



Association of home cooking with caregiver–child interaction and child mental health: results from the Adachi Child Health Impact of Living Difficulty (A-CHILD) study

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Abstract

Objective: To examine the associations of home cooking with caregiver–child interaction and child mental health in Japan.

Design: Cross-sectional data collected in 2018. Frequency of home cooking was assessed by a questionnaire among 4126 caregivers and classified as high (almost every day), medium (4–5 d/week) or low (≤ 3 d/week). Caregiver–child interaction was evaluated by assessing frequency of talking and playing together (per week). Behaviour problems and prosocial behaviour were assessed by the Strengths and Difficulties Questionnaire, and resilience was assessed using the Children's Resilient Coping Scale.

Setting: Japan.

Participants: Children aged 9–10 years and their caregivers in Adachi, Tokyo, Japan.

Results: Low and middle frequency of home cooking were associated with lower frequencies of talking about school life, talking about news with the child, talking about television shows with the child and helping with the child's homework. Children with low and/or middle frequency of home cooking had more behaviour problems (low frequency: $\beta = 3.95$, 95% CI 1.30, 6.59 and medium frequency: $\beta = 3.38$, 95% CI 2.07, 4.70), lower prosocial behaviour (low frequency: $\beta = -5.85$, 95% CI -10.04 , -1.66) and lower resilience (low frequency: $\beta = -6.56$, 95% CI -9.77 , -3.35 and medium frequency: $\beta = -4.11$, 95% CI -5.71 , -2.51), compared with children with high frequency of home cooking after adjusting covariates including socio-economic status. These associations were mediated by child's eating behaviours and/or caregiver–child interaction.

Conclusions: Creating an environment that encourages caregivers to cook at home may be important for children's mental health.

Keywords
Home cooking
Meal preparation
Children
Family meal
Parenting
Behaviour problem resilience

Child mental health is a challenging public health problem^(1,2). Globally, about one-fifth of children and adolescents suffers from mental disorders⁽¹⁾. A recent meta-analysis showed that the estimated worldwide pooled prevalence was 2.6% for any depressive disorder, 3.4% for attention-deficit/hyperactivity disorder, 5.7% for any disruptive disorder, 3.6% for oppositional defiant disorder and 2.1% for conduct disorder among children and adolescents⁽³⁾. Child mental health problems have been shown to be associated with long-term adverse consequences, such as worse economic outcomes in adulthood and premature death^(4,5). Considering that a substantial proportion of mental problems in adulthood

start in early life^(6,7), it is important to identify preventive factors that can be targeted for intervention in childhood.

Over the last few decades, mental health research interests have moved away from risk factors and psychopathology, towards promoting positive outcomes such as resilience. Resilience refers to the capacity for, or outcome of, successful adaptation despite challenging or threatening circumstances^(8,9). In the face of life stresses, some children develop behavioural difficulties and mental problems, whereas other children, referred to as 'resilient,' escape the expected problems by developing successful adaptation strategies⁽⁹⁾. Previous studies have revealed that children and adolescents with higher resilience have fewer

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mental health problems such as depression and anxiety in later life^(10,11). Additional research is necessary to identify factors that increase resilience and prevent mental health problems among children. Because young children spend a large amount of time at home, it is important to clarify which home environmental factors prevent children's behavioural problems and increase their resilience.

Among the factors in the home environment such as making healthful foods available in the home, mealtime setting (e.g. eating meals while watching TV) and family meal, home cooking has received attention in the context of diet-related diseases, such as obesity⁽¹²⁾. Although there is no widely accepted and established definition, a recent systematic review of home cooking defined 'home cooking' as the practices and skills for preparing foods at home⁽¹³⁾. Home cooking may be a protective factor for children's mental health through the following two pathways. First, regarding the diet-mediated pathway, a systematic review reported the dietary benefits of eating home-cooked meals, including greater consumption of fruit and vegetables, enhanced nutrient intake and higher diet quality⁽¹³⁾. Inadequate diet and insufficient nutrient intake have been shown to be linked to cognitive deficits and behavioural problems among children^(14,15). Moreover, several studies have reported an association between food insecurity, which is material hardship related to food, and children's cognitive, behavioural and emotional problems^(16,17). Thus, home cooking may be beneficial to children's mental health because it encourages a proper diet among children.

The second pathway is the caregiver-child interaction-mediated pathway. Because social activities are organised around food, daily mealtimes play an important role in children's development⁽¹⁸⁾. Several studies have suggested that family meals (i.e. the caregiver and child eating together) provide an opportunity for caregiver-child communication⁽¹⁹⁾ and are related to better mental health and lower risk behaviours^(20,21). However, home cooking may be more beneficial for healthy child development than family meals because children feel closer to their caregivers through having home-cooked meals. Adolescents participating in an intervention providing families with home-cooking resources reported talking with their caregivers about how they enjoyed the food, what they liked about the meal and sometimes also about school⁽²²⁾. In Japan, there is a cultural word '*Ofukuro-no-aji*' ('taste of mom's home cooking'), which refers to a comfort food cooked by mother. A study that examined factors affecting a feeling of satisfaction about eating in Japan showed that 70% of the students with a high level of satisfaction valued '*Ofukuro-no-aji*', while 30% of those with a low level of satisfaction⁽²³⁾. Thus, home cooking may provide valuable opportunities for children, not only to eat better diets but also to communicate with their caregivers about daily events and to experience satisfying their meals, which is important for the development of mental capital⁽²⁴⁾.

In high-income countries, there has been a shift away from home cooking towards eating out or buying prepared meals⁽²⁵⁻²⁷⁾. If eating less home-cooked meals has an adverse association not only with obesity⁽²⁸⁾ but also with children's mental health problems, it is necessary to sound the alarm. Therefore, the purpose of this study was to investigate whether home cooking is associated with (1) caregiver-child interaction and (2) children's mental health in Japan.

Materials and methods

Study design and subjects

This study used data from the Adachi Child Health Impact of Living Difficulty (A-CHILD) project, which was established in 2015 to evaluate the determinants of health among children in Adachi, Tokyo, Japan⁽²⁹⁾. Specifically, this study used cross-sectional data collected in 2018. The survey covered all sixty-nine public elementary schools in Adachi. Questionnaires with anonymous unique ID were distributed to 5311 elementary school students in the fourth grade (aged 9-10 years). Teachers asked these children to give the questionnaires to their caregivers at home for completion. The children then returned the completed questionnaires to the school. Questionnaires were collected from a total of 4605 child-caregiver pairs (response rate: 86.7%). Of these respondents, 4290 pairs provided informed consent and returned all questionnaires. For the analysis, 4126 participants were included after those who did not complete the questions related to home cooking status (n 12) or mental health status (n 152) were excluded. The sample comprised 2089 boys and 2037 girls. Among the caregiver participants, 91.0% were mothers and 7.7% were fathers.

Mental health status

Child's behavioural difficulties, prosocial behaviour and resilience were evaluated to assess children's mental health. Child's behavioural difficulties and prosocial behaviour were assessed using the Japanese version of the Strengths and Difficulties Questionnaire⁽³⁰⁾. This questionnaire comprises twenty-five items and includes the following five subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour. The respondents (caregivers) rated their children's behaviours using a response scale ranging from 0 (not true) to 2 (certainly true). The total score of four subscales (emotional symptoms, conduct problems, hyperactivity/inattention and peer relationship problems) was calculated as the total difficulties score. These scores were rescaled to range from 0 to 100 to aid in the interpretation of coefficients in the statistical analysis, following previous work^(31,32). Higher scores for total difficulties, emotional symptoms, conduct



problems, hyperactivity/inattention and peer relationship problems meant that children had more difficulties. A higher prosocial behaviour score corresponded to a higher level of prosocial behaviour. In our study sample, Cronbach's alpha was 0.78 for total difficulties score, 0.64 for the emotional symptoms, 0.64 for the conduct problems, 0.77 for the hyperactivity/inattention, 0.58 for the peer relationship problems and 0.70 for the prosocial behaviour score.

Child's resilience was assessed using the Children's Resilient Coping Scale. This scale was developed by Japanese experts to suit the Japanese context and has been confirmed to have high internal consistency (Cronbach's alpha = 0.80) and sufficient validity⁽³¹⁾. The scale comprises the following eight items: 1) speak positively about their future; 2) try to do their best; 3) able to tolerate teasing or mean comments well; 4) know how to properly greet others; 5) able to get ready for school, study and do their chores without directions; 6) seek appropriate advice when necessary; 7) able to give up things they want or do things that they do not like to do for better future outcomes and 8) able to ask questions to learn about what they do not understand. Respondents (caregivers) rated child resilience/coping behaviours on a scale of 0 (never) to 4 (very frequently). Total scores were again rescaled to range from 0 to 100. A high score corresponded to a higher level of resilience. Cronbach's α for the eight included items was 0.85 in our study sample.

Caregiver-child interaction

To evaluate caregiver-child interaction, caregiver involvement with their children was assessed. Caregiver involvement with their children was evaluated by caregivers using the following eight items: frequency of 1) talking about school life with their child; 2) talking about news with their child; 3) talking about television shows with their child; 4) helping with their child's homework; 5) going out with their child; 6) engaging in physical exercise with their child; 7) playing computer games with their child and 8) playing card games or participating in pretend play with their child^(33,34). The five response options were 'every day', '3-4 times/week', '1-2 times/week', '1-2 times/month' and 'rarely'. In this analysis, the scores of 7, 3.5, 1.5, 0.375 and 0 (times/week) were assigned to these categories, respectively, and the resulting variables were treated as continuous to make easier to interpret the results. These items were selected by experts of Japanese parent-child attachment. Cronbach's α for the eight included items was 0.61 in our study sample⁽³⁴⁾. These items were found to have predictive validity as they are associated with child's resilience⁽³⁴⁾.

Home cooking frequency

Home cooking frequency over the past month was assessed using the following question in the

caregiver-report questionnaire: 'How many times did you or someone else in your family cook meals at home?'⁽²⁸⁾ A home-cooked meal was defined as more than a simple meal, such as a fried egg. The five response items were 'almost every day', '4-5 d/week', '2-3 d/week', 'a few days/month' and 'rarely.' According to the distribution of answers to this question and based on categories previously used in other studies^(28,35,36), the responses were collapsed into the following three groups: high (almost every day), medium (4-5 d/week) and low (≤ 3 d/week).

Covariates

Household and caregiver's status were assessed using the caregiver-report questionnaire⁽²⁸⁾. Household status included marital status, the presence of siblings, cohabitation with the child's grandparents and household income. Caregiver's status included the responding caregiver's mental health, mother's age, mother's educational attainment and mother's employment and daily time of returning home. The responding caregiver's mental health was assessed by the Kessler 6 scale (Japanese version)⁽³⁷⁾. The cut-off point for this scale is a score of 4/5, and higher scores indicate more frequent problems with psychological distress⁽³⁸⁾. Mother's educational attainment was categorised into three groups (low: junior high school, dropped out of high school or high school; middle: professional school, some college or dropped out of college and high: college or higher)⁽²⁸⁾. Mother's employment/time of returning home was categorised into five groups (employed, returning home before 18.00 hours; employed, returning home at 18.00-20.00 hours; employed, returning home after 20.00 hours; employed, irregular time of returning home and not employed)⁽²⁸⁾. Child's eating behaviour included frequency of vegetable intake, frequency of eating breakfast and snacking habits⁽²⁸⁾. Frequency of child's vegetable intake was assessed via the caregiver-report questionnaire. Frequency of breakfast consumption and snacking habits was assessed via the child-report questionnaire. Eating with caregiver at dinner on weekdays over the past month, the following question was asked in the child-report questionnaire: 'With whom do you eat dinner on weekdays (the days you go to school)?' The five response options were: 'eat with parents or grandparents', 'eat with siblings or friends', 'eat with people other than family', 'eat alone' and 'do not eat dinner.' Multiple responses were allowed. To evaluate caregiver-child meals, children who reported that they ate with their parents or grandparents were defined as eating dinner with their caregivers.

Statistical analysis

First, children's and caregivers' characteristics were stratified by home cooking status, and the differences in characteristics were tested using the χ^2 test. Second, multivariate linear regression models were used to examine the

association between the frequency of home cooking and the frequency of caregiver–child interactions. The following sequence of models was constructed. Model 1 was adjusted for potential confounders (household income; the responding caregiver's mental health and mother's age, education and employment/time of returning home). Model 2 was further adjusted for eating with caregivers at dinner as a covariate to examine whether the relationship between home cooking and caregiver–child interactions was independent of eating with caregivers. Third, multivariate linear regression models were used to examine the association between the frequency of home cooking and child's mental health, including behavioural difficulties, prosocial behaviour and resilience. The following sequence of models was constructed. Model 1 was adjusted for potential confounders (household income; the responding caregiver's mental health and mother's age, education and employment/time of returning home). Model 2 was further adjusted for eating with caregivers at dinner as a covariate to examine whether the relationship between home cooking and child's mental health was independent of eating with caregivers. Model 3 was further adjusted for child's eating behaviours (frequency of vegetable intake, breakfast consumption and snacking habits). Model 4 was adjusted for caregiver–child interaction (frequency of talking together about school life, news and television shows; helping with the child's homework and playing card games or engaging in pretend play with the child) instead of child's eating behaviours. Model 5 was adjusted for both child's eating behaviours and caregiver–child interaction. Fourth, we conducted a mediation analysis to determine the proportion of the association between home cooking and child's mental health that was mediated by the potential mediators (child's eating behaviours and caregiver–child interaction). Using the Paramed package in Stata⁽³⁹⁾, we estimated the indirect effects via mediators after controlling for all covariates. The exposure was treated as a binary variable, with 0 representing high frequency of home cooking and 1 representing low or medium frequency of home cooking. To assess the indirect effect via caregiver–child interaction, we used a factor score calculated by exploratory factor analysis, applying the principal factors method with promax rotation. For determination of the number of factors to be retained, we first conducted a principal factor analysis and then considered components with an eigenvalue >1.0 as well as the scree test results and interpretability of the factors. The factor scores were calculated for each participant. All analyses were conducted using Stata, version 15.

Results

Characteristics of children and caregivers are presented in Table 1. Among the children in the sample, 49 % were girls,

10 % consumed vegetables less than three times per week, 9.8 % did not eat breakfast every day and 49 % snacked freely. About 80 % of the households included married parents and siblings. Only 10 % of the families lived with the child's grandparents. A total of 3584 (87 %) families cooked almost every day (high), 442 (11 %) cooked 4–5 d/week (medium) and 100 (2.4 %) cooked fewer than 3 d/week (low). Among households where married parents were not present, those where the child had no siblings and low-income households, the frequency of home cooking was low. When the mother was young, had low educational background or returned home late from work, the frequency of home cooking was low. Children exposed to a low frequency of home cooking tended to consume fewer vegetables, skip breakfast and eat snacks freely.

The associations between the frequency of home cooking and the measures of caregiver–child interactions are shown in Table 2. A low and medium frequency of home cooking was also associated with a lower frequency of caregiver involvement with their children in terms of talking and supporting the children. The multiple linear regression analysis revealed that a low and/or medium frequency of home cooking was associated with lower frequencies of talking about school life with the child (β for low frequency, -1.33 , 95 % CI -1.75 , -0.91 ; β for medium frequency, -0.56 , 95 % CI -0.77 , -0.35), talking about news with the child (β for low frequency, -0.88 , 95 % CI -1.31 , -0.46 ; β for medium frequency, -0.35 , 95 % CI -0.56 , -0.13), talking about television shows with the child (β for low frequency, -0.86 , 95 % CI -1.36 , -0.37 ; β for medium frequency, -0.40 , 95 % CI -0.65 , -0.15), helping with the child's homework (β for low frequency, -0.85 , 95 % CI -1.38 , -0.32 ; β for medium frequency, -0.63 , 95 % CI -0.89 , -0.36) and playing card games or engaging in pretend play with the child (β for low frequency, -0.31 , 95 % CI -0.55 , -0.07), after adjusting for potential confounders (model 1). These associations were significant after adjusting for eating with caregivers at dinner (model 2). There was no significant association between home cooking and the frequency of going out with the child, engaging in physical exercise with the child or playing computer games with the child.

The association between the frequency of home cooking and the examined indicators of child's mental health is shown in Table 3. The multiple linear regression analysis revealed that children exposed to a low and/or medium frequency of home cooking had more behaviour problems (total difficulties score: β for low frequency, 4.07 , 95 % CI 1.43 , 6.72 and β for medium frequency, 3.39 , 95 % CI 2.08 , 4.71 ; emotional symptoms: β for low frequency, 5.85 , 95 % CI 2.15 , 9.54 and β for medium frequency, 2.70 , 95 % CI 0.86 , 4.55 ; peer relationship problems: β for low frequency, 5.88 , 95 % CI 2.37 , 9.39 and β for medium frequency, 3.32 , 95 % CI 1.57 , 5.07), lower prosocial behaviour (β for low frequency, -5.92 , 95 % CI -10.1 , -1.73) and

**Table 1** Characteristics of children and caregivers enrolled in the study (*n* 4126)*

	Total		Frequency of home cooking			<i>P</i>
	<i>n</i>	%	High	Medium	Low	
			(<i>n</i> 3584, 86.9%)	(<i>n</i> 442, 10.7%)	(<i>n</i> 100, 2.4%)	
			%	%	%	
Child's status						
Sex						
Boy	2089	50.6	51.3	46.4	46.0	0.097
Girl	2037	49.4	48.7	53.6	54.0	
Eating behaviours						
Frequency of vegetable intake						
Twice/d	1696	41.1	43.9	22.4	25.0	<0.001
Once/d	1997	48.4	48.1	54.8	31.0	
<3 times/week	423	10.3	7.9	22.4	42.0	
Missing	10	0.2	0.2	0.5	2.0	
Frequency of breakfast consumption						
Every day	3687	89.4	91.1	78.5	75.0	<0.001
Often	321	7.8	6.4	17.4	14.0	
Rarely or never	81	2	1.6	2.9	10.0	
Missing	37	0.9	0.9	1.1	1.0	
Snacking habits						
No snacking	1798	43.6	45.5	31.4	28.0	<0.001
Snacking at a set time (controlled)	271	6.6	6.5	6.8	8.0	
Snacking freely	2025	49.1	47.2	60.9	63.0	
Missing	32	0.8	0.8	0.9	1.0	
Eating with caregivers at dinner						
No	313	7.6	7.2	8.8	16.0	0.003
Yes	3813	92.4	92.8	91.2	84.0	
Household status						
Caregiver's marital status						
Married/common-law marriage	3252	78.8	80.2	70.6	65.0	<0.001
Unmarried/divorced/widowed	124	3	2.5	4.8	12.0	
Other/missing	750	18.2	17.2	24.7	23.0	
Presence of siblings						
No	813	19.7	18.3	28.1	34.0	<0.001
Yes	3313	80.3	81.7	71.9	66.0	
Living with the child's grandparents						
No	3708	89.9	89.5	93.0	90.0	0.07
Yes	418	10.1	10.5	7.0	10.0	
Household income (million Japanese yen)						
<3.00	442	10.7	9.7	16.1	22.0	<0.001
3.00–5.99	1238	30	29.9	30.3	34.0	
6.00–9.99	1373	33.3	34.3	27.4	21.0	
≥10.0	490	11.9	12.0	11.5	10.0	
Missing	583	14.1	14.1	14.7	13.0	
Caregiver's status						
Responding caregiver's K6 score						
<5	2754	66.7	68.2	57.5	54.0	<0.001
≥5	1360	33	31.5	42.1	45.0	
Missing	12	0.3	0.3	0.5	1.0	
Mother's age (years)						
<35	450	10.9	10.2	14.7	18.0	0.001
35–44	2490	60.3	60.8	58.4	52.0	
≥45	1063	25.8	26.1	23.3	23.0	
Missing	123	3	2.8	3.6	7.0	
Mother's education						
Low	1059	25.7	25.0	29.2	34.0	<0.001
Middle	1336	32.4	33.3	27.1	24.0	
High	632	15.3	16.0	11.1	8.0	
Other/missing	1099	26.6	25.7	32.6	34.0	
Mother's employment and time of returning home						
Employed, returns home before 18.00	1904	46.1	47.5	37.3	36.0	<0.001
Employed, returns home at 18.00–20.00	611	14.8	14.0	20.8	18.0	
Employed, returns home after 20.00	140	3.4	2.8	6.3	12.0	
Employed, irregular time of returning home	129	3.1	3.0	4.3	2.0	
Not employed	902	21.9	22.5	17.6	16.0	
Missing	440	10.7	10.2	13.6	16.0	

K6, Kessler 6 scale.

**P* values are from χ^2 tests.

Table 2 Results of regression analyses of caregiver–child interaction by frequency of home cooking among Japanese schoolchildren*

Frequency of home cooking	Frequency (n/week)		Crude		Model 1†		Model 2‡	
	Mean	SD	β	95 % CI	β	95 % CI	β	95 % CI
Frequency of talking about school life with child								
High (almost every day)	5.8	2.0	Reference		Reference		Reference	
Medium (4–5 times/week)	5.1	2.4	-0.68	-0.89, -0.47	-0.56	-0.77, -0.35	-0.56	-0.77, -0.35
Low (≤ 3 times/week)	4.2	2.6	-1.55	-1.97, -1.13	-1.33	-1.75, -0.91	-1.29	-1.71, -0.87
Frequency of talking about news with child								
High (almost every day)	1.9	2.2	Reference		Reference		Reference	
Medium (4–5 times/week)	1.5	1.9	-0.40	-0.61, -0.19	-0.35	-0.56, -0.13	-0.34	-0.56, -0.13
Low (≤ 3 times/week)	1.0	1.7	-0.98	-1.40, -0.56	-0.88	-1.31, -0.46	-0.87	-1.30, -0.45
Frequency of talking about TV shows with child								
High (almost every day)	3.9	2.5	Reference		Reference		Reference	
Medium (4–5 times/week)	3.4	2.5	-0.44	-0.69, -0.20	-0.40	-0.65, -0.15	-0.40	-0.65, -0.15
Low (≤ 3 times/week)	2.9	2.5	-0.94	-1.43, -0.45	-0.86	-1.36, -0.37	-0.82	-1.31, -0.33
Frequency of helping child's study								
High (almost every day)	4.2	2.7	Reference		Reference		Reference	
Medium (4–5 times/week)	3.3	2.7	-0.88	-1.14, -0.61	-0.63	-0.89, -0.36	-0.63	-0.89, -0.36
Low (≤ 3 times/week)	3.0	2.8	-1.23	-1.77, -0.69	-0.85	-1.38, -0.32	-0.82	-1.35, -0.29
Frequency of going out with child								
High (almost every day)	2.1	1.7	Reference		Reference		Reference	
Medium (4–5 times/week)	2.2	1.7	0.13	-0.03, 0.30	0.15	-0.01, 0.32	0.16	-0.01, 0.32
Low (≤ 3 times/week)	1.9	1.6	-0.19	-0.52, 0.15	-0.19	-0.52, 0.15	-0.17	-0.50, 0.17
Frequency of physical exercising with child								
High (almost every day)	1.0	1.4	Reference		Reference		Reference	
Medium (4–5 times/week)	0.9	1.3	-0.08	-0.22, 0.05	-0.07	-0.21, 0.07	-0.07	-0.20, 0.07
Low (≤ 3 times/week)	0.9	1.3	-0.13	-0.40, 0.15	-0.12	-0.39, 0.15	-0.12	-0.39, 0.16
Frequency of playing computer games with child								
High (almost every day)	0.8	1.4	Reference		Reference		Reference	
Medium (4–5 times/week)	0.8	1.5	0.05	-0.09, 0.20	0.01	-0.14, 0.16	0.01	-0.13, 0.16
Low (≤ 3 times/week)	1.0	1.8	0.24	-0.05, 0.54	0.19	-0.10, 0.48	0.20	-0.09, 0.49
Frequency of playing card games/pretend play with child								
High (almost every day)	0.8	1.2	Reference		Reference		Reference	
Medium (4–5 times/week)	0.7	1.3	-0.04	-0.16, 0.08	-0.05	-0.17, 0.07	-0.05	-0.17, 0.08
Low (≤ 3 times/week)	0.5	0.9	-0.29	-0.53, -0.04	-0.31	-0.55, -0.07	-0.31	-0.55, -0.06

β = non-standardised beta-coefficients.

Boldface indicates statistical significance ($P < 0.05$).

*All variables: d/week (range: 0–7).

†Model 1: Adjusted for household income, responding caregiver's K6 scale score; and mother's age, education and employment/time of returning home.

‡Model 2: Model 1 + adjusted for eating with caregivers at dinner.

lower resilience (β for low frequency, -6.70 , 95 % CI -9.91 , -3.49 and β for medium frequency, -4.13 , 95 % CI -5.73 , -2.53), compared with children with a high frequency of home cooking, after adjusting for potential confounders (model 1). These associations were slightly attenuated but significant after adjusting for eating with caregivers at dinner (model 2). Adjusting for child's eating behaviours reduced these associations (model 3). After adjusting for caregiver–child interactions instead of child's eating behaviours, the associations of low frequency of home cooking with total difficulties score, prosocial behaviour and resilience became non-significant (model 4).

An exploratory factor analysis of the eight items of caregiver involvement with their children in the present study sample yielded two factors (Table 4). The first pattern had a higher loading for talking with the child and helping with the child's homework. The second pattern had a higher loading for playing and going out with the child. Table 5

displays the mediation results for the hypothesised mediators, comparing children exposed to a low or medium frequency of home cooking with those exposed to a high frequency of home cooking. We found evidence of mediation between low or medium frequency of home cooking and child's behavioural difficulties (total difficulties score) through child's breakfast intake (22.7 %, $P = 0.04$ for low frequency and 20.1 %, $P < 0.001$ for medium frequency of home cooking), child's vegetable intake (21.9 %, $P = 0.047$ for medium frequency of home cooking) and the first pattern of caregiver–child interactions, that is, talking and helping (15.2 %, $P = 0.01$ for medium frequency of home cooking). For the association with child's resilience, we observed evidence of mediation through child's breakfast intake (22.1 %, $P = 0.01$ for low frequency and 14.1 %, $P < 0.01$ for medium frequency of home cooking), child's vegetable intake (57.7 %, $P < 0.001$ for medium frequency of home cooking) and the first pattern of caregiver–child



Table 3 Results of regression analyses of child's mental health by frequency of home cooking among Japanese schoolchildren* (Mean values and Standard deviation)

Frequency of home cooking	Mean	SD	Crude		Model 1†		Model 2‡		Model 3§		Model 4		Model 5¶	
			β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Behaviour problems (SDQ score)														
Total difficulties score														
High (almost every day)	23.1	13.8	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	27.9	14.4	4.86	3.48, 6.23	3.39	2.08, 4.71	3.38	2.07, 4.70	2.31	0.97, 3.64	2.72	1.41, 4.03	1.96	0.63, 3.28
Low (≤ 3 times/week)	29.5	14.8	6.38	3.63, 9.14	4.07	1.43, 6.72	3.95	1.30, 6.59	2.51	-0.16, 5.18	2.17	-0.46, 4.79	1.36	-1.29, 4.01
Emotional symptoms														
High (almost every day)	18.5	18.9	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	22.6	20.2	4.15	2.26, 6.03	2.70	0.86, 4.55	2.70	0.85, 4.54	1.94	0.06, 3.81	2.41	0.55, 4.27	1.79	-0.10, 3.67
Low (≤ 3 times/week)	26.6	22.0	8.10	4.30, 11.90	5.85	2.15, 9.54	5.79	2.09, 9.48	5.11	1.35, 8.87	5.29	1.57, 9.01	4.86	1.09, 8.62
Conduct problem														
High (almost every day)	22.4	18.2	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	25.9	20.5	3.56	1.74, 5.39	2.18	0.38, 3.99	2.18	0.37, 3.98	1.22	-0.62, 3.05	1.40	-0.40, 3.21	0.82	-1.01, 2.65
Low (≤ 3 times/week)	24.4	19.8	2.03	-1.64, 5.70	-0.13	-3.76, 3.49	-0.21	-3.83, 3.42	-1.51	-5.19, 2.17	-2.35	-5.97, 1.27	-2.93	-6.59, 0.74
Hyperactive/inattention														
High (almost every day)	32.4	23.3	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	39.6	24.2	7.20	4.89, 9.51	5.38	3.09, 7.66	5.36	3.07, 7.64	3.53	1.22, 5.84	4.19	1.93, 6.46	2.93	0.63, 5.22
Low (≤ 3 times/week)	40.0	24.2	7.56	2.92, 12.21	4.69	0.11, 9.27	4.50	-0.08, 9.09	1.90	-2.73, 6.53	1.46	-3.09, 6.00	-0.10	-4.69, 4.48
Peer relationship problem														
High (almost every day)	19.1	17.7	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	23.6	18.5	4.51	2.75, 6.28	3.32	1.57, 5.07	3.30	1.55, 5.05	2.54	0.76, 4.32	2.85	1.10, 4.61	0.91	0.52, 4.07
Low (≤ 3 times/week)	26.9	19.7	7.84	4.29, 11.39	5.88	2.37, 9.39	5.71	2.20, 9.22	4.55	0.98, 8.12	4.27	0.76, 7.79	1.82	0.06, 7.18
Prosocial behaviour (SDQ score)														
High (almost every day)	67.4	20.9	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	66.0	21.6	-1.45	-3.52, 0.63	-1.53	-3.62, 0.55	-1.53	-3.62, 0.56	-0.23	-2.34, 1.89	-0.05	-2.10, 2.00	0.64	-1.44, 2.72
Low (≤ 3 times/week)	61.8	20.7	-5.62	-9.79, -1.45	-5.92	-10.10, -1.73	-5.85	-10.04, -1.66	-4.18	-8.42, 0.07	-2.21	-6.32, 1.90	-1.73	-5.89, 2.43
Resilience (CRCS Total score)														
High (almost every day)	69.8	16.4	Reference		Reference		Reference		Reference		Reference		Reference	
Medium (4–5 times/week)	64.6	16.7	-5.22	-6.85, -3.60	-4.13	-5.73, -2.53	-4.11	-5.71, -2.51	-1.97	-3.56, -0.38	-2.79	-4.31, -1.28	-1.37	-2.88, 0.15
Low (≤ 3 times/week)	61.3	17.6	-8.49	-11.76, -5.22	-6.70	-9.91, -3.49	-6.56	-9.77, -3.35	-3.54	-6.73, -0.35	-2.55	-5.58, 0.48	-0.91	-3.95, 2.12

CRCS = Children's Resilient Coping Scale; SDQ = Strengths and Difficulties Questionnaire; β = non-standardised beta-coefficients.

Boldface indicates statistical significance ($P < 0.05$).

*All variables range from 0 to 100.

†Model 1: Adjusted for household status (marital status, the presence of siblings, household income); responding caregiver's K6 score; and mother's age, education and employment/time of returning home.

‡Model 2: Model 1 + adjusted for eating with caregivers at dinner.

§Model 3: Model 2 + adjusted for child's eating behaviours (frequency of vegetable intake, breakfast consumption and snacking habits).

||Model 4: Model 2 + adjusted for caregiver-child interaction (caregiver and child eating dinner together; frequency of caregiver and child talking together about school life, news and television shows; frequency of the caregiver helping with the child's homework and frequency of playing card games or engaging in pretend play).

¶Model 5: Model 2 + adjusted for child's eating behaviours and caregiver-child interaction.

Table 4 Factor loading matrix for the two major patterns of caregiver involvement with their child

Caregiver involvement with their child	Factor 1	Factor 2
	Talking and helping	Playing and going out
Talking about school life with the child	0.39*	-0.03
Talking about news with the child	0.37*	0.00
Talking about television shows with the child	0.39*	-0.01
Helping with the child's homework	0.25	0.11
Going out with the child	0.11	0.27
Engaging in physical exercise with the child	0.05	0.41*
Playing computer games with the child	-0.08	0.39*
Playing card games or engaging in pretend play with the child	-0.03	0.41*

*Factors with loadings ≥ 0.3 .**Table 5** Mediation analyses between frequency of home cooking and child's mental health among Japanese schoolchildren*

Mediator	Low frequency of home cooking†				Medium frequency of home cooking‡			
	Estimated Indirect Effect			Proportion mediated, %	Estimated Indirect Effect			Proportion mediated, %
	Coefficient	95 % CI	P		Coefficient	95 % CI	P	
Total difficulties (SDQ score)								
Child's eating behaviours								
Frequency of vegetable intake	-0.49	-2.02, 1.05	0.53	22.7	0.76	0.01, 1.50	0.047	21.9
Frequency of breakfast intake	0.86	0.05, 1.67	0.04		0.67	0.31, 1.02	<0.001	20.1
Snacking habits	0.03	-0.34, 0.40	0.89		0.00	-0.24, 0.23	0.98	
Caregiver-child interactions								
Factor 1: Talk and help (factor score)	1.20	-0.37, 2.77	0.13		0.48	0.10, 0.86	0.01	15.2
Factor 2: Play and go out (factor score)	-0.26	-0.79, 0.27	0.34		0.01	-0.06, 0.09	0.72	
Prosocial behaviour (SDQ score)								
Child's eating behaviours					-		-	
Frequency of vegetable intake	-0.51	-2.95, 1.92	0.68		-		-	
Frequency of breakfast intake	-0.67	-1.85, 0.51	0.26		-		-	
Snacking habits	1.05	-0.46, 2.56	0.17		-		-	
Caregiver-child interactions								
Factor 1: Talk and help (factor score)	-1.26	-3.69, 1.17	0.31		-		-	
Factor 2: Play and go out (factor score)	0.49	-0.43, 1.42	0.30					
Resilience (CRCS Total score)								
Child's eating behaviours								
Frequency of vegetable intake	-0.73	-2.57, 1.10	0.43	22.1	-2.34	-3.28, -1.41	<0.001	57.7
Frequency of breakfast intake	-1.30	-2.33, -0.26	0.01		-0.57	-0.96, -0.18	<0.01	14.1
Snacking habits	0.03	-0.40, 0.47	0.88		-0.28	-0.59, 0.03	0.08	6.8
Caregiver-child interactions								
Factor 1: Talk and help (factor score)	-1.48	-3.31, 0.36	0.12		-1.61	-2.30, -0.92	<0.001	40.7
Factor 2: Play and go out (factor score)	0.33	-0.33, 0.99	0.33		-0.05	-0.30, 0.20	0.71	

CRCS = Children's Resilient Coping Scale; SDQ = Strength and Difficulties Questionnaire.

Boldface indicates statistical significance ($P < 0.05$).

*Models: Adjusted for household income, caregiver's K6, mother's age, education and employment, and eating with caregivers at dinner.

†Low frequency of home cooking was treated as a binary, with 0 = high frequency of home cooking and 1 = low frequency of home cooking.

‡Medium frequency of home cooking was treated as a binary, with 0 = high frequency of home cooking and 1 = medium frequency of home cooking.

interactions, that is, talking and helping (40.7%, $P < 0.001$ for medium frequency of home cooking).

Discussion

This cross-sectional study among Japanese schoolchildren and their caregivers found that low frequency of home cooking was associated with low caregiver-child

interaction, including low frequency of caregivers talking with their children about school life, news and television shows; low frequency of caregivers helping with their children's homework and low frequency of caregivers and children playing card games or engaging in pretend play together. Home cooking was not associated with frequency of caregivers going out with their children, engaging in physical exercise with their children and playing computer games with their children. Children exposed



to a low or medium frequency of home cooking had more behaviour problems, lower prosocial behaviour and lower resilience. The associations with behaviour problems and resilience were significantly mediated by children's eating behaviours and caregiver-child interaction.

Children's eating behaviours including vegetable intake and breakfast skipping partially mediated the association between home cooking and children's behaviour problems and resilience. A recent longitudinal study of families with children aged 5–7 years in the US showed that home-cooked meals were more likely to contain fruit and vegetables than were pre-prepared meals or restaurant meals⁽⁴⁰⁾. The present study found that only 8% of children with a high level of home cooking consumed vegetables less than three times per week, whereas 42% of children with a low level of home cooking consumed vegetables less than three times per week (Table 1). Several studies have shown that increased vegetable consumption and a healthy dietary pattern are associated with better mental health among children and adults^(41–43). Thus, home cooking may be associated with children's mental health via the diet-mediated pathway.

The present study also found evidence supporting the caregiver-child interaction-mediated pathway. The associations of medium frequency of home cooking with children's behaviour problems and resilience were mediated by caregiver-child interaction. This finding is in line with a previously reported negative association between parents having a late time of returning home and children's mental health, operating through reduced frequency of caregiver-child interaction⁽³³⁾. Likewise, the present study found that the frequency of home cooking was lower when the caregivers returned home later (Table 1). Caregivers who usually cooked at home talked more with their children and helped their children more with their homework, compared with caregivers who infrequently cooked at home (Table 2). Therefore, caregivers who usually cooked at home might have tended to talk about their own and others' emotions with their children, teaching their children how to deal not only with school-related problems but also with other emotional problems. Home cooking may be beneficial for creating positive caregiver-child interactions.

In the present study, home cooking was found to be associated with caregiver involvement in terms of talking with their children. A systematic review exploring family perceptions of eating together identified family connection and communication as the main perceived benefits of family meals⁽⁴⁴⁾. The association between home cooking and caregiver involvement with their children remained even after adjusting for eating with caregiver. A study among parents of children aged 8–10 years reported the benefits of eating with family to include not only increased opportunities for parents and their children to talk about their daily lives but also consuming good home-cooked food⁽⁴⁵⁾. The present study also found that infrequent home cooking was associated with a low frequency of helping with the

child's homework. In Japan, the most common place for elementary schoolchildren to study is in the living room (family room): The family living room was listed as a place to study outside of school by more than 80% of children – a higher percentage than that for the child's own room⁽⁴⁶⁾. Caregivers may help with the child's homework before, during or after cooking at home.

Home cooking was not associated with playing with the child or going out with the child. An exploratory factor analysis of the eight items of caregiver involvement with their children in the present study sample yielded two factors, talking and helping pattern and playing and going out pattern (Table 4). Home cooking may be particularly effective for the first of these patterns of caregiver involvement. For the items in the second factor, home cooking was associated only with playing card games or engaging in pretend play with the child. This may be because card games and pretend play are often done in the living room, unlike other types of play. Frequent home meals may increase the time caregivers and children spend in the living room. Additionally, unlike other types of play, pretend play requires caregivers to follow their children's rules. Therefore, caregivers who frequently cook at home may have the time required to engage in play organised according to their children's perspectives. To investigate this hypothesis, it would be necessary to examine the relationships of home cooking with the places where children spend their time and with caregiver emotional flexibility.

This study had several limitations. First, common method bias may have occurred because frequency of home cooking, caregiver involvement with the child and children's mental health were assessed via the caregiver-report questionnaire. However, we confirmed a similar association between the caregiver-provided frequency of home cooking and child-reported family meals. To address this common source bias, it would be useful to collect information from a third person, such as a teacher, who could evaluate the child's mental health, or to examine these associations when children are old enough to provide information about their mental health themselves. Second, caregiver involvement with their children was assessed using items that have not been validated. However, the four items gauging caregiver involvement extracted as the first pattern in the factor analysis showed the same associations with home cooking. Third, misclassification of the level of home cooking may have occurred because home cooking was defined as a basic and simple practice, such as frying an egg. Thus, caregivers who cook only a few dishes or only low-quality meals, for example, may have been included in the high frequency of home cooking category, which may have led to an underestimation of the effect of home cooking on children's mental health. Moreover, when older sibling was in charge of cooking frequently at home, children will be included in the high frequency of home cooking category, which may have led to an underestimation of the effect of home

cooking on caregiver–child interactions and children’s mental health. Additionally, home cooking could not distinguish whether caregiver cooked with their children. Fourth, we could not distinguish whether children ate dinner with both their parents and grandparents or only with parents or grandparents. Fifth, potential confounding factors such as parents’ working conditions, the other parent’s mental health and children’s lifestyle rhythm including children’s cram school situation and after-school lessons have not been adjusted. Moreover, it has not reached full reliability in the measurement of the included covariates. Seventh, because our study was conducted only among public school students in one city in Tokyo, the generalisability to children attending private schools or residing in other areas is not high⁽²⁹⁾. Finally, we could not assess causality because this study was cross-sectional. There might, for example, be an effect in the opposite direction, from the child’s mental health on the parent–child interaction and frequency of home cooking. Longitudinal studies are needed to demonstrate the effectiveness of home cooking in increasing children’s prosocial behaviour and resilience and in preventing children’s mental health problems.

Conclusions

Our study has provided novel findings regarding the associations of home cooking with caregiver–child interaction and children’s mental health. Infrequent home cooking was associated with low caregiver–child interaction, including a low frequency of caregivers and their children talking together. Infrequent home cooking was also found to be associated with high levels of behaviour problems, low prosocial behaviour and low resilience among children. The associations with behaviour problems and resilience were mediated by children’s eating behaviours and caregiver–child interaction. Specifically, the difference between those with high and low frequency of home cooking can mainly be accounted for by the frequency of breakfast intake, while the difference between those with high and medium frequency of home cooking is also accounted for differences in vegetable intake and by the talking/helping interaction factor. Creating an environment that encourages caregivers to cook at home may be important for children’s mental health.

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