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Original Article

Orthopedic, ophthalmic, and psychiatric diseases primarily affect activity limitation for Japanese males and females: Based on the Comprehensive Survey of Living Conditions

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ABSTRACT

Background: Healthy life expectancy (HLE) is used as one of the primary objectives of fundamental health promotion plans and social development plans. Activity limitation is used to calculate HLE, but little study has been done to identify determinants of activity limitation in order to extend HLE. The purpose of this study is to identify diseases and injuries that commonly lead to activity limitation to prioritize countermeasures against activity limitation.

Methods: We used anonymous data from the 2007 "Comprehensive Survey of Living Conditions," collected by the Ministry of Health, Labour and Welfare of Japan according to the Statistics Act, Article 36. We used logistic regression analyses and calculated odds ratios (ORs) after adjusting for age and sex. Limitation in daily activities was applied as the dependent variable, and each disease/injury was applied as an independent variable in this analysis. Furthermore, population attributable fractions (PAFs) were calculated.

Results: The provided data included 98,789 subjects. We used data for 75,986 valid subjects aged 12 years or older. The following diseases showed high PAF: backache (PAF 13.27%, OR 3.88), arthropathia (PAF 7.61%, OR 4.82), eye and optical diseases (PAF 6.39%, OR 2.01), and depression and other mental diseases (PAF 5.70%, OR 11.55). PAFs of cerebrovascular diseases, hypertension, and diabetes were higher for males than for females; on the other hand, PAFs of orthopedic diseases were higher among females.

Conclusions: Our results indicate that orthopedic diseases, ophthalmic diseases, and psychiatric diseases particularly affect activity limitation.

1. Introduction

Healthy life expectancy (HLE) is used as one of the primary objectives of fundamental health promotion plans[1–4] and social development plans. Japan has adopted HLE as the first objective of the national health promotion plan, Health Japan 21 (the second term), which was launched in 2012, and also uses HLE as a domain in other plans, such as the Japan Revitalization Strategy. The United States used HLE as one of the main target objectives for Healthy People 2010 and Healthy People 2020. The European Union (EU) adopted Healthy Life Years (HLY), which is the same as HLE, in social development plans, such as the Lisbon Strategy and Europe 2020, in addition to the health promotion plan of the EU health programme. Health-adjusted life expectancy (HALE), which is a kind of HLE, is also used to compare health status between countries.[1,5–7] Prolonging HLE is important for health policy in each country and region. Several studies have investigated the risk factors of reduced HLE and reported effects of educational disparities, socioeconomic status, and chronic diseases.[8–10] Hashimoto[11] reported that elimination of diseases and injuries in Japan increased HLE.

There are several indices for HLE, such as life expectancy without activity limitation, good perceived health, absence of chronic morbidity, and the average period of time spent

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independently in daily activities. Among them, the most popular index is life expectancy without activity limitation, calculated by the Sullivan method[12] using mortality rates and proportion of activity limitation for each age group. Therefore, revealing determinants of activity limitation is useful for prolonging HLE, aside from determinants of mortality. WHO[13] defines activity limitation as difficulty encountered by an individual in executing tasks or actions in everyday life. Difficulties in activities of daily living (ADL) correspond to the most severe level of activity limitation.[14] Many studies[15–17] have examined the risk factors of impairment of ADL. However, activity limitation, which is used to calculate HLE, is less serious than ADL impairment, and the risk factors of the two might be different. It is important to identify determinants of activity limitation in order to extend HLE.

The purpose of this study is to identify diseases and injuries associated with activity limitation so as to prioritize countermeasures.

2. Methods

2.1. Data

We used data of activity limitation and diseases and injuries for treatment from the 2007 Comprehensive Survey of Living Conditions,[18] which is a self-administered questionnaire survey for all residents living in 5440 areas selected by stratified random sampling method of census enumeration districts in Japan.[19,20] This survey is conducted every 3 years. The response rate of the 2007 survey was 79.9%. Data were provided by the Ministry of Health, Labour and Welfare, Japan with permission according to the Statistics Act, Article 36. These data were resampled to make the original data anonymous. The 2007 data is the latest of the provided information.

Activity limitation in this survey was evaluated using the answer to the question "Is your daily life now affected by health problems?" A respondent who answered "Yes" was considered to have an activity limitation. On the other hand, a respondent who answered "No" was considered to be without activity limitation.

Diseases and injuries requiring treatment were evaluated by answers to the following two questions: "Do you now go to a hospital, clinic, or a facility for Japanese traditional massage, acupuncture, moxibustion, or judo-orthopedics for diseases or injuries?" and "What are your diseases or injuries?" The second question was multiple choice with questions regarding 39 diseases or injuries, and was asked of persons who replied "Yes" to the first question.

2.2. Statistical analyses

Odds ratios (ORs) of activity limitation for both sexes, and for males and females separately, were computed from logistic regression analyses adjusted for age group and sex (for both sexes). Being with or without activity limitation was assigned as a dependent variable. Each disease and injury for treatment was assigned as an independent variable for respective models. Analyses were performed with SPSS ver.21 for Windows (IBM, New York, NY, USA).

In addition, we computed population attributable fractions (PAF) for each disease and injury as follows:[21]

$$PAF_X = \{(RR_X - 1)/RR_X\}*\{A_X/(A_X + NA_X)\}$$

where PAF refers to risk ratios (RR_x), number of affected individuals (A_x), and number of non-affected individuals (NA_x). The affected and non-affected individuals were among those having activity limitation. We considered the RRs and ORs to be approximated because the proportion with activity limitation was low among the subjects. In this study, PAF means the proportion of people for whom activity limitation would be expected to decrease if no participant suffered from this disease or injury.

3. Results

The provided data included 98,789 subjects. We used data for 75,986 subjects after eliminating 11,129 subjects who were less than 12 years old, 10,573 subjects who had invalid responses to the questions regarding activity limitation, and 1101 subjects w an invalid response to the questions regarding each disease and injury for treatment.

Table 1 shows the age-class distribution of the proportion of those with activity limitations by gender. The proportion of participants with activity limitation among old people was about 10 times higher than among young people. The proportion of participants with activity limitation for males was higher than for females among those under 20 years old and was the reverse among those over 20 years old.

Table 2 shows the number and proportion of outpatients with each disease and injury among males and females, respectively. We eliminated "infertility" from the analysis because its prevalence was very low. Diseases with high prevalence for both sexes were hypertension (9.88%), backache (5.25%), dental diseases (4.65%), eye and optical diseases (4.40%), hyperlipemia (3.81%), and diabetes (3.66%). These diseases were more prevalent among females than males, except for diabetes.

Table 3 shows the OR and PAF for each disease and injury. For both sexes, diseases and injuries showing high ORs were Parkinson's disease (19.27; 95% CI, 10.58–35.07), fracture (12.44; 95% CI, 9.91–15.63), depression and other mental diseases (11.55; 95% CI, 10.16–13.13), and other nervous diseases (9.37; 95% CI, 7.60–11.54). The OR of Parkinson's disease was 29.47 (95% CI, 11.56–75.11) for females and 13.15 (95% CI, 5.93–29.18) for males. In other words, the OR for females was 2.2 times higher than for males.

Diseases and injuries showing high PAF for both sexes were backache (13.27%), arthropathia (7.61%), eye and optical diseases (6.39%), depression and other mental diseases (5.70%), and diabetes

Table 1
Age-class distribution of the proportion of activity limitation by gender and age class.

	Male		Female	
	n	%	*n*	%
12–14	1385	5.85	1269	4.41
15–19	2424	5.53	2137	4.49
20–24	2195	3.87	2154	5.80
25–29	2382	5.00	2433	5.88
30–34	3069	5.05	3254	6.45
35–39	3219	5.90	3435	7.57
40–44	2778	6.44	2915	7.99
45–49	2750	6.84	2848	10.22
50–54	2921	8.87	2962	11.88
55–59	3626	11.20	3702	12.51
60–64	2810	13.67	2822	13.43
65–69	2506	17.16	2638	18.61
70–74	2049	23.47	2363	23.83
75–79	1473	28.65	1811	34.07
80–84	818	39.00	1342	42.77
85–89	325	43.08	689	54.28
90-	139	48.20	343	60.93
Total	36,869	10.96	39,117	13.90

% is the proportion of subjects with activity limitation divided by all subjects of the age class.

Table 2
Number and prevalence of each disease and injury among both sexes and for males and females separately.

	Both sexes		Males		Females	
	n	%	*n*	%	*n*	%
01. Diabetes	2783	3.66	1681	4.56	1102	2.82
02. Adiposity	390	0.51	170	0.46	220	0.56
03. Hyperlipemia	2894	3.81	1202	3.26	1692	4.33
04. Thyroid diseases	697	0.92	137	0.37	560	1.43
05. Depression and other mental diseases	1096	1.44	433	1.17	663	1.69
06. Dementia	290	0.38	96	0.26	194	0.50
07. Parkinson's disease	98	0.13	41	0.11	57	0.15
08. Other nervous diseases	447	0.59	191	0.52	256	0.65
09. Eye and optical diseases	3344	4.40	1216	3.30	2128	5.44
10. Ear and aural diseases	717	0.94	296	0.80	421	1.08
11. Hypertension	7511	9.88	3576	9.70	3935	10.06
12. Cerebrovascular diseases	872	1.15	543	1.47	329	0.84
13. Angina pectoris and Myocardial infarction	1259	1.66	748	2.03	511	1.31
14. Other circulatory system diseases	1050	1.38	537	1.46	513	1.31
15. Acute rhinitis/laryngitis	367	0.48	135	0.37	232	0.59
16. Allergic rhinitis	1139	1.50	484	1.31	655	1.67
17. Asthma	796	1.05	358	0.97	438	1.12
18. Other respiratory system diseases	581	0.76	347	0.94	234	0.60
19. Gastric and duodenum diseases	1323	1.74	683	1.85	640	1.64
20. Hepatic and gallbladder disease	875	1.15	484	1.31	391	1.00
21. Other digestive system diseases	692	0.91	316	0.86	376	0.96
22. Dental diseases	3537	4.65	1552	4.21	1985	5.07
23. Atopic dermatitis	625	0.82	296	0.80	329	0.84
24. Other skin diseases	1465	1.93	663	1.80	802	2.05
25. Gout	600	0.79	553	1.50	47	0.12
26. Rheumatoid arthritis	505	0.66	110	0.30	395	1.01
27. Arthropathia	1686	2.22	464	1.26	1222	3.12
28. Stiff shoulder	2586	3.40	677	1.84	1909	4.88
29. Backache	3988	5.25	1566	4.25	2422	6.19
30. Osteoporosis	1000	1.32	61	0.17	939	2.40
31. Kidney diseases	587	0.77	310	0.84	277	0.71
32. Hypertrophy of prostate	801	1.05	801	2.17	–	–
33. Failure at or after menopause	140	0.18	–	–	140	0.36
34. Fracture	406	0.53	164	0.44	242	0.62
35. Injury or burn other than bone fracture	493	0.65	219	0.59	274	0.70
36. Anemia and Blood diseases	442	0.58	122	0.33	320	0.82
37. Malignant neoplasms	434	0.57	189	0.51	245	0.63
38. Pregnancy and Postpartum	177	0.23	–	–	177	0.45

% is the percentage of affected individuals in the entire cohort among both sexes ($N = 75{,}986$), males ($N = 36{,}869$) and females ($N = 39{,}117$).

(4.99%). PAFs of cerebrovascular diseases, hypertension, diabetes, angina pectoris, and myocardial infarction were higher for males than for females. On the other hand, PAFs of osteoporosis, arthropathia, stiff shoulder, backache, and rheumatoid arthritis were higher for females than males. No diseases or injuries showed an OR less than unity or a PAF less than zero.

4. Discussion

Our results showed that PAFs of orthopedic diseases, ophthalmic diseases, and psychiatric diseases were high. Health promotion strategies should prioritize these diseases in order to prevent activity limitation. The PAF value depends on the proportion of affected individuals and an OR for each disease and injury. Even though the ORs of arthropathia, backache, and ophthalmic diseases were not so high, PAFs were high because there were many patients. On the other hand, fracture and neurological diseases showed high ORs for activity limitation but lower PAFs (Table 3). This is because the number of patients seen for fracture and neurological diseases was small compared to those seen for arthropathia, backache and ophthalmic diseases.

The Japanese Orthopedic Association mentions preventing "Locomotive Syndrome" to extend HLE.[22] Their paper was based on data of causes of long-term care or support needs, which indicate ADL impairment. In The Netherlands, it was reported that back pain affected activity limitation.[23] To our knowledge, however, our paper is the first to show that orthopedic disease is the most important disease affecting the more broadly defined activity limitation used to calculate HLE.

Past studies reported that ophthalmic disease decreased quality-adjusted life-years (QALYs) in Singapore and also decreased health-related quality of life in Korea.[24,25] In addition, some studies have estimated QALY loss by blindness, glaucoma, diabetic retinopathy, and cataract.[26–29] It has also been reported that the leading causes of visual impairment in Japan were glaucoma (24.3%), diabetic retinopathy (20.6%), degenerative myopia (12.2%), age-related macular degeneration (10.9%), and cataract (7.2%).[30] Our finding that ophthalmic disease is one of the major determinants of activity limitation is consistent with the findings of these studies.

The prevalence of psychiatric diseases was lower than that of arthropathia, backache, and ophthalmic diseases. However, ORs of psychiatric diseases were higher than the ORs of those diseases. This means that a high proportion of affected individuals have activity limitation. In 2010, mental disease was reported as a major burden of Years Lost due to Disability in the United Kingdom, Iran, and China.[31–33] Also, in Japan, mental disorders were added to the five major diseases in 2011.[34]

Looking at gender differences of PAF in our study, PAFs of osteoporosis, arthropathia, stiff shoulder, backache, and rheumatoid arthritis were higher in females than males. Furthermore,

Table 3
OR and PAF for each disease and injury among both sexes and for males and females separately.

	Both sexes		Males		Females		PAF difference (males − females) (%)
	OR	PAF (%)	OR	PAF (%)	OR	PAF (%)	
01. Diabetes	2.15	4.99	2.16	6.39	2.13	3.93	2.46
02. Adiposity	3.14	1.11	3.27	1.01	3.08	1.19	−0.18
03. Hyperlipemia	1.47	2.44	1.71	2.95	1.34	2.04	0.92
04. Thyroid diseases	2.00	1.03	1.97	0.45	2.01	1.45	−1.00
05. Depression and other mental diseases	11.55	5.70	13.17	5.12	10.59	6.11	−0.99
06. Dementia	6.38	1.98	6.97	1.48	6.09	2.34	−0.85
07. Parkinson's disease	19.27	0.85	13.15	0.75	29.47	0.92	−0.17
08. Other nervous diseases	9.37	2.68	12.20	2.77	7.60	2.59	0.18
09. Eye and optical diseases	2.00	6.39	2.49	6.65	1.77	6.08	0.57
10. Ear and aural diseases	2.74	1.96	3.05	2.03	2.55	1.90	0.13
11. Hypertension	1.28	4.38	1.40	5.83	1.19	3.11	2.72
12. Cerebrovascular diseases	5.19	4.27	5.36	6.06	4.87	2.92	3.14
13. Angina pectoris and Myocardial infarction	2.82	3.88	2.95	5.14	2.61	2.90	2.24
14. Other circulatory system diseases	3.24	3.66	3.53	4.28	2.95	3.16	1.11
15. Acute rhinitis/laryngitis	3.45	0.97	4.06	0.95	3.14	0.99	−0.04
16. Allergic rhinitis	2.74	2.04	3.16	2.25	2.43	1.86	0.39
17. Asthma	2.98	1.94	2.55	1.65	3.35	2.16	−0.50
18. Other respiratory system diseases	4.48	2.42	4.41	3.27	4.63	1.79	1.49
19. Gastric and duodenum diseases	2.14	2.45	1.96	2.42	2.32	2.48	−0.06
20. Hepatic and gallbladder disease	3.09	2.44	3.50	3.34	2.66	1.76	1.59
21. Other digestive system diseases	3.03	2.02	3.42	2.21	2.72	1.85	0.36
22. Dental diseases	1.54	2.60	1.63	2.87	1.47	2.37	0.50
23. Atopic dermatitis	2.70	0.83	3.04	1.03	2.39	0.68	0.36
24. Other skin diseases	2.38	2.47	2.12	2.29	2.60	2.59	−0.30
25. Gout	1.92	0.76	1.77	1.38	3.68	0.31	1.07
26. Rheumatoid arthritis	5.93	2.62	5.60	1.18	6.09	3.70	−2.53
27. Arthropathia	4.82	7.61	5.51	4.88	4.63	9.65	−4.76
28. Stiff shoulder	2.40	4.74	2.59	2.95	2.34	6.08	−3.13
29. Backache	3.88	13.27	4.15	11.61	3.73	14.47	−2.86
30. Osteoporosis	2.76	3.51	3.69	0.60	2.78	5.75	−5.16
31. Kidney diseases	5.79	2.75	6.16	3.34	5.41	2.31	1.03
32. Hypertrophy of prostate	2.24	1.91	2.30	4.58	–	–	–
33. Failure at or after menopause	3.82	0.40	–	–	3.75	0.69	–
34. Fracture	12.44	2.67	15.69	2.36	10.25	2.87	−0.51
35. Injury or burn other than bone fracture	6.96	1.91	9.60	2.22	5.39	1.66	0.56
36. Anemia and Blood diseases	4.58	1.77	3.63	1.06	4.96	2.28	−1.22
37. Malignant neoplasms	4.33	1.68	4.42	1.88	4.22	1.53	0.35
38. Pregnancy and Postpartum	4.03	0.29	–	–	3.96	0.51	–

OR, odds ratio; PAF, population attributable fraction.
P values of all ORs were <0.001.
OR and PAF were adjusted for age.

some diseases, such as diabetes, cerebrovascular diseases and hypertension, showed higher PAF for males than for females.

Osteoporosis, arthropathia, stiff shoulder, backache, and rheumatoid arthritis showed a much higher prevalence among females than males, although these diseases showed higher ORs among males than females. Hence, these diseases that show high PAF are considered to be of higher prevalence. Some studies reported that deficiency of estrogen increased the risk of developing knee osteoarthritis and osteoporosis,[35,36] and that psychological stress increased the risk of developing lower back pain among females.[37]

As is the case with orthopedic diseases, the prevalence of cerebrovascular diseases and diabetes for males was greater than for females. Therefore, the sex difference of PAF for diabetes and stroke is considered to be due to morbidity.

On the other hand, the prevalence of hypertension was almost the same for both males (9.70%) and females (10.06%), so the sex difference in the PAF of hypertension is considered to be caused by complicating diseases. Hypertension itself may not directly cause activity limitation, but it is associated with cerebrovascular diseases, cardiovascular diseases, kidney diseases, and other conditions.[38] Indeed, past studies in hypertension patients showed that the morbidities of cerebrovascular diseases and cardiovascular diseases are higher for males than for females.[39–41] These studies support our findings.

The value of our study is that it investigates for the first time the relationship between each disease/injury and activity limitation, which is directly used to calculate HLE using nationally representative data. These results identified how much each disease and injury affected activity limitation.

There are some limitations to the present study. First, it is a cross-sectional study. If we conducted a cohort study to examine incidence to activity limitation, the results may be different depending on the follow-up time. Second, we calculated ORs separately for each disease/injury. Some people, especially the aged, have multiple diseases, but we did not adjust for other existing disease. Though some concurrent diseases are confounders, other diseases may also be intermediate variables. For example, hypertension may cause kidney disease and lead to activity limitation, but kidney disease may also cause hypertension. Assessing the causal relationships among all of the diseases and injuries is a future challenge. Third, the target population of those who participate in the Comprehensive Survey of Living Conditions consists of people staying at home and does not include people staying in hospitals and nursing homes. Therefore, the proportion of those with activity limitation and the prevalence of each disease/injury may be different from that in the entire population. However, HLE in Japan and other countries is also calculated for people staying at home and living independently.

In conclusion, we calculated ORs and PAFs for the association of various diseases/injuries with activity limitation. Our results indicate that orthopedic diseases, ophthalmic diseases, and psychiatric diseases particularly affect activity limitation.

Conflicts of interest

None declared.

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