Original

Nutrition teacher's class in elementary school and dietary pattern in adolescence

Tohru Kobayashi[1*], and Eisaku Okada[2]

[1]*Department of Food Science and Human Wellness, Rakuno Gakuen University, Ebetsu, Hokkaido, Japan*

[2]*Faculty of Social Policy and Administration, Hosei University, Machida, Tokyo, Japan.*

ABSTRACT *Background and purpose.* The association between the experience of nutrition teacher's class (NTC) during elementary school and dietary pattern in adolescence remains unclear. This study aimed to explore the association between receiving a nutrition teacher's class (NTC) during elementary school and dietary patterns in adolescence. *Methods*. This study participants were one high school students comprising 352 boys and 321 girls recruited between May and July 2020.Data on the experience of receiving NTC and individual characteristics were obtained using self-administered questionnaires. Dietary intake data were obtained using a validated brief-type self-administered diet history questionnaire for elementary to high-school-age students (BDHQ15y). Dietary patterns were identified using principal component analysis with varimax rotation performed using 67 food and beverages items from the BDHQ15y stratified by sex. Multiple logistic regression analysis ($p < 0.05$) was used to analyze the proportion of high dietary pattern scores more than 75 percentile based on the experience of receiving NTC. *Result*. After adjusting potential confounding factors, among the students who received NTC, the odds ratio (OR) of a high score of healthy Japanese dietary pattern in boys was 1.85 (95% confidence interval, 1.09–3.15), and that of the snack foods pattern in girls was 0.52 (95% confidence interval, 0.31–0.90) compared with those who did not receive NTC. *Conclusion. R*eceiving NTC during elementary school may improve dietary patterns in adolescence.

Keywords: nutrition education, high school students, dietary habit, epidemiology, dietary habit

INTRODUCTION

Nutrition education aims to improve dietary habits, behaviors, nutrition literacy, and lifestyle, contributing to human health. In particular, nutrition education has been counteracting health problems such as overweight and obesity in elementary school-age students.[1] Therefore, the nutrition education program has been increasingly adopted in the school curricula worldwide.[2-6]

A previous interventional study reported that nutrition education classes and farm tours increase knowledge of vitamins and minerals and

* To whom correspondence should be addressed: tkoba@rakuno.ac.jp

improve vegetable consumption behavior among elementary school students.[7] Another interventional study suggested that both lecture- and experience-based nutrition education methods improved dietary habits and nutritional knowledge among elementary school students after being followed.[8] In addition, nutrition education interventions for elementary school students and their parents have improved their nutrition label literacy.[9] However, the above evidence indicates a short-term positive effect of nutrition education on students. Although an interventional study with 1-year follow-up revealed that nutrition education positively affects body mass index (BMI),[10] limited long-term studies exist.

In Japan, nutrition education has been called "Shokuiku," and the Basic Act on Shokuiku (Food and Nutrition Education) was established in 2005.[11] Shokuiku mainly targets primary and middle school students to obtain knowledge of and ability to choose appropriate food and nutrition through their experiences that aim to develop children's cultivation of humanity and acquisition of life skills. To enhance school-based Shokuiku programs, the Diet and Nutrition Teacher System was established in April 2007[2] and has been conducted in Japan since then. An interventional study in Japanese elementary schools indicated that a school-based nutrition education program, including a 45-minute lecture and homework, increased the knowledge level among students.[12] Moreover, one cross-sectional study suggested that people who received nutrition education at elementary and middle school tended to have a more positive attitude toward nutrition education.[13] However, the effect of nutrition education during elementary school age on dietary patterns in adolescence remains unclear.

Systematic reviews have reported that unhealthy dietary patterns during childhood and adolescence are related to the risk of cardiometabolic alterations,[14,15] waist circumference, blood pressure,[14] and higher levels of several pro-inflammatory biomarkers.[16] Therefore, improving unhealthy dietary patterns during childhood and adolescence is important to future health outcomes. Providing nutrition education during elementary school days may be a beneficial strategy for establishing good dietary patterns in adulthood. This study thus aims to explore the association between the experience of receiving nutrition education from nutrition teachers in elementary school and dietary patterns in adolescence among Japanese high school students.

METHODS

Study Population

The students of 10th–12th grades in a private high school in Hokkaido, Japan, were recruited between May and July 2020 for this study. We administered a self-administered anonymous questionnaire and requested the participants to fill it out and return it via a class teacher. Questionnaires were filled out anonymously. We explained the purpose of the survey and obtained oral informed consent to the participants face-to-face in their classrooms. This study was conducted in accordance with the guidelines of the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee of Rakuno Gakuen University (2020, No.20-2).

Data Collection and Measures

The question asked to the participants regarding their experience of nutrition teacher's class (NTC) during elementary school was, "Did you receive nutrition education from nutrition teachers during elementary school?" The participants responded yes, no, or unknown. For lifestyle factors and individual characteristics, we recorded living arrangement (with family or dormitory), school club activity

(participating or not participating), frequency of breakfast (every day, 4–6 days/week, 2–3 days/week, or ≤1 day/week), and having anemia (yes or no). A previous scoping review reported that parental involvement is one of the dominant teaching strategies for nutrition education programs.[17] Thus, participants were asked whether their parents are interested in "Shokuiku" by participants answering yes or no. A validated brief self-administered diet history questionnaire (BDHQ)[18] was used to assess the preceding month's dietary intake of elementary-to-high-school-age students (BDHQ15y) regarding the consumption frequency of 67 foods and beverages commonly consumed by the Japanese population. Total daily energy intake was calculated based on daily food intake information and the Japanese food composition table.[19] We obtained the height and body weight data from participants who answered questions present in the BDHQ15y. Body mass index (BMI) was calculated as weight (kg) / height (m).[2]

Dietary Pattern

Dietary patterns were identified by principal component analysis with varimax rotation, which was performed using 67 food and beverages items from the BDHQ15y. Referring to previous studies using the BDHQ,[20-22] we applied dietary patterns by considering eigenvalues, scree plots, and extracted factor interpretability. Dietary pattern scores were calculated by summing the factor loadings weighted by daily food intake. Factor loadings indicated positive or negative associations with the dietary patterns. Food with a positive factor loading indicated a positive association with dietary patterns; conversely, food with a negative factor loading was negatively associated with dietary patterns. A high dietary pattern score indicated sufficient adherence to dietary patterns. Dietary patterns were analyzed according to sex.

Outcome Measures

We assessed the outcome measures using a high dietary pattern score. A high dietary pattern score was defined as 75 percentiles or higher scores in the distribution of each dietary pattern score.

Statistical Analyses

We categorized the distribution of lifestyle factors and individual characteristics based on the experience of receiving NTC in elementary school into two groups: no or unknown and yes. A logistic regression model was used to calculate the odds ratios (ORs) (95% confidence intervals (CIs)) of a high score of each dietary pattern scores based on the experience of receiving NTC after adjusting for potential confounding factors. We selected confounding factors using an analytical framework for a directed acyclic graph (DAG),[23] which applied a minimum adjustment model (Figure 1). The multivariable-adjusted model included grade, school club activity, anemia, and interesting to "Shokuiku" in parent. All analyses were performed using JMP Pro 12.1.0 software (SAS Institute Inc. Cary, NC, USA). The level of significance was set at $p < 0.05$.

RESULTS

A total of 826 individuals were eligible for study participation, and 764 participants (92.5%) returned the questionnaire. Of them, participants with missing data on height and body weight (n =14), those with less than 600 kcal or 4,000 kcal or more of total energy intake (n = 59), and those who did not answer questions about their experience of receiving NTC during elementary school (n = 18) were excluded from this study. Thus, 673 participants (352 boys and 321 girls) were included in the final analysis.

The characteristics of the study participants, grouped based on their experience of receiving NTC in elementary school, are presented in Table 1. Regarding the experience of receiving NTC, 54.5%

were boys and 61.1% were girls. Among boys, those who had an experience of receiving NTC comprised a higher proportion of 10th-grade students, had breakfast every day, and had a lower participation proportion in school club activities than those who had not received NTC. Among girls who had an experience of receiving NTC, the prevalence of anemia was higher than that of those who had not received NTC.

Table 2 presents the factor loading matrix for the major dietary patterns among boys identified by principal component analysis. The first factor was a healthy Japanese dietary pattern characterized by a high intake of fish, diverse vegetables, mushrooms, seaweed, and soybean products such as natto and tofu. The second factor was the high intake of confectioneries, noodles, and fats such as butter and margarine, named as snack foods pattern. The third factor was the animal food pattern characterized by a high meat intake, such as chicken, pork, beef, yogurt, and cheese. The first to third dietary patterns accounted for 8.4, 5.8, and 4.8%, respectively, of the variance in food intake and explained 19.0% of the variability.

Table 3 presents the factor-loading matrix for the major dietary patterns among girls identified by principal component analysis. The first and third factors of the snack foods pattern in girls represented similar results to the first and second factors of the healthy Japanese dietary pattern in boys. However, the second factor, named the Japanese breakfast pattern, is characterized by a high intake of eggs, soybean products, vegetable pickles, fruits, yogurt, and cheese. The first to third dietary patterns accounted for 8.1, 4.9, and 4.8%, respectively, of the variance in food intake and explained 17.8% of the variability.

Table 4 presents the ORs (95% Cis) for the proportion of a high-score group of each dietary pattern among boys and girls. Among boys, after adjusting for all related variables, the OR higher than the median value for healthy Japanese pattern score in those who had an experience of receiving NTC was 1.85 (95% CI, 1.09–1.85) compared with those who had not received NTC. Among girls, after adjusting for all related variables, the OR higher than median value for snack foods pattern score in those who had an experience of receiving NTC was 0.52 (95% CI, 0.31–0.90) compared with those who had not received NTC.

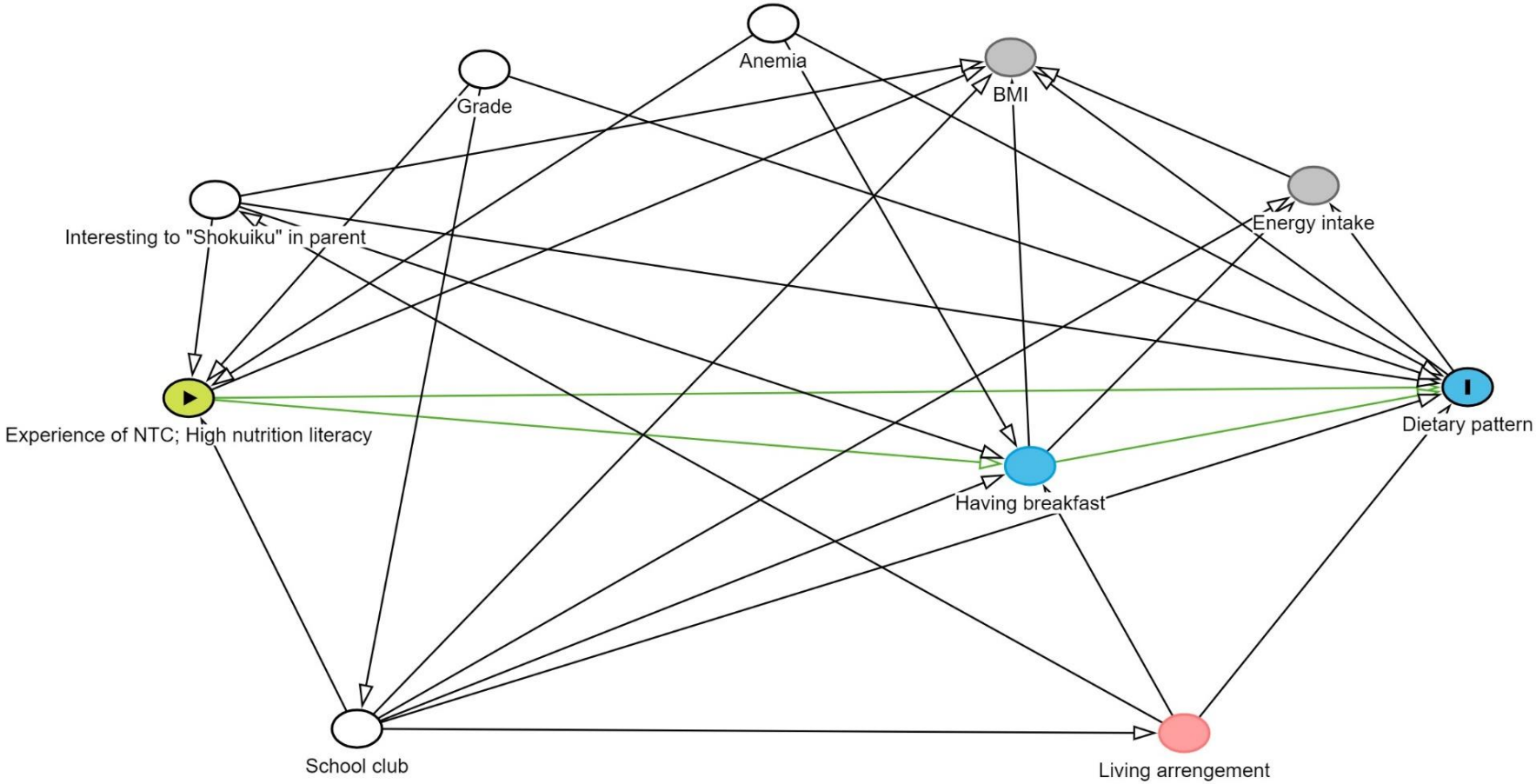

Figure 1. Analytical framework selected confounders using a DAG

NTC: Nutrition teacher's class; BMI: Body Mass Index;

Shokuiku: A common name the nutrition education in Japan

Table 1 Characteristics of the 673 high school students according to experience of received nutrition teacher's class during elementary school

		An experience of received NTC			
		Boys (n =352)		Girls (n = 321)	
		No or unknown	Yes	No or unknown	Yes
		n = 160	n = 192	n = 125	n = 196
Grade	10th	58 (36.3)	103 (53.7)	52 (41.6)	91 (46.4)
	11th	45 (58.1)	45 (23.4)	34 (27.2)	56 (28.6)
	12th	57 (35.6)	44 (22.9)	39 (31.2)	49 (25.0)
BMI (kg/m^2)	<18.5	20 (12.5)	29 (15.1)	14 (11.2)	22 (11.2)
	18.5～24.9	123 (76.9)	144 (75.0)	102 (81.6)	162 (82.7)
	≥25.0	17 (10.6)	19 (9.9)	9 (7.2)	12 (6.1)
Living arrangement	With family	117 (73.1)	136 (71.2)	83 (66.4)	134 (69.0)
	Dormitory	43 (26.9)	55 (28.8)	42 (33.6)	60 (30.9)
School club activity	Participating	69 (44.0)	65 (34.2)	47 (38.2)	87 (44.9)
	Not participating	88 (56.1)	125 (65.8)	76 (61.8)	107 (55.2)
Having breakfast	Everyday	80 (50.0)	112 (58.3)	71 (56.8)	107 (54.6)
	4–6 days/week	14 (8.8)	20 (10.4)	14 (11.2)	24 (12.2)
	2–3 days/week	34 (21.3)	26 (13.5)	15 (12.0)	34 (17.4)
	≤1 day/week	27 (16.9)	34 (17.7)	24 (19.2)	30 (15.3)
	Unknown	5 (3.1)	0 (0.0)	1 (0.8)	1 (0.5)
Anemia		19 (12.5)	17 (9.1)	14 (11.3)	39 (19.9)
Parents are interested in "Shokuiku"	Yes	107 (67.7)	126 (66.0)	88 (71.5)	137 (69.9)
	No	51 (32.3)	65 (34.0)	35 (28.5)	59 (30.1)

Data are mean and standard deviation or n (%).

NTC: Nutrition teacher's class

Table 2 Factor loading matrix for major dietary patterns identified by principal component analysis among boys

	Healthy Japanese	Snack foods	Animal foods
Chicken		-0.31	0.57
Pork and beef			0.59
Ham, sausages and bacon			0.64
Liver			0.26
Squid, octopus, shrimp and clam	0.40		
Small fish with bones	0.34		
Canned tuna	0.28		
Dried fish and salted fish	0.28		
Oily fish	0.42		
Non-oily fish	0.39		
Seafood paste products	0.30		
Eggs	0.38		
Tofu and tofu products	0.40		
Natto	0.35		
Salted green and yellow vegetable pickles	0.45		
Other salted vegetable pickles	0.34		
Raw cabbage and lettuce	0.51	-0.27	
Green leafy vegetables	0.60		
Cabbage	0.66		
Carrots and pumpkins	0.60		
Radishes and turnips	0.59		
Other root vegetables	0.57		
Boiled tomato and stewed tomato	0.34		
Mushrooms	0.60		
Seaweeds	0.51		
Cakes, cookies and biscuits		0.57	
Japanese sweets		0.54	
Rice crackers		0.49	
Ice cream	-0.28		0.54
Snacks made from wheat flour		0.61	
Chocolates		0.26	
Buckwheat noodles		0.27	
Japanese wheat noodles		0.26	
Chinese noodles		0.39	
Spaghetti and macaroni		0.33	
French fries and potato chips		0.49	
Potatoes	0.39		
Butter		0.46	
Margarine		0.40	
Rice		-0.49	-0.60
Miso soup	0.26	-0.28	-0.46
Yoghurt			0.43
Cheese			0.49
Water		-0.28	-0.26

Natto: Fermented soyabeans; Tofu: Soyabean curd

Factor loadings less than ±0.25 shown by a blank for simplicity.

Table 3 Factor loading matrix for major dietary patterns identified by principal component analysis among girls

	Healthy Japanese	Japanese breakfast	Snack foods
Pork and beef			0.28
Ham, sausages and bacon			0.43
Squid, octopus, shrimp and clam			0.30
Oily fish	0.32	-0.26	
Non-oily fish	0.28		
Seafood paste products			0.36
Eggs		0.50	
Tofu and tofu products	0.39	0.27	
Natto		0.41	
Salted green and yellow vegetable pick	0.33	0.31	
Other salted vegetable pickles	0.26		
Raw cabbage and lettuce	0.69		
Green leafy vegetables	0.71		
Cabbage	0.73		
Carrots and pumpkins	0.75		
Radishes and turnips	0.70		
Other root vegetables	0.56		
Boiled tomato and stewed tomato	0.33	0.27	
Mushrooms	0.53		
Seaweeds	0.55		
Cakes, cookies and biscuits		-0.47	
Snacks made from wheat flour		-0.46	0.32
Chocolates		-0.51	
Citrus fruit including oranges		0.32	
Strawberries, persimmons and kiwi fruit		0.53	
Other fruits		0.44	
Breads	-0.27		
Japanese wheat noodles			0.36
Chinese noodles			0.38
Spaghetti and macaroni			0.30
French fries and potatoe chips			0.40
Potatoes	0.34		
Butter			0.29
Mayonnaise			0.42
Tomato ketchup			0.29
Worcestershire sauce and soy sauce		0.29	0.33
Rice			-0.67
Miso soup			-0.38
Yoghurt		0.44	
Cheese		0.32	
Cola and sweetened soft drinks	-0.27		

Natto: Fermented soyabeans; Tofu: Soyabean curd

Factor loadings less than ±0.25 shown by a blank for simplicity.

Table 4 Odds ratio and 95% confidence interval for proportion of each high dietary pattern scores according to experience of received nutrition teacher's class during elementary school*

	An experience of received NTC								P
	No or unknown				Yes				
Boys	n = 192				n = 160				
Healthy Japanese	1.00	(	reference	)	1.85	(	1.09 – 3.15	)	0.023
Snack foods	1.00	(	reference	)	1.05	(	0.62 – 1.79	)	0.849
Animal foods	1.00	(	reference	)	1.02	(	0.61 – 1.70	)	0.946
Girls	n = 196				n = 125				
Healthy Japanese	1.00	(	reference	)	1.19	(	0.49 – 1.45	)	0.533
Japanese breakfast	1.00	(	reference	)	1.23	(	0.71 – 2.15	)	0.456
Snack foods	1.00	(	reference	)	0.52	(	0.31 – 0.90	)	0.019

*A high dietary pattern scores was defined as 75 percentile or more in distribution of each dietary pattern score.
Adjusted for grade, school club activity, anemia and parents are interested in "Shokuiku"
NTC: Nutrition teacher's class

DISCUSSION

In the current study, we analyzed dietary patterns in adolescent high school students, grouped based on their experience of receiving NTC during elementary school. We observed that participants who received NTC exhibited higher scores for healthy Japanese dietary patterns among boys and lower scores for snack food patterns among girls than those who did not receive NTC. To the best of our knowledge, this is the first study to suggest an association between dietary patterns and the experience of receiving NTC in elementary school.

A previous study on Japanese university students suggested that those with experience receiving NTC during elementary school had a higher intake of vegetables and eggs than those who did not receive NTC,[24] which is similar to the results of the present study. However, few reports exist on the long-term effects of nutrition education on dietary patterns from school age to adolescence. A prospective study that underwent a 2-year follow-up indicated that increased fruit and vegetable intake followed the nutrition education intervention among elementary school students.[25] In addition, a recent cohort study in the age range of 14 to 22 years reported that a defective dietary pattern established in adolescence may continue into young adulthood.[26] These studies support our findings.

The association between an experience of receiving NTC during elementary school and dietary patterns in this study showed different trends among boys and girls. A previous systematic review among adolescents reported that unhealthy dietary patterns characterized by energy-dense snacks, fatty foods, and animal foods are associated with a risk of overweight and obesity; conversely, healthy dietary patterns such as vegetables, fruits, and fish may reduce that risk.[27] Therefore, participants with experience of receiving NTC can be considered focusing on eating healthy foods, as seen among boys, and reducing snack foods, as observed in girls. In addition, a previous cross-sectional study suggested that girls tend to eat more

snacks while watching television than boys.[28] In the present study, despite girls having a higher intake of vegetables, fish, eggs, and confectioneries, and had a lower total energy intake than boys (Data not shown). Therefore, the gender difference observed in the association between the experience of receiving NTC and the dietary pattern is primarily the disparities in dietary behaviors and food preferences between boys and girls.

Primary and middle schools in Japan constitute 6,924 nutrition teachers,[29] accounting for approximately 24.0% of the assigned nutrition teachers. Schools in Japan still have the vacancy to assign more nutrition teachers. Therefore, the Japanese government need to promoting increased employment of nutrition teachers to enhance NTC, contributing to future health for Japanese and not only improving dietary patterns among primary and middle school students.

In the present study, notably, we have assessed dietary intake using BDHQ15y and estimated dietary patterns using principal component analysis. Dietary patterns determined by the factor-loading matrix of food items are useful for understanding the dietary characteristics of adolescents. We also detected dietary patterns stratified by sex, which assessed the characteristics of the association between NTC received during elementary school and dietary patterns in adolescence. Further, we adjusted for confounding factor characteristics of high school students, such as grade, living arrangement, and club activity. The present study survey had a high response rate of 92.5%, which is noteworthy. However, this study has some limitations. First, we only collected subjective data on whether the participants received NTC during elementary school; quantitative data regarding the NTC frequency and content were not obtained. Therefore, we could not evaluate the quantitative data on the relationship between receiving NTC and dietary patterns. Second, we did not obtain data on parental dietary behaviors and nutrition literacy. Parental dietary behavior and whether they received adequate nutrition education are significantly associated with dietary patterns among their children.[30-33] However, we analyzed that adjusted for the factor parents are interested in "Shokuiku", reduced the bias of the involved parent, and reinforced the validity of the study findings. Finally, the relatively small sample size may have affected the statistical power of the analysis. Therefore, further studies with larger sample sizes are warranted.

In conclusion, the current study demonstrates that the experience of receiving NTC during elementary school is related to dietary patterns in adolescence. Enhancing NTC through the elementary school curriculum may improve literacy regarding healthy food choices among adolescents in the future. Present study may useful to educationists or policy makers formulate policy, systems for an effective nutrition program that may develop children's physical and mental growth. However, the effect of receiving NTC in elementary school on health outcomes after adolescence requires further investigation.

ACKNOWLEDGMENTS

We thank the students of the Department of Food Science and Human Wellness, Rakuno Gakuen University, for their cooperation and assistance during this study.

CONFLICT OF INTEREST

The authors no conflict of interest to disclose.

REFERENCES

1. Follong BM, Verdonschot A, Prieto-Rodriguez E, Miller A, Collins CE, Bucher T. Nutrition across the curriculum: A scoping review exploring the integration of nutrition education within primary schools. Nutr Res Rev. 35:181-196.2022.
2. Miyoshi M, Tsuboyama-Kasaoka N, Nishi N. School-based “Shokuiku” program in Japan: Application to nutrition education in Asian countries. Asia Pac J Clin Nutr 21: 159-162. 2012
3. Pittman DW, Bland IR, Cabrera ID, et al. The Boss' healthy buddies nutrition resource is effective for elementary school students. J Obes. 2018: 4659874. 2018.
4. Woo T. The school meal system and school-based nutrition education in Korea. J Nutr Sci Vitaminol. 61:S23-S24. 2015.
5. Maldonado L, Farias SC, Damião JJ, et al. A proposal for food and nutrition education integrated into the preschool and elementary school curriculum. Cad Saude Publica. 37: e00152320. 2022.
6. Hawkins M, Watts E, Belson SI, et al. Design and implementation of a 5-year school-based nutrition education intervention. J Nutr Educ Behav 52: 421-428. 2020.
7. Moss A, Smith S, Null D, et al. Farm to school and nutrition education: Positively affecting elementary school-aged children's nutrition knowledge and consumption behavior. Child Obes. 9: 51-56. 2013.
8. Jung LH, Choi JH, Bang HM, et al. A comparison of two differential methods for nutrition education in elementary school: Lecture-and experience-based learning program. Nutr Res Pract 9: 87-91. 2015.
9. Katz DL, Katz CS, Treu JA, et al. Teaching healthful food choices to elementary school students and their parents: The Nutrition Detectives™ program. J Sch Health 81: 21-28. 2011.
10. Hao M, Han W, Yamauchi T. Short-term and long-term effects of a combined intervention of rope skipping and nutrition education for overweight children in Northeast China. Asia Pac J Public Health 31: 348-358. 2019.
11. Ministry of Agriculture, Forestry and Fisheries. Basic act on shokuiku (food and nutrition education). 2005.
12. Asakura K, Mori S, Sasaki S, et al. A school-based nutrition education program involving children and their guardians in Japan: Facilitation of guardian-child communication and reduction of nutrition knowledge disparity. 20: 92. Nutr J. 2021.
13. Kuwahara M, Eum W. Effects of childhood nutrition education from school and family on eating habits of Japanese adults. Nutrients 14: 2517. 2022
14. Teixeira B, Afonso C, Rodrigues S, et al. Healthy and sustainable dietary patterns in children and adolescents: A systematic review. Adv Nutr. 13: 1144-1185. 2022.
15. Rocha NP, Milagres LC, Longo GZ, et al. Association between dietary pattern and cardiometabolic risk in children and adolescents: A systematic review. J Pediatr. 93(3): 214-222. 2017.
16. Bujtor M, Turner AI, Torres SJ, et al. Associations of dietary intake on biological markers of inflammation in children and adolescents: A systematic review. Nutrients 13: 356. 2021.
17. Peralta LR, Dudley DA, Cotton WG. Teaching healthy eating to elementary school students: A scoping review of nutrition education resources. J Sch Health 86: 334-345. 2016.
18. Kobayashi S, Murakami K, Sasaki S, et al. Comparison of relative validity of food group

intakes estimated by comprehensive and brief-type self-administered diet history questionnaires against 16 d dietary records in Japanese adults. Public Health Nutr 14: 1200-1211. 2011.

19. Ministry of Education, Sports, Science and Technology. Standard Tables of Food Composition in Japan. 2010.

20. Kokubun K, Yamakawa Y. Association between food patterns and gray matter volume. Front Hum Neurosci 13: 384. 2019.

21. Suthuvoravut U, Takahashi K, Murayama H, et al. Association between traditional Japanese diet washoku and sarcopenia in community-dwelling older adults: Findings from the Kashiwa study. J Nutr Health Aging 24: 282-289. 2020.

22. Kurotani K, Kochi T, Nanri A, et al. Dietary patterns and sleep symptoms in Japanese workers: The Furukawa Nutrition and Health Study. Sleep Med 16: 298-304. 2015.

23. Textor J, van der Zander B, Gilthorpe MS, et al. Robust causal inference using directed acyclic graphs: the R package 'dagitty'. International journal of epidemiology 45: 1887-1894. 2016.

24. Kobayashi T. Effects of receiving nutrition teacher's class during elementary school on dietary habits in young adulthood. J Jpn Diet Assoc. 61: 501-506. 2018 (in Japanese).

25. Marshall AN, Markham C, Ranjit N, et al. Long-term impact of a school-based nutrition intervention on home nutrition environment and family fruit and vegetable intake: A two-year follow-up study. Prev Med Rep 20: 101247. 2020.

26. Appannah G, Murray K, Trapp G, et al. Dietary pattern trajectories across adolescence and early adulthood and their associations with childhood and parental factors. Am J Clin Nutr 113: 36-46. 2021.

27. Liberali R, Kupek E, Assis MAA. Dietary patterns and childhood obesity risk: A systematic review. Child Obes 16: 70-85. 2020

28. Larson NI, Miller JM, Watts AW, et al. Adolescent snacking behaviors are associated with dietary intake and weight status. J Nutr. 2016;146:1348-1355.

29. Ministry of Education, Sports, Science and Technology. Situation of assign the Diet and Nutrition Teacher. 2023.

30. Angeles-Agdeppa I, Monville-Oro E, Gonsalves JF, et al. Integrated school based nutrition programme improved the knowledge of mother and schoolchildren. Matern Child Nutr 15: e12794. 2019.

31. Davison B, Saeedi P, Black K, et al. The association between parent diet quality and child dietary patterns in nine- to eleven-year-old children from Dunedin, New Zealand. Nutrients 9: 483. 2017.

32. Emmett PM, Jones LR, Northstone K. Dietary patterns in the Avon Longitudinal Study of Parents and Children. Nutr Rev 73(suppl 3): 207-230. 2015.

33. Tenjin K, Sekine M, Yamada M, et al. Relationship between parental lifestyle and dietary habits of children: A cross-sectional study. J Epidemiol 30: 253-259. 2020.