

## Effects of SO<sub>2</sub> on the respiratory system in Miyakejima residents seven years after returning to the island

Satoko Iwasawa<sup>1</sup>, Tazuru Tsuboi<sup>1</sup>, Takeshi Kochi<sup>1</sup>, Makiko Nakano<sup>1</sup>, Takamoto Uemura<sup>2</sup>, Shigeru Tanaka<sup>3</sup>, Kazuyuki Omae<sup>1</sup>

<sup>1</sup>Keio University, Japan, <sup>2</sup>Kyorin University, Japan, <sup>3</sup>Jumonji University, Japan

E-mail: iwasawa@a5.keio.jp

Background: Miyakejima Island is an island volcano 8 km in diameter, located 180 km south-southwest of Tokyo. In the last 500 years, Mt. Oyama has erupted repeatedly every 50 years. The last eruption started in June, 2000, and due to continuous eruptions and emissions of lethal/unsafe amounts of volcanic gas, the Miyake village government decided to evacuate all the citizens from the island in September, 2000. At the time of the evacuation, the amount of discharge of sulfur dioxide (SO<sub>2</sub>), the major toxic component of the volcanic gas, was 50,000 tons/day. The volcanic activity gradually decreased, but it has not ceased, and SO<sub>2</sub> discharge of 400 - 700 tons/day continues to be observed as of January, 2013. In February, 2005, citizens began to return to live on the island despite the fact that volcanic gas was still being emitted.

Objectives: In this study, the health effects of exposure to the environment on Miyakejima Island following the lifting of the evacuation order in February, 2005, were investigated, first in February, 2006, and then in each November from 2006 to 2011. The relationship between the amount of exposure to SO<sub>2</sub> and health effects was studied in Miyakejima residents.

Method: The subjects of this study were registered residents of Miyakejima. A total of 4,089 check-ups for adults and 1,005 check-ups for children were conducted. The mean values and percentages hourly values of 0.10 ppm or more were obtained from 81 months of exposure concentration data obtained by fixed-point monitoring. Based on these values, we used averages to categorize the inhabited area into 1 lower-SO<sub>2</sub> area and 2 higher-SO<sub>2</sub> areas, namely, the Izu and Kamitsuki districts, referred to as Area L, the Igaya and Tsubota districts, referred to as Area H-1, and the Ako district, referred to as Area H-2. Health effects were evaluated through pulmonary function tests. Results: The average SO<sub>2</sub> concentrations in Areas L, H-1, and H-2 were 4.57, 18.9, and 26.1 ppb, respectively. The rates at which the one-hour average SO<sub>2</sub> concentrations exceeded 0.1 ppm in Areas L, H-1, and H-2 were 1.35, 4.16, and 5.80 %, respectively. The Air Quality Standard of SO<sub>2</sub> in Japan is 0.04 ppm or below for the daily average of one-hour SO<sub>2</sub> concentrations and 0.1 ppm or below for the one-hour SO<sub>2</sub> concentration. The island as a whole has not yet achieved the standard.

In adult Miyakejima residents, there were significant differences in the %FVC and %FEV1 values observed in a comparison of pulmonary function by area. However, no significant difference was observed in a comparison over time. By contrast, children showed no reduction in lung function.

Conclusions: Follow-up observation should be continued with a focus on the relationship between the amount of exposure to SO<sub>2</sub> and health effects until the volcanic gas emissions have ceased.