Design of the Nationwide Nursery School Survey on Child Health Throughout the Great East Japan Earthquake

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ABSTRACT

Background: The Great East Japan Earthquake inflicted severe damage on the Pacific coastal areas of northeast Japan. Although possible health impacts on aged or handicapped populations have been highlighted, little is known about how the serious disaster affected preschool children’s health. We conducted a nationwide nursery school survey to investigate preschool children’s physical development and health status throughout the disaster.

Methods: The survey was conducted from September to December 2012. We mailed three kinds of questionnaires to nursery schools in all 47 prefectures in Japan. Questionnaire “A” addressed nursery school information, and questionnaires “B1” and “B2” addressed individuals’ data. Our targets were children who were born from April 2, 2004, to April 1, 2005 (those who did not experience the disaster during their preschool days) and children who were born from April 2, 2006, to April 1, 2007 (those who experienced the disaster during their preschool days). The questionnaire inquired about disaster experiences, anthropometric measurements, and presence of diseases.

Results: In total, 3624 nursery schools from all 47 prefectures participated in the survey. We established two nationwide retrospective cohorts of preschool children; 53,747 children who were born from April 2, 2004, to April 1, 2005 (those who did not experience the disaster during their preschool days) and children who were born from April 2, 2006, to April 1, 2007 (those who experienced the disaster during their preschool days). The questionnaire inquired about disaster experiences, anthropometric measurements, and presence of diseases.

Conclusions: With the large dataset, we expect to yield comprehensive study results about preschool children’s physical development and health status throughout the disaster.

Key words: natural disaster; preschool children; physical development; children’s health; retrospective cohort

INTRODUCTION

The Great East Japan Earthquake, which occurred on March 11, 2011, was beyond our experience in modern Japanese history. The massive 9.0 magnitude earthquake was the largest quake ever recorded in Japan, and the following giant tsunami inflicted severe damage on the Pacific coastal areas of northeast Japan.1–5 The number of deaths and missing persons due to the disaster was 18,412 across Iwate, Miyagi, and Fukushima Prefectures (Figure 1).6 Furthermore, the earthquake caused a nuclear alert in the vicinity of the Fukushima Daiichi Nuclear Power Plant.7–10

Previous studies have reported health issues among the survivors and have focused attention on vulnerable
populations, including the elderly, disabled, and hospitalized patients. Children are also vulnerable, but there has been little research documenting their health after the disaster. In order to investigate the possible health impacts of the devastating natural disaster on preschool children, we conducted a nationwide nursery school survey. The survey should provide comprehensive and valuable epidemiological evidence of the impact of the disaster on preschool children, focusing on the differences in physical development before and after the disaster and assessing the extent to which experiencing the disaster, including environmental changes due to the disaster, may influence children’s health. This paper describes the design of the survey and the results of data collection.

**METHODS**

**Survey design and population**

We collected data on nursery school children not only from the most seriously affected areas of Iwate, Miyagi, and Fukushima Prefectures, but also from other areas across Japan. In the present survey, the prefectures indicate the location of the nursery schools that children were attending at the time of the survey. Prior to the survey, invitation letters were distributed to 23,711 authorized nursery schools, and 4,266 (18%) nursery schools expressed interest in participating in the survey. From September to December 2012, we mailed three kinds of questionnaires to the 4,266 nursery schools, and nursery teachers completed the questionnaires and mailed them back to the coordination office at Tohoku University.

The new school term in Japan starts on April 1, and a class consists of children who are born from April 2 to April 1 of the following year. We targeted children who were born in two classes: children who were born from April 2, 2004, to April 1, 2005, who were in the 5-year-old class of 2010 and did not experience the disaster during their preschool days; and children who were born from April 2, 2006, to April 1, 2007, who were in the 5-year-old class of 2012 and experienced the disaster during their preschool days (47 to 59 months of age when the disaster occurred). We defined the former group of children as a historical control group (Figure 2).

**Measurements**

Questionnaire “A” addressed information on each nursery school: name of the nursery school, whether or not the nursery school was affected by the disaster, and the damage sustained in the disaster (collapse of the building, tsunami, fire, relocation of the nursery school, and others), if affected. Additionally, we asked for teachers’ subjective opinion...
through the question: “Do you think that experiencing the disaster influenced children’s development?” with an open-ended question about possible factors that might affect children’s development (eAppendix 1).

Questionnaires “B1” and “B2” addressed individual data on children who were born from April 2, 2004, to April 1, 2005 and those who were born from April 2, 2006, to April 1, 2007, respectively. Both anonymous questionnaires included questions about sex, year and month of birth, presence of diseases diagnosed by medical doctors (kidney disease, heart disease, atopic dermatitis, bronchial asthma, and others), history of moving in and moving out, and anthropometric measurements. According to the guidelines for childcare in nursery school, all nursery schools have to periodically perform physical measurements (generally every month) using a measurement procedure recommended by the Ministry of Health, Labour and Welfare. Considering the seasonal variation in growth, we retrospectively collected individuals’ height and weight measured in April and October for a maximum of 7 years. Additionally, we inquired about personal disaster experience with the following options: collapse of house, tsunami, fire, moving house, evacuation center, and death of a family member (eAppendix 2 and eAppendix 3).

Ethical considerations
The survey protocol was approved by the institutional review board of Tohoku University. We collected only existing data, so we did not obtain informed consent from participants in either cohort. In accordance with the national Ethical Guidelines for Epidemiological Research, we disclosed information regarding the survey in two ways: we announced the conduct of the survey to parents using a poster displayed in each nursery school, and we disclosed the survey information, including the significance, objective, and methods of the survey, to the public on the website of Tohoku University’s School of Medicine at http://www.med.tohoku.ac.jp/public/ekigaku2013.html. Parents had the right to opt out.

RESULTS
As shown in Table 1, nursery schools from all 47 prefectures participated in the survey. Of the nursery schools that agreed to participate in the survey, 3624 returned at least one of the three questionnaires. We acquired school information from 3495 nursery schools. We obtained individuals’ data for 54,558 children who were born from April 2, 2004, to April 1,
Table 1. Proportion of nursery schools that participated in the survey

| Prefecture | Number of nursery schools | Proportion |
|------------|---------------------------|------------|
| Code       | Target (n = 23 711)       | Participation (n = 3624) |
| 1          | Hokkaido                  | 139 16%    |
| 2          | Aomori                    | 108 23%    |
| 3          | Iwate*                    | 81 23%     |
| 4          | Miyagi*                   | 132 38%    |
| 5          | Akita                     | 88 35%     |
| 6          | Yamagata                  | 42 17%     |
| 7          | Fukushima*                | 97 31%     |
| 8          | Ibaraki                   | 53 11%     |
| 9          | Tochigi                   | 79 22%     |
| 10         | Gunma                     | 62 15%     |
| 11         | Saitama                   | 164 17%    |
| 12         | Chiba                     | 142 16%    |
| 13         | Tokyo                     | 204 11%    |
| 14         | Kanagawa                  | 120 11%    |
| 15         | Niigata                   | 156 22%    |
| 16         | Toyma                     | 62 20%     |
| 17         | Ishikawa                  | 50 14%     |
| 18         | Fukushima                 | 40 15%     |
| 19         | Yamanashi                 | 37 16%     |
| 20         | Naganome                  | 60 10%     |
| 21         | Gifu                      | 42 10%     |
| 22         | Shizuoku                  | 98 19%     |
| 23         | Aichi                     | 237 20%    |
| 24         | Mie                       | 77 16%     |
| 25         | Shiga                     | 21 10%     |
| 26         | Kyoto                     | 23 5%      |
| 27         | Osaka                     | 95 8%      |
| 28         | Hyogo                     | 77 9%      |
| 29         | Nara                      | 25 13%     |
| 30         | Wakayama                  | 10 5%      |
| 31         | Tottori                   | 29 15%     |
| 32         | Shimane                   | 45 16%     |
| 33         | Okyama                    | 106 26%    |
| 34         | Hiroshima                 | 132 21%    |
| 35         | Yamaguchi                 | 53 17%     |
| 36         | Tokushima                 | 48 6%      |
| 37         | Kagawa                    | 41 20%     |
| 38         | Ehime                     | 49 15%     |
| 39         | Kochi                     | 44 17%     |
| 40         | Fukushima                 | 146 16%    |
| 41         | Saga                      | 23 9%      |
| 42         | Nagasaki                  | 67 15%     |
| 43         | Kumanoto                  | 88 15%     |
| 44         | Oita                      | 37 13%     |
| 45         | Miyazaki                  | 66 17%     |
| 46         | Kagoshima                 | 48 10%     |
| 47         | Okinawa                   | 18 5%      |

*The three prefectures that were most severely affected by the earthquake include Iwate, Miyagi, and Fukushima Prefectures.

bWe defined participation as returning at least one questionnaire from Questionnaire “A,” Questionnaire “B1,” and Questionnaire “B2.”

2005 (historical controls), and 69 702 children who were born from April 2, 2006, to April 1, 2007 (exposed children). As an initial data cleaning step, we excluded data on children who were born in a different year and those whose anthropometric measurements were not provided, leaving totals of 53 747 historical controls and 69 004 exposed children eligible for the initial dataset (Table 2).

Table 3 briefly summarizes the characteristics of each cohort. The two cohorts were similar in distributions of sex, birth month, and presence of diseases diagnosed by medical doctors. Among children who experienced the disaster during their preschool days, 1003 (1.5%) were reported to have specific personal experiences with the disaster.

Table 4 presents the residential distribution of children with personal disaster experiences based on the location of the nursery schools that children were attending at the time of the survey. While 732 children (73.0%) were residing in Iwate, Miyagi, and Fukushima Prefectures, 271 (27.0%) were residing in various parts of the country other than the three affected prefectures.

Nursery School Survey Throughout the Great East Japan Earthquake

Table 2. Number of completed questionnaires returned from nursery schools

| Prefecture | Questionnaire A: Questions regarding nursery school | Questionnaire B1: Questions for children born from April 2, 2004 to April 1, 2005 | Questionnaire B2: Questions for children born from April 2, 2006 to April 1, 2007 |
|------------|--------------------------------------------------|------------------------------------|------------------------------------|
| Code       | Target (n = 3495)                                | (n = 53 747)                       | (n = 69 004)                       |
| 1          | Hokkaido                                         | 137                                | 1665                              |
| 2          | Aomori                                           | 105                                | 1135                              |
| 3          | Iwate*                                          | 78                                 | 906                               |
| 4          | Miyagi*                                         | 122                                | 1804                              |
| 5          | Akita                                            | 87                                 | 1463                              |
| 6          | Yamagata                                         | 41                                 | 628                               |
| 7          | Fukushima*                                       | 97                                 | 1004                              |
| 8          | Ibaraki                                          | 53                                 | 770                               |
| 9          | Tochigi                                          | 77                                 | 1116                              |
| 10         | Gunma                                            | 61                                 | 1180                              |
| 11         | Saitama                                          | 155                                | 2429                              |
| 12         | Chiba                                            | 138                                | 2488                              |
| 13         | Tokyo                                            | 190                                | 2573                              |
| 14         | Kanagawa                                         | 116                                | 2031                              |
| 15         | Niigata                                          | 154                                | 2020                              |
| 16         | Toyma                                            | 61                                 | 1068                              |
| 17         | Ishikawa                                         | 49                                 | 903                               |
| 18         | Fukushima                                        | 39                                 | 408                               |
| 19         | Yamanashi                                        | 37                                 | 720                               |
| 20         | Naganome                                         | 55                                 | 1143                              |
| 21         | Gifu                                             | 42                                 | 927                               |
| 22         | Shizuoku                                         | 90                                 | 1866                              |
| 23         | Aichi                                            | 231                                | 5121                              |
| 24         | Mie                                              | 73                                 | 1112                              |
| 25         | Shiga                                            | 21                                 | 427                               |
| 26         | Kyoto                                            | 22                                 | 407                               |
| 27         | Osaka                                            | 91                                 | 1611                              |
| 28         | Hyogo                                            | 72                                 | 1467                              |
| 29         | Nara                                             | 25                                 | 334                               |
| 30         | Wakayama                                         | 9                                  | 178                               |
| 31         | Tottori                                          | 29                                 | 354                               |
| 32         | Shimane                                          | 45                                 | 482                               |
| 33         | Okyama                                           | 104                                | 1778                              |
| 34         | Hiroshima                                        | 125                                | 2522                              |
| 35         | Yamaguchi                                        | 51                                 | 534                               |
| 36         | Tokushima                                        | 12                                 | 157                               |
| 37         | Kagawa                                           | 40                                 | 462                               |
| 38         | Ehime                                            | 48                                 | 508                               |
| 39         | Kochi                                            | 43                                 | 653                               |
| 40         | Fukushima                                        | 139                                | 2571                              |
| 41         | Saga                                             | 22                                 | 354                               |
| 42         | Nagasaki                                         | 65                                 | 547                               |
| 43         | Kumanoto                                         | 80                                 | 995                               |
| 44         | Oita                                             | 36                                 | 311                               |
| 45         | Miyazaki                                         | 59                                 | 415                               |
| 46         | Kagoshima                                        | 46                                 | 452                               |
| 47         | Okinawa                                          | 17                                 | 82                                |

bTotal number was not equal to 3624 as described in Table 1 because 129 nursery schools did not return Questionnaire “A.”
DISCUSSION

The present survey is the first nationwide survey to investigate how the Great East Japan Earthquake affected preschool children’s physical development and health status. The main strength of the present survey is the large amount of data we acquired. With the cooperation of 3624 nursery schools all over Japan, we established nationwide retrospective cohorts of 53,747 children who were born from April 1, 2004, to April 2, 2005, and 69,004 children who were born from April 1, 2006, to April 2, 2007. These cohorts represent 4.9% and 6.3% of the number of births in Japan during the same period, respectively.

Preschool education in Japan is mainly provided either by nursery schools, which are governed by the Child Welfare Act and operate under the supervision of municipal governments, or by kindergartens, which are governed by the School Education Act; a nursery school is a childcare and educational facility that cares for children ranging from newborn infants to preschool children, whereas a kindergarten offers early childhood education for children aged 3 to 5 years. Because nursery schools care for children for a longer period than kindergartens, we targeted nursery school children and obtained longitudinal data of physical measurements. Generalizability should be interpreted with caution. However, it has been reported that more than 40% of Japanese preschool children aged 3 years and older currently attend nursery schools and that the number of nursery school children has been increasing, so nursery school children may be sufficiently representative.

Table 3. Characteristics of nursery school children

|                     | Children born from April 2, 2004 to April 1, 2005 | Children born from April 2, 2006 to April 1, 2007 | P     |
|---------------------|--------------------------------------------------|--------------------------------------------------|-------|
| **Sex**             |                                                  |                                                  | 0.31  |
| Boy                 | 27,823                                           | 35,536                                           | 51.5% |
| Girl                | 25,449                                           | 32,884                                           | 47.7% |
| Missing             | 475                                              | 584                                              | 0.8%  |
| **Birth month**     |                                                  |                                                  | 0.58  |
| April               | 4556                                             | 5657                                             | 8.2%  |
| May                 | 4562                                             | 5968                                             | 8.6%  |
| June                | 4404                                             | 5733                                             | 8.3%  |
| July                | 4748                                             | 5992                                             | 8.7%  |
| August              | 4676                                             | 5946                                             | 8.6%  |
| September           | 4680                                             | 6028                                             | 8.7%  |
| October             | 4405                                             | 5963                                             | 8.3%  |
| November            | 4294                                             | 5642                                             | 8.2%  |
| December            | 4361                                             | 5682                                             | 8.2%  |
| January             | 4482                                             | 5680                                             | 8.2%  |
| February            | 3771                                             | 4801                                             | 7.0%  |
| March               | 4221                                             | 5528                                             | 8.0%  |
| April (following year) | 110                                           | 114                                              | 0.2%  |
| Missing             | 477                                              | 540                                              | 0.8%  |
| **Presence of diseases diagnosed by medical doctors** |                                                  |                                                  | 0.28  |
| No                  | 44,380                                           | 58,452                                           | 82.6% |
| Yes                 | 6064                                             | 7,832                                            | 11.3% |
| Unknown             | 307                                              | 342                                              | 0.5%  |
| Missing             | 2996                                             | 2,368                                            | 3.4%  |
| **Experience of the disaster** |                                                  |                                                  |       |
| No                  | N/A                                              | 62,244                                           | 90.2% |
| Yes                 | N/A                                              | 1,003                                            | 1.5%  |
| Missing             | N/A                                              | 5,757                                            | 8.3%  |
| (Specific experience) |                                                |                                                  |       |
| Collapse of house   | 366                                              |                                                  |       |
| Tsunami             | 224                                              |                                                  |       |
| Fire                | 3                                                |                                                  |       |
| Moving house        | 189                                              |                                                  |       |
| Evacuation center   | 279                                              |                                                  |       |
| Death of family member | 31                                            |                                                  |       |

Differences in sex, birth month, and presence of diseases between two cohorts were tested by chi-square tests.
In addition, all nursery school teachers have paid close attention to children’s physical development by conducting periodic body measurements. They graduated from schools designated by the Ministry of Health, Labour and Welfare as educational institutions for nursery teachers, passed a national examination, and registered in the nursery teachers’ registry. Therefore, the anthropomorphic measurements obtained by such qualified teachers may be sufficiently reliable and accurate.

Ochi et al suggested that evaluations of the health impacts of disasters need baseline data from before the events. We therefore retrospectively collected nursery school children’s anthropometric measurements for a maximum of 14 times. Specifically, for children who experienced the disaster during their preschool days, we obtained their height and weight measured in April and October between 2006 and 2012, including 10 measurements before the disaster and four measurements after the disaster. Thus, the data reflect childhood physical development trajectories before and after the disaster.

We observed preschool children who had personal experiences with the disaster not only in Iwate, Miyagi, and Fukushima Prefectures, which were devastated by the disaster, but also in other areas all over Japan. Among 1003 children who were reported to have specific disaster experiences, 271 (27.0%) were residing outside of the affected prefectures. Because we conducted a nationwide survey, we collected valuable data, including data on children who might have moved from the affected areas.

In conclusion, by comprehensively examining the results from the present survey, we aim to provide valuable epidemiological evidence that may not only shed light on the impact of the Great East Japan Earthquake disaster on preschool children’s physical development and health, but may also provide specific suggestions for response to the next mega-disaster worldwide.

ONLINE ONLY MATERIALS

eAppendix 1. Questionnaire A (Nursery school information).
eAppendix 2. Questionnaire B1 (Children who were born from April 2, 2004 to April 1, 2005).
eAppendix 3. Questionnaire B2 (Children who were born from April 2, 2006 to April 1, 2007).

Abstract in Japanese.

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