Trends in Intervention Studies on Food and Nutrition Education in Japan Utilizing the School Lunch — A Systematic Review

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ABSTRACT

Purpose: A systematic review was undertaken for the purpose of determining trends in food and nutrition education utilizing school lunches following the enactment of the *Shokuiku* Basic Act in 2005.

Method: A search for academic papers published over the 12-year period from 2005 to 2016 was conducted using the database of the Japan Medical Abstracts Society as well as a manual search. The criteria for selection were as follows: Firstly, papers had to be published in reviewed academic journals. Secondly, papers had to be original articles. Thirdly, the subjects of the papers had to be Japanese elementary school or junior high school students. Fourthly, the contents had to relate to the school lunch program. Fifthly, the papers had to contain statistical analyses.

Results: A total of 165 papers were selected from the database search and 86 papers from the manual search. Eleven papers were ultimately chosen. The contents of these papers comprised food and nutrition education taught in the classroom (eight papers) and food and nutrition education that utilized school lunch times (three papers). The reports were published following the enactment of the *Shokuiku* Basic Act in 2005 and the School Lunch Act in 2008. Three papers were published in the period 2005 to 2010 and eight in the period 2011 to 2016.

Conclusion: In recent years there has been an increase in the number of reports relating to food and nutrition education using school lunches with the recommendation that this method of education becomes part of the curriculum.

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Key words: school lunch, diet and nutrition teacher, food and nutrition education, team teaching, systematic review

I. Introduction

The *Shokuiku* Basic Act¹⁾ was enacted in June 2005 for the purpose of cultivating a healthy mind and body among citizens over the course of their entire lives and nurturing a rich sense of humanity in response to lifestyle and social changes accompanying Japan's rapid economic growth and an increasingly diversified sense of values regarding individual eating habits and food. The preamble of the *Shokuiku* Basic Act emphasizes *shokuiku* targeted at children in particular; "Food, more than anything else, is important to ensure that children develop a rich sense of humanity and the strength to live." Moreover, Article 5 of this Act mentions the roles played by parents and school personnel in children's *shokuiku*, indicating that aggressive steps should be taken to promote *shokuiku*: "Persons

engaged in the education and upbringing of children must have an adequate awareness of the importance of *shokuiku* and take the necessary steps to promote *shokuiku* among children." Article 20 discusses the proliferation of knowledge regarding the establishment of a guidance system, the implementation of a school lunch program that takes advantage of characteristics unique to the school or local community and the promotion of *shokuiku* among children through various learning experiences conducted as part of the educational curriculum. It also discusses the effects of under-eating or obesity on health and measures to be deployed to encourage healthy eating habits among children along with healthy mental and physical growth through the effective promotion of appealing food and nutrition education at schools, day care centers and other educational institutions. This indicates the considerable

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expectation placed on the school lunch program and on food and nutrition education.

In response to these trends, the School Lunch Act²⁾, following its revision in June 2008, stipulated the promotion of *shokuiku* through the school lunch program and enhanced educational elements of the school lunch program. According to the School Lunch Act²⁾, the school lunch program is positioned as part of school education. Article 1 of this law stipulates essential matters relating to the school lunch program and the implementation of food and nutrition education utilizing the school lunch program by indicating that it contributes to the healthy mental and physical development of elementary school or junior high school students and fulfills an important role in terms of fostering correct knowledge and the ability to make proper decisions relating to food by these students. In addition, the promotion of food and nutrition education at schools was once again stipulated to enhance the proliferation of the school lunch program and the promotion of *shokuiku* at schools. The role of a diet and nutrition teacher was legislated to develop school lunch menus as teaching materials for food and nutrition education. This places considerable importance on the school lunch menu as a teaching aid for the formation of desirable eating habits targeted at school children during their stage of growth and development.

There have been numerous reports, including those at schools in Japan, on the practical implementation of food and nutrition education, its management and the coordination of teaching materials. Although there have recently been reports on trends in intervention studies relating to school-based food and nutrition education³⁾ as well as systematic reviews relating to educational programs at cooking schools focusing on food and nutrition education⁴⁾ in various foreign countries, there have hardly been any reports of systematic reviews comprising a detailed organization and analysis of intervention contents and methods regarding the utilization of food and nutrition education and teaching materials during school lunches in Japan. On the basis thereof, the purpose of this study is to determine trends in food and nutrition education utilizing the school lunch following the enactment of the *Shokuiku* Basic Act in 2005 by focusing on intervention research on this topic in Japan and organizing that research according to subjects, intervention contents and major evaluation

criteria.

II. Methods

1. Extraction of papers

Papers were extracted from a database as well as a manual search.

1) Standardization of research themes

Prior to gathering papers, the PICO method (Population, Intervention, Comparator, Outcome) was used to set the research theme for the systematic review with respect to the subjects of the study, intervention method, comparative measurement method and outcome^{5, 6)}. With regards to this study, P = elementary school or junior high school students, I = interventions relating to food and nutrition education correlated with school lunch times, teaching materials, moral education, foreign language activities, time allotted for integrated studies and special activities utilizing school lunches, O = what types of effects are observed and C = before and after intervention or between an intervention group and control group.

2) Selection of target papers

The criteria for selecting papers was as follows: Firstly, papers had to be extracted from reviewed academic journals excluding bulletins and proceedings. Secondly, papers had to be original, concise and practical (excluding proceedings, case reports and commentaries). Thirdly, the subjects of the papers had to be Japanese elementary school or junior high school students. Fourthly, the contents had to be related to school lunches. Fifthly, the papers had to contain statistical analyses. Finally, the contents had to have been published in the period from 2005 to 2016.

Primary screening consisted of carefully examining titles and abstracts and excluding those papers that did not match the selection criteria. Next, secondary screening was conducted on those papers selected in primary screening. Secondary screening consisted of obtaining and carefully reading the papers and choosing target papers based on the selection criteria. The target papers were selected by two persons, and in cases in which the decisions differed between these two persons, final selection was decided through discussions.

3) Database search

The database search was conducted on 12 May 2017

Table 1 Search Words and Search Format for Papers Examining Food and Nutrition Education at School Lunches in Japan Using the Japan Medical Abstracts Society Database

Group	Search Term
1. Subjects	(School/TH or School/AL)
2. School Lunch	(School lunch/TH or School lunch/AL, (School lunch/TH or School lunch/AL)
3. Food/Nutrition Education	(Food education/TH or Food education/AL), Food education/AL, (Nutrition education/TH or Nutrition education AL), (Eating behavior/TH or Eating behavior/AL), Food education/AL or Eating attitude/AL or Food knowledge/AL or School lunch guidance/AL

Limit conditions: 2005~2016, people, children, excluding case studies, case reports and proceedings.

Search format: Search terms of each group connected with OR, each group linked with AND, searches made according to limit conditions.

TH: Thesaurus, AL: Partial match search targeted at all data.

Search date: May 12, 2017

using Web Version 5 of the Japan Medical Abstracts Society (JMAS) database. The search terms and search format are shown in Table 1. The search terms were obtained by dividing key words relating to this study into three groups based on PICO, connecting the terms in the groups with OR, linking groups with AND, and setting limit conditions.

4) Manual search

The manual search was conducted by referencing previous studies^{7, 8)}. Fifteen journals containing articles on research relating to school education, school lunches, food and nutrition education or nutrition education were targeted. They were the Japanese Journal of Nutrition and Dietetics, Journal of the Family Education Research Center, Japanese Journal of School Health, Journal of the Food Hygienic Society of Japan, Journal of Child Health, Journal of the Japan Dietetic Association, Journal of Nutritional Science and Vitaminology, Journal of Home Economics of Japan, Japanese Journal of Home Economics Education, Bulletin of Japanese Curriculum Research and Development, Japanese Journal of Health Education and Promotion, Japanese Journal of Public Health, Journal of Japanese Society of Shokuiku, Journal for the Integrated Study of Dietary Habits and Journal of Japan Society for the Study of Obesity.

This study contains food and nutrition education in the search terms. Since the JMAS database used for the search mainly contains research relating to medicine, dentistry, pharmacology, nursing, veterinary science and related fields⁹⁾ and frequently rejects subject matter relating to food science¹⁰⁾, it was thought that there would be limitations regarding coverage of papers relating to this study when using this database alone. The extraction of papers by manual search employed the same search terms

and conditions as those used in the database search. In extracting papers, tables of contents were examined from index numbers indicated in academic society journals and websites in the database. Since some journals do not allow access to full abstracts only those that did were examined along with their titles.

2. Production of evidence tables

Evidence tables were produced and organized according to purpose, study subjects, intervention contents, evaluation times, evaluation methods and major results.

III. Results

1. Extraction of papers

The results of the article search are shown in Figure 1. One hundred and sixty five papers were extracted from the JMAS database from which 28 papers were selected based on a careful examination of their titles and abstracts. Subsequently these papers were carefully read in their entirety ultimately resulting in the selection of five papers. During the manual search, 86 papers were selected from 15 academic journals through a careful examination of titles and abstracts in the same manner as the database search, after which the entire contents of the papers were read thoroughly, ultimately resulting in the selection of six papers. Accordingly, a total of 11 papers were selected from a combination of the database and manual search.

The ultimately selected papers were classified into two evidence tables according to the type of intervention, and were organized for purpose, methods and major results. The contents of the selected papers consisted of eight papers describing food and nutrition education provided in the classroom¹¹⁻¹⁸⁾ (Table 2) and three papers describing

Figure 1 Flow Chart of Selection of Papers

Figures in parentheses () indicate the number of papers.

food and nutrition education provided during lunch times¹⁹⁻²¹⁾ (Table 3). School courses offered in the classroom refer to all subjects, moral education, foreign language activities, integrated studies and special activities as indicated in The Course of Study²²⁾.

2. Years of publication and number of papers

The years of publication and number of papers ultimately selected consisted of two papers published in 2008^{11, 12)}, one in 2009¹⁹⁾, one in 2011¹³⁾, one in 2012¹⁴⁾, one

in 2013¹⁵⁾, four in 2015^{16-18, 20)} and one in 2016²¹⁾. All reports were published after 2008 following the revision of the School Lunch Act in that year - three in the period 2008 to 2010 and eight from 2011 to 2016.

3. Study subjects

The subjects targeted in these papers consisted of elementary school students^{11, 13-17, 19, 20)} (eight papers), elementary school students and junior high school students¹²⁾ (one paper), elementary school students and their

parents¹⁸⁾ (one paper) and elementary school students and teachers²¹⁾ (one paper). The school year having the largest number of reports was sixth graders^{11-13, 16, 17, 19)} (six papers), with three papers targeted at fourth graders^{15, 18, 20)}, two papers targeted at fifth graders^{12, 13)} and one paper targeted at second graders¹⁴⁾. In addition, two reports targeted all elementary school grades^{18, 21)} and one report targeted first year junior high school students¹²⁾.

4. Major study purpose

The purpose of the intervention research described in the papers consisted of ten papers targeted at behavioral changes attributable to the effectiveness of food and nutrition education programs. Six of these papers focused on the amount of leftovers of school lunches or improvement in the amount of food consumed^{12, 14, 15, 19-21)} and four papers targeted combinations of foods and improvement of meal contents^{11, 13, 16, 18)}. In addition to behavioral changes, these papers also targeted improvement in attitude towards food such as greater enjoyment from school lunches^{12, 18, 20)}, improvement in understanding and awareness of food such as distinguishing between staple foods, main dishes and side dishes^{13, 16, 19, 20)}, and determining the approach to school lunch guidance by teachers, although not in the form of intervention research²¹⁾. There was also one paper describing research conducted for the purpose of accepting cultural differences relating to food culture¹⁷⁾.

5. Contents of food and nutrition education in school lunches

The people in charge of food and nutrition education in the classroom shown in Table 2 were reported to be in the form of a team comprising a diet and nutrition teacher, homeroom teacher and subject instructor (three papers)^{13, 15, 18)}, a single supervisor such as the homeroom teacher or subject instructor in two papers^{11, 17)}, and other people (three papers)^{12, 14, 16)}. The contents of the classroom courses shown in Table 2 were classified based on curriculum guidelines. The numbers of papers found for each category consisted of two papers indicating home economics^{11, 13)}, one paper indicating social studies in the area of course studies¹⁵⁾, no papers on moral education, one paper indicating foreign language activities¹⁷⁾, one paper indicating the period for integrated studies¹¹⁾ and four papers indicating special activities^{12, 14, 16, 18)}.

Specific methods used to implement food and nutrition education for second graders included intervention through picture storytelling and panel theater performances¹⁴⁾. Methods targeted at fourth graders consisted largely of learning in the classroom, including experiments relating to the five senses and hands-on learning involving eating school lunch using the five senses, discussion on things noticed when eating²⁰⁾, lectures utilizing 10 minutes before lunch¹⁹⁾ or learning using time allotted for social studies or integrated studies¹⁵⁾. Methods targeted at fifth graders consisted of the posting of school lunch news announcements or distributing food and nutrition education news bulletins, as well as learning in the classroom using time allotted for home economics¹³⁾. During this time, the program involved learning about dietary balance as well as actually preparing properly balanced menus and lunches. There were numerous reports of classroom learning methods targeted at sixth graders and these included learning about food culture using time allotted for foreign language activities¹⁷⁾, using time allotted for home economics in the same manner as fifth graders¹³⁾, lectures using the 10 minutes prior to lunch¹⁹⁾, and learning related to staple foods, main dishes and side dishes through homeroom activities¹⁶⁾. Other reports described the posting of school lunch news announcements¹²⁾ and the distribution of food and nutrition education news bulletins¹³⁾. Methods targeted at first year junior high school students were reported to include the posting of school lunch news announcements¹²⁾.

According to reports describing methods targeted at all grades, activities included the holding of events allowing children to confirm school lunch leftovers and the manner in which they are cleaned up²¹⁾, the provision of menus featuring home-grown foods held once a month as part of a school-wide food and nutrition education program¹⁸⁾, the holding of school lunch gatherings combining different grades, and guidance on how to hold chopsticks and on the proper posture when eating held twice a month for the purpose of learning table manners. In the case of classroom learning this included the holding of food and nutrition education classes, and the creation of songs for the purpose of enhancing a sense of appreciation for food producers and preparation staff.

There was also one report targeted at parents instead of elementary school or junior high school students¹⁸⁾. This

Table 2 Food and Nutrition Education Provided in the Classroom†

References	Author (Year Published)	Purpose	Methods			Major Results
			Study Subjects	Intervention Contents	Evaluation Times	Evaluation Methods (Major Evaluation Parameters)
11	Shimada, et al. (2008)	Improvement of Food Selection by Children Through Learning about a Lunch Buffet using the "Lunchbox Diet Method"	<ul style="list-style-type: none"> Elementary school students 61 sixth graders (30 boys, 31 girls) at the S elementary school in Setagaya ward, Tokyo 	<ul style="list-style-type: none"> Use of home economics time, integrated studies time, and school lunch time. Learning program implemented by the home-room teacher, health center staff, home economics teachers, research group members, and others Food-related learning program held at the S elementary school from May to February for 40 hours annually About 11 hours required for learning about lunch buffets, lunch buffets held in May and November ① Making posters about seasonal foods, ② Learning about staple foods, main dishes, and side dishes of a lunch buffet, and learning how to determine suitable amounts for one meal, ③ Planning of well-balanced lunches and presentation of results by children. 	1st intervention (1st lunch buffet) 2nd intervention (2nd lunch buffet)	<ul style="list-style-type: none"> Photographic method (photographs of lunches after lunch buffet) and measurement of lunch weights (nutrient levels, food weight, meal composition) Questionnaire (things noticed by children) Amounts of carbohydrates, carotene, vitamin B1, and dietary fiber increased significantly during 2nd intervention in comparison with 1st intervention, amounts of retinol decreased significantly Fat energy ratio decreased significantly Average weight of rice increased significantly Amounts of green and yellow vegetables and total amount of vegetables increased significantly Amounts of spaghetti and potatoes decreased significantly Amounts of oils and fats consumed by girls decreased significantly Meal compositions changed favorably for all of staple foods, main dishes, and side dishes for both boys and girls
12	Ishikawa, et al. (2008)	Effects on Attitudes and Behavior relating to School Lunches of Elementary and Junior High School Students attributable to School Lunch News Bulletins Provided by High School Students	<ul style="list-style-type: none"> Elementary school students and junior high school students 5th and 6th graders at 11 elementary schools and 7th graders at 5 junior high schools in N City 163 5th graders (67 boys, 96 girls), 138 6th graders (56 boys, 82 girls) 7th graders (43 boys, 56 girls) Total: 400 students (no. of valid survey replies) 	<ul style="list-style-type: none"> Use of special activities time. Contents of learning programs examined by high school teachers, university instructors, and the school dietitian, school lunch bulletins prepared by high school students. Tomatoes selected as the theme, bulletins posted for about 1 month starting the day before tomatoes were served in school lunches to the final day on which eggs were served. Process from tomato production to use in school lunches summarized in bulletins and posted. Color copies of school lunch bulletins prepared by high school students posted in classrooms. Served school lunches using tomatoes and eggs. 	After intervention	<ul style="list-style-type: none"> Questionnaire (whether or not read school lunch bulletin, contents read, whether ate school lunches containing tomatoes and eggs) As a result of a path analysis, a significant path change was observed among elementary school students from "read school lunch bulletins prepared by high school students" to "ate all of the beaten egg soup". significant path change from "read school lunch bulletins prepared by high school students" to "talked with friends", and then from "talked with family members", significant path change also confirmed to "what to eat at home" and then to "talked with family members". "Action of talking with friends" had strong influence on "Action of talking with family members" among elementary and junior high school students.
13	Murai, et al. (2011)	Study of Effects of food and nutrition education Utilizing a Dietary Balance Guide	<ul style="list-style-type: none"> Elementary school students Intervention group consisted of 279 5th and 6th graders at elementary schools in Sakai City. Control group consisted of 206 5th and 6th graders at neighboring elementary schools. 	<ul style="list-style-type: none"> The diet and nutrition teacher performed food-related guidance through team teaching with the home economics teacher. Distribution of school lunch bulletins, lectures using dietary balance guide primarily in home economics class, classes held on menu planning and lunch box preparation. 	Before intervention After intervention	<ul style="list-style-type: none"> Questionnaire survey (changes in manner of eating breakfast and dinner, awareness, degree of understanding and selection rates of staple foods, main dishes and side dishes) After intervention, intervention group compared with control group. Significant increase in "Ate more of staple food than side dish" and "Ate more of side dish than main dish", significant decrease in "Did not eat side dish". Intervention group observed to have proper understanding of staple foods, main dishes and side dishes.
14	Murai, et al. (2012)	Study of Educational Effects of Implementing Food-related Guidance	<ul style="list-style-type: none"> Elementary school students 111 2nd graders at 3 elementary schools in Osaka Breakdown: 2 classes at elementary school A (26 students, 12 boys, 14 girls, 26 students, 12 boys, 14 girls), 1 class at elementary school B (27 students, 14 boys, 13 girls), 1 class at elementary school C (32 students, 15 boys, 17 girls) 	<ul style="list-style-type: none"> College students studying diet and nutrition provided food-related guidance to children for 45 minutes (theme: No leftovers from school lunch) followed by a comparison before and after guidance. ① Picture storytelling, ② Panel theater, ③ Plays 	Before intervention After intervention	<ul style="list-style-type: none"> Questionnaires (degree of acquiring guidance contents, motivation to try foods do not like, enjoyment of school lunches) 62.5% to 69.2% of children stated understood that they should eat all of their lunch without leaving any leftovers. Significant increases were observed in school lunch enjoyment scores in one class following guidance.

15	Sakamoto, et al. (2013)	Potential for Implementation of Food-related Guidance during Social Studies Courses and Integrated Studies Times led by Homeroom Teachers	<ul style="list-style-type: none"> Elementary school students 106 4th graders at public elementary schools in Osaka prefecture (45 boys, 61 girls) 	<ul style="list-style-type: none"> Team teaching during social studies course. Classes planned by 3 homeroom teachers, the diet and nutrition teacher and nutrition education researchers Held during "Daily Life and Garbage" social studies course for a total of 9 hours from June 1 to June 29. One hour devoted to food-related guidance performed through team teaching by homeroom teacher and diet and nutrition school teacher. Learned about amount and contents of garbage produced by school lunches. Integrated studies time used for total of 27 hours from June 1 to July 19 (Thinking about the environment) 	<p>Before intervention</p> <p>After intervention</p> <p>Follow-up survey (2 months after intervention)</p>	<ul style="list-style-type: none"> Questionnaires (attitude toward leftover food, self-efficacy regarding eating entire meal without leaving leftovers, typical leftover status) School lunch leftover rates (intervention group vs. all students excluding intervention group): Also implemented during intervention 	<ul style="list-style-type: none"> With respect to self-efficacy, the number of children who replied they would or somewhat would try to eat the entire lunch without leaving any leftovers even if there were foods they didn't like increased from 83.5% before intervention to 90.7% after intervention, and to 94.8% after the follow-up survey. Significant differences were observed before and after intervention and between after intervention and the follow-up survey. Significant differences were observed for typical leftover status before and after intervention and between after intervention and the follow-up survey. School lunch leftover rates in the intervention group decreased significantly during the intervention period as compared with before intervention, and significant differences were observed between the six month intervention period and the time of the follow-up survey. There were no significant changes in leftover rates for all students excluding the intervention group.
16	Murai, et al. (2015)	Learning about Staple Foods, Main Dishes, and Side Dishes Leading to Practical Implementation of Eating Combinations of Foods	<ul style="list-style-type: none"> Elementary school students 27 students of a 6th grade class at N elementary school in Osaka (14 boys, 13 girls) 	<ul style="list-style-type: none"> Use of homeroom activities as special activity. Classes supervised by author and one 4th year graduate student in field of nutrition education. Implementation of food and nutrition education program. Classes were held twice during the 45 minute homeroom period (2nd class held as second day of 1st class), and a check was made by self-monitoring following guidance. Classes were held on staple foods, main dishes and side dishes using a worksheet. School lunches shared by students were used when checking combinations of foods. 	<p>Before intervention</p> <p>Two months after intervention</p>	<ul style="list-style-type: none"> Questionnaire survey (degree of awareness and understanding of staple foods, main dishes, and side dishes) 	<ul style="list-style-type: none"> Significant increase in children eating better breakfasts before and after guidance. Significant increase in degree of awareness. Significant improvement of degree of understanding of main dishes and side dishes.
17	Kanda, et al. (2015)	Verification of Learning Effects of <i>Shokuiku</i> (food and nutrition education) Program during Foreign Language Activities Incorporating International Exchange	<ul style="list-style-type: none"> Elementary school students 120 sixth graders (3 classes) at G municipal elementary school in Gifu prefecture 	<ul style="list-style-type: none"> Utilization of foreign language activities Shokuiku education conducted for 45 minutes led by the same English teacher for both groups at both schools (course objective: enhance interest and understanding of food culture of South Korea), class focused on understanding food culture. International exchange held after implementing three Shokuiku education classes during foreign language activities held once a week Students introduced school lunches from their own country during international exchange. School lunch menus for 5 days from both schools used as teaching materials. 	<p>Before intervention</p> <p>After intervention</p> <p>Follow-up survey</p>	<ul style="list-style-type: none"> Questionnaire in Japanese (interest and understanding of Korean food culture, interest, importance, and understanding of foreign languages, interest, and importance of meals) 	<ul style="list-style-type: none"> In a comparison of acceptance of different cultures regarding the food culture of South Korea, students regarded a significantly greater desire to eat those foods in a comparison between before and after intervention, indicating that they would like to try Korean-style makizushi or Korean confections, and this desire was maintained throughout the follow-up survey.
18	Shimada, et al. (2015)	Examination of the Effects of <i>Shokuiku</i> (food and nutrition education) Program	<ul style="list-style-type: none"> Elementary school students and their parents 226 students and 170 parents from municipal elementary schools in a rural area of Shikoku 	<ul style="list-style-type: none"> Team teaching using special activities Food and nutrition education programs were held starting in June 2011 utilizing homeroom activities, class gatherings, and optional observation days in collaboration with homeroom teachers (summary: (1) improvement of learning guidance, (2) contrivances to school lunch times, (3) food and nutrition education activities in cooperation with parents). Distribution of school lunch bulletins to parents, holding of parent-child cooking classes, implementation of individual consultations for parents with children having obese tendencies. 	<p>Before intervention</p> <p>After intervention</p>	<ul style="list-style-type: none"> Questionnaires (knowledge and self-awareness regarding food through hands-on learning, enjoyment of school lunches, breakfast consumption status, status of eating with others) 	<ul style="list-style-type: none"> Percentage of children indicating that they enjoyed school lunches very much increased from 61.7% before intervention to 77.5% after intervention. Parents replied that the amounts of meat, wieners, vegetables, and fruit decreased at dinner time, while the amounts of fish, shellfish and dairy products increased. Amounts of meat and wieners eaten decreased during breakfast, while amounts of fish, shellfish, eggs, and dairy products eaten increased.

† Classroom: Course studies, moral education, foreign language activities, integrated studies time, special activities

Table 3 Food and Nutrition Education Provided during Lunch Time

References	Author (Year Published)	Purpose	Methods			Major Results
			Study Subjects	Intervention Contents	Evaluation Times	Evaluation Methods (Major Evaluation Parameters)
19	Okazaki, et al. (2009)	Effects of Practical Implementation for Improving School Lunch Intake	<ul style="list-style-type: none"> Elementary school students 71 fourth graders from 2 classes and 74 sixth graders from 2 classes at the S elementary school in Tsurugashima City, Saitama Prefecture 	<ul style="list-style-type: none"> Food and nutrition education implemented for 10 minutes before lunch by the college instructor and 4th years students of the management training course. Held a total of 6 times (once every two weeks for 5 months). Held for the purpose of acquiring knowledge regarding nutrition education consisting mainly of the purpose of school lunches and their understanding. 	<ul style="list-style-type: none"> Before intervention After intervention 	<ul style="list-style-type: none"> Questionnaire (eating habits, lifestyle habits) Lunch leftover survey: Lunch leftover surveys conducted before intervention, on day of intervention and after intervention In-school physical measurements (height, weight), results of dental examinations <p> <ul style="list-style-type: none"> Many 4th graders in the intervention group midway through the intervention period replied that they were familiar with the amount of food leftover from school lunches in comparison with a control group, and a significant difference was observed. Similar results were obtained during the latter part of the intervention period. Many 6th graders in the intervention group midway through the intervention period replied that they were familiar with the purpose of school lunches in comparison with a control group, and a significant difference was observed. Similar results were obtained during the latter part of the intervention period. During the latter part of the intervention period, 4th graders in the intervention group were found to be familiar with the effect of chewing food well, while many 6th graders replied that they were grateful for the food and its producers, and significant differences were observed. Average leftover rates were high among 4th graders before intervention and early in the intervention period, and although there were significant differences between the intervention group and control group, these differences were no longer observed during the latter part of the intervention period. Average leftover rates among 6th graders were lower in comparison with those among the control group during the latter part of the intervention period, and a significant difference was observed. </p>
20	Ueda, et al. (2015)	Study of the Efficacy of a Taste Education Program for Children	<ul style="list-style-type: none"> Elementary school students Two classes of 4th graders of the elementary school of N Women's University (Class A: 39 students, Class B: 39 students) 	<ul style="list-style-type: none"> Methods and contents of "Learning about Food" class determined by the diet and nutrition Teacher and the homeroom teacher, and classes held using experiments and worksheet on enjoying eating using the five senses. School lunches eaten using the five senses in order to confirm the contents of the "Learning about Food" class during 3 hours of the "Learning about Food" class and during school lunch time, and things noticed by the students were written on tags and affixed to a challenge sheet, or presentations were given. 	<ul style="list-style-type: none"> Before intervention After intervention 	<ul style="list-style-type: none"> Questionnaires (relating to enjoyment of eating and school lunches) School lunch leftover survey: A survey of the amounts of leftovers by meal was conducted during the intervention period. <p> <ul style="list-style-type: none"> Parameters relating to factors behind conditions for enjoying eating improved following learning, and a significant difference was observed in conditions for enjoying eating between the intervention group and control group. A significant difference was observed in leftover rates between the intervention group and control group, and was similarly observed between menus. </p>
21	Ishihara, et al. (2016)	Verification of Changes in School Lunch Leftover rates before and after holding a "School Lunch Education Program" and Approach to School Lunch of Teachers	<ul style="list-style-type: none"> Elementary school students and teachers Four elementary schools in the S school district in Tokyo. 680 lunches were served at school A, 360 at school B, 390 at school C and 510 at school D. 68 teachers at the four schools (18 at school A, 15 at school B, 15 at school C and 20 at school D) 	<ul style="list-style-type: none"> "School Lunch Education Program" developed primarily by school management and the school dietitian. "School Lunch Education Program" conducted at school A. ①Teaching materials relating to school lunches for carrying by children and all teachers (used before school lunches, when passing out school lunches, while eating school lunches and during cleanup) prepared and distributed in the form of a booklet. ②Holding of a "School Lunch Champion" event. Amounts of leftovers and cleanup are monitored by students during the 5-day event week. ③Review of school lunch menu by the school dietitian, teachers, and all children. 	<ul style="list-style-type: none"> Before intervention After intervention 	<ul style="list-style-type: none"> School lunch leftover rates Questionnaires (contents of guidance provided during school lunches, manner in which guidance provided, average amount of time required for lunch, etc.); Targeted at teachers <p> <ul style="list-style-type: none"> The results of the school lunch leftover survey indicated a decrease on the day following the "School Lunch Champion" event. Statistical analysis was not performed. The average value for leftover rates for the 2013 school year in the intervention group was low, and a significant difference was observed between the intervention group and a control group. </p>

report described the distribution of school lunch news bulletins once a month and food and nutrition education news bulletins twice a month, individual consultations targeted at parents of children with obese tendencies, and the holding of lecture meetings and parent-child cooking courses focusing on the importance of good food and nutrition.

The contents of food and nutrition education were classified into six categories according to the “Food-Related Guidebook”²³⁾ published by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in March 2010. These categories included “the importance of food,” “mental and physical health,” “ability to select foods,” “sense of gratitude,” “social responsibility” and “food culture.” The respective numbers of papers consisted of one paper on the “importance of food,”¹⁸⁾ including guidance for its enjoyment and on regular eating; four papers on “mental and physical health”^{13, 14, 16, 19)} including understanding the desirable way to consume nutrients and meals, reviewing one’s own eating habits and attempting to form better eating habits; two papers on “ability to select foods”^{11, 18)} including the ability to acquire proper sound knowledge and make judgments relating to food; five papers on “sense of gratitude”^{12, 15, 19–21)} such as not leaving food on the plate and appreciating those responsible for producing food; two papers on “social responsibility”^{15, 21)} including the practical implementation of eating habits that give consideration to the environment and natural resources; and one paper on “food culture”¹⁷⁾ targeted at enhancing understanding of Japanese culture and food culture.

6. Evaluation methods and outcomes of food and nutrition education at school lunches

Evaluations were performed using the questionnaire survey method in all the studies examined with seven papers^{11, 12, 15, 17, 18–20)} determining food-related awareness; three papers^{13, 14, 16)} determining awareness and degree of understanding and a fact-finding survey of school lunches²¹⁾. In addition, dietary surveys were conducted in 10 papers, with five reports describing quantitative determinations^{11, 15, 19–21)} and five describing qualitative determinations^{12–14, 16, 18)}. The quantitative survey methods used included photographic methods in one paper¹¹⁾ and calculation of leftover rates in four papers^{15, 19–21)}. One paper also contained a report that included physical mea-

surements and dental examination results in addition to a dietary survey²⁰⁾.

IV. Discussion

This study provides the first report of trends in food and nutrition education utilizing school lunches conducted in Japan. It consists of a systematic review relating to research verifying the effects of food and nutrition education in school lunches targeted at elementary school or junior high school students, the findings from which are reported below.

1. Number of papers

The systematic review focused on papers published after the enactment of the *Shokuiku* Basic Act in 2005. The papers that met the research criteria were published from 2008 following a revision of the School Lunch Act, with six of the total of 11 selected papers containing reports undertaken in the period 2015–2016, ten years after the enactment of the *Shokuiku* Basic Act. The number of reports relating to food-related guidance during school lunches has increased in recent years, and activities were suggested for implementation during school lunches as part of the educational curriculum. The papers selected comprised eight papers describing intervention contents related to food and nutrition education conducted in the classroom, and three papers describing intervention contents relating to food and nutrition education that utilized school lunch times.

Following legislation of the Diet and Nutrition School Teacher System and the revision of the School Lunch Act, reports have been published relating to the effects of food and nutrition education. This indicates that the role of the diet and nutrition school teacher is in line with the inherent objective of deploying food and nutrition education utilizing school lunches, and that school lunches are being implemented in the form of educational activities as a part of the curriculum. During the course of primary screening, 117 papers were excluded on the basis of not satisfying the selection criteria. In this study, some of the selection criteria were that papers had to be original articles, written concisely and be practical accounts. Proceedings, case reports and commentaries were excluded. Consequently, although there were a large number of reports^{24–28)} in the form of bulletins and practical activities that were

suitable for the theme of this study, including the development of a food and nutrition education program using school lunches²⁹⁾ and the effect of using food and nutrition education luncheon mats during school lunches³⁰⁾, these were excluded because they did not fit the criteria.

Also excluded were the Super *Shokuiku* School Projects initiated in 2014³¹⁾. Although the majority of their contents have not yet been reported, a listing of the types of programs implemented is available on the MEXT³²⁾ website. More recently, the results of analyzing the contents of food education programs implemented in 69 examples of Super *Shokuiku* School Projects during the 2014 and 2015 school years have been reported as reference materials³³⁾.

The School Lunch Act²⁾ places the responsibility on the diet and nutrition teacher to provide food and nutrition education utilizing school lunch programs. The duties performed by diet and nutrition teachers include the provision of food and nutrition education in three areas: during school lunch time, in the classroom, and guidance in the form of individual consultations for school children having health issues relating to food. There was however no report describing interventions in the form of individual consultations extracted for this study. Although the selected papers included reports of individual consultations targeted at parents of children with obese tendencies²¹⁾, descriptions regarding the effects of this intervention were not available. However, a report was found relating to the provision of stepwise dietary guidance and the effects thereof targeted at high school students requiring special needs education³⁴⁾. Although this paper was not selected since this study is targeted at elementary or junior high school students, according to the School Lunch Act³⁵⁾, high schools providing special needs education operate according to the Criteria for Provision of School Lunches. Schools for special needs education are operated with greater flexibility while giving ample consideration to such factors as the health status of individual students, daily living status and actual conditions in the community³⁵⁾. Since dietary management for students at schools for special needs education is intimately related to eating habits at home or in the dormitory as well as meals served at hospitals - homeroom teachers, diet and nutrition teachers, school dietitians, school nurses, school physicians, primary physicians, parents and other related persons were shown to collaborate in an attempt to imple-

ment dietary management that takes into view lifestyle habits of students while striving towards a common understanding. Individual consultation and guidance needs to be provided by the diet and nutrition teacher on a daily basis corresponding to the actual circumstances³⁵⁾.

In its "Future School Lunch Program Centering on Diet and Nutrition Teacher"³⁶⁾ released in March 2017 MEXT indicates practical methods for individual consultations and guidance provided by diet and nutrition teachers. Examples provided of likely areas for individual guidance include "unbalanced eating tendencies," "obese tendencies," "under-eating tendencies," "food allergies" and "sports." Individual guidance is expected to be effective since it allows students to receive in-depth guidance and advice that takes advantage of the expertise offered by diet and nutrition teachers. In the future, there is expected to be an increase in the number of these practical case studies resulting in the development and sharing of practical educational practices and evaluation methods.

During the course of secondary screening which involved the careful reading of papers selected during primary screening, 34 papers described investigative research for dietary and nutritional management, accounting for a large number of the papers. In the report released by MEXT entitled, "*Shokuiku* henceforth centering on Diet and Nutrition Teachers"³⁶⁾, each of the programs promote dietary and nutritional management as an integral part of school lunch management by striving to achieve a correlation with annual guidance programs implemented in the classroom. Previous research reports that duties around school lunches account for a large part of dietary and nutritional management³⁷⁾ and are required for proper and safe school lunches³⁸⁾. There is therefore thought to be a large number of research papers relating to dietary and nutritional management. Although a large number of reports relating to investigative research and basic research³⁹⁻⁴⁶⁾ were identified, only 11 papers contained reports of interventions involving food and nutrition education, and coordination between basic research and practical research such as intervention research is recommended for the future.

2. Purpose and contents of food and nutrition education during school lunches

When the contents of food and nutrition education were examined using the classifications advocated by MEXT,

the results indicated that the most frequently observed contents fell under the category of a “sense of gratitude,” including placing importance on food and not leaving any leftovers as an expression of gratitude. However, this is thought to be due to a correlation between the methods used to evaluate food and nutrition education and outcome indicators. Since surveys on the amount of food left over can be conducted quantitatively facilitating comparative studies, they can also be used to assess the outcome of guidance. Among the 11 papers ultimately selected, left-over rates were calculated in four papers^{15, 19–21}). In addition, a large number of reports were identified in which the guidance deployed fell under the category of “mental and physical health.” Food and nutrition education utilizing school lunches has been implemented in Japan for the purpose of maintaining and promoting the mental and physical health of elementary and junior high school students while addressing various food-related health issues associated with children. Education utilizing school lunches has been deployed to instill behavioral change, and impart knowledge regarding proper combinations of foods and suitable dietary intake per meal. This provides an understanding of the desirable way to consume nutrients and meals, thereby enabling students to manage their diets on their own.

Most of the studies showed that persons in charge of food and nutrition education and of food-related interventions implemented in the classroom took the form of a team comprising a diet and nutrition teacher, homeroom teacher and subject instructor. Food and nutrition education utilizing school lunch time was indicated in three papers^{19–21}). School lunch programs were provided five times a week³⁵), and since this gives an opportunity for hands-on learning through the eating of school lunches, it allows for systematic and continuous guidance leading to expectations of behavioral changes. However, in the case of instruction provided only during school lunch times, it is difficult to verify and evaluate effectiveness due to the short time period, and this is thought to be responsible for the small number of intervention reports. In the future, guidance will be required that combines food and nutrition education in the classroom with school lunch times which provide an opportunity for hands-on learning on a daily basis. In addition, many of the papers targeted by this study contained ambiguous reports that were not system-

atic or organized. Since food and nutrition education is implemented at schools to achieve education goals, it is considered important to publish reports demonstrating a clear understanding of correlation by clarifying the manner in which food and nutrition education is positioned.

3. Evaluation methods and outcomes of food and nutrition education during school lunches

According to the School Lunch Act, food and nutrition education utilizing the school lunch program is positioned as one of the duties of the diet and nutrition teacher. When considering that food and nutrition education is legally positioned in this manner, evaluation of educational effects is considered to be one of the responsibilities of the diet and nutrition teacher, and research reports in this area are expected in the future.

Ministry of Education, Culture, Sports, Science and Technology described the evaluation of food and nutrition education in its “Future School Lunch Program Centering on the Diet and Nutrition Teacher”³⁶⁾ released in March 2017. Although this report indicated knowledge relating to food, awareness of food, eating habits, lifestyle habits, obesity and under-eating as evaluation parameters of food and nutrition education, evaluation indices are not indicated for each parameter. The indices used to evaluate food and nutrition education as well as the methodology, are major issues. Discussions⁴⁷⁾ and proposals⁴⁸⁾ have been made relating to the evaluation of food and nutrition education at schools, and evaluation theories and techniques are likely to be devised. The evaluation methods revealed in this study included photographic methods that were examined for validity¹¹⁾. In many of the other reports, questionnaire forms and worksheets were used that were proprietarily developed by the person providing guidance. In future, the establishment of evaluation theories and techniques and the development of questionnaire forms that have been examined for validity are expected to result in an increase in the number of studies using these tools along with facilitated comparisons with previous studies.

4. Novelty and limitations of this study

This study provided the first report of a systematic review of trends in food and nutrition education utilizing school lunches implemented in Japan and has identified the contents of food and nutrition education following legislation of the Diet and Nutrition Teacher system and

revision of the School Lunch Act. The purpose of this study was to gather papers as comprehensively as possible, proceed with research using systematic review techniques, and combine the use of a database search and a manual search. Since six papers were selected on the basis of a manual search, it is thought that failure to gather important papers was minimized.

With respect to the limitations of this study, since the target papers were restricted to domestic journals and the database search was limited to the JMAS database, there is an issue with regards to the limited number of papers reviewed. Although the search format was carefully constructed, the existence of applicable papers that did not register a hit with the search words used in this study cannot be denied. The omission of papers from the search could therefore not be completely prevented. Although a manual search was conducted in conjunction with the database search for this reason, given that the search was limited to only certain journals, the study did not target all papers published in Japan, and there is the possibility that some studies were overlooked. Although decisions on which papers were selected were made after two persons carefully examined the papers and discussed their results, the presence of bias in making subjective judgments cannot be ruled out.

V. Conclusion

In this study, a systematic review of research papers was conducted to determine trends in food and nutrition education in Japan utilizing school lunches following the enactment of the *Shokuiku* Basic Act in 2005, the revision of the School Lunch Act in 2008 and legislation regarding the Diet and Nutrition Teacher system. A total of 11 papers were ultimately selected. These reports suggested that the role of a diet and nutrition teacher is in line with the inherent objective of deploying food and nutrition education utilizing school lunches, and that school lunches are being utilized as part of the educational curriculum. In particular, a large majority of food and nutrition education was observed to be taught in the classroom, and this was reported to lead to favorable changes. In the future, steps to promote behavioral changes are expected to be taken by implementing guidance using school lunch times, which serves as an opportunity for hands-on learning

roughly 190 times a year, in combination with food and nutrition education provided in the classroom.

Conflict of Interest

This study does not contain matters constituting a conflict of interest.

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