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Independent and combined relationship of habitual unhealthy eating behaviors with depressive symptoms: A prospective study

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ABSTRACT

Background: Unhealthy eating has been found to be associated with the prevalence of depressive symptoms. However, prospective evidence of the combined effects of unhealthy eating and depressive symptoms has not been reported. This study aimed to elucidate the prospective relationship between habitual unhealthy eating habits and depressive symptoms.
Methods: A 2-year prospective cohort study of 376 Japanese adults aged 24–83 years without depressive symptoms at baseline was conducted. Information about participants' eating behaviors was obtained via a self-administered questionnaire, in which skipping breakfast, eating dinner shortly before bedtime, and snacking after dinner were recorded. Depressive symptoms were assessed using the Japanese version of the Zung Self-rating Depression Scale.
Results: The 2-year incidence of depressive symptoms was found to be 23.7% (89/376). Covariate-adjusted multivariate Poisson regression analyses showed that habitual snacking after dinner was significantly associated with the incidence of depressive symptoms (relative risk [RR] 1.77; 95% confidence interval [CI], 1.00–3.14, $p = 0.049$), whereas no relationship was found between skipping breakfast or eating dinner shortly before bedtime and depressive symptoms. On the other hand, there was an interaction effect of snacking after dinner and dinner before bedtime on depressive symptoms (p for the interaction = 0.044). Participants with more than two unhealthy eating behaviors had a higher incidence of depressive symptoms compared to those with fewer than two unhealthy eating behaviors (RR 1.71; 95% CI, 1.06–2.77, $p = 0.028$).
Conclusions: This prospective study is the first to reveal the combined relationship between unhealthy eating and the incidence of depressive symptoms.

1. Introduction

Depression is regarded as one of the most costly mental disorders,[1] and it has received attention because of its relationship to physical decline[2] and the risk of coronary heart disease and mortality.[3] The prevalence of depressive symptoms has increased continuously during last two decades.[4,5] Although population-based studies have found that poor health status, such as physical limitations and cognitive decline, are potential risk factors for depressive conditions,[6] it would seem to be more helpful to take preventive action against depressive symptoms before a person's health deteriorates. Accordingly, it is necessary to clarify the relationship between the lifestyle and behaviors that are characteristic of an ordinary life and the incidence of depressive symptoms.

Eating habits contribute to general health status. Population-based studies have found that some unhealthy eating habits, including skipping breakfast, snacking between meals, and eating at night, are associated with an elevated risk of diabetes.[7,8] Among these, skipping breakfast has been associated with poor physical health[9] and a decline in cognitive function.[10] More importantly, an increasing number of studies have found that unhealthy eating habits are also likely to influence mental-health status. Older

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individuals who did not receive home-delivered breakfasts had a higher prevalence of depressive symptoms as compared to those who did receive them in one study.[11] Other epidemiologic studies have found that nighttime eating[12,13] and habitual snacking[14] are associated with depressive symptoms.

Although there is evidence of an association between unhealthy eating and depressive symptoms, a prospective relationship has not been established. Moreover, previous knowledge of the combined relationship of unhealthy eating habits with the prevalence of depressive symptoms has not been clarified. Thus, this population-based study aimed to investigate the prospective relationship between unhealthy eating behaviors (skipping breakfast, eating dinner shortly before bedtime, and snacking after dinner) and depressive symptoms, and to examine whether there is a combined impact of these eating habits on the incidence of depressive symptoms in adults.

2. Methods and materials

2.1. Study population

The Oroshisho Study is a prospective cohort study on risk factors of lifestyle-related diseases. In brief, the study was carried out between 2008 and 2011 at the Sendai Oroshisho Center, a group of over 120 small and medium enterprises in Sendai City, Japan. Participants received an annual health examination and answered questions about their mental health and daily lifestyle. Data collections were conducted when the subjects participated in an annual health examination, which was conducted in the second week of August every year. Data collected from 1263 participants in 2009 were used as baseline data for this study because detailed information about the participants' sleep status was available. Further details of the Oroshisho Study have been described elsewhere.[15]

In this study, 1215 adult employees agreed to provide written informed consent for their data to be analyzed (response rate: 96.2%). The participants without data on eating habits (n = 46) and depressive conditions (n = 5) were excluded. Participants with missing information on sleep disturbances, living status, and educational level were also excluded from the statistical analyses (n = 6). To evaluate the incidence of depressive symptoms over the 2-year follow-up period, an additional 606 adults were excluded because they had depressive symptoms at baseline, which were defined as a score of Zung Self-rating Depression Scale (SDS) more than 40.[16,17] Finally, 176 participants were excluded because follow-up information on depressive conditions was unavailable; this left 376 individuals (300 men) aged 24–83 years old for the analysis. The protocol for the current study was approved by the institutional review board of the Tohoku University Graduate School of Medicine.

2.2. Eating behaviors

Unhealthy eating behaviors (skipping breakfast, eating dinner shortly before bedtime, and snacking after dinner) during the preceding month were measured using a self-administered questionnaire. The frequency of eating breakfast was assessed with the question: “How often do you eat breakfast that consists of a staple food?”. The possible responses were 0–7 times/week. Participants who did not eat breakfast at least 3 times/week were considered to have skipped breakfast. Dinner before bedtime was assessed with the question: “Do you eat dinner within 2 h before bedtime more than three times a week?”, which required a “yes” or “no” response. The following question was asked to assess snacking after dinner: “Do you eat snacks (not including three meals per day) after dinner more than three times a week?”, which required a “yes” or “no” response. Participants who responded affirmatively to these two dichotomous questions were categorized as those with the habits of eating dinner shortly before bedtime and snacking after dinner, respectively. Unhealthy eating behaviors (≥3 times/week) were defined based on a standard lifestyle questionnaire,[18] which was developed by the Japan Ministry of Health, Labour and Welfare and is widely used for Specific Health Checkups (Tokutei Kenshin) in Japan.[19]

2.3. Depressive symptoms

Depressive symptoms were measured at baseline and follow-up with the SDS, which has been used with various types of patients and with healthy persons.[16] The Japanese version of the SDS used in this study has been previously validated.[20] The 20 items of the scale are scored from 1 (little or none of the time) to 4 (most of the time) for each item, with a total SDS score ranging from 20 to 80; higher scores represent greater symptom severity. Participants scoring ≥40 on the SDS are regarded as having symptoms of mild depression.[17]

2.4. Relevant covariates

The frequency of daily intake of snacks/sweets during the preceding month was assessed using the Brief Dietary History Questionnaire (BDHQ), a self-administered tool.[21] Based on the frequency of dietary consumption, the estimated daily intake of energy and fat were calculated using a computer program for the BDHQ, which was based primarily on the 5th edition of the Japanese Food Composition Table. Other lifestyle-related and socio-demographic information, including smoking status (current, former, or never), frequency of alcohol intake (every day, sometimes, or never), sex, age, occupation (desk work or not), marital status (married or not), living status (living alone or with others), and educational level (≥college or not), were obtained using a self-administered questionnaire. Participants' duration of sleep per night was calculated based on the time they went to bed and the time they awoke. Sleep quality was assessed by the question: “Do you usually feel refreshed after sleep?”, with the possible answers of “yes” or “no”. Participants who responded negatively to this question were considered to have poor sleep quality. Sleep disturbance was classified according to the presence of one or more of the following factors during the previous month: use of sleeping pills because of trouble falling asleep, long time needed to fall asleep (more than 30 min), and restless movements of the limbs during sleep. Daily physical activity (PA) was measured using the International Physical Activity Questionnaire.[22] Total PA was calculated and classified into three categories: 0, 0.1–22.9, and ≥23 metabolic equivalent (MET) hours/week. More than 23 MET hours/week is a recommended reference quantity for the prevention of lifestyle-related diseases in Japan.[23]

Anthropometric parameters (height, body weight, and waist circumference) were measured according to a standardized protocol. Body mass index (BMI) was calculated as the ratio of weight to height^2 (kg/m^2) and was divided into three categories: <21, 21–24.9, and ≥25 kg/m^2. Systolic and diastolic blood pressures were measured from the upper right arm using an automatic device (Yamasu 605P; Kenzmedico, Saitama, Japan) with the participant in the sitting position. Fasting blood samples were drawn from the antecubital veins of the participants who were in a seated position. Concentrations of serum glucose (Eurotec, Tokyo, Japan), triglycerides, and high-density lipoprotein-cholesterol (Sekisui Medical, Tokyo, Japan) were analyzed with enzymatic methods using the appropriate kits. Metabolic syndrome was defined according to