

[ORIGINAL ARTICLE]

Risk Factors of Mortality from Foreign Bodies in the Respiratory Tract: The Japan Collaborative Cohort Study

Kenichi Katabami, Takashi Kimura, Takumi Hirata and Akiko Tamakoshi;
on behalf of the JACC Study Group

Abstract:

Objective This study assessed the risk factors of mortality from foreign bodies in the respiratory tract using the Japan Collaborative Cohort Study for the Evaluation of Cancer Risk data.

Methods Data of 110,585 participants 40-79 years old living in 45 areas in Japan were collected between 1988 and 2009. Mortality from foreign bodies in the respiratory tract was assessed in a multivariable-adjusted analysis using a Cox proportional hazard regression model.

Results Among all participants, 202 deaths occurred from foreign bodies in the respiratory tract. In the multivariable-adjusted model, older age [50-59 (hazard ratio, 4.93; 95% confidence interval, 1.91-12.74), 60-69 (hazard ratio, 14.96, 6.01-37.25) and 70-79 (hazard ratio, 53.81; 95% confidence interval, 21.44-135.02) years old compared to 40-49 years old], male sex (hazard ratio, 2.34; 95% confidence interval, 1.54-3.54), a history of apoplexy (hazard ratio, 7.04; 95% confidence interval, 4.24-11.67) and the absence of a spouse (hazard ratio, 1.56; 95% confidence interval, 1.05-2.32) were associated with an increased risk of mortality from foreign bodies in the respiratory tract.

Conclusions Older age, male sex, medical history of apoplexy and the absence of a spouse were potential risk factors of mortality from foreign bodies in the respiratory tract. Especially in elderly men, social connections, such as cohabitation or relationships, may be important for ensuring the early detection of asphyxia and preventing death due to foreign bodies in the respiratory tract.

Key words: aged, asphyxia, airway obstruction, cohort studies, risk factors

(Intern Med 61: 1353-1359, 2022)

(DOI: 10.2169/internalmedicine.8437-21)

Introduction

The proportion of older adults is increasing worldwide, and deaths from foreign bodies in the respiratory tract are also increasing in many developed countries (1-4). Japan is the world's most aged society, and airway problems as emergency medical issues among the elderly are increasing (1, 5, 6). Since 2006, choking due to airway foreign bodies has been the leading cause of unintentional accidental death in Japan (4). Among 1,381,093 deaths, 14,145 (1.0%; 10,149 men, 3,996 women) were reported to be due to foreign bodies in the respiratory tract. The incidence rates among people in their 40s, 50s, 60s and 70s were 0.61, 1.44, 3.45 and 13.34 per 100,000 population, respectively, in

2019 in Japan (7).

Older age has been reported to be a risk factor of airway problems in adults (8). Previous reports have also shown that an age-related decrease in the swallowing function, the use of sedative medications and stroke-related dysphagia, dementia and Parkinson's disease are risk factors for choking and aspiration (9-12). In prehospital emergency patients, the presence of witnesses and a rapid response are related to the prognosis of cardiopulmonary arrest due to food choking (13, 14). Seasonal and regional validations of food choking deaths in Japan have also been reported (2, 14).

Foreign body airway obstruction (FBAO) occurs most often in children 1-3 years old and people over 60 years old (5, 15). Causes of FBAO include food or toys in children but are mostly food in the elderly (11). The most com-

mon causes of FBAO are meat, bread and rice cake in Japan (14, 16). In Japan, it has been reported that about 10% of FBAO is caused by the consumption of rice cakes, and about 25% of rice-cake FBAO cases occur during the first 3 days of the new year since it is popular in Japan to eat warm and soft rice cakes at that time (14). FBAO is sometimes fatal and can lead to cardiac arrest due to systemic hypoxia within minutes if not responded to quickly and appropriately. Cardiac arrest due to FBAO has been reported to have a poor neurological prognosis because of the prolonged hypoxia of the brain (14, 17). The rate of a favorable neurological outcome is less than 3% in out-of-hospital cardiac arrest patients following FBAO (13, 14). The importance of the early removal of a foreign body from the airway to prevent cardiac arrest has been reported (17). Therefore, it is important to identify the risk factors, prevent airway problems and prepare for airway emergencies, especially in the recently aging society. However, there are few reports on mortality from foreign bodies in the respiratory tract, and the risk factors are not well understood.

In this study, we examined the risk factors for death from foreign bodies in the respiratory tract using data from the Japan Collaborative Cohort Study for the Evaluation of Cancer Risk (JACC), a nationwide community-based cohort study.

Materials and Methods

Study population

This study was conducted using data from the JACC study, a prospective nationwide cohort study that was started in 1988, and the participants were followed until the end of 2009. In the JACC study, the data of 110,585 participants (46,395 men and 64,190 women) 40-79 years old living in 45 areas in Japan were collected using self-administered questionnaires about their lifestyles and medical histories. The JACC study was designed to evaluate the relationship between lifestyle and mortality from all causes, including cardiovascular diseases and major cancers, and to provide prevention strategies for chronic diseases. The details of this study have been previously described (18).

The procedures followed in this study were in accordance with the Declaration of Helsinki, and the study protocol was approved by the Ethics Committee of Hokkaido University School of Medicine, Japan.

Baseline assessments and risk factors

Participants' demographic and lifestyle information was collected from self-administered questionnaires at the baseline of the JACC study. We classified age into four categories (40-49, 50-59, 60-69, 70-79 years old). Medical histories (present or absent) of apoplexy (APO), myocardial infarction (MI), hypertension (HT) and diabetes mellitus (DM); presence of a spouse (yes or no); education duration (<16, 16-19, ≥19 years); smoking history [yes (including ex-

smokers) or no]; body mass index (BMI) according to the self-reported weight and height (<18.5, 18.5-23.4, 23.5-24.9, ≥25 kg/m²); and drinking status, calculated from the daily alcohol consumption and weekly frequencies [non-drinker (including ex-drinkers) and current drinkers of ethanol at < 23, 23-25.9, 46-68.9, ≥69 g per day], were evaluated as possible risk factors based on the responses to the baseline questionnaire.

Follow-up

The mortality data of the participants in this study were obtained from the official death certificates provided by the Ministry of Health, Labor, and Welfare in Japan. The causes of death were determined by physicians, and the coding of the causes of death by the government was based on the 9th (used until 1994) and 10th Revisions (used from 1995) of the International Statistical Classification of Diseases and Related Health Problems (ICD-9 and ICD-10, respectively).

In this study, death from an FBAO was defined based on the following causes of death and codes: "Foreign body in the respiratory tract" (T17), which included "asphyxia due to foreign body" and "choking on food or phlegm" in ICD-10; and "Foreign body in the pharynx and larynx" (933), and "Foreign body in the trachea, bronchus, and lung" (934) in ICD-9. The follow-up of the causes of death in JACC study was continued until the end of 2009 in 35 communities, and 4, 4 and 2 communities had been followed-up as of 1999, 2003 and 2008, respectively.

Statistical analyses

The person-years of follow-up among participants were calculated as the period from the date of the baseline data collection to the date of either death, moving out of the area, or end of follow-up. Age-specific death rates due to foreign bodies in the respiratory tract were calculated by the participants' attained age in the JACC study. Hazard ratios (HRs) and 95% confidence intervals (CIs) for death from foreign bodies in the respiratory tract were estimated in univariable, sex- and age-adjusted (Model 1) and multivariable (Model 2) Cox proportional hazards regression models. Multivariable models were adjusted for age, sex, medical history (APO, MI, HT or DM), presence of a spouse, education duration, smoking history, BMI and drinking status. Tests for trends in HRs were performed according to continuous values for education duration, BMI and drinking status. A stratified analysis was also conducted by age categories to predict the effects of covariates, such as medical history, presence of a spouse, education and drinking status. In all analyses, two-tailed p-values <0.05 were statistically significant. All of the analyses were conducted using the SAS software program, version 9.4 (SAS Institute, Cary, USA).

Results

During the 1,781,318 person-years of follow-up of the 110,585 participants, there were 202 deaths from foreign

Table 1. Baseline Characteristics of All the JACC Study Participants Included in This Study and Those That Died from Foreign Bodies in the Respiratory Tract.

	All		Case of foreign bodies	
	n	%	n	%
n (%)	110,585	100.0	202	100.0
Age, n (%)				
<50	27,233	24.6	5	2.5
50-59	33,879	30.6	30	14.9
60-69	33,622	30.4	77	38.1
≥70	15,851	14.3	90	44.6
Female, n (%)	64,190	58.0	81	40.1
Medical history, n (%)				
APO				
No	93,978	85.0	147	72.8
Yes	1,496	1.4	20	9.9
Missing	15,111	13.7	35	17.3
MI				
No	92,889	84.0	163	80.7
Yes	2,994	2.7	2	1.0
Missing	14,702	13.3	37	18.3
HT				
No	76,248	68.9	115	56.9
Yes	22,531	20.4	60	29.7
Missing	11,806	10.7	27	13.4
DM				
No	90,798	82.1	154	76.2
Yes	5,283	4.8	15	7.4
Missing	14,504	13.1	33	16.3
Presence of spouse, n (%)				
No	12,252	11.1	36	17.8
Yes	82,707	74.8	130	64.4
Missing	15,626	14.1	36	17.8
Education year, n (%)				
<16	31,684	28.7	79	39.1
<19	39,005	35.3	47	23.3
≥19	10,590	9.6	12	5.9
Missing	29,306	26.5	64	31.7
Smoking history, n (%)				
No	60,484	54.7	84	41.6
Yes	39,141	35.4	93	46.0
Missing	10,960	9.9	25	12.4
Body mass index, n (%)				
<18.5	6,288	5.7	15	7.4
18.5-23.4	58,188	52.6	103	51.0
23.5-24.9	17,611	15.9	30	14.9
≥25	21,894	19.8	34	16.8
Missing	6,604	6.0	20	9.9
Drinking status, n (%)				
Non drinker	55,026	49.8	80	39.6
Current drinker (ethanol g/day)				
<23 g/day	12,574	11.4	17	8.4
23-45.9 g/day	9,553	8.6	28	13.9
46-68.9 g/day	7,597	6.9	16	7.9
≥69 g/day	3,524	3.2	9	4.5
Missing	22,311	20.2	52	25.7

APO: apoplexy, MI: myocardial infarction, HT: hypertension, DM: diabetes mellitus

bodies in the respiratory tract. Table 1 shows the baseline characteristics of all participants and those who died from FBAO in the JACC Study. Overall, there were more women (n=64,190, 58.0%) than men (n=46,395, 42.0%), but the 202 deaths included more men (121, 59.9%) than women (n=81, 40.1%). By age group, there were 27,233 (24.6%) vs. 5 (2.8%); 33,879 (30.6%) vs. 30 (16.9%); 33,622 (30.4%) vs. 77 (43.3%); and 15,851 (14.3%) vs. 90 (50.6%) participants who were 40-49, 50-59, 60-69 and 70-79 years old overall and among the 202 deaths, respectively. Figure shows the age-specific death rates due to foreign bodies in the respiratory tract by attained age categories. The older the attained age category, the higher the risk of death from FBAO.

Table 2 shows the Cox regression model results of the age- and sex-adjusted (Model 1) and the multivariable adjusted (Model 2) analyses of mortality from foreign bodies in the respiratory tract. Compared to those 40-49 years old, older participants were associated with a higher risk of death from foreign bodies in the respiratory tract. In Model 2, the HRs by age categories were 4.93 (95% CI, 1.91-12.74), 14.96 (95% CI, 6.01-37.25) and 53.81 (95% CI, 21.44-135.02) in those 50-59, 60-69 and 70-79 years old compared with those 40-49 years old. Compared to women, men (HR, 2.34; 95% CI, 1.54-3.54) were associated with an increased risk of mortality. A medical history of APO (HR, 7.04; 95% CI, 4.24-11.67), the absence of a spouse (HR, 1.56; 95% CI, 1.05-2.32) and a habit of drinking over 69 g of alcohol per day (HR, 2.11; 95% CI, 1.01-4.39) were also associated with increased risks compared to their reference groups. More education was associated with decreased HRs for deaths from foreign bodies in the respiratory tract (p for trend=0.005), but statistically significant trends of HRs were not observed for the BMI (p for trend=0.849) or drinking status (p for trend=0.069) in Model 2.

Table 3 shows the multivariable HRs of the analysis stratified by age category for mortality from foreign bodies in the respiratory tract. Compared to female sex, male sex was associated with the risk of death for those 50-59 (HR, 1.92; 95% CI, 0.64-5.77), 60-69 (HR, 2.70; 95% CI, 1.34-5.45) and 70-79 (HR, 2.23; 95% CI, 1.23-4.05) years old, respectively. A medical history of APO in those 50-59 (HR, 14.34; 95% CI, 3.90-52.80) and 60-69 (HR, 13.55; 95% CI, 6.14-27.02) years old was associated with higher risks of death than in those 70-79 years old (HR, 3.47; 95% CI, 1.35-7.49). A medical history of HT in those 50-59 years old (HR, 2.51; 95% CI, 1.08-5.82) and the absence of a spouse in those 50-59 (HR, 1.75; 95% CI, 0.51-6.04), 60-69 (HR, 1.32; 95% CI, 0.63-2.74) and 70-79 (HR, 1.41; 95% CI, 0.83-2.40) years old were associated with an increased risk of death. Statistically significant trends in HRs were not observed for education duration or drinking status in any age category.

Discussion

In the present study, an older age, male sex, medical his-

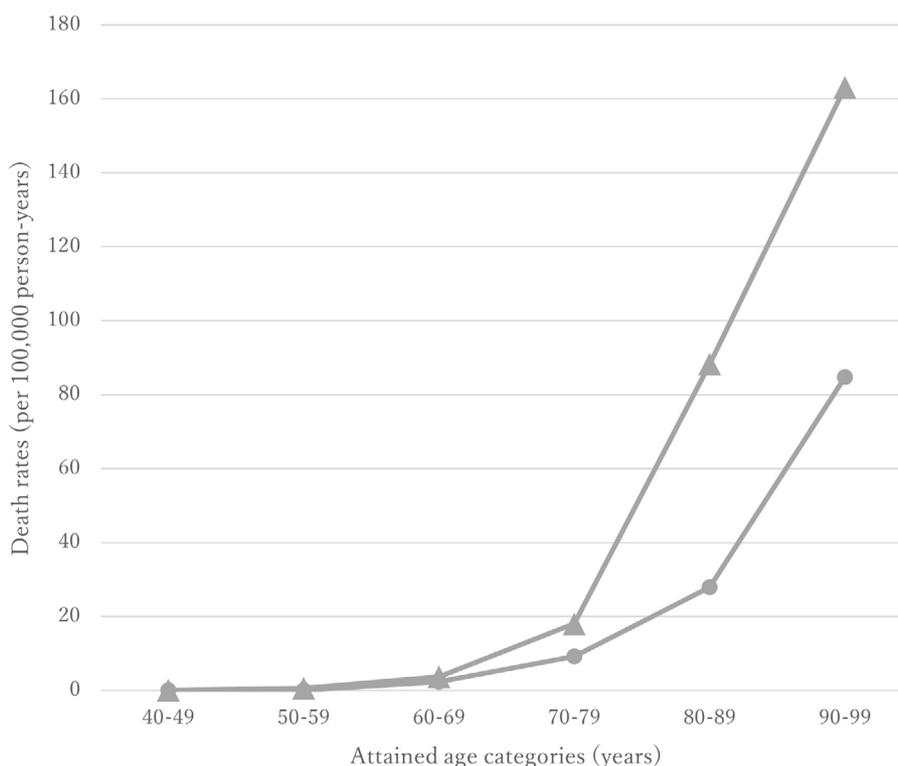


Figure. Age-specific death rates due to a foreign body in the respiratory tract by attained age in the JACC study. Death rates of men (triangle), death rates of women (circle). JACC: Japan Collaborative Cohort Study for the Evaluation of Cancer Risk

tory of APO and the absence of a spouse were risk factors for death from foreign bodies in the respiratory tract. We also found that the HRs of medical history of APO in patients 50-59 and 60-69 years old were higher than in those 70-79 years old. Some previous reports have described accidental deaths from choking in prehospital emergency patients (12-14), but there have been few reports about the risk factors of death from foreign bodies in the respiratory tract. To our knowledge, this study is the first to describe the risk factors for death from foreign bodies in the respiratory tract using national-scale, large-sized prospective cohort data.

In this study, older age was associated with an increased risk of death from foreign bodies in the respiratory tract. This result is consistent with the results from previous reports (2, 3, 11, 16, 19, 20). Increasing age is reported as a risk for aspiration, a decreased swallowing function (5, 21) and a reduced esophageal function (22). Older age is also associated with dementia, Parkinson's disease and APO, which can cause disability of coughing, reduced reflexes and unconsciousness (23). It has been reported that antipsychotics are also associated with dysphagia and aspiration (24), and an older age may affect the frequency of using antipsychotics and other sedative agents. We also found that the HRs for a medical history of APO in patients 50-59 and 60-69 years old were higher than that in those 70-79 years old. A medical history of stroke, dementia (such as Alzheimer's disease), Parkinson's disease, age-related reduction in the swallowing function and alcohol and drug intoxication lead-

ing to unconsciousness have been reported as risk factors of airway foreign bodies in the elderly (11, 12). In 70- to 79-year-olds, the possibility of other causes of death, such as neoplasm or cardiovascular diseases, is increased, so the impact of a medical history of APO may be lower than in those 50-59 and 60-69 years old. However, this result may also indicate that a reduction in the swallowing function might occur in the elderly, even in the absence of cerebrovascular disease. Dysphagia in young people is often due to cerebrovascular diseases, such as stroke, so a history of HT in 50- to 59-year-olds, which can lead to many vascular illnesses, may be associated with death from foreign bodies in the respiratory tract.

The absence of a spouse was associated with the risk of death from foreign bodies in the respiratory tract. The presence of a spouse may markedly influence the living conditions at the time of occurrence of a foreign body in the respiratory tract. With a foreign body in the respiratory tract, a patient goes into cardiac arrest within minutes if there is no appropriate resuscitation by witnesses, and the prognosis of the patient is poor because of systemic hypoxia, especially in the brain (4, 13, 14, 16). Therefore, preventive measures, such as swallowing training, oral care and meal assistance, are important for elderly individuals with an increased risk of foreign bodies in the respiratory tract. The time to remove foreign bodies from the airway affects the survival rate and neurological prognosis (12, 17, 25). Social relationships, such as cohabitation or other relationships, and meal-

Table 2. Hazard Ratios and 95% Confidence Intervals for Deaths from Foreign Bodies in the Respiratory Tract in Multivariable Cox Hazard Regression Analysis.

	Case of foreign bodies	Person-year	^a Model 1 HR	95% CI	^b Model 2 HR	95% CI
Age						
<50 years old	5	494,409	1.00		1.00	
50-59 years old	30	589,104	5.34	2.26-15.68	4.93	1.91-12.74
60-69 years old	77	513,783	17.33	7.01-42.86	14.96	6.01-37.25
≥70 years old	90	184,023	69.70	28.22-172.15	53.81	21.44-135.02
Sex						
Male	121	727,710	2.48	1.87-3.28	2.34	1.54-3.54
Female	81	1,053,609	1.00		1.00	
Medical history						
APO						
No	147	1,545,656	1.00		1.00	
Yes	20	17,151	6.21	3.86-9.99	7.04	4.24-11.67
MI						
No	163	1,530,339	1.00		1.00	
Yes	2	36,702	0.30	0.07-1.19	0.23	0.06-0.99
HT						
No	115	1,275,447	1.00		1.00	
Yes	60	332,186	1.30	0.95-1.79	1.16	0.83-1.64
DM						
No	154	1,498,298	1.00		1.00	
Yes	15	71,125	1.39	0.82-2.36	1.23	0.68-2.22
Presence of spouse						
No	36	178,835	1.59	1.07-2.37	1.56	1.05-2.32
Yes	130	1,364,816	1.00		1.00	
Smoking						
No	84	1,005,828	1.00		1.00	
Yes	93	607,871	1.06	0.72-1.56	1.02	0.69-1.51
Education year						
<16 years	79	481,927	1.53	1.07-2.21	1.54	1.07-2.21
<19 years	47	631,505	1.00		1.00	
≥19 years	12	167,927	0.74	0.39-1.40	0.75	0.40-1.42
				p for trend 0.005		p for trend 0.005
Body mass index						
<18.5 kg/m ²	15	88,246	1.13	0.65-1.95	1.12	0.65-1.94
18.5-23.4 kg/m ²	103	943,207	1.00		1.00	
23.5-24.9 kg/m ²	30	290,627	1.07	0.71-1.61	1.03	0.69-1.55
≥25 kg/m ²	34	362,691	1.03	0.70-1.53	0.99	0.67-1.47
				p for trend 0.998		p for trend 0.849
Drinking status						
Non drinker	80	880,613	1.00		1.00	
Current drinker (ethanol g/day)						
<23 g/day	17	204,849	0.91	0.53-1.57	0.98	0.57-1.69
23-45.9 g/day	28	150,883	1.44	0.90-2.32	1.51	0.93-2.44
46-68.9 g/day	16	122,732	1.21	0.68-2.16	1.23	0.69-2.22
≥69 g/day	9	55,213	1.96	0.95-4.05	2.11	1.01-4.39
				p for trend 0.099		p for trend 0.069

^aModel 1: Adjusted for age, sex^bModel 2: Adjusted for age, sex, APO, MI, HT, DM, presence of spouse, education year, smoking, body mass index, drinking status

APO: apoplexy, MI: myocardial infarction, HT: hypertension, DM: diabetes mellitus, HR: hazard ratio, CI: confidence interval

time assistance are important for elderly individuals with multiple risk factors, as this ensures a quicker response, which can help prevent deaths from foreign bodies in the respiratory tract.

The present study found that men had a higher risk of death from foreign bodies in the respiratory tract than women. This result is consistent with the findings of previous reports (3, 11, 26). It is possible that different lifestyles

Table 3. Hazard Ratios and 95% Confidence Intervals for Death from Foreign Bodies in the Respiratory Tract in Multivariable Cox Hazard Regression Analysis Stratified by Age Categories.

		50-59 years				60-69 years				70-79 years					
		Case of foreign bodies	Person-year	HR	95% CI	Case of foreign bodies	Person-year	HR	95% CI	Case of foreign bodies	Person-year	HR	95% CI		
Male		18	238,933	1.92	0.64-5.77	50	204,629	2.70	1.34-5.45	51	69,946	2.23	1.23-4.05		
Female		12	350,171	1.00		27	209,154	1.00		39	114,077	1.00			
APO	No	22	518,018	1.00		52	423,098	1.00		68	141,113	1.00			
	Yes	3	4,045	14.34	3.90-52.80	10	7,249	13.55	6.14-27.02	7	4,828	3.47	1.35-7.49		
HT	No	15	430,121	1.00		48	318,700	1.00		48	98,142	1.00			
	Yes	11	103,789	2.51	1.08-5.82	19	131,236	0.71	0.38-1.33	29	58,353	1.12	0.69-1.83		
MI	No	25	513,645	1.00		60	416,890	1.00		73	137,986	1.00			
	Yes	0	8,700	NA		1	16,165	0.47	0.06-3.54	1	9,344	0.18	0.02-1.46		
DM	No	22	500,721	1.00		60	407,614	1.00		67	135,356	1.00			
	Yes	3	22,111	2.68	0.77-9.36	3	26,826	0.51	0.13-1.91	9	12,170	1.55	0.71-3.35		
Presence of spouse	No	3	41,342	1.75	0.51-6.04	9	62,253	1.32	0.63-2.74	23	44,249	1.41	0.83-2.40		
	Yes	22	475,269	1.00		54	363,910	1.00		51	98,775	1.00			
Education year	<16 years	5	156,011	0.48	0.17-1.36	29	169,527	1.45	0.79-2.65	43	65,196	1.95	1.09-3.47		
	<19 years	13	217,026	1.00		17	159,995	1.00		16	44,317	1.00			
	≥19 years	0	50,946	NA		5	45,371	0.84	0.31-2.27	6	14,344	0.95	0.37-2.44		
				p for trend 0.986				p for trend 0.068				p for trend 0.068			
Drinking status	Non drinker	11	286,301	1.00		32	272,395	1.00		35	104,518	1.00			
	<23 g/day	2	68,994	0.71	0.15-3.31	4	50,815	0.54	0.19-1.58	10	15,525	1.57	0.76-3.26		
	23-45.9 g/day	3	47,892	1.15	0.28-4.77	12	43,783	1.51	0.72-3.20	13	14,311	1.78	0.88-3.60		
	46-68.9 g/day	5	43,994	2.11	0.60-7.40	8	32,344	1.36	0.58-3.23	3	6,732	0.85	0.25-2.90		
	≥69 g/day	1	20,925	0.91	0.11-7.94	6	11,090	3.45	1.32-9.02	1	1,982	1.11	0.15-8.38		
				p for trend 0.791				p for trend 0.778				p for trend 0.248			

All results were adjusted for age, sex, APO, MI, HT, DM, presence of spouse, education year, smoking, body mass index and drinking status.

APO: apoplexy, MI: myocardial infarction, HT: hypertension, DM: diabetes mellitus

between men and women may affect the risk of death from foreign bodies in the respiratory tract. Further investigations are needed to determine the cause of these sex differences in airway problems.

Differences in countries and food cultures affect the causes of FBAO. In Japan, there is a culture of eating hot and soft rice cakes during the new year, and indeed, about 25% of rice-cake-related FBAO incidents occur within the first 3 days of the new year (14). Regional variations in incidents of FBAO in Japan due to the consumption of rice cakes are also reported (5). In Italy, pizza is reported to be the food with the highest risk of FBAO for adults (27). Tube feeding has also been reported as a potential risk factor of FBAO, the installation of which has recently been increasing among patients in Japan (28).

Several limitations associated with the present study warrant mention. First, we evaluated the mortality of participants using ICD-10 (T17: "Foreign body in respiratory tract") and ICD-9 codes (933: "Foreign body in the pharynx and larynx" and 934: "Foreign body in the trachea, bronchus, and lung"). Data concerning external causes of death were not collected in this study, so we were unable to examine the relationship with the following ICD-10 (W79: "Inhalation and ingestion of food causing obstruction of the respiratory tract") and ICD-9 codes (799: "Asphyxia"). Second, because this study was based on information from a baseline

questionnaire survey, we were unable to adjust for detailed information about changes in lifestyle, living environment and the physical condition of the participants. Third, although previous studies reported that a rapid and appropriate response was related to the prognosis of asphyxia (12, 13), we were unable to obtain detailed information concerning the emergency care delivered by the witness. Further detailed investigations are needed concerning the risk factors for death from foreign bodies in the respiratory tract.

In conclusion, older age, male sex, a medical history of APO and the absence of a spouse were potential risk factors for death from foreign bodies in the respiratory tract. It is important to ensure that elderly men with a history of APO who do not have a spouse maintain social connections, such as cohabitants or relatives, to aid in the early detection of asphyxia. The prognosis of cardiac arrest from foreign bodies in the respiratory tract is poor, so we should be familiar with the risk factors of airway problems and pay attention to elderly individuals with multiple risk factors in order to prevent avoidable deaths from foreign bodies in the respiratory tract.

The authors state that they have no Conflict of Interest (COI).

Acknowledgments

The authors of this study thank all of the staff members in-

involved in the JACC study for their efforts in conducting the baseline survey and follow-up.

References

- Kramarow E, Chen LH, Hedegaard H, Warner M. Deaths from unintentional injury among adults aged 65 and over: United States, 2000-2013. *NCHS Data Brief* **199**: 2015.
- Pavitt MJ, Nevett J, Swanton LL, et al. London ambulance source data on choking incidence for the calendar year 2016: an observational study. *BMJ Open Respir Res* **4**: e000215, 2017.
- Chung CH, Lai CH, Chien WC, Lin CH, Cheng CH. A population-based study of inpatients admitted due to suffocation in Taiwan during 2005-2007. *Accid Anal Prev* **50**: 523-529, 2013.
- Landoni G, Morselli F, Silveti S, Frontera A, Zangrillo A. Pizza in adults and grape in children are the most frequent causes of foreign body airway obstruction in Italy. A national media-based survey. *Resuscitation* **149**: 141-142, 2020.
- Taniguchi Y, Iwagami M, Sakata N, Watanabe T, Abe K, Tamiya N. Epidemiology of food choking deaths in Japan: time trends and regional variations. *J Epidemiol* **31**: 356-360, 2020.
- Kawashima K, Motohashi Y, Fujishima I. Prevalence of dysphagia among community-dwelling elderly individuals as estimated using a questionnaire for dysphagia screening. *Dysphagia* **19**: 266-271, 2004.
- Ministry of Health, Labor and Welfare in Japan. Report of vital statistics in 2019 [Internet]. [cited 2021 Apr 5]. Available from: <https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei19/index.html>.
- Kinoshita K, Azuhata T, Kawano D, Kawahara Y. Relationships between pre-hospital characteristics and outcome in victims of foreign body airway obstruction during meals. *Resuscitation* **88**: 63-67, 2015.
- Muder RR. Pneumonia in residents of long-term care facilities: epidemiology, etiology, management, and prevention. *Am J Med* **105**: 319-330, 1998.
- Makhnevich A, Feldhamer KH, Kast CL, Sinvani L. Aspiration pneumonia in older adults. *J Hosp Med* **14**: 429, 2019.
- Kramarow E, Warner M, Chen LH. Food-related choking deaths among the elderly. *Inj Prev* **20**: 200-203, 2014.
- Igarashi Y, Yokobori S, Yoshino Y, Masuno T, Miyauchi M, Yokota H. Prehospital removal improves neurological outcomes in elderly patient with foreign body airway obstruction. *Am J Emerg Med* **35**: 1396-1399, 2017.
- Inamasu J, Miyatake S, Tomioka H, et al. Cardiac arrest due to food asphyxiation in adults: resuscitation profiles and outcomes. *Resuscitation* **81**: 1082-1086, 2010.
- Kiyohara K, Sakai T, Nishiyama C, et al. Epidemiology of out-of-hospital cardiac arrest due to suffocation focusing on suffocation due to Japanese rice cake: a population-based observational study from the Utstein Osaka Project. *J Epidemiol* **28**: 67-74, 2018.
- Soroudi A, Shipp HE, Stepanski BM, et al. Adult foreign body airway obstruction in the prehospital setting. *Prehospital Emerg Care* **11**: 25-29, 2007.
- Igarashi Y, Norii T, Sung-Ho K, et al. New classifications for life-threatening foreign body airway obstruction. *Am J Emerg Med* **37**: 2177-2181, 2019.
- Olasveengen TM, Mancini ME, Perkins GD, et al. Adult basic life support: international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Resuscitation* **156**: A35-A79, 2020.
- Tamakoshi A, Ozasa K, Fujino Y, et al. Cohort profile of the Japan Collaborative Cohort study at final follow-up. *J Epidemiol* **23**: 227-232, 2013.
- Dolkas L, Stanley C, Smith AM, Vilke GM. Deaths associated with choking in San Diego county. *J Forensic Sci* **52**: 176-179, 2007.
- Wick R, Gilbert JD, Byard RW. Café coronary syndrome-fatal choking on food: an autopsy approach. *J Clin Forensic Med* **13**: 135-138, 2006.
- Clavé P, Shaker R. Dysphagia: current reality and scope of the problem. *Nat Rev Gastroenterol Hepatol* **12**: 259-270, 2015.
- Schnoll-Sussman F, Katz PO. Managing esophageal dysphagia in the elderly. *Curr Treat Options Gastroenterol* **14**: 315-326, 2016.
- Kikutani T, Tamura F, Tohara T, Takahashi N, Yaegaki K. Tooth loss as risk factor for foreign-body asphyxiation in nursing-home patients. *Arch Gerontol Geriatr* **54**: e431-e435, 2012.
- Crouse EL, Alastanos JN, Bozymski KM, Toscano RA. Dysphagia with second-generation antipsychotics: a case report and review of the literature. *Ment Heal Clin* **7**: 56-64, 2017.
- Norii T, Igarashi Y, Sung-Ho K, et al. Protocol for a nationwide prospective, observational cohort study of foreign-body airway obstruction in Japan: the MOCHI registry. *BMJ Open* **10**: 1-6, 2020.
- Berzlanovich AM, Muhm M, Sim E, Bauer G. Foreign body asphyxiation - an autopsy study. *Am J Med* **107**: 351-355, 1999.
- Landoni G, Morselli F, Silveti S, et al. Pizza in adults and grape in children are the most frequent causes of foreign body airway obstruction in Italy. A national media-based survey. *Resuscitation* **149**: 141-142, 2020.
- Komiya K, Ishii H, Iwashita T, et al. Risk factors for unexpected death from suffocation in elderly patients hospitalized for pneumonia. *Geriatr Gerontol Int* **13**: 388-392, 2013.

The Internal Medicine is an Open Access journal distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view the details of this license, please visit (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).