Validation of a Modified Questionnaire of Interests in Healthy Eating Habit for Japanese Adolescent

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(Received September 3, 2021)

Summary

To evaluate the effect and outcome by Shokuiku and nutrition education, it is need to develop the reliability and validity questionnaire for behaviors and interests in healthy eating habits for Japanese adolescents. Our aim was to develop the reliability and validity questionnaire about them for Japanese adolescents. Interests in healthy eating habits for Japanese adolescents were modified Japanese questionnaire of consciousness in dietary life (JQCDL) for university students developed by Hamaguchi et al. The surveys were carried out at two public junior high schools and 381 students in second year participated. Reliability of JQCDL–adolescent form (JQCDL–AF) was examined by factor analysis and calculation of Cronbach’s α. Validity of JQCDL–AF was examined by divergent of gender and by experimental intervention which investigated the changed scores from lunchbox to school lunch. High score of JQCDL–AF showed more interests in healthy eating habits. From histogram and factor analysis, four questions were excluded from JQCDL. We chose two subscale factors to form the domains: reduction unhealthy foods when eating out or snacking (4 items), and meal manners and meal preparation (7 items). Cronbach’s α of two subscales and all items (11 questions) were 0.845, 0.826, and 0.860, respectively. The total JQCDL–AF scores in girls were significantly higher than those of boys. Moreover, the total JQCDL–AF scores 1-mo after introducing school lunches increased significantly from the lunchbox. Therefore, the JQCDL–AF could evaluate interests in healthy eating habits in Japanese adolescents.

Key Words
reliability, validity, interests in healthy eating habits, Japanese adolescents, questionnaire, school meal

Developed nations have presented promising school food environment policies, such as the direct provision of healthy foods, beverages, fruits, and vegetables, quality standards for competitive foods and beverages, and quality standards for school meals (lunch) (1). In the meta-analysis, Micha et al. reported that school food environment policies improved overall dietary habits of children in and outside schools (1). In Japan, the basic act on Shokuiku (Food and Nutrition Education) was enacted in 2005 (2, https://www.mext.go.jp/content/20211012-mxt_kenshoku-000008678_2.pdf). From 2006, the basic plan for the promotion of Shokuiku have been implemented. Moreover, at March 31 2021, the 4th basic plan for the promotion of Shokuiku were presented. Therefore, Shokuiku is one of the important educations in order to develop healthy food habits during childhood.

Reliable and valid questionnaires for eating habits and behavior are need due to evaluate the benefits and outcome by Shokuiku. In other countries, some questionnaire for eating habits and behavior were developed such as the adolescent food habits checklist (3), self-regulation of eating behavior questionnaire in adolescent (4), children’s food preference questionnaire (5) and food choice questionnaire (6). However, there are no reliable and valid questionnaire of food consumption behaviors and interests in healthy eating habits for Japanese junior high school students. Hamaguchi et al. reported relationship between the consciousness and behavior in dietary life of university students (7). In the study, 15 questions about the consciousness in dietary life were extracted (7). We considered that the 15 questions were useful for assessing interests in healthy eating habits for Japanese adolescent. Thus, we modified the 15 questions and examined the reliability and validity of these questions in Japanese junior high school students.
Materials and Methods

Subjects and ethical considerations. The surveys were carried out at two public junior high schools (X school and Y school) and 381 students (166 students in X school and 217 students in Y school) in second year participated. All procedures were conducted in accordance with code of ethics of World Medical Association (Declaration of Helsinki). Homeroom teachers and the authors explained the details of the study orally and students’ answering of the questionnaires was interpreted as their consent to participate in the study. All the surveys were approved by the principals of these Public Junior High Schools and by the Mukogawa Women’s University Research Ethics Committee (Permitted Number: 18-87 and 21-06).

Study designs. At the X school, the first survey was conducted in January 2019. In February 2019, the lunch system was changed from students bringing lunchbox from home (lunchbox) to providing meals prepared on site (school lunch). The second survey took place in March 2019.

At the Y school, the first survey was conducted in January 2021. In February 2021, the lunch system was changed from lunchbox to school lunch. The second survey took place in March 2021.

| Table 1. Baseline information. |
|--------------------------------|
| X school | Y school | p value |
| Number of all students in second year, numbers | 166 | 217 | — |
| Number of students participated in the first survey, numbers | 152 | 215 | — |
| Number of students who completely answered the first JQCDL-AF, numbers | 150 | 210 | — |
| Gender | | | |
| Boys | 75 (50.0%) | 106 (50.5%) | 1.000 |
| Girls | 75 (50.0%) | 104 (49.5%) |
| Number of days breakfast is taken per week, d/wk | 7 (7–7) | 7 (7–7) | 0.386 |
| Frequency of sharing the breakfast with the family | | | |
| Almost everyday, numbers | 64 (42.7%) | 80 (38.1%) |
| 4–5 d a week, numbers | 20 (13.3%) | 30 (14.3%) |
| 2–3 d a week, numbers | 14 (9.3%) | 23 (11.0%) | 0.648 |
| 1 d a week, numbers | 11 (7.3%) | 9 (4.3%) |
| Almost never, numbers | 41 (27.3%) | 68 (32.4%) |
| Items eaten for breakfast | | | |
| A soup or smoothie only, numbers | 8 (5.3%) | 11 (5.2%) |
| Staple food only (e.g., Onigiri, bread), numbers | 85 (56.7%) | 111 (52.9%) |
| Staple food and main dish, numbers | 42 (28.0%) | 53 (25.2%) | 0.904 |
| (e.g., bread and scrambled eggs) | | | |
| Staple food, main and side dishes, numbers | 15 (10.0%) | 25 (11.9%) |
| (e.g., bread, scrambled eggs, and salad) | | | |
| N/A, numbers | 0 | 10 (4.8%) |
| Number of days snacks are taken per week, d/wk | 7 (5–7) | 7 (5–7) | 0.447 |
| Extracurricular activities | | | |
| Sports club | 83 (55.3%) | 116 (55.2%) |
| Cultures club | 58 (38.7%) | 72 (34.3%) | 0.295 |
| Not belong to any club | 8 (5.3%) | 20 (9.5%) |
| Other and N/A, numbers | 1 (0.7%) | 2 (1.0%) |
| Travel time to school from home | 30 (15–40) | 14 (5–20) | <0.001 |

1 Data are presented in number of students or median and 25th–75th percentiles.
2 Statistical analysis were assessed by Mann–Whitney U test, chi-square test or Fisher’s exact test. Differences with p < 0.05 were considered significant.
Reliability and validity of JQCDL–adolescent form (JQCDL–AF) in Japanese junior high school students. Reliability of JQCDL–AF in junior high school students was examined by factor analysis on principal factor solution and varimax rotation, and calculation of Cronbach’s α. Cronbach’s α is an index of internal consistency reliability.

Convergent validity of JQCDL–AF in junior high school students was examined by stratified analysis of the student’s gender and the frequency of sharing the breakfast with the family. Divergent validity was examined by the travel time to school from home. Validity of experimental intervention was investigated by the changed scores from lunchbox to school lunch.

Statistical analysis. Factor analyses and calculations of Cronbach’s α were performed with SPSS for Windows (version 28.0; SPSS, Chicago, IL, USA). Cut-off point in a factor loading used 0.4. Cronbach’s α<0.8 determined no problem with reliability coefficients.

Scores of JQCDL–AF are presented as medians and 25th–75th percentiles. Baseline information in X and Y schools was assessed by Mann–Whitney U test, chi-square test or Fisher’s exact test. Convergent and divergent validity was assessed by Mann–Whitney U test. Validity by experimental intervention was assessed by Wilcoxon signed-rank test. Differences with p<0.05 were considered significant. Comparison analyses were performed with GraphPad Prism version 5.0 (GraphPad Software, San Diego, CA, USA).

Results

Subject numbers

At X school, 152 students participated in the first survey (Cooperation rate: 91.6%). Two students left any blank or incomplete responses in the JQCDL–AF. At Y school, 215 students participated in the first survey (cooperation rate: 99.1%). Five students left any blank or incomplete responses in the JQCDL–AF. Therefore, the numbers for the analysis of internal consistency reliability were 360. The numbers for the analysis of convergent and divergent validities in X and Y schools were 150 (boys 575, girl 575) and 210 (boys 106, girl 104), respectively. The student’s baseline information was shown in Table 1.

At X school, 149 students participated in both of the first and second surveys. Two students left any blank or incomplete responses in the JQCDL–AF in each of the first or second surveys. At Y school, 207 students participated in both of the first and second surveys. Eight students left any blank or incomplete responses in the JQCDL–AF in each of the first or second surveys. Therefore, the numbers for the analysis of validity by experimental intervention in X and Y schools were 147 and 199, respectively.

Reliability of JQCDL–AF

Q1 and Q3 were excluded from JQCDL–U because these questions observed a ceiling effect (Supplemental Online Material, Table S1). Moreover, Q2 and Q4 were excluded from JQCDL–U because a factor loading of these questions were less than 0.4 (data not shown). As a result of excluding these four items and performing factor analysis again, the factor loading was 0.4 or more in all items (Table 2). We chose two subscale factors to form the domains (Table 2): Reduction of unhealthy foods when eating out or snacking (Factor 1: 4 items), and meal manners and meal preparation (Factor 2: 7 items). Cronbach’s α of two subscales and all items (11 questions) were 0.845, 0.826, and 0.860, respectively.

Table 2. Factor loading and Cronbach’s α in the Japanese Questionnaire of Consciousness in Dietary Life–adolescent form (JQCDL–AF).1

| No. | Question | Factor 1 | Factor 2 | Cronbach’s α |
|-----|----------|----------|----------|--------------|
| 1   |          | 0.860    |          |              |
| 2   |          |          |          |              |
| 3   |          |          |          |              |
| 4   |          |          |          |              |
| 5   | Reduce the frequency of using the convenience store | 0.725 | 0.224 | 0.845 |
| 6   | Avoid eating fast food | 0.731 | 0.257 |
| 7   | Avoid buying ready-made meals | 0.766 | 0.250 |
| 8   | Reduce the frequency of eating out | 0.689 | 0.144 |

1 Data of 360 students who had participated in the first survey and who did not leave any blank or incomplete responses in the JQCDL.
2 The cut-off point of factor loading after three times varimax rotations is 0.4.
3 More 0.8 of Cronbach’s α indicate that scale items measure related concepts.
respectively (Table 2). The final 11 items were JQCDL–AF.

Convergent and divergent validities of JQCDL–AF

Convergent validity is confirmed by the association with factors that appear to be relevant. Divergent validity is confirmed by the no association with factors that appear to be unrelated. We used that the relevant factors were the student’s gender and the frequency of sharing the breakfast with the family and that the unrelated factor was travel time to school from home.

In both of X and Y schools, the total JQCDL–AF scores in girls were significantly higher than those of boys (Supplemental Online Material, Tables S2 and S3, \( p < 0.001 \) and \(< 0.001\), respectively). Moreover, the total JQCDL–AF scores were significantly higher to students answering “Almost everyday” than those answering “Almost never” (Supplemental Online Material, Tables S2 and S3). Thus, the student’s gender and the frequency of sharing the breakfast with the family is confirmed by the no association with factors that appear to be relevant. Divergent validities of JQCDL–AF are reflected interests in healthy eating habits not only in Japanese university students but also in Japanese junior high school students. Thus, we modified the 15 questions for Japanese adolescent and examined the reliability and validity of this questionnaire for Japanese adolescent. We challenged to develop the reliability and validity of questionnaire for Japanese junior high school students in order to assess interests in healthy eating habits.

Questions for assessing interests in healthy eating habits were created with reference to the report by Hamaguchi et al. (7). In the Hamaguchi’s report (7), as a result of ceiling effect, factor analysis, and model analysis, 15 questions of JQCDL–U were finally selected after 33 questions. We considered that the 15 questions reflected interests in healthy eating habits not only in Japanese university students but also in Japanese junior high school students. Thus, we modified the 15 questions for Japanese adolescent and examined the reliability and validity of these questions.

Cronbach’s \( \alpha \) is an index of internal consistency reliability (8). Cronbach’s \( \alpha \) is the lower bound of the reliability coefficient, and the true reliability coefficient is always closer to 1 than calculated Cronbach’s \( \alpha \) (8). Cronbach’s \( \alpha > 0.8 \) is no problem with reliability coefficients (8). In the first surveys, Cronbach’s \( \alpha \) of two subscales and all items (11 questions) in JQCDL–AF were more than 0.8. Therefore, it was suggested that the internal consistency reliability of this questionnaire was no problem.

Convergent validity of JQCDL–AF is to discriminate between impacts variables associated with interests in healthy eating habits (8). Kajiyama et al. reported that female Japanese junior high school students were more attentive to having a good nutritional balance than male students (9). Matsumoto and Fukasawa reported that Japanese junior high school students sharing the breakfast with the family is more frequency of nutrition and health than the students eating breakfast alone (10). Ezaki reported a relationship between the meal-related quality of life and the student’s perception of sharing the meals with the family (11). Thus, the student’s gender and the frequency of sharing the breakfast with

**Discussion**

Shokuiku (Food and Nutrition Education) is important to develop healthy food habits during childhood. Reliable and valid questionnaires are need to evaluate the benefit and outcome by Shokuiku. However, there are no reliable and valid Japanese questionnaire of food consumption behaviors and interests in healthy eating habits for Japanese adolescent. We challenged to develop the reliability and validity of questionnaire for Japanese junior high school students in order to assess interests in healthy eating habits.

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**Table 3. Change of Japanese Questionnaire of Consciousness in Dietary Life–Adolescent Form (JQCDL–AF) scores from First survey (lunchbox) to Second survey (school lunch).**

|                | X school (n=147) | Y school (n=199) |
|----------------|-----------------|-----------------|
|                | Scores          | \( p \) value\(^2\) | Scores          | \( p \) value\(^2\) |
| All items (11 items) |                |                  |                |                  |
| First survey (lunchbox) | 26 (21–32) | \(<0.001\) | 29 (24–34) | \(0.020\) |
| Second survey (school lunch) | 29 (23–34) |                  | 30 (24–35) |                  |
| Factor 1 (4 items, Question 5–8) |                |                  |                |                  |
| First survey (lunchbox) | 9 (5–11) | \(<0.001\) | 10 (8–12) | \(0.642\) |
| Second survey (school lunch) | 10 (7–13) |                  | 10 (8–13) |                  |
| Factor 2 (7 items, Question 9–15) |                |                  |                |                  |
| First survey (lunchbox) | 18 (14–21) | \(<0.001\) | 19 (16–22) | \(0.006\) |
| Second survey (school lunch) | 19 (15–23) |                  | 20 (16–23) |                  |

\(^1\)Data are presented in medians and 25th–75th percentiles. Factor 1 shows ”Reduction of unhealthy foods when eating out or snacking,” and Factor 2 shows ”Meal manners and meal preparation.”

\(^2\)Statistical analysis were used by Wilcoxon signed-rank test. Differences with \( p < 0.05 \) were considered significant.
the family were prepared as the item related to JQCDL–AF. In the first surveys, the total JQCDL–AF scores in girls were significantly higher than those in boys at the both schools. Moreover, the total JQCDL–AF scores were significantly higher to students answering “Almost everyday” than those answering “Almost never.” On the other hands, divergent validity is confirmed by the no association with factors that appear to be unrelated (8).

The travel time to school from home was prepared as items unrelated to JQCDL–AF. There was no association between the travel time to school from home and the total JQCDL–AF scores. Therefore, we confirmed the convergent and divergent validity of JQCDL–AF in Japanese junior high school students.

Validity by experimental intervention confirms to reflect the changes when related interventions are performed (8). In the HEALTHY Study, students at schools participating in the national school lunch program were more inclined to make healthy food choices (12). Cohen et al. reported that the introduction of a chef to the school lunch preparation team increased daily per-student consumption of whole grains and vegetables compared to the control school (13). These results suggested that the provision of healthy meals improves students’ food-consumption behaviors. We hypothesized that the provision of healthy meals also increased interests in healthy eating habits. Thus, we compared the JQCDL–AF scores between the first survey (lunchbox) and second survey (school lunch). The total JQCDL–AF scores 1-mo after introducing school lunches increased significantly from the lunchbox. Moreover, in the subscale analysis, the Factor 2 (Meal manners and meal preparation) scores 1-mo after introducing school lunches increased significantly from the lunchbox. Japanese school lunch is served by the students themselves. It was suggested that direct involvement in the provision of meals increased interests of meal manners and meal preparation. Therefore, we showed the experimental intervention validity of JQCDL–AF by the changed scores after introducing school lunches.

In Table 3, the change of total JQCDL–AF score by introducing school lunches were smaller in the students of Y school than those of X school. There were no differences of baseline information between X and Y schools (Table 1). The first survey at X and Y schools were conducted in January 2019 and January 2021, respectively. On 11 March 2020, the World Health Organization declared coronavirus disease 2019 pandemic. In a survey of 5,460 Japanese adults at August 2020, 50.9% of respondents answered that they “became more careful about their diet and nutrition” after the first state of emergency [https://www.meijiyasuda.co.jp/profile/news/release/2020/pdf/20200902_01.pdf]. Moreover, in a survey carried out by Ministry of Agriculture, Forestry and Fisheries at December 2020, due to the coronavirus disease 2019 pandemic, approximately 36.47 and 29% of the generation of 30–49 y old answered “increase” in the frequencies of eating at home, cooking at home and eating with family, respectively [https://www.maff.go.jp/j/syokuiku/ishiki/r03/pdf/houkoku_2_9.pdf]. In a survey of 2,299 Japanese adults at July 2020, Hayashi et al. reported that in terms of changes in the importance of eating habits compared with before the coronavirus disease 2019 pandemic. “no change” was the most common (47.2%), followed by “increase (46.3%)” and by “decrease (6.5%)” (14). Thus, it is suggested that junior high school students also have increased their health interests due to the coronavirus disease 2019 pandemic. At baseline, the total and Factor 1 scores of JQCDL–AF in the students of Y school were significantly higher than those of X school (Supplemental Online Material, Table S4. p = 0.008 and 0.008, respectively). Therefore, it was considered that the change of JQCDL–AF by introducing school lunches was small at Y school because interests in healthy eating habits already heightened before introducing school lunches.

There are several limitations to this study. First, we did not carry out a preliminary survey to create questions. Second, we did not explore socioeconomic status of students’ family. The average annual income calculated from the reports of municipal taxation status on 2020 [https://www.soumu.go.jp/main_sosiki/jichi_zei_sei/czaisei/czaisei_scido/ichiran09_20.html] is 1.9-folds higher in the area with these public junior high schools than the average in Japan. Thus, the students in these public junior high school may not be generalizable to all Japanese junior high school students. Third, we did not examine the test-retest reliability. In this study, we conducted twice surveys in a short term to confirm the experimental intervention validity of JQCDL–AF. Thus, it was difficult to investigate once time more survey for the test-retest reliability. It is difficult for the evaluation of sustainable Shokuku effects by JQCDL–AF because this questionnaire asked Japanese adolescents for interests in healthy eating habits. However, sustainable effects by Shokuku appear such as food-consumption behaviors and habitual nutritional state. Moreover, the dietary nutritional intake in Japanese children can be measured by Japanese Food Guide Spinning Top (15) and a brief self-administered diet history questionnaire (16). Therefore, utilizations of some questionnaires including JQCDL–AF are able to evaluate the comprehensive effects by Shokuku.

From the surveyed results, we considered that the reliability and validity of JQCDL–AF met above a certain level although the survey had several limitations. We concluded that the JQCDL–AF could evaluate interests in healthy eating habits in Japanese junior high school students. Moreover, from the results of Table 3, JQCDL–AF is useful for the temporary outcome by Shokuku.

Authorship

AM, MO, and KT designed the research. MO surveyed in two public junior high schools. AM and KT analyzed the collected questionnaire at Mukogawa Women’s University. AM, MO and KT drafted the manuscript. All authors have read and approved the final version of the manuscript.
Disclosure of state of COI
The authors have no conflict of interest to declare.

Acknowledgments
We extend our sincerest gratitude to the students who participated in the study. Additionally, we are grateful to the teachers in surveyed junior high schools for their contribution to this work as well as the members of diet and nutrition teachers. Furthermore, we are grateful to Kozue Izumoto who tallied the collected data. Moreover, we would like to thank Editage for the English language editing.

Supporting information
Supplemental online material is available on J-STAGE.

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