TEMPORAL DIETARY PATTERNS ARE ASSOCIATED WITH OBESITY IN US ADULTS

DS201: FINAL PROJECT REPORT

Submitted By

Team - 08

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1 Introduction

An important public health issue is the rise in obesity prevalence. Obesity results in the development of chronic diseases like type 2 diabetes (T2D) and metabolic syndrome (MetS) and also contributes to it (1,2). Modifiable behavioural risk factors for obesity and chronic disease include dietary intake (3, 4). Traditional studies on the relationship between diet and health have concentrated on specific actions (such as skipping breakfast) (5–7) or aspects of dietary intake (such as individual nutrients) (8–10) in relation to health outcomes; however, a variety of behaviour and dietary factors may interact to affect health (3). Dietary patterns are a manner of conceptualising various dietary exposures as a complex entity, comprising the amounts, proportions, frequencies, and combinations of various foods and beverages in diets (3, 11). Compared to single nutrients or food group approaches, this multidimensional approach enables a more thorough analysis of the relationship between diet and health and may uncover greater connections between health indicators and the function of diet (11, 12).
The Body Mass Index (BMI), a simple measure of weight in relation to height, is frequently used to categorise humans as being overweight or obese. It is calculated as the individual's kilogram weight divided by the square of his or her height in metres (kg/m2). Underweight is a BMI greater than or equal to 18.5, normal weight is a BMI between 18.5 and 24.9, overweight is a BMI between 25 and 29.9 and obesity is a BMI greater than or equal to 30. Obesity and overweight are primarily caused by an imbalance in energy between calories ingested and calories burned. Around the world, there have been an increase in the consumption of fatty and sugary foods that are rich in energy, as well as an increase in physical inactivity because of the changing modes of transportation, growing urbanisation, and the sedentary nature of many occupations. A lack of supporting policies in areas including health, agriculture, transportation, urban planning, environment, food processing, distribution, marketing, and education often leads to environmental and sociological changes that affect dietary and physical activity habits. However, the quantity of energy or food ingested at one time may influence the amount ingested at subsequent EOs or be connected to the overall amount ingested during the day (14). Thus, knowledge of the significance of these many determinants to health will grow as we learn if and how patterns of intake throughout the course of a day, including the time, quantity of energy, and sequence of EOs, are connected with health status. Furthermore, understanding whether and to what extent these factors work together to affect health status may improve chances for early identification of behavioural patterns that increase risk for obesity and chronic illness.

2 Materials & Methods

NHANES data 2003-2004, 2005-2006 were combined for this analysis. The analytic sample included nonpregnant US adults aged 20-65 years with reliable 24-h recall dietary data (n=1445). Pregnant women,children,adolscents,and adults older than retirement age were excluded because their daily patterns may include variations characteristic to the life stages they represent. The parameters that were considered for analysis are age(20-65 years), Gender, Race, weight(in kg), Waist Circumference(in cm), alcohol level(in g), BMI(in kg/m2) classified as Underweight(<18.5),Normal weight(18.5 - 24.9), Overweight(24.9 - 29.9), Obese(>=30), total sugar intake(in g), total fat intake(in g), total energy(in kcal), total cholestrol intake(in mg), total weight of food(in g),PIR and Physical activity(in minutes).
We made an effort to prove the following hypothesis:
1.Obesity can result from consuming large quantities of fatty and sugary meals.
2.Obesity might result from an increase in physical inactivity brought on by sedentary work.
The tSNE method is employed for dimensional reduction. DBSCAN algorithm is used for clustering. Box-plots, bar graphs, scatter plots, and heat maps are all plotted for visualisation. Heat maps are used in the visualization(Figure 1) to show how the parameters in each cluster relate to one another. In a heatmap, values for an important primary variable across two axis variables are shown as a grid of coloured squares.

3 Results

Characteristics of participants in the four clusters representing TDP's are shown in Figure 3. Cluster 1 contains 126 paricipants, 485 participants in cluster 2, 810 participants in cluster 3 and 24 participants in

cluster 4. The least number of participants are in cluster 4, while the most are in cluster 2. In clusters 1 and 2, there are no males. Cluster 3 and 4 contain five female paticipants. Cluster 2 contain more obese people(35.46%) compared to 26.17% in cluster 3, 25% in cluster 4 and 34.12% in cluster 1. It is clear from the heat maps of all clusters that BMI is directly related to Waist Circumference and body weight.

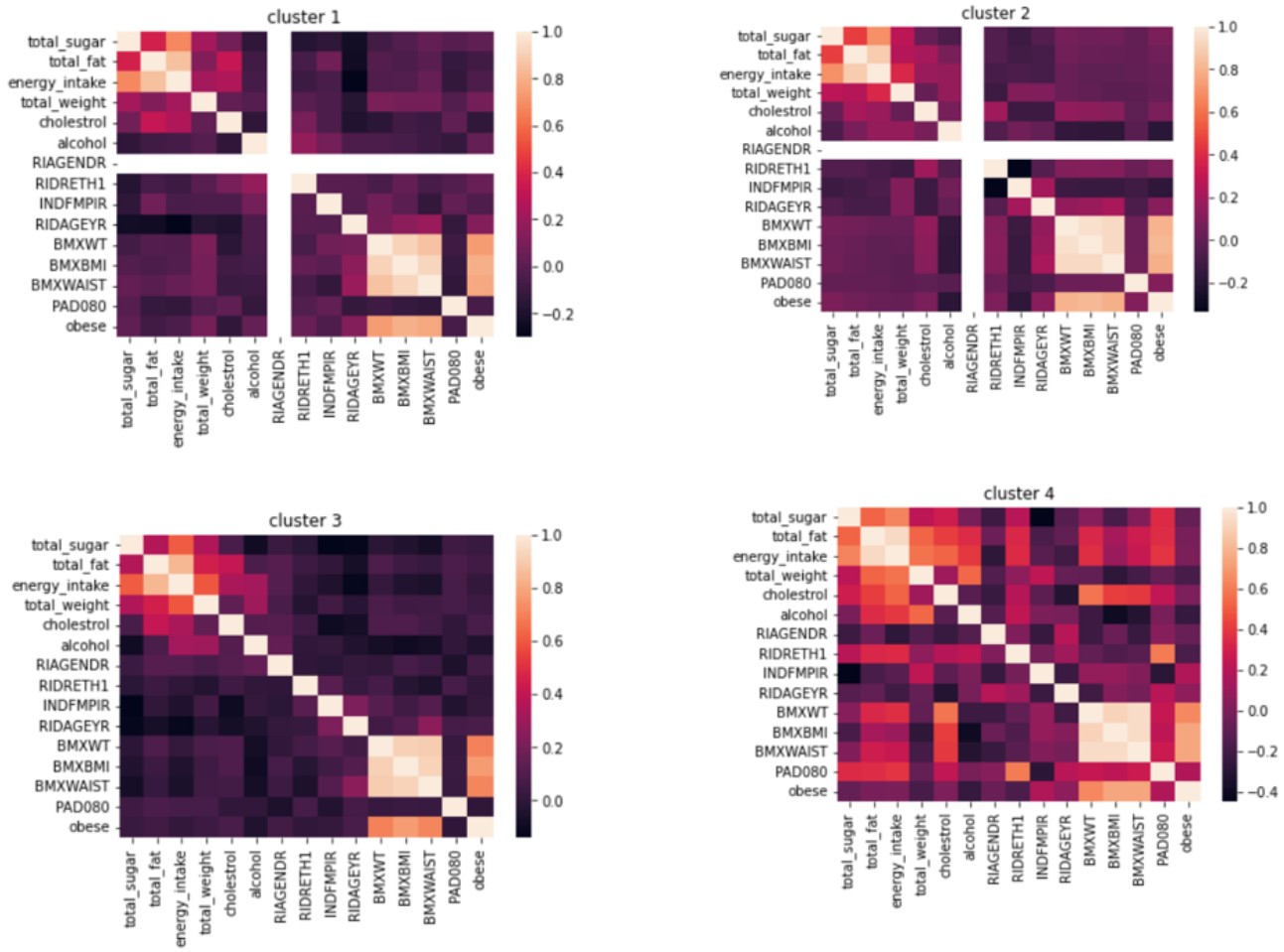

Figure 1: Heat maps of four clusters

Cluster 1

The number of participants in this cluster is 126. There are no males in this cluster.The percentage of overweight people(37.30%) is more than obese(34.12%). In comparison to other age groups, there are more participants of age 20 - 34. The mean BMI of this cluster is 27.95(in kg/m^2).

Cluster 2

This cluster has 485 participants, which is a moderate number. Similar to cluster 1, this cluster does not contain any male participants. The percentage of normal weight people(38.76%) is more than obese(35.46%).This cluster contain more participants of age 35-49 years and 20-34 years compared to people of age 50-65 years.The mean BMI of this cluster is 28.15(in kg/m^2).

Cluster 3

The number of participants in this cluster is 810 which is very large. Unlike cluster 1 and 2 this cluster contain large number of male participants. This cluster contain higher proportion of age 20-34 compared with other age groups. Similar to cluster 1, this cluster also has a higher percentage of overweight individuals (39.50%) than obese individuals (26.17%). This cluster's average BMI is 27.64(in kg/m^2).

Cluster 4

The number of participants in this cluster is 24 which is very less. This cluster has five female participants.In comparison to other clusters, this one has the lowest BMI which is 26.59(in kg/m^2).

4 Discussion

From heat maps it is evident that BMI is directly proportional to WC, body weight. In cluster 4, the mean BMI(26.59) is lower and the mean physical activity is higher (113.63). This suggests that people are less likely to become obese if they engage in greater physical activity.

Figure 2: Mean values of four clusters

Characteristic	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Total(n)	126	485	810	24
Total sugar_intake(in g)	98.52	110.00	155.98	133.37
Total fat_intake (in g)	62.54	72.74	101.49	99.24
Total energy_intake(in Kcal)	1748.35	1886.70	2792.62	2581.62
Total cholestrol_intake(in mg)	15.84	16.23	22.31	23.00
Total food_intake(in g)	2534.65	2719.69	3646.45	3328.07
Alcohol(in g)	2.58	7.00	21.52	17.67
Age	35.44	37.99	39.04	38.16
BMI(in kg/m^2)	27.95	28.15	27.64	26.59
Weight(in kg)	69.58	76.26	86.41	180.62
Waist Circumference(in cm)	92.52	92.65	97.42	93.13
Physical Activity(in min)	35.35	38.17	39.95	113.63

Despite the fact cluster 2 has a higher mean BMI value, the mean values of total sugar intake , total fat intake, total cholestrol intake and total energy intake, total food intake is less compared to cluster 3 and cluster 4 which has less BMI compared to cluster 2 which is not expected. The reason for the above result could be that obese persons might have stopped consuming more fatty and sugary foods as a result of their weight.

Conclusions

BMI is directly related to Waist Circumference and body weight. Heat maps were used to produce the above result. The mean values of Cluster 4 show that Physical Activity also effects BMI. Increased physical exercise

Figure 3: Characteristics of clusters representing temporal dietary patterns of US adults aged 20-65 y as drawn from the NHANES 2003-2004, 2005-2006(n=1445)

Characteristic	Total (n)	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Total	1445	126	485	810	24
Gender					
Male	824	0	0	805	19
Female	621	126	485	5	5
Race/ethnicity					
Mexican-American	260	105	6	145	4
Other Hispanic	59	21	9	29	0
Non-Hispanic white	683	0	273	396	14
Non-Hispanic black	368	0	166	197	5
Other	75	0	31	43	1
Age group, y					
20-34	612	66	192	343	11
35-49	509	39	206	256	8
50-65	324	21	87	211	5
PIR					
0-0.99	309	53	96	155	5
1.00-1.99	326	48	109	162	7
2.00-2.99	210	15	57	136	2
3.00-3.99	164	7	58	92	7
4.00-4.99	124	1	46	77	0
>=5.00	312	2	119	188	3
BMI					
Underweight	36	4(3.17%)	20(4.1%)	11(1.4%)	1(4.1%)
Normal weight	497	32(25.39%)	188(38.76%)	267(39.9%)	10(41.6%)
Overweight	479	47(37.3%)	105(21.64%)	320(39.5%)	7(29.16%)
Obese	432	43(34.12%)	172(35.46%)	212(26.17%)	5(25%)

will reduce the risk of obesity in people. It is evident from the heat maps of clusters that factors like alcohol consumption and dietary cholesterol levels are not significantly correlated with BMI. These factors barely have an impact on BMI.

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