consuming “always” pasta and sugary drinks were higher compared to high fat group.

**Association of simple carbohydrate consumption during breakfast and other parameters:**

Data in Fig. 2a and b represented correlation of consumption of simple carbohydrate during breakfast with the different parameters. The Fig. 2a and b showed that there was no significant correlation observed between fat mass and visceral fat with consumption of simple carbohydrate during breakfast ( $R^2 = 0.042$  and  $R^2 = 0.029$ , respectively). In terms of intake, the correlation ( $R^2$ ) of simple carbohydrate consumption during breakfast with total calorie intake was very weak (0.060) (Fig. 2c). Similar result was obtained with total carbohydrates consumption during the day ( $R^2 = 0.068$ ) (Fig. 2d).

**DISCUSSION**

This study investigated if the simple carbohydrates intake during breakfast is associated with body fat mass percentage among young Saudi female adults. Findings of this study is supported by previous studies which stated that the predominant food group was carbohydrates and bread was the most preferred among the Saudi students<sup>16</sup>.

In addition, in the present study, groups with different fat mass percentages (normal and high) have been shown to consume almost the same amount of calories and macro-nutrients which is coincided with previous literature<sup>16</sup>. Taken together, these results may indicated that carbohydrate is not the culprit of increased fat mass. In contrast, a study reported that high carbohydrate diet suppresses fat oxidation, which is in disagreement with findings of the present study<sup>4</sup>. A plausible explanation would be that the extent of the effect would vary between a simple intake and a dietary habit. When considering fat oxidation, the effect would be perceived at a

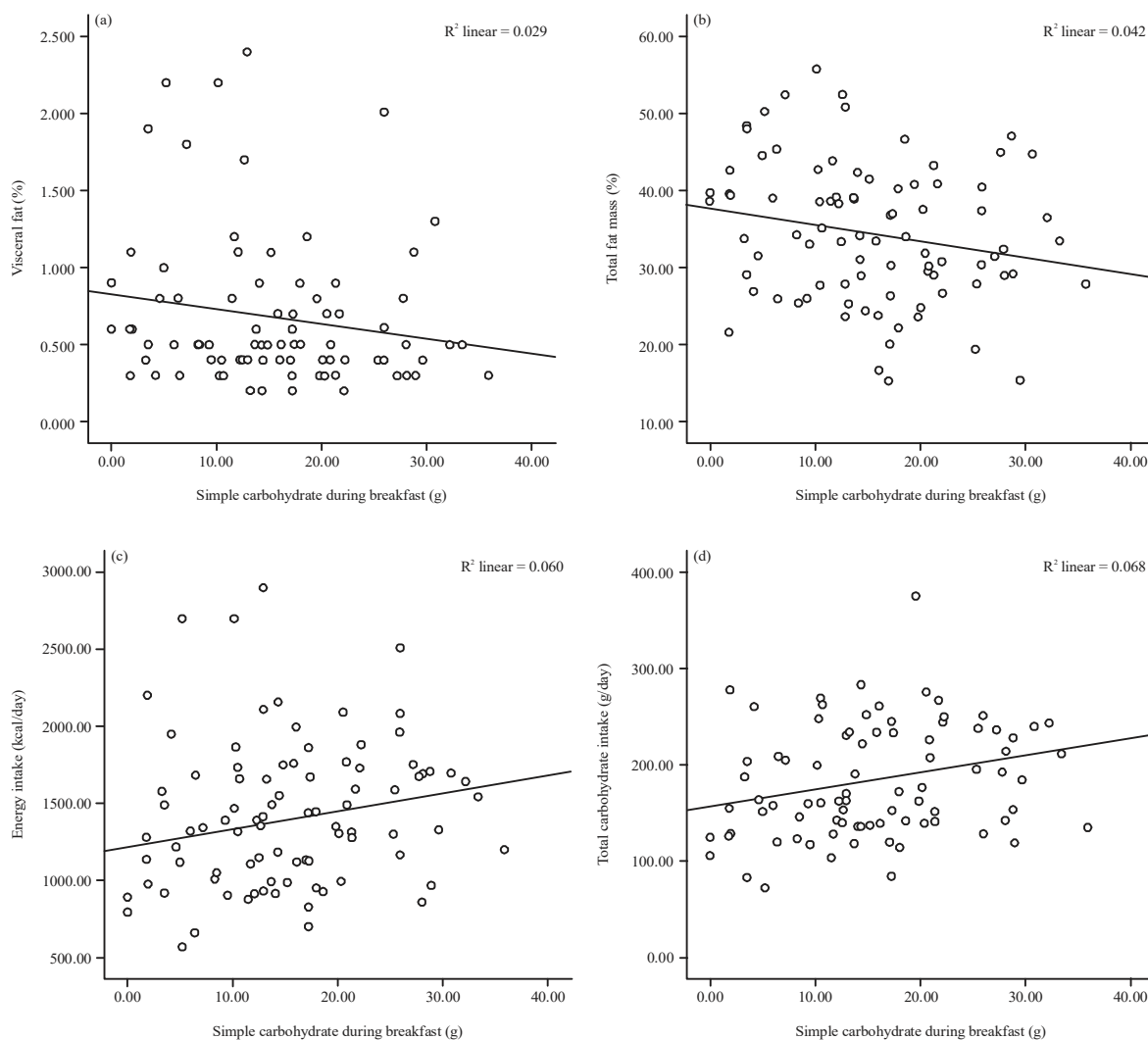


Fig. 2(a-d): Associations between simple carbohydrate intake during breakfast with different parameters, (a) Visceral fat (%), (b) Fat mass(%), (c) Energy intake (Kcal/day) and (d) Total carbohydrate intake during the day (g) (n = 84)  
Correlation is measured with person correlation test

short term as demonstrated by Koutsari and Sidossis<sup>4</sup>, who measured the fat oxidation instantly after carbohydrate consumption, while the effect on fat accumulation seems to be dependent on other factors than carbohydrate consumption only. As it was previously indicated, short-term dietary interventions result in a moderate weight loss at the beginning only and this does not apply on the long term. It was shown that providing high-fat and low-fat diet appears to have the same impact on body weight in the long term<sup>21</sup>. This could be elucidated by the possible role of genes in the susceptibility to weight gain for certain diet high-fat or high-carbohydrate diet among individuals<sup>22</sup>, although emphasis have been made on the need to further investigate on the differences in the susceptibility of the human body to

these diets<sup>23</sup>. Thus, it seems that dietary factor is not the major cause of increased fat mass in this studied population as other causes could be of influence in this parameter.

The difference between energy intake and energy need with no significant effect on body weight could be explained through evidence that sedentary individuals have less energy requirement<sup>24</sup>. In terms of intake, results showed that there was no considerable difference in energy and nutrients intake between normal and high fat mass groups. Interestingly, normal fat mass group consumed more simple carbohydrate during breakfast in comparison to high fat mass group. These findings are in agreement with a previous study, which demonstrated that low carbohydrate breakfast seemed to provide daylong minimum energy consumption<sup>7</sup>. In this study,

the group who consumed less simple carbohydrate during breakfast showed lower energy intake during the day. A limitation of this study was its small sample size. Further studies are needed to investigate the other potential factors in addition to dietary habits that might affect body fat mass among young Saudi female adults.

## CONCLUSION

Findings of the present study showed that there was no association between the consumption of simple carbohydrate during breakfast meal and fat mass. However, consuming simple carbohydrate during breakfast resulted in a slight increase of energy and carbohydrate consumption throughout the day. This might indicate that dietary factor was not the only factor responsible for the increase of body fat mass in the studied population.

## SIGNIFICANCE STATEMENT

This study discovers that prevalence of Saudi women with high fat mass is high and that it is not affected by consuming simple carbohydrate during breakfast. This study will help researchers to uncover that fat mass is influenced by other factors at long term, an observation not made by any research before among Saudi women. Thus, adequate recommendations on reducing the abnormally high fat among this population can be formulated and implemented.

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