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Associations between Breakfast Skipping and Body Mass Index, and Type 2 Diabetes in South Korea

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Abstract

Objective: The purpose of this study was to investigate the associations between breakfast skipping and body mass index (BMI), and type 2 diabetes (T2D) in South Korea.

Methods: Data were obtained from the Korea National Health and Nutrition Examination Survey IV (2007–2009) using a rolling sampling design of a complex, stratified, multistage, probability-cluster survey of civilian non-institutionalized Korean residents. In total, 12,172 of 18,210 subjects were included in this study (subjects with missing variables were excluded).

Results: The odds of T2D in individuals who did not consume breakfast was 3.05 (95% confidence interval (CI), 2.46–3.77) than in those who consumed breakfast. The estimated BMI was decreased by 0.19 kg/m^2 (p<0.001) in those who did not consume breakfast compared with those who did.

Conclusions: Breakfast skipping in South Korea is associated with increased T2D and BMI, similar to research results reported in Western countries.

Keywords: Type 2 diabetes; Body mass index; South Korea

Introduction

Diabetes was the eighth highest leading cause of death worldwide in 2012 [1]. Thus, diabetes management and prevention programs have become a main point of interest among researchers. Lifestyle recommendations to prevent type 2 diabetes (T2D) include an increase in physical activity, weight loss, and change in dietary patterns. According to the nutrition recommendations for diabetes from American Diabetes Association, they are important to reduce intakes of energy, saturated and Trans fat, cholesterol, and sodium for nutrition interventions for T2D [2]. Alcohol consumption, vitamin E intake, and smoking are also related to a higher risk of T2D [3]. Among these recommendations, dietary interventions are generally the most recommended therapy [4].

There are various dietary intervention strategies for patients with T2D [5]. Many studies have reported that breakfast consumption itself can reduce the risk of T2D [6-8] because prolonged fasting ceases [9]. Thus, eating breakfast can reduce hunger, eating, and body mass index (BMI) and contribute to the prevention of metabolic syndrome [10].

However, most studies on breakfast skipping have been conducted in Western countries. Western and Asian breakfast patterns are quite different. Most Asian breakfast patterns include white rice, which is

associated with an increased risk of T2D [11]. Therefore, this study focused on the associations between breakfast skipping and BMI, and T2D in South Korea.

Materials and Methods

Study population

Data from the Korea National Health and Nutrition Examination Survey (KNHANES) 2007–2009 were used in this study. The KNHANES is a cross-sectional and nationally representative survey that includes a 24-hour recall dietary intake questionnaire. In total, 12,172 of 18,210 subjects were included in this study (subjects with missing variables or those who were <20 years of age were excluded).

Study variables

BMI and T2D were used as dependent variables. Patients with T2D were identified by the question, "Do you currently have diabetes?". The KNHANES did not distinguish between patients with type 1 or type 2 diabetes; therefore, type 1 diabetes was defined as a diabetes onset age of <19 years [12].

As an interesting variable, the breakfast skipping status was retrieved from a 24-hour recall dietary intake questionnaire. In the 24-

hour recall dietary intake questionnaire, subjects who answered as "breakfast" for the question "what meal is this food for?" were regarded as they had breakfast. With respect to independent variables, sociodemographic and health risk behaviors were included in this study as covariates. Age was classified as <30, 30–49, 50–64, or >65 years. Education level was classified as less than elementary, middle school, high school, or more than college. Household income was a quartile variable obtained by dividing the household monthly income by the household size [10]. Smoking status was categorized as never-smoker, past smoker, or current smoker. A drinking audit was included to assess drinking behavior [13]. It was classified into groups of 0–7, 8–15, 16–19, or >20. Subjects were also categorized as underweight (BMI ≤ 18.5 kg/m^2), normal weight (BMI 18.5 kg/m^2– 22.9 kg/m^2), overweight (BMI 23.0 kg/m^2–24.9 kg/m^2), or obese (BMI ≥ 25.0 kg/m^2) [14]. Vigorous physical activity was defined as whether subjects exercised intensively for over 20 minutes and for more than 3 days per week or not [15]. Energy intake per day was included to adjust for the total energy intake per day regardless of breakfast consumption.

Statistical analysis

The chi-squared test and ANOVA were used to identify the distributions of the general characteristics. Multiple logistic regression analysis was used to identify the association between breakfast consumption and T2D. PROC SURVEYLOGISTIC and PROC SURVEYREG were used to take account the sampling design weights. The association between breakfast and BMI was assessed by linear regression analysis. All independent variables, which were age, sex, education level, household income, obesity, smoking status, drinking audit, vigorous physical activity, energy intake per day, were adjusted in the logistic regression. In the regression, obesity was not included as a covariate because it is related to BMI. SAS version 9.3 (SAS Institute, Inc., Cary, NC, USA) was used for all analyses.

Results

Table 1 shows the general characteristics of the study population. Of the 12,172 research subjects included in our study, 780 had T2D. The mean BMI of obese subjects was 29.32 ± 0.07 kg/m^2 and that of overweight subjects was 25.33 ± 0.01. The prevalence of breakfast consumption in those with T2D was 8.9%. Table 2 shows the adjusted effect of the study variables on T2D. The risk of T2D in obese subjects was 3.62-fold higher (95% confidence interval [CI], 1.73–7.59) than in underweight subjects. The risk of T2D was 3.05-fold higher (95% CI, 2.46–3.77) and the estimated BMI was increased by 0.81 kg/m^2 (SE, 0.08; $p < 0.001$) in those who skipped breakfast compared with those who consumed breakfast.

	T2D		No diabetes			BMI	
	N	%	N	%	p-value	Mean ± SE	p-value
Total	780	5.7	11392	94.3		23.62 ± 0.04	
Breakfast skipping					<0.001		<0.001
No	387	8.9	3959	91.1		23.40 ± 0.05	
Yes	393	5.0	7433	95.0		23.95 ± 0.07	
Age (yr)					<0.001		<0.001
<40	18	0.9	1963	99.1		23.09 ± 0.06	
40–49	84	3.1	2665	96.9		23.98 ± 0.07	
50–64	319	11.4	2474	88.6		24.34 ± 0.06	
≥65	359	7.7	4290	92.3		23.63 ± 0.09	
Sex					<0.001		<0.001
Female	347	5.1	6420	94.9		23.07 ± 0.06	
Male	433	8.0	4972	92.0		24.10 ± 0.06	
Education					<0.001		<0.001
≤Elementary	394	12.8	2690	87.2		24.11 ± 0.08	
Middle school	137	9.5	1302	90.5		24.07 ± 0.09	
High school	158	3.6	4199	96.4		23.50 ± 0.07	
≥College	91	2.8	3201	97.2		23.37 ± 0.07	
Smoking					<0.001		<0.001
Never	371	5.5	6370	94.5		23.28 ± 0.05	
Past	259	9.8	2387	90.2		24.03 ± 0.09	

Current	150	5.4	2635	94.6			23.87 ± 0.08	
Severe physical activity					0.847			0.431
No	666	6.4	9745	93.6			23.61 ± 0.04	
Yes	114	6.5	1647	93.5			23.69 ± 0.10	
Drink audit					0.069			<0.001
0–7	558	6.7	7808	93.3			23.43 ± 0.05	
8–15	133	5.5	2264	94.5			23.82 ± 0.08	
16–19	43	6.3	642	93.7			24.31 ± 0.15	
≥20	46	6.4	678	93.6			23.89 ± 0.14	
Obesity					<0.001			<0.001
Underweight	14	2.4	562	97.6			17.57 ± 0.04	
Normal	298	4.7	6038	95.3			21.70 ± 0.02	
Overweight	276	7.9	3237	92.1			25.33 ± 0.01	
Obese	192	11.0	1555	89.0			29.32 ± 0.07	
Household income					<0.001			0.009
High	130	3.8	3330	96.2			23.46 ± 0.06	
Middle-high	149	4.5	3194	95.5			23.61 ± 0.07	
Middle-low	215	7.2	2780	92.8			23.82 ± 0.08	
Low	286	12.0	2088	88.0			23.64 ± 0.11	
Energy intake per day (kcal)					<0.001			<0.001
Q1 (<1293.5)	235	7.7	2809	92.3			23.36 ± 0.08	
Q2 (1293.5–1689.0)	231	7.6	2811	92.4			23.51 ± 0.08	
Q3 (1689.0–2180.4)	167	5.5	2877	94.5			23.56 ± 0.08	
Q4 (≥2180.4)	147	4.8	2895	95.2			23.94 ± 0.07	

Table 1: General characteristic of the study subjects

	T2D		BMI		
	OR	95% CI	Estimate	SE	p-value
Breakfast skipping					
No	1.00		.	.	
Yes	3.05	(2.46–3.77)	0.81	0.08	<.001
Age (yr)					
<30	1.00		.	.	
30–49	9.23	(5.04–16.93)	0.92	0.09	<0.001
50–64	28.07	(15.48–50.90)	1.09	0.10	<0.001
≥65	41.79	(22.54–77.47)	0.40	0.15	0.007

Sex					
Female	1.00		.	.	
Male	2.25	(1.65–3.07)	1.01	0.12	<0.001
Education					
≤Elementary	1.00		.	.	
Middle school	0.93	(0.70–1.22)	–0.30	0.13	0.016
High school	0.75	(0.57–0.99)	–0.57	0.13	<0.001
≥College	0.76	(0.52–1.09)	–0.62	0.15	<0.001
Smoking					
Never	1.00		.	.	
Past	0.88	(0.62–1.25)	–0.01	0.13	0.996
Current	0.76	(0.53–1.10)	–0.15	0.13	0.230
Severe physical activity					
No	1.00		.	.	
Yes	0.92	(0.72–1.18)	–0.02	0.11	0.832
Drink audit					
0–7	1.00		.	.	
8–15	0.86	(0.66–1.12)	0.08	0.10	0.419
16–19	1.18	(0.78–1.80)	0.35	0.17	0.034
≥20	0.91	(0.60–1.38)	–0.06	0.15	0.644
Obesity					
Underweight	1.00		.	.	.
Normal	1.61	(0.78–3.34)	.	.	.
Overweight	2.35	(1.13–4.88)	.	.	.
Obese	3.62	(1.73–7.59)	.	.	.
Household income					
High	1.00		.	.	
Middle-high	1.12	(0.83–1.51)	0.16	0.10	0.095
Middle-low	1.19	(0.88–1.60)	0.28	0.10	0.007
Low	1.39	(0.99–1.93)	0.01	0.15	0.994
Energy intake per day (kcal)					
Q1 (<1300.5)	1.00		.	.	
Q2 (1300.5–1696.0)	1.13	(0.87–1.47)	0.06	0.11	0.589
Q3 (1696.1–2189.3)	0.70	(0.53–0.94)	0.01	0.11	0.924
Q4 (≥2189.4)	0.82	(0.59–1.15)	0.29	0.11	0.012

Table 2: Associations between breakfast skipping and T2D, and BMI

Discussion

In this study, our primary purpose was to investigate the associations between breakfast skipping and BMI, and T2D using a nationally representative sample of the general population of South Korea. The results of this study showed that breakfast skipping is significantly associated with a higher risk of T2D and a higher BMI in South Korea. These associations are independent of sociodemographic variables (age, sex, education, and household income), health risk and behavior variables (smoking status, physical activity, and drinking status), and energy intake per day.

In general, obesity was more frequent in diabetic than in nondiabetic subjects from 1998 to 2011 in South Korea [16]. Obesity increases the risk of long-term vascular complications of T2D, including stroke, chronic kidney disease, heart disease, peripheral vascular disease, and death [17].

Breakfast is the first meal in the morning that breaks the overnight fast. Prolonged periods of fasting, such as by omitting breakfast, even on a single occasion, can increase postprandial insulin resistance and hyperinsulinemia in response to foods consumed at the next meal [18,19]. In addition, skipping breakfast has been associated with an increased risk of obesity [20].

Many previous studies evaluating breakfast consumption and the risk of chronic disease have yielded inconsistent results [21]. Although several observational studies have shown an inverse association between breakfast consumption and BMI [22,23], the limited evidence from randomized controlled trials does not support an effect of breakfast consumption on weight loss [24,25]. In a randomized crossover trial, men who regularly consumed breakfast had better metabolic and endocrine responses to foods consumed later during the day than did those who skipped breakfast [18]. Our findings on breakfast skipping and the risk of T2D are consistent with those in previous studies [6].

There are several limitations to this study. First, cross-sectional data were used, and therefore the order of incidence and the causal mechanisms between breakfast skipping and T2D could not be delineated clearly. Second, because the data were self-recorded, recall bias may exist. Despite these limitations, the primary strength of this study is that it assessed a large sample of the population such that the results can be generalized to the adult South Korean population.

Traditional Korean breakfast usually includes refined grains such as white rice, which has a high carbohydrate content and glycemic index [26]. Although such foods increase the risk of T2D [27], breakfast consumption in Korea was associated significantly with a reduced risk of T2D and a lower BMI in this study. Our previous research indicated that even the Korean traditional breakfast pattern is associated with a reduced risk of metabolic syndrome 10].

In conclusion, despite the fact that rice, which may increase the risk of T2D, is the main food staple in South Korea, breakfast skipping in South Korea is associated with an increased T2D risk and BMI, similar to the research results reported in Western countries.

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