

ORIGINAL RESEARCH

TRENDS IN THE PREVALENCE OF FRAILTY IN JAPAN: A META-ANALYSIS FROM THE ILSA-J

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Abstract: *Objective:* To examine whether age-specific prevalence of frailty in Japan changed between 2012 and 2017. *Design:* This study performed meta-analyses of data collected from 2012 to 2017 using the Integrated Longitudinal Studies on Aging in Japan (ILSA-J), a collection of representative Japanese cohort studies. *Setting:* The ILSA-J studies were conducted on community-living older adults. *Participants:* ILSA-J studies were considered eligible for analysis if they assessed physical frailty status and presence of frailty in the sample. Seven studies were analyzed for 2012 (± 1 year; $n = 10312$) and eight studies were analyzed for 2017 (± 1 year; $n = 7010$). Five studies were analyzed for both 2012 and 2017. *Measurements:* The study assessed the prevalence of frailty and frailty status according to 5 criteria: slowness, weakness, low activity, exhaustion, and weight loss. *Results:* The overall prevalence of physical frailty was 7.0% in 2012 and 5.3% in 2017. The prevalence of frailty, especially in people 70 years and older, tended to decrease in 2017 compared to 2012. Slight decreases were found in the prevalence of frailty subitems including weight loss, slowness, exhaustion, and low activity between 2012 and 2017, but change in the prevalence of weakness was weaker than other components. *Conclusions:* The prevalence of physical frailty decreased from 2012 to 2017. There are age- and gender-related variations in the decrease of each component of frailty.

Key words: Frailty, aging, cohort study, older.

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Introduction

Frailty is defined as a clinically recognizable state of increased vulnerability in older adults resulting from age-associated declines in physiologic reserves and function across multiple organ systems (1). Although it is recognized as a multidimensional construct, comprising psychological and social conditions and symptoms in addition to physical, the physical frailty phenotype is well defined and its impact on adverse health outcomes such as disability, hospitalization, and death has been examined in many prior studies (2-5). Clinical practice guidelines based on the current evidence base provide recommendations for identifying and managing frailty in older adults (6). Reducing the risk and prevalence of frailty may play an important role in extending healthy life expectancy in the aged population.

The most common components used to assess physical frailty are the frailty phenotype proposed by Fried et al. using data from the Cardiovascular Health Study (CHS) (2). Based on the Fried criteria, a wide prevalence of frailty has been

reported among community-dwelling people aged 65 years and older, ranging from 4% to 27% (7, 8). In Japan, with a rapidly increasing aging population, the overall prevalence of frailty was 7.4%, with a similar prevalence in men (7.6%) and women (8.1%) (9). These prevalence rates increased with advancing age (1.9%, 3.8%, 10.0%, 20.4%, and 35.1% for people aged 65 to 69, 70 to 74, 75 to 79, 80 to 84, and 85 or older, respectively) (9).

In the past several decades, both life and health expectancy have increased in many countries. In Japan, the average life expectancy was 81.3 years for men and 87.3 years for women in 2018, according to data from the Ministry of Health. There may be improvement in physical health status among older adults based on increased life and health expectancy. Although previous studies indicated the prevalence of frailty in a large cohort or meta-analysis, no studies focused on trends in the prevalence of frailty and assessment years.

This study performed meta-analyses using data from the National Center for Geriatrics and Gerontology's Integrated Longitudinal Studies on Aging in Japan (ILSA-J), a collection

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Table 1
Characteristics of the cohort studies included in the meta-analysis

Cohort	2012							2017						
	N of subjects	Gender (Women %)	Age group (n)					N of subjects	Gender (Women %)	Age group (n)				
			65-69	70-74	75-79	80-84	85-89			65-69	70-74	75-79	80-84	85-89
A	4779	51.1%	1898	1479	866	412	124	1249	49.2%	0	0	667	433	149
B	874	48.6%	239	234	208	136	57	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C	545	100.0%	0	0	111	333	101	1021	100.0%	389	317	271	44	0
D	564	55.0%	162	151	135	87	29	590	59.6%	127	178	156	94	35
E	791	57.0%	212	245	207	99	28	831	57.2%	335	157	192	99	48
F	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1196	59.5%	0	376	457	282	81
G	809	67.6%	206	218	188	139	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H	1950	50.4%	631	625	432	205	57	927	47.2%	45	371	294	158	59
I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	287	55.1%	86	81	49	51	20
J	N/A	N/A	N/A	N/A	N/A	N/A	N/A	909	63.7%	210	264	196	160	79

of 13 longitudinal cohort studies on aging in Japan involving community-dwelling older adults, to test whether the age-specific prevalence of frailty changed in Japan between 2012 and 2017.

Methods

Data Sources

This study performed meta-analyses using ILSA-J data on frailty. The ILSA-J included a total of 13 longitudinal cohort studies conducted throughout Japan (Table 1). Studies were considered eligible for inclusion in the present analysis if they assessed physical frailty status and prevalence of frailty in the sample using the Fried criteria (2) (e.g., slowness, weakness, exhaustion, low activity, and weight loss). Of the 13 cohort studies, 7 (total n = 10312; 4611 men and 5701 women) were analyzed for 2012 (±1 year), and 8 (total n = 7010; 2662 men and 4348 women) were analyzed for 2017 (±1 year). Finally, only 10 of the 13 cohort studies in the ILSA-J project were included in this meta-analysis, because 3 cohort studies did not provide data on frailty status in 2012 and 2017.

Main Outcome Measures and Operational Definition of Frailty

The main outcome measures in this study were the prevalence of frailty status and the five frailty sub-items (%). This study determined physical frailty status according to the 5 criteria of physical frailty suggested by the Japanese version of the CHS (J-CHS) (10, 11) and a slightly revised criterion: weight loss, slowness, weakness, exhaustion, and low activity. Participants whose responses did not correspond to any of these target criteria were considered to be robust; those who responded positively for 1 or 2 criteria were considered pre-frail; and those with 3 or more positive criteria responses were considered frail.

Although all the cohort studies included in the current

meta-analysis used the same 5 criteria to assess frailty status, there were differences in the subcriteria (Appendix table 1). The 5 criteria defining physical frailty were assessed as follows. Weight loss was identified by a response of “yes” to the question (12), “Have you lost 2 kg or more in the past 6 months?” Slowness was identified by a normal walking speed of <1.0 m/s (10). Weakness was identified according to grip strength of the subject’s dominant hand: <26 kg for men and <18 kg for women (13). Exhaustion was identified by a response of “yes” to the question (12), “In the last 2 weeks, have you felt tired for no reason?” Low activity was identified by a response of “no” to both the following questions (10): “Do you engage in moderate levels of physical exercise or sports aimed at health?” and “Do you engage in low levels of physical exercise aimed at health?”

Data Collection

All ILSA-J cohort studies were approved by the ethics committee of the relevant university or institute. Among the 13 total cohort studies, those that assessed frailty provided data on the prevalence of frailty status (frailty, pre-frailty, and robust) and the 5 frailty subitems for meta-analyses. Thus, no author of the present study could access participants’ individual data.

Statistical Analysis

A two-step approach was used in the current study. First, we obtained the frailty prevalence in each cohort study separately, then, we calculated the combined prevalence using meta-analysis. The prevalence rates of frailty and pre-frailty for the years 2012 and 2017 were calculated by age group and gender. The 5 frailty items were also included to calculate prevalence. The present meta-analysis used a two-step approach. First, Cochran’s Q test was used to assess the presence of heterogeneity across cohorts, indicated by p<0.05, and I2 statistic values of 25%, 50%, and 75% indicated low, moderate, and high degrees of heterogeneity, respectively (14).

Table 2
 Prevalence of physical frailty by age group

Age group			Heterogeneity		
(N of studies, N of subjects)	Prevalence % (95% CI)		Q-value	p	I-squared
All					
2012					
All (7 studies, n=10312)	7.0(5.4-9.0)		602.15	0.00	89.70
65-69 (6 studies, n=3348)	2.0(1.6-2.6)		9.26	0.60	0.00
70-74 (6 studies, n=2952)	3.7(2.6-5.1)		25.72	0.01	57.24
75-79 (7 studies, n=2147)	7.4(5.3-10.3)		52.64	0.00	77.20
80-84 (7 studies, n=1411)	12.6(9.1-17.1)		54.42	0.00	77.95
85-89 (7 studies, n=454)	23.2(15.8-32.7)		45.46	0.00	73.60
2017					
All (8 studies, n=7010)	5.3(4.3-6.6)		225.52	0.00	70.29
65-69 (6 studies, n=1192)	2.2(1.5-3.3)		3.61	0.96	0.00
70-74 (7 studies, n=1744)	2.9(2.2-4.0)		15.37	0.22	21.94
75-79 (8 studies, n=2282)	4.4(3.6-5.3)		18.75	0.17	25.34
80-84 (8 studies, n=1321)	8.4(6.9-10.1)		23.36	0.05	40.07
85-89 (7 studies, n=471)	17.0(13.8-20.9)		12.99	0.45	0.00
Men					
2012					
65-69 (6 studies, n=1540)	1.9(1.3-2.8)		4.49	0.48	0.00
70-74 (6 studies, n=1434)	3.9(3.0-5.1)		7.94	0.16	37.04
75-79 (6 studies, n=942)	6.3(3.5-10.8)		18.65	0.00	73.18
80-84 (6 studies, n=519)	9.9(6.0-16.0)		14.02	0.02	64.33
85-89 (6 studies, n=176)	24.6(18.4-32.1)		11.05	0.05	54.75
2017					
65-69 (5 studies, n=357)	2.4(1.2-4.8)		1.72	0.79	0.00
70-74 (6 studies, n=629)	2.5(1.5-4.4)		5.54	0.35	9.67
75-79 (7 studies, n=882)	3.2(2.1-4.6)		4.47	0.61	0.00
80-84 (7 studies, n=565)	6.8(4.9-9.4)		7.22	0.30	16.85
85-89 (7 studies, n=229)	16.4(12.0-22.1)		6.59	0.36	9.00
Women					
2012					
65-69 (6 studies, n=1808)	2.1(1.5-2.9)		4.63	0.46	0.00
70-74 (6 studies, n=1518)	4.0(2.4-6.6)		14.28	0.01	65.00
75-79 (7 studies, n=1205)	8.1(5.0-12.8)		31.22	0.00	80.78
80-84 (7 studies, n=892)	14.8(9.5-22.3)		37.01	0.00	83.79
85-89 (7 studies, n=278)	26.3(14.9-42.2)		32.68	0.00	81.64
2017					
65-69 (6 studies, n=835)	2.2(1.4-3.5)		1.83	0.87	0.00
70-74 (7 studies, n=1115)	3.1(2.2-4.5)		9.44	0.15	36.42
75-79 (8 studies, n=1400)	5.0(3.9-6.3)		10.37	0.17	32.48
80-84 (8 studies, n=756)	9.4(7.4-11.9)		13.59	0.06	48.50
85-89 (7 studies, n=242)	17.6(13.2-23.1)		6.29	0.39	4.61

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Then, prevalence and 95% confidence intervals (CIs) were calculated for frailty and pre-frailty using a random-effects model if heterogeneity was present ($p < 0.05$) and a fixed-effects model if heterogeneity was absent based on Cochran's Q test (9). In addition, we performed a sensitivity analysis restricting the meta-analysis to surveys performed at both time-points, 2012 and 2017. Statistical analyses were completed using Comprehensive Meta-Analysis software (Version 3; Biostat, Englewood, NJ, USA).

Results

Table 2 presents the data on the presence of heterogeneity across cohorts and the prevalence of physical frailty among each age group in 2012 and 2017. There was a slight decrease (1.7%) in overall prevalence of physical frailty between 2012 and 2017. The overall prevalence of physical frailty was 7.0% (95% CI 5.4-9.0%) in 2012 and 5.3% (95% CI 4.3-6.6%) in 2017. The sensitivity analysis restricted to surveys with data at both time-points (2012 and 2017) provided similar results to the main analysis (Appendix table 2). Greater decreases in the prevalence of frailty were found in adults aged 75 years and older. Specifically, in 2012, the prevalence of frailty was 7.4% in the 75-79 age group, 12.6% in the 80-84 group, and 23.2% in the 85-89 group. In 2017, a 3.0% decrease was found in the 75-79 age group, a 4.2% decrease in the 80-84 group, and a 6.2% decrease in the 85-89 group.

Among men, frailty prevalence increased with advancing age in both 2012 and 2017. In 2012, prevalence was 6.3% in the 75-79 age group, 9.9% in the 80-84 group, and 24.6% in the 85-89 group; in 2017, a decrease of 3.1% was found in the 75-79 age group (prevalence of 3.2%), 3.1% in the 80-84 group (prevalence of 6.8%), and 8.2% in the 85-89 group (prevalence of 16.4%).

Similar trends were observed in women. The prevalence of frailty in 2012 was 8.1% in the 75-79 age group, 14.8% in the 80-84 group, and 26.3% in the 85-89 group. In 2017, a decrease of 3.1% was found in the 75-79 age group (prevalence of 5.0%), 5.4% in the 80-84 group (prevalence of 9.4%), and 8.7% in the 85-89 group (prevalence of 17.6%).

The gender-stratified prevalence of physical frailty subitems is shown in Tables 3 and 4. Regardless of gender, slight decreases (less than 5%) in the subitems were found between 2012 and 2017 among young old groups (ages 65-69 and 70-74), with the exception of low activity in men aged 65-69 and women aged 70-74. Differing trends between men and women were found among old groups (ages 75-79, 80-84, and 85-89). In men, subitems with greater decreases (more than 5%) included exhaustion, which decreased 6.0% in the 75-79 age group, 5.2% in the 80-84 group, and 8.9% in the 85-89 group; slowness, which decreased 7.7% in the 85-59 group; and low activity, which decreased 7.2% in the 85-89 group.

Compared with men, women were found to have decreased prevalence in many components. In the 75-79 age group, all

components except for weakness decreased (weight loss, 9.7%; slowness, 5.8%; exhaustion, 7.3%; low activity, 6.4%). All components decreased in the 80-84 and 85-89 groups (weight loss, 7.5% and 8.1%, respectively; slowness, 12.1% and 16.6%; weakness, 6.1% and 5.5%; exhaustion, 9.3% and 5.8%; low activity, 5.4% and 5.9%).

Discussion

This study performed meta-analyses using data from ILSA-J cohort studies and showed that the prevalence of frailty tended to decrease in 2017 compared to 2012, especially in adults 75 years and older. The sensitivity analysis confirmed the main findings and indicates that this increases the robustness of the findings.

A recent systematic review of articles published in 28 countries estimated the global incidence of frailty among community-dwelling adults (15). Among robust individuals who survived a median follow-up of 3.0 years, 13.6% became frail, with a pooled incidence rate of 43.4 cases per 1000 person-years (15); incidence rates varied by diagnostic criteria and country income level. Previous systematic review and meta-analysis studies have also suggested variation in the prevalence of frailty based on diagnostic criteria (16), country income level (17), and residential environment (18, 9). Additionally, the prevalence of frailty among community-dwelling older adults has been reported to differ based on race (9, 19). Therefore, the influences of those characteristics should be considered when discussing the prevalence of frailty and prevention strategies.

Most systematic review and meta-analysis studies that examine the prevalence of frailty include articles published after 2000. Worldwide, there were 901 million people aged 60 years or over in 2015, an increase of 48% over the global total of 607 million older people in 2000 (20). The global number of people aged 60 years or over increased by 68% in urban areas, compared to 25% in rural areas, from 2000 to 2015 (20). In Japan, approximately 12% of the population was 65 years or older in 1990, about the same as the total in the USA in 1990 (21). By 2010, the 65 and older population in Japan doubled, rising from 15 million to 29 million and comprising 23% of the total population, the highest proportion in the world (21). The percentage rose to over 28% in 2019. Although the number of older people in Japan is increasing rapidly, their latent capabilities and background factors can be changed. Health-related measures among Japanese community-dwelling older adults from 2007 to 2017 indicate that a phenomenon of "rejuvenation" is occurring among the new generation of older Japanese adults (22). In the United States, dementia declined significantly between 2000 and 2012, and one associated factor was an increase in educational attainment (23). Thus, better change in older adults' latent capabilities and background factors may lead to a decrease in the prevalence of frailty.

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Table 3
 Prevalence of physical frailty components (Men)

Age group	2012					2017		
	Prevalence % (95% CI)	Heterogeneity			Prevalence % (95% CI)	Heterogeneity		
		Q-value	p	I-squared		Q-value	p	I-squared
Weight loss								
65-69	16.2(14.4-18.2)	7.79	0.17	35.83	16.8(13.2-21.1)	2.19	0.70	0.00
70-74	14.1(10.1-19.4)	22.00	0.00	77.27	13.0(10.5-15.9)	7.94	0.16	37.05
75-79	13.7(11.7-16.1)	3.71	0.59	0.00	10.0(8.2-12.3)	5.99	0.42	0.00
80-84	15.1(12.1-18.5)	8.77	0.12	42.98	10.5(8.0-13.6)	5.87	0.44	0.00
85-89	13.7(9.2-19.8)	2.70	0.75	0.00	14.5(10.4-19.9)	5.01	0.54	0.00
Slowness								
65-69	4.2(1.7-10.1)	35.72	0.00	86.00	3.3(1.9-5.9)	0.87	0.93	0.00
70-74	6.9(2.8-15.8)	66.53	0.00	92.48	5.6(3.0-10.2)	13.45	0.02	62.82
75-79	10.1(4.8-20.1)	53.46	0.00	90.65	8.9(5.4-14.2)	21.56	0.00	72.17
80-84	20.7(10.7-36.4)	53.22	0.00	90.60	16.8(11.3-24.1)	18.66	0.00	67.84
85-89	38.5(19.0-62.6)	33.39	0.00	85.03	30.8(24.9-37.4)	11.30	0.08	46.88
Weakness								
65-69	2.0(0.8-4.9)	15.51	0.01	67.75	4.6(2.8-7.4)	1.55	0.82	0.00
70-74	6.8(5.5-8.2)	10.46	0.06	52.20	6.9(4.0-11.8)	14.16	0.01	64.68
75-79	11.6(7.7-17.1)	19.27	0.00	74.06	10.4(7.5-14.4)	13.28	0.04	54.81
80-84	20.8(14.3-29.2)	18.95	0.00	73.61	19.4(16.3-22.9)	10.33	0.11	41.92
85-89	32.9(20.4-48.4)	16.88	0.00	70.38	39.5(27.6-52.8)	17.70	0.01	66.10
Exhaustion								
65-69	12.2(6.8-20.8)	55.48	0.00	90.99	12.0(7.1-19.6)	9.80	0.04	59.19
70-74	13.8(7.0-25.4)	86.52	0.00	94.22	13.4(10.9-16.3)	3.31	0.65	0.00
75-79	19.0(12.5-27.8)	36.45	0.00	86.28	13.0(8.8-18.8)	22.03	0.00	72.76
80-84	23.5(16.1-32.9)	22.28	0.00	77.56	18.3(11.3-28.1)	31.69	0.00	81.07
85-89	29.8(18.8-43.8)	14.41	0.01	65.30	20.9(15.9-26.9)	8.84	0.18	32.13
Low activity								
65-69	20.0(13.3-29.1)	50.15	0.00	90.03	26.0(21.6-30.8)	6.04	0.20	33.82
70-74	17.8(11.9-25.9)	42.51	0.00	88.24	15.6(12.9-18.7)	9.69	0.08	48.42
75-79	20.8(13.5-30.7)	42.08	0.00	88.12	16.0(13.7-18.6)	8.49	0.20	29.31
80-84	21.1(12.3-33.9)	39.61	0.00	87.38	16.9(14.0-20.3)	8.04	0.23	25.40
85-89	26.8(14.9-43.4)	17.18	0.00	70.90	19.6(14.9-25.3)	2.63	0.85	0.00

Note. Sample sizes for 2012 age groups were as follows: 65-69, n=1540 (6 studies); 70-74, n=1434 (6 studies); 75-79, n=942 (6 studies); 80-84, n=519 (6 studies); 85-89, n=176 (6 studies). Sample sizes for 2017 age groups were as follows: 65-69, n=357 (5 studies); 70-74, n=629 (6 studies); 75-79, n=882 (7 studies); 80-84, n=565 (7 studies); 85-89, n=229 (7 studies).

Several important factors, such as comorbidities, low socioeconomic position, poor diet, and sedentary lifestyle, increase the risks of frailty (24). Some of these are modifiable. Therefore, it may be possible to reduce the prevalence of frailty by controlling or improving risk factors. Although this study's meta-analyses had a relatively short observational term of 5 years, decreasing trends in the prevalence of frailty may become clearer based on long-term observation.

Among 5 components of frailty, weakness and slowness may have greater impacts on increased risk of disability (11, 25). In this study, there was a decreasing trend in the prevalence of almost all items, however there was less change in the prevalence of weakness compared with other items. No change or a slight increase in the prevalence of weakness was observed in men in all age groups, whereas for women, only a decrease in the 80 years and older group was observed.

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Table 4
Prevalence of physical frailty components (Women)

Age group	2012					2017			
	Prevalence % (95% CI)	Heterogeneity			Prevalence % (95% CI)	Heterogeneity			
		Q-value	p	I-squared		Q-value	p	I-squared	
Weight loss									
65-69	13.5(10.0-17.9)	21.38	0.00	76.61	12.1(10.0-14.5)	2.59	0.76	0.00	
70-74	13.1(11.4-14.9)	5.40	0.37	7.38	9.5(6.2-14.2)	26.26	0.00	77.15	
75-79	17.3(15.2-19.6)	7.51	0.28	20.11	7.6(5.1-11.2)	27.10	0.00	74.17	
80-84	18.0(15.6-20.7)	6.34	0.39	5.41	10.5(7.1-15.2)	18.00	0.01	61.11	
85-89	22.1(17.5-27.5)	5.28	0.51	0.00	14.0(10.0-19.2)	3.47	0.75	0.00	
Slowness									
65-69	4.1(2.3-7.3)	20.69	0.00	75.84	4.7(3.4-6.5)	6.29	0.28	20.49	
70-74	6.0(2.9-12.2)	51.15	0.00	90.22	4.2(2.5-7.0)	16.95	0.01	64.60	
75-79	16.5(9.2-28.0)	101.01	0.00	94.06	10.7(9.2-12.5)	8.26	0.31	15.29	
80-84	32.0(19.9-47.2)	98.14	0.00	93.89	19.9(15.5-25.2)	16.60	0.02	57.84	
85-89	54.3(36.9-70.7)	37.70	0.00	84.08	37.7(31.7-44.1)	9.48	0.15	36.71	
Weakness									
65-69	7.0(3.8-12.3)	38.77	0.00	87.10	9.3(7.5-11.5)	5.41	0.37	7.59	
70-74	10.3(6.9-15.1)	26.01	0.00	80.78	11.7(8.2-16.4)	24.26	0.00	75.27	
75-79	19.1(12.0-29.1)	74.73	0.00	91.97	19.9(16.4-23.8)	19.00	0.01	63.17	
80-84	33.1(26.7-40.0)	23.01	0.00	73.92	27.0(21.0-33.9)	24.12	0.00	70.98	
85-89	55.1(49.1-60.9)	9.43	0.15	36.40	49.6(43.2-56.0)	8.67	0.19	30.83	
Exhaustion									
65-69	15.0(9.9-22.0)	47.08	0.00	89.38	13.9(9.8-19.5)	14.50	0.01	65.51	
70-74	20.6(14.6-28.3)	43.34	0.00	88.46	15.9(12.7-19.6)	13.87	0.03	56.74	
75-79	26.7(19.6-35.2)	49.42	0.00	87.86	19.4(15.3-24.3)	28.13	0.00	75.11	
80-84	29.6(20.9-40.1)	49.44	0.00	87.86	20.3(14.5-27.5)	29.17	0.00	76.01	
85-89	31.3(19.7-45.9)	27.55	0.00	78.22	25.5(16.4-37.5)	17.80	0.01	66.30	
Low activity									
65-69	16.8(12.1-22.8)	31.84	0.00	84.30	17.9(15.4-20.7)	6.01	0.30	16.84	
70-74	18.0(13.9-22.9)	20.55	0.00	75.67	12.4(10.6-14.4)	2.54	0.86	0.00	
75-79	18.3(13.6-24.0)	29.01	0.00	79.32	11.9(8.9-15.8)	23.49	0.00	70.20	
80-84	21.0(14.3-29.8)	41.50	0.00	85.54	15.6(13.2-18.4)	5.64	0.58	0.00	
85-89	27.4(16.8-41.4)	25.60	0.00	76.56	21.5(16.6-27.3)	7.36	0.29	18.46	

Note. Sample sizes for 2012 age groups were as follows: 65-69, n=1808 (6 studies); 70-74, n=1518 (6 studies); 75-79, n=1205 (7 studies); 80-84, n=892 (7 studies); 85-89, n=278 (7 studies). Sample sizes for 2017 age groups were as follows: 65-69, n=835 (6 studies); 70-74, n=1115 (7 studies); 75-79, n=1400 (8 studies); 80-84, n=756 (8 studies); 85-89, n=242 (7 studies).

This study found significant differences in frailty prevalence between men and women. Older women, especially in the old-old population (aged 75 years and over), were found to have decreased prevalence in almost all frailty items. Recently, the ILSA-J reported differences between the years 2007 (± 2 years) and 2017 (± 2 years) in several indices (e.g., body composition, walking speed, and grip strength) that are related to the health and functioning of older adults (22). Better health status and a slower decline in most of the health-related measures were

observed in 2017 compared with a decade ago. Japanese older adults living in the community have been consistently increasing their walking speed over the past 25 years, and the improvement in walking speed is especially striking in women (26, 27). In a previous study that analyzed IADL performance in 17,680 older adults with dependency in basic ADL, the men were found to have 3 times higher prevalence of poor performance of IADL compared with the women (28). Older adult women may reduce age-related decline in functional level

by increasing or maintaining the multidimensional aspects of their lives, such as social and leisure time activities. In addition, our data showed higher study participation rates in women than in men for both 2012 and 2017. These findings may indicate that women have more interest in their health compared with men. Increased interest in personal health may prevent or delay the progression of frailty.

Consistent “female disadvantage” in physical performance among older adults has been demonstrated (29). One previous study with 4683 Japanese nondisabled community-dwelling older adults demonstrated increasing significant gender differences in one-legged stance performance and gait speed with age. In contrast, gender differences significantly decreased in hand-grip strength with increasing age (30). In other words, strength may be more affected by advancing age in older adult men than in older adult women. Thus, preventing or delaying the progression of weakness with age may be difficult in men. Weakness was determined according to grip strength of the subject’s dominant hand, with cutoff values of 26 kg for men and 18 kg for women. Although the average values of grip strength may decrease slightly in new generation of Japanese older adults (22), the changes may not reach sufficient levels, indicating that this component is less susceptible to generation changes than the others.

Several limitations of the present study should be noted. First, the meta-analyses in the present study used cross-sectional data from 7 cohort studies in 2012 (± 1 year) and 8 cohort studies in 2017 (± 1 year). Therefore, the study design was not longitudinal, following the same individuals and cohorts. Second, the current study used data from 2012 and 2017, analyzing the trends in prevalence over a period of 5 years. This may be too short to fully examine trends of change. Third, the number of participants varied widely by age group, especially participants in the 85 and older group, which had a relatively small sample size (fewer than 200 men in 2012). Finally, assessment protocols were dependent on each cohort study, not unified across all cohorts. We believe that the cohort studies included in the current meta-analysis had high data quality, but not all of the studies were designed using probabilistic samples. For instance, recruitment methods (e.g., random sampling, direct mail to all citizen, and volunteers) varied. In addition, more knowledge on the prevalence of the risk factors for frailty and those components, such as comorbidities, nutritional status, and cognitive function will support the phenomenon of decreasing frailty in the new generation of Japanese older adults.

Although this study examines a relatively short period of time (5 years), it has several strengths. First, it is, to our knowledge, the first study to describe trends in the prevalence of frailty. Second, the prevalence of frailty and subitems were assessed through a meta-analysis of 10 Japanese cohort studies, which provided data from 287 to 4779 older adults. Third, frailty status was assessed not only by questionnaires but also by objective measures such as grip strength and walking speed;

therefore, are results may reflect functional status.

In conclusion, the current meta-analyses suggested that the prevalence of frailty has shown a decreasing trend in the new generation of Japanese older adults, especially in adults aged 75 years and older. This finding may indicate physical rejuvenation in older adults. Progression of this trend may improve health expectancy and shorten the gap between life expectancy and health expectancy. Future studies with more long-term follow-up period and a larger sample will be needed to clarify the trends in the prevalence of frailty among community-dwelling older adults.

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Conflicts of Interest: None declared.

Ethics Statement: This study was conducted in compliance with the current laws of Japan.

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