

# Relationship Between Poverty and Diet Among High School Students in Okinawa, Japan: a Cross-sectional Study Using a Questionnaire Survey Among High School Students and Their Parents

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## Research Article

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## Abstract

**Background:** Because most Japanese high schools do not have school lunch programs, the students' meals depend on the economic situation of the household. However, few studies on the relation between diet and poverty have been conducted in Japanese high school students. This study aimed to clarify the relationship between poverty and diet among Japanese high school students.

**Methods:** A cross-sectional study using a questionnaire survey was conducted among 2,792 pairs of high school students and their parents in Okinawa, Japan. High school students were asked about the frequency of breakfast intake and consumption of the following food groups: fish and meat, fish and meat products, vegetables, fruits, milk and dairy products, sweets, sugar-sweetened beverages, instant noodles, and fast food. Households with an income of less than 1.22 million yen were considered to belong to the poverty group, whereas those with higher income belonged to the non-poverty group. Chi-square tests and logistic regression analyses were performed to examine the association between poverty and diet.

**Results:** The poverty group accounted for 18.5%. Compared to the non-poverty group, those in the poverty group had a higher OR for sugar-sweetened beverages (OR=1.38; 95% CI=1.04, 1.82), instant noodles (OR=3.10; 95% CI= 1.57, 6.13), fast food (OR=2.76; 95% CI=1.37, 5.54) more than once a day. This association remained significant even after adjusting for confounders.

**Conclusions:** High school students in the poverty group tended to consume ultra-processed foods. These results suggest the need to provide high school students without school lunch programs in a healthy food environment that considers their socioeconomic status.

## Background

In recent years, many studies have been conducted on the relationship between socioeconomic status and children's health [1]. Children living in poverty have poor mental health [2], more sedentary behavior [3], obesity [4], and dental caries [5, 6]. Poverty is also associated with low-quality diets [7]. Economic constraints lead people to choose low-quality diets, which are low in price and high in energy density. It has been reported that the link between poverty and obesity is mediated by this low-quality diet, making it an urgent issue to be addressed worldwide. There is a general agreement that similar trends exist in the association between poverty and diet quality in children [8–10] and adolescents [11]. A systematic review of adolescents and young adults [11] found that good parental socioeconomic status, especially higher education, was associated with higher consumption of fruits, vegetables, and dairy products and lower consumption of sugar-sweetened beverages (SSB) and energy-dense foods. In Japan, several studies on the relationship between child poverty and diet have been conducted in recent years. The Japanese child poverty rate is 13.9% [12], which is the 13th highest among Organisation for Economic Co-operation and Development countries, and a serious situation [13]. In a cross-sectional study of Japanese children [14], a higher household income was associated with higher dietary scores among high school students aged 15–18. However, no significant association was found between elementary and junior high school students aged 6–14 years. The study suggested the influence of school lunch programs as a factor in the lack of significant associations between 6–14 years. In Japan, 99.1% of elementary schools and 89.9% of junior high schools provide school lunches [15]. A cross-sectional study of elementary schoolchildren [16] found that the school lunch program may reduce dietary disparities due to differences in economic status. Another study [17] suggested that the school lunch program alleviated the socioeconomic status-related gradient in vegetable and fruit intake.

However, Japanese high schools, except for 384 part-time evening high schools (7.8% of the total number of high schools [18]), do not have a school lunch program [15]. Therefore, unlike elementary and junior high school students, who are provided with school lunches, high school students' meals (breakfast, lunch, dinner, and snacks) are all left up to the economic situation of the household. However, only a few studies have examined Japanese high school students. The only previous study that included Japanese high school students [14] had limitations, such as a small number of subjects and insufficient adjustment for confounders.

The purpose of this study was to clarify the relationship between household poverty and diet among Japanese high school students. A cross-sectional study using a questionnaire survey was conducted with Japanese high school students and their parents.

## Methods

We used data from the Survey of Child Living Conditions, which is a cross-sectional study conducted by the Okinawa Prefecture Government Bureau in Japan [19].

## • Participants

Eligible participants were second-grade high school students aged 16–21 years from all 60 Okinawa Prefectural high schools, and their parents. We excluded high school students who were 22 years old or above and enrolled in the correspondence course. The total number of high school students is 13,716. Of these, 50% (those with odd-numbered attendance numbers) were selected for each class and 6,858 were included in the survey.

## • Date source

Data were collected from November 5 to 25, 2019. Two separate self-administered questionnaires for high school students and their parents were distributed by the classroom teachers. The parents' questionnaires were distributed to and collected from parents of high school students. The questionnaire for high school students consisted of questions about sociodemographic attributes, school life, part-time job status, lifestyle, career path, and health condition. The questionnaire for parents consisted of questions about sociodemographic attributes, employment status, high school students' career paths, parent-child relations, household income, health status, and use of the social welfare system. Questionnaires were returned by 4,386 high school students (64.0%) and 4,305 parents (62.8%). A total of 4,259 pairs (62.1%) completed by high school students and their parents were included in the analysis. We excluded pairs with any of the following criteria: missing variables of household income ( $n = 443$ ), breakfast intake and food group intake frequency ( $n = 227$ ), sex of high school students, exercise habits excluding exercise class at school, BMI, household size, number of siblings, mother's age, employment status, educational attainment, and BMI ( $n = 797$ ). Finally, 2,792 pairs were included in the analysis. The characteristics of the samples excluded from the analysis were poverty; less educated mothers; single-parent households; low exercise habits; and consumption of fish and meat, vegetables, milk, and sweets for less than a day.

## • Measures

### o Outcome: frequency of intake of breakfast and each food group

Breakfast: High school students were asked, "Do you usually have breakfast?" and to answer "Yes" or "No". Each food group: High school students were asked, "How many times a week do you usually eat or drink the following food groups?": Fish and meat, fish and meat products, vegetables, fruits, milk and dairy products (yogurt, cheese, etc.), sweets, SSB (cola, soft drinks, etc.), instant noodles, and fast food. We asked participants to select one of the following options: (1) less than once a week, (2) once a week, (3) two to four times a week, (4) five to six times a week, (5) once a day, and (6) more than twice a day. The categorization of food groups in the Tokyo Metropolitan Survey on Children's Living Conditions [20] and previous studies in Japan [16, 21] were used as references. The HBSC questionnaire [22] was translated into Japanese by the author and was used as a response option.

The frequency of intake of each food group was categorized into two values: those who answered less than once a week, once a week, 2–4 times a week, and 5–6 times a week were categorized as "less than once a day," and those who answered, once a day, more than twice a day were categorized as "more than once daily."

## • Predictor: poverty

The economic status of the households was based on equivalent disposable income. Equivalent disposable income was calculated by dividing household income by the square root of the number of people in a household. Household income is defined as the combined income of the child and all living members of the household. It is defined as take-home pay after subtracting the amount of taxes and social insurance premiums. Participants selected one of the following choices: (1) less than 10,000 yen, (2) 1 to less than 500,000 yen, (3) 500,000 to less than 1 million yen, (4) 1 to less than 1.5 million yen, (5) 1.5 to less than 2 million yen, (6) 2 to less than 2.5 million yen, (7) 2.5 to less than 3 million yen, (8) 3 to less than 4 million yen, (9) 4 to less than 5 million yen, (10) 5 to less than 6 million yen, (11) 6 to less than 7 million yen, (12) 7 to less than 8 million yen, (13) 8 to less than 9 million yen, (14) 9 to less than 10 million yen, (15) 10 million yen and over. These options were chosen rather than open questions, to increase the response rate. The economic status of households was classified into two groups: poverty and non-poverty. This classification was based on the poverty line of the Ministry of Health, Labor, and Welfare's National Survey on Living Standards [12]. The poverty line was set at 1.22 million yen, which is half of the median equivalent disposable income. The median was 2.44 million yen. An

equivalent disposable income of less than 1.22 million yen was defined as the poverty group, and 1.22 million yen or more was defined as the non-poverty group.

## • Confounders

Confounders were selected based on previous studies on this topic [16, 17, 23, 24]. High school students' sex, exercise habits, family structure, presence of siblings, mother's age, education, employment status, and BMI were considered as confounders. Data on potential confounders were obtained from high school students' questionnaires. It included sex (male, female), exercise habits excluding exercise class at school (yes, no), and BMI (height to the nearest centimeter and weight to the nearest kilogram). Data on parental and household confounders were obtained from parents' questionnaires and included age (< 30, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65≤), household size (the number of family members living with the high school student), number of children (1, 2, 3, 4, 5≤), mother's educational attainment (junior high school, high school, vocational school, junior college/college of technology, college/graduate school, other), employment status (regular employment, others), and BMI (height to the nearest cm and weight to the nearest kg). The BMI was calculated as weight (kg)/height (m)<sup>2</sup>. The BMI was classified into three categories: thin (< 18.5), normal (18.5–24.9), and obese (≥ 25.0). Household size was categorized as single-parent households, two-parent households, and other households based on the number of family members. Household size and parents were asked to indicate the number of family members living with high school students and categorize them as single-parent households, two-parent households, or other households.

## • Statistical analysis

First, the chi-square test was used to compare the characteristics of the participants as categorical data by poverty status. Next, we compared the frequency of breakfast intake and each food group according to poverty. A binomial logistic regression was used to assess the association between poverty and diet. The non-poverty group served as the control group. The odds ratios of "less than once a day" for breakfast and the frequency of intake of each food group in the poverty group were calculated. The reference category was "more than once a day". For SSB, instant noodles, and fast food, the odds ratios of "more than once a day" intake frequency in the poverty group were determined. The reference category was "less than once a day". The adjustment model included confounders of high school students' gender, exercise habits, BMI, household size, living with siblings, mother's age, education, employment status, and BMI. Data analyses were conducted using IBM SPSS Statistics version 27 for Macs (IBM Co., Tokyo, Japan). All statistical tests were two sided. The level of statistical significance was set at  $P < 0.05$ .

## Results

### • Characteristics of participants

Table 1 shows the results of the comparison of participant characteristics according to poverty status. Poverty accounted for 18.5% of the total population. Compared to high school students in the non-poverty group, those in the poverty group were more likely to exercise less frequently, suffer from obesity, and have single-parent households, no siblings, young mothers, part-time jobs, or low education.

Table 1  
 Characteristics of participants according to poverty status

|  |   | Poverty |      | Non-poverty |      | p-value |
|--|---|---------|------|-------------|------|---------|
|  |   | n       | %    | n           | %    |         |
| High school student  |   | 517     | 18.5 | 2275        | 81.5 |         |
| Gender   | Male  | 245     | 47.4 | 1063        | 46.7 | 0.117   |
|  | Female                                      | 258     | 49.9 | 1179        | 51.8 |         |
|  | Other                                       | 14      | 2.7  | 33          | 1.5  |         |
| Exercise habits excluding exercise class at school   | Yes   | 285     | 55.1 | 1481        | 65.1 | <.001   |
|  | No  | 232     | 44.9 | 794         | 34.9 |         |
| BMI  | <18.5                                       | 93      | 18.0 | 396         | 17.4 | 0.046   |
|  | 18.5–24.9                                   | 373     | 72.1 | 1724        | 75.8 |         |
|  | ≥ 25  | 51      | 9.9  | 155         | 6.8  |         |
| Household size   | Not single-parent                           | 357     | 45.9 | 2574        | 84.5 | <.001   |
|  | Single-parent                               | 421     | 54.1 | 473         | 15.5 |         |
| Living with siblings   | Yes   | 443     | 14.3 | 1820        | 20.0 | 0.001   |
|  | No  | 74      | 85.7 | 455         | 80.0 |         |
| Mother   |   |         |      |             |      |         |
| Age  | <40years                                    | 94      | 18.2 | 169         | 7.4  | <.001   |
|  | 40-44years                                  | 154     | 29.8 | 534         | 23.5 |         |
|  | 45-49years                                  | 136     | 26.3 | 839         | 36.9 |         |
|  | 50-54years                                  | 88      | 17.0 | 562         | 24.7 |         |
|  | ≥ 55years                                   | 45      | 8.7  | 170         | 7.5  |         |
| Educational attainment   | Junior high school                          | 90      | 17.4 | 86          | 3.8  | <.001   |
|  | High school                                 | 240     | 46.4 | 736         | 32.4 |         |
|  | Vocational school                           | 99      | 19.1 | 641         | 28.2 |         |
|  | Junior college/<br>College of Technology    | 68      | 13.2 | 512         | 22.5 |         |
|  | College/ Graduate school                    | 15      | 2.9  | 295         | 13.0 |         |
|  | Other                                       | 5       | 1.0  | 5           | 0.2  |         |
|  |   |         |      |             |      |         |
| Employment status  | Full-time job                               | 88      | 17.0 | 859         | 37.8 | <.001   |
|  | Part-time job, Self-employed,<br>Unemployed | 429     | 83.0 | 1416        | 62.2 |         |
| BMI  | <18.5                                       | 38      | 7.4  | 126         | 5.5  | 0.002   |
|  | 18.5–24.9                                   | 316     | 61.1 | 1575        | 69.2 |         |
| Participants were 2,792 second grade high school students at all Okinawa Prefectural high schools, Japan, 2019 |   |         |      |             |      |         |
| Chi-square test  |   |         |      |             |      |         |

|  | Poverty  | Non-poverty | <i>p</i> -value |
|--|----------|-------------|-----------------|
| $\geq 25$  | 163 31.5 | 574 25.2    |                 |
| Participants were 2,792 second grade high school students at all Okinawa Prefectural high schools, Japan, 2019 |          |             |                 |
| Chi-square test  |          |             |                 |

## • Comparison frequency of intake of breakfast and each food group by poverty

Table 2 compares the frequency of breakfast intake and each food group between the poverty and non-poverty groups. The percentage of those skipping breakfast was significantly higher in the poverty group than in the non-poverty group. Overall, 14.2% skipped breakfast, 21.9% in the poverty group, and 12.5% in the non-poverty group. There were significant differences between the poverty and non-poverty groups in the frequency of intake of each food group. Compared to the non-poverty group, the poverty group consumed "fish and meat," "fish and meat products," "vegetables," "fruits," and "milk and dairy products" less frequently. In contrast, they consumed "SSB," "instant noodles," and "fast food" more frequently.

Table 2  
Frequency of intake of breakfast and each food group in the poverty and non-poverty groups

|  |                      | Poverty |      | Non-poverty |      | <i>p</i> -value |
|--|----------------------|---------|------|-------------|------|-----------------|
|  |                      | n       | %    | n           | %    |                 |
| Breakfast  | More than once a day | 402     | 77.8 | 1996        | 87.7 | < .001          |
|  | Less than once a day | 115     | 22.2 | 279         | 12.3 |                 |
| Fish and meat  | More than once a day | 162     | 31.3 | 959         | 42.2 | < .001          |
|  | Less than once a day | 355     | 68.7 | 1316        | 57.8 |                 |
| Fish and meat products   | More than once a day | 85      | 16.4 | 499         | 21.9 | 0.003           |
|  | Less than once a day | 432     | 83.6 | 1776        | 78.1 |                 |
| Vegetables   | More than once a day | 229     | 44.3 | 1255        | 55.2 | < .001          |
|  | Less than once a day | 288     | 55.7 | 1020        | 44.8 |                 |
| Fruits   | More than once a day | 57      | 11.0 | 316         | 13.9 | 0.047           |
|  | Less than once a day | 460     | 89.0 | 1959        | 86.1 |                 |
| Milk, dairy products   | More than once a day | 108     | 20.9 | 612         | 26.9 | 0.003           |
|  | Less than once a day | 409     | 79.1 | 1663        | 73.1 |                 |
| Sweets   | More than once a day | 135     | 26.1 | 614         | 27.0 | 0.364           |
|  | Less than once a day | 382     | 73.9 | 1661        | 73.0 |                 |
| Sugar-sweetened beverages  | More than once a day | 112     | 21.7 | 354         | 15.6 | < .001          |
|  | Less than once a day | 405     | 78.3 | 1921        | 84.4 |                 |
| Instant noodles  | More than once a day | 17      | 3.3  | 35          | 1.5  | 0.010           |
|  | Less than once a day | 500     | 96.7 | 2240        | 98.5 |                 |
| Fast foods   | More than once a day | 16      | 3.1  | 34          | 1.5  | 0.015           |
|  | Less than once a day | 501     | 96.9 | 2241        | 98.5 |                 |
| Participants were 2,792 second grade high school students at all Okinawa Prefectural high schools, Japan, 2019 |                      |         |      |             |      |                 |
| Chi-square test  |                      |         |      |             |      |                 |
| More than once a day: once a day and more than twice a day   |                      |         |      |             |      |                 |
| Less than once a day: less than once a week, once a week, 2-4 times a week, and 5-6 times a week               |                      |         |      |             |      |                 |

## • Logistic regression analysis of the association between poverty and frequency of intake of breakfast and each food groups

Table 3 shows the OR and 95% CI for breakfast consumption and the frequency of consumption of each food group among high school students. Poverty was significantly associated with the frequency of intake of several food groups by high school students. Compared to the non-poverty group, the poverty group had a higher OR of consuming breakfast, fish and meat, fish and meat products, vegetables, milk, and dairy products less than once a day. The ORs of consuming SSB, instant noodles, and fast food more than once a day were higher (crude model). However, this association was not significant after adjusting for confounding factors. The SSB, instant noodles, and fast food OR remained significant after adjusting for confounders. Compared to the non-poverty group,

those in the poverty group had a higher OR of SSB (OR 1.38, 95%CI: 1.04, 1.82), instant noodles (OR 3.10, 95%CI: 1.57, 6.13), fast food (OR 2.76, 95%CI: 1.37, 5.54), and more than once a day (adjusted model).

Table 3  
OR of "less than once daily" intake of breakfast and food groups based on group

|  |             | Crude model |             |   |                 | Adjusted model  |             |             |                 |             |              |
|--|-------------|-------------|-------------|---|-----------------|-----------------|-------------|-------------|-----------------|-------------|--------------|
|  |             | OR          | 95% CI      |   | <i>p</i> -value | OR              | 95% CI      |             | <i>p</i> -value |             |              |
| Breakfast <sup>†</sup>                 | Poverty     | <b>2.05</b> | <b>1.61</b> | - | <b>2.61</b>     | <b>&lt;.001</b> | 1.26        | 0.94        | -               | 1.68        | 0.121        |
|  | Non-poverty | 1.00        |             |   |                 |                 | 1.00        |             |                 |             |              |
| Fish and meat <sup>†</sup>             | Poverty     | <b>1.60</b> | <b>1.30</b> | - | <b>1.96</b>     | <b>&lt;.001</b> | 1.14        | 0.90        | -               | 1.44        | 0.278        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Fish and meat products <sup>†</sup>    | Poverty     | <b>1.43</b> | <b>1.11</b> | - | <b>1.84</b>     | <b>0.006</b>    | 0.98        | 0.73        | -               | 1.30        | 0.883        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Vegetables <sup>†</sup>                | Poverty     | <b>1.55</b> | <b>1.28</b> | - | <b>1.88</b>     | <b>&lt;.001</b> | 1.01        | 0.81        | -               | 1.26        | 0.936        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Fruits <sup>†</sup>                    | Poverty     | 1.30        | 0.97        | - | 1.76            | 0.085           | 0.91        | 0.64        | -               | 1.27        | 0.571        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Milk, dairy products <sup>†</sup>      | Poverty     | <b>1.39</b> | <b>1.11</b> | - | <b>1.76</b>     | <b>0.005</b>    | 0.99        | 0.76        | -               | 1.29        | 0.926        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Sweets <sup>†</sup>                    | Poverty     | 0.96        | 0.77        | - | 1.19            | 0.685           | 1.18        | 0.92        | -               | 1.52        | 0.196        |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Sugar-sweetened beverages <sup>‡</sup> | Poverty     | <b>1.50</b> | <b>1.18</b> | - | <b>1.90</b>     | <b>&lt;.001</b> | <b>1.38</b> | <b>1.04</b> | -               | <b>1.82</b> | <b>0.026</b> |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Instant noodles <sup>‡</sup>           | Poverty     | <b>2.18</b> | <b>1.21</b> | - | <b>3.92</b>     | <b>0.009</b>    | <b>3.10</b> | <b>1.57</b> | -               | <b>6.13</b> | <b>0.001</b> |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |
| Fast foods <sup>‡</sup>                | Poverty     | <b>2.11</b> | <b>1.15</b> | - | <b>3.84</b>     | <b>0.015</b>    | <b>2.76</b> | <b>1.37</b> | -               | <b>5.54</b> | <b>0.004</b> |
|  | Non-poverty | 1.00        |             |   |                 |                 |             |             |                 |             |              |

Participants were 2,792 second grade high school students at all Okinawa Prefectural high schools, Japan, 2019

Binomial logistic regression analyses

Adjusted high school students' gender, exercise habits excluding exercise class at school, family structure, presence of siblings, mother's age, education, employment status, and BMI.

OR: odds ratios

CI: confidence intervals

<sup>†</sup> The reference category was "More than once a day"

<sup>‡</sup> The reference category was "Less than once a day".

## Discussion

This study clarified the relationship between poverty and the frequency of breakfast intake and each food group among Japanese high school students. The strengths of this study are the large number of subjects than that for in previous studies, the precise

definition of poverty, and confounding adjustments. High school students from poverty group consumed "SSB," "instant noodles," and "fast food" more frequently than those from non-poverty group. This association remained significant even after adjusting for confounders. High school students in the poverty group also tended to consume breakfast, fish and meat, fish and meat products, vegetables, fruits, and dairy products less frequently than those in the non-poverty group. However, after adjusting for confounders, significant associations disappeared. The trend shown in this study of higher consumption of SSBs, instant noodles, and fast food among the poverty group is generally consistent with trends in systematic reviews of diet and socioeconomic disparities among adolescents and young adults [11]. A previous study reported that the consumption of SSB and energy-dense foods is associated with socioeconomic status worldwide. Consumption of SSBs and energy-dense foods tended to be higher when socioeconomic status indicators were unfavorable. Other foods, in addition to socioeconomic status-related indicators, were reported to be very specific to each country or region and influenced by ethnic and immigrant disparities. One mechanism for the link between poverty and diet is that energy density and costs are inversely related [7]. People living in poverty try to reduce food costs and choose cheaper and more energy dense foods to maintain their dietary energy. SSBs, instant noodles, and fast food are classified as ultra-processed foods (UPFs) [25]. UPF is an inexpensive, energy-dense, and nutrient-dense food with lower nutrient density than fresh foods. The UPF was designed to produce a low-cost, profitable product. It is very tasty, easy to prepare, and convenient for food. However, they are high in energy intake, refined carbohydrates, saturated fatty acids, salt, and food additives, and low in micronutrients and dietary fiber [26]. In recent years, it has been shown that high purchase and consumption of UPF are associated with overweight and obesity. In a cross-sectional study in Brazil [27], the price of UPFs was inversely associated with the prevalence of overweight and obesity, mainly among those with the lowest socioeconomic status. A systematic review of childhood and adolescence [28] found a positive correlation between UPF consumption and body fat. In this study, the poverty group consumed UPF more frequently than the non-poverty group, and had a higher prevalence of obesity. Although the association between UPF consumption and obesity was not examined, the association between poverty and obesity among high school students in this study may be mediated by UPFs, such as SSB, fast food, and instant noodles. Breakfasts, fish and meat, fish and meat products, vegetables, and milk/dairy products were consumed less frequently in the poverty group than in the non-poverty group.

A cross-sectional study of Japanese adults [29] found that households with lower incomes consumed more staple foods and fewer vegetables, fruits, and fish. A cross-sectional study [21] of Japanese elementary school children reported that children from low-income households had less frequently of eating out, consumed less breakfast and vegetables and more fish and meat products and instant noodles than children whose households were high-income households. The results of this study were similar for breakfast, fish, vegetables, and instant noodles. However, fish and meat products showed different trends in previous studies. In this study, the non-poverty group consumed fish and meat products more frequently than the poverty group. One possible reason for this is that the dietary culture of Okinawa Prefecture, the study area where fish and meat products are often eaten, outweighed the effects of poverty. People of Okinawa frequently eat fish and meat products, such as pork luncheon, corned beef, and canned tuna. After World War II, these canned goods were introduced to the United States, where they are still popular [30]. The results of the national household survey show that the purchase of processed meats other than ham, sausage, bacon, and canned seafood is the highest in Japan [31].

This study has several limitations. First, because of the cross-sectional research design, it was not possible to establish a causal relationship between poverty and diet among high school students. However, the reverse causality and eating habits of high school students are unlikely to affect the poverty status of households. Second, the survey was conducted in a specific region, limiting the generalizability of the results. Okinawa Prefecture, the target of the survey, is a remote island located at the southernmost tip of Japan. It is also characterized by the extremely poor socioeconomic conditions of residents. The per capita income of the prefecture is the lowest in the country [32] and the divorce rate [33] is the highest in the country [34]. However, we have the advantage of revealing the reality of the most impoverished areas in Japan. The third point is the possible bias due to missing values ( $n = 1,467$ ). The results may be underestimated because the sample that dropped out had a higher percentage of poverty. Fourth, the frequency of food intake was based on a self-administered questionnaire rather than on an actual food survey. Recall bias, underestimation, and overestimation bias are inevitable. Finally, the food preferences of high school students were not adjusted. Fruits and vegetables have been found to increase in intake with increasing preferences [35].

## Conclusions

This study used a relatively large population-based dataset to identify the association between poverty and diet among Japanese high school students. High school students in the poverty group tended to consume SSB, fast food, and instant noodles, called UPF, more frequently than those in the non-poverty group. The results of this study suggest the need to provide high school students without support from school feeding programs with a healthy food environment that considers their SES.

## Abbreviations

**SSB:** Sugar-sweetened beverages

**BMI:** Body mass index

**SPSS:** Statistical package for social sciences

**OR:** Odds ratios

**95%CI:** 95% confidence intervals

**UPF:** Ultra-processed foods

## Declarations

### Ethics approval and consent to participate

The questionnaires were anonymous and self-administered. The following information was included at the beginning of the questionnaire: there was no need to write any personal information, the survey would be compiled statistically and would not identify any individual or school, and there was no need to answer any questions that they did not want to answer. To submit the questionnaire, parents and high school students were asked to place the parent and high school student forms in their own envelopes, seal them, and place them together in an envelope. Care was taken to ensure that the parents did not see the high school students' responses or vice versa. This study was approved by the Ethics Review Committee for Research Involving Human Subjects of Okinawa University (2021-08).

### Consent for publication

Not applicable.

### Availability of data and materials

The data that support the findings of this study are available from the Survey Research Consortium on Child Poverty, but restrictions apply to the availability of these data, which were used under license for the current study and so are not publicly available.

### Competing interests

The authors declare that they have no competing interests.

### Funding

No funding was received for this study.

### Contributions

YK conceived and designed the research, performed statistical analysis, drafted the manuscript.

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