

Relationship between Various Food Uptakes and Body Mass Index (BMI) in Japanese Young and Old Men and Women

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Abstract

Background: Sucrose and sweet beverage uptakes have been implicated to be one of causes of obesity. We wanted to know if any food uptake may be related to increase in Body Mass Index (BMI) in healthy young and old men and women.

Methods: Healthy young and old men and women were given self-administered diet history questionnaires and described answers on each item by recollection of diets they took. From these questionnaires, we calculated the intake of energy, carbohydrate, fat and protein.

Results: Old people took more protein, lipids, carbohydrates, and omega fatty acids than young people. Men took such foods more than women. There was no statistically significant relationship between particular food uptakes and BMI.

Conclusion: Uptakes of sucrose and sweet beverage did not increase BMI in healthy people. We do not think that sucrose uptake is a major reason for obesity.

Keywords: Sucrose; Sweet beverage; Carbohydrate; Lipid; Obesity

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Introduction

On Dec 27, 2016, Public Health England released its latest analysis of the behavior and health of adults in the UK aged 40 to 60 years. The data showed that between 1991-93 and 2011-2013 the percentage of overweight and obese people has increased from 66.7% to 76.8% for men and from 54.8% to 63.4% for women [1].

It has been reported that 7 out of the top 10 leading causes of death and the disability in the United States today are chronic diseases such as cancer and diabetes [2].

The close link between obesity and these conditions has been recognized. Uptakes of high-calorie foods, decrease in time spent in physical activities, and sedentary life styles may account for increase in the number of obese people [3,4].

Recently many health professionals think that the consumption of sugary drinks may be a major factor in increase of the number of people suffering from obesity and diabetes. In fact WHO urged global action to curtail consumption and health impacts of sugary drinks [5]. WHO recommended that if people do consume free sugars, they keep their intake below 10% of their total energy

needs, and reduce it to less than 5% for additional health benefits?

Last November, residents of California bay including San Francisco as well as Boulder, Colorado, passed by wide margins a law to institute a per-ounce tax on sugar-sweetened beverage [6]. Such sugar tax has been imposed in Berkeley, California, Philadelphia, Pennsylvania, in US and France, UK, Mexico, the Philippines and South Africa.

In Japan, the consumption and sales of sugar have been declining constantly, but the number of obese people and diabetes patients has been increasing. So, we thought if sugar uptake per se is harmful for human health and a major risk factor of obesity and diabetes [7,8].

We here report the results of our research on relationship between food uptakes, especially sugary drink uptakes and obesity.

Methods

We asked male and female acquaintances older than 50 years old and male and female college students to participate in the experiments. Checked their health carefully and recruited them if there were no health problems such as diabetes, hypertension and if not serious diseases experienced in the past. They did not smoke in the past. We also excluded people who took drugs for dyslipidemia, hyperglycemia, or hypertension. We collected blood samples early morning. Participants were asked not to eat anything after 21.00 PM the previous evening. Plasma specimens were collected for assays of blood parameters. We obtained an informed consent prior to conducting the protocol which had been approved by the Ethical Committee of Showa Women's University and Saiseikai Shibuya Satellite Clinic.

Healthy participants were given self-administered diet history questionnaires and described answers on each item by recollection of diets they took. From these questionnaires, we calculated the intake of energy, carbohydrate, fat and protein.

Statistics

The results are presented as means \pm SEM. Statistical significance of the differences between groups was calculated according by

one-way ANOVA. When ANOVA indicated a significant difference ($P < 0.05$), the mean values of the treatment were compared using Tukey's least significant difference test at $P < 0.05$. Spearman's correlation tests were used to examine statistical significance (Tables 1-3).

Results

Figures 1 and 2 shows that sucrose and sweet beverage uptake had nothing to do with BMI in young and old men and women.

Figures 3 and 4 shows that cakes and confectionaries uptake had nothing to do with BMI in old and young men and women.

Discussion

We examined glycemic index after giving glucose and sucrose to young and old men and women and found that there are big age and gender differences in glycemic index although substances with distinct structures such as glucose and sucrose are used [9-11].

We have recently reported that uptakes of sucrose and sweet beverage, carbohydrates, lipids and proteins had nothing to do with Body Mass Index (BMI) in young and old men in Japan [12].

Table 1: Background parameters of healthy young and old men and women. Old people take more energy, protein, lipid, and carbohydrate than young people. Men take energy, protein, lipid, carbohydrate more than women. One-way ANOVA was used for evaluating statistical significance. The superscript values a, b, c, and d indicates the values of young men and women or old men and women, respectively. $P < 0.05$ was considered significant.

	a Young male (n=49)	b Young female (n=47)	c Old male (n=25)	d Old female (n=39)	Statistical Significances
Age	20.7 \pm 1.5	21.2 \pm 0.7	60.8 \pm 9.9	67.4 \pm 7.5	a vs. c; $p < 0.01$, a vs. d; $p < 0.01$, b vs. c; $p < 0.01$, b vs. d; $p < 0.01$, c vs. d; $p < 0.01$
Height (m)	1.72 \pm 0.06	1.58 \pm 0.05	1.69 \pm 0.07	1.57 \pm 0.06	a vs. b; $p < 0.01$, a vs. d; $p < 0.01$, b vs. c; $p < 0.01$, c vs. d; $p < 0.01$
Weight (kg)	65.1 \pm 8.9	51.4 \pm 5.8	71.1 \pm 13.1	50.6 \pm 6.8	a vs. b; $p < 0.01$, a vs. d; $p < 0.01$, b vs. c; $p < 0.01$, c vs. d; $p < 0.01$
BMI	22.1 \pm 3.1	20.4 \pm 1.6	24.9 \pm 3.7	20.5 \pm 2.5	a vs. b; $p < 0.01$, a vs. c; $p < 0.01$, a vs. d; $p < 0.05$, b vs. c; $p < 0.01$, c vs. d; $p < 0.01$
Energy uptake (kcal/day)	1918 \pm 554	1413 \pm 407	2220 \pm 544	1941 \pm 535	a vs. b; $p < 0.01$, b vs. c; $p < 0.01$, b vs. d; $p < 0.01$
Protein uptake (g/day)	67.9 \pm 23.6	51.8 \pm 17.6	83.8 \pm 27.4	80.0 \pm 27.3	a vs. b; $p < 0.01$, a vs. c; $p < 0.05$, b vs. c; $p < 0.01$, b vs. d; $p < 0.01$
Lipid uptake (g/day)	58.7 \pm 22.7	45.3 \pm 13.5	63.8 \pm 19.8	60.9 \pm 20.9	a vs. b; $p < 0.01$, b vs. c; $p < 0.01$, b vs. d; $p < 0.01$
Carbohydrate uptake (g/day)	264.2 \pm 85.9	183.7 \pm 61.8	268.0 \pm 66.9	248.3 \pm 76.9	a vs. b; $p < 0.01$, b vs. c; $p < 0.01$, b vs. d; $p < 0.01$

Table 2: The amounts of various food uptakes. Old people take more protein, lipid, omega fatty acids, carbohydrate than young people and men take more protein, lipid, omega fatty acids, and carbohydrate than women.

Food Uptakes	Units	a Young male (n=49)	b Young female (n=47)	c Old male (n=24)	d Old female (n=39)	Statistical significance
Energy	kcal	1918 ± 554	1413 ± 407	2220 ± 544	1941 ± 535	a vs. b; p<0.01, b vs. c; p<0.01, b vs. d; p<0.01
Protein	g	67.9 ± 23.6	51.8 ± 17.6	83.8 ± 27.4	80.0 ± 27.3	a vs. b; p<0.01, a vs. c; p<0.05, b vs. c; p<0.01, b vs. d; p<0.01
Animal Protein	g	39.5 ± 18.2	30.4 ± 14.4	49.2 ± 20.5	47.4 ± 19.8	b vs. c; p<0.01, b vs. d; p<0.01
Vegetable Protein	g	28.4 ± 9.1	21.4 ± 6.8	35.2 ± 9.3	32.6 ± 10.9	a vs. b; p<0.01, a vs. c; p<0.05, b vs. c; p<0.01, b vs. d; p<0.01
Lipid	g	58.7 ± 22.7	45.3 ± 13.5	63.8 ± 19.8	60.9 ± 20.9	a vs. b; p<0.01, b vs. c; p<0.01, b vs. d; p<0.01
Animal Lipid	g	29.1 ± 14.5	21.2 ± 9.0	30.3 ± 13.0	29.0 ± 10.7	a vs. b; p<0.01, b vs. c; p<0.01, b vs. d; p<0.01
Vegetable Lipid	g	29.7 ± 10.2	24.1 ± 7.3	33.6 ± 9.6	31.9 ± 11.9	a vs. b; p<0.05, b vs. c; p<0.01, b vs. d; p<0.01
Saturated Fatty Acid	g	16.8 ± 7.5	12.5 ± 4.5	16.5 ± 6.7	16.3 ± 5.6	a vs. b; p<0.01, b vs. d; p<0.05
Monounsaturated Fatty Acid	g	21.3 ± 8.5	16.8 ± 5.4	23.0 ± 7.2	21.6 ± 7.7	a vs. b; p<0.05, b vs. c; p<0.01, b vs. d; p<0.05
Polyunsaturated Fatty Acid	g	13.6 ± 4.5	10.5 ± 3.2	15.9 ± 4.5	14.6 ± 5.3	a vs. b; p<0.01, b vs. c; p<0.01, b vs. d; p<0.01
N-3 Fatty Acid	g	2.5 ± 0.9	2.0 ± 0.8	3.4 ± 1.2	3.1 ± 1.4	a vs. c; p<0.01, a vs. d; p<0.05, b vs. c; p<0.01, b vs. d; p<0.01
N-6 Fatty Acid	g	11.1 ± 3.7	8.5 ± 2.5	12.5 ± 3.4	11.4 ± 4.0	a vs. b; p<0.01, b vs. c; p<0.05, b vs. d; p<0.05
Cholesterol	mg	358 ± 166	309 ± 141	461.1 ± 177	440 ± 188	b vs. c; p<0.01, b vs. d; p<0.01
Carbohydrate	g	264.2 ± 85.9	183.7 ± 61.8	268.0 ± 66.9	248.3 ± 76.9	a vs. b; p<0.01, b vs. c; p<0.01, b vs. d; p<0.01

Table 3: Correlation coefficients between foods uptakes and BMI. There was no significant correlation between any food uptake and BMI.

Food uptakes	Correlation coefficients			
	Young male (n=49)	Young female (n=47)	Old male (n=25)	Old female (n=39)
Energy uptakes vs. BMI	-0.04	0.02	-0.13	0.13
Protein uptakes vs. BMI	-0.07	0.09	-0.08	0.16
Animal protein uptakes vs. BMI	-0.14	0.15	-0.06	0.12
Vegetable protein uptakes vs. BMI	0.09	-0.09	-0.11	0.17
Lipid uptakes vs. BMI	-0.15	0.05	0.12	0.16
Animal lipid uptakes vs. BMI	-0.15	0.11	-0.04	0.07
Vegetable protein uptakes vs. BMI	-0.12	-0.03	0.30	0.22
Carbohydrate uptakes vs. BMI	-0.01	-0.10	-0.13	0.07

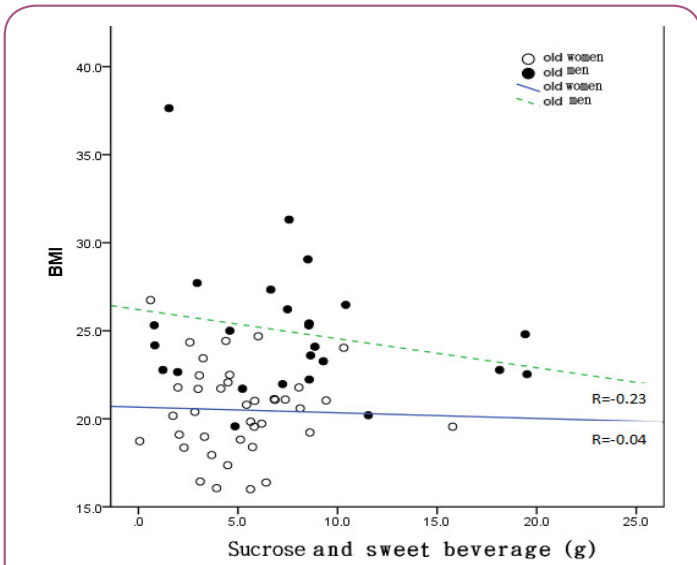


Figure 1 Sucrose and sweet beverage uptake and BMI in old people.

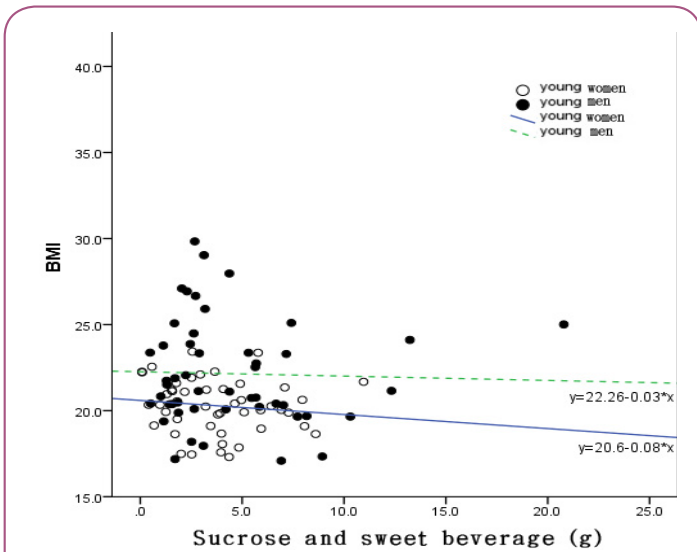


Figure 2 Sucrose and sweet beverage uptake in young people.

However, roles of gender in disease and health have been paid more attention by researchers and clinicians recently [13,14]. The National Institutes of Health Revitalization Act, passed in 1993 and amended in 2001, mandates the inclusion of women in all NIH-funded research [15].

We have previously reported gender differences in foods uptakes, glycemic index, BMI, and various plasma parameters in young men and women [10]. However it may be important to examine whether such results could be obtained in old men and women. Diseases related to obesity such as diabetes mellitus or cardiovascular diseases are often observed in old people.

We now report relationship between food uptakes and BMI in healthy young and old men and women in Japan.

As shown in the present study, any particular food uptake did not have any relationship with BMI, thus probably any food uptake

may not cause obesity. Especially sucrose and sweet beverage uptake had nothing to do with BMI.

We usually think that obesity is caused by reduced calorie expenditure and increased calorie uptakes. Recently, it has been proposed that calorie expenditures of human beings are similar regardless of the extent of physical activity [16,17]. Although exercise is very important for human health, exercise is not an effective measure of reducing weight. Thus, it has been said that obesity is a disease of too much eating than sloth. This further supports the contention that eating reasonable amounts of foods is important for preventing obesity and that specific food uptakes such as sugar uptakes have nothing to do with obesity.

As to sex differences of various obesity related diseases, arrhythmias, particularly atrial fibrillation, have different consequences for women. Women have higher mortality, more symptoms, and higher rates of recurrence. Women have a higher risk of atrial fibrillation-associated stroke than men and experience significantly higher mortality after stroke [18-23]. So

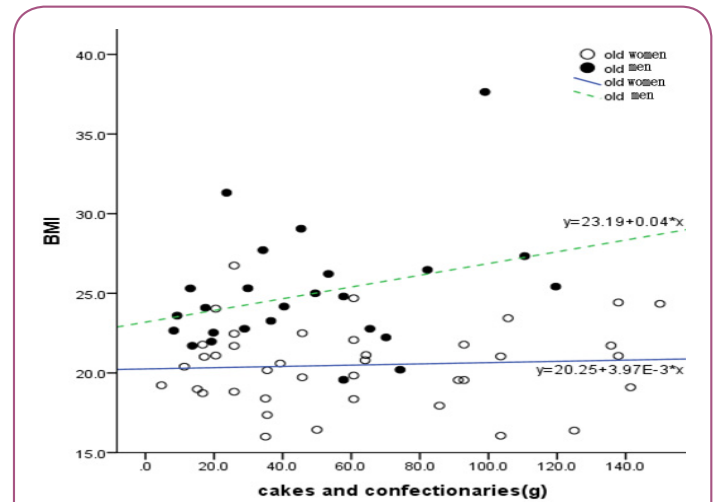


Figure 3 Cakes and confectionaries uptake in old people.

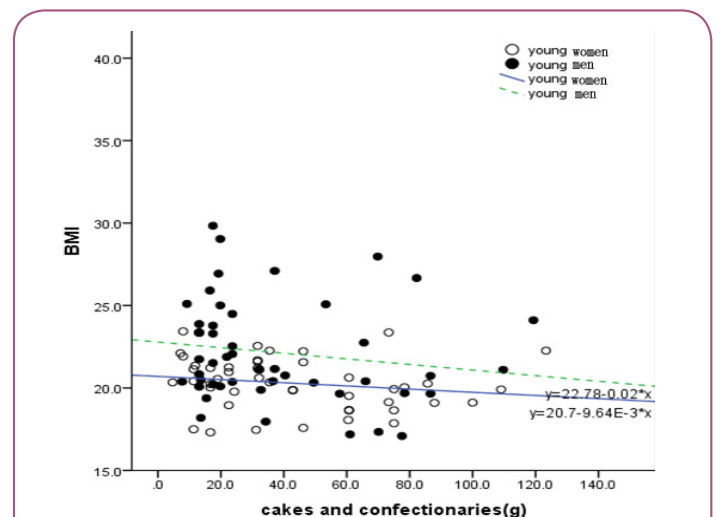


Figure 4 Cakes and confectionaries uptake in young people.

it is important to examine relationship between food uptakes and weight gain in women too.

Pharmacotherapy and lifestyle intervention have been suggested to be used and considered to be beneficial for the reduction of weight. Pharmacotherapy with lifestyle intervention may also be of benefit in facilitating the maintenance of reduced weight [24-27].

Recently surgical interventions have been paid attention. Roux limb of jejunum results in food bypasses of 95% of the stomach and duodenum and most of the jejunum. The recently introduced vertical-sleeve gastrectomy involves removal of approximately 70% of the stomach, with subsequent acceleration of gastric emptying [28,29].

Gastric banding results in a mean weight reduction of 15-20% at 1 year. Larger reductions can be achieved with vertical-sleeve gastrectomy and Roux-en-Y procedures: approximately 25% and 30%, respectively. More than half of patients who undergo Roux-en-Y gastric bypass have weight loss of 25% or more at 1 year [29]. By reviewing these data, Heymsfield and Wadden suggested that the most effective way to reduce body weight is bariatric surgery [30].

Thus only effective way to prevent and treat obesity may be to reduce food uptake using surgical operations such as bariatric surgery. It has been shown that bariatric surgery is more effective than life style or pharmacological intervention to treat obesity.

Our results suggest that in healthy people uptakes of any food do not increase BMI. Probably, there may be set-points for weight

and in obese people uptakes set-point may be high in comparison to healthy people. So for obese people, uptakes of some food which is not a cause of obesity may increase BMI.

As a conclusion, any kind of food uptakes is not related to increase in BMI. Especially, sucrose and sweet beverage uptakes have nothing to do with BMI increase.

Ethics

This work has been approved by the Ethical committees of Showa Women's University (15-02) and NPO "International projects on food and health" (15-01) and has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments.

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Experiments were designed and performed by all of the authors. AT wrote a manuscript. Statistical analyses were done by TT. All authors read the manuscript and approved the final version. All the authors had responsibilities for the final content. AT is a chairman of NPO "International Projects on Food and Health". The NPO is financially supported by people who agreed with the purpose of the organization and voluntarily donated for the project. Since no profit is obtained by the present research, there are no conflicts of interest, thus no conflicts of interest for any author.

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