

## The Influence of Changed Life Environment on Swallowing and Respiration in Healthy Elderly: A Comparison of Disaster Victim and Non-Victim Elderly Individuals

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### Abstract

The purpose of the current study was to clarify problems that the swallowing and respiratory functions of victim elderly individuals in Fukushima. Participants were healthy elderly individuals, who were living in Fukushima or Nagasaki in Japan. The subjects in the Fukushima group were 50 elderly individuals, and the subjects in the Nagasaki group were 19 elderly individuals. The swallowing and respiratory functions were compared between the 2 groups and the 5 groups (4 areas in the Fukushima group and 1 area in the Nagasaki group). The swallowing and respiratory functions were significantly lower in the Fukushima group than in the Nagasaki group. We conclude that it is important to include social environment in the assessment of and intervention for respiratory and swallowing problems in victims of disaster.

**Keywords:** Swallowing function; Respiration function; Victim; Earthquake

### Introduction

The Great East Japan earthquake occurred almost 5 years ago, on March 11, 2011. Many of the people of Fukushima have been living in temporary housing close to the Fukushima nuclear and earthquake disaster, and consequently have experienced anxiety and stress. The sudden change of environment has also affected the physiological functions of elderly individuals. These elderly individuals have isolated themselves in their temporary houses, as they have lost their familiar neighborhood, friends, and family.

This way of life may cause sarcopenia in the elderly; “activity-related sarcopenia” is a form of sarcopenia that can result from bed-rest, a sedentary lifestyle, deconditioning, or zero gravity conditions [1]. Swallowing functions have been reported to be lower in elderly individuals with sarcopenia than in those without this condition [2]. We therefore considered that the swallowing and respiratory functions of elderly individuals in Fukushima may have been compromised, and assessed this in the present study.

### Subjects

Participants were healthy elderly individuals, who were living in Fukushima or Nagasaki in Japan. The subjects in the Fukushima group were 50 elderly individuals (6 men and 44 women) aged  $77.1 \pm 7.0$  years, who originated from 4 areas: the subjects of area A were 17 individuals (2 men and 15 women) aged  $77.8 \pm 5.7$  years, the subjects of area B were 13 individuals (2 men and 12 women) aged  $78.2 \pm 9.0$  years, the subjects of area C were 10 individuals (1 man and 9 women)

aged  $73.1 \pm 6.9$  years, and the subjects of area D were 10 individuals (1 man and 9 women) aged  $76.5 \pm 5.0$  years. These individuals were all victims of the Great East Japan Earthquake who had been living in temporary housing for more than 1 year. More than 90% of them lived alone or as couples. The subjects in the Nagasaki group were 19 elderly individuals (1 man and 18 women), aged  $76.2 \pm 5.8$  years, who lived alone or as couples.

This study was approved by the ethics committee of the Nagasaki University, and all prospective participants completed an informed consent process prior to study entry.

### Methods

#### Researchers

Researchers in Fukushima included 2 occupational therapists, 1 physical therapist, and 3 public health nurses. Researchers in Nagasaki were 4 occupational therapists. All researchers received instructions on measurement methods prior to the study.

#### Assessment

In the present study, respiratory function was assessed using the following assessment tools: Maximum exhalation time using a party horn (party horn test) [3] and Maximum Phonation Time (MPT) [4]. The party horn test employed a party horn of 80 cm in length (Party Horn Entertainment Village, Hyogo, Japan), which was connected to a disposable mouthpiece (Tsutsumi, Tokyo, Japan). The party horn test was administered to subjects who were seated on the floor. The process was first demonstrated to the subjects; the subject was asked to exhale quickly and forcefully into the party horn. The time of the party horn

test was measured from when the party horn began to straighten, until when it had completely unfurled.

The MPT was the longest time for which a participant could phonate a vowel, typically /a/.

The swallowing function was assessed using the Repetitive Saliva Swallowing Test (RSST) [5,6].

The RSST is intended to assess a patient's ability to swallow voluntarily, repeatedly, which is highly correlated with aspiration. Three or more dry swallows within 30 s is considered normal.

Nutrition assessment tools included body mass index (BMI), which was calculated in kg/m<sup>2</sup>.

### Statistical analysis

Data were compared between the Fukushima and Nagasaki groups using the Mann–Whitney U test, and one-way ANOVA and Turkey's test were used to compare the data from the 5 groups (4 areas in the Fukushima group and 1 area in the Nagasaki group). Correlation analysis was done with multiple regression analysis. Statistical analysis was performed with the computer software, PASW ver. 18.0 for Mac. The level of significance was set at 0.05.

### Results

Table 1 summarizes the respiratory, swallowing, and nutrition characteristics of the Fukushima and Nagasaki groups. There were significant differences in the results of the party horn test and RSST

between the two groups. The party horn test and RSST values of the Fukushima group were significantly lower than those of the Nagasaki group.

	Fukushima group (n=50)	Nagasaki group (n=19)
Respiratory Factor		
Party horn test	26.9 ± 10.0	36.5 ± 13.6**
MPT	14.0 ± 4.9	12.5 ± 3.6
Swallowing Factor		
RSST	4.3 ± 2.0	5.7 ± 2.2**
Nutrition Factor		
BMI	23.8 ± 3.1	22.7 ± 3.8
Mann–Whitney U test *p<0.05; **p<0.01; Party horn test: Maximum exhalation time with party horn; MPT: Maximum Phonation Time; RSST: Repetitive Saliva Swallowing Test; BMI: Body Mass Index		

**Table 1:** Comparison of outcomes between the Fukushima and Nagasaki groups.

Table 2 summarizes the outcomes for each area in the Fukushima and Nagasaki groups. There were significant differences in the party horn test and RSST among the 5 groups. The party horn test results followed the order: E, D, C, B, and A. The RSST value of group A was significantly lower than that of group E.

	Fukushima group				Nagasaki group	Tuckey's test
	A (n=17)	B (n=13)	C (n=10)	D (n=10)	E (n=19)	
Party horn test**	22.8 ± 7.5	26.0 ± 8.0	26.2 ± 10.2	35.6 ± 10.4	36.5 ± 13.6	A, B, C, D<E
MPT	13.1 ± 4.0	13.0 ± 4.0	13.9 ± 3.8	17.2 ± 7.1	12.5 ± 3.6	
RSST**	4.2 ± 1.8	4.2 ± 2.5	4.5 ± 2.0	4.4 ± 1.9	5.7 ± 2.2	A<E
BMI	23.9 ± 3.1	22.5 ± 2.8	25.8 ± 3.7	23.8 ± 2.3	22.7 ± 3.8	
One-way ANOVA *p < 0.05 **p < 0.01; Party horn test=maximum exhalation time with party horn MPT=Maximum Phonation Time, RSST=Repetitive Saliva Swallowing Test, BMI=Body Mass Index						

**Table 2:** Outcomes according to the area in Fukushima and Nagasaki.

	Beta (β)	P value
Respiratory Factor		
Party horn test	-0.15	0.02
MPT	-0.16	0.02
Swallowing Factor		
RSST	0.72	0.01
Nutrition Factor		
BMI	-0.04	0.42

**Table 3:** Results of multiple regression analysis.

Table 3 summarizes the result of multiple regression analysis. Of all the parameters, only RSST significantly associated with multiple regression analysis.

### Discussion

Differences in respiratory and swallowing functions between elderly individuals living in the Fukushima and Nagasaki areas were investigated. The Fukushima group (as a whole, and the subgroups representing four regions) showed a significant reduction in respiratory function with the party horn test as compared to the Nagasaki group. This may imply that elderly individuals living in Fukushima have lost skeletal muscle strength, including that of the respiratory muscles [7], due to activity-related sarcopenia [8]. Moreover, the Fukushima group showed a significant reduction in swallowing function with the RSST, with the value in the group A

(Fukushima) significantly lower than that in the group E (Nagasaki). It is therefore likely that swallowing muscles were also influenced by sarcopenia, as were the respiratory muscles. These results indicate that the respiratory and swallowing functions of Fukushima's elderly population was influenced by the Fukushima nuclear and earthquake disaster, along with loss of life balance, loss of social interaction, mental fatigue, reducing living space, etc. One of the factors of a loss of social environment has been influenced by the low return rate (26.9%) of adults under 50 years old [9].

Nutrition, as represented by BMI, was not significantly between the Fukushima and Nagasaki groups. However, the reduced respiratory and swallowing muscle function in Fukushima's elderly population may also lead to feeding/eating difficulties, contributing to malnutrition. Moreover, the mean age of the groups did not differ significantly. Thus, it is necessary to prevent deterioration of respiratory and swallowing functions by nutrition-related sarcopenia [1] in victims of disasters.

A limitation of this study was that we did not take into account the background of the subjects. Each subject's background (lifestyle, meal balance, social participation, etc.) should be considered in detail. Moreover, nutrition status was only assessed by considering BMI in this study; in future, nutrition should be evaluated more comprehensively (e.g., by blood tests, muscle mass determinations, etc.).

## Conclusion

In conclusion, the respiratory and swallowing functions of elderly individuals living in the Fukushima region were significant lower than those of similarly aged individuals living in Nagasaki, and may have been influenced by activity-related sarcopenia, which in turn may have been influenced by loss of a social environment after the Great East Japan earthquake. We conclude that it is important to include social environment in the assessment of and intervention for respiratory and swallowing problems in victims of disaster. According to Ciccone et al., as the empowerment model was introduced and implemented, patients would be activated to participate more fully in their health care [10].

Even in disaster areas, it is important for victims and medical workers to partner with each other to promote empowerment.

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