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Epidemiology

Impact of Speed-Eating Habit on Subsequent Body Mass Index and Blood Pressure Among Schoolchildren
— The Ibaraki Children's Cohort Study (IBACHIL) —

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Background: Habitual speed eating is a risk factor of obesity but evidence of this in children is limited. We examined the association between speed-eating habit and subsequent body mass index (BMI) and blood pressure (BP) among Japanese children.

Methods and Results: The community-based study comprised 1,490 Japanese boys and girls who were born in 1989, involved in the Ibaraki Children's Cohort Study at age 3 years, and had returned questionnaires at both ages 6 and 12 years. In a subsample, we measured BP (n=263). Speed-eating habit was categorized into 4 groups: Never, Quit, Newly, and Continuous. Sex-specific mean values of questionnaire-based BMI and measured BPs at age 12 were examined according to speed-eating habit. Children with continuous speed eating had a higher BMI at age 12 than those who had never had a speed-eating habit (20.0 vs. 17.9 kg/m^2 for boys (P<0.001); 20.0 vs. 18.4 kg/m^2 (P<0.001) for girls). Systolic BP at age 12 was higher in boys with continuous speed eating than in those without (117 vs. 110 mmHg, P=0.01), but such a difference was not observed in girls (112 vs. 111 mmHg, P=0.95).

Conclusions: Habitual speed eating was positively associated with subsequent BMI among boys and girls as well as with systolic BP among boys.

Key Words: Eating habits; Epidemiology; Hypertension; Obesity; Prospective studies

Speed eating is considered as a risk factor for the development of obesity,[1] but there is limited evidence in the literature with regards to children.[2] Furthermore, an associative link between habitual speed eating and subsequent effect on blood pressure (BP) is also scarce. In order to gain a greater understanding of this association in children, we conducted a long-term cohort study to examine the association between habitual speed eating at 6 years old and follow-up body mass index (BMI) as well as BP at 12 years old among Japanese children. Our hypothesis was that children who continued speed eating from 6 to 12 years old would have higher BMI and BP levels at 12 years old compared with slower eaters at either age.

Methods

Study Subjects

The Ibaraki Children's Cohort (IBACHIL) Study is an ongoing, long-term, prospective cohort study involving children born in 1989 within 87 communities of Ibaraki Prefecture, Japan. In 1992, we distributed a health questionnaire to parents who attended community-based health checkups for 3-year-old children. From a total of 10,526 children who had the checkups, questionnaires for 4,592 were returned by mail. We subsequently carried out follow-up surveys when they were 6 years old (2,141 subjects; follow-up rate, 46.6%) and 12 years old (2,375 subjects; follow-up rate, 51.7%) based on postal surveys sent to their parents. We included 822 boys and 668 girls who had completed 6- and 12-year-old questionnaires and provided valid information on eating habits, height and weight. Independently, some junior high schools carried out health checkups for 12 year olds; 25 municipal education boards permitted usage of the health checkup data for the present study (number of participants, 615). Additionally, in the survey at age 12, we asked parents for permission to obtain

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Table 1. Mean Values of Baseline Characteristics at Age 6 Years According to Speed-Eating Habit

	Speed-eating habit at ages 6 and 12 years				
	Never	Quit	Newly	Continuous	P for overall difference
Boys, n†	242	108	185	287	
BMI, kg/m^2	15.5±1.3	15.7±1.4	15.9±1.3*	16.7±2.2***	<0.001
Height, cm	113.2±5.0	113.6±4.5	113.8±4.2	114.6±4.7*	0.04
Weight, kg	19.9±2.6	20.2±2.5	20.7±2.5*	21.9±3.6***	<0.001
Physical inactivity, %	31	27	28	27	0.77
Girls, n†	348	121	104	95	
BMI, kg/m^2	15.6±1.5	16.1±2.1	16.0±1.5	16.7±2.3***	<0.001
Height, cm	111.9±4.9	112.6±4.7	114.1±3.8**	113.4±4.9*	0.001
Weight, kg	19.7±2.9	20.5±3.5	20.8±2.6*	21.6±3.9***	<0.001
Physical inactivity, %	32	36	39	31	0.44

P for difference with never speed-eating group: *P<0.05, **P<0.01 and ***P<0.001. †Because of missing data, sample size ranged from 610 to 808 for boys and from 487 to 658 for girls. BMI, body mass index.

health checkup information of their children from other providers, and 518 (consent rate, 84%) parents consented. Of these, 263 participants (141 boys, 122 girls) had both the checkup data and participated in the age 6 survey, so we used them for a subsample analysis. We regarded consent as implied if questionnaires were returned, and for use of health checkup information, written informed consent was obtained from the parents in addition to consent from the municipal education boards. The study protocol was approved by the Epidemiology Combination Ethics Review Committee of Ibaraki Prefecture.

Baseline and Follow-up Questionnaires

A questionnaire administered to parents with regard to their 6-year-old children included questions addressing several lifestyle and physical factors including height, weight, physical activity and eating habits. The query for speed eating was "Does your son/daughter have the tendency to speed eat?" and the 4 possible responses were yes, somewhat, rarely, and never. The same query about speed eating was included in the questionnaire at age 12. We condensed the choices "yes" and "somewhat" into affirmative for speed eating and "rarely" and "never" as negative for speed eating. Then, we divided the participants into 4 groups based on speed-eating habit at ages 6 and 12: "Never" (no habitual speed eating at either age); "Quit" (speed eating at age 6 but not at age 12); "Newly" (speed eating at age 12 but not age 6); and "Continuous" (speed eating at both ages 6 and 12). This grouping was adopted to reduce misclassification for speed eating, because the eating pattern reported at survey at age 6 may change over the next 6 years. BMI was calculated from questionnaire responses as weight (kg) divided by the square of the height in meters (m^2). Physical activity levels were derived from a query asking "How long does your son/daughter play outside on weekdays?" and we defined less than 2 h/day as non-active.

Outcomes

Height and weight for children aged 12 years were based on the questionnaire, and BMI was calculated. For the subsample analysis, systolic and 5th-phase diastolic BP were measured by trained nurses. If the recorded BP read was ≥140 mmHg for systolic and/or ≥90 mmHg for diastolic, the measurement was repeated and the lowest reading was recorded. Total and high-density lipoprotein (HDL) cholesterol levels were measured at the Ibaraki Health Service Association using enzymatic (total cholesterol) and phosphotungstic acid-magnesium (HDL-cholesterol) methods.

Statistical Analysis

Sex-specific crude and adjusted means across the speed-eating habit group were tested by analysis of (co)variance and Dunnett's t-tests. For multivariable adjustments, we included physical activity and BMI at age 6 in the models. All statistical analyses were performed by SAS version 9.3 (SAS Institute Inc., Cary, NC. USA). All probability values for statistical tests were performed as two-tailed and values <0.05 were regarded as statistically significant.

Results

At baseline, boys and girls who displayed "Continuous" speed eating had significantly higher BMI than the "Never" speed-eating group (**Table 1**). Boys in the "Newly" group also displayed a higher BMI in comparison with the "Never" speed-eating group. Both height and weight were significantly higher among boys and girls in the "Newly" and "Continuous" groups than in the "Never" group, except for height in boys in the "Newly" group. Physical activity did not differ across the groups.

For both boys and girls, BMI was significantly higher among those with both "Continuous" and "Newly" groups of speed eating compared with those who never displayed the habit (20.0 kg/m^2 (P<0.001) and 19.3 kg/m^2 (P<0.001) vs. 17.9 kg/m^2 for boys and 20.0 kg/m^2 (P<0.001) and 19.8 kg/m^2 (P<0.001) vs. 18.4 kg/m^2 for girls; **Table 2**). Further adjustment for BMI and physical activity at age 6 did not change the associations and the differences remained statistically significant (19.7 kg/m^2 (P<0.001) and 19.2 kg/m^2 (P<0.001) vs. 18.3 kg/m^2 for boys and 19.5 kg/m^2 (P=0.001) and 19.7 kg/m^2 (P<0.001) vs. 18.6 kg/m^2 for girls). Similar associations were observed for weight and height.

Accordingly, systolic BP levels were significantly higher among "Continuous" speed-eating boys compared with "Never" speed-eating boys in the subsample analysis (117 mmHg vs. 110 mmHg, P=0.01). This association was unchanged after adjustment for BMI and physical activity at age 6 (116 mmHg vs. 110 mmHg, P=0.046). However, such an association was not observed in girls (112 mmHg

Table 2. Mean and Standard Error of BMI, BP Levels and Lipid Profiles at Age 12 Years According to Speed-Eating Habit

	Speed-eating habit at ages 6 and 12 years				
	Never	Quit	Newly	Continuous	P for overall difference
Boys, n‡	242	108	185	287	
BMI, kg/m^2					
Crude	17.9±0.2	18.3±0.3	19.3±0.2***	20.0±0.2***	<0.001
Multivariable adjusted†	18.3±0.2	18.5±0.2	19.2±0.2***	19.7±0.1***	<0.001
Height, cm					
Crude	153.4±0.5	154.3±0.8	155.9±0.6**	156.9±0.5***	<0.001
Multivariable adjusted†	153.7±0.5	154.4±0.8	156.0±0.6**	156.6±0.5***	<0.001
Weight, kg					
Crude	42.5±0.6	43.9±0.9	47.1±0.7***	49.6±0.6***	<0.001
Multivariable adjusted†	43.6±0.6	44.3±0.8	47.1±0.6***	48.6±0.5***	<0.001
Subsample analyses, n	37	15	37	52	
Systolic BP, mmHg					
Crude	110±2	105±3	109±2	117±2*	<0.001
Multivariable adjusted†	110±2	106±3	109±2	116±2*	0.003
Diastolic BP, mmHg					
Crude	59±1	57±2	57±1	60±1	0.32
Multivariable adjusted†	59±1	58±2	57±1	60±1	0.31
HDL-cholesterol, mg/dL					
Crude	60±2	60±3	60±2	59±2	0.95
Multivariable adjusted†	60±2	61±3	60±2	59±2	0.92
Total cholesterol, mg/dL					
Crude	162±4	165±6	167±4	162±3	0.75
Multivariable adjusted†	163±4	164±6	167±4	162±3	0.76
Girls, n‡	348	121	104	95	
BMI, kg/m^2					
Crude	18.4±0.1	18.9±0.2	19.8±0.3***	20.0±0.3***	<0.001
Multivariable adjusted†	18.6±0.1	18.9±0.2	19.7±0.2***	19.5±0.2**	<0.001
Height, cm					
Crude	152.2±0.3	152.7±0.5	155.1±0.6***	154.0±0.6*	<0.001
Multivariable adjusted†	152.1±0.3	152.7±0.5	155.0±0.6***	153.9±0.6*	<0.001
Weight, kg					
Crude	42.7±0.4	44.2±0.7	47.6±0.7***	47.5±0.8***	<0.001
Multivariable adjusted†	43.1±0.4	44.2±0.6	47.3±0.7***	46.4±0.7***	<0.001
Subsample analyses, n	64	24	14	20	
Systolic BP, mmHg					
Crude	111±2	113±3	117±3	112±3	0.40
Multivariable adjusted†	111±2	113±3	117±4	112±3	0.46
Diastolic BP, mmHg					
Crude	58±1	60±2	61±2	60±2	0.37
Multivariable adjusted†	58±1	60±2	60±2	61±2	0.34
HDL-cholesterol, mg/dL					
Crude	61±1	62±2	56±3	59±2	0.43
Multivariable adjusted†	61±1	62±2	57±3	58±2	0.48
Total cholesterol, mg/dL					
Crude	168±3	173±5	170±7	167±6	0.81
Multivariable adjusted†	168±3	173±5	170±7	167±6	0.79

P for difference with never speed-eating group using Dunnet's test: *P<0.05, **P<0.01 and ***P<0.001. †Adjusted for baseline BMI and physical activity. ‡Because of missing data, sample size ranged from 791 to 801 for boys and from 644 to 652 for girls. BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein.

vs. 111 mmHg, P=0.95 for the crude model; and 112 mmHg vs. 111 mmHg, P=0.97 for the adjusted model). Diastolic BP and lipids were not associated with speed-eating habits in either boys or girls.

We had measured BMI data for this subsample. When we performed similar analyses using measured, instead of self-reported, BMI, the associations were similar (20.4 kg/m^2 in "Continuous" vs. 18.7 kg/m^2 in "Never" for boys (P=0.02), and 20.4 kg/m^2 vs. 19.1 kg/m^2 (P=0.15) for girls; data not shown).

Discussion

We found that boys and girls with a continuous habit of speed eating from ages 6 to 12 years had a higher BMI at age 12. Furthermore, a speed-eating habit was associated with increased systolic BP levels in boys. The mean body weight in boys and girls with a speed-eating habit was 49.6 kg and 47.5 kg, respectively, which was 6–10% higher than mean body weight at age 12 in 2002 (45.2 kg and 44.9 kg, respectively) for the national representative sample.[3]

The association between speed eating and high BMI has been established in cross-sectional studies of both adults[4–7] and children,[8–10] and a few longitudinal studies have been conducted on this topic. A retrospective study of 529 male workers[1] and a prospective study of 1,314 university students[11] consistently reported a positive association of eating speed with the rate of body weight gain or becoming overweight. As for children, Sugimori et al[2] showed that speed eating at age 6 was associated with temporal changes in BMI from ages 3 to 6 years. Further, a randomized controlled trial for 106 obese children aged 9–17 years[12] demonstrated that modification of eating behavior (including slowing eating speed and reducing total intake using a computerized device) reduced the BMI standard deviation score more than the clinic's standard care after a 12-month intervention. In that trial,[12] however, changes in BP levels did not differ between the groups. No other cross-sectional or prospective cohort studies have so far focused on the association between speed eating and BP in children.

The association between habitual speed eating and BP was unchanged and remained statistically significant even after adjustment for BMI at age 6. Other etiologies such as the adverse effect of speed eating on blood glucose,[7] insulin resistance,[13] metabolic syndrome[14] or diabetes,[15] as well as type A behavior pattern,[16] may also be involved in this mechanism.

We focused on the effect of a speed-eating habit on BMI at age 12, but children at this age are still growing. Further follow-up of the participants until adulthood is necessary to examine the long-term health effects of speed eating.

Study Limitations

These include (1) the non-validated, self-reported questionnaires (however, the association with measured BMI in the subsample did not materially differ from that of the self-reported BMI, especially for boys); (2) unmeasured residual confounding (e.g., the amount of food and food composition, educational background, and other aspects of socioeconomic status); and (3) limited numbers for subsample analysis of BP and lipids. Another limitation is a possible selection bias (response rate for the baseline survey was 44%, and 31% of the baseline survey participants were involved in this study). We unfortunately did not have any information on non-responders, but there was no material difference in the distribution of habitual speed eating at baseline between the participants of survey at age 6 only and those included in both surveys at ages 6 and 12 (data not shown). Limitations notwithstanding, this study serves as the first real report on associations between juvenile speed-eating habit and BP and will serve as the seminal foundation for future studies.

In conclusion, a habit of speed eating in childhood affected subsequent BMI for both boys and girls, as well as systolic BP levels for boys. Health education about slower eating could be a new approach to preventing future obesity and hypertension-related diseases.

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References

1. Tanihara S, Imatoh T, Miyazaki M, Babazono A, Momose Y, Baba M, et al. Retrospective longitudinal study on the relationship between 8-year weight change and current eating speed. *Appetite* 2011; **57:** 179–183.
2. Sugimori H, Yoshida K, Izuno T, Miyakawa M, Suka M, Sekine M, et al. Analysis of factors that influence body mass index from ages 3 to 6 years: A study based on the Toyama Cohort Study. *Pediatr Int* 2004; **46:** 302–310.
3. Ministry of Education, Culture, Sports, Science and Technology. Annual Report of School Health Statistics Research. 2002. http://www.mext.go.jp/b_menu/toukei/chousa05/hoken/1268826.htm (accessed June 22, 2017).
4. Maruyama K, Sato S, Ohira T, Maeda K, Noda H, Kubota Y, et al. The joint impact on being overweight of self reported behaviours of eating quickly and eating until full: Cross sectional survey. *BMJ* 2008; **337:** a2002.
5. Otsuka R, Tamakoshi K, Yatsuya H, Murata C, Sekiya A, Wada K, et al. Eating fast leads to obesity: Findings based on self-administered questionnaires among middle-aged Japanese men and women. *J Epidemiol* 2006; **16:** 117–124.
6. Sasaki S, Katagiri A, Tsuji T, Shimoda T, Amano K. Self-reported rate of eating correlates with body mass index in 18-y-old Japanese women. *Int J Obes Relat Metab Disord* 2003; **27:** 1405–1410.
7. Lee KS, Kim DH, Jang JS, Nam GE, Shin YN, Bok AR, et al. Eating rate is associated with cardiometabolic risk factors in Korean adults. *Nutr Metab Cardiovasc Dis* 2013; **23:** 635–641.
8. Murakami K, Miyake Y, Sasaki S, Tanaka K, Arakawa M. Self-reported rate of eating and risk of overweight in Japanese children: Ryukyus Child Health Study. *J Nutr Sci Vitaminol (Tokyo)* 2012; **58:** 247–252.
9. Ochiai H, Shirasawa T, Ohtsu T, Nishimura R, Morimoto A, Hoshino H, et al. The impact of eating quickly on anthropometric variables among schoolgirls: A prospective cohort study in Japan. *Eur J Public Health* 2014; **24:** 691–695.
10. Ochiai H, Shirasawa T, Nanri H, Nishimura R, Matoba M, Hoshino H, et al. Eating quickly is associated with waist-to-height ratio among Japanese adolescents: A cross-sectional survey. *Arch Public Health* 2016; **74:** 18.
11. Yamane M, Ekuni D, Mizutani S, Kataoka K, Sakumoto-Kataoka M, Kawabata Y, et al. Relationships between eating quickly and weight gain in Japanese university students: A longitudinal study. *Obesity (Silver Spring)* 2014; **22:** 2262–2266.
12. Ford AL, Bergh C, Sodersten P, Sabin MA, Hollinghurst S, Hunt LP, et al. Treatment of childhood obesity by retraining eating behaviour: Randomised controlled trial. *BMJ* 2009; **340:** b5388.
13. Otsuka R, Tamakoshi K, Yatsuya H, Wada K, Matsushita K, OuYang P, et al. Eating fast leads to insulin resistance: Findings in middle-aged Japanese men and women. *Prev Med* 2008; **46:** 154–159.
14. Zhu B, Haruyama Y, Muto T, Yamazaki T. Association between eating speed and metabolic syndrome in a three-year population-based cohort study. *J Epidemiol* 2015; **25:** 332–336.
15. Radzeviciene L, Ostrauskas R. Fast eating and the risk of type 2 diabetes mellitus: A case-control study. *Clin Nutr* 2013; **32:** 232–235.
16. Rosenman RH, Friedman M. Association of specific behavior pattern in women with blood and cardiovascular findings. *Circulation* 1961; **24:** 1173–1184.