

Body Image and Body Satisfaction Play Important Roles in the Path to Dieting Behavior in Japanese Preadolescents: The Toyama Birth Cohort Study

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Abstract

Objectives: To analyze the path to dieting behavior in Japanese preadolescents.

Methods: A cross-sectional study of dieting behavior among 5,244 preadolescents (2,452 boys and 2,792 girls aged 12–13) born in Toyama prefecture.

Results: While increasing with body mass index (BMI), the percentage of those who had tried dieting was higher in those who perceived themselves fat than in those who perceived themselves thin or average. Of those who wanted to be thinner, 16.1% of boys and 26.8% of girls had tried dieting. Path analysis in nonobese subjects (2,116 boys and 2,334 girls) showed that (1) body image was primarily based on BMI, (2) body image led to body dissatisfaction, and (3) body dissatisfaction led to dieting behavior. Pubertal changes had a significant effect on body image (path coefficient <0) for boys and body satisfaction (path coefficient >0) for girls, in addition to that on BMI. Maternal BMI had a significant effect on BMI but not on body image, body satisfaction, or dieting behavior.

Conclusions: Body image and body satisfaction play important roles in the path to dieting behavior in Japanese preadolescents. Pubertal changes may reinforce dieting behavior, but the mechanism may differ by sex.

Key words: preadolescents, dieting behavior, path analysis

Introduction

Because of the tracking of health conditions and lifestyles from childhood to adulthood (1–5), it is important to educate people about the sense of weight control from childhood. Currently, there is increasing emphasis on thinness, which occasionally incites pre- and post-adolescents to harmful dieting behavior. Dieting behavior can be associated with poor diet quality (6), and frequent dieters can be at a high risk of developing eating disorders (7). Factors related to dieting behavior may be useful information for both promoting weight control and avoiding harmful dieting behavior.

Many investigators have reported about the relationships between body image, body satisfaction, and dieting behavior in preadolescents and adolescents (8–15). Pubertal changes are likely to have some role in dieting behavior, but there have been few attempts to examine the effects of pubertal changes on body image, body satisfaction, and dieting behavior. Environmental factors such as parents, peers, friends, the mass media influence body image, body satisfaction, and dieting behavior (6, 16–20). In particular, parental influence is important, because children and their parents share lifestyles as well as genetic predispositions (21). We previously reported that weight changes of children were concurrent with weight changes of their parents (22). In this study, we aimed to analyze the path to dieting behavior in Japanese preadolescents. We examined the effects of pubertal changes and maternal overweight in the path analysis.

Subjects and Methods

The Toyama Birth Cohort Study is an ongoing population-

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based birth cohort study, which consists of almost all children born from April 2, 1989 to April 1, 1990 in Toyama prefecture, Japan (23). The initial survey using a questionnaire and anthropometric measurement was conducted in 1992 (at ages 2–4). The follow-up surveys using a questionnaire were conducted in 1996 (at ages 6–7), 1999 (at ages 9–10, described below as age 9), and 2002 (at ages 12–13, described below as age 12). Information on family members, lifestyles, and the physical status of the children and their parents was collected at each survey. Informed consent was obtained from all the parents of the participants, and we paid special attention to the protection of the anonymity and confidentiality of the available information.

The study subjects were 5,244 eligible participants in the age 12 survey (2,492 boys and 2,752 girls), who had complete information on sex, height and weight at age 12, body image, body satisfaction, dieting behavior, pubertal changes, maternal height and weight (collected at the age 12 survey), and height and weight at age 9 (collected at the age 9 survey).

Heights and weights at ages 9 and 12 were reported by children and parents. Heights were specified to the nearest 0.1 cm and weights were specified to the nearest 0.1 kg. Previous studies revealed that heights and weights reported by children and parents were close to actually measurements (24, 25). Body mass index (BMI; kg/m²) was used to assess obesity in children, because the International Obesity Task Force proved BMI to offer a reasonable measure of body fat in

children (26). BMI in childhood changes substantially with age (27, 28), therefore, BMIs were classified as age- and sex-specific quartiles of the study subjects: ≤15.4, 15.5–16.7, 16.8–18.5, and 18.6≤ for boys at age 9; ≤15.2, 15.3–16.4, 16.5–18.0, and 18.1≤ for girls at age 9; ≤17.1, 17.2–18.4, 18.5–20.4, and 20.5≤ for boys at age 12; ≤17.0, 17.1–18.5, 18.6–20.5, and 20.6≤ for girls at age 12.

Body image, body satisfaction, and dieting behavior were assessed using the following questions, respectively: (1) Do you perceive yourself thin, average, or fat? (2) Do you want to be thinner or fatter, or are you satisfied as you are? (3) Have you tried dieting? Pubertal changes were defined by one or more affirmative answers to the following questions: (1) Has your axillary hair grown? (2) Has your pubic hair grown? (3) Has your voice changed? (for boys) (4) Have you experienced your first menstruation? (for girls).

Maternal BMIs, which were calculated from self-reported heights and weights, were classified as underweight (≤18.5), normal (18.6–24.9), and overweight (25.0≤) on the basis of the Japanese expert committees' guidelines (29).

Statistical analyses were performed with the Statistical Analysis Systems (SAS, version 8.2). The distributions of body image, body satisfaction, and dieting behavior were compared by chi-square test and Mantel-Haenszel test (for stratified data). The percentages of those who perceived themselves fat, those who want to be thinner, and those who have tried dieting were calculated by BMI quartile, and their trends were examined by

Table 1 Percentages of preadolescents who want to be thinner and who have tried dieting in the context of BMI and body image

BMI quartile		Boy (n=2492)				Girl (n=2752)			
		All	Body image			All	Body image		
			Thin	Average	Fat		Thin	Average	Fat
All	Want to be thinner	647/2492 (26.0%)	11/656 (1.7%)	249/1338 (18.6%)	387/498 (77.7%)	1595/2752 (58.0%)	18/332 (5.4%)	707/1478 (47.8%)	870/942 (92.4%)
	Dieting behavior	141/2492 (5.7%)	8/656 (1.2%)	58/1338 (4.3%)	75/498 (15.1%)	477/2752 (17.3%)	9/332 (2.7%)	180/1478 (12.2%)	288/942 (30.6%)
1st	Want to be thinner	21/638 (3.3%)	3/421 (0.7%)	14/212 (6.6%)	4/5 (80.0%)	167/681 (24.5%)	10/266 (3.8%)	124/380 (32.6%)	33/35 (94.3%)
	Dieting behavior	6/638 (0.9%)	4/421 (1.0%)	2/212 (0.9%)	0/5 (0.0%)	51/681 (7.5%)	5/266 (1.9%)	37/380 (9.7%)	9/35 (25.7%)
2nd	Want to be thinner	75/603 (12.4%)	6/176 (3.4%)	53/405 (13.1%)	16/22 (72.7%)	343/695 (49.4%)	6/59 (10.2%)	249/545 (45.7%)	88/91 (96.7%)
	Dieting behavior	14/603 (2.3%)	3/176 (1.7%)	9/405 (2.2%)	2/22 (9.1%)	93/695 (13.4%)	3/59 (5.1%)	63/545 (11.6%)	27/91 (29.7%)
3rd	Want to be thinner	157/627 (25.0%)	2/55 (3.6%)	105/502 (20.9%)	50/70 (71.4%)	481/683 (70.4%)	2/7 (28.6%)	241/415 (58.1%)	238/261 (91.2%)
	Dieting behavior	28/627 (4.5%)	1/55 (1.8%)	20/502 (4.0%)	7/70 (10.0%)	145/683 (21.2%)	1/7 (14.3%)	55/415 (13.3%)	89/261 (34.1%)
4th	Want to be thinner	394/624 (63.1%)	0/4 (0.0%)	77/219 (35.2%)	317/401 (79.1%)	604/693 (87.2%)	0/0 (—)	93/138 (67.4%)	511/555 (92.1%)
	Dieting behavior	93/624 (14.9%)	0/4 (0.0%)	27/219 (12.3%)	66/401 (16.5%)	188/693 (27.1%)	0/0 (—)	25/138 (18.1%)	163/555 (29.4%)

BMI: body mass index.

BMIs were classified as age- and sex-specific quartiles: 1st ≤17.1, 2nd 17.2–18.4, 3rd 18.5–20.4, 4th 20.5≤ for boys at age 12; 1st ≤17.0, 2nd 17.1–18.5, 3rd 18.6–20.5, 4th 20.6≤ for girls at age 12.

Percentage of those who want to be thinner: p<0.001 in boys, p<0.001 in girls (Mantel-Haenszel test).

Percentage of those who have tried dieting: p<0.001 in boys, p<0.001 in girls (Mantel-Haenszel test).

the Cochran-Armitage test. Path analysis (30) was conducted to examine the relationships between BMIs at ages 9 and 12 (quartiles), body image (1=thin, 2=average, 3=fat), body satisfaction (1=to be fatter, 2=satisfied, 3=to be thinner), dieting behavior (0=no, 1=yes), pubertal changes (0=no, 1=yes), and maternal BMI (1=underweight, 2=normal, 3=overweight). To focus on unnecessary or harmful dieting behavior, only nonobese subjects were included in the path analysis. The 85th percentile of BMI for age and sex is widely used and recommended as the cutoff for identifying overweight (27, 28). Therefore, 2,116 boys and 2,334 girls who had a BMI of less than the 85th percentile of the study subjects (22.3 for boys and 21.8 for girls at age 12) were counted as nonobese. The strength of the relationship was determined using path coefficient, which was estimated as a partial regression coefficient (β) in a multiple regression model. The final path diagrams consisted

of paths with a path coefficient of more than 0.05 or less than -0.05.

Results

Table 1 shows the percentages of preadolescents who want to be thinner and who have tried dieting in the context of BMI and body image. While increasing with BMI (Cochran-Armitage test for trend $p < 0.001$), the percentage of those who want to be thinner was higher in those who perceived themselves fat than in those who perceived themselves thin or average. The same pattern was found for the percentage of those who have tried dieting. Of those who wanted to be thinner, 16.1% of boys and 26.8% of girls had tried dieting.

Table 2 shows the percentages of preadolescents who perceive themselves fat, who want to be thinner, and who have

Table 2 Percentages of preadolescents who perceive themselves fat, who want to be thinner, and who have tried dieting by pubertal changes

BMI quartile		Boy (n=2492)			Girl (n=2752)		
		All	Pubertal changes		All	Pubertal changes	
			-	+		-	+
All	Perceive themselves fat	498/2492 (20.0%)	198/966 (20.5%)	300/1526 (19.7%)	942/2752 (34.2%)	147/819 (17.9%)	795/1933 (41.1%)
	Want to be thinner	647/2492 (26.0%)	244/966 (25.3%)	403/1526 (26.4%)	1595/2752 (58.0%)	322/819 (39.3%)	1273/1933 (65.9%)
	Dieting behavior	141/2492 (5.7%)	33/966 (3.4%)	108/1526 (7.1%)	477/2752 (17.3%)	90/819 (11.0%)	387/1933 (20.0%)
1st	Perceive themselves fat	5/638 (0.8%)	2/353 (0.6%)	3/285 (1.1%)	35/681 (5.1%)	24/419 (5.7%)	11/262 (4.2%)
	Want to be thinner	21/638 (3.3%)	9/353 (2.5%)	12/285 (4.2%)	167/681 (24.5%)	100/419 (23.9%)	67/262 (25.6%)
	Dieting behavior	6/638 (0.9%)	2/353 (0.6%)	4/285 (1.4%)	51/681 (7.5%)	30/419 (7.2%)	21/262 (8.0%)
2nd	Perceive themselves fat	22/603 (3.6%)	13/258 (5.0%)	9/345 (2.6%)	91/695 (13.1%)	34/231 (14.7%)	57/464 (12.3%)
	Want to be thinner	75/603 (12.4%)	40/258 (15.5%)	35/345 (10.1%)	343/695 (49.4%)	99/231 (42.9%)	244/464 (52.6%)
	Dieting behavior	14/603 (2.3%)	7/258 (2.7%)	7/345 (2.0%)	93/695 (13.4%)	30/231 (13.0%)	63/464 (13.6%)
3rd	Perceive themselves fat	70/627 (11.2%)	31/162 (19.1%)	39/465 (8.4%)	261/683 (38.2%)	35/103 (34.0%)	226/580 (39.0%)
	Want to be thinner	157/627 (25.0%)	58/162 (35.8%)	99/465 (21.3%)	481/683 (70.4%)	66/103 (64.1%)	415/580 (71.6%)
	Dieting behavior	28/627 (4.5%)	3/162 (1.9%)	25/465 (5.4%)	145/683 (21.2%)	16/103 (15.5%)	129/580 (22.2%)
4th	Perceive themselves fat	401/624 (64.3%)	152/193 (78.8%)	249/431 (57.8%)	555/693 (80.1%)	54/66 (81.8%)	501/627 (79.9%)
	Want to be thinner	394/624 (63.1%)	137/193 (71.0%)	257/431 (59.6%)	604/693 (87.2%)	57/66 (86.4%)	547/627 (87.2%)
	Dieting behavior	93/624 (14.9%)	21/193 (10.9%)	72/431 (16.7%)	188/693 (27.1%)	14/66 (21.2%)	174/627 (27.8%)

BMI: body mass index.

BMIs were classified as age- and sex-specific quartiles: 1st ≤ 17.1 , 2nd 17.2–18.4, 3rd 18.5–20.4, 4th $20.5 \leq$ for boys at age 12; 1st ≤ 17.0 , 2nd 17.1–18.5, 3rd 18.6–20.5, 4th $20.6 \leq$ for girls at age 12.

Percentage of those who perceive themselves fat: $p < 0.001$ in boys, $p = 0.7$ in girls (Mantel-Haenszel test).

Percentage of those who want to be thinner: $p < 0.001$ in boys, $p < 0.05$ in girls (Mantel-Haenszel test).

Percentage of those who have tried dieting: $p < 0.05$ in boys, $p = 0.1$ in girls (Mantel-Haenszel test).

tried dieting by pubertal changes. For boys, pubertal changes were significantly associated with the percentages of those who perceive themselves fat, who want to be thinner, and who have tried dieting; those with pubertal changes were more likely to report dieting behavior; on the other hand, they were less likely to perceive themselves fat and want to be thinner. For girls, pubertal changes were significantly associated with the percentage of those who want to be thinner; those with pubertal changes were more likely to want to be thinner.

Table 3 shows the percentages of preadolescents who perceive themselves fat, who want to be thinner, and who have tried dieting by maternal BMI. The percentages of those who perceive themselves fat, who want to be thinner, and who have tried dieting were higher in those whose mother was overweight than in those whose mother was normal or underweight. However, when taking account of BMI, maternal BMI was not

significantly associated with the percentages of those who perceive themselves fat, who want to be thinner, or who have tried dieting.

Fig. 1 shows the path diagrams for dieting behavior in nonobese boys and girls. Body image was primarily based on BMI, body image led to body dissatisfaction, and body dissatisfaction led to dieting behavior. Pubertal changes had a significant effect on body image (path coefficient <0) for boys and body satisfaction (path coefficient >0) for girls, in addition to that on BMI. Maternal BMI had a significant effect on BMI but not on body image, body satisfaction, or dieting behavior. For boys, the total effect on dieting behavior was largest in body satisfaction (0.07), followed by body image (0.03) and BMI at age 12 (0.01). For girls, the total effect on dieting behavior was largest in body image (0.14), followed by body satisfaction (0.13), pubertal changes (0.04), and BMI at age 12 (0.03).

Table 3 Percentages of preadolescents who perceive themselves fat, who want to be thinner, and who have tried dieting by maternal BMI

BMI quartile		Boy (n=2492)				Girl (n=2752)			
		All	Maternal BMI			All	Maternal BMI		
			Underweight	Normal	Overweight		Underweight	Normal	Overweight
All	Perceive themselves fat	498/2492 (20.0%)	38/299 (12.7%)	386/1993 (19.4%)	74/200 (37.0%)	942/2752 (34.2%)	74/319 (23.2%)	715/2151 (33.2%)	153/282 (54.3%)
	Want to be thinner	647/2492 (26.0%)	55/299 (18.4%)	512/1993 (25.7%)	80/200 (40.0%)	1227/2752 (44.6%)	143/319 (44.8%)	882/2151 (41.0%)	202/282 (71.6%)
	Dieting behavior	141/2492 (5.7%)	10/299 (3.3%)	108/1993 (5.4%)	23/200 (11.5%)	477/2752 (17.3%)	44/319 (13.8%)	369/2151 (17.2%)	64/282 (22.7%)
1st	Perceive themselves fat	5/638 (0.8%)	0/117 (0.0%)	5/497 (1.0%)	0/24 (0.0%)	35/681 (5.1%)	1/124 (0.8%)	32/521 (6.1%)	2/36 (5.6%)
	Want to be thinner	21/638 (3.3%)	2/117 (1.7%)	19/497 (3.8%)	0/24 (0.0%)	167/681 (24.5%)	21/124 (16.9%)	134/521 (25.7%)	12/36 (33.3%)
	Dieting behavior	6/638 (0.9%)	0/117 (0.0%)	5/497 (1.0%)	1/24 (4.2%)	51/681 (7.5%)	7/124 (5.6%)	39/521 (7.5%)	5/36 (13.9%)
2nd	Perceive themselves fat	22/603 (3.6%)	3/75 (4.0%)	15/491 (3.1%)	4/37 (10.8%)	91/695 (13.1%)	13/87 (14.9%)	73/569 (12.8%)	5/39 (12.8%)
	Want to be thinner	75/603 (12.4%)	10/75 (13.3%)	55/491 (11.2%)	10/37 (27.0%)	343/695 (49.4%)	37/87 (42.5%)	290/569 (51.0%)	16/39 (41.0%)
	Dieting behavior	14/603 (2.3%)	0/75 (0.0%)	12/491 (2.4%)	2/37 (5.4%)	93/695 (13.4%)	8/87 (9.2%)	75/569 (13.2%)	10/39 (25.6%)
3rd	Perceive themselves fat	70/627 (11.2%)	4/60 (6.7%)	62/522 (11.9%)	4/45 (8.9%)	261/683 (38.2%)	28/68 (41.2%)	213/559 (38.1%)	20/56 (35.7%)
	Want to be thinner	157/627 (25.0%)	17/60 (28.3%)	130/522 (24.9%)	10/45 (22.2%)	481/683 (70.4%)	46/68 (67.6%)	391/559 (69.9%)	44/56 (78.6%)
	Dieting behavior	28/627 (4.5%)	0/60 (0.0%)	25/522 (4.8%)	3/45 (6.7%)	145/683 (21.2%)	15/68 (22.1%)	123/559 (22.0%)	7/56 (12.5%)
4th	Perceive themselves fat	401/624 (64.3%)	31/47 (66.0%)	304/483 (62.9%)	66/94 (70.2%)	555/693 (80.1%)	32/40 (80.0%)	397/502 (79.1%)	126/151 (83.4%)
	Want to be thinner	394/624 (63.1%)	26/47 (55.3%)	308/483 (63.8%)	60/94 (63.8%)	236/693 (34.1%)	39/40 (97.5%)	67/502 (13.3%)	130/151 (86.1%)
	Dieting behavior	93/624 (14.9%)	10/47 (21.3%)	66/483 (13.7%)	17/94 (18.1%)	188/693 (27.1%)	14/40 (35.0%)	132/502 (26.3%)	42/151 (27.8%)

BMI: body mass index.

BMI's were classified as age- and sex-specific quartiles: 1st ≤17.1, 2nd 17.2–18.4, 3rd 18.5–20.4, 4th 20.5≤ for boys at age 12; 1st ≤17.0, 2nd 17.1–18.5, 3rd 18.6–20.5, 4th 20.6≤ for girls at age 12.

Percentage of those who perceive themselves fat: p=0.2 in boys, p=0.5 in girls (Mantel-Haenszel test).

Percentage of those who want to be thinner: p=0.4 in boys, p=0.1 in girls (Mantel-Haenszel test).

Percentage of those who have tried dieting: p=0.1 in boys, p=0.5 in girls (Mantel-Haenszel test).

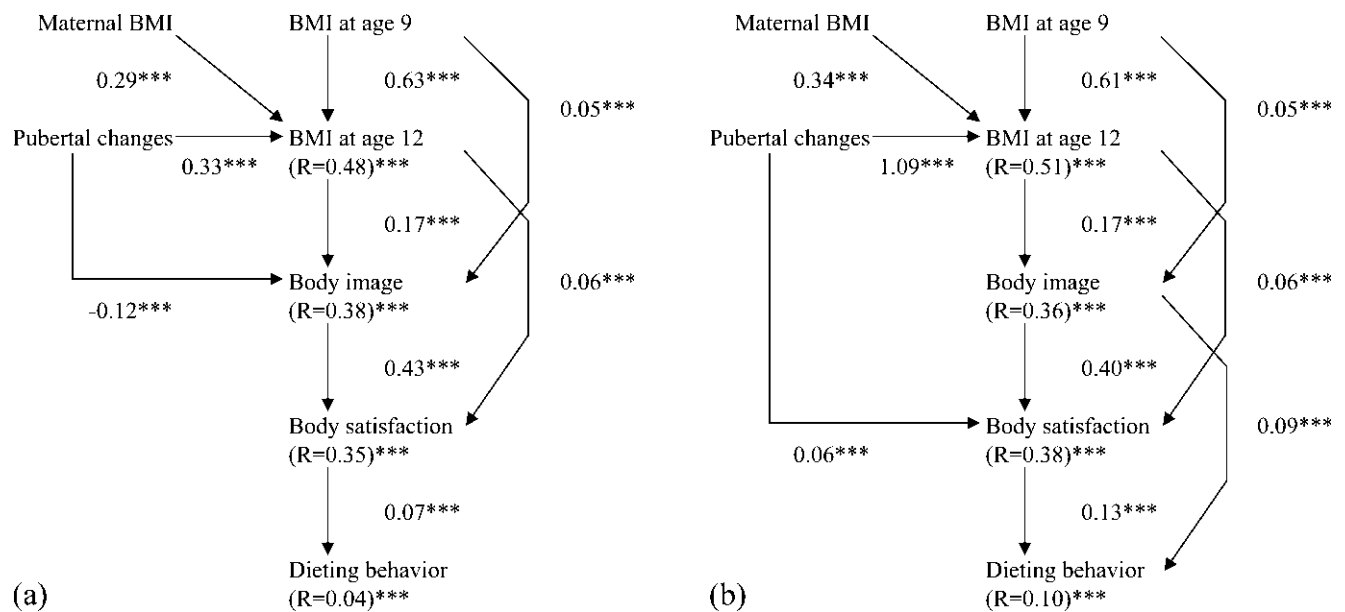


Fig. 1 Path diagrams for dieting behavior in nonobese boys and girls. (a) Nonobese boys (n=2116). (b) Nonobese girls (n=2334). BMI: body mass index. Values are path coefficients indicating the strength of relationship. *** p<0.001.

Discussion

This is the first study to analyze the path to dieting behavior in Japanese preadolescents. Based on the Toyama Birth Cohort Study, we demonstrate the path diagram of body image, body satisfaction, and dieting behavior in relation to pubertal changes and maternal BMI.

Path analysis in nonobese subjects showed that (1) body image was primarily based on BMI, (2) body image led to body dissatisfaction, and (3) body dissatisfaction led to dieting behavior. Body image and body satisfaction were ranked among the top two factors in terms of total effect on dieting behavior. The gap between actual and ideal body images may cause body dissatisfaction (20), which may lead to induce dieting behavior. The fact that body image may contribute to the establishment of dieting behavior suggests the importance of the education of preadolescents in understanding their healthy weight and correcting their body image (both actual and ideal body images).

Pubertal changes had a significant effect on body image (path coefficient <0) for boys and body satisfaction (path coefficient >0) for girls. Compared with those without pubertal changes, boys with pubertal changes were more likely to perceive themselves thin or average and girls with pubertal changes were more likely to want to be thinner. It is possible that pubertal changes reinforce dieting behavior due to their effect on body image or body satisfaction. As shown in previous studies (17, 18), boys seem to accept pubertal changes, particularly physiological changes towards a muscular body, positively and adopt strategies to increase muscle tone, while girls seem to accept pubertal changes, particularly a physiological increase in body fat, negatively and adopt strategies to lose weight. In addition to obvious sex differences in body image and body satisfaction, the effect of pubertal changes should be considered in the education of preadolescents.

Maternal BMI had a significant effect on BMI but not on body image, body satisfaction, or dieting behavior. Previous studies suggested the significant effects of maternal BMI on child’s weight concerns and dieting behavior, which contradicted each other; Tienboon reported that maternal overweight increased child’s weight concerns and dieting behavior (31); on the other hand, Strauss reported that children of under- and normal-weight mothers were more likely to perceive themselves overweight and want to be thinner (10). From the results of this study and previous studies, it is difficult to determine the effect of maternal BMI on a child’s dieting behavior, but it is worth pointing out the possible maternal influence on a child’s dieting behavior. Previous studies revealed that parental feedback on a child’s weight influenced child’s body image (17, 19, 20), body satisfaction (19), and dieting behavior (16, 17, 19). If family members, particularly mother, frequently went on a diet, the child might be highly concerned with weight and go on a diet (6, 16). Unfortunately, the Toyama Birth Cohort Study did not collect information on parental feedback on a child’s weight and parental dieting behavior. It is possible that the effect of maternal BMI in this study represents maternal feedback on a child’s weight and maternal dieting behavior in addition to a child’s negative perspective on maternal overweight.

As a major limitation of this study, the cross-sectional design makes it difficult to determine the causal relationships. BMI, body image, body satisfaction, and dieting behavior may form a feedback loop (20); dieting behavior, which depends on BMI, body image, and body satisfaction, will lead to a lower BMI. However, in this study, the percentage of those who have tried dieting was higher in those who had higher BMI. The results of this study were less likely to be affected by the feedback loop. The path to dieting behavior in this study should be confirmed in other populations and in a follow-up design.

In conclusion, body image and body satisfaction play

important roles in the path to dieting behavior in Japanese preadolescents. Pubertal changes may reinforce dieting behavior, but the mechanism may differ by sex. The results of this study suggest the importance of the education of preadolescents in understanding their healthy weight and correcting their body image. In addition to obvious sex differences in body image and body satisfaction, the effect of pubertal changes should be considered in the education of preadolescents.

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