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Original Article

# Alterations in physique among young children after the Great East Japan Earthquake: Results from a nationwide survey

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ABSTRACT

*Background:* Data for earthquake-related alterations in physique among young children in developed countries is lacking. The Great East Japan Earthquake caused severe damage in Iwate, Miyagi, and Fukushima Prefectures in northeastern Japan.

*Methods:* We retrospectively obtained anthropometric measurements in nursery school from 40,046 (cohort 1, historical control) and 53,492 (cohort 2) children aged 3.5–4.5 years without overweight in October 2008, and in October 2010, respectively. At the time of the earthquake in March, 2011, children in cohort 1 had already graduated from nursery school; however, children in cohort 2 were still enrolled in nursery school at this time. We compared the onset of overweight at 1 year after the baseline between children enrolled in their school located in one of the three target prefectures versus those in other prefectures using a logistic regression model, with adjustment for sex, age, history of disease, and obesity index at baseline. Overweight was defined as an obesity index of >+15%, which was calculated as (weight minus sex- and height-specific standard weight)/sex- and height-specific standard weight.

*Results:* The odds ratio (OR) for the onset of overweight in the three target prefectures was significant in cohort 2 (OR 1.25; 95% confidence interval [CI], 1.01–1.55) but not in cohort 1. When the two cohort were pooled (n = 93,538), the OR of the interaction term for school location × cohort was significant (OR 1.56; 95% CI, 1.09–2.23).

*Conclusions:* Incident overweight in young children was significantly more common in the three prefectures affected by the Great East Japan Earthquake than in other prefectures after the disaster.



## Introduction

Humanity has suffered many indiscriminate disasters throughout history. Disasters can occur anywhere in the world, not only in developing countries but also in developed countries, where advanced medical support systems might contribute to the acute

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recovery of survivors' health. We would like to share our experience from the Great East Japan Earthquake of March 11, 2011 with people around the world to help reduce disaster risk, especially the prolonged impact of this huge earthquake on children's health in Japan, one of the most developed countries in the world. The Great East Japan Earthquake was followed by a giant tsunami that caused severe damage along the Pacific coast of Northeastern Japan, with deaths or missing persons amounting to 18,466 in the three prefectures most affected by the earthquake: Iwate, Miyagi, and Fukushima (Fig. 1).[1]

Disasters affect children's health by increasing the prevalence of psychiatric problems[2,3] and physical symptoms.[4–7] In particular, alterations in physique have been a major health problem. In developing countries, underweight among children after disasters has been recognized as a serious health problem.[6,7] However, in developed countries, there are no data on earthquake-related alterations in physique among young children. Extrapolation of results from developing countries to developed countries may not be appropriate, since the social environment, including financial resources, educational background of parents, development of transportation networks, and public health policies and resources, are distinctly different between developing and developed countries.

We conducted a nationwide survey to investigate the possible health impacts of the Great East Japan Earthquake on nursery school children.[8] According to childcare guidelines, all nursery schools in Japan must perform periodic body measurements.[9] Our survey retrospectively collected pre-existing data for scheduled anthropometric measurements accumulated in each school before and after the earthquake. The aim of the present analysis was to clarify alterations in physique among young children after a huge earthquake in a developed country.

## Methods

### *Design*

The present study is part of the “Surveillance Study on Child Health in the Great East Japan Earthquake Disaster Area”.[8] In this surveillance study, children's physical development data (i.e., height and weight) for a maximum of 7 years were retrospectively collected for the purpose of investigating the impact of the Great East Japan Earthquake on the physical development and physical and mental health of children.[8] From all 47 prefectures in Japan, 23,711 nursery schools certified by the governor of each prefecture were asked to join the study. Among them, 4266 schools showed interest in taking part, and study questionnaires were mailed to these schools. Of these, 3624 schools returned completed questionnaires. The participation rate was 15.3% in total and was significantly different between the three prefectures most impacted by the earthquake (30.3%) and the other prefectures (14.6%, chi-square $P < 0.0001$). The participation rates were 22.6% in Iwate, 38.2% in Miyagi, and 30.6% in Fukushima.[8] The survey was conducted from September 2012 through December 2012.

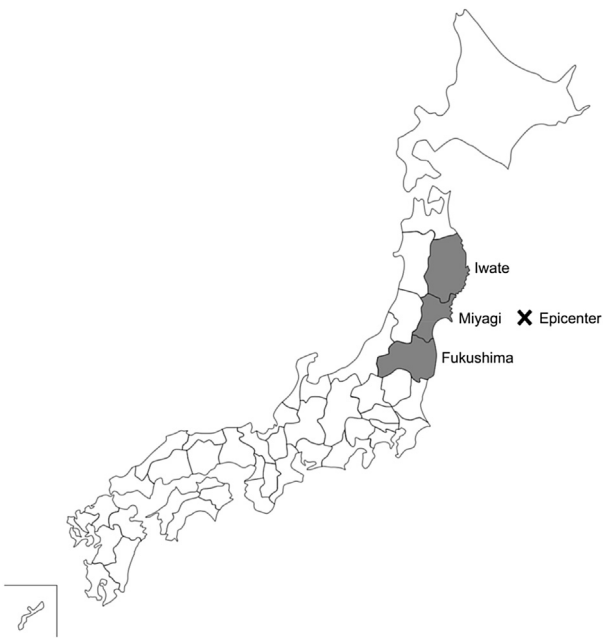


**Fig. 1.** Map of Japan showing the epicenter of the Great East Japan Earthquake. Iwate, Miyagi, and Fukushima Prefectures were the areas most severely damaged by the earthquake.

The survey protocol was approved by the institutional review board of Tohoku University. It was not necessary to obtain informed consent from the children and their parents because any information that could possibly identify individuals, such as names and addresses, was not collected. Furthermore, the purposes and procedures of the survey were explained to nursery teachers in the invitation letter and announced to parents via a poster displayed in each nursery school. Parents had the right to opt out of the study. The information for the present study was also disclosed to the public on the website for the Graduate School of Medicine, Tohoku University, Sendai, Japan.

### *Study population*

From the 3624 nursery schools that participated in the “Surveillance Study on Child Health in the Great East Japan Earthquake Disaster Area”,[8] data for two groups of young children born in different fiscal years were collected for the present study. We obtained data from 54,558 children who were born from April 2, 2004 to April 1, 2005 (cohort 1) and from 69,702 children who were born from April 2, 2006 to April 1, 2007 (cohort 2).[8] The reason for selecting these periods was that new school terms in Japan start on April 1 and the birth dates for the children in each class range from April 2 of the current year to April 1 of the following year. Participants in cohort 1 were children aged 5 years in 2010 who did not experience the earthquake during their nursery school days. Consequently, cohort 1 was a historical control group. On the other hand, participants in cohort 2 were children aged 5 years in 2012 who did experience the earthquake during their nursery school days. According to previous cross-sectional reports, children in northeastern Japan, including Iwate, Miyagi, and Fukushima Prefectures, show a higher prevalence of obesity than other parts of Japan.[10] To separate the regional differences and the effects of the earthquake on children, as well as to collect historical control data (cohort 1), we decided to collect data from all over Japan, not only from the earthquake-affected prefectures, using a large sample.

As initial data cleaning, we excluded data for children who were not born in the target fiscal year and children whose anthropometric measurements were not provided, leaving a total of 53,747 children in cohort 1 and 69,004 children in cohort 2.[8] We then excluded 1187 and 1362 children from cohort 1 and cohort 2, respectively, due to the following reasons: (1) sex was unknown (n = 475 and 584, respectively), (2) birth year or month was unknown (n = 392 and 423, respectively), (3) measurement data were null in individual children after deleting overlapping measurements or inconsistent height measurements that were smaller than the previous value (n = 125 and 75, respectively), (4) duplicated data in different children (n = 1 and 0, respectively), and (5) children who had more than one height measurement that exceeded +3 standard deviations (SD) (n = 194 and 280,

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