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Original Article

Relationship between dietary habits and folic acid awareness in registered dietitian course students

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Summary

Registered dietitians may have the opportunity to provide pregnant females with important information about folic acid. Registered dietitian course students are expected to learn important information about folic acid. We provided lectures and administered questionnaire surveys to investigate the knowledge of folic acid, which reduces the risk of neural tube defects, and the intake of folic acid in the diet by registered dietitian course students. Among female registered dietitian course students, 564 provided effective responses. The folic acid intake of students with knowledge of folic acid (N = 448, 233.9 ± 73.5 μg/day) was significantly higher ($p < 0.05$) than that of students without (N = 116, 210.0 ± 58.2 μg/day). Similarly, the intake of green and yellow vegetables significantly differed ($p < 0.05$) between students with knowledge of folic acid (N = 448, 66.6 ± 43.4 g/day) and those without (N = 116, 55.4 ± 33.9 g/day). It was clarified that conscious promotion of the intake of green and yellow vegetables promotes the intake of folic acid. However, at the time of the survey, most of the students who responded were not considered to have responded in consideration of pregnancy, suggesting that they may not consciously ingest folic acid even if they have knowledge of it.

Introduction

Neural tube defects (NTDs), including spina bifida and anencephaly, are preventable congenital diseases, but it is not widely known that promoting folic acid intake reduces the incidence of NTDs[1)]. Regarding the causes of NTDs and their prevention, there are reports of genetic factors[2)], environmental factors[3)] and nutritional factors[4)]. Regarding nutritional factors, a randomized controlled trial reported in 1992 demonstrated that NTDs are congenital anomalies that can be prevented by folic acid supplementation[4)]. In 2000, the Japanese government recommended that females planning to become pregnant have a folic acid intake of 400 μg/day[5)]. However, in Japan, although the Ministry of Health, Labour and Welfare recommended the intake of folic acid supplements in 2000[5)], the incidence of spina bifida, a typical NTD, did not decrease from 2000 to 2015[1)]. The incidence is 4.7 to 6.2 per 10,000 births[1)].

Healthcare providers have the opportunity to provide pregnant females with important information about folic acid[6)]. The knowledge rate of folic acid varies depending on the medical field[6)]. A previous survey of folic acid among registered dietitian course students reported the following results. (1) Folic acid was less well known and its recognition depends on learning experience[7)]. (2) Folic acid intake was not affected by the presence of folic acid knowledge[8)]. (3) Folic acid intake was affected by dietary attitudes and dietary consciousness[9)]. (4) Folic acid intake was promoted by improving dietary consciousness[10,11)]. However, our reports[7-11)] thus far were the result of examining only the relationship between dietary habits and folic acid intake and food intake based on the FFQg survey, and a survey of the relationship between knowledge of folic acid and food intake by FFQg has not been performed.

In the present study, a survey was conducted among registered dietitian course students because they learn about folic acid, folic acid intake and how to intake folic acid. Such knowledge will help them explain important information about folic acid to others when they work as a registered dietitian in the future[6)].

The purpose of the present study was to investigate knowledge of folic acid, dietary habits, and the relationship among knowledge of folic acid, folic acid intake and food intake by associating individual dietary questionnaire re-

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sults with FFQg results.

Materials and Method

1. Subjects

A food frequency questionnaire and questionnaire of dietary habits were administered to 820 female first and second year students in the registered dietitian course in Osaka and Nara prefecture. They enrolled in the registered dietitian course between 2016 and 2019. The years and dates of the students surveyed were as follows: The present study investigated first and second year students. Surveys were administered between October and December for first-years and from August for second-years. The first year is before the folic acid lecture. Second year students have taken a lecture on folic acid.

2. Food intake and knowledge of folic acid

The relationship between food intake and knowledge of folic acid was investigated by the food frequency questionnaire based on groups (FFQg) Version 4.0[12]. Two types of questionnaires, the dietary habit questionnaire attached to the FFQg and the folic acid knowledge survey questionnaire, were used together. The dietary habit questionnaire attached to the FFQg consisted of 67 questions divided into four question groups. The question groups comprised sections I to IV: Section I (health questions; 14 questions), Section II (dietary behavior; 19 questions), Section III (dietary habits; 19 questions) and Section IV (dietary consciousness; 15 questions). In the present study, we surveyed question No. 52 in Section IV "Are you consciously trying to intake vegetables?" and the three choices were "Always consciously to intake vegetables", "Neither" and "Do not care about vegetables". The reasons for selecting question No. 52 were as follows: As a folic acid source food, it has been reported that intake from vegetables was high as a food group[13] and No. 52 was used. In FFQg, two values of vegetable intake were output: one was the intake value of green and yellow vegetable and the other was intake value of "other vegetables". In the present study, the intake value of green and yellow vegetables was used for the survey as analytical data because there were many kinds of vegetables for the intake value of "other vegetables".

In the folic acid knowledge survey questionnaire, a four-choice selection system was used for the question "Q. Do you know about folic acid?" (Do not know, heard about, read about in books and articles, and learned in another lecture)[7]. Three answers (heard about, read about in books and articles, and learned in another lecture) were considered "Known of folic acid" and one answer (do not know) was considered "Unknown of folic acid". Regarding the knowledge of folic acid, the answers were evaluated as "Known of folic acid" and "Unknown of folic acid".

3. Energy correction

The intake of each food group and the folic acid intake were converted to intakes per 1,000 kcal by correcting the energy using the residual method to eliminate the effects of energy intake due to physique and physical activity. The residual method can theoretically eliminate the effects of total energy intake[14].

4. Statistical analysis

One-way analysis of variance (ANOVA) using the Excel add-in statistical package software Statcel Version 4 was performed[15]. If a significant difference was found between the respective groups, a multiple comparison test (Tukey method) was performed to calculate the differences between the groups. The significance probability was set to 5%.

5. Privacy policy

The FFQg survey was approved by the ethics committee of Kindai University Faculty of Medicine (No. 20140227). Response to the survey was voluntarily anonymous, the responses were filled out on the survey form and submitting the survey form was considered consent to cooperate. The use of personal information (sex, date of birth, height and body weight) obtained from the survey and the storage of survey forms conformed to the Kindai University Basic Policy on the Protection of Personal Information (2013)[16].

Results

1. Subjects

The physical characteristics of the registered dietitian course students and their folic acid intake with total energy correction are shown in Table 1.

Table 1 Physical characteristics of female registered dietitian course students

Number of female registered dietitian course students	564	
	Mean ±	SD
Age (years old)	19.0 ±	1.4
Height (cm)	158.5 ±	5.4
Body weight (kg)	52.1 ±	7.1
Body mass index (kg/m^2)	20.7 ±	2.4
Total energy intake (kcal)	1,785.7 ±	497.3 #
Folic acid intake with energy correction (μg/day)	229.0 ±	71.3 $

: Estimated value by food frequency questionnaire survey
$: Estimated value by food frequency questionnaire survey with energy correction

2. Number of questionnaire surveys distributed and the effective response rate

The FFQg and two types of dietary questionnaires were distributed to 820 female registered dietitian course students. Six hundred and eleven students responded to the FFQg and two types of questionnaires, and 564 students responded to all questionnaires. The effective response rate was 68.8%.

3. Responses to the folic acid knowledge survey questionnaire

As a result of investigating the relationship between the knowledge of folic acid and the intake of folic acid-rich foods (cereals, potatoes, green and yellow vegetables, seaweeds, meats and fruits), the knowledge of folic acid was significantly higher by those who ate more potatoes and green and yellow vegetables (Table 2). Regarding folic acid intake, that of students with "Known" (233.9 ± 73.5 μg/day) was significantly higher ($p < 0.05$) than that of those with "Unknown" (210.0 ± 58.2 μg/day). Regarding green and yellow vegetable intake, that of students with "Known" (66.6 ± 43.4 g/day) was significantly higher ($p < 0.05$) than that of those with "Unknown" (55.4 ± 33.9 g/day). Furthermore, for potato intake, that of students with "Known" (35.2 ± 26.2 g/day) was significantly higher ($p < 0.05$) than that of those with "Unknown" (27.4 ± 23.8 g/day).

4. The dietary habits questionnaire attached to the FFQg

Regarding green and yellow vegetables, answers to question No. 52 of the FFQg "Are you consciously trying to intake vegetables?" are shown in Table 3. Therefore, the relationship between conscious intake of green and yellow vegetables and folic acid intake were examined in detail. However, conscious intake of potatoes was not included in the FFQg[12]. Thus, it was not possible to investigate the relationship between conscious intake of potatoes and folic acid intake.

Regarding the relationship between the questionnaire and folic acid and green and yellow vegetable intake, 496 students answered "Always conscious". Their folic acid intake was 235.4 ± 69.5 μg/day and their green and yellow vegetable intake was 68.0 ± 41.9 g/day. Nine students answered "Neither". Their folic acid intake was 183.6 ± 53.5 μg/day and their green and yellow vegetable intake was 28.6 ± 22.7 g/day. Fifty-nine students answered "Do not care about". Their folic acid intake was 182.1 ± 69.3 μg/day and their green and yellow vegetable intake was 39.0 ± 30.7 g/day. The folic acid intake of students who answered "Always conscious" was significantly higher ($p < 0.05$) than that of those who answered "Do not care about". Furthermore, the green and yellow vegetable intake of students who answered "Always conscious" was significantly higher ($p < 0.05$) than that of those who answered "Neither" or "Do not care about".

Table 2 Knowledge of folic acid by female registered dietitian course students

Number of female registered dietitian course students (%)	Known 448 (79.4%)	Unknown 116 (20.6%)	
	Mean ± SD	Mean ± SD	(p-value)
Folic acid (μg/day)	233.9 ± 73.5	210.0 ± 58.2*	(0.001)
Cereals (rice, noodles, etc.) (g/day)	352.9 ± 79.4	358.9 ± 79.4	(0.472)
Potatoes (g/day)	35.2 ± 26.2	27.4 ± 23.8*	(0.004)
Green and yellow vegetables (g/day)	66.6 ± 43.4	55.4 ± 33.9*	(0.001)
Seaweed (g/day)	3.9 ± 4.8	3.1 ± 3.5	(0.091)
Meat (g/day)	93.0 ± 45.2	84.5 ± 39.4	(0.061)
Fruit (g/day)	58.1 ± 65.3	55.2 ± 56.1	(0.660)

*: Significant difference ($p < 0.05$) between recognition of folic acid and no recognition

Table 3 Relationship between folic acid and green and yellow vegetable intake

Question and choices	Number of female registered dietitian course students	Folic acid (μg/day)	Green and yellow vegetables (g/day)
		Mean ± SD	Mean ± SD
Q. Are you conscious of your vegetable intake?			
Always conscious	496	235.4 ± 69.5 [a]	68.0 ± 41.9 [a]
Neither	9	183.6 ± 53.5 [a, b]	28.6 ± 22.7 [b]
Do not care about	59	182.1 ± 69.3 [b]	39.0 ± 30.7 [b]

Values with different superscripts "a" and "b" are significantly different ($p < 0.05$)
Values with the superscript "a, b" are not significantly different from those with a superscript "a" or "b"

Discussion

1. Subjects

The average height, weight and BMI of the 564 registered dietitian course students surveyed were similar to those reported by the National Health and Nutrition Survey in Japan in the 2019[17] (Females, age: 19 years old, N = 15, height: 156.7 cm, weight: 51.2 kg and BMI: 15-19 years old, N = 81, 20.2 kg/m^2) and our report in 2020 (Females, N = 258, age: 18.9 years old, height: 158.6 cm, body weight: 51.7 kg, BMI: 20.6 kg/m^2)[18].

2. Responses to the folic acid knowledge survey questionnaire by registered dietitian course students

Knowledge of folic acid by 836 students in the registered dietitian course, childcare course or medical course at universities was reported by 47.4% in the 2009 survey[7], 93.1% of 163 students attending registered dietitian or nursing training schools reported knowledge in the 2013 survey[6], and 68.0% of 296 students at universities of nutrition and health care reported knowledge in the 2017[9] and in 2018 surveys[10]. First year students (N = 189) answered "known" (N = 144, 76.2%) and "unknown" (N = 45, 23.8%), whereas all 55 (100.0%) second year students answered "known".

In the present study, the knowledge rate of folic acid was 79.4% (known: 448 students; unknown: 116 students), which was similar to previous reports[9, 10]. The present study investigated first and second year students. Surveys were administered between October and December for first-years and from August for second-years. According to Sato et al.[6], who investigated the knowledge of folic acid in freshmen and senior registered dietitian course students (third and fourth year students), 70% of the freshmen knew of folic acid and almost 100% of senior students knew of folic acid. In addition, freshmen reported that after graduating from high school, their knowledge of folic acid was comparable with that of ordinary females. We previously reported the knowledge of folic acid by first and second year students[10]. Regarding the knowledge of folic acid, 76.2% of first year students and 100% of second year students responded as knowing. However, the present study did not separate first and second year students. The knowledge of folic acid by first and second year students was similar to that reported by Sato et al.[6] and our previous study[10].

3. Knowledge of folic acid and folic acid intake

There are several reports stating that folic acid knowledge is not related to folic acid intake[8-10]. In the 2017 study[9], a survey of 295 students (registered dietitian course students and nursing course students), there was no significant difference in the folic acid intake of students. In the 2018 survey[10], 244 registered dietitian course students responded, (Known: N = 199, 223.3 ± 61.4 μg/day, Unknown: N = 45, 211.9 ± 77.2 μg/day), but there was no significant association between folic acid knowledge and folic acid intake. On the other hand, in the present study, which surveyed 564 registered dietitian course students (Table 2), there was a significant association.

In our previous report[7-11], there was no difference in knowledge of folic acid or folic acid intake as a result of group-by-group comparison. However, in the present study, knowledge of folic acid, folic acid intake and food intake were investigated by combining individual results, revealing a relationship between the knowledge of folic acid and folic acid intake. Moreover, as the number of students surveyed almost doubled, this increase was considered to have led to a significant difference[19]. Thus, the increase in the number of students in the survey increased the reliability of statistical analysis.

Registered dietitian course students have the opportunity to explain important information about folic acid to others when working as a registered dietitian in the future[6]. The experience of registered dietitian course students learning about knowledge of folic acid, their own folic acid intake and how to intake folic acid will be a source for them to explain the importance of folic acid and what foods they should intake in the future. Therefore, it is important for registered dietitian course students to learn to promote folic acid intake early in pregnancy to reduce the incidence of NTDs.

4. Conscious intake of green and yellow vegetables and intake of folic acid

According to the National Health and Nutrition Survey in Japan 2019[17], the intake of green and yellow vegetables by women aged 15-19 was 73.2 g (N = 119). In addition, according to a survey by Kamino et al.[20], the intake of yellow vegetables by 63 female students was 85.7 g. In the present study, the intake of green and yellow vegetables was similar.

The main sources of folic acid are vegetables (especially green and yellow vegetables), legumes, fruits, liver and green tea[13]. Improving dietary awareness and adjusting dietary conditions will increase the intake of green and yellow vegetables, thereby promoting an increase in folic acid intake[10, 11].

It was suggested that the conscious intake of green and yellow vegetables promotes the intake of folic acid.

Limitations

In general, college students are not thinking about getting pregnant and are not willing to take folic acid supplements even if they are interested in health during pregnancy or recognize that folic acid is a necessary nutrient in early pregnancy[18]. It is not possible to apply the findings of college students to females who wish to become pregnant. In addition, Kondo et al.[1] investigated recognition and intake rates by multiparous females, and reported that understanding the importance of folic acid does not necessarily lead to taking folic acid supplements.

Conclusion

Surveys were conducted with FFQg and two types of questionnaires (the dietary habit questionnaire attached to the FFQg and the folic acid knowledge survey questionnaire) to investigate the relationship between the knowledge of folic acid and the intake of vegetables by female registered dietitian students. At the time of the survey, most of the responding students were not considered to have responded in consideration of pregnancy. The present study suggested that folic acid awareness promotes vegetable intake. Furthermore, the intake of vegetables promoted the intake of folic acid. Although it is possible that the students knew about folic acid but were not conscious of their folic acid intake, the present study clarified that conscious intake of vegetables increases the intake of folic acid.

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Disclosure

None.

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