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IMPACT OF THE FUKUSHIMA NUCLEAR ACCIDENT ON THE BODY MASS INDEX OF CHILDREN IN JAPAN 2010–2014

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ABSTRACT

Based on prefecture-level panel data from Japan for the period 2010–2014, this study investigates the influence of the 2011 Fukushima nuclear accident on the body mass index (BMI) and obesity rates of children and any changes over time. A differences-in-differences approach was used to show that: (1) BMI and obesity rates in disaster-damaged areas are higher than those in other areas; (2) The difference in the BMI (and obesity rate) of children between damaged and other areas increased after the accident, suggesting that the accident led to increases in both BMI and obesity rates; (3) For cohorts aged between 5 and 7 years old in 2010, the influence of the accident is persistent even after 3 years. Furthermore, the effect of the accident increased as time passed; (4) Cohorts aged between 8 and 10 years in 2010 were no longer influenced by the accident 2 years afterwards.

These findings suggest that restrictions placed on outdoor exercise as a result of the nuclear accident in Fukushima prevented younger primary school children from burning calories. Consequently, younger children developed a habit of inactivity, leading a persistent increase in BMI. In contrast, such a habit was not formed by older children and therefore the effect of the accident was temporary.

JEL classification: I18; H12

Keywords: Fukushima, Nuclear accident; Body mass index; Obesity rate

1. Introduction

On March 11, 2011, Japan was struck by a large-scale natural disaster combining both an earthquake and tsunami. Immediately after the earthquake and tsunami, the Fukushima Daiichi nuclear plants located on the Fukushima coast in northeast Japan were crippled. A level 7 nuclear disaster rating was assigned to the Fukushima nuclear accident, a level reached only once before with the Chernobyl disaster. Inevitably, Fukushima's residents had to directly confront the danger of radiation exposure.

The Great East Japan Earthquake and the Fukushima nuclear accident have had a substantial impact on economic conditions (Ando and Kimura, 2012; Hayashi, 2012) and happiness level (Uchida et al., 2014; Rehdanz et al., 2015; Yamamura et al., 2015) in Japan. Regarding issues of health and human biology, according to media reports in Japan, the nuclear accident led to "a lack of physical exercise and stress stemming from prolonged living in shelters and restrictions on playing outside" (Daily Yomiuri, 2012). Consequently, "an alarming trend toward obesity has been found among children in Fukushima Prefecture, which has the highest rate of obese children in every age group between 5 and 9 years old" (Daily Yomiuri, 2012). Existing studies assessing other nuclear accidents such as Three Mile Island and Chernobyl provide evidence that nuclear accidents have not only short-term but also long-term detrimental influences on human life[1]. However, little is known about how and to what extent the Fukushima accident has affected body mass indexes (BMIs) and changes in obesity rates. Overweight children are thought to face a higher risk of developing various diseases in the future. Accordingly, there is the possibility that the Fukushima accident has indirectly influenced residents' health status because of obesity. Thus, it is of value to assess the subsequent effect of the Fukushima accident on the physical condition of children. Therefore, based on prefecture-level data covering 2010–2014, this study uses a differences-in-differences approach to assess the long-term influence of the

[1] The Chernobyl accident was found to reduce people's happiness levels (Danzer and Weisshaar, 2009) and the performance of the labor market in the Ukraine (Lehmann and Wadsworth, 2008). The effects of the accident have also been observed in other European countries. For instance, Germans were found to be more likely to worry about the environment after the Chernobyl disaster (Berger, 2010). In Sweden, students born in regions exposed to higher levels of Chernobyl radiation fallout produced poorer performances at secondary school (Almond et al., 2009). Other major disasters have also been found to influence the outcomes of elections and policies in the United States (Eisensee and Strömberg, 2007; Kahn, 2007).

nuclear accident on the BMI and obesity rate of children in Japan.

2. Data and methods

2.1. Data

The Ministry of Education, Culture, Sports, Science and Technology conducts an annual school health survey across Japan. This survey collects data regarding the height, weight and obesity rate of school-aged children. There are 47 prefectures in Japan and the ministry releases the average heights and weights for each prefecture[2]. Height and weight data are further categorized for male and female children. The data used in this paper covered the period 2010–2014[3]. The sample areas (those damaged in the 2011 disaster) are Fukushima, Iwate and Miyagi prefectures because the Great East Japan Earthquake directly hit those areas. However, data from the three prefectures were not collected in 2011 because of the tremendous damage suffered from the disaster. Therefore, 2011 data are not included in the dataset used in this paper.

Data showing average height and weight values from 2010 to 2014 were obtained for 47 prefectures (Table 1). To assess the subsequent effect of the Fukushima accident on small children over time, we conducted estimations by cohort groups. Smaller children are more likely to be influenced by circumstance than older ones. Therefore, data used in this analysis covered six cohort groups in which children were aged 5–10 years old in 2010[4]. In the same cohort, for instance, children who were aged 5 years in 2010 were 7, 8 and 9 years old in 2012, 2013 and 2014, respectively. Furthermore, separate data are available for male and female children. A total of 2,256 observations were used in this study.

Using the data, average BMI values can be calculated. BMI reflects how overweight the children in each cohort are, on average. However, BMI is possibly influenced by outliers in the sample. To remove any bias caused by outliers, it is worth considering the composition of the physical structure in the population. For

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[2] A Japanese prefecture is considered to be equivalent to a state in the United States or a province in Canada.

[3] Data regarding children's heights and weights used in this paper are available from the website of the Ministry of Education, Culture, Sports, Science and Technology: http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001044483&cycode=0 (accessed on May 10, 2015).

[4] Available data covered the height and weight of 5–17-year-olds in each year. However, our focus was on younger children, those aged 5–10 in 2010.

this purpose, in addition to BMI, we also assessed the obesity rate to determine robustness of the BMI data. The obesity rate is defined in Table 4. We focused on the BMI and obesity rates from 2010 to 2014, and compared the BMI and obesity rates between disaster-damaged areas and other areas. Figure 1 demonstrates how the difference between the average BMI of disaster-damaged areas and other areas in each cohort (5, 6 and 7 years old in 2010) changed from 2010 to 2014. If the value is over 0, the average BMI of children in the disaster-damaged areas is higher than other areas. Throughout the period, the difference in BMI was consistently positive, indicating that the average BMI of children in disaster-damaged areas was higher than that in other areas. The difference in BMI increased consistently from 2010 to 2014 for cohorts aged 5 and 6 in 2010. In contrast, the difference in BMI increased until 2013 and then declined from 2013 to 2014 for cohorts aged 7 in 2010. However, the value of the difference is approximately 0.05 in 2014, which is larger than 0.03 in 2014. Therefore, the difference in BMI in 2014 did not return to the pre-accident levels.

Figure 2 demonstrates the difference in BMI of children between areas for older cohorts (8, 9 and 10 years olds in 2010). The difference increased from 2010 to 2012, and then decreased. An inverted U-shaped curve is observed in Figure 2. Figures 3 and 4 demonstrate the difference in obesity rates for younger and older cohorts, respectively. The observations in Figures 3 and 4 are similar to those in Figures 1 and 2. Considering Figures 1–4 together, the Fukushima accident led to an increase in the BMIs of children in disaster-damaged areas compared with those in other areas. The effect of the accident is persistent over time for younger children, but for older children it is temporary and is no longer apparent after several years.

Table 2 shows the difference in BMIs of children before and after the Fukushima accident in 2011 by comparing disaster-damaged areas and other areas. The table shows that after the accident, the average BMI is significantly higher at the 1% level in children in both damaged and other areas. The difference between periods for damaged areas is 1.74, which is larger than that for other areas (1.55). The difference between areas before the accident shows that the BMI of children in damaged areas was higher by 0.27 when compared with other areas. Fukushima, Iwate and Miyagi are considered rural areas. Hence, the above result is consistent with the finding that children's BMIs are more likely to be high in rural areas compared with urban areas (Yamamura, 2012). After the accident, the average BMI of children living in damaged areas is higher (by 0.46) than that for children in other areas. Table 3 shows the mean difference for obesity rates. Findings from

Table 3 are similar to those of Table 2. All in all, Tables 2 and 3 reveal that the Fukushima accident caused children's BMI to increase not only in damaged areas but also in other areas. However, the effect of the accident is more apparent in damaged areas than other areas. Inferred from the observations above, a decrease in physical exercise as a consequence of the Fukushima accident resulted in an increase in BMIs throughout Japan. Thus, the greater the effect of the accident, the greater the restriction on physical exercise, and the higher the increase in children's BMIs.

2.2. Econometric Framework

Table 4 presents the definition of the variables used in the estimation and the mean difference tests between damaged areas and other areas. As shown in Tables 2 and 3, *BMI* and *Obesity rate* of children in the damaged areas are higher than in other areas. *Income* is lower in the damaged areas and *Unemployment* is higher. This suggests that economic conditions are worse in damaged areas than in other areas. Following the description in the previous subsection, the estimated function takes the following form:

$$BMI\ (or\ Obesity\ rate)_{itga} = \alpha_1 Damaged\ area_i * 2012\ year\ dummy_t + \alpha_2\ Damaged\ area_i * 2013\ year\ dummy_t + \alpha_3 Damaged\ area_i * 2014\ year\ dummy_t + \alpha_4 Damaed\ area_i + \alpha_5 2012\ year\ dummy_t + \alpha_6 2013\ year\ dummy_t + \alpha_7 2014\ year\ dummy_t + \alpha_8 Male_g + \Upsilon'_{itga} B_{itga} + e_a + k_i + u_{itga},$$

where *BMI (or Obesity rate)*$_{itga}$ represents the dependent variable in prefecture *i*, year *t,* sex *g* and cohort *a*. To control for the effects of years, *year dummies* are included and the reference group is 2010 reflecting conditions before the Fukushima accident in 2011. As explained earlier, data for 2011 are not available, thus, the dataset used in the estimation covered a 5-year period, 2010, 2012, 2013 and 2014.).

Based on data from 2010 and 2014, to scrutinize the effect of the Fukushima accident on the BMI (or obesity rate) of children, changes in BMIs (or obesity rate) from 2010 to other years in the disaster-damaged areas are compared with those in other areas. That is, a differences-in-differences approach is used to examine the impact of the 2011 disaster on children's BMIs (or obesity rate). In this study, the treatment group (damaged areas) includes Fukushima, Iwate and Miyagi because the Great East Japan Earthquake directly hit those prefectures; the control group is other prefectures. The interaction terms between *Damaged area* and *Year dummies* are key variables to examine how the effect of the Fukushima accident has changed as years have passed. The interaction terms show how and the extent to which the BMI (or obesity rate) is larger than those in the base year (2010). If the Fukushima accident increases the BMI (or obesity rate) and the effect is observed in 2012, the coefficient of *Damaged area* $_i$ * *2012 year dummy* $_t$ will be positive.

Male is included to represent sex differences. The vectors of the control variables (including unemployment rate,[5] per capita income[6], rate of expenditure for cooked food and expenditure for food[7]) are denoted by Y_{itga}. Per capita income and unemployment rate capture economic conditions. BMI and obesity rates are considered to depend on calorie intake. However, data for calorie intake cannot be obtained. By definition of the statistics bureau, cooked food consists of various fast-food, which is considered high-calorie food. Therefore, instead of calorie intake, *Cooked Food* (expenditure on cooked food) is included to capture calorie intake. The coefficient of *Cooked Food* is thus predicted to be positive. In addition, the log of *Food expenditure* (expenditure on food) is also included. The regression parameters are denoted by α, and B is the vector of the regression parameters for the control variables. Furthermore, e_a represents cohort effects, which are controlled by including cohort dummies, k_i represents time invariant prefecture effects, which are controlled by the fixed effects model and the error term is denoted by u_{itga}.

3. Estimation results and their interpretation

Tables 5 and 6 exhibit the estimation results of the fixed effects model. In each

[5] Data regarding unemployment rates are available on the website of the Ministry of Internal Affairs and Communications–Statistics Bureau, Director-General for Policy Planning & Statistical Research and Training Institute:
http://www.stat.go.jp/data/roudou/pref/index.htm (accessed on May 10, 2015).

[6] Data regarding per capita income are available on the website of the Ministry of Internal Affairs and Communications–Statistics Bureau, Director-General for Policy Planning & Statistical Research and Training Institute:
http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001036889&cycode=0 (accessed on May 10, 2015).

[7] Data regarding percentage of expenditure on cooked food and food expenditure are available on the website of the Ministry of Internal Affairs and Communications–Statistics Bureau, Director-General for Policy Planning & Statistical Research and Training Institute: http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001064772 (accessed on May 10, 2015).

table, column (1) shows the results based on the full sample consisting of six cohorts (those aged 5–10 in 2010). After dividing the sample into younger cohorts and older cohorts, estimations were conducted and their results suggest how the effect of the Fukushima accident differs between younger and older cohorts. In each table, column (2) presents results based on the sample of cohorts for those aged 5–7 in 2010, while column (3) shows results based on a sample consisting of cohorts aged 8–10 in 2010.

Table 5 shows positive values of cross terms such as *damaged area*2012 year dummy, damaged area*2013 year dummy and damaged area*2014 year dummy.* These cross terms are statistically significant at the 1% level in columns (1) and (2). Hence, the effect of the Fukushima accident is persistent during the 2012–2014 period. In column (1), the absolute value of the coefficient of *damaged area*2013 year dummy* is 0.20, and is larger than that for *damaged area*2012 year dummy* (0.19) and *damaged area*2014 year dummy* (0.17). Thus, the effect of the Fukushima accident on BMI is largest in 2013. Turning to column (2), the absolute values of the coefficient of *damaged area*2012 year dummy, damaged area*2013 year dummy* and *damaged area*2014 year dummy* are 0.21, 0.26 and 0.29, respectively. These can be interpreted as follows: the difference in BMI of children for damaged areas and other areas in 2012 is higher (by 0.21) than that in 2010, and it continues to increase in subsequent years (0.26 in 2013, 0.29 in 2014). Thus, the effect of the Fukushima accident on BMI has increased as years have passed. Regarding column (3), *damaged area*2012 year dummy* shows statistical significance. However, *damaged area*2013 year dummy* and *damaged area*2014 year dummy* fail to reach statistical significance. Furthermore, the absolute values of the coefficient of *damaged area*2012 year dummy* is 0.18, which is smaller than that in column (2). Thus, the effect of the Fukushima accident is only observed in 2012, and not in 2013 and 2014. For the older cohorts, the effect of the accident is considered temporary. Compared with the younger cohort group, the effect of the accident in 2012 is smaller, even though a significant effect is observed. With respect to the results of the year dummies in Table 5, these dummies are positive and statistically significant at the 1% level in all columns. In column (1), the absolute values of the coefficients of the *2012 year dummy, 2013 year dummy* and *2014 year dummy* are 0.99, 1.57 and 2.17, respectively. In estimations of this analysis, we assessed the BMI of each cohort and the year dummies reflect the increase in age. That is, for the cohort of children aged 5 in 2010, the *2012 year dummy* captures the difference between the BMI of children aged 7 and when they were 5. Hence, the results of the year dummies are interpreted to suggest that children's body structures develop as they grow older. That is, their muscles develop and increase during periods of growth. BMI naturally increases as a consequence of an increase in muscle because muscle is heavier than fat (if the cubic volume is the same).

Table 6 shows similar results to those in Table 5, the cross terms between *Damaged area* and *year dummies* are positive in columns (1)–(3), and are statistically significant in columns (1) and (2). In contrast, only *Damaged area*2012 year dummy* is statistically significant in column (3). As observed in column (2), the coefficient of *Damaged area*2012 year dummy* is 1.84, the coefficient of *Damaged area*2013 year dummy* is 2.08 and that of *Damaged area*2014 year dummy* is 2.28. Thus, the rate of obese children in 2012 is higher than that in 2010 (by 1.84%). Compared with the 2010 rates, the obesity rate for children increased by 2.08% in 2013 and 2.28% in 2014. This reflects the persistent and increasing effect of the Fukushima accident on obesity rates for younger children. Turning to column (3), the coefficient of *Damaged area*2012 year dummy* is only 1.18, which is far smaller than that in column (2). Hence, for the older cohort, the effect of the Fukushima accident was no longer apparent 2 years afterwards. Therefore, the effect of the accident is temporary and smaller than for the younger cohort. As a whole, the results for the key variables in Table 6 are very similar to those in Table 5. This suggests that the results of Table 5 are robust when alternative specifications are used.

Based on observations thus far, the following argument can be derived: in response to the nuclear accident in Fukushima, outdoor exercise was restricted for children. As a consequence, younger primary school children could not burn calories. Such an effect has a greater impact on younger children than older children because younger children are more likely to develop a habit of inactivity, which persistently reduces physical activity and sports participation. It is important to urge children aged less than 7 years to get enough physical exercise. Therefore, a policy implication from the key findings is to enhance physical exercise for younger children to help develop an active habit to maintain proper weight and good health in the future.

4. Conclusion

The Great East Japan Earthquake caused a massive radiation leak, especially in disaster-damaged areas such as Fukushima, Iwate and Miyagi prefectures.

Radiation leaks influence human behavior because radiation exposure has a detrimental effect on health. In the disaster-damaged areas after the Great East Japan Earthquake, schools and parents prevented children from playing outside because of the risk of radiation exposure. A decrease in outdoor exercise is thought to reduce calorie burn-off, causing an increase in BMI and obesity. Hence, the impact of the accident on BMIs and obesity rates is expected to differ between damaged areas and other areas in Japan. By employing a differences-in-differences approach, this study investigated the long-term influence of the impact of the Fukushima accident on children's BMIs.

Based on prefecture-level panel data from Japan for the period 2010–2014, this study investigated how the 2011 Fukushima nuclear accident affected the BMIs of children between 5–10 years old in 2010 and whether its effect changed over time. A differences-in-differences approach was used to show that: (1) The Fukushima accident resulted in an increase in the BMI and obesity rates of children; (2) For cohorts between 5 and 7 years old in 2010, the effect of the accident remained evident after 3 years. Furthermore, the effect of the accident increased as time passed; (3) For cohorts between 8 and 10 years old in 2010, the influence of the accident was observed 1 year after the accident but was no longer apparent after 2 years.

These findings suggest that restrictions placed on outdoor exercise as a result of the nuclear accident in Fukushima prevented younger children from burning calories. Thus, a habit of inactivity was formed, leading to a persistent increase in BMI. In contrast, this habit did not form for older children and the effect of the accident was no longer apparent after 2 years. This suggests the importance of getting enough physical exercise to ensure that young children maintain a proper weight and enjoy good health in the future.

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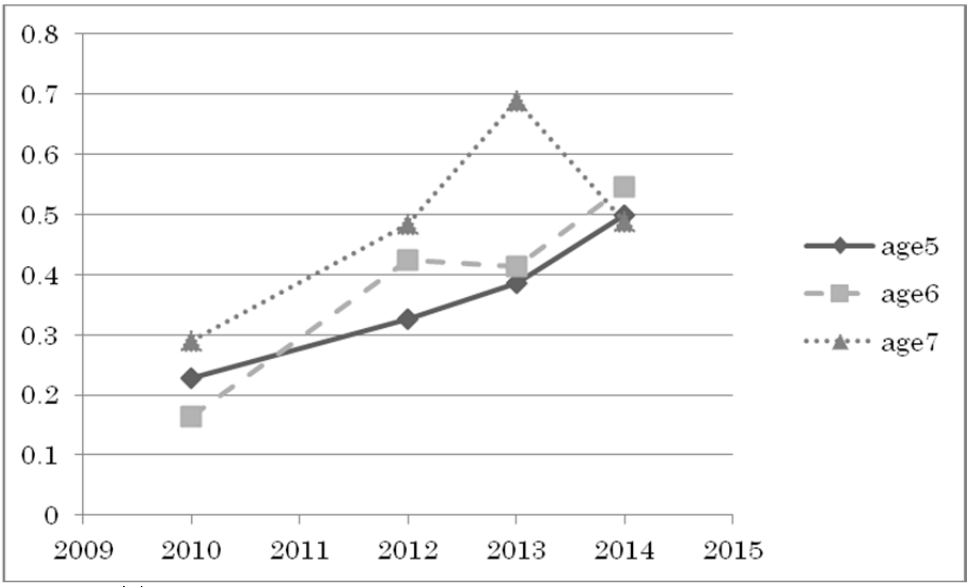

Figure 1(a). Difference in average BMI between children from damaged and other areas for each cohort (5, 6 and 7 years old in 2010)

Note: Cohorts denote the children's ages in 2010.
The difference in average BMI is calculated using the following formula for each year:
(Average value of BMI for children from damaged areas – Average value of BMI for children from other areas).

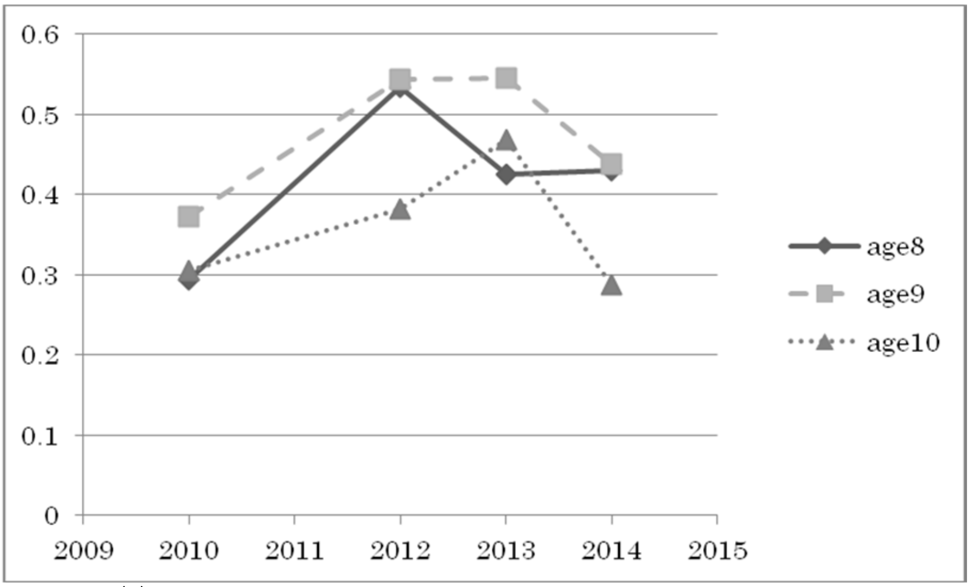

Figure 1(b). Difference in average BMI between children from damaged and other areas for each cohorts (8, 9 and 10 years old in 2010)

Note: Cohorts denote the children's ages in 2010.
The difference in average BMI is calculated using the following formula for each year:
(Average value of BMI for children from damaged areas – Average value of BMI for children from other areas).

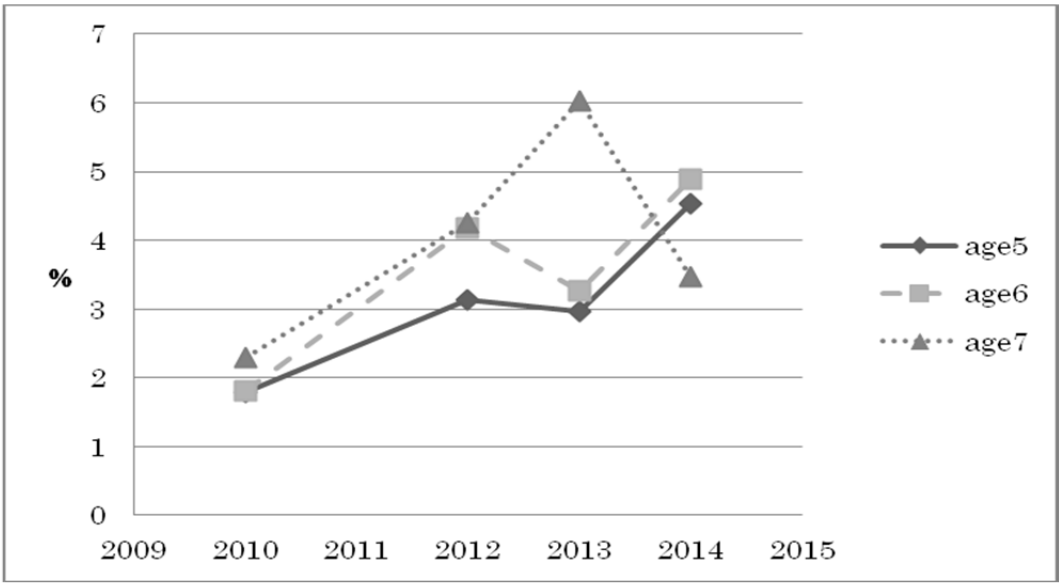

Figure 2(a). Difference in average obesity rate between children from damaged and other areas for each cohort (5, 6, and 7 years old in 2010)

Note: Cohorts denote the children's ages in 2010.
The difference in average obesity rate is calculated using the following formula for each year:
(Average value of obesity rate for children from damaged areas – Average value of obesity rate for children from other areas).

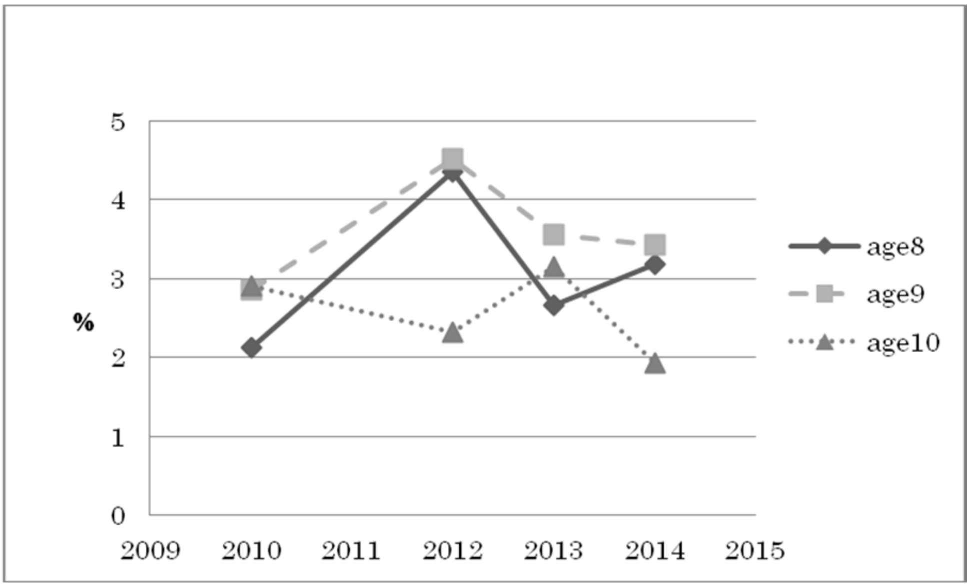

Figure 2(b). Difference in average obesity rate between children from damaged and other areas for each cohort (8, 9 and 10 years old in 2010)

Note: Cohorts denote the children's ages in 2010.
The difference in average obesity rate is calculated using the following formula for each year:
(Average value of obesity rate for children from damaged areas – Average value of obesity rate for children from other areas).

Table 1
Data structure (showing the number of data units)

Prefectures	Years (2010–2014)	Sex (male and female)	Cohorts (ages 5–10 in 2010)	Observations
47	4	2	6	2,256

Note: Prefectures × Years × Sex × Cohorts = Total observations
Data for 2011 were unavailable.

Table 2. Mean difference test for BMIs between children from damaged and other areas

	Before accident (1)	After accident (2)	Difference in BMI (1)–(2)	Absolute t-values
Damaged (I)	16.7	18.4	−1.74	8.09***
Other (II)	16.4	17.9	−1.55	27.6***
Difference in BMI (I)–(II)	0.27	0.46		
Absolute t-values	2.07**	3.82***		

Note: ** and *** indicate significance at the 5% and 1% level, respectively.

Table 3. Mean difference test for obesity rates between children from damaged and other areas (%)

	Before accident (1)	After accident (2)	Difference in Obesity rate (1)–(2)	Absolute t-values
Damaged (I)	8.75	12.26	−3.51	6.70***
Other (II)	6.45	8.61	−2.15	16.5***
Difference in Obesity rate (I)–(II)	2.29	3.65		
Absolute t-values	4.35***	15.1***		

Note: ** and *** indicate significance at the 5% and 1% level, respectively.

Table 4

Basic statistics of variables used in the estimation and their mean difference test between children from damaged and other areas

Variables	Definition	Damaged	Other	Absolute t-values
BMI	Body mass index	17.9	17.5	3.67***
Obesity rate	Obesity rate (%) A child is considered obese if the following value is larger than 20: $\{(\text{Weight} - \text{Stadard weight in each height}) / \text{Stadard weight in each height}\} \times 100$ Obesity rate is the percentage of obese children in each age group	11.4	8.1	13.8***
2010 year dummy	1 if 2010, otherwise 0	---	---	---
2012 year dummy	1 if 2012, otherwise 0	---	---	---
2013 year dummy	1 if 2013, otherwise 0	---	---	---
2014 year dummy	1 if 2014, otherwise 0	---	---	---
Damage	1 if Fukushima, Iwate or Miyagi prefectures, otherwise 0	---	---	---
Income	Per capita income (million yen) in 2010	2458	2722	7.49***
Unemployment	Unemployment rate in 2010 (%)	5.18	4.34	10.4***
Cooked Food	Percentage expenditure on cooked food (Annual Expenditure on cooked food per household /annual total expenditure on food per household)	11.4	11.6	3.48***
Food Expenditure	Total annual expenditure on food per household (thousands yen)	873	883	1.80*
Male	1 if male, otherwise 0	---	---	---

Note: * and *** indicate significance at the 10% and 1% level, respectively.

Table 5

Determinants of BMI (fixed effects model)

	(1) Full sample Age 5–10 in 2010	(2) Sub-sample Age 5–7 in 2010	(3) Sub-sample Age 8–10 in 2010
*Damaged area *2012 year dummy*	0.19***	0.21***	0.18**
	(2.80)	(3.00)	(1.98)
*Damaged area *2013 year dummy*	0.20***	0.26***	0.14
	(3.05)	(3.97)	(1.61)
*Damaged area *2014 year dummy*	0.17***	0.29***	0.06
	(2.65)	(4.29)	(0.75)
2010 year dummy		<Reference>	
2012 year dummy	0.99***	0.72***	1.27***
	(26.2)	(18.8)	(25.8)
2013 year dummy	1.57***	1.22***	1.92***
	(45.8)	(35.4)	(43.2)
2014 year dummy	2.17***	1.78***	2.55***
	(78.1)	(63.9)	(70.8)
Ln(Income)	−1.01	−0.06	−0.16
	(−0.43)	(−0.22)	(−0.49)
Unemployment	−0.04	−0.01	−0.07**
	(−1.62)	(−1.22)	(−2.32)
Cooked Food	1.61	3.02*	0.20
	(1.01)	(1.88)	(0.10)
Ln(Food Expenditure)	1.01	0.29	−0.08
	(0.56)	(1.50)	(−0.30)
Male	0.08***	0.21***	−0.05***
	(7.13)	(18.7)	(−3.52)
Observations	2256	1128	1128
R-squared	0.90	0.93	0.94

Note: Cohort dummies are considered as time invariant variables and are controlled via a fixed effects model. Furthermore, prefecture dummies are included but their results are not reported. Numbers in parentheses are t-statistics. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 6

Determinants of obesity rate (fixed effects model)

	(1) Full sample Age 5–10 in 2010	(2) Sub-sample Age 5–7 in 2010	(3) Sub-sample Age 8–10 in 2010
*Damaged area *2012 year dummy*	1.51***	1.84***	1.18**
	(3.33)	(3.27)	(2.07)
*Damaged area *2013 year dummy*	1.21***	2.08***	0.33
	(2.81)	(3.90)	(0.61)
*Damaged area *2014 year dummy*	1.21***	2.28***	0.14
	(2.79)	(4.25)	(0.26)
2010 year dummy		<Reference>	
2012 year dummy	1.71***	2.45***	0.96***
	(6.90)	(8.00)	(3.09)
2013 year dummy	2.25***	3.64***	0.87***
	(10.0)	(13.0)	(3.06)
2014 year dummy	2.27***	4.33***	0.21
	(12.5)	(19.3)	(0.95)
Ln(Income)	−1.43	−0.24	−2.63
	(−0.87)	(−0.12)	(−1.26)
Unemployment	−0.14	0.07	−0.34*
	(−0.88)	(0.35)	(−1.74)
Cooked Food	14.6	11.1	18.0
	(1.39)	(0.86)	(1.37)
Ln(Food Expenditure)	0.12	0.12	0.13
	(0.10)	(0.08)	(0.08)
Male	1.27***	1.08***	1.45***
	(17.1)	(11.9)	(15.5)
Observations	2256	1128	1128
R-squared	0.57	0.74	0.58

Note: Cohort dummies are considered as time invariant variables and are controlled using a fixed effects model. Furthermore, prefecture dummies are included but their results are not reported. Numbers in parentheses are t-statistics. * and *** indicate significance at the 10% and 1% levels, respectively.