PM566 Final Project

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Is Ultra-Processed Food Consumption Associated with Obesity among Young Adults?

Introduction

In the United States, more than half of the total dietary energy consumption has been composed by ultra-processed foods (UPFs)[1-2]. Most UPFs are calorie-dense and high in sugar, salt, and unhealthy fats, while low in protein, vitamins, and minerals[1,3-6]. Studies have demonstrated that the increased consumption of UPFs could result in a poor nutritional quality of the overall diet and high chances of developing chronic diseases[3-21]. Therefore, the aim of the study focuses on exploring the association between UPF consumption and obesity, which is the primary study interest, and type 2 diabetes (T2DM) among young adults, using data obtained from the Children's Health Study (CHS).

Methods

UPF Classification

In this study, UPFs are defined as food items that go through multiple manipulated process before people purchase or eat them. A total of 1167 food items (including ingredients) were collected at baseline visit and a total of 807 food items were collected were collected at follow-up visit using the 24-hour dietary recalls (24HRs). Two reviewers conducted following two processes independently. Firstly, reviewers used NOVA classification to group food items into 4 groups: unprocessed and minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods (UPFs)[1,22]. Secondly, reviewers grouped the first 3 groups into non-UPFs group, so only two groups were resulted. After grouping, reviewers had disagreements on food item classification, reviewers share own perspectives to seek an agreement. In general, UPF classification criteria were as following: the major ingredient of a food item; how the food is made in the U.S. normally; the way most people get the food – purchase from a grocery store or homemade.

Data Analysis

The data used were obtained from the baseline visit (between 2014 and 2018) of the CHS, which contained 158 participants aging from 17 to 22 years old. The 24-hour dietary recall was used to obtain the food items that participants consumed and to further calculate the UPF consumption percentage (UPF%). The inclusion criteria of participants were successfully completing the 24-hour dietary recall, BMI measurement, and glucose measurements. UPF% equaled to the UPF consumption amount in grams divided by total food consumption amount in grams. Demographic variables, body mass index (BMI), UPF%, and T2DM related variables (fasting glucose, blood glucose after 120 minutes, and HbA1c) were included in this study. BMI was used as the reference of obesity, and fasting glucose and blood glucose after 120 minutes were used as references of T2DM. The statistical analysis tool used was RStudio.

Starting with data wrangling, the dataset contained outcome measurements (e.g., BMI, fasting glucose, blood glucose after 120 minutes) and the dataset contained UPF% were combined into one dataset. Appropriate names of variables were given to better view the dataset in RStudio. To better apply the numeric variable (the UPF%) in the study, the author created 2 categorical UPF% variables. The first one has 4 groups, which was created by evenly dividing the UPF% into 4 groups. The second one was a binary UPF variable, which was created by assuming those who consumed less than 50% of UPFs as low UPF consumption group and the rest as high UPF consumption group. Participants with missing values in T2DM or fasting glucose or blood glucose after 120 minutes were excluded. Participants with implausible fasting glucose of greater than 200 mg/dL and blood glucose after 120 minutes of greater than 400 mg/dL were also excluded.

A new categorical variable (names as "UPF and BMI"), that contained all cases of the UPF binary variable and 3 BMI categories combination was created to explore the association between UPF consumption and BMI. This variable has 6 groups: Low UPF% Normal Weight, Low UPF% Overweight, Low UPF% Obese, High UPF% Normal Weight, High UPF% Overweight, and High UPF% Obese.

Tables were created for readers to understand the numeric values of study of interests. Summaries tables of fasting glucose and blood glucose after 120 minutes containing total numbers, minimum values, and maximum values in regard to UPF 4 groups, UPF binary variable, and BMI categories were created. The summary table of number of subjects for each "UPF and BMI" combination was also created.

Different kinds of plots were created for readers to visualize the exposure and outcomes in the study. Smooth lineplots of UPF% vs. BMI, fasting glucose, and blood glucose after 120 minutes were created. Histograms of BMI, fasting glucose, and blood glucose after 120 minutes by sex were created. A barchart of the combination of UPF% and BMI by UPF% 4 groups and a statistical summary graph of UPF% by BMI were also created.

Results

A total of 155 (98.1%) participants had appropriate UPF% were included in the study. After excluding participants who did not have T2DM related variables and implausible blood glucose levels, a total of 153 (96.8%) participants were being studied.

Table 1 to 3 are descriptive tables showing the number of participants, the minimum and maximum vales of fasting glucose and blood glucose after 120 minutes. Most participants were overweight obese and ate less than 50% of UPFs. Only 4 participants ate UPF in 50-75% and only 1 participant ate UPF greater than 75%. Table 4 combines the circumstances of UPF consumption and BMI categories, indicating that most participants ate low UPF in their diet and were overweight or obese.

Table 1. Fasting glucose (total number of participants, minimum values, and maximum values) and blood glucose after 120 minutes (total number of participants, minimum values, and maximum values) by BMI categories.

BMI categories	Number of Participants	Fasting Glucose min (mg/dL)	Fasting Glucose max (mg/dL)	Blood Glucose after 120 minutes min (mg/dL)	Blood Glucose after 120 minutes max (mg/dL)
Normal (18.5-25 kg/m^2)	24	64	107	55	176
Overweight (25-30 kg/m^2)	73	76	107	55	200
Obese (30+ kg/m^2)	56	77	109	83	208

Table 2. Fasting glucose (total number of participants, minimum values, and maximum values) and blood glucose after 120 minutes (total number of participants, minimum values, and maximum values) by UPF% in 4 groups.

UPF% groups	Number of Participants	Fasting Glucose min (mg/dL)	Fasting Glucose max (mg/dL)	Blood Glucose after 120 minutes min (mg/dL)	Blood Glucose after 120 minutes max (mg/dL)
0-25%	105	76	119	55	208
25-50%	43	74	110	70	200
50-75%	4	76	95	99	131
75-100%	1	91	91	135	135

Table 3. Fasting glucose (total number of participants, minimum values, and maximum values) and blood glucose after 120 minutes (total number of participants, minimum values, and maximum values) by UPF% binary groups.

UPF% binary groups	Number of Participants	Fasting Glucose min (mg/dL)	Fasting Glucose max (mg/dL)	Blood Glucose after 120 minutes min (mg/dL)	Blood Glucose after 120 minutes max (mg/dL)
Low (0-50%)	148	75	119	55	208
High (50-100%)	5	76	95	99	135

Table 4. Number of subjects of each combination of UPF binary groups and BMI categories.

	Low UPF% + Normal Weight	Low UPF% + Overweight	Low UPF% + Obese	High UPF% + Normal Weight	High UPF% + Overweight	High UPF% + Obese
Number of Participants	24	70	54	0	3	2

Figure 1 to 3 are smooth lineplots that show the UPF% in regard to BMI, fasting glucose and blood glucose after 120 minutes. No clear patten between UPF% and those variables interested in is seen from those figures.

Fig1: Smooth Lineplot of UPF vs. BMI

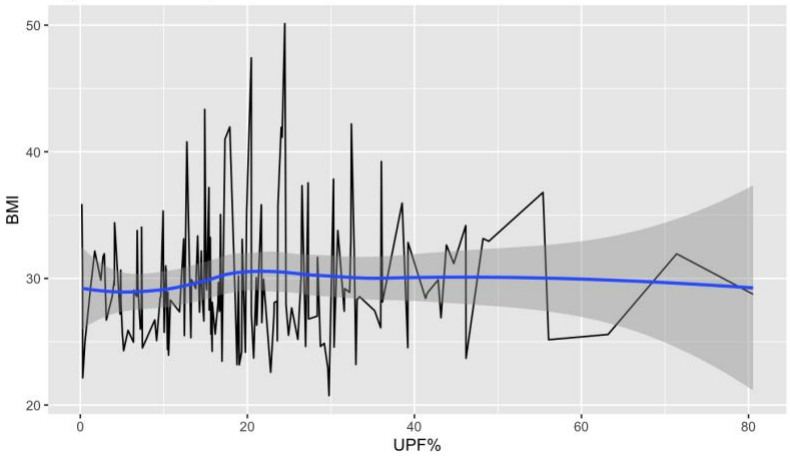


Fig2: Smooth Lineplot of UPF vs. Fasting Glucose

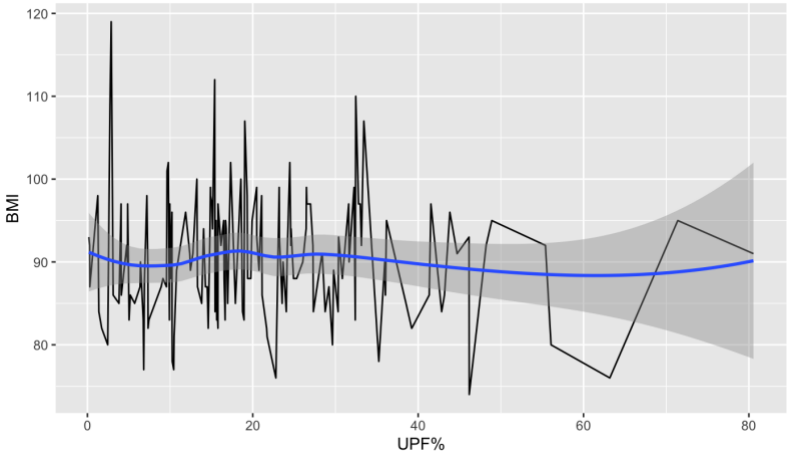


Fig3: Smooth Lineplot of UPF vs. Blood Glucose after 120 minutes

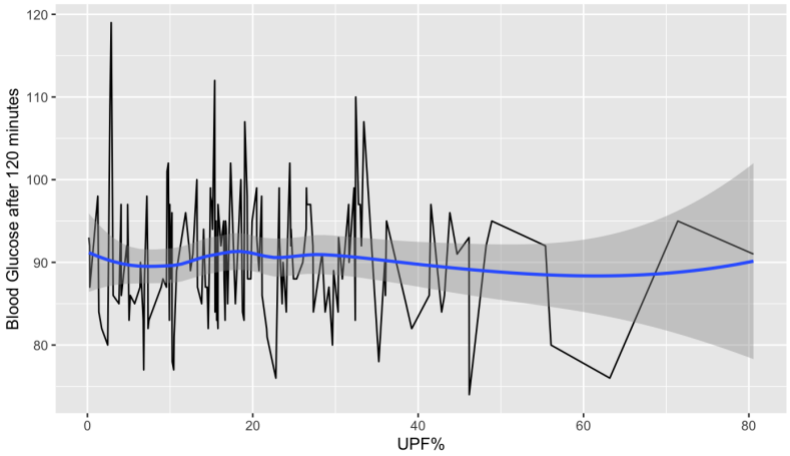


Figure 4, BMI by sex, shows that males have a right skewed distribution while females do not. Figure 5, UPF% by sex, shows that both males and females have right skewed bell shapes, and males have high UPF%. Figure 6, UPF% by BMI, straightly shows that more participants were overweight and consumed less than 40% UPFs.

Fig4: BMI by Sex

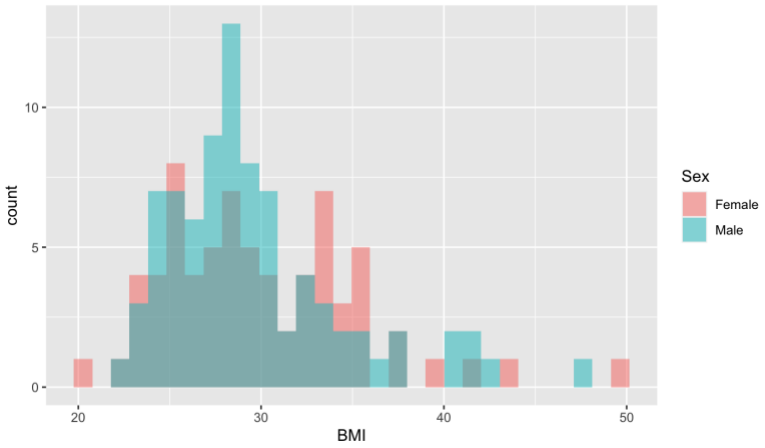


Fig5: UPF% by Sex

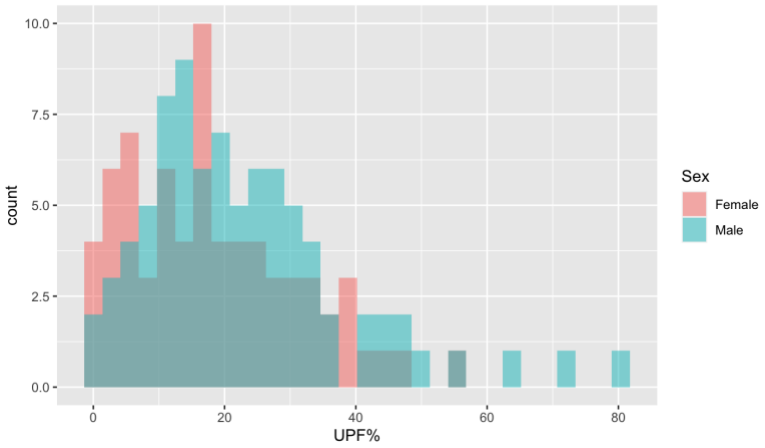


Fig6: UPF% by BMI

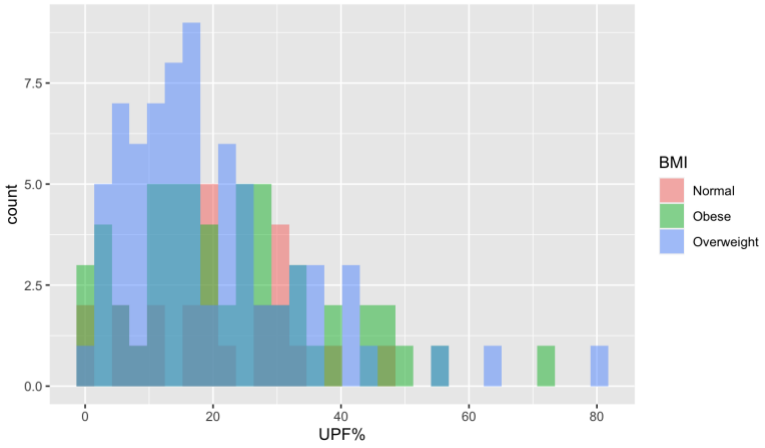


Figure 7 shows Table 4 in a visualized way, but it does not indicate any association between UPF plus BMI and UPF 4 categories. Figure 8 shows the primary outcome of interest BMI in regard to UPF%. Participants consumed more UPF were overweight instead of obese, suggesting no association between UPF% and obesity, indicating by BMI categories.

Fig7: UPF binary and BMI combined by UPF Categories

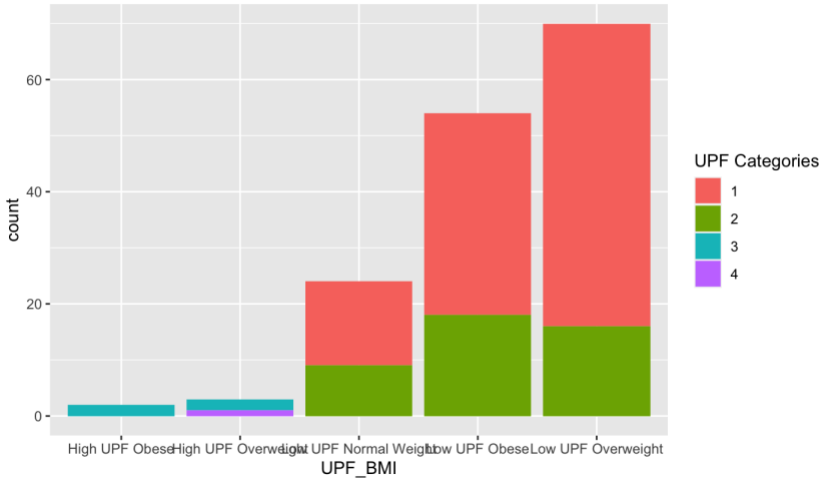
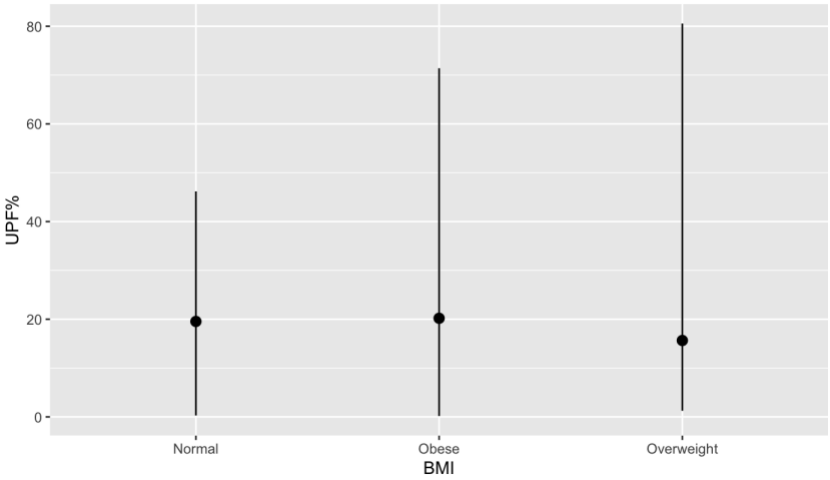


Fig8: Statistical Summary of UPF% by BMI Categories



Conclusion

Based on the above data exploration and graphs, no clear pattern shows that UPF consumption is associated with obesity or T2DM, indicating by BMI categories and blood glucose. One reason can be the number of participants is limited. The other reason might be limited outcomes of interests to study. Only 3 variables were used to make tables and figures to visualize. Although this study does not any association between UPF consumption and obesity and T2DM, further studies are needed to explore any potential relationships between UPFs and metabolic diseases.

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