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Original article

Relationship between diet (consciousness and attitude) and folic acid intake of female nursing students

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Summary

Folic acid, a water-soluble B vitamin, is recognized as a major component of periconceptional care for women of reproductive age. Its deficiency can lead to fetal neural tube defects and megaloblastic anemia in the mother. Folic acid should be consumed daily by women of childbearing age through healthy eating patterns. This study investigated the relationship between diet and folic acid intake in female nursing students, using a food frequency questionnaire to clarify the proper diet for promoting folic acid intake. Overall, 296 female nursing students were enrolled in this study. Students who answered "frequently" regarding their vegetable intake exhibited significantly higher folic acid intake than those who answered "sometimes," "occasionally," and "never" ($p < 0.05$). Regarding the intake of soybean products and fruits, those who answered "frequently" exhibited significantly higher folic acid intake than those who answered "occasionally" and "never" ($p < 0.05$). Additionally, based on the current dietary status reported in the Dietary Habit Survey, skipping breakfast was found to result in significantly lower folic acid intake than skipping dinner ($p < 0.05$). Students should eat breakfast and make a conscious effort to eat more vegetables to promote folic acid intake.

Introduction

Changes in nutrient intake depend on food consumption, which is closely related to food awareness and attitudes[1)]. Dietary awareness refers to awareness of one's dietary and eating habits[2)]. Previous studies have reported the impact of a diet with good nutritional value on quality of life[2), 3)]. In Health Japan 21 (Second Phase), Japan's national health promotion program, many cases of worsened achievement status for lifestyle-related items and unachieved targets were reported[2)]. Therefore, in Health Japan 21 (Third Phase), people with limited interest in nutrition and diet should be approached[4)]. According to the National Health and Nutrition Survey Japan 2019, protein, Vitamin D, Vitamin B groups, and iron are insufficient in the modern Japanese diet[5)].

Folic acid is found naturally in plants such as yellow and green vegetables and beans, and also synthesized *de novo* by humans, enabling daily requirements (240 μg/day) to be met by the dietary intake of folic acid supplements or folic acid-rich foods. Folic acid deficiency causes numerous health problems, including fetal neural tube defects and megaloblastic anemia. The Ministry of Health, Labor and Welfare of Japan recommends that women of childbearing age take folic acid (800 μg/day)to prevent fetal neural tube defects[6)]. However, compared to other countries, folic acid awareness in Japan remains low, and food fortification with folic acid is not commonly practiced[7)]. Thus, the incidence of fetal neural tube defects has shown little change compared to past levels[8)].

Nurses must possess the skills to collaborate with other healthcare professionals and understand the significance of individual nutrients when assisting patients in treating their illnesses. This study examined the relationship be-

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tween dietary habits and folic acid intake among female nursing students through a questionnaire survey, aiming to identify specific dietary behaviors that promote higher folic acid intake.

Materials and Methods

1. Participants

We distributed a questionnaire to 480 first-year female nursing students between 2016 and 2019. Overall, 339 students consented to participate in this study, of which 296 responded, with a valid response rate of 87%.

2. Survey

To examine the relationship between diet (consciousness and attitude) and folic acid intake, we used the Food Frequency Questionnaire Based on Food Groups Version 5.0 (FFQg)[9]. The FFQg[9] consisted of four question groups: exercise and health (14 questions), dietary behavior (19 questions), dietary attitudes (19 questions), and dietary consciousness (15 questions). In the present study, question groups of dietary attitudes and dietary consciousness were used as indicators of dietary habits.

3. Energy correction

Folic acid and food group intakes were adjusted to per 1,000 kcal using the residual method to eliminate the influence of energy intake related to physical activity. This method can theoretically eliminate the effects of total energy intake[10].

4. Statistical analysis

Experimental data are expressed as mean ± standard deviation. The SPSS 29 STATISTICS BASE AC (IBM, Armonk, NY, USA) was utilized for all statistical analysis. Tukey's honest significant difference test or the Games-Howell test was used to analyze the differences between the mean values, depending on the results of the analysis of variance. Statistical significance was set at $p < 0.05$.

5. Privacy policy

The FFQg was approved by the Ethics Committee of the Kindai University Faculty of Medicine (approval number: 25–245). Survey responses were voluntarily anonymous and the responses were entered into the survey form. Personal information including sex, date of birth, height, and body weight were obtained through the survey, conforming to the Kindai University Basic Policy on the Protection of Personal Information (2013)[11].

Results

1. Participants

The physical characteristics of the female nursing students are listed in Table 1.

2. Relationship between diet (consciousness and attitude)

The relationship between consciousness and folic acid intake is presented in Table 2.

・50) Of the FFQg, "Do you consciously eat more dairy products?"

The relationship between dairy consumption awareness and folic acid intake was analyzed. Among the respondents, 86 students answered "frequently," with a mean folic acid intake of 243 ± 95 μg/day; 106 answered "sometimes," with an intake of 263 ± 54 μg/day; 60 answered "occasionally," with an intake of 221 ± 67 μg/day; and 39 answered "never," with an intake of 199 ± 73 μg/day. The folic acid intake among students who answered, "frequently" was significantly higher ($p < 0.05$) than that of those who answered "sometimes" and "never."

・51) Of the FFQg, "Do you consciously eat more soybean products?"

The relationship between awareness of soybean consumption and folic acid intake was examined. Among the respondents, 58 students answered "frequently conscious,"

Table 1 Physical characteristics of female nursing students

Number of students	296	
Age		19.0 ± 1.6
Height (cm)		158.0 ± 5.3
Body weight (kg)		51.6 ± 6.3
Body mass index: BMI (kg/m^2)		20.7 ± 2.3
Total energy intake (kcal/day)		1770 ± 578 #
Folic acid intake with energy correction (μg/day)		219 ± 103 ##

Mean ± SD

Estimated values from the food frequency questionnaire

Estimated values from the food frequency questionnaire survey with energy correction

Table 2 Relationship between dietary habits and folic acid intake

	Number	Folic acid intake (μg/day)
50) Do you consciously eat more dairy products?		
frequently	86	243 ± 95 [a]
sometimes	106	207 ± 54 [b]
occasionally	60	221 ± 67 [a,b]
never	39	199 ± 73 [b]
51) Do you consciously eat more soybean products?		
frequently	58	258 ± 106 [a]
sometimes	94	218 ± 61 [a,b]
occasionally	95	212 ± 60 [b]
never	44	193 ± 60 [b]
52) Do you consciously eat more vegetables?		
frequently	139	249 ± 86 [a]
sometimes	104	200 ± 51 [b]
occasionally	36	186 ± 43 [b,c]
never	16	156 ± 39 [c]
54) Do you consciously eat more fruits?		
frequently	44	250 ± 84 [a]
sometimes	113	229 ± 78 [a,b]
occasionally	92	209 ± 71 [b,c]
never	40	187 ± 46 [c]
53) How many servings of vegetable dishes do you eat per day?		
over 5 servings	13	310 ± 156 [a,b]
3–4 servings	55	264 ± 87 [a]
1–2 servings	184	212 ± 52 [b]
almost nothing	44	164 ± 43 [c]

Mean ± SD
Values with different superscripts are significantly different ($p < 0.05$).

with a mean folic acid intake of 258 ± 106 μg/day; 94 answered "sometimes," with an intake of 218 ± 61 μg/day; 95 answered "occasionally," with an intake of 212 ± 60 μg/day; and 44 answered "never," with an intake of 193 ± 60 μg/day. Folic acid intake among students who answered "frequently conscious" was significantly higher ($p < 0.05$) than that of those who answered "occasionally" and "never."

・52) Of the FFQg, "Do you consciously eat more vegetables? "

The relationship between vegetable intake awareness and folic acid intake was analyzed. Among the respondents, 139 students answered "frequently," with a mean folic acid intake of 249 ± 86 μg/day; 104 answered "sometimes," with an intake of 200 ± 51 μg/day; 36 answered "occasionally," with an intake of 186 ± 43 μg/day; and 16 answered "never," with an intake of 156 ± 39 μg /day. Therefore, the folic acid intake among students who answered "frequently conscious" was significantly higher ($p < 0.05$) than that of those who answered "sometimes," "occasionally," or "never."

・54) Of the FFQg, "Do you consciously eat more fruits?"

The relationship between fruit intake awareness and folic acid intake was examined. Among the respondents, 44 students answered "frequently conscious," with a mean folic acid intake of 250 ± 84 μg/day; 113 answered "sometimes," with an intake of 229 ± 78 μg/day; 92 answered "occasionally," with an intake of 209 ± 71 μg /day; and 40 answered "never," with an intake of 187 ± 46 μg /day. Folic acid intake among students who answered being "frequently conscious" of eating more fruits was significantly higher ($p < 0.05$) than among those who answered "occasionally" or "never."

・53) Of the FFQg, "How many servings of vegetable dishes do you eat per day?"

The relationship between vegetable intake and folic acid intake was evaluated. Among the respondents, 13 students reported consuming "over 5 servings" per day, with a mean folic acid intake of 310 ± 156 μg/day; 55 answered "3–4 servings," with an intake of 264 ± 87 μg/day; 184 answered "1–2 servings," with an intake of 212 ± 52 μg/day; and 44 answered "almost nothing," with an intake of 164 ± 43 μg/day. Folic acid intake among students who reported consuming "over 5 servings," "3–4 servings," or "1–2 servings" was significantly higher ($p < 0.05$) than among those who answered "almost nothing."

The results of the analysis of the relationship between dietary attitudes and folic acid intake are summarized in

Table 3.

・35) Of the FFQg, "How often do you skip meals?"

The relationship between meal-skipping frequency and folic acid intake was assessed. Among the respondents, 25 students reported skipping meals "almost every day," with a mean folic acid intake of 188 ± 66 μg/day; 36 answered "3–4 times weekly," with an intake of 206 ± 68 μg/day; 82 answered "1–2 times weekly," with an intake of 214 ± 69 μg/day; 99 answered "almost never," with an intake of 226 ± 71 μg/day; and 54 answered "never," with an intake of 235 ± 91 μg/day. No significant differences in folic acid intake were observed among the groups.

・36) Of the FFQg, "What meal do you most frequently skip?"

The relationship between skipped meals and folic acid intake was analyzed. Among the respondents, 146 students reported skipping breakfast, with a mean folic acid intake of 204 ± 61 μg/day; 18 students reported skipping lunch, with an intake of 222 ± 63 μg/day; and 44 reported skipping dinner, with an intake of 245 ± 88 μg/day. Folic acid intake among students who skipped dinner was significantly higher ($p < 0.05$) than among those who skipped breakfast.

・47) Of the FFQg, "Do you think the volume of your snacks is adequate?"

The relationship between perceived snack volume and folic acid intake was analyzed. Among the respondents, 78 students answered "adequate," with a mean folic acid intake of 234 ± 90 μg/day; 117 answered "too much," with an intake of 206 ± 65 μg/day; and 101 answered "unknown," with an intake of 222 ± 71 μg/day. Students who responded "adequate" had a significantly higher folic acid intake compared to those who responded "too much" ($p < 0.05$).

・48) Of the FFQg, "Do you think the status of your meals is good?"

The relationship between perceived meal status and folic acid intake was examined. Among the respondents, 44 students answered "good," with a mean folic acid intake of 257 ± 98 μg /day; 115 answered "neither good nor problematic," with an intake of 217 ± 61 μg/day; 84 answered "moderately problematic," with an intake of 221 ± 71 μg/day; and 53 answered "severely problematic," with an intake of 187 ± 72 μg/day. Folic acid intake among students who answered "good" was significantly higher ($p < 0.05$) than among those in all other response categories.

Discussion

This study indicated that being mindful of vegetable intake and choosing more vegetable dishes were associated with higher overall folic acid intake. Hayashi et.al. reported that serum folic acid levels were significantly improved by the ingestion of green and yellow vegetables and supplements[12]. In addition, folic acid intake was elevated when students consumed dairy products[13], soybean products[14], and fruits[15], consistent with the results of the present study.

Students who frequently skipped breakfast had lower folic acid intake than those who skipped dinner, whereas Leech et.al. reported no significant correlation between skipping lunch or dinner and folic acid intake[16]. Our results aligned with those of previous studies, suggesting that eating breakfast contributes to increased folic acid intake[16].

The folic acid intake of students who were conscious of

Table 3 Relationship between dietary attitudes and folic acid intake

36) What meal do you most frequently skip?		
breakfast	146	204 ± 61 [a]
lunch	18	222 ± 63 [a,b]
dinner	44	245 ± 88 [b]
47) Do you think the volume of your snacks is adequate?		
adequate	78	234 ± 90 [a]
too much	117	206 ± 65 [b]
unknown	101	222 ± 71 [a,b]
48) Do you think the status of your meal is good?		
good	44	257 ± 98 [a]
neither good nor problematic	115	217 ± 61 [b,c]
moderately problematic	84	221 ± 70 [b]
severely problematic	53	187 ± 72 [c]

Mean ± SD
Values with different superscripts are significantly different ($p < 0.05$).

improving their dietary attitudes and dietary consciousness was similar to the recommended intake of 240 μg/day [17]. This intake level can prevent megaloblastic anemia. However, students who do not improve their dietary attitudes and dietary consciousness are at risk of developing megaloblastic anemia. Additionally, in the present study folic acid intake did not meet the requirement of 400 μg/day[17], the level thought to reduce the incidence of fetal neural tube defects. If there is a plan to become pregnant, dietary strategies to increase folic acid intake should be considered.

Leech[16] et al. reported that students who perceived their snack volume as "too much" exhibited low folic acid intake, which aligns with our findings. Notably, further quantitative and qualitative research is necessary to explore the relationship between folic acid intake and snack habits among Japanese women of childbearing age, as current data is insufficient.

In conclusion, students with higher folic acid intake tended to have a higher frequency of consuming vegetables, soybean products, and fruits; skipped meals less frequently; maintained an appropriate snack volume; and viewed their eating habits positively.

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