Snack intake among college students with overweight/obesity and its association with gender, income, stress, and availability of snacks during the COVID-19 pandemic

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Snack intake among college students with overweight/obesity and its association with gender, income, stress, and availability of snacks during COVID-19 pandemic

Snack intake in college students with overweight/obesity during COVID-19

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Abstract: Objective. To assess the determinants of snack intake among college students with overweight/obesity during COVID-19 pandemic. We hypothesized that younger and male students, those from minority background, those experiencing higher stress levels, and those with higher accessibility/availability of unhealthy snacks would snack more frequently or consume more unhealthy snack choices. Methods. This was a secondary analysis of the baseline data obtained from the Snackability trial, a trial to test the efficacy of a smartphone application for improving the quality of snack intake in US college students with overweight/obesity. Participants completed a survey on socio-demographics, stress level, and snack patterns at the baseline visit (n=298). Analyses included correlation, Mann–Whitney U test, Kruskal–Wallis, and logistic regressions. Results. Most students were females (81.9%), 40.9% were whites, and 55.7% had a household income of <$50,000. Snack intake was consumed 6.0 (5.0, 7.0) times per week. Most students knew how to choose a healthy snack (84.6%) but most indicated a high access to unhealthy snacks (69.5%). Male students had lower odds of consuming unhealthy snacks (odds ratio, OR, 0.52, 95% CI: 0.27-0.98). Those with higher household income had lower odds of having accessibility/availability to unhealthy snacks (OR 0.33, 95% CI: 0.17-0.67). As stress increased, the consumption of snacks increased as well (p<0.05). Higher accessibility to unhealthy snacks was associated with a higher snack frequency (p<0.05). Conclusions: Snack intake among US college students with overweight/obesity was significant influenced by gender, income, stress, and accessibility/availability to unhealthy snacks.
Keywords: college students, overweight, obesity, socio-demographics, snack intake, COVID-19 pandemic, stress

1. Introduction

College is a challenging period in which students transition to an independent lifestyle [1]. Several factors, including emotions, stress, time constrains, may promote the adoption of unhealthy behaviors such as poor dietary choices that, in turn, could lead to weight gain [2]. The prevalence of snack intake in the US has increased from 71% in 1977 to 97% in 2006 and so has the total daily percentage of caloric intake from snacks, increasing from 18% to 24% in this period [3]. This contributes to a higher energy intake in college students [4]. College students in the United States (US) tend to choose unhealthy snacks more frequently than healthy ones [4]. During the COVID-19 pandemic, there are reports of higher snack intake among adults [5] but little is known about snack patterns in college students during this period.

Previous studies have reported age, gender, race/ethnicity, and income as important determinants of snack intake before the pandemic. For example, younger students tend to snack more [6] with lower diet quality than older students probably due to lifestyle factors including perceived social norms, social support for healthy eating, stress and time management [7]. Female students are more concerned about eating healthy snacks [8], consume healthier diets [9], and consume less snacks [10,11] compared to males. Furthermore, Black and Hispanic college students tend to consume less healthy snacks when compared to other groups [12]. Other determinants include income [10][13], academic stress [14–16], field of study [11,13]. For the present study, we hypothesized that younger and male students, those from minority background, those experiencing higher stress levels, and those with higher accessibility/availability of unhealthy snacks would snack more frequently or consume more unhealthy snacks. Participants for this study were selected from the Snackability trial which included college students with overweight/obesity only. Other studies have also studied the association between snacking frequency and body weight in individuals with overweight and/or obesity [17]. It is important to understand the snacking patterns in this group in particular as this is population that is in higher need of interventions to improve the quality of the diet, such as the types of snacks consumed. To test our hypothesis, we assessed the determinants of snack intake in a sample of college students with overweight/obesity across US during the COVID-19 pandemic using a cross-sectional analysis.

2. Materials and Methods

Design and population. This is a secondary analysis of the participants’ baseline data obtained from the Snackability trial between June 2020 and March 2021. The Snackability trial was a two-arm, 12-weeks randomized controlled trial to test the efficacy of a newly developed smartphone application known as Snackability for improving the quality of snacks and for preventing weight gain [18].

Participant selection. Participants were recruited by using emails, social media, and a study website. For recruiting by email, a list of the largest US universities was created, then each institution’s IRB was contacted to request permission to email the faculty. If the IRB allowed this, then professors from each university were contacted with a sample email and the flyer of the study, and they were asked to forward this information to their students. For social media, the Snackability trial had social media accounts (Instagram and Facebook), and several posts and paid campaigns were posted about the study. A website with information about the study was also created with enrollment information. All interested students were directed to complete the online screening survey Qualtrics (www.qualtrics.com), a secured web-based survey, to confirm their eligibility for the study. Potential participants were asked to report their height and weight. This online questionnaire had a built-in equation to estimate BMI and determine if the potential participant was eligible for this study. College students with overweight/obesity (body mass index, BMI, 25–39.9 kg/m2) aged 18-24 years were eligible for participation if they owned a smartphone with Android or iOS platforms, had access to an internet connection to use the app, and were willing to participate in a clinical trial for 3 months. Exclusion criteria were enrolled in a weight loss and/or nutrition program, nutrition students, pregnancy, or breastfeeding.

Procedures: All study procedures were approved by the Institutional Review Board at Florida International University (FIU; approval number IRB-20-0275). Written informed consent was obtained from all participants prior to study commencement.

Study variables
Socio-demographic survey: this included age (in years), gender (male, female, or other), race/ethnicity (White, African American, Hispanic/Latino, Asian, Afro Caribbean and Other), household income (<$50,000 or $50,000-$75,000 or $75,000-$100,000 or >100,000), field of study, and level of stress over the past week using a validated scale from 0 (no stress) to 10 (extreme stress), and re-categorized as low (0-3), medium (4-7), or high (8-10) to have a better understanding of the severity of stress and facilitate the statistical analysis.

Snack survey. We used the baseline data from the snack intake survey from the Snackability trial to assess frequency of snacks consumption per week and per day during confinement at home, types of snacks available and accessible (healthy such as fruits, vegetables, and nuts or unhealthy such as chips, crackers, and cookies), the perception of knowledge about how to choose healthy snacks (yes/no), and an open-ended question asked about usual snacks consumed, which was re-categorized based on the US Smart Snack guidelines[20] as (1) healthy snacks (fruits and dried fruits; vegetables, nuts, nut butters and trail-mix; granola, bars, cereal, and whole grain crackers; dairy, milk, cheese and yogurt; and protein foods such as meats, and protein bars) or as (2) unhealthy snacks (chips, crackers, pretzels and popcorn; pickles and jerky; candies, sweets and gummies; chocolates; cookies and cakes; desserts, ice creams and puddings; breads, pastries and baked goods; sugary beverages; and honey, jam, dips and sauces).

Perception of snack intake survey: A validated survey[21] with the following statements was included: “I can find healthy snacks that come in handy, small packages”, “Fruits and vegetables can be easily eaten without being cooked”, “Healthy snacks come in little packages that help me to not eat too much”, “Fruits and vegetables (fresh or frozen) are usually available in my home”, “I cannot get healthy snacks in the snack machines”. The options ranged from strongly agree (4 points) to strongly disagree (1 point).

Analysis. Since this study utilized the baseline data from the Snackability trial, eligible participants who completed the baseline visit were included in this analysis. Power calculations were performed for the main outcome of the trial, which was quality of the snack intake. Descriptive analyses included frequency for categorical variables and medians (25th and 75th percentiles) for continuous variables. To evaluate the associations between age and snack intake, Spearman’s rank correlation coefficient was used. Mann-Whitney U test and Kruskal-Wallis were used, as appropriate, to evaluate if snack intake differed by gender, race, ethnicity, income, field of study, level of stress, or by accessibility and availability of snacks. Moreover, logistic regression was used to associate the accessibility of snacks, knowledge about snacks, and types of snacks usually consumed with gender, race, ethnicity, income, field of study, and level of stress. Analyses were performed using SPSS software version 22.0 and statistical significance was set at p<0.05.

3. Results

A total of 1401 students completed the pre-screening form, 535 were eligible to participate, 359 signed the consent form, and 298 completed the baseline questionnaires. Most students were female (81.9%) and white (40.9%), with a median age of 21.0 (20.0, 22.0) years (Table 1). Also, most participants were in health sciences majors (nursing, medical science, public health among others) and 55.7% had a low household income (<$50,000). Median level of stress was 7.0 (6.0, 8.0) which suggests that participants had a medium stress level.

Table 1. Socio-demographic characteristics of the sample (n=298)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Median (25th and 75th percentiles) or N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>21.0 (20.0, 22.0)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>244 (81.9)</td>
</tr>
<tr>
<td>Male</td>
<td>53 (17.8)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>122 (40.9)</td>
</tr>
</tbody>
</table>
The frequency of snacks consumed per week was 6.0 (5.0, 7.0) days and by day it was 2.0 (2.0, 3.0) snacks (Supplemental Table). In regard to unhealthy snacks, most students indicated a higher access (69.5%) and consumption (56.9%), particularly chips, crackers, pretzels, and popcorn (24.4%). Among the healthy snacks, fruits and dried fruits were the most commonly consumed (13.0%). Also, most students knew how to choose a healthy snack (84.6%). Additionally, most students agreed that they could not get healthy snacks in vending machines (69.8%), that they could find healthy snacks in small packages (74.2%), that small packages helped them to not eat too much (56.7%), that fruits and vegetables could be eaten without being cooked (85.2%), and that these were available at home (73.5%). No correlation was found between age and the frequency of snacks consumed per week ($R= -0.062; p=0.296$) or between age and frequency of snacks per day ($R=0.04; p=0.47$).

There were no significant differences in snack intake by gender, race, ethnicity, household income, or field of study ($p>0.05$) (Table 2). However, the frequency of snacks consumed per week was significantly higher among those categorized as having high levels of stress compared to medium or low levels of stress ($p<0.05$).

Table 2. Snack intake by socio-demographic variables in the sample ($n=298$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency of snacks consumed per week</th>
<th>Frequency of snacks consumed per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (25th, 75th percentile)</td>
<td>P-value*</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6.0 (5.0, 7.0)</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Male students had lower odds of consuming unhealthy snacks compared to females (odds ratio, O.R., 0.52, 95% C.I.: 0.27-0.98) (Table 3). Also, those with a household income of $50,000-$75,000 had lower odds of having unhealthy snacks more accessible (O.R. 0.50, 95% C.I.: 0.25-0.99) compared to those with a household income <$50,000. Similarly, those with a household income >$100,000 had lower odds of having unhealthy snacks more accessible (O.R. 0.33, 95% C.I.: 0.17-0.67).

### Table 3. Associations between socio-demographic characteristics and accessibility, knowledge, and type of snack consumed in the sample (n=298)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Having unhealthy snacks more accessible OR (95% C.I.)</th>
<th>Not knowing how to choose a healthy snack OR (95% C.I.)</th>
<th>Usually consuming unhealthy snacks OR (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Male</td>
<td>0.77 (0.40, 1.47)</td>
<td>1.17 (0.50, 2.71)</td>
<td>0.52 (0.27, 0.98)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Black</td>
<td>2.06 (0.90, 4.73)</td>
<td>1.06 (0.39, 2.93)</td>
<td>1.69 (0.80, 3.58)</td>
</tr>
</tbody>
</table>

Bold indicates statistical significance

*Mann–Whitney U test and Kruskal–Wallis, as appropriate
Asian       1.42 (0.57, 3.52) 0.48 (0.10, 2.23) 2.01 (0.80, 5.04)  
Other/multiracial  2.13 (1.18, 3.86) 1.07 (0.51, 2.25) 1.13 (0.66, 1.93)  
Hispanic/Latino  
No         1  1  1  
Yes        0.97 (0.58, 1.61) 0.97 (0.50, 1.90) 0.90 (0.56, 1.45)  
Field of study  
Math & engineering  1  1  1  
Health sciences     1.42 (0.66, 3.05) 1.08 (0.39, 3.03) 0.73 (0.35, 1.50)  
Basic sciences      0.81 (0.36, 1.81) 1.05 (0.33, 3.27) 0.52 (0.24, 1.16)  
Business & management 1.23 (0.44, 3.41) 1.42 (0.39, 5.16) 0.63 (0.23, 1.70)  
Other              1.25 (0.53, 2.93) 1.16 (0.37, 3.63) 0.90 (0.40, 2.06)  
Household income  
<50,000              1  1  1  
$50,000-$75,000    0.50 (0.25, 0.99) 0.76 (0.29, 1.98) 1.18 (0.62, 2.24)  
$75,000-$100,000   0.66 (0.27, 1.56) 1.21 (0.42, 3.50) 1.31 (0.58, 2.96)  
>100,000           0.33 (0.17, 0.67) 1.09 (0.43, 2.73) 0.73 (0.37, 1.43)  
Level of stress (0-10)  
Low (0-3)          1  1  1  
Medium (4-7)       0.49 (0.15, 1.55) 1.20 (0.25, 5.60) 0.90 (0.34, 2.33)  
High (8-10)        0.77 (0.23, 2.52) 1.95 (0.42, 9.11) 1.61 (0.60, 4.31)  

**Bold** indicates statistical significance  
*Logistic regression

Those that have unhealthy snacks more accessible/available have a significantly higher snack frequency per day (p<0.05) (Table 4). Similarly, those that agreed with not being able to get healthy snacks in vending machines had a significantly higher snack intake (p<0.05).

**Table 4. Snack intake and accessibility and availability of snacks in the sample (n=298)**

<table>
<thead>
<tr>
<th>Perception of food and snack consumption</th>
<th>Frequency of snacks consumed per week</th>
<th>P-value*</th>
<th>Frequency of snacks consumed per day</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of snacks more accessible/available</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy snacks (i.e., fruits, vegetables, nuts, etc.)</td>
<td>6.0 (5.0, 7.0)</td>
<td>0.66</td>
<td>2.0 (1.5, 3.0)</td>
<td><strong>0.02</strong></td>
</tr>
<tr>
<td>Unhealthy snacks (i.e., chips, crackers, cookies, etc.)</td>
<td>6.5 (5.0, 7.0)</td>
<td>2.0 (2.0, 3.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘I cannot get healthy snacks in the vending machines’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat or completely disagree</td>
<td>6.0 (5.0, 7.0)</td>
<td>0.12</td>
<td>2.0 (1.5, 2.5)</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Somewhat or completely agree</td>
<td>7.0 (5.0, 7.0)</td>
<td>2.0 (2.0, 3.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘I can find healthy snacks that come in handy, small packages’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat or completely disagree</td>
<td>6.0 (5.0, 7.0)</td>
<td>0.71</td>
<td>2.0 (2.0, 3.0)</td>
<td>0.87</td>
</tr>
<tr>
<td>Somewhat or completely agree</td>
<td>6.5 (5.0, 7.0)</td>
<td>2.0 (2.0, 3.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
‘Healthy snacks come in little packages that help me to not eat too much’

<table>
<thead>
<tr>
<th></th>
<th>Somewhat or completely disagree</th>
<th>Somewhat or completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.8 (5.0, 7.0)</td>
<td>6.0 (5.0, 7.0)</td>
</tr>
</tbody>
</table>

Somewhat or completely disagree 6.8 (5.0, 7.0) 0.22 2.0 (2.0, 3.0) 0.87

Somewhat or completely agree 6.0 (5.0, 7.0) 2.0 (2.0, 3.0)

‘Fruits and vegetables can be easily eaten without being cooked’

<table>
<thead>
<tr>
<th></th>
<th>Somewhat or completely disagree</th>
<th>Somewhat or completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.0 (5.0, 7.0)</td>
<td>6.0 (5.0, 7.0)</td>
</tr>
</tbody>
</table>

Somewhat or completely disagree 6.0 (5.0, 7.0) 0.47 2.0 (2.0, 3.0) 0.82

Somewhat or completely agree 6.0 (5.0, 7.0) 2.0 (2.0, 3.0)

‘Fruits and vegetables (fresh or frozen) are usually available in my home’

<table>
<thead>
<tr>
<th></th>
<th>Somewhat or completely disagree</th>
<th>Somewhat or completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.0 (5.0, 7.0)</td>
<td>6.0 (5.0, 7.0)</td>
</tr>
</tbody>
</table>

Somewhat or completely disagree 6.0 (5.0, 7.0) 0.75 2.0 (2.0, 3.0) 0.36

Somewhat or completely agree 6.0 (5.0, 7.0) 2.0 (2.0, 3.0)

**Bold** indicates statistical significance

*Mann–Whitney U test

4. Discussion

The present study among 298 US college students with overweight/obesity showed that frequency of snack intake was significantly higher among those with higher levels of stress compared to medium or low levels of stress. Also, male students had lower odds of consuming unhealthy snacks compared to females and that a higher household income was associated with lower odds of having unhealthy snacks more accessible compared to low household income. Lastly, participants who had unhealthy snacks more accessible/available and those who with limited access to healthy snack in vending machines had a significantly higher snack frequency per day (p<0.05).

In first trimester of 2020 the world significantly changed due to the surge of COVID-19 cases, promoting an environment of uncertainty and stress that changed people’s lifestyle. Food acquisition was significantly influenced during home confinement starting in March 2020 in the US [22]. Some evidence suggested that during the first period of lockdown (March-May 2020), snacks and sweets intake had a significant increase among the population studied [23,24]; and in combination with the lack of physical activity and perceived stress about the pandemic, it could have promoted weight gain during this period [25]. A study assessing longitudinal weight gain during COVID-19 pandemic (May-October 2020) among US adults found that 40% of participants reported weight gain (1-4 lbs.) and that they engaged in eating behaviors such as frequent ultra-processed foods intake and snacking [26]. Data before the pandemic suggested that increased snacking, particularly those high in calories, fat and simple sugars may lead to a positive energy balance [27] which can cause weight gain in some individuals [28].

Although it was hypothesized that younger students should snack more frequently, this was not found in the present study. A study among 3,062 Australian college students found that young age was significantly associated with a higher consumption frequency of snacks [6]. Also, a study in the US found that 4-year college students reported better dietary intake and more frequent meals when compared to 2-year college students [7]. The present study did not have a large age range to be able to find these associations. Contrary to the suggested hypothesis and to the literature, male students had lower odds of consuming unhealthy snacks compared to females. A study among 779 students from the University of Mississippi found that female students tended to place greater importance on beliefs related to eating healthy snacks when compared to male students [8]. Similarly, in 865 college students from India and in 891 students from Egypt, male students tended to snack more frequently than female students [10,11]. Importantly, studies reporting eating behaviors during COVID-19 pandemic home confinement found that females were more likely to consume high-calorie snacks and fruits and vegetables in more frequency than males [29,30].

With respect to race and ethnicity, no significant associations were found with snacking patterns, as hypothesized. A study among 779 US students from a large public southeastern university found that African
American students had a significantly lower intention to choose healthy snacks [1]. Additionally, another study found that Native American, Black, and mixed-race adolescents had the highest intake of sugary drinks and energy-dense and nutrient-poor snacks [31]. In regard to household income, we found that the higher the income the lower the odds of having unhealthy snacks more accessible, confirming our hypothesis and similar previous literature. A study comparing Indian college students from low- and high-income backgrounds found that snacks were favored over meals by low-income students due to the lower prices of snacks [10]. Likewise, a study in the UK found that students from low-income backgrounds showed higher snacking pattern scores [13].

As hypothesized, there was a greater frequency of snack intake among those categorized as having high levels of stress compared to those with lower levels of stress. Similarly, a study in 2,541 college students in China found that those with a higher stress score had a significantly higher frequency of snack intake [14]. Among 400 medical sciences college students in Saudi Arabia, female students with moderate-high levels of stress were more likely to consume more snacks [15]. Moreover, in a study among 736 students from a southwestern university in the US, perceived stress was significantly associated with consumption of salty snacks, energy drinks, and frozen meals [2]. A study conducted during COVID-19 pandemic among US adults found that there was a positive association between stress and sweets snacks intake, and that this association was stronger with higher emotional overeating [32]. It has been suggested that frequent consumption of energy dense snacks may help to ameliorate negative emotions such as stress and boredom related to the pandemic and associated lockdown measures [33].

Also, as hypothesized, those with higher accessibility or availability of unhealthy snacks had a daily snack frequency, similar to other studies. For example, a study among 1,448 UK students found that the frequency of consumption of convenient foods, such as snacks, was independently associated with higher snacking frequency [13].

The current study had a few strengths and limitations that should be acknowledged. One of the strengths was that the study included students from different colleges and states within the US. Another strength was that the hypotheses in the present study were based on a recent literature search and that the most commonly observed determinants of snack intake in this search were examined. Among the limitations are the cross-sectional nature of the study that cannot prove cause and effect relationships. Data on snack intake before the COVID-19 pandemic was not collected; therefore, this study could not evaluate if snack intake changed during the confinement. The sample for this study was not representative of all US college, therefore, findings cannot be generalizable. The nutritional quality (e.g., low-fat, low sugar, etc.) of certain snacks could not be evaluated due to the self-reporting nature of the survey.

In conclusion, snack intake among this sample of US college students with overweight/obesity was significantly influenced by gender, socioeconomic status, stress, and convenience. Male students had lower odds of usually consuming unhealthy snacks. A lower income was associated with higher odds of having unhealthy snacks more accessible. As stress increased, the consumption of snacks increased as well. Higher accessibility to unhealthy snacks was associated with a higher snack frequency per day. Given the high prevalence of unhealthy snack intakes in college students in the US (before the pandemic), the knowledge gained from this study may be used to design and implement tailored programs that promote behavior change to improve snack intake in college students similar to the present study. Future studies could benefit from incorporating a larger sample and from evaluating changes of snack intake with the pandemic.

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