

庭訪問をした。本児が示していた症状は、ちょっとした揺れでも周囲がびっくりするほど怖がる、落ち着かない、口内炎になった、不眠がちとなった、といった内容であった。母親はこの状態をストレスが大きくなっているためと考え、天気の良い日には公園に連れ出し、遊ばせるなどして対応してきた。遊んだ日はよく眠れていた。本児は、地震の揺れよりは津波で海が迫ってきた様子や魚が津波に運ばれてくる様子、そして海上に火災が発生し、炎の燃え上がる様子に恐怖を抱いたと言う。弟も震災後から声が出なくなったり、夜尿が始まったり、便秘と下痢を繰り返すようになるなど震災の衝撃を強く受けていた。

- ②4歳の女兒。震災直後の4月末に家庭訪問をした。震災により家が全壊し、母親と離れ離れになり、父親と二人で避難所で過ごした。避難所を出た後、女兒は家族4人で祖父母のもとに身を寄せた。この頃は地震が頻発した時期であったが、女兒はちょっとした揺れを感じただけで恐怖を感じ、落ち着かなくなり、汗びっしょりの状態を示していた。母親が抱きかかえると、女兒の心臓の拍動がはっきりと伝わってくるほど身体が反応していた。夜は寝つくことができず、遅くまで起きていた。また、赤ちゃん返りをきたし、弟をライバルのように意識し、母親が弟に授乳するのを見て、自分にもおっぱいを飲ませるようにと要求していた。

## (2) 災害急性期後期

災害精神医学では、災害のステージを、pre-disaster (災害前)、acute disaster (災害急性期)、post-acute disaster (災害急性期後期)、post-disaster (災害後期) の4つに分けている。災害急性

期後期に当たる時期の子どもの症例を提示する。

- ①小学2年男児。6月4日の運動会が終わった後から、吐き気を訴えるようになり、不登校状態になった。カウンセラーを経て私のところに紹介された。子どもが心の中を語れるようになると、「怖い気持ちに困っている」という。「余震の度に地震を思い出して怖くなる」、次いで2年生になって担任が女性から男性に替わったが、「この先生が怖かった」と語る。また、震災以前から母親が心身の不調を呈していたが、母親のことをずっと以前から心配であったと語る。本事例は、震災の衝撃を契機に、それまで心の中にしまいこんできた母親に対する不安が頭をもたげて、震災の恐怖感と母親への不安の両者に苦しんだ事例であった。

- ②被災時3歳の女兒。震災による津波で家は全壊流出。母親は津波にさらわれ行方不明となり、2週間後に悲惨な状態の遺体となって発見された。本児には対面させず、葬式をすませた。本児は保育所が再開した時、担当保育士に「先生！ お母さんが見つかったんだよ」とささやくように話した。この頃は、本児は感情が不安定で、感情が高まったり、落ち込んだり、ボーっとしていたりといった状態が毎日のように繰り返されていた。躁状態やうつ状態そして乖離状態が示されていたのであるが、1年以上経た最近まで相談などを受けてはいない。年が替わった3月には記念日反応を示し、「ママって死んだんだよね」と再び問いかけてくるようになった。現在でも感情が落ち着かず、感情が高まったり、ボーとしたりの状態を繰り返している。

## 3. 子どもに対する支援の実態

災害により心に衝撃を受けた子どもに対する支援

には多くのバリアーが立ち塞がっている。被災者の命を守り生活の支援をするためには、ゆく手を阻むガレキを片づけながら被災者に支援を届ける道を確保するが、心の傷ついた子どもの支援も、ガレキを片づけ道を開くと同じように、その子どもに到達する道を開かなくてはならない。

#### (1) 行く手を阻むものとは

最も大きなバリアーは、被災地の支援者が被災者であり、かつ疲弊困憊の中で子どものみならず大人の避難者の支援活動をしていることにある。こうした支援者が被災者であること、その中には自分の住む家を失い、家族を失い、この中には配偶者やわが子を失いながらも住民の支援を続けてきた市や町の職員が少なくないのである。被災住民のすぐそばで支援に当たっているために休めないし、休日を取れるようになって心は休息できない。このような重度のストレスの中に置かれている支援者であれば、子どもの心の状態に目が向くだけの余裕はないであろう。

子どもは大人以上に震災によって衝撃を受ける。その理由は大人が長い時間をかけて習得した危機対応力のような能力をまだ身に着けていないからである。また、心の衝撃や苦悩を表現するだけの言語能力を身に着けていないので、大人が分かるようには伝えてくれない。しかしながら、子どもは行動や態度で心の中を外に表す。周囲の大人たちが子どもの行動や態度から子どもの心の苦悩や衝撃の程度を察するためには、大人が子どもと落ち着いた状態で接する、あるいは身近に信頼できる専門家のサポートが得られているといった条件が必要である。この度の被災地のように、広範囲に及び、しかも県の中心部から遠く離れた東北の沿岸部では、こうした条件や環境を整えることはきわめて困難であった。

県内外から多くの心のケアの支援が提供された。しかしながら、心のケアでは、ボランティアセンターが被災者のニーズを把握し、適切にボランティアを割り振ったような役割を果たせないまま今日に至っている。そのため被災者が支援を望む時期と支援者が支援を提供したい時期がずれ、支援の受け手である被災者が困惑する場合も少なくなかったと聞く。大人に対しても子どもに対しても支援のニーズを適切に把握して、その支援を適切に割り振り、そして災害後期の対策をマネジメントする役割を果たす機関の存在が望まれる。

#### (2) 心のケアの必要な子どもたちの実態

この度の災害で死亡した子どもの数は、平成24年5月9日の文科省ホームページから数え上げると東北3県の小中高生の死亡者数は545名となる。とりわけ宮城県の犠牲は群を抜いて多く、行方不明者及び児童福祉施設の児童(保育所など)を合わせると501名にのぼる。親を失った子どもの数については、全国で240名、宮城県だけでも126名を数える。遺児については、あしなが育英会の報告によると1,698名で、宮城県では732名に及ぶ。

親を失うという事態は子どもにとって深刻な心的外傷となっているはずである。孤児や遺児は被災後数か月して少しずつ身体的な症状や精神症状を発するようになり、私たちの心のケアチームの相談に上がり始めたところである。様々な理由からこうした子どもの大半は悲しみや怒りをひたすら堪えている。また、ケアが必要にもかかわらず大人から気が付かれず、あるいはケアの場や機会が得られず放置されている可能性が高いのである。

心的外傷に関して言えば、アメリカのハリケーンカトリナによるPTSD(心的外傷後ストレス障害)は災害の直撃を受けた住民の30から40%に及んだ

ことが知られている。この度の大災害を見ると、子どもにとっての心的外傷につながるような出来事は、震度6強におよぶ地震の揺れ、襲いかかってくる津波の異常な光景、いくつかの地域では湾内火災、親や家族の喪失、無残な遺体の目撃、などがあげられる。こうした子どもたちは果たして適切なケアや支援を受けているのであろうか。

追い打ちをかけられるように、長期にわたる狭小な仮設住宅での生活や、福島県の子どもたちに代表される転居転校という生活の足場の喪失と新たな生活に取り組む負担が子どもたちに覆いかぶさっている。こうした子どもたちの心のケアは震災2年目となった本年度はまさに正念場を迎えているのである。

#### 4. 子どもの支援をめぐる問題とこれからの課題

##### (1) 東日本大震災とは

いったいどのような災害であったのか

災害とは自然や人為的な脅威に対する地域の対処能力を圧倒するような出来事と理解される。この度の震災は、地域社会の対処能力を圧倒するどころか、地域の対処能力を壊滅し、奪い去ったのである。1年2か月を経た5月の時点を見ると、多重的問題により復旧・復興が進まず、住民の心を蝕む事態が進行中である。いまだに20万人以上の市民は不自由な仮設住宅の生活をしている。被害の規模を見る限り、一度にこれだけの広大な地域が破壊された災害はかつてなかったと思われるが、支援の体制は災害の実態に見合う内容だろうかと思望に近い観を抱かざるを得ない。当然のことながら、子どもたちの育つ環境は心配だらけである。子どもたちの育ちにとって、家庭以外の地域や学校という環境に目を向けたとき、せめて楽しくかつ安全に遊べる空間や安心して学べる学校は確保されているのであろうか？

震災で使えなくなった学校は東北3県で173校におよび、元の校舎で授業を再開した学校は32校に過ぎず、残りは仮設校舎で授業を受けたり、他校に間借りして授業を受けているのである。保育所や幼稚園も同様である。また、学校の校庭が仮設住宅にあてがわれている学校も多く、子どもたちは遊びの空間や運動の場を制限されながら、エネルギーを持って余しかねない思春期を送ることになる。

##### (2) これから懸念されること

被災地の被災者も支援者もこの1年を必死で生きてきた。今を生きるのに必死で、苦痛や辛さ、そして将来への不安と絶望等の感情を押し殺して生きてきた。子どもも、大人が必死に耐える姿を見て、子どもなりに耐え、頑張ってきたはずである。被災後1年を経て、一息つく時期ではあるが、今度はこの先の大変さが見え始める。この先の負担や困難を前にして、絶望の淵に立つ住民も少なくない。親はイライラして夫婦喧嘩が多くなり、配偶者間暴力や児童虐待が増え始めているようである。子どもたちも、震災の衝撃に先の見えない不安やストレスが加わって、子どもに課せられた発達課題に取り組めなくなっているようである。不登校が増え始めていると聞く。また集中力が下がり、勉強に身が入らない子どもが少なくないようだ。私たちのケアチームに持ち込まれる子どもの問題は深刻な精神障害が目立つようになり、この震災が子どもに与えた深刻な影響がいよいよ形に現れたという感じを抱く。このような2年目に入った時期に、潮目が変わるかのよう心のケアについても外からの支援はほとんど撤回した。

##### (3) 提言に代えて

災害からの復興は長い道のりとなる。マラソンの

ように、被災者一人一人の歩みは異なるが、すべての被災者が目的地までたどり着けるような支援の仕組みが望まれる。そのためにも被災者の心の支えは決定的に重要である。親にとってはわが子が適切に支援されることが困難に取り組むうえでの大きな力になるであろうし、子どもにとっては自分のことが誰かに理解されているという感覚を持って、不安になった時に振り向けばほどほどに感受性の良い支援者が眼に見える所にいてくれる関係が大きな力となる。求めれば心のうちを聞いてくれる。そして子どもそばにいる支援者が困ったときには、少し時間がかかるが、子どもに対する支援者の関係と同じように、もう少し専門的な支援者が後ろに控えているような関係が必要である。このような仕組みが早くに整備されることが望まれる。

先進国と言われる日本において、援助の必要な被災者が、特に子どもたちが、未だに放置された状態にある。千年に一度と言われるこの度の震災に対する支援の在りようは、これから先に待ち受けている

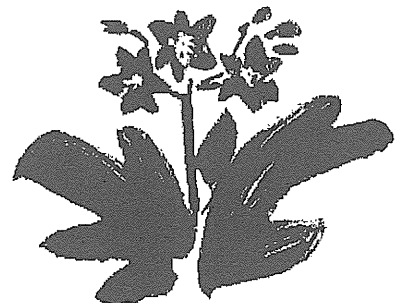
様々な災害に対応できるかどうかを占う意味がある。そして、忘れられがちな被災地の子どもの心の大変さに目を向け、私たちの将来に希望をつなぐためにもすべての子どもを大事にする社会全体の理解を願う。

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#### キーワード：災害精神医学

災害に対応するための精神医学で、メンタルヘルスに関わる様々な知識を応用し、災害の各ステージで直面する問題や課題に対してその知識と技術を用いる。精神医学の以下の分野を統合して行う。① Emergency Psychiatry、② Trauma Psychiatry、③ Community Psychiatry、④ Consult-liaison Psychiatry、⑤ International Psychiatry、⑥ Preventive Medicine。



**Changes in the Condition of Psychiatric Inpatients After the Complex Fukushima  
Disaster**

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**Abstract:**

After the high magnitude earthquake and the subsequent tsunami in Japan on March 11, 2011, the residents of Fukushima Prefecture suffered not only from tremendous physical injury caused by the earthquake and tsunami but also from the effects of radiation contamination after a hydrogen explosion at the Fukushima Daiichi nuclear power plant on March 12, 2011. The complex Fukushima disaster is characterized by additional stress due to the fear of continued exposure to invisible radiation. We investigated whether there were any changes in the clinical mental state of patients admitted in our inpatient ward of the Fukushima Medical University Hospital, Japan, 7 days after the earthquake. Overall, the patients demonstrated no gross changes in their psychiatric symptoms or conditions. Anxiety levels in the patients who originally showed coexisting anxiety disorders became exaggerated. The depressive state was improved after the earthquake in 1 patient with depression. One restrictive-type anorexia nervosa patient resumed food consumption. These findings suggest that caregivers should be attentive to slight symptomatic changes among such patients after sudden disasters.

## INTRODUCTION

Our institution, Fukushima Medical University Hospital, is the central hospital in Fukushima Prefecture and is a public corporation financially supported by the prefecture. The hospital is located in the prefectural capital, Fukushima city, approximately 50 km from the Fukushima Daiichi nuclear power plant. Our hospital has 30 clinical departments and 778 beds, including 49 psychiatric beds. After the high magnitude earthquake and the subsequent tsunami in Japan on March 11, 2011, the residents of Fukushima Prefecture suffered not only from tremendous physical injury caused by the earthquake and tsunami but also from the effects of radiation contamination after a hydrogen explosion at the Fukushima Daiichi nuclear power plant on March 12, 2011. Kario et al. has previously reported an increase in “white coat” hypertension in response to stress due to the Hanshin-Awaji earthquake that occurred in 1995<sup>1,2)</sup>. However, compared to the Hanshin-Awaji earthquake, the complex Fukushima disaster is characterized by additional stress due to the fear of continued exposure to invisible radiation.

Apart from the atomic bombings of Hiroshima and Nagasaki, the only major accidents in the past wherein human residential areas were exposed to radiation were the Three Mile Island accident in the United States and the Chernobyl nuclear power plant disaster in the former Soviet Union. To the best of our knowledge, no reports regarding comparative changes in the condition of psychiatric patients before and after radiation exposure in these two major accidents have been published. Although post-traumatic stress disorder (PTSD) has received considerable attention as the main psychiatric problem after a disaster<sup>3,4)</sup>, the dynamic states of patients with other types of psychiatric disorders when facing serious disasters need to be reported in detail.

Therefore, in this paper, we have reported the changes observed among inpatients in our psychiatric ward after the complex Fukushima disaster that included a nuclear power plant accident. We aim to determine the various issues that should be considered in psychiatric patients after any major disaster in the future.

## **MATERIALS AND METHODS**

We obtained approval for this study from the ethics committee of Fukushima Medical University (approval No. 1313). We investigated whether there were any changes in the clinical mental state of patients admitted in our inpatient ward of the Fukushima Medical University Hospital 7 days after the earthquake. We obtained these data from patient's case records.

## **RESULTS**

Table 1 shows the age, sex, and diagnosis of the patients admitted in our inpatient ward on the day of the earthquake as well as the changes in the patients' clinical states 7 days after the earthquake. The time period of 7 days was selected because it is thought to be the period during which acute reactions to serious events occur<sup>5)</sup>. During the surveyed period, psychotropic drugs administered to the admitted patients remained basically unchanged. However, psychotherapy or psychosocial therapy could not be administered due to the emergency conditions prevailing at that time.

Overall, during the surveyed period, the patients demonstrated no gross changes in psychiatric symptoms or conditions. However, several issues were noteworthy, particularly in patients with depression and those with primary or coexisting anxiety disorders.



No remarkable changes were observed in the conditions of patients with schizophrenia (cases 1–6) or dementia (cases 15 and 16). Among the patients with developmental disorders, 1 patient (case 24) who originally showed a high level of anxiety showed an increase in irritability. Among the patients with depression (cases 9–14), those with coexisting anxiety disorders (cases 9 and 10) showed an increase in anxiety levels. However, in the case of 1 patient with depression (case 12), the patient’s volition increased, and he could control his thoughts and did not feel hopeless and helpless. With regard to the anorexia nervosa patients, 1 restrictive-type patient (case 20) showed a dramatic change, i.e., the patient resumed normal food consumption just after the earthquake. In contrast, in another anorexia nervosa patient with coexisting avoidant personality disorder (case 21) who originally demonstrated severe anxiety, the anxiety levels intensified, with overeating and vomiting being worsened, and the patient’s overall condition deteriorated. We have described here the changes in case 20 (Table 1), who showed dramatic symptomatic improvement after the earthquake, in greater detail. The patient had a history of adjustment difficulties at school at 13 years of age, along with refusal to eat food, which led to her admission to our inpatient ward 26 days before the earthquake. On admission, her food intake was approximately 10–40% of the hospital meals served. She spoke few words, and was thought to be alexithymic. However, starting on the day after the earthquake, she began to eat almost the entire meal, and the flow of conversation with other people became smoother. Blood tests on admission showed a total protein level of 6.2 g/dL, but this increased to 6.9 g/dL on day 17 after the earthquake. In addition, she had pancytopenia on admission; however, this also improved by day 17 after the earthquake. Interview records from 3 days after the earthquake revealed that the critical and chaotic situation—including the

earthquake and the preventive use of iodine tablets against possible radiation contamination from the nuclear power plant accident—altered her prior defense mechanisms and internal conflicts, leading to self-realization of the meaning of life and the implications of improving her behavior and symptoms.

## DISCUSSION

The changes in the psychiatric conditions before and after the complex Fukushima disaster of patients who were hospitalized on the day of the earthquake can be summarized as follows:

1. Overall, the patients demonstrated no gross changes in their psychiatric symptoms or conditions.
2. Anxiety levels in the patients who originally showed coexisting anxiety disorders became exaggerated.
3. The depressive state was improved after the earthquake in 1 patient with depression.
4. One restrictive-type anorexia nervosa patient resumed food consumption immediately after the earthquake, with dramatic symptomatic improvements.

When the nuclear power plant accident occurred after the earthquake on March 11, 2011, people experienced fear of invisible radiation, as adequate information regarding how to deal with the situation was not available owing to the sudden and unexpected nature of the disaster. In addition, it was impossible to predict when the situation would improve. Evacuation to locations away from the disaster area within a short time period was difficult for many people. Thus, many people experienced continuous fear of exposure to invisible radiation, which induced severe stress, particularly among patients with psychiatric disorders.

Therefore, even in patients who have been stable for many years, careful attention must be paid to any sign of worsening in the condition. If there is even a slight sign of worsening, a prompt increase in the doses of mood-stabilizing drugs or preventive hospitalization on the basis of patients' consent should be considered.

In conclusion, we have reported here a brief summary of the effects of the complex Fukushima disaster on patients with psychiatric disorders. Increased anxiety levels in patients with primary or coexisting anxiety disorders were noted. In addition, intriguingly, the disaster triggered improvement in some patients with depression and anorexia nervosa. These findings suggest that caregivers should be mindful of slight symptomatic changes among such patients after sudden and serious disasters.

### **Acknowledgments**

This report is a reflection of our clinical activities during the tense early days after the complex Fukushima disaster, which could have been written by any of our colleagues. Thus, the authors wish to express their sincere thanks to all of their colleagues whose devotion, professionalism, and dedication were essential in the battlefield-like conditions in the ward, but are not listed as the authors of this manuscript.

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Case	Age	Sex	Diagnosis	Changes before and after earthquake	Case	Age	Sex	Diagnosis	Changes before and after earthquake
1	70	F	Schizophrenia	No change	16	80	M	Alzheimer Type Dementia	No change
2	17	F	Schizophrenia	No change	17	54	F	Parkinson Disease	Increased anxiety
3	63	F	Schizophrenia	No change	18	61	M	Parkinson Disease	No change
4	60	M	Schizophrenia	No change	19	50	F	Anorexia Nervosa	No change
5	18	M	Schizophrenia	Slight improvement	20	14	F	Anorexia Nervosa	Marked improvement
6	40	F	Schizophrenia	No change	21	35	F	Anorexia Nervosa,	Increased anxiety
7	40	M	Bipolar Disorder (manic state)	No change				Avoidant Personality Disorder	
8	69	M	Bipolar Disorder (manic state)	No change	22	18	M	Asperger's Disorder	No change
9	75	F	Depression, Anxiety Disorder	Increased anxiety	23	28	M	Pervasive Developmental Disorder	No change
10	53	M	Depression, Anxiety Disorder	Increased anxiety	24	15	M	Asperger's Disorder	Worsening irritability
11	49	F	Depression	No change	25	13	M	Vocal Tic Disorder	No change
12	54	M	Depression	Increased volition, tended to improve	26	35	F	Adjustment Disorder (Depressive state)	No change
13	50	M	Depression	No change				27	
14	20	M	Depression	No change	Borderline Personality Disorder	Increased anxiety			
15	61	M	Alzheimer Type Dementia	No change	28	58	F	Mental Retardation	No change

**Table 1.** Patients admitted in the psychiatry ward of the Fukushima Medical University Hospital at the time of the Fukushima complex disaster.

Special Article

## Study Protocol for the Fukushima Health Management Survey

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### ABSTRACT

**Background:** The accidents that occurred at the Fukushima Daiichi Nuclear Power Plant after the Great East Japan Earthquake on 11 March 2011 have resulted in long-term, ongoing anxiety among the residents of Fukushima, Japan. Soon after the disaster, Fukushima Prefecture launched the Fukushima Health Management Survey to investigate long-term low-dose radiation exposure caused by the accident. Fukushima Medical University took the lead in planning and implementing this survey. The primary purposes of this survey are to monitor the long-term health of residents, promote their future well-being, and confirm whether long-term low-dose radiation exposure has health effects. This report describes the rationale and implementation of the Fukushima Health Management Survey.

**Methods:** This cohort study enrolled all people living in Fukushima Prefecture after the earthquake and comprises a basic survey and 4 detailed surveys. The basic survey is to estimate levels of external radiation exposure among all 2.05 million residents. It should be noted that internal radiation levels were estimated by Fukushima Prefecture using whole-body counters. The detailed surveys comprise a thyroid ultrasound examination for all Fukushima children aged 18 years or younger, a comprehensive health check for all residents from the evacuation zones, an assessment of mental health and lifestyles of all residents from the evacuation zones, and recording of all pregnancies and births among all women in the prefecture who were pregnant on 11 March. All data have been entered into a database and will be used to support the residents and analyze the health effects of radiation.

**Conclusions:** The low response rate (<30%) to the basic survey complicates the estimation of health effects. There have been no cases of malignancy to date among 38 114 children who received thyroid ultrasound examinations. The importance of mental health care was revealed by the mental health and lifestyle survey and the pregnancy and birth survey. This long-term large-scale epidemiologic study is expected to provide valuable data in the investigation of the health effects of low-dose radiation and disaster-related stress.

**Key words:** cohort study; radiation; disaster; thyroid gland; mental health

### INTRODUCTION

The Great East Japan Earthquake occurred at 2:46 PM on 11 March 2011. Later a tsunami hit the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant, causing a radiation hazard in Fukushima Prefecture. Due to the possible health impacts, the Fukushima prefectural government decided to conduct the Fukushima Health Management Survey to assist in the long-term health

management of residents. The Radiation Medical Science Center for the Fukushima Health Management Survey was established in Fukushima Medical University to carry out the survey.<sup>1</sup>

Japan experienced atomic bombings in Hiroshima and Nagasaki in 1945. Acute radiation injuries were investigated by a joint Japan-US team, beginning in September of that year.<sup>2</sup> In 1947, the Atomic Bomb Casualty Commission (ABCC) was established to investigate the health impacts on

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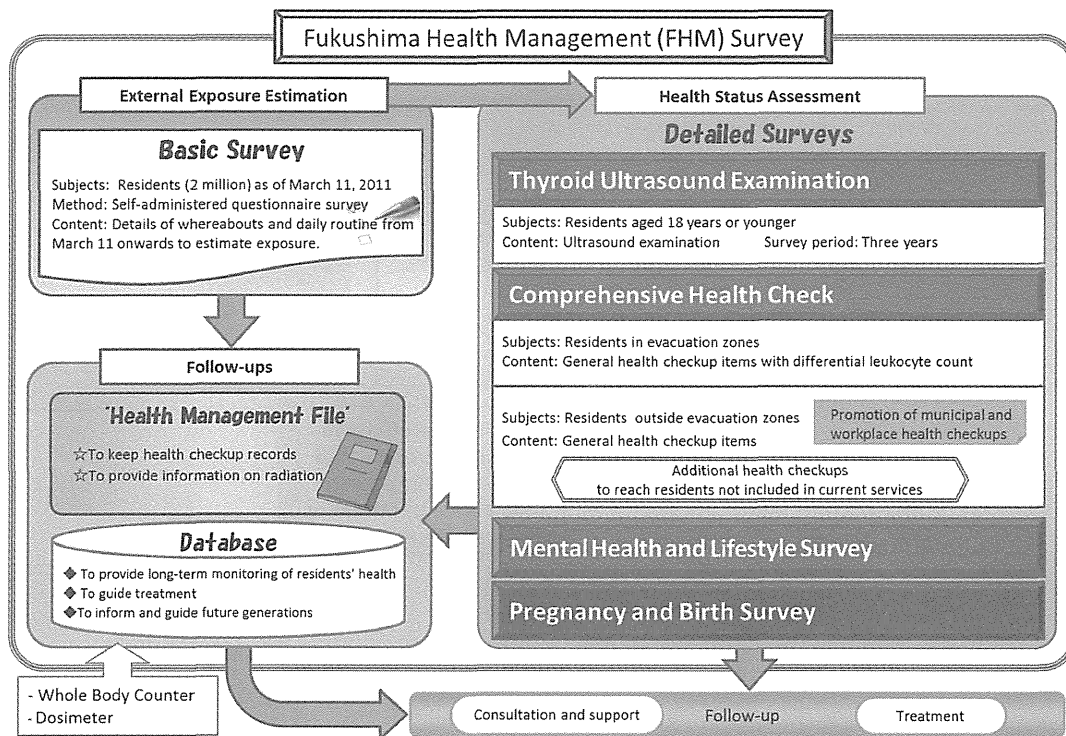


Figure 1. Framework of the Fukushima Health Management Survey

atomic-bomb (A-bomb) survivors. Later, a large-scale cohort study of the survivors was begun to investigate the long-term stochastic effects of radiation. The study used data from the 1950 Japan national census, which was conducted 5 years after the exposure. ABCC continued follow-up surveys until 1975, when it was succeeded by the Radiation Effects Research Foundation (RERF), which has continued the study until the present. The initial population size of survivors was 284 000 at the time of the census, and the established cohort—ie, the Life Span Study cohort—consisted of 120 000 individuals.<sup>3–5</sup>

In April 1986, the worst nuclear disaster in human history occurred at the Chernobyl Nuclear Power Plant. The accident released a large quantity of radioactive contamination into the atmosphere. The USSR Ministry of Health started the Russian National Medical and Dosimetric Registry in June the same year to register residents exposed to radiation. They also launched a program to evaluate health impacts of radiation exposure and later released partial results.<sup>6</sup> However, an epidemiologic study, which is a direct, reliable method for evaluating long-term radiation effects on public health, was unfortunately not implemented soon enough after the accident.<sup>7</sup> Although small-scale epidemiologic investigations<sup>8</sup> have been conducted since around 1989, no investigation has recruited subjects for a comprehensive evaluation of health impacts.

The primary purposes of the Fukushima Health Management Survey are to monitor the long-term health of residents, promote their future well-being, and determine

whether long-term low-dose radiation exposure has health effects. The ongoing basic survey was begun at the end of June (approximately 3 months after the accident) to estimate external exposure doses in Fukushima Prefecture at the time of the accident. In addition, we decided on sequential implementation of detailed surveys of forced evacuees who had lived in the evacuation zone—a government-designated area (radius, 20 km) around the nuclear power plant. This report describes the rationale and implementation of the Fukushima Health Management Survey, provides preliminary information on the participants, and reports some of the survey findings.

## METHODS

### Survey population

The Fukushima Health Management Survey consists of a basic survey and 4 detailed surveys, namely, the thyroid ultrasound examination, comprehensive health check, mental health and lifestyle survey, and pregnancy and birth survey (Figure 1). The target population of the basic survey is about 2.05 million. To be selected for the basic survey, individuals had to be either a registered resident of Fukushima Prefecture during the period of 11 March to 1 July (including those evacuated or transferred to residence registration in another prefecture); a resident of Fukushima Prefecture who was registered in another prefecture during the period of 11 March to 1 July; a resident of another prefecture who commuted to Fukushima Prefecture during the period of 11 March to 1 July;

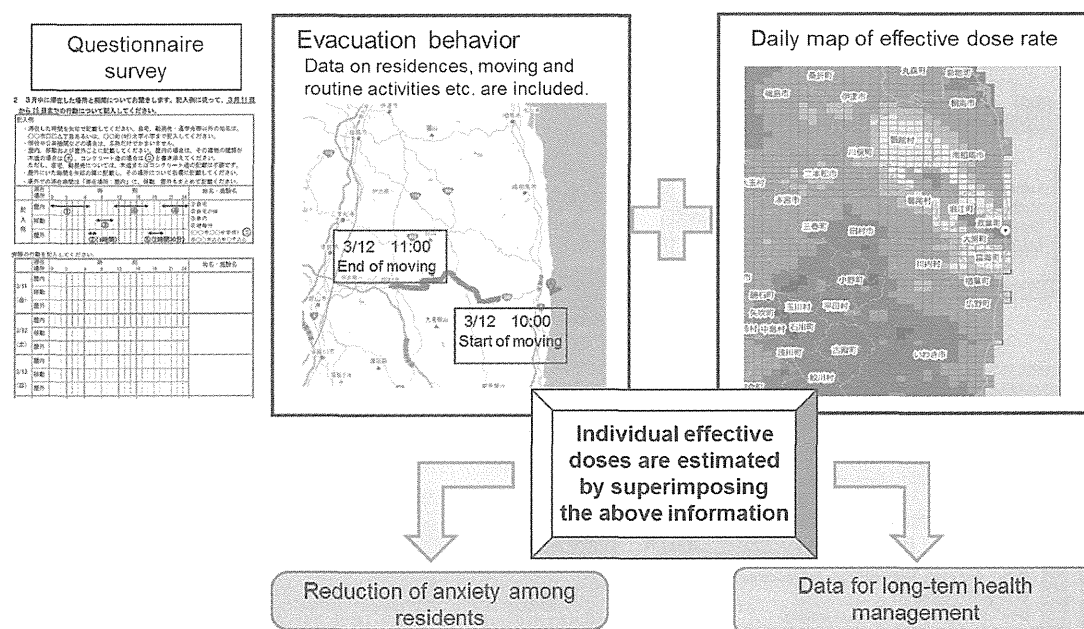


Figure 2. System for evaluating external radiation

or a resident of another prefecture who temporarily stayed in Fukushima Prefecture during the period of 11 March to 25 March. The detailed surveys targeted selected people on the basis of the particular criteria used for each survey. External exposure dose, as indicated on the basic survey, and information from the detailed surveys will be linked and maintained in the database for later analysis.

### Basic survey

Estimation of individual radiation dose, though costly and laborious, was essential for risk assessment in the Life Span Study of A-bomb survivors in Hiroshima and Nagasaki. Interviews were conducted from 1954 to 1965 to determine distance from the hypocenter and exposure conditions for each survivor.<sup>5</sup> On the basis of that experience, we have implemented a rigorous system for estimating external exposure doses, with technical support from the National Institute of Radiological Sciences. We mailed self-administered questionnaires to collect information from residents on, among other variables, their dwelling place, places visited, length of time indoors and outdoors, and travelling time during the period from 11 March to 11 July, the period when atmospheric radiation dose was highest. The respondents were asked to mail back the questionnaires. To ensure that potential respondents understood that participation was noncompulsory, they received the following notification in the questionnaire cover letter: "Please note that participation in the survey is voluntary and that you will not be disadvantaged in any way if you decide not to participate." This method of using respondent activities and location ("trail") to evaluate external exposure dose is almost identical to the procedure used in the evaluation carried

out after the Chernobyl accident.<sup>9</sup> Individual external exposure was estimated based on a respondent's trail, using the system for external exposure dose assessment developed by the National Institute of Radiological Sciences in Japan<sup>10</sup> (Figure 2). It is important to note that internal radiation levels of Fukushima residents were measured separately by Fukushima Prefecture, using whole-body counters. The results showed that the estimated maximum internal exposure doses of Cs-134 and Cs-137 among 122 residents in Namie Town, Iitate Village, and the Yamakiya district of Kawamata Town were as low as less than 1 mSv.<sup>11</sup>

### Detailed surveys

#### Thyroid ultrasound examination

The Chernobyl accident revealed that thyroid cancer in children was increased by internal exposure to radioiodine.<sup>12-14</sup> Thus, to ensure early identification and treatment of thyroid cancer in children, and their lifelong follow-up, we decided to perform thyroid ultrasound examinations on all children. Because the increase in thyroid cancer was reported to start 4 or 5 years after the Chernobyl accident,<sup>15</sup> we expect no excess occurrence in the first 3 years in Japan. Therefore, assessment of current thyroid status will be completed within 3 years. Due to the importance of long-term follow-up of all children in the prefecture and the considerable anxiety of their parents, all children aged 18 years or younger in the prefecture will undergo ultrasound examination.

**Target:** All prefectural inhabitants aged between 0 and 18 years on 11 March 2011, ie, those born from 2 April 1992 to 1 April 2011, including evacuees living in other prefectures. The total population is approximately 360 000.



*Methods and criteria:* Thyroid ultrasound, the primary examination, is done using a device that (a) has a 10-MHz or higher frequency probe, (b) is able to save Digital Imaging and Communications in Medicine (DICOM) images, (c) has a color Doppler function, (d) is able to save moving images, and (e) is able to transfer saved data to media. Examiners are required to be a medical specialist of either the Japan Thyroid Association, the Japan Association of Endocrine Surgeons, the Japanese Society of Thyroid Surgery, or the Japan Society of Ultrasonics in Medicine (a body surface/general medical specialist); a pediatric specialist of the Japan Endocrine Society; or a laboratory technician (specializing in the body surface) from the Japanese Society of Sonographers.

When the primary examination reveals a nodule or cyst, a confirmatory examination is to be carried out at Fukushima Medical University Hospital or another hospital (certified by our expert committee) for advanced ultrasound examination. During the confirmatory examination, a detailed ultrasound, blood testing, urine analysis, and aspiration biopsy cytology are performed as necessary. Ultrasound devices used in the confirmatory examination must have a 18-MHz or higher frequency probe. Other device and personnel requirements are the same as those listed above for the primary examination. The confirmatory examination is to be done at institutions that employ suitably qualified examiners or pathologists. Specialists of the Japanese Society of Pathology are required for cytodiagnosis.

The following diagnostic criteria are used: A1, no nodule or cyst; A2, nodule less than 5.0 mm and/or cyst less than 20.1 mm; B, further examination necessary (nodule  $\geq 5.0$  mm and/or cyst  $\geq 20.1$  mm); and C, urgent need for further examination.

*Schedule:* The thyroid ultrasound examination is to be provided to all children for 2.5 years, from October 2011 to March 2014. From April 2014, children will undergo thyroid examination every 2 years until age 20 years and every 5 years after that. The target cohort will include those born before 1 April 2012. By April 2012, at least 1 institute was designated as an examination center in each of the 46 prefectures, to serve the approximately 20 000 evacuees living in other prefectures.

#### *Comprehensive health check*

Many evacuees from the government-designated evacuation zone were forced to change their lifestyle, diet, exercise, and other personal habits. Some could not receive adequate health checks, and some had anxieties about their health.<sup>16</sup> The comprehensive health check attempts to review their health information, assess the incidence of various diseases, and improve their health status.

*Target:* The target groups were residents of all ages living in the evacuation zone specified by the government, ie, Hironomachi, Naraha-machi, Tomioka-machi, Kawauchi-mura, Okuma-machi, Futaba-machi, Namie-machi, Kazurao-mura, Iitate-mura, Minamisoma City, and Tamura City. The residents of Yamakiya in Kawamata-machi, Namie-machi,

and Iitate-mura also completed the comprehensive health check, even though that area is farther than 20 km away from the plant, because nuclear fallout spread northwest of the plant, and because their inclusion was required based on the results of the Basic Survey. The size of the target cohort is 210 189 as of 31 March 2011.

*Methods:* The following items have been added to the Special Health Checkup performed as part of the Municipal National Health Insurance system, which is performed among adults aged 40 years or older in the prefecture. For people who do not participate in the Special Health Checkup, a visiting comprehensive health check has been held a total of 104 times at 29 locations since January 2012. Children aged 0 to 15 years have received health checks at 102 pediatric medical institutions in the prefecture since January (153 pediatricians agreed to be registered to conduct the comprehensive health checks).

Comprehensive health checks have also been performed outside the prefecture, with the cooperation of the Japan Anti-Tuberculosis Association, at 827 member institutions of the Japan Municipal Hospital Association, the Japan National Health Insurance Clinics and Hospitals Association, the All-Japan Federation of Social Insurance Associations, and the Japan Red Cross Society. A total of 554 pediatric medical institutions also helped to conduct health checks for children aged 15 years or younger.

*Evaluation items:* In addition to assessing the effects of radiation, additional variables are specified according to age to assess health, prevent lifestyle-related diseases, and find or treat diseases at an early stage (Table 1). Individuals aged 16 years or older are evaluated according to items in the Specific Health Examination based on the Act on Assurance of Medical Care for Elderly People (Act No. 80, 1982). The examination includes measurements of height, weight, abdominal circumference/body mass index (BMI), blood pressure, aspartate aminotransferase (AST), alanine aminotransferase (ALT),  $\gamma$ -glutamyl transpeptidase ( $\gamma$ -GTP), triglyceride (TG), high-density lipoprotein-cholesterol (HDL-C), low-density lipoprotein-cholesterol (LDL-C), hemoglobin A1c (HbA1c), fasting blood glucose, and urine testing (protein and sugar). Additional items for assessment include blood count—red blood cell (RBC), hematocrit (Hct), hemoglobin (Hb), platelet count, white blood cell (WBC), and WBC count—serum creatinine (Cr), estimated glomerular filtration rate (eGFR), uric acid (UA), and urine testing for occult blood. The survey items for children aged 7 to 15 years are height, weight, blood pressure, RBC, Hct, HB, platelet count, WBC, and WBC count. Upon request, AST, ALT,  $\gamma$ -GTP, TG, HDL-C, LDL-C, HbA1c, serum Cr, eGFR, and UA are added. For children aged 0 to 6 years, height, weight, RBC, Hct, HB, platelet count, WBC, and WBC count are examined.

#### *Mental health and lifestyle survey*

Mental health disorders were an important long-term health

**Table 1. Items included in comprehensive health check**

Age, y	Items
0–6	Height, weight, blood count (RBC, Hct, HB, platelets, WBC, WBC count)
7–15	Height, weight, blood count (RBC, Hct, HB, platelets, WBC, WBC count) If requested by patient: Blood chemistry (AST, ALT, $\gamma$ -GTP, TG, HDL-C, LDL-C, HbA1c, FBG, S-Cr, eGFR, UA)
$\geq 16$	Height, weight, abdominal circumference/BMI, BP Blood count (RBC, Hct, HB, Platelet, WBC count) Blood chemistry (AST, ALT, $\gamma$ -GTP, TG, HDL-C, LDL-C, HbA1c, FBS, S-Cr, eGFR, UA) Urinary testing (protein, sugar, blood)

Abbreviations:  $\gamma$ -GTP,  $\gamma$ -glutamyl transpeptidase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; BP, blood pressure; eGFR, estimated glomerular filtration rate; FBG, fasting blood glucose; LDL-C, low-density lipoprotein-cholesterol; HbA1c, hemoglobin A1c; Hb, hemoglobin; Hct, hematocrit; HDL-C, high-density lipoprotein-cholesterol; RBC, red blood cells; S-Cr, serum creatinine; TG, triglyceride; UA, uric acid; WBC, white blood cells.

**Table 2. Overview of mental health and lifestyle survey**

Category	Age criteria	Mental health items	Method
Adults	Born before 1 April 1995 (ie, high school student on 11 March 2011)	K6 (Kessler, 2003); PCL (PTSD Checklist Stressor-Specific Version, Weathers, 1994)	Self-administered
Children (3)	Born after 2 April 1995 but before 1 April 1998 (ie, junior high school student on 11 March 2011)	SDQ (Strengths and Difficulties Questionnaire)	Partially self-administered
Children (2)	Born after 2 April 1998 but before 1 April 2004 (ie, primary school student on 11 March 2011)	SDQ	Completed by parents
Children (1)	Born after 2 April 2004 but before 11 March 2011 (ie, pre-primary school on 11 March 2011)	SDQ for children aged 4 years or older	Completed by parents

effect of the Chernobyl accident.<sup>17–27</sup> Deaths of close relatives, loss of home and property, and fearful experiences during the disaster resulted in psychological trauma for many residents of Fukushima Prefecture. Furthermore, some may have been mentally affected by evacuation, and others may have experienced anxiety regarding radiation exposure. To prevent excess mortality, it is essential to assess their mental health and lifestyle, prevent lifestyle-related diseases, and provide care as necessary.

**Target:** The target cohort was the same as that for the comprehensive health check, 210 189 people.

**Methods:** Questionnaires have been mailed since 18 January 2012.

**Survey items:** The survey items vary according to age category (there are 3 age categories for children and 1 for adults) but mainly ask about current mental and physical status, lifestyle (diet, sleep, smoking, alcohol, and exercise), activities during the last 6 months, and experience during the earthquake (Table 2). Parents of children aged 4 through 15 years are asked to evaluate their children using the Strength and Difficulties Questionnaire (SDQ).<sup>28</sup> The K6 scale and PTSD Checklist Stressor-Specific Version (PCL) are self-administered for people 16 years or older.<sup>29,30</sup>

**Support after the survey:** Clinical psychologists and other specialists on the mental health support team offer telephone counseling as necessary based on answers to the questionnaires. When telephone counseling reveals a need for medical support, 93 registered doctors in medical institutions in Fukushima Prefecture are available for introduction.

Further treatment is given by a specialist at Fukushima Medical University if necessary. These registered doctors are mainly psychiatrists or pediatricians who agreed to be registered and who attended a relevant seminar or are certified by Fukushima Medical University.

When telephone counseling reveals a need for care by a doctor specialized in radiation, a member of the Radiation Health Consultation Team, which consists of faculty at Fukushima Medical University, will be introduced.

#### *Pregnancy and birth survey*

The World Health Organization concluded in the “Health Effects of the Chernobyl Accident and Special Health Care Programmes, 2006”<sup>7</sup> that the Chernobyl accident did not significantly increase child anomalies or fetal deaths related to radiation exposure. In Fukushima, no significant increase in induced abortion or miscarriage was observed after 11 March 2011; however, the nuclear accident required pregnant women to change clinics/hospitals, and many received insufficient antenatal care and faced difficulties in appropriately managing their personal health and that of their children.<sup>31</sup> The pregnancy and birth survey aims to collect data that might improve obstetrical and perinatal care and support women who have, or plan to deliver, a baby in Fukushima Prefecture.

**Target:** Women who received Maternal and Child Health Handbooks from municipal offices in Fukushima Prefecture between 1 August 2010 and 31 July 2011 or those who had handbooks issued in other prefectures but delivered babies in Fukushima Prefecture on March 11 or later. The total number of women meeting these criteria is 15 954.

*Methods:* Questionnaires have been mailed out since 18 January 2012. Because many pregnant women evacuated to other prefectures, letters of request were sent to the Japan Society of Obstetrics and Gynecology and the Japan Association of Obstetricians and Gynecologists to request their help in enrolling pregnant evacuees in the survey.

*Survey items:* The survey included antenatal health and delivery records and mental health (Whooley's 2-item case-finding instrument for depression).<sup>32</sup>

*Post-survey support:* Telephone and e-mail hot lines have been launched and midwives or public health nurses provide consultation services for health management, child care, and anxiety. Midwives and nurses from Fukushima Medical University also provide telephone consultations when further support is necessary. Depending on the problems revealed during telephone counseling, consultation can be arranged with the respondent's regular obstetrician or one from Fukushima Medical University. For evacuees outside Fukushima Prefecture, support is provided by a survey team that includes university obstetricians.

This survey was approved by the ethical review committee of Fukushima Medical University (No. 1257, 1275, 1294, 1316, 1317, 1318, and 1319).

## DISCUSSION

The basic survey and all 4 detailed surveys in this large-scale cohort study were launched within 1 year of the accident.<sup>33</sup> It was essential for the basic survey to begin as early as possible because its accuracy relies on participant memory. The health effects of radiation can be assessed by linking data on external exposure dose from the basic survey plus data on internal exposure level, as measured by whole-body counters, with detailed health data from the other 4 surveys, cancer registries, and vital statistics. There is limited scientific understanding of the human health impact of chronic low-dose exposure, and this study is thus of global importance.<sup>34</sup> We should note that the regional cancer registry needs to be improved if we are to accurately assess changes in cancer incidence.

### Basic survey

As of 31 March 2012, responses were sent from 451 446 of 2 056 994 questionnaires, a response rate of 21.9%. This low rate is a critical problem, as the lack of external exposure dose data complicates health management and estimation of health impacts. The response rate exceeded 37% in the Soso district, which is close to the affected nuclear power plants, but was lower than 15% in Aizu and Minami-Aizu. The highest response rate by age was among those aged 60 to 69 years (60%), whereas the lowest rate was among those aged 20 to 29 years. Such variation in response rate may reflect differences in exposure awareness.

The low overall response rate suggests that the basic survey has not been recognized as the most important information

source for health management. The aims of the survey appear in newspapers and regional newsletters, and in DVDs, posters, and leaflets that have been sent to kindergartens and schools. Participation in the basic survey is also encouraged at the institutions where thyroid or health examinations are held, and guidance on completing the survey questions is offered at temporary evacuee housing. Furthermore, a letter of request has been sent to nonrespondents, and municipal governments and various organizations and companies continue to raise awareness of the survey's importance.

### Detailed surveys

#### *Results of the thyroid ultrasound examination*

In total, 38 114 (79.8%) of 47 766 people underwent thyroid examination by March 2012. With regard to diagnostic code, 99.5% were classified as A (A1 and A2), and most did not require a secondary examination; 186 (0.5%) were classified as B (14 of whom underwent secondary examination), but no malignancy was detected. None were classified as C.

#### *Results of the comprehensive health check*

As of 31 March 2012, the number of Fukushima Prefecture residents who underwent the health check was 48 530 of 149 159 (32.5%) children and adolescents aged 16 years or older and 13 557 of 19 303 (70.2%) of those aged 15 years or younger. For those living in other prefectures, the tentative figures were 8070 of 33 340 (24.2%) among those aged 16 or older and 4199 of 8387 (50.1%) among those aged 15 or younger. Overall, 74 556 of 210 189 (35.4%) participated in the health check. The data have been aggregated and will be announced when the examinations are finished.

#### *Results of the mental health and lifestyle survey*

As of 31 March 2012, the number of people who participated in the survey included 7713 of 11 717 children in category 1 on Table 2 (65.8%), 7377 of 11 791 in category 2 (62.6%), and 3330 of 6077 in category 3 (54.8%). Among adults, 70 193 of 180 604 (38.9%) participated in the survey. Overall, 88 613 answered the survey questionnaires (42.2%).

As part of telephone counseling, we attempt to identify people who need urgent support. To do so, we modified the cut-off values for the SDQ (16 was changed to 20), K6 (13 to 20), and PCL (44 to 70). In addition, answers to open-ended questions on the questionnaire were used to prioritize respondents. The results revealed that 4.7% of adults and 5.3% of children in category 1, 7.4% in category 2, and 6.4% in category 3 needed immediate support. The target of the telephone counseling service will be expanded after counseling is completed for the highest-priority group.

#### *Results of the pregnancy and birth survey*

Questionnaires were sent to 15 954 women; 8886 (55.7%) replied. A total of 1298 (14.6%) women gave affirmative answers to both depression items or were assessed as in need of support based on their free comments. They are offered telephone counseling from midwives, public health nurses, and nurses.

### Survey management and the International Expert Symposium

We are continuing to build the database. Although the results are preliminary, we have started reporting invaluable findings. Regarding the assessment of mental health, Boice stated that “the study of mental disorders [is] important and [should] be emphasized” because “the long-term psychological effects of such a disaster have not been well studied”.<sup>35</sup>

We face 4 important managerial issues. First, the call center in the Radiation Medical Science Center handles inquiries regarding details of the survey. Augmentation of this system is essential to provide residents with the necessary timely and ongoing support. Second, although the investigation will continue for 30 years, the road map from 2012 onwards has not been completed as of this writing. Mid- and long-term investigation schedules need to be completed soon. Third, residents should be given immediate feedback on the survey results and the scientific interpretation of the findings. Therefore, we urge the establishment of a research system that includes development of a database and an epidemiologic network for researchers. Last, it is critically important to improve risk communication, including appropriate and prompt information-sharing with residents regarding the aims, content, and results of the Fukushima Health Management Survey.

An expert committee was established for each survey. These committees meet almost every week and are attended by Japanese experts in each survey field. In addition, a managerial committee was formed on 19 May 2011. The members of the committee are Dr Masafumi Abe (Vice President) and Dr Seiji Yasumura (Professor, Department of Public Health) of Fukushima Medical University, who were asked to conduct the Fukushima Health Management Survey, and Dr Makoto Akashi (Executive Director, National Institute of Radiological Sciences), Dr Kazunori Kodama (Chief Scientist, The Radiation Effects Research Foundation), Dr Kenji Kamiya (Director, Research Institute for Radiation Biology and Medicine, Hiroshima University, Vice President, Fukushima Medical University), Dr Shunichi Yamashita (Vice President, Fukushima Medical University), Dr Hokuto Hoshi (Board Member, Fukushima Medical Association), Setsuo Sato (Former Director General, Social Health & Welfare Department, Fukushima Prefecture), and Hiroyuki Kanno (Present Director General, Social Health & Welfare Department, Fukushima Prefecture). Since the establishment of the committee, representatives of the Japanese Ministry of Economy, Trade and Industry; the Ministry of Education, Culture, Sports, Science and Technology; and the Ministry of Health, Labour and Welfare have attended the meetings as observers. A representative of the Ministry of Environment has participated since the fifth meeting, which was held on 25 January 2012.

We must establish a health system that can respond to the resident health care needs identified on the Fukushima Health

Management Survey. Moreover, an international advisory board should be formed to increase support from international experts and verify that the survey is scientifically sound and credible.<sup>36</sup> The Nippon Foundation, Sasakawa Memorial Health Foundation, and Fukushima Medical University organized The International Expert Symposium in Fukushima—Radiation and Health Risks, which was held in Fukushima on 11–12 September 2011. In its conclusions and recommendations, the authors write that “Initial plans for the Fukushima Health Management Survey were presented at the Symposium and were welcomed under the recognition that there is a critical need to develop organized community participation to express the collective concerns of the population as a whole”.<sup>37</sup> This large-scale long-term epidemiologic study is likely to provide important data on the health effects of low-dose radiation and disaster-related stress. We need and desire ongoing concern and support from epidemiologists all over the world.

### ACKNOWLEDGMENTS

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Conflicts of interest: None declared.

### APPENDIX

#### The Fukushima Health Management Survey Group

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