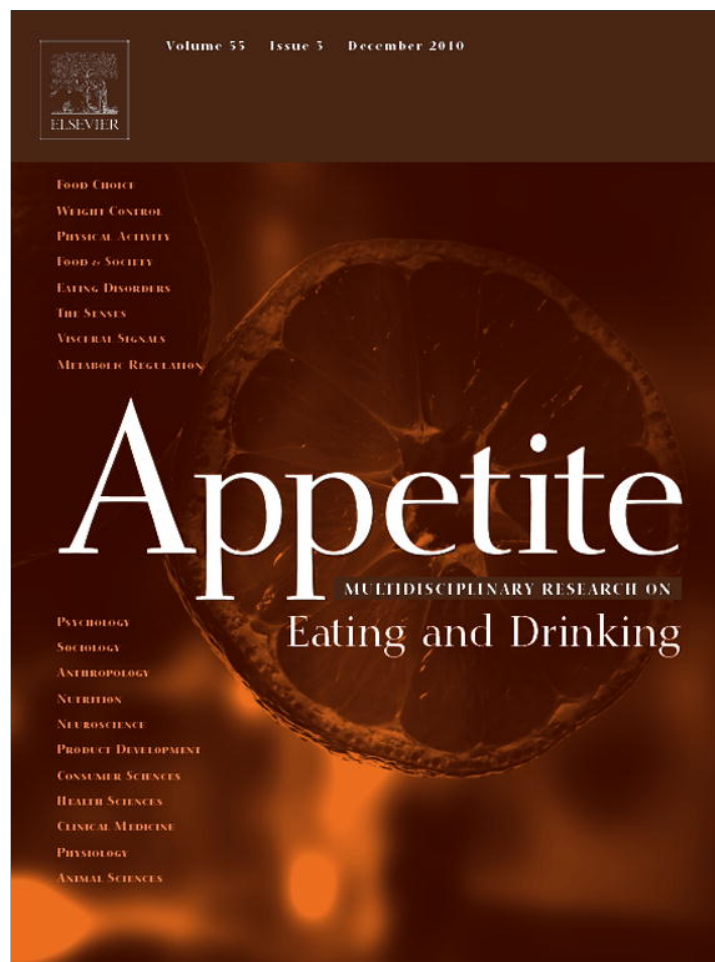


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## Short communication

# Skipping breakfast is associated with reproductive dysfunction in post-adolescent female college students<sup>☆</sup>

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## ABSTRACT

Although increasing attention has been paid to the adverse effects of skipping breakfast on quality of life, there are very few reports concerning the relationship between skipping breakfast and reproductive function. Therefore, we examined this issue by conducting a questionnaire survey of female college students aged from 18 to 20 years old. The 5 annual surveys of questionnaire demonstrated that the severity of dysmenorrhea was significantly higher in the population that skipped breakfast. The incidence of irregular menses was also higher in the population that skipped breakfast, although there was no difference in the incidence of premenstrual symptoms. The group that skipped breakfast showed a tendency to suffer from constipation. In addition, despite no difference in body mass index, there was a significantly higher incidence of a self-perception of poor general health among the group that skipped breakfast. These findings suggest that skipping breakfast is associated with menstrual disorders, and affects the physical condition of female college students who are undergoing post-adolescent maturation. Since these menstrual disorders may influence the quality of life of young women not only in the present but also in the future, skipping breakfast should be re-evaluated from the perspective of future reproductive function.

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## Introduction

It is widely accepted that dietary habits are fundamental factors that influence human lifestyles and individuals' quality of life (QOL). Recently, environmental hormones and toxins, which can contaminate foods, have been highlighted as having adverse effects on human health in later life (Milligan et al., 1998; O'Halloran et al., 2001; Wahlqvist & Saviage, 2000). Accordingly, an assessment of the dietary habits of young women should be carried out from the perspective of the total benefit gained throughout their entire life.

In Japan, the shift from Japanese to Western foods is increasing. The consumption of fast food and the habit of skipping meals are also widespread among young women (Murata, 1992). One of the most common nutritional issues among young women in Japan is poor energy intake and/or inappropriate food selection due to the limiting of diet for cosmetic purposes. This results in poor intake of protein, carbohydrate, and essential fatty acids along with diet-related psychological stress (Fujiwara & Nakata, 2004). It is speculated that

these factors influence not only the current lifestyle of young women but also the prevalence of medical disorders, such as cardiovascular, metabolic, and malignant diseases, in the future (Arai, 2002; Kato, Tominaga, & Kuroishi, 1987; Yamori, Miura, & Taira, 2001). Furthermore, menstrual and reproductive factors have also been proposed to induce diseases such as endometrial cancer and breast cancer (Eliassen & Hankinson, 2008; Kaneko, Tamakoshi, Ohno, Mizoue, & Yoshimura, 2003). Accordingly, it is important to evaluate the present food habits of young women and estimate their influence on menstrual disorders.

Recently, it was reported that breakfast consumption improves cognitive function related to memory, test grades, and school attendance (Rampersaud, Pereira, Girard, Adams, & Metz, 2005). However, skipping breakfast increases in prevalence during the transition to adulthood, and is associated with increased weight gain from adolescence to adulthood (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006). In 2003, we reported that young women who skip breakfast have a significantly higher prevalence of symptoms of dysmenorrhea than young women who eat breakfast, suggesting a positive correlation between skipping breakfast and menstrual disorders (Fujiwara, 2003). In general, irregular menstruation and dysmenorrheal and premenstrual syndrome are considered as representative menstrual disorders (Carpenter, 1994; Cerin, Collins, Landgren, & Eneroth, 1993; Deligeorgiou, 2000). Among these disorders, irregular menstrua-

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tion is known to be induced by inadequate food intake, such as that during dieting (Carpenter, 1994). However, the precise relationship between dietary habits and other menstrual disorders remains unclear. In adolescence, dysmenorrhea is frequently associated with immaturity of reproductive function (Deligeorglou, 2000), suggesting that dysmenorrhea is a symptom of functional disorders. However, dysmenorrhea is also an important clinical sign of organic reproductive diseases, such as endometriosis and uterine myoma (Fauconnier & Chapron, 2005), which significantly influence QOL during the subsequent reproductive period. Consequently, information about whether college students in the post-adolescent stage of life still suffer from dysmenorrhea is very important.

Given this background, we consider that skipping breakfast should be re-evaluated from the perspective of reproductive function in young women. However, there have been few studies that have investigated the relationship between skipping breakfast and subsequent menstrual disorders in young women. Therefore, we carried out a longitudinal investigation about the above issue by conducting a questionnaire survey. In this study, we comprehensively analyzed data from the previous 5 years to raise awareness of the harmful effects of skipping breakfast on reproductive function in female college students who are undergoing post-adolescent maturation.

## Methods

### Respondents to a questionnaire

The subjects were young Japanese women aged from 18 to 20 years old who studied at the Faculty of Home Economics of Ashiya College and Kyoto Bunkyo Junior College. The study protocol was approved by the Committee on Food Culture at Ashiya College. We sent questionnaires to all students who belonged to the Faculty of Home Economics and Child Education between 2004 and 2008. Information regarding the aim of this study was sent with the questionnaire, and consent was obtained from all participants. There were 975 participants in the sequential study, and we obtained responses that were suitable for statistical analysis from 945 students.

### Questionnaire items

**Skipping breakfast.** All study participants completed a food-frequency questionnaire about breakfast (food intake until 10:00 am) and were divided into three groups as follows: Group I: having breakfast every morning; Group II: having breakfast one to six times a week; and Group III, having breakfast less than once a week.

**Body mass index (BMI) assessment.** Information on body mass (kilograms) and height (meters) was obtained from all participants. The data on body mass and height were obtained from a physical examination organized by the Health Center at Ashiya College and Kyoto Bunkyo Junior College. BMI was calculated using the formula: body weight in kilograms divided by height in meters squared.

**Bowel movement.** The frequency of bowel movement was classified into Grade 1 (not more than once a week), Grade 2 (2–6 times a week), and Grade 3 (every day). We obtained responses that were suitable for statistical analysis of this item from 945 students.

**General condition (physical condition).** The participants were divided into two groups based on their self-perception of good or poor general health. In this study, the students who had experienced a general ill feeling during the past month were classified into the group with poor general health. We obtained responses that were suitable for statistical analysis of this item from 935 students.

**Dysmenorrhea.** Dysmenorrhea was graded as previously described (Fujiwara, 2003): Grade 1 (free of pain or painful, but can

manage without an analgesic), Grade 2 (painful, requiring an analgesic), and Grade 3 (painful, not relieved by an analgesic). We obtained responses that were suitable for statistical analysis of this item from 945 students.

**Irregular menstruation.** In addition, the participants were divided into two groups depending on whether they had regular or irregular menstruation. Regular menstruation was strictly defined as constant 26–32-day intervals in each menstrual cycle, as previously described (Fujiwara, 2007; Fujiwara, Sato, Awaji, & Nakata, 2007). We obtained responses that were suitable for statistical analysis of this item from 944 students.

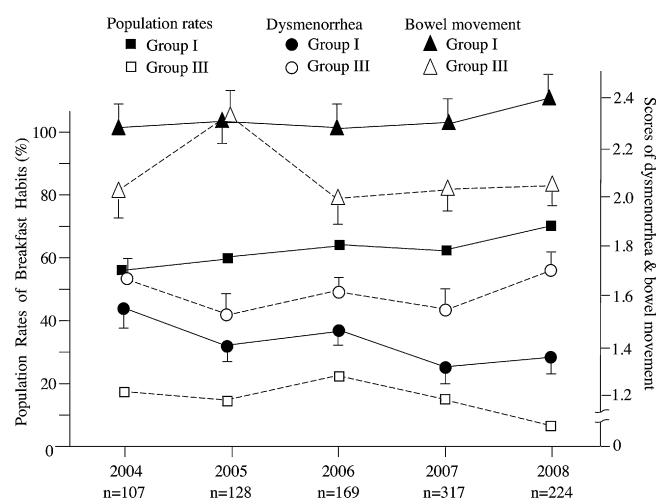
**Premenstrual symptoms.** The participants were further divided into two groups in relation to the presence or absence of premenstrual symptoms. The students were requested to detail their experiences of 10 symptoms and signs during the premenstrual phases: psychological disorders such as irritability, depression, nervousness, and mood swings and/or somatic complaints such as abdominal bloating, peripheral edema, lumbago, headache, general fatigue, and acne (Smith & Schiff, 1989). In this study, when the students experienced one or more of the above symptoms that rapidly disappeared just after the onset of menstruation for at least three or more sequential menstrual cycles, they were classified as having premenstrual symptoms. We obtained responses that were suitable for statistical analysis of this item from 846 students.

### Statistical analysis

The data are shown as mean  $\pm$  standard deviation (SD). Differences in the bowel movement, general health, dysmenorrhea, the incidence of irregular menstruation, and premenstrual symptoms among Groups I–III were analyzed by the Kruskal–Wallis test, followed by the Mann–Whitney test for multiple comparisons. The relationship between BMI and skipping breakfast was analyzed by one-way analysis of variance, followed by Scheffe's *F*-test for multiple comparisons. *P*-values less than 0.05 were considered significant.

## Results

During 5 years, the population of Group I gradually increased from 54.2% to 70.0%, while population of Group III gradually decreased to fewer than 10% in recent years (Fig. 1). There were no



**Fig. 1.** Changes in population rates and dysmenorrhea and bowel movement scores in Groups I and III throughout a 5 annual survey from 2004 to 2008. During 5 years, the population of Group I gradually increased from 54.2% to 70.0%, while the population of Group III was between 7.6% and 21.9%, decreasing to fewer than 10% in recent years. Note that similar differences between Groups I and II were observed in dysmenorrhea and bowel movement scores throughout the surveillance period.

**Table 1**

The relationship between skipping breakfast and BMI, bowel movement scores or dysmenorrhea scores.

	Group I	Group II	Group III
Body mass index ( <i>n</i> = 945)	20.70 ± 2.69	20.37 ± 2.45	20.57 ± 3.00 (Not significant)
Bowel movement ( <i>n</i> = 945)	2.34 ± 0.58	2.20 ± 0.52	2.14 ± 0.62 (I vs. II and III, <i>P</i> < 0.01)
Dysmenorrhea ( <i>n</i> = 945)	1.40 ± 0.56	1.54 ± 0.66	1.61 ± 0.65 (I vs. III, <i>P</i> < 0.01; I vs. II, <i>P</i> < 0.05)

The differences in body mass index values among the three groups were analyzed by one-way analysis of variance, followed by Scheffe's *F*-test for multiple comparisons. Differences in bowel movement and dysmenorrhea scores among the three groups were analyzed by the Kruskal–Wallis test, followed by the Mann–Whitney test for multiple comparisons. In Groups II and III, the bowel movement scores were significantly lower and dysmenorrhea scores were significantly higher than those in Group I (*P* < 0.01). The data are shown as mean ± SD.

**Table 2**

The relationship between breakfast skipping and general health, the irregularity of menstrual cycles or the incidence of premenstrual symptoms.

	Group I	Group II	Group III
General health ( <i>n</i> = 935)			
Good	473	156	81
Poor	113	58	54
			(I vs. III, <i>P</i> < 0.01; I vs. II, <i>P</i> < 0.05)
Menstrual cycle ( <i>n</i> = 944)			
Regular	360	125	69
Irregular	227	93	70
			(I vs. III, <i>P</i> < 0.05)
Premenstrual symptom ( <i>n</i> = 846)			
Positive	363	140	78
Negative	175	51	39
			(Not significant)

The relationship between breakfast skipping and general health, menstrual cycle and premenstrual symptom was analyzed using the Kruskal–Wallis test, followed by the Mann–Whitney test for multiple comparisons. The populations with a self-perception of poor general health and an irregular menstrual cycle were significantly larger in Groups III than in Group I (*P* < 0.01 and *P* < 0.05, respectively). On the other hand, there was no significant difference in the incidence of premenstrual symptoms among Groups I–III.

significant differences in BMI among the three groups at any point during the investigation (Table 1). The bowel movement in Groups II and III was significantly poorer than that in Group I (*P* < 0.01) (Table 1). This tendency remained almost constant throughout the surveillance period (Fig. 1). In addition, the intensity of dysmenorrhea in Groups II and III was significantly higher than that in Group I (Table 1). This tendency also remained constant throughout the surveillance period (Fig. 1).

The populations with a self-perception of poor general health were significantly larger in Groups III and II than that in Group I (*P* < 0.01 and *P* < 0.05, respectively) (Table 2). Furthermore, the rate of irregular menstruation in Group III was significantly higher than that in Group I (Table 2). However, there was no significant difference in the incidence of premenstrual symptoms among Groups I–III (Table 2).

## Discussion

Although assessment of reproductive disorders was not conducted by clinical examination, this recent longitudinal 5 surveys annually confirmed the initial hypothesis that young women who skip breakfast have a significantly higher degree of dysmenorrheal symptoms than those who eat breakfast (Fujiwara, 2003). Our questionnaire survey performed in 2007 revealed that women with a high intake of fast food and processed foods had a

significantly higher incidence of dysmenorrhea (Fujiwara, Sato, Awaji, Sakamoto, & Nakata, 2009). Since the population of this study is limited to young Japanese women at two junior colleges located close together, it is reasonable to consider that the educational, economical and cultural backgrounds of these students are similar. Taken together, it is suggested that dietary habits can adversely affect uterine function.

It is well known that inappropriate dieting often induces amenorrhea in young women and may cause ovarian dysfunction during the subsequent reproductive years (Branca, 1999; Koebnick, Strassner, Hoffmann, & Leitzmann, 1999). It was also reported that a vegetarian low caloric diet led to menstrual cycle disorders with a short luteal phase (Lloyd, Schaeffer, Walker, & Demers, 1991; Pedersen et al., 1991). Accordingly, it is widely accepted that irregular menstruation in young students is partially caused by an inadequate nutritional state, inducing dysfunction in the hypothalamic–pituitary–ovarian axis (Montero, Bernis, Fernandes, & Castro, 1996). When we strictly limited the definition of regular menstrual cycle to a 26–32-day cycle, a significantly higher incidence of irregular menstruation in the group that skipped breakfast was observed. To our knowledge, these findings are the first evidence to suggest that skipping breakfast can adversely affect ovarian function in young women.

Recently, we reported that college students with premenstrual symptoms had a high incidence of menstrual pains, suggesting a correlation between premenstrual syndrome and dysmenorrhea (Fujiwara & Nakata, 2007). Although these findings provide a warning that various organic diseases causing dysmenorrhea may latently develop in young Japanese women with premenstrual symptoms, skipping breakfast did not correlate with the incidence of premenstrual symptoms in the present study, which is compatible with the results obtained from our single year survey in 2007 (Fujiwara et al., 2009).

The group that skipped breakfast showed a tendency to suffer from constipation, suggesting that skipping breakfast may generate some stress in young women. Notably, despite the absence of a significant difference in body mass index, there was a significantly larger population with a self-perception of poor general health among the group that skipped breakfast. In our recent survey, post-adolescent female college students with high intakes of fast food and processed food did not complain of self-perceived poor general health or increased episodes of irregular menstruation (Fujiwara et al., 2009). These findings suggest that eating breakfast is one of the most important dietary habits influencing QOL. Previously, we found that the intensity of dysmenorrhea was high in young women with a history of dieting in adolescence, suggesting that diet in adolescence has long-lasting adverse effects on reproductive function in young women. Interestingly, it was also shown that the intensity of dysmenorrhea in young women who were currently dieting was not high. Consequently, the findings of this study suggest the possibility that dietary restriction in adolescence becomes a trigger for the subsequent development of organic gynecologic diseases, supporting the concept that inadequate dietary habits may influence women's QOL not only in the present but also in the future (Fujiwara, 2007). A recent study reported that skipping breakfast and taking meals irregularly are associated with the prevalence of fatigue in Japanese medical students (Tanaka, Mizuno, Fukuda, Shigihara, & Watanabe, 2008). It was also found that skipping breakfast is associated with increased blood pressure in adolescents (Kollias et al., 2009). Accordingly, attention is increasingly paid to the adverse effects of skipping breakfast on QOL not only in pre-adolescents, but also in adolescents (Pearson, Biddle, & Gorely, 2009). However, there are very few reports on the effects of skipping breakfast on reproductive function, especially in post-adolescents. In this regard, our findings are informative in that they show for the first time the possibility that skipping



breakfast is associated with menstrual disorders in female post-adolescents.

However, a hypothesized causal relation between breakfast skipping and dysmenorrhea cannot be validated by the findings of this study. Such validation will require a prospective study and/or animal experiments. Although the precise mechanisms behind the above findings are unclear, our preliminary animal experiments showed that greater impairment of the estrus cycle in young female rats that were starved during the day, i.e., the daytime (non-active phase) than those that were starved at night (active phase), suggesting that the timing of food consumption in daily life is an important issue that affects reproductive function in the young (unpublished data). Supporting our findings, it was very recently reported that the timing of food intake itself may play a significant role in weight gain (Arble, Bass, Laposky, Vitaterna, & Turek, 2009 Obesity). This study focused on the role of the circadian phase of food consumption in weight gain and found that nocturnal mice fed a high-fat diet only during the 12-h light phase gained significantly more weight than mice fed only during the 12-h dark phase, suggesting that the circadian system is an important factor in the effects of food intake. Taken together, we now speculate that failure to eat at the start of daily activities, as observed in students who skip breakfast, is an important factor that causes reproductive and non-reproductive disorders in young women. Since these menstrual disorders may influence QOL in young women not only in the present but also in the future, skipping breakfast should be re-evaluated from the perspective of future reproductive function.

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