Effect of the Fukushima earthquake on weight in early childhood: a retrospective analysis

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ABSTRACT

Objective There have been no reports evaluating the physical growth in early childhood in Fukushima Prefecture after the Great East Japan Earthquake. We retrospectively investigated the health examination data in early childhood (aged 0–3 years).

Methods We divided the affected children into respective groups according to the interval from the disaster to the time of health examination and age as follows: group I, birth to 3–4 months in boys (1.81 (range, 0–6 months)) and girls (1.79 (range, 0–7 months)); group II, 3–4 months to 6–10 months in boys (6.37 (range, 3–9 months)) and girls (6.35 (range, 3–9 months)); group III, 6–10 months and 18 months in boys (16.2 (range, 5–22 months)) and girls (16.9 (range, 5–22 months)); and group IV, 18 months to 36–42 months in boys (21.0 (range, 18–24 months)) and girls (21.0 (range, 18–24 months)). Using height and body mass index, the health status of each group was compared with that of unaffected controls (ie, children who experienced the disaster after their health examination at 36–42 months).

Results The change in body mass index between the health examinations at 18 months and 36–42 months was significantly increased in group I (95% CI: all boys, 0.192 to 0.276 vs −0.006 to 0.062, P<0.001 and all girls, 0.108 to 0.184 vs −0.109 to −0.035, P<0.001) and group II (95% CI: all boys, 0.071 to 0.141 vs −0.006 to 0.062, P=0.002 and all girls, −0.042 to 0.024 vs −0.109 to −0.035, P=0.013).

Conclusions Children who were affected by the disaster in Fukushima Prefecture in early childhood were overweight. The use of pre-existing information, such as health examination data, was beneficial for investigating the physical growth of affected children.

INTRODUCTION

The Great East Japan Earthquake occurred on 11 March 2011[1] and caused a great deal of damage in the areas of Iwate, Miyagi and Fukushima Prefectures.[2] The resultant tsunami destroyed many houses on the Pacific coast and forced many people in the area to evacuate. Moreover, the Fukushima Daiichi Nuclear Power Plant accident forced many people living around the power plant to leave their homes. Therefore, the residents in Fukushima Prefecture were likely influenced, either directly or indirectly, by the earthquake disaster. The influence of the disaster on affected adults and nursery school children over the age of 3 years has been reported.[3–9] In this study, we performed a growth survey on children who were affected in early childhood (aged 0–3 years) in Fukushima Prefecture.

Generally, body mass index (BMI) is used to assess physical data, such as obesity, in adults. However, BMI cannot be compared among children because it varies in different age groups and changes substantially with age. In order to standardise the height and BMI in childhood according to sex and age, we used the SD score (SDS).

METHODS
Study design and subjects
The survey design and population were described in detail in a previous paper.[10]

What is already known on this topic?

After the 2011 Great East Japan Earthquake, lifestyle diseases, such as obesity, in affected adults were reported. Recently, overweight in nursery school children aged over 3 years and who were affected by the disaster has also been reported.

What this study hopes to add?

After the disaster in Fukushima Prefecture, a trend towards being overweight was observed in early childhood (aged 1 to 3 years). The use of pre-existing data on early childhood, such as health examination data, was beneficial for investigating the physical growth of the affected children.
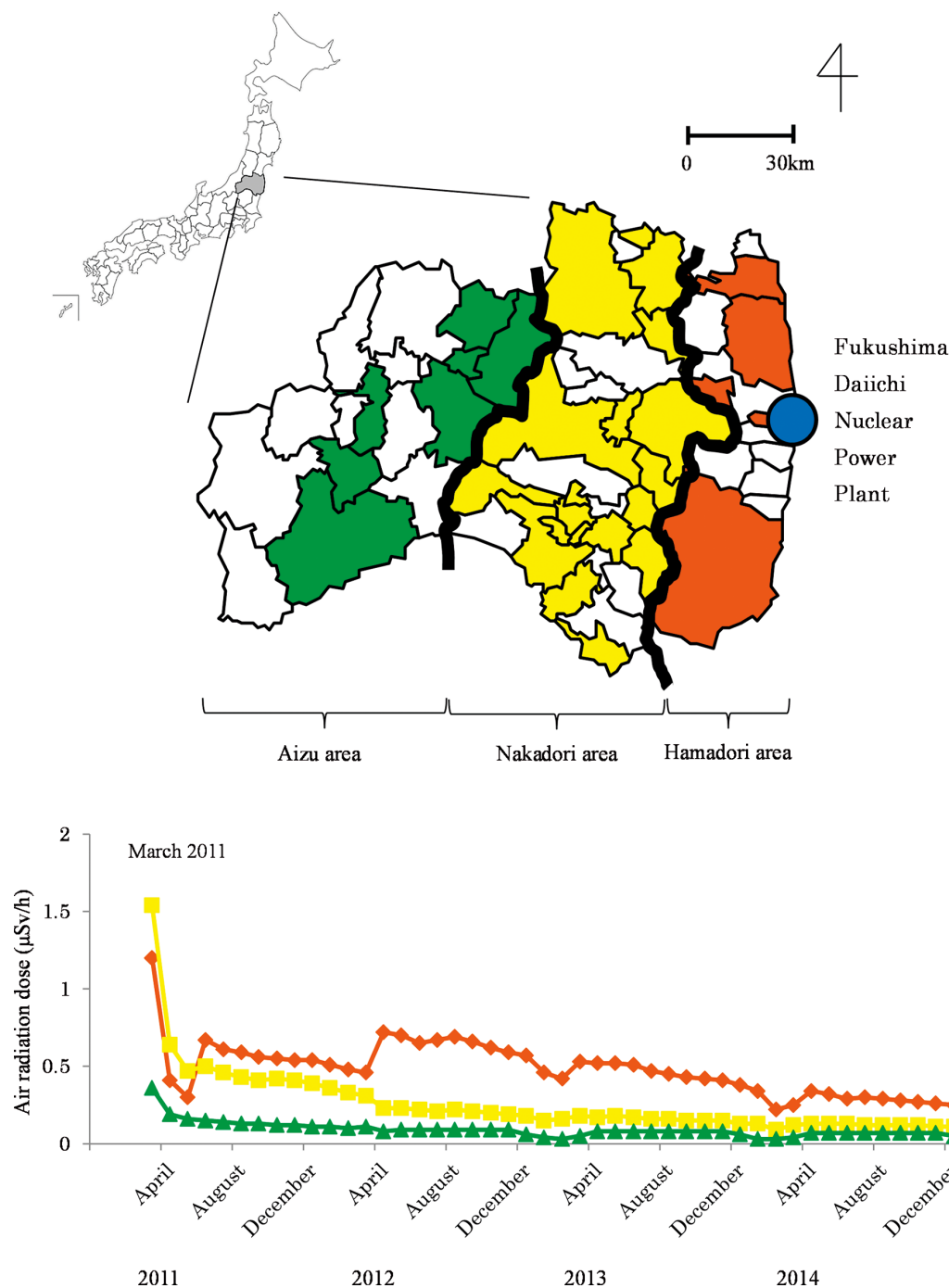
Figure 1   Upper: the 31 local governments that participated in this survey are shown on the map of Fukushima Prefecture. Lower: the air radiation dose from March 2011 to December 2014 for each of the three areas is shown. ◆: Hamadori area, ■: Nakadori area, ▲: Aizu area.

According to the Maternal and Child Health Act, local governments across Japan must perform health examinations between 18 months and 2 years and between 3 years and 4 years of age.[11] Moreover, publicly funded infant medical examinations are carried out in Fukushima Prefecture at 3–4 and 6–10 months of age. We sought to retrospectively investigate the records of these five health examinations, including those at birth, and invited all local governments in Fukushima Prefecture to participate in the survey. Eventually, 31 of 57 local governments,

representing 79.6% of the total number of births in Fukushima Prefecture during the target periods, participated in this survey (figure 1).

Data were provided by the one of the following methods: (1) completion of survey sheets by public health nurses who were employed by the local governments, (2) visits to local health centres to transcribe health examination data or (3) submission of electronic datasets of pre-existing health examination records from which all personally identifiable information was removed. The survey
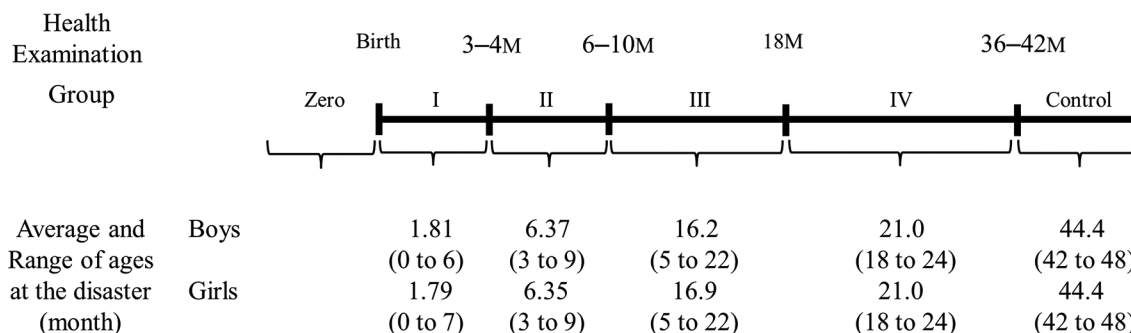
Health Examination Group		Birth	3–4M	6–10M	18M	36–42M
		Zero	I	II	III	IV	Control

| Average and Range of ages at the disaster (month) | Boys | 1.81 (0 to 6) | 6.37 (3 to 9) | 16.2 (5 to 22) | 21.0 (18 to 24) | 44.4 (42 to 48) |
| | Girls | 1.79 (0 to 7) | 6.35 (3 to 9) | 16.9 (5 to 22) | 21.0 (18 to 24) | 44.4 (42 to 48) |

Figure 2 The health examination periods (birth, 3–4 months, 6–10 months, 18 months and 36–42 months) and the six groups (zero, I, II, III, IV and control) divided according to the age during the disaster and average (range) age of each group. M, month health examination.

was conducted from July 2012 to October 2014, in order to collect data on children who were born over a relatively wide range of birth years.

During the periods of investigation, we collected data on 4387 children who were born between 1 March 2007 and 31 August 2007 and who experienced the disaster and its after effects after their health examinations at 36–42 months; on 6167 children who were born between 1 March 2009 and 31 August 2009 and experienced the disaster before their health examinations at 36–42 months; and on 10 046 children who were born between 1 June 2010 and 30 April 2011 and who either experienced the disaster when they were under 10 months of age or were not yet born. During these target periods, data were collected from a total of 20 600 children, who accounted for 81.9% of the 25 148 total number of births registered by the 31 local governments.

We classified the children into the following six groups: (1) group zero included children who experienced the disaster before birth; (2) group I included children who experienced the disaster between birth and their health

examination at 3–4 months; (3) group II included children who experienced the disaster between their health examinations at 3–4 and 6–10 months; (4) group III included children who experienced the disaster between their health examinations at 6–10 and 18 months; (5) group IV included children who experienced the disaster between their health examinations at 18 and 36–42 months; and (6) the control group, which included 3206 children who experienced the disaster after their health examinations at 36–42 months.

We aimed to compare the groups based on the age when the children experienced the disaster and their physical activity level (figure 2). In the process of gathering such necessary data (figure 3) and in order to ensure that the data gathered were from the same children in all health examinations, we used only complete data from at least four health examinations and excluded the incomplete data. Group zero represented the group of children who experienced the disease before birth and were, therefore, not eligible and excluded from this survey. The number of children who satisfied the definition of group III during the first data collection was very few. Because of this small number and the large difference in the populations, group III was not comparable with the other groups under equal conditions and was excluded. We eventually used the available data from 12 008 children.

From the Pacific coast side to the west, Fukushima Prefecture is separated into three areas (ie, Hamadori, Nakadori and Aizu) by mountains and highlands that are 500–2000 m above sea level. The distance from the west side of the Fukushima Daiichi Nuclear Power Plant to the Hamadori, Nakadori and Aizu areas is approximately 0–85 km, 15–100 km and 70–170 km, respectively. It was thought that the degree of actual radioactive contamination differed among the three areas (figure 1), and the influence on the residents of Fukushima Prefecture was likewise expected to differ. Therefore, we further divided each of the four patient groups according to these three areas and evaluated the corresponding influence of the disaster (table 1 and online supplementary tables S1-S6).

Statistical analysis

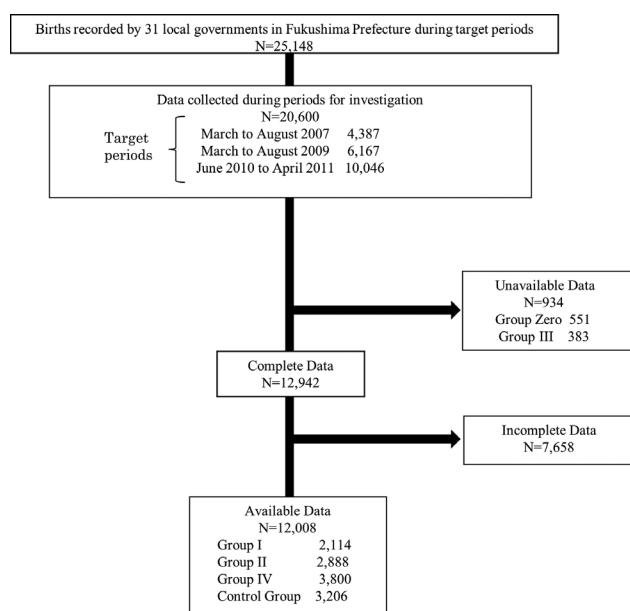We assessed height and BMI using the records at birth and each of the health examinations undertaken at 3–4

Figure 3 The number of data collected from the 31 local governments participating in this survey.

Table 1 The sex distribution in each area and group in those with complete data

	Sex	Complete data*					
		Zero	I	II	III	IV	Control
All area†	Boys	297	(836)1061	(1174)1478	180	(1492)1911	(1414)1645
	Girls	254	(843)1053	(1121)1410	203	(1436)1889	(1333)1561
Hamadori area	Boys	145	351	460	26	573	477
	Girls	115	328	420	32	558	392
Nakadori area†	Boys	118	(330)555	(505)809	129	(688)1107	(732)963
	Girls	116	(371)581	(508)797	144	(680)1133	(730)958
Aizu area	Boys	34	155	209	25	231	205
	Girls	23	144	193	27	198	211

*The only data from group I, II, IV and control are used in this study.
†The number in brackets represents the number of children who were examined at birth. They are fewer than the number of other health examination periods because some data on height at birth were missing in Nakadori area.

months, 6–10 months, 18 months and 36–42 months of age. Due to the fact that BMI in childhood changes substantially with age, comparison of BMI among children of different age groups is difficult. Moreover, the age in months of children taking the same health examination varies. For that reason, it was necessary to standardise each BMI in childhood according to sex and age. Cole[12] constructed centile curves for BMI using the lambda-mu-sigma (LMS) method, which was adopted by Inokuchi *et al* for the Japanese population.[13] Therefore, we are now able to express BMI as SDS. SD is defined as the square root of the variance and represents the width of the distribution. The zero of SDS represents the average value, and the SDS represents the number of times that the SD diverges from the average value. We converted the height and BMI of all children to height SDS and BMI SDS using a calculation software,[14] and then calculated the ΔBMI SDS as the difference in BMI SDS between two consecutive health examinations as follows: between birth and 3–4 months, between 3–4 and 6–10 months and between 18 and 36–42 months.

Using the Microsoft Excel 2010 software package for Windows, the t-test was performed to assess the significance of differences in height SDS, BMI SDS and ΔBMI SDS. We stratified the indicators by region and sex in order to examine the differences between the control group and groups I, II and IV. In our analysis, because there were three pairwise comparisons between the control group and the other three groups for each analysis stratified by region and sex, a P value of less than 0.016 was regarded as statistically significant using the Bonferroni correction.

Ethics committee approval
Our survey was conducted in accordance with the National Ethical Guidelines for Epidemiological Research.[15] We collected only existing data and, therefore, did not obtain informed consent from the participants. Accordingly, we disclosed information, including the significance, objectives and methods of the survey,

to the public via the website of the School of Medicine, Tohoku University (http://www.med.tohoku.ac.jp/public/ekigaku2013.html).

RESULTS
We compared the height SDS, BMI SDS and ΔBMI SDS before and after the disaster between the affected children (group I, II and IV) and the unaffected children (control group). Moreover, we compared the ΔBMI SDS in these groups according to the three areas (ie, Hamadori, Nakadori and Aizu).

Height SDS
As shown in figure 4 and table 2, no significant differences were observed between the control group and groups I, II and IV.

BMI SDS
As shown in figure 5 and table 3, the BMI SDS of groups I, II and IV was equal to or less than that of the control group before the disaster. After the disaster, on the health examination at 36–42 months, the BMI SDS for boys in the control group (95% CI 0.187 to 0.277) was significantly lower than that in group I (95% CI 0.298 to 0.404; P=0.001) and group II (95% CI 0.302 to 0.390; P<0.001). For girls, the BMI SDS in the control group (95% CI:0.162 to 0.250) was significantly lower than that in group I (95% CI 0.240 to 0.346; P=0.013) and group II (95% CI 0.265 to 0.355; P=0.001).

ΔBMI SDS
As shown in figure 6 and table 4, in the Hamadori area, the ΔBMI SDS between the health examinations at 3–4 and 6–10 months for boys was higher in group I than in the control group (95% CI 0.085 to 0.233 vs −0.124 to 0.030, P<0.001). The ΔBMI SDS between the health examinations at 18 months and 36–42 months was significantly higher in group I than in the control group in both boys (95% CI 0.319 to 0.473 vs −0.052 to 0.068, P<0.001) and
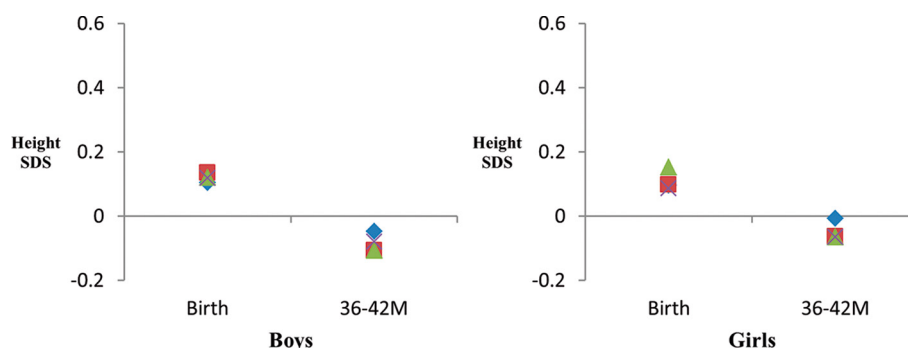
Figure 4 Height SDS of all boys and girls in Fukushima Prefecture. ◆: control group, ■: group I, ▲: group II, ✕: group IV. M, month health examination; SDS, SD score.

girls (95% CI 0.208 to 0.342 vs −0.206 to −0.048, P<0.001). The ΔBMI SDS between the health examinations at 18 months and 36–42 months was significantly higher in group II than in the control group in both boys (95% CI 0.163 to 0.285 vs −0.052 to 0.068, P<0.001) and girls (95% CI 0.019 to 0.148 vs −0.206 to −0.048, P<0.001).

In the Nakadori area, the ΔBMI SDS between the health examinations at 18 months and 36–42 months was significantly higher in group I than in the control group in both boys (95% CI 0.123 to 0.233 vs 0.008 to 0.100, P=0.001) and girls (95% CI 0.062 to 0.166 vs −0.086 to 0.004, P<0.001). For all of the three periods in the Aizu area, no significant differences were observed between the control group and groups I, II and IV.

DISCUSSION

The ΔBMI SDS between the health examinations at 18 months and 36–42 months was significantly increased in children who experienced the disaster between birth and their health examination at 6–10 months. Also, a trend towards overweight children was observed in the Hamadori and Nakadori areas, but not in the Aizu area.

In the aftermath of the tsunami, Fukushima Prefecture was severely affected by the Fukushima Daiichi Nuclear Power Plant accident. The radiation levels were relatively high in the Hamadori area, somewhat elevated in the Nakadori area and only slightly elevated in the Aizu area (figure 1).[16] After the accident, the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labour and Welfare of Japan jointly released a statement on restrictions to outdoor activity in all schools and nursery schools based on the air radiation. Restrictions on outdoor activity were enforced by the local governments across almost all of the Hamadori area and much of the Nakadori area that had high radiation levels.[17 18]

There was a relatively close correlation between the areas with high air radiation level in which restriction of outdoor activity was deemed necessary and the areas in which a trend towards overweight children was observed. The impact of restriction of outdoor activity after the disaster might have been more significant on children aged over 1 year than on other children probably because of the fact that toddlers are generally encouraged and actually begin to engage in various activities, including outdoor play, after 1 year of age.[19]

Body mass in young adults is strongly related to body mass in childhood.[20] Moreover, an early adiposity

Table 2 Number, average (95% CI) and P value for height SDS in Fukushima Prefecture

Height SDS	Birth			36–42 M		
	n	Average (95% CI)	P value	n	Average (95% CI)	P value
All boys						
Control group	1414	0.105 (0.050 to 0.160)		1645	−0.046 (−0.091 to −0.001)	
Group I	836	0.136 (0.065 to 0.207)	0.522	1061	−0.106 (−0.164 to −0.048)	0.110
Group II	1174	0.121 (0.064 to 0.178)	0.728	1478	−0.107 (−0.154 to −0.060)	0.069
Group IV	1492	0.119 (0.069 to 0.169)	0.748	1911	−0.079 (−0.122 to −0.036)	0.300
All girls						
Control group	1333	0.097 (0.038 to 0.156)		1561	−0.006 (−0.055 to 0.043)	
Group I	843	0.098 (0.025 to 0.171)	0.979	1053	−0.063 (−0.122 to −0.004)	0.143
Group II	1121	0.153 (0.096 to 0.210)	0.187	1410	−0.065 (−0.115 to −0.015)	0.100
Group IV	1436	0.088 (0.035 to 0.141)	0.816	1889	−0.064 (−0.107 to −0.021)	0.080

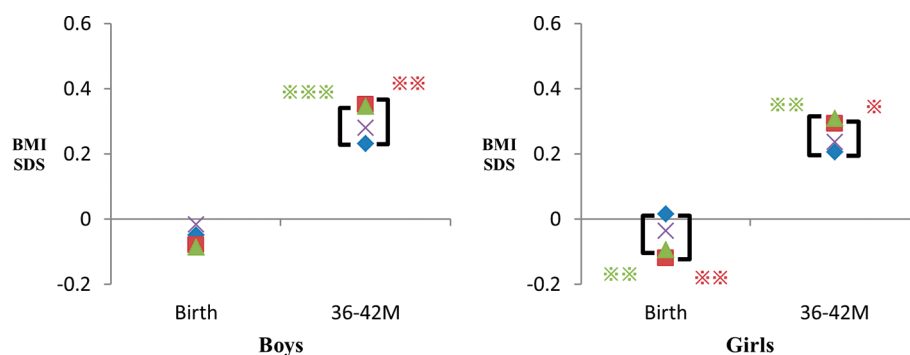M, month health examination; SDS, SD score.

Figure 5 The BMI SDS of all boys and girls in Fukushima Prefecture. ◆: control group, ■: group I, ▲: group II, ✕: group IV. *P value <0.016, **P value <0.01, ***P value <0.001. BMI, body mass index; M, month health examination; SDS, SD score.

rebound has been found to be significantly associated with BMI level at a later age and an increased risk for being overweight.[21 22] Early detection of adiposity rebound is important in preventing metabolic syndrome.[23] It is also important to promote early intervention in order to prevent adult obesity. Some studies have reported that stress on the affected mothers caused growth failure in children during the perinatal period[24 25] and is a risk factor for childhood obesity.[26] Early intervention for the affected mothers prior to delivery is, therefore, also necessary to preserve the health of their children.[27]

There are three limitations to this study. First, we used data from only 31 of 57 local governments that agreed to participate in this survey. Nevertheless, these local governments were large municipalities and covered 79.6% of the number of childbirths in Fukushima Prefecture during the target periods. Second, we did not investigate the causes of overweight in detail and outdoor activity itself in early childhood; there had been no comprehensive or extensive survey on outdoor activity in early childhood after the disaster. Being overweight may be associated with an unbalanced diet; the changes in the eating habits in the evacuation area were considered to be one of the causes of adult obesity.[5 28] However, there are no reports on the relationship between early childhood diet, such as

milk or baby food, and changes in body size before and after the disaster. Another possible cause of overweight is stress, and it has been shown that stress may cause growth failure and lead to being overweight. Sleep disorders may also be an important factor in being overweight among affected adults and children.[29 30] However, we did not investigate in this study the influence of stress and sleep disorders on being overweight. Therefore, diet, stress and sleep disorders cannot be excluded as factors that might have contributed to being overweight in this study. Lastly, because the interval between data collections was more than 6 months, the number of children included in group III became much smaller than the other groups. Consecutive data collection could have minimised the difference between sample sizes of the groups analysed.

We retrospectively analysed the data on health examination and discovered that the availability of normal baseline data for comparison with those after the event were useful. The health examination data from within Fukushima prefecture is large, but not all could be obtained and the only common variables available were height and weight. The use of an online backup service and standardisation of the format of data sheets to manage health examination records nationwide will likely enable easier collection of more data.

Table 3 Number, average (95% CI) and P value for BMI SDS in Fukushima Prefecture

BMI SDS	Birth			36–42 M		
	n	Average (95% CI)	P value	n	Average (95% CI)	P value
All boys						
Control group	1414	−0.048 (−0.102 to 0.006)		1645	0.232 (0.187 to 0.277)	
Group I	836	−0.080 (−0.146 to −0.014)	0.479	1061	0.351 (0.298 to 0.404)	**0.001**
Group II	1174	−0.085 (−0.143 to −0.027)	0.363	1478	0.346 (0.302 to 0.390)	**<0.001**
Group IV	1492	−0.017 (−0.068 to 0.034)	0.406	1911	0.281 (0.239 to 0.323)	0.120
All girls						
Control group	1333	0.016 (−0.041 to 0.073)		1561	0.206 (0.162 to 0.250)	
Group I	843	−0.119 (−0.190 to −0.048)	**0.004**	1053	0.293 (0.240 to 0.346)	**0.013**
Group II	1121	−0.094 (−0.155 to −0.033)	**0.009**	1410	0.310 (0.265 to 0.355)	**0.001**
Group IV	1436	−0.035 (−0.088 to 0.018)	0.202	1889	0.237 (0.196 to 0.278)	0.300

BMI, body mass index; M, month health examination; SDS, body mass index SD score.
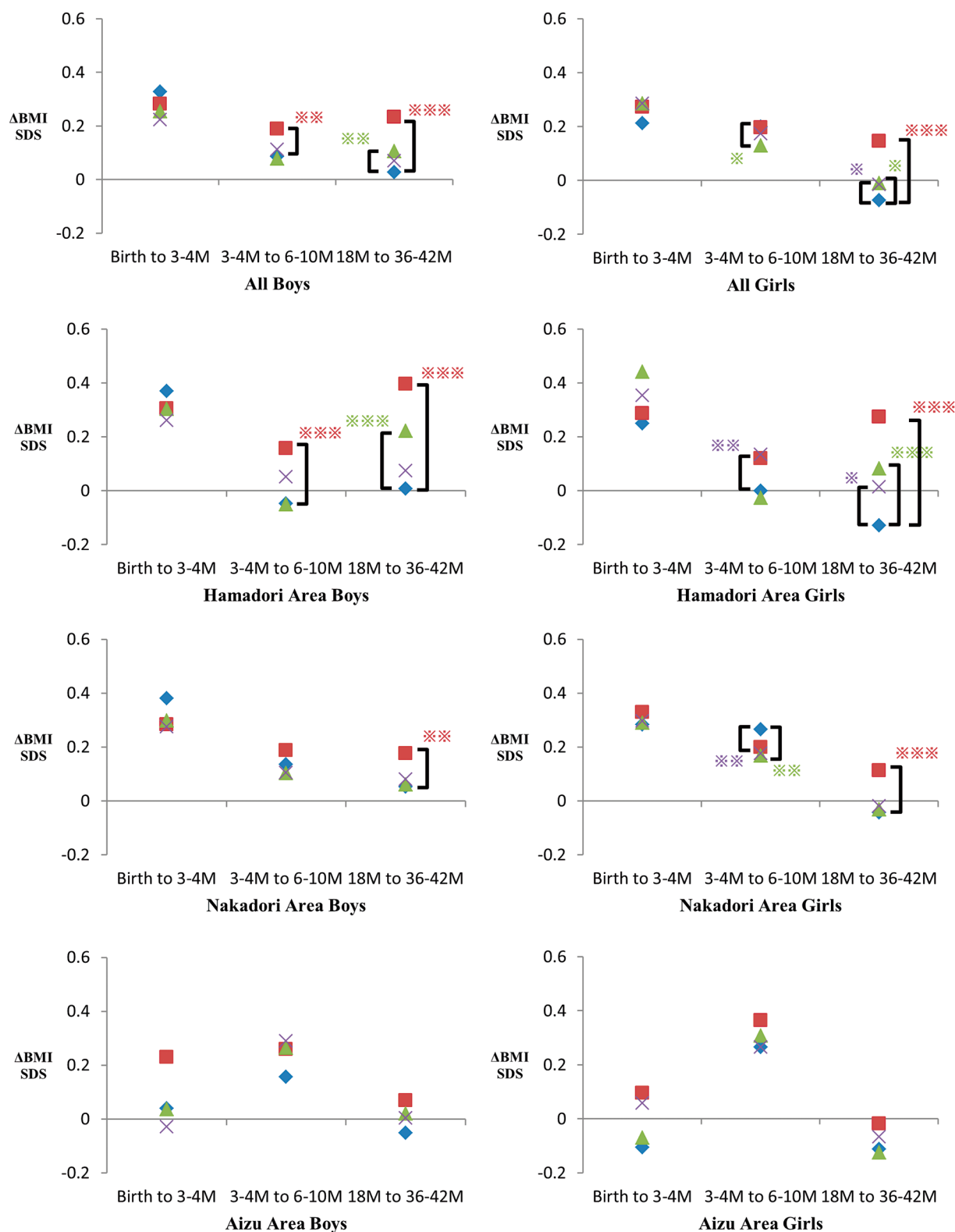
Figure 6 ΔBMI SDS of all boys and girls in Fukushima Prefecture. ◆: control group, ■: group I, ▲: group II, ✕: group IV. *P value <0.016, **P value <0.01, ***P value <0.001. BMI, body mass index; ΔBMI SDS, BMI SDS between two consecutive health examinations; M, month health examination; SDS, SD score.

CONCLUSION

After the disaster, being overweight was observed between the health examination at 18 months and 36–42 months in children who experienced the disaster between birth and their health examination at 6–10 months; this trend was observed in the Hamadori and Nakadori areas where the radiation levels were relatively high. The use of pre-existing health

Table 4 Number, average (95% CI) and P value for ΔBMI SDS in Fukushima Prefecture

ΔBMI SDS	Birth to 3–4 M			3–4 M to 6–10 M			18 M to 36–42 M		
	n	Average (95% CI)	P value	n	Average (95% CI)	P value	n	Average (95% CI)	P value
All boys									
Control group	1414	0.329 (0.261 to 0.397)		1645	0.086 (0.046 to 0.126)		1645	0.028 (−0.006 to −0.062)	
Group I	836	0.284 (0.200 to 0.368)	0.415	1061	0.189 (0.145 to 0.233)	0.001	1061	0.234 (0.192 to 0.276)	**< 0.001**
Group II	1174	0.255 (0.183 to 0.327)	0.144	1478	0.079 (0.380 to 0.120)	0.808	1478	0.106 (0.071 to 0.141)	**0.002**
Group IV	1492	0.224 (0.157 to 0.291)	0.031	1911	0.112 (0.078 to 0.146)	0.330	1911	0.070 (0.039 to 0.101)	0.071
All girls									
Control group	1333	0.212 (0.143 to 0.281)		1561	0.200 (0.162 to 0.238)		1561	−0.072 (−0.109 to −0.035)	
Group I	843	0.273 (0.184 to 0.362)	0.285	1053	0.198 (0.150 to 0.246)	0.929	1053	0.146 (0.108 to 0.184)	**< 0.001**
Group II	1121	0.285 (0.211 to 0.359)	0.157	1410	0.130 (0.089 to 0.171)	**0.013**	1410	−0.009 (−0.042 to 0.024)	**0.013**
Group IV	1436	0.287 (0.222 to 0.352)	0.123	1889	0.174 (0.139 to 0.209)	0.310	1889	−0.013 (−0.043 to 0.017)	**0.013**
Hamadori boys									
Control group	477	0.371 (0.249 to 0.493)		477	−0.047 (−0.124 to 0.030)		477	0.008 (−0.052 to −0.068)	
Group I	351	0.305 (0.178 to 0.432)	0.472	351	0.159 (0.085 to 0.233)	<0.001	351	0.396 (0.319 to 0.473)	**< 0.001**
Group II	460	0.305 (0.191 to 0.419)	0.440	460	−0.049 (−0.119 to 0.021)	0.972	460	0.224 (0.163 to 0.285)	**< 0.001**
Group IV	573	0.262 (0.157 to 0.367)	0.180	573	0.053 (−0.007 to 0.113)	0.042	573	0.075 (0.015 to 0.135)	0.127
Hamadori girls									
Control group	392	0.250 (0.115 to 0.385)		392	0.001 (−0.078 to 0.080)		392	−0.127 (−0.206 to −0.048)	
Group I	328	0.287 (0.144 to 0.430)	0.713	328	0.121 (0.041 to 0.201)	0.039	328	0.275 (0.208 to 0.342)	**< 0.001**
Group II	420	0.442 (0.325 to 0.559)	0.034	420	−0.026 (−0.098 to 0.046)	0.625	420	0.083 (0.019 to 0.148)	**< 0.001**
Group IV	558	0.355 (0.248 to 0.462)	0.229	558	0.135 (0.074 to 0.196)	*0.008	558	0.015 (−0.043 to 0.073)	**0.004**
Nakadori boys									
Control group	732	0.383 (0.290 to 0.476)		963	0.137 (0.085 to 0.189)		963	0.054 (0.008 to 0.100)	
Group I	330	0.285 (0.146 to 0.424)	0.252	555	0.189 (0.125 to 0.253)	0.23 4	555	0.178 (0.123 to 0.233)	**0.001**
Group II	505	0.299 (0.185 to 0.413)	0.262	809	0.104 (0.048 to 0.160)	0.394	809	0.062 (0.014 to 0.110)	0.082
Group IV	688	0.276 (0.175 to 0.377)	0.127	1107	0.106 (0.061 to 0.151)	0.374	1107	0.081 (0.041 to 0.121)	0.384
Nakadori girls									
Control group	730	0.284 (0.193 to 0.375)		958	0.267 (0.220 to 0.314)		958	−0.041 (−0.086 to 0.004)	
Group I	371	0.392 (0.199 to 0.459)	0.570	581	0.200 (0.134 to 0.266)	0.090	581	0.114 (0.062 to 0.166)	**< 0.001**
Group II	508	0.291 (0.178 to 0.404)	0.926	797	0.169 (0.115 to 0.223)	**0.006**	797	−0.030 (−0.074 to 0.014)	0.726
Group IV	680	0.297 (0.203 to 0.391)	0.840	1133	0.117 (0.132 to 0.222)	*0.007	1133	−0.018 (−0.056 to 0.020)	0.435

Continued

Table 4 Continued

ΔBMI SDS		Birth to 3–4 M			3–4 M to 6–10 M			18 M to 36–42 M		
		n	Average (95% CI)	P value	n	Average (95% CI)	P value	n	Average (95% CI)	P value
Aizu boys										
Control group		205	0.041 (−0.137 to 0.219)		205	0.157 (0.049 to 0.265)		205	−0.050 (0.006 to −0.006)	
Group I		155	0.230 (0.043 to 0.417)	0.154	155	0.261 (0.152 to 0.370)	0.193	155	0.070 (−0.034 to 0.174)	0.092
Group II		209	0.038 (−0.117 to 0.193)	0.979	209	0.266 (0.157 to 0.375)	0.167	209	0.021 (−0.063 to 0.105)	0.258
Group IV		231	−0.028 (−0.199 to 0.143)	0.583	231	0.291 (0.193 to 0.389)	0.072	231	0.005 (−0.076 to 0.086)	0.370
Aizu girls										
Control group		211	−0.105 (−0.267 to 0.057)		211	0.266 (0.162 to 0.370)		211	−0.112 (−0.213 to −0.011)	
Group I		144	0.095 (−0.123 to 0.313)	0.138	144	0.365 (0.237 to 0.493)	0.236	144	−0.017 (−0.112 to 0.078)	0.200
Group II		193	−0.069 (−0.240 to 0.102)	0.766	193	0.309 (0.200 to 0.418)	0.581	193	−0.124 (−0.202 to −0.046)	0.851
Group IV		198	0.058 (−0.097 to 0.213)	0.152	198	0.266 (0.153 to 0.379)	0.992	198	−0.067 (−0.154 to 0.020)	0.506

*Data before the 2011 earthquake disaster.
BMI, body mass index; ΔBMI SDS, BMI SDS between two consecutive health examinations; M, month health examinations; SDS, SD score.

examination data in early childhood, when physical growth was marked, was beneficial because the physical examination findings were described in detail.

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Competing interests None declared.

Ethics approval The survey protocol was approved by the institutional review board of Fukushima Medical University (authorisation number 1487).

Provenance and peer review Not commissioned; externally peer reviewed.

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