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[Original Article]

THE BASIC DATA FOR RESIDENTS AGED 15 YEARS OR YOUNGER WHO RECEIVED A COMPREHENSIVE HEALTH CHECK IN 2011–2012 AS A PART OF THE FUKUSHIMA HEALTH MANAGEMENT SURVEY AFTER THE GREAT EAST JAPAN EARTHQUAKE

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Abstract : Aim : To assist in the long-term health management of residents and evaluate the health impacts after the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant accident in Fukushima Prefecture, the Fukushima prefectural government decided to implement the Fukushima Health Management Survey. This report describes the results for residents aged 15 years or younger who received health checks and evaluates the data obtained from 2011 and 2012. **Methods :** The target group consisted of residents aged 15 years or younger who had lived in the evacuation zone. The health checks were performed on receipt of an application from any of the residents. The checks, which included the measurements of height, weight, blood pressure, biochemical laboratory findings, and peripheral blood findings, were performed as required. **Results :** 1) A total of 17,934 (64.5%) and 11,780 (43.5%) residents aged 15 years or younger received health checks in 2011 and 2012, respectively. 2) In both years, a number of male and female residents in the 7–15 year age group were found to suffer from obesity, hyperlipidemia, hyperuricemia, or liver dysfunction. Furthermore, pediatric aged 15 years or younger were commonly observed to suffer from hypertension or glucose metabolic abnormalities. 3) A comparison of data from 2012 and 2011 demonstrated that both males and females frequently showed increased body

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height and decreased body weight in 2012. The prevalence of hypertension, glucose metabolic abnormalities, or high γ-GTP values in males and females in the 7-15 year age group in 2012 was lower than that in 2011. However, the prevalence of hyperuricemia among residents in the 7-15 year age group was higher in 2012 than in 2011.

Conclusions : These results suggested that some residents aged 15 years or under who had lived in the evacuation zone had developed obesity, hyperlipidemia, hyperuricemia, liver dysfunction, hypertension, or glucose metabolic abnormalities. Therefore, we think that it is necessary to continue the health checks for these residents in order to ameliorate these lifestyle-related diseases.

Key words : health check, Fukushima Health Management Survey, The Great East Japan Earthquake, child, adult

INTRODUCTION

On March 11, 2011, a massive undersea earthquake and subsequent tsunami struck East Japan. With a Richter-scale magnitude of 9.0, the Great East Japan Earthquake was one of the most powerful earthquakes on record and the largest to hit Japan[1-4]. The associated tsunami hit the northern part of the main island of Honshu, covering more than 800km of the Pacific coastline and claiming nearly 20,000 lives. In Fukushima Prefecture, 1,609 people were confirmed killed and 207 remain missing[5,6].

The Fukushima Daiichi Nuclear Power Plant, which is owned and operated by the Tokyo Electric Power Company was severely damaged by the earthquake and tsunami. The tsunami destroyed the direct current power supply, resulting in a complete loss of power to the Nuclear Power Plant cooling system. Consequently, the overheated Nuclear Power Plant reactor cores underwent a meltdown and hydrogen gas explosions dispersed large amounts of radionuclide materials into the surrounding areas[7]. Due to the accident at the Fukushima Daiichi Nuclear Power Plant, residents of all ages living in the evacuation zone-, a government-designated area around the nuclear power plant in Fukushima prefecture, were evacuated. As a result, many child evacuees from the government-designated evacuation zone were forced to make changes to their lifestyle, such as school life, diets, free play outside with friends, exercise patterns, and sleep patterns. Further, some parents experienced anxiety regarding their health status, particularly with regard to radiation exposure.

The Fukushima prefectural government decided to conduct what it called the Fukushima Health Management Survey (FHMS) to assist in the long-term health management of residents, to evaluate the health impacts of the accident, to promote the future well-being of residents, and to determine whether long-term low-dose radiation exposure has any effect of their health[4,8]. The framework of the FHMS was showed in Fig. 1. Comprehensive health checks (CHCs) are part of the detailed FHMSs and we sought to review the data regarding their health, assess the incidence of various diseases, and improve the health status of evacuees.

To assist in the long-term health management of residents aged 15 years or under and evaluate the health impacts after the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant accident, we performed health checks for child evacuees from the government-designated evacuation zone and analyzed the basic data.

METHODS

The study was carried out under the auspices of the Committee for Human Experiments at the Fukushima Medical University School (the Institutional Review Board approval number 1319). Informed consent was obtained from all residents aged 15 years or under, who have received health checks or their parents. The target group and methods employed in the CHC were reported previously by Yasumura *et al.*[8].

Target group

The target group consisted of residents aged 15 years or under who had lived in Hirono-machi, Naraha-machi, Tomioka-machi, Kawamata-machi Kawauchi-mura, Okuma-machi, Futaba-machi, Namie-machi, Kazurao-mura, Iitate-mura, Minami-soma City, Tamura City and the part of Date city specifically recommended for evacuation.

The residents aged 15 years or under have received health checks at 102 pediatric medical institutions in the prefecture since January 2011 (153 pediatricians agreed to be registered to conduct these

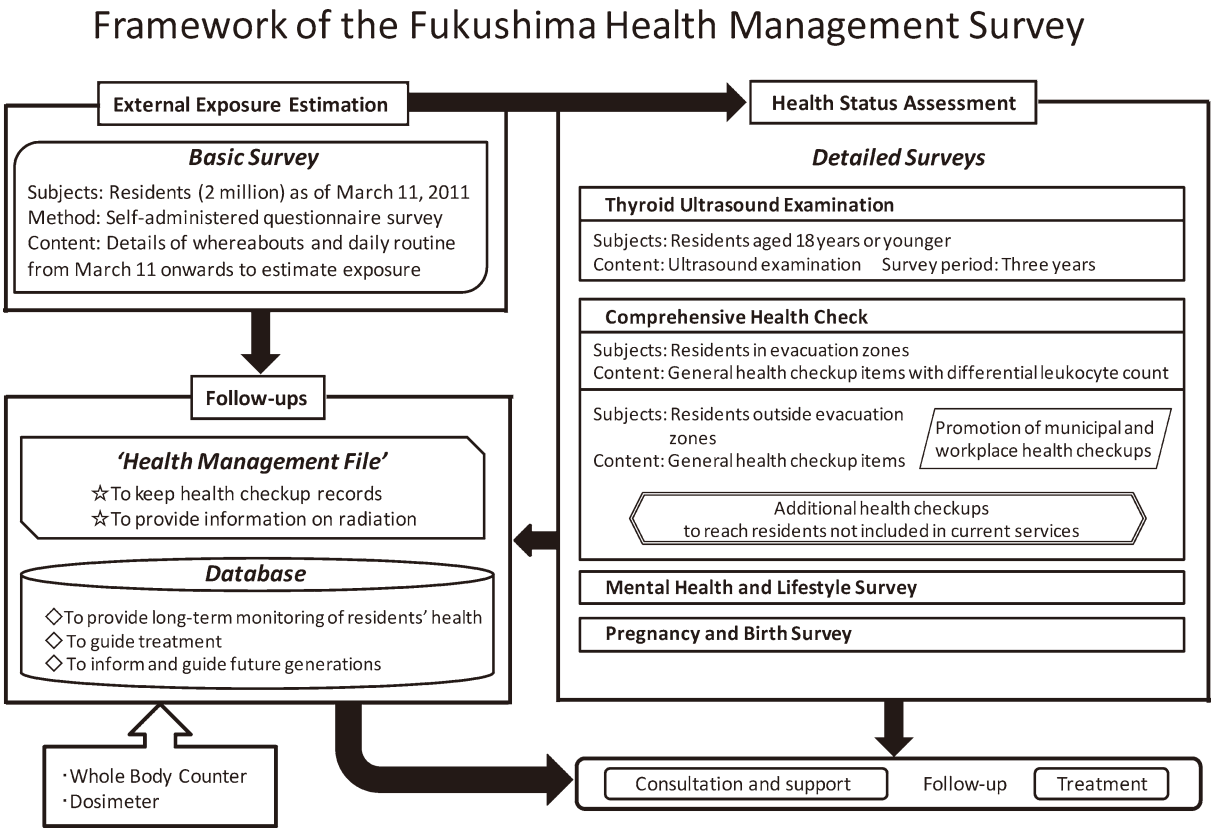

Fig. 1. Items included in the comprehensive health check.

comprehensive health checks).

The CHCs have also been performed outside the prefecture, with a total of 554 pediatric medical institutions helping to conduct health checks for children aged 15 years or younger.

Evaluation items

In addition to assessing the effects of radiation, additional variables were specified according to age in order to assess health, prevent lifestyle-related diseases, and identify or treat diseases at an early stage. The survey items for children aged 7 to 15 years consisted of height, weight, blood pressure, red blood cell (RBC) count, hematocrit (Hct), hemoglobin (Hb), platelet count, and white blood cell (WBC) count. Upon request, aspirate aminotransferase (AST), alanine aminotransferase (ALT), γ-glutamyl transpeptidase (γ-GTP), triglyceride (TG), high-density lipoprotein-cholesterol (HDL-C), low-density lipoprotein-cholesterol (LDL-C), hemoglobin A1c (HbA1c), fasting plasma glucose concentration, serum creatinine (Cr), and uric acid (UA) could be added. For children aged 0 to 6 years, height, weight, RBC count, Hct, Hb, platelet count, and WBC count were examined.

Definitions

Hypertension, anemia, liver dysfunction, hyperuricemia and hyperlipidemia were defined as previously reported[9].

Statistics

Data are expressed as the mean values.

RESULTS

1) Baseline characteristics for residents aged 15 years or under who had lived in the evacuation zone (Table 1)

In 2011, 17,934 (64.5%) of the residents aged 15 years or younger received health checks, whereas 11,780 (43.5%) of those aged 15 years or younger received health checks in 2012. The numbers of residents aged 15 years or under who had lived in Hirono-machi, Naraha-machi, Tomioka-machi, Kawamata-machi Kawauchi-mura, Okuma-machi, Futaba-machi, Namie-machi, Kazurao-mura, Iitate-mura, Minami-soma City, Tamura City and the part of Date city are shown in Table 1.

Table 1. The number of residents aged 15 years or under who had lived in the evacuation zone in childhood.

	Date City	Tamura City	Minamisoma City	Kawamata Machi	Hirono Machi	Naraha Machi	Tomioka Machi
0–6 years	98	1,720	3,664	580	257	347	760
7–15 years	200	3,503	6,078	1,190	515	688	1,431

	Kawauchi Mura	Okuma Machi	Futaba Machi	Namie Machi	Katsurao Machi	Iitate Machi
0–6 years	88	777	362	1,016	53	280
7–15 years	175	1,126	559	1,709	105	538

Table 2. The mean body height of residents aged-less than 6 years old who had lived in the evacuation zone in 2011 and 2012.

Age years (Y), month (M)	male					female				
	2011		2012		(b)-(a)	2011		2012		(b)-(a)
	n	means (cm) (a)	n	means (cm) (b)		n	means (cm) (a)	n	means (cm) (b)	
10M-1Y	44	73.6	46	73.3	△0.3	36	71.5	49	72.0	0.5
1Y-1Y2M	77	74.8	52	74.1	△0.7	79	73.7	60	73.4	△0.3
1Y2M-1Y4M	68	76.5	64	77.2	0.7	85	75.1	41	75.2	0.1
1Y4M-1Y6M	93	78.7	54	79.1	0.4	80	77.4	54	77.8	0.4
1Y6M-1Y8M	80	81.2	59	80.2	△1.0	78	78.9	53	78.9	0.0
1Y8M-1Y10M	73	82.1	56	82.5	0.4	86	81.2	49	81.1	△0.1
1Y10M-2Y	83	83.8	52	83.7	△0.1	98	82.0	52	81.8	△0.2
2Y-2Y6M	281	86.6	181	87.4	0.8	263	85.4	178	85.6	0.2
2Y6M-3Y	269	90.7	196	91.4	0.7	288	89.9	199	89.7	△0.2
3Y-3Y6M	281	94.8	193	94.9	0.1	255	93.5	208	94.0	0.5
3Y6M-4Y	257	98.6	170	99.0	0.4	246	97.3	181	97.4	0.1
4Y-4Y6M	258	101.7	203	102.3	0.6	275	100.6	175	100.8	0.2
4Y6M-5Y	280	105.7	193	105.7	0.0	253	104.2	192	103.9	△0.3
5Y-5Y6M	286	108.5	182	108.9	0.4	286	107.6	197	107.5	△0.1
5Y6M-6Y	293	111.4	199	111.9	0.5	296	110.3	191	111.1	0.8

2) Body height, weight and blood pressure in residents aged 15 years or under who had lived in the evacuation zone (Table 2, 3, 4, 5,and 6)

1 Body height

Body height is shown in Table 2, 3, 4, and 5. Increases in body height were observed in males in the 1 year (Y) 2 month (M)-1Y6M , 1Y8M-1Y10M, and 2Y-14Y age groups in 2012 in comparison to the data for 2011, with gains in body height also observed in females in the 10M-1Y, 1Y2M-1Y6M, 2Y-2Y6M, 3Y-4Y6M, 5Y6M-9Y, 11Y, 13Y, and 15Y age groups in 2012 compared to 2011.

2 Body weight

Decreased body weight was observed in males in the 10M-1Y6M, 1Y8M-2Y, 2Y6M-6Y, 8Y-10Y, 12Y, and 15Y age groups in 2012 in comparison to the data for 2011, with decreases in body weight also observed in females in the 10M-3Y, 3Y6M-5Y6M, 6-8Y, 10Y, and 12Y-15Y age groups in 2012 compared to 2011.

3 blood pressure

With regard to blood pressure, the prevalence of high systolic BP or high diastolic BP in the male residents in 2011 was 0.9% and 0.8%, respectively, in the 7-15Y age group, while in the female residents it was 0.2% and 0.4%, respectively, in the 7-15 Y age group. In 2012, the prevalence of high systolic BP or high diastolic BP in the male residents was 0.4% and 0.4%, respectively, in the 7-15 Y age group, while in the female residents it was 0.1% and 0.3%, respectively, in the 7-15 Y age group (Table 6). In addition, the prevalence of hypertension in both the male and female residents in the 7-15 Y age

Table 3. The mean body weight of residents aged-less than 6 years old who had lived in the evacuation zone in 2011 and 2012.

Age years (Y), month (M)	male					female				
	2011		2012		(b)-(a)	2011		2012		(b)-(a)
	n	means (kg) (a)	n	means (kg) (b)		n	means (kg) (a)	n	means (kg) (b)	
10M-1Y	44	9.8	46	9.4	△0.4	36	8.9	49	8.7	△0.2
1Y-1Y2M	77	9.9	52	9.5	△0.4	79	9.4	60	9.1	△0.3
1Y2M-1Y4M	68	10.4	64	10.2	△0.2	85	9.7	41	9.4	△0.3
1Y4M-1Y6M	93	10.9	54	10.5	△0.4	80	10.3	54	10.1	△0.2
1Y6M-1Y8M	80	11.2	59	11.2	0.0	79	10.5	53	10.4	△0.1
1Y8M-1Y10M	73	11.6	56	11.4	△0.2	86	11.0	49	10.5	△0.5
1Y10M-2Y	83	12.0	52	11.6	△0.4	98	11.2	52	10.8	△0.2
2Y-2Y6M	281	12.7	181	12.8	0.1	263	12.1	178	11.9	△0.2
2Y6M-3Y	269	13.8	196	13.5	△0.3	288	13.2	199	12.9	△0.3
3Y-3Y6M	281	14.8	193	14.6	△0.2	255	14.1	208	14.1	0.0
3Y6M-4Y	257	15.9	170	15.7	△0.2	246	15.2	181	15.0	△0.2
4Y-4Y6M	258	16.8	203	16.6	△0.2	275	16.4	175	16.0	△0.4
4Y6M-5Y	280	17.9	193	17.8	△0.1	253	17.2	193	17.0	△0.2
5Y-5Y6M	286	18.7	182	18.5	△0.2	286	18.4	197	18.2	△0.2
5Y6M-6Y	293	20.0	199	19.9	△0.1	296	19.3	191	19.6	0.3

Table 4. The mean body height of residents aged-7-15 years old who had lived in the evacuation zone in 2011 and 2012.

Age (years)	male					female				
	2011		2012		(b)-(a)	2011		2012		(b)-(a)
	n	means (cm) (a)	n	means (cm) (b)		n	means (cm) (a)	n	means (cm) (b)	
6	584	116.6	383	116.6	0.0	533	115.6	391	115.6	0.0
7	630	122.8	459	123.0	0.2	611	121.5	401	121.6	0.1
8	692	128.1	424	128.5	0.4	623	127.5	381	127.9	0.4
9	633	133.4	460	133.9	0.5	652	133.6	424	133.9	0.3
10	682	139.3	433	139.4	0.1	675	140.4	438	140.0	△0.4
11	721	145.5	488	145.8	0.3	641	146.9	440	147.4	0.5
12	662	153.2	438	153.3	0.1	641	152.2	389	152.1	△0.1
13	568	160.1	386	160.6	0.5	645	154.6	400	154.9	0.3
14	621	165.3	327	165.7	0.4	610	156.4	357	156.4	0.0
15	512	168.4	223	168.2	△0.2	563	157.0	225	157.3	0.3

Table 5. The mean body weight of residents aged-7-15 years old who had lived in the evacuation zone in 2011 and 2012.

Age (years)	male					female				
	2011		2012		(b)-(a)	2011		2012		(b)-(a)
	n	means (kg) (a)	n	means (kg) (b)		n	means (kg) (a)	n	means (kg) (b)	
6	584	22.1	383	21.5	△0.6	533	21.7	391	21.1	△0.6
7	632	24.8	459	24.8	0.0	611	24.1	401	24.0	△0.1
8	692	28.4	424	28.0	△0.4	623	27.4	381	27.2	△0.2
9	633	32.6	460	32.2	△0.4	652	31.0	424	31.3	0.3
10	682	36.0	433	35.9	△0.1	675	35.7	438	34.8	△0.9
11	721	40.5	488	40.7	0.2	641	40.5	440	40.7	0.2
12	662	46.9	438	45.4	△1.5	641	45.8	389	44.0	△1.8
13	568	51.2	386	51.5	0.3	645	48.5	400	47.4	△1.1
14	621	56.1	327	56.1	0.0	610	51.8	357	50.7	△1.1
15	512	60.0	223	58.7	△1.3	563	53.5	225	51.7	△1.8

Table 6. lood pressure in residents aged-7-15 years old who had lived in the evacuation zone in 2011 and 2012.

		Systolic BP (mmHg)			Diastolic BP (mmHg)		
		n	means	≥140	n	means	≥90
2011	male	5,728	108.6	0.9%	5,727	62.6	0.8%
	female	5,686	106.3	0.2%	5,684	62.2	0.4%
2012	male	3,778	106.2	0.4%	3,778	61.2	0.4%
	female	3,601	104.1	0.1%	3,601	60.6	0.3%

Table 7. RBC counts, Hg, Hct, and platelet counts in residents aged-0-15 years old who had lived in the evacuation zone.

	Age (years)	Sex	RBC counts (10^6/μl)					Hb (g/dL)					Hct (%)					Platlet counts (10^3/μl)					
		male	n	means	≤3.69	≤3.99	≥5.80	n	means	≤12.0	≤13.0	≥18.0	n	means	≤35.9	≤37.9	≥55.0	n	means	≤89	≤129	≥370	≥450
		female			≤3.39	≤3.69	≥5.50			≤11.0	≤12.0	≥16.0			≤28.9	≤32.9	≥48.0						
2011	0-6	male	3,253	4.72	0.0%	0.6%	0.2%	3,253	12.5	24.5%	74.2%	0.0%	3,253	37.2	28.4%	64.4%	0.0%	3,251	321.2	0.3%	0.5%	22.3%	6.4%
		female	3,175	4.68	0.1%	0.1%	0.9%	3,175	12.6	3.1%	23.8%	0.0%	3,175	37.4	0.2%	2.1%	0.0%	3,172	322.5	0.2%	0.4%	22.7%	5.7%
2012	0-6	male	2,166	4.72	0.0%	0.9%	0.4%	2,166	12.6	25.3%	71.4%	0.0%	2,166	37.6	24.1%	56.6%	0.0%	2,164	321.1	0.1%	0.3%	22.8%	6.0%
		female	2,176	4.67	0.0%	0.0%	0.9%	2,176	12.6	3.2%	23.1%	0.0%	2,176	37.9	0.1%	1.4%	0.0%	2,172	325.4	0.3%	0.6%	24.0%	6.7%
2011	7-15	male	5,765	7.91	0.0%	0.3%	1.1%	5,765	13.8	3.8%	24.9%	0.0%	5,765	40.9	5.2%	19.0%	0.0%	5,763	277.4	0.0%	0.1%	7.2%	1.0%
		female	5,709	4.69	0.0%	0.1%	0.8%	5,710	13.3	1.6%	7.6%	0.1%	5,710	39.8	0.2%	0.9%	0.1%	5,708	273.5	0.1%	0.3%	5.6%	0.8%
2012	7-15	male	3,809	4.90	0.0%	0.3%	0.7%	3,809	13.8	3.2%	21.9%	0.0%	3,809	41.3	2.8%	12.9%	0.0%	3,807	276.3	0.0%	0.3%	6.1%	0.6%
		female	3,626	4.70	0.0%	0.1%	0.6%	3,626	13.4	1.0%	6.2%	0.2%	3,626	40.4	0.0%	0.4%	0.2%	3,624	273.6	0.0%	0.1%	5.7%	0.5%

Table 8. WBC counts, including neutrophil counts, lymphocyte counts, basophil counts, monocyte counts, and eosinophil counts, in residents aged-0-15 years old who had lived in the evacuation zone in childhood.

	Age (years)	Sex	WBC counts (10^3/μl)						Neutrophils counts (/μl)			Lymphocyte counts (/μl)			Basophils counts (/μl)		Monocyte counts (/μl)		Eosinophils counts (/μl)	
			n	means	≤2.9	≤3.9	≥9.6	≥11.1	n	means	≤500	n	means	≤500	n	means	n	means	n	means
2011	0-6	male	3,253	8.5	0.1%	0.7%	28.3%	12.9%	3,247	3,683	0.0%	3,247	4,055	0.0%	3,247	38	3,247	454	3,247	250
		female	3,176	8.5	0.1%	0.4%	27.9%	13.0%	3,171	3,649	0.1%	3,171	4,214	0.0%	3,171	35	3,171	426	3,171	195
2012	0-6	male	2,166	8.6	0.0%	0.3%	29.3%	13.2%	2,158	3,555	0.1%	2,158	4,202	0.0%	2,158	40	2,158	460	2,158	316
		female	2,176	8.6	0.1%	0.5%	29.0%	13.5%	2,162	3,521	0.0%	2,162	4,321	0.0%	2,162	37	2,162	431	2,162	261
2011	7-15	male	5,765	6.5	0.2%	3.4%	6.0%	2.1%	5,762	3,321	0.0%	5,762	2,533	0.1%	5,762	433	5,762	366	5,762	244
		female	5,710	6.5	0.2%	4.0%	5.7%	1.8%	5,708	3,425	0.0%	5,708	2,514	0.1%	5,708	29	5,708	343	5,708	185
2012	7-15	male	3,809	6.5	0.2%	2.7%	6.5%	2.2%	3,806	0.0%	0.0%	3,806	2,582	0.0%	3,806	36	3,806	362	3,806	304
		female	3,626	6.5	0.2%	2.5%	5.4%	1.8%	3,623	3,341	0.0%	3,623	2,569	0.0%	3,623	30	3,623	337	3,623	226

group in 2012 was lower than that in male and female residents in 2011.

3) Peripheral blood data for residents aged 15 years or under who had lived in the evacuation zone (Table 7 and 8)

In 2011, the prevalence of anemia in the male residents was 24.5% in the 0-6 Y and 3.8% in the 7-15 Y age group, while that in the female residents was 3.1% in the 0-6 Y, and 1.6% in the 7-15 Y age group. Similarly, the prevalence of anemia in the male residents in 2012 was 25.3% in the 0-6 Y and 3.2% in the 7-15 year age group, while that in female residents was 3.2% in the 0-6 Y and 1.0% in the 7-15 year age group. There were no differences in the prevalence of anemia, peripheral WBC counts, including neutrophils and lymphocytes, or platelet counts among age groups or between males and females in both 2011 and 2012.

4) Biochemical laboratory findings for residents aged 15 years or under who had lived in the evacuation zone (Table 9, 10, and 11)

With regard to lipid function, the prevalence of high LDL-C or high TG values in the male residents in 2011 was 3.3% and 7.7%, respectively, in the 7-15 Y age group, and 3.6% and 6.3%, respectively, in the 7-15 Y age group in females. In 2012, the prevalence of high LDL-C or high TG values was 3.2% and 7.7%, respectively, in the 7-15 Y age group in males, and 3.6% and 6.5%, respectively, in the 7-15 Y age group in females. There were no significant differences in the prevalence of high LDL-C and high TG values in the 7-15 year age group in both males and females between 2012 and 2011 (Table 9).

In terms of liver function, the prevalence of

Table 9. LDL-C, triglyceride, and HLD-C values in residents aged-7-15 years old who had lived in the evacuation zone in childhood.

		HDL-C (mg/dL)			Triglyceride (mg/dL)				LDL-C (mg/dL)			
		n	means	<40	n	means	≥150	≥300	n	means	≥120	≥140
2011	male	5,586	62.2	3.1%	5,584	75.5	7.7%	0.6%	5,587	91.9	11.7%	3.3%
	female	5,515	62.7	2.8%	5,507	77.5	6.3%	0.5%	5,511	96.3	14.8%	3.6%
2012	male	3,711	61.4	3.1%	3,711	75.9	7.7%	0.6%	3,710	91.9	10.7%	3.2%
	female	3,532	61.1	2.3%	3,531	78.1	6.5%	0.7%	3,530	95.6	13.9%	3.6%

Table 10. Liver function and uric acid levels in residents aged-7-15 years old who had lived in the evacuation zone in childhood.

		AST (U/l)				ALT (U/l)				γ-GT (U/l)				Uric acid (mg/dL)			
		n	means	≥31	≥51	n	means	≥31	≥51	n	means	≥51	≥101	n	means	≥7.1	≥8.0
2011	male	5,588	25.1	12.8%	1.3%	5,588	17.8	7.0%	2.6%	5,587	16.0	1.0%	0.1%	5,584	4.8	4.7%	1.2%
	female	5,515	22.0	6.4%	0.4%	5,515	13.6	2.0%	0.7%	5,514	13.2	0.2%	0.0%	5,507	4.3	0.3%	0.1%
2012	male	3,711	25.6	14.1%	1.2%	3,711	17.8	7.4%	2.2%	3,710	16.0	0.7%	0.2%	3,704	5.0	6.1%	2.0%
	female	3,532	22.6	7.0%	0.5%	3,532	13.5	2.0%	0.5%	3,532	13.3	0.1%	0.0%	3,528	4.4	0.6%	0.2%

Table 11. Fasting blood sugar, HbA1c levels, and serum creatinine in residents aged-7-15 years old who had lived in the evacuation zone in childhood.

	Sex	Fasting plasma glucose concentration (mg/dL)					HbA1c (%) (NGSP)					Serum creatinine (mg/dL)			
	male	n	means	≥110	≥130	≥160	n	means	≥6.0	≥7.0	≥8.0	n	means	≥1.15	≥1.35
	female													≥0.98	≥1.15
2011	male	5,569	89.4	2.4%	0.3%	0.1%	5,578	5.3	1.2%	0.1%	0.1%	5,588	0.49	0.0%	0.0%
	female	5,494	87.7	2.3%	0.3%	0.1%	5,506	5.3	0.9%	0.1%	0.0%	5,512	0.45	0.0%	0.0%
2012	male	2,908	87.1	0.7%	0.0%	0.0%	3,711	5.3	0.8%	0.1%	0.1%	3,694	0.49	0.0%	0.0%
	female	2,779	85.4	0.6%	0.1%	0.0%	3,527	5.3	0.5%	0.1%	0.0%	3,518	0.46	0.0%	0.0%

high AST, ALT, and γ-GTP values in males in 2011 was 12.8%, 7.0% and 1.0%, respectively, in the 7-15 Y age group, and 6.4%, 2.0% and 0.2%, respectively, in the 7-15 Y age group in females. In 2012, the prevalence in males was 14.1%, 7.4% and 0.7%, respectively, in the 7-15 Y age group, while in females it was 7.0%, 2.0% and 0.1%, respectively, in the 7-15 Y age group. The prevalence of high AST or ALT values in males in the 7-15 Y age group in 2012 was slightly increased compared to the frequencies observed in 2011, and the prevalence of high AST values in female in the 7-15 Y age group in 2012 was slightly increased compared to the values observed in 2011. On the other hand, the prevalence of high γ-GTP values in male and female residents aged 7-15 Y in 2012 was slightly decreased compared to the values observed in 2011 (Table 10).

The prevalence of hyperuricemia in the male residents in 2011 was 4.7% in the 7-15 Y age group, and 0.3% in females in the 7-15 Y age group. The 2012 data reveal that the prevalence of hyperuricemia in the male residents was 6.1% in the 7-15 Y age group, while in females it was 0.6% in the 7-15 Y age group. Hyperuricemia was more common in males than in females aged 7-15 Y in both 2011 and 2012. The prevalence of hyperuricemia in the 7-15 Y age group in both males and females in 2012 was slightly increased compared to the values in 2011 (Table 10).

With regard to fasting plasma glucose concentration and HbA1c levels, the prevalence of high fasting plasma glucose concentration and HbA1c values was 2.4% and 1.2%, respectively, in the 7-15 Y age group in males, and 2.3% and 0.9%, respectively, in females. In 2012, high fasting plasma glucose concentration and HbA1c values were observed in

0.7% and 0.8%, respectively, of males in the 7–15 Y age group, with the respective values among females being 0.6% and 0.5% in the 7–15 Y age group. The prevalence of high HbA1c values in the 7–15 Y age group for both males and females in 2012 were slightly decreased compared to the values recorded in 2011(Table 11).

As to renal function, the prevalence of high serum creatinine was 0.0% in the 7–15 Y age group in both males and females in both 2011 and 2012 (Table 11).

DISCUSSION

The Great East Japan Earthquake and Fukushima Daiichi nuclear disaster forced people to evacuate their homes without notice, caused them to change their lifestyle in terms of diet, exercise patterns, and other personal habits, to adapt to a completely new situation, and produced a good deal of anxiety with regard to radiation exposure. In response to this situation, the Fukushima prefectural government made the decision to implement what they termed FHMS to assist in the long-term health management of residents and to evaluate the health impact of the nuclear disaster and forced evacuation. However, to date, there have been no reports on the health checks implemented for residents aged 15 years or under living in the evacuation zones at the time of the disasters.

We previously reported that, among the adult residents living in the evacuation zone, a certain number of both males and females aged 16 years or older demonstrated obesity or hyperlipidemia, and the prevalence of these conditions was seen to increase with age in 2011. In addition, some males aged 16 years or older were found to have hyperuricemia and liver dysfunction, and the prevalence of hyperuricemia and liver dysfunction also increased with age. Furthermore, the prevalence of hypertension, glucose metabolic abnormalities and renal dysfunction was found to increase in those aged 40 years or older[9]. The above results also show that, among the child residents who were living in the evacuation zone at the time of the disaster, a number of males and females aged 15 years or younger demonstrated hyperlipidemia and some males aged 15 years or younger were found to have hyperuricemia and liver dysfunction. Furthermore, hypertension and glucose metabolic abnormalities were common among the 7–15 Y age group. We believe that these findings may be associated with changes in the residents' lifestyle, diet, exercise patterns, mental stress levels, and sleep patterns in childhood, as shown in our report on adult health. However, there is no data available on the laboratory findings for pediatric residents who were living in the evacuation zone before the Great East Japan Earthquake, so a comparison of health status among the pediatric population before and after the Great East Japan Earthquake is not possible.

A comparison of body height and body weight between 2011 and 2012 showed that mean body height was increased and mean body weight decreased in both males and females in 2012 in comparison to 2011. These results suggest a tendency toward obesity in children who were living in the evacuation zone in 2011 after the Great East Japan Earthquake. To evaluate the body weight gains, it is necessary to further investigate changes in body weight on long-term basis.

In addition, the prevalence of hypertension and glucose metabolic abnormalities in 2012 was lower than that in 2011. Furthermore, the prevalence of high γ-GTP values in male and female residents aged 7–15 Y in 2012 was slightly decreased compared to the values observed in 2011. These results show that these changes, including hypertension and glucose metabolic abnormalities, obesity, and high γ-GTP values, improved from 2011 to 2012. However, the prevalence of hyperuricemia in both males and females in the 7–15 Y age group in 2012 was slightly higher than that in the respective age groups in 2011, and the prevalence of high TG values in 2012 was similar to that in 2011, suggesting that there was no improvement in these findings from 2011 to 2012. In addition, there were no differences in the prevalence of anemia or in peripheral WBC counts, including neutrophils and lymphocytes, or platelet counts between 2011 and 2012. These results indicate that it is necessary to continue our observation of these residents through health checks and to use the data obtained to improve their lifestyle.

Lifestyle-related diseases, including obesity and nonalcoholic fatty liver disease (NAFLD), are a major health problem, and their incidence is increasing worldwide[10]. Mutsuhashi et al. observed that the prevalence of overweight children was 3.12% among those aged 6 years in 1985, from which time it steadily increased to 4.68% in 2005[11]. In addition, pediatric NAFLD has increased in line with the increased prevalence of pediatric obesity and has become an important health problem worldwide. It is also reported that the prevalence of obesity and NAFLD in elementary school children in increas-

ing.[12,13)]

Thus, to evaluate the frequency of children with lifestyle-related diseases including obesity and/or NAFLD more precisely, it is necessary to compare the number of pediatric patients with lifestyle-related diseases between the population living in the evacuation zone and the general population.

The frequency of residents aged 15 years or younger who received health checks in 2011 was 64.5%, while that in 2012 was only 43.5%, which appears to indicate a decrease in interest in the health checks provided by the Fukushima Health Management Survey. This decrease in the number of child residents who received health checks could affect the results of our study and it is, therefore, necessary to encourage interest in these health checks through advertising and better education.

With regard to the limitations of our study, although there was no change in the criteria for residents aged 15 years or under targeted for health checks between 2011 and 2012, the actual pediatric residents who received health checks, the time at which they received the health checks and the medical institutions offering the health checks all varied between 2011 and 2012. Thus, a simple comparison of the data from 2011 and 2012 using statistical analysis was not feasible. To evaluate the health impacts of the disaster and forced evacuation more accurately, it is necessary to evaluate changes in the health status of the residents aged 15 years or under receiving the health checks in both 2011 and 2012 based on the results of the health checks. In addition, it is necessary to accumulate laboratory data from the comprehensive health checks over a long-term follow-up period and the prevention of each disease, including lifestyle-related diseases, should be considered independently on the basis of the long-term data.

In conclusion, these findings presented herein suggest that a number of children living in the evacuation zone at the time of the disaster suffered from a variety of conditions including obesity, hyperlipidemia, hyperuricemia, liver dysfunction, hypertension, and glucose metabolic abnormalities. We, therefore, believe that it is necessary to continue with the health checks for these residents aged 15 years or under in order to assist in resolving the observed lifestyle-related diseases.

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APPENDIX

The Fukushima Health Management Survey Group

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CONFLICT OF INTEREST

We have no conflicting interests affecting the present study.

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