

ORIGINAL ARTICLE

Factors associated with functional limitations in the daily living activities of Japanese hip osteoarthritis patients

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Abstract

Aim: As society ages, there is a vast number of elderly people with locomotive syndrome. In this study, the factors associated with functional limitations in daily living activities evaluated by female hip osteoarthritis (OA) patients were investigated.

Methods: This study was a cross-sectional study. The subjects were 353 female patients who were newly diagnosed with hip OA at an orthopedic clinic with no history of hip joint surgery. Outcome indices were functional limitations in two daily living activities obtained from a questionnaire completed by the patients: (i) standing up (standing from a crouched position) and (ii) stair-climbing (climbing and/or descending stairs). The odds ratios (ORs) and 95% confidence intervals (CIs) were computed for explanatory variables using the proportional odds model in logistic regression to evaluate their associations with functional limitations.

Results: Functional limitations in standing up were associated with heavy weight (third tertile *vs.* first tertile: 1.91, 1.11–3.27), participation in sports at school (0.62, 0.40–0.98), parity (*vs.* nullipara: 1.96, 1.08–3.56), old age and OA stage. Associations with functional limitations in stair-climbing were seen with short height (< 151.0 cm *vs.* ≥ 156.0 cm: 2.05, 1.02–4.12), bilateral involvement (*vs.* unilateral: 1.71, 1.01–2.88), old age and OA stage.

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Conclusion: Old age, OA stage, heavy weight, parity, shorter height and bilateral OA were associated with functional limitations in standing up and/or stair-climbing, whereas participation in sports such as club activities in school maintained standing up.

Key words: anthropometric factors, epidemiology, functional limitation, hip osteoarthritis, parity, sports.

INTRODUCTION

As society ages, there is a vast number of elderly people with locomotive syndrome limiting their activities of daily living and impacting greatly on their quality of life. Limitations in activities of daily living give rise to the need for support or nursing care. Among the causative motor system disorders, bone fractures, spinal disease, and osteoarthritis (OA) are common.¹ Because there have been few epidemiological studies of OA in Japanese people in which hip OA was an outcome, a nationwide epidemiologic study of hip OA was conducted, and the current status of patients with hip OA, including the disease etiology, was examined.²⁻⁴

Epidemiological studies of primary hip OA in Western people have reported race,⁵ female sex,⁵ old age,⁵⁻⁸ history of external hip joint trauma⁹⁻¹¹ and manual labor^{5,10-13} as risk factors. In contrast, consistent conclusions have not been reached in studies on the relationships of anthropometric factors (height, weight, body mass index [BMI]),^{8-10,14-22} reproductive factors^{23,24} or physical activity^{9,10,25-27} to hip OA. Recent studies have reported that social factors such as marital status, residence, education, income and receipt of a pension are related to hip OA.²⁸⁻³¹ In a case-control study of hip OA in Japan, an association with occupation was reported.³² Most of the outcome indices in these epidemiologic studies were the incidence of hip OA or hip replacement due to OA, and there were few outcome indices evaluated by the patients themselves.

The present study focused on two everyday living activities of female Japanese hip OA patients, standing up and stair-climbing, and clarified the factors associated with functional limitations evaluated by the patients in these two activities.

METHODS

Study subjects

This was designed as a cross-sectional study. An epidemiologic study of hip OA at the orthopedic departments of 15 institutions across Japan was conducted from January to September 2008. The subjects were patients who were newly diagnosed with hip OA at an orthopedic clinic. The patients were told that the survey

was an academic survey carried out as a research project of the Japanese Orthopaedic Association (JOA), and the patients who consented to participate were the subjects of the study. There was a substantially larger number of female patients than male patients, and the etiology was assessed to be acetabular dysplasia in most patients.²⁻⁴

The study protocol was approved by the Ethics Committee of the Osaka City University Graduate School of Medicine.

Information collection

Data on date of birth, height and weight at the time of diagnosis, cause of disease, unilateral or bilateral OA, medical history and classification of OA stage were collected using a questionnaire completed by doctors. The stages of hip OA were the following four indices modified from JOA criteria.³³ Pre-OA stage: when a symptomatic hip demonstrated no radiological OA changes but showed morphological changes of the acetabulum and/or proximal femur related to OA; Initial stage: the joints that had one or more OA changes and possible narrowing of the joint space were assessed as being at the initial stage. An additional condition for the joints at the initial stage was that the width of the joint space was maintained at 2 mm or more throughout the weight-bearing area; Advanced stage: the joint was assessed as being at the advanced stage when the width of the joint space was < 2 mm at the thinnest point or when the length of joint space loss in anteroposterior view was < 15 mm in weight-bearing portion; and Terminal stage: the loss of joint space extended \geq 15 mm. Based on a preliminary study³⁴ where observer agreement on assessment items in a multicenter survey was examined, we defined these indices. In cases of bilateral involvement, the more severely affected joint was staged.

Data on patients' functional limitations in daily living and background factors, including lifestyle habits, were collected using a questionnaire completed by the patients. The indices of functional limitation in activities of daily living were the following two questions, modified from the JOA score:³⁵ (i) standing up: Can you stand up from a crouched position (e.g., when

using a Japanese-style toilet for a bowel movement)? (Responses: impossible, possible with support or assistance, or possible); and (ii) stair-climbing: Can you climb and descend stairs? (Responses: impossible, possible with support or assistance, or possible). Background factors collected from patients were history of treatment for hip injury, medical history, comorbidity, education (age of leaving school), participation in sports clubs at school (yes, no), longest held occupation, parity (nulliparous or parous), and smoking and alcohol habits (never, past, current). BMI was used to examine the association with obesity because information about waist circumference was not obtained. BMI was calculated from each patient's weight (kg) divided by the square of the height (m²).

Statistical analysis

Outcome indices were functional limitations in the two everyday living activities, (i) standing up and (ii) stair-climbing; in both cases, impossible versus possible with support or assistance versus possible.

Continuous explanatory variables were divided into tertiles for comparison. Education was classified into three categories of number of years of schooling: up to 9 years (elementary/junior high school), 10–12 years (senior high school), and over 13 years (junior college/vocational school or higher). Occupation was classified according to the classification of the Japan National Census and divided into two groups: physical workers were defined as agricultural/fishery workers, mining workers, and factory/construction workers or laborers; all other occupations were defined as non-physical workers. OA stage was classified into three categories: pre-OA or initial stage, advanced stage and terminal stage.

For the analysis, odds ratios (ORs) and their 95% confidence intervals (CIs) for the explanatory variables were computed using the proportional odds model in logistic regression. The *P*-values for the scores were calculated to test for the proportional odds assumption. The *P*-value was > 0.05 in all models. Thus, use of the proportional odds models appeared appropriate. To construct the final models, age and OA stage-adjusted ORs were calculated for two outcomes: (i) standing up; and (ii) stair-climbing. Variables showing *P*-values < 0.1 or that seemed likely to be associated with functional limitations in the two everyday living activities were considered potential confounders for adjustment. To clarify whether weight and height were associated with hip OA, weight and height (not BMI) were included in the final model. Hence, eight variables

(height and weight at diagnosis, education, participation in sports at school, parity, age, site of hip OA and OA stage) were included in the final model. Furthermore, to determine whether comorbidity has an influence on functional disorders, each comorbidity was entered into the two final multivariable models. The test for trend was performed by including increasing exposure categories in the model as explanatory variables coded with ordinal numbers. The level of significance was taken as *P* < 0.05. All analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

RESULTS

A total of 494 hip OA patients (54 male, 440 female) from 15 hospitals in five districts consented to participate in the survey. Male patients (*n* = 54), female patients with a history of hip surgery (*n* = 39) and female patients who had missing data on OA stage or site of hip OA or the self-administered questionnaire (*n* = 48) were excluded. Thus, the subjects for analysis in this study were 353 female hip OA patients.

Of the 353 subjects, 192 (54%) had unilateral OA, and 161 (46%) had bilateral OA (Table 1). The subjects' median age was 59.0 years (range 15–85 years), mean height was 153.3 cm (range 135.0–173.0 cm), and median weight was 53.0 kg (range 31.0–105.0 kg). These values largely resembled the age-specific height and weight averages of Japanese adults according to the 2008 National Nutrition Survey.³⁶ OA stage was: pre-OA stage, 40 (11%); initial stage, 50 (14%); advanced stage, 98 (28%); and terminal stage, 165 (47%).

Old age, high BMI, physical worker, parity and OA stage were significantly associated with functional limitation in standing up on univariable analysis (Table 2). Many years of education, participation in sports at school and current alcohol consumption showed inverse associations with functional limitation. Factors showing *P* < 0.1 for functional limitation in standing up in the age and OA stage-adjusted multivariable analyses were heavy weight (third tertile *vs.* first tertile: 1.95, 1.18–3.20), high BMI (third tertile *vs.* first tertile: 1.82, 1.09–3.02), years of education (\geq 13 years *vs.* \leq 9 years: 0.47, 0.24–0.90), participation in sports at school (0.67, 0.44–1.02) and parity (*vs.* nullipara: 2.02, 1.14–3.60). In the final model, old age (third tertile *vs.* first tertile: 3.89, 2.09–7.25, trend *P* < 0.001), heavy weight (third tertile *vs.* first tertile: 1.91, 1.11–3.27, trend *P* = 0.020), participation in sports at school (0.62, 0.40–0.98), parity (*vs.* nullipara: 1.96, 1.08–3.56), and

Table 1 Selected subject characteristics

Characteristic	N = 353	No. of subjects	Range, median or percentage
Age (years)			
Range			15–85
Median			59.0
Height at diagnosis (cm)			
Range			135.0–173.0
Median			153.0
Weight at diagnosis (kg)			
Range			31.0–105.0
Median			53.0
Median body mass index at diagnosis (kg/m ²)			22.8
Comorbidity			
Cerebral stroke		1	0.3
Hypertension		91	26
Heart disease		12	3
Liver disease		10	3
Tuberculosis		3	1
Diabetes mellitus		18	5
Cholelithiasis		6	2
Gastrointestinal disease		26	7
Depression		8	2
Asthma, chronic bronchitis, pulmonary emphysema		9	3
History of treatment for hip injury (≥ 2 weeks)		11	3
Education (years)			
≤ 9		63	18
10–12		189	54
≥ 13		101	29
Sports participation such as club activities in school		161	46
Physical workers (occupation)	(N = 348)	38	11
Parity			
Nulliparous		58	16
Parous		295	84
Smoking	(N = 352)		
Never		288	82
Past		31	9
Current		33	9
Consumption of alcohol	(N = 351)		
Never		236	67

Table 1 (continued)

Characteristic	N = 353	No. of subjects	Range, median or percentage
Past		12	3
Current		103	29
Site of hip osteoarthritis (OA)			
Unilateral		192	54
Bilateral		161	46
OA stage			
Pre-OA stage		40	11
Initial stage		50	14
Advanced stage		98	28
Terminal stage		165	47

OA stage (terminal stage *vs.* pre-OA stage or initial stage: 2.60, 1.46–4.62, trend $P < 0.001$) were significantly associated with functional limitation in standing up.

Old age, short height (< 151.0 cm), high BMI, parity and OA stage were significantly associated with functional limitation in stair-climbing on univariable analysis (Table 3). Many years of education, participation in sports at school, and current alcohol consumption showed inverse associations with functional limitation. Factors showing $P < 0.1$ for functional limitation in stair-climbing in the age and OA stage-adjusted multivariable analyses were height (< 151.0 cm *vs.* ≥ 156.0 cm, 1.93, 1.03–3.62) and years in education (≥ 13 years *vs.* ≤ 9 years: 0.38, 0.17–0.89). In the final model, old age (third tertile *vs.* first tertile: 4.81, 2.17–10.7, trend $P < 0.001$), short height (< 151.0 cm *vs.* ≥ 156.0 cm, 2.05, 1.02–4.12), bilateral OA (*vs.* unilateral OA: 1.71, 1.01–2.88) and OA stage (terminal stage *vs.* pre-OA stage or initial stage: 6.28, 3.19–12.4, trend $P < 0.001$) were significantly associated with functional limitation in stair-climbing.

In the present study, the comorbidities of the subjects included cerebral stroke ($n = 1$), high blood pressure ($n = 91$), heart disease ($n = 12$), liver disease ($n = 10$), tuberculosis ($n = 3$), diabetes mellitus ($n = 18$), cholelithiasis ($n = 6$), gastrointestinal disease ($n = 26$), depression ($n = 8$), asthma, chronic bronchitis and pulmonary emphysema ($n = 9$) (Table 1). When each of these diseases was entered into the two final multivariable models, in all models, the adjusted ORs of age were significantly associated with functional limitation, but the adjusted ORs of comorbidities were not associated with functional limitation as follows: high blood pressure, functional limitation in standing up: OR = 1.03, 95% CI = 0.62–1.69, functional limitation

Table 2 Association between selected characteristics and functional limitation of newly diagnosed female hip osteoarthritis (OA) patients: standing up

	Standing up <i>n</i> (%)			Crude OR (95% CI)	Age and OA stage-adjusted OR (95% CI)	Final model† (95% CI)
	Impossible (<i>N</i> = 83)	Can with support or assistance (<i>N</i> = 170)	Can (<i>N</i> = 100)			
Age (years)						
< 54	14 (12)	54 (45)	52 (43)	1		1
54–66	18 (16)	60 (52)	37 (32)	1.57 (0.96–2.56)		0.99 (0.57–1.72)
≥ 67	51 (43)	56 (48)	11 (9)	6.53 (3.89–11.0)		3.89 (2.09–7.25)
<i>P</i> for trend				< 0.0001		< 0.0001
Height at diagnosis (cm)						
< 151.0	30 (26)	58 (51)	26 (23)	1.59 (0.98–2.58)	0.88 (0.52–1.48)	0.87 (0.49–1.56)
151.0–155.9	30 (25)	55 (46)	34 (29)	1.33 (0.82–2.14)	1.07 (0.65–1.76)	1.17 (0.70–1.97)
≥ 156.0	23 (19)	57 (48)	40 (33)	1	1	1
<i>P</i> for trend				0.061	0.629	0.658
Weight at diagnosis (kg)						
< 50.5	24 (20)	57 (48)	39 (33)	1	1	1
50.5–57.9	28 (25)	49 (45)	33 (30)	1.23 (0.76–2.00)	1.07 (0.64–1.76)	1.04 (0.62–1.75)
≥ 58.0	31 (25)	64 (52)	28 (23)	1.48 (0.92–2.37)	1.95 (1.18–3.20)	1.91 (1.11–3.27)
<i>P</i> for trend				0.107	0.009	0.020
Body mass index at diagnosis (kg/m²)						
< 21.46	22 (19)	54 (46)	41 (35)	1	1	
21.46–24.38	28 (24)	55 (47)	35 (30)	1.32 (0.81–2.13)	1.10 (0.67–1.81)	
≥ 24.39	33 (28)	61 (52)	24 (20)	1.87 (1.15–3.05)	1.82 (1.09–3.02)	
<i>P</i> for trend				0.011	0.021	
History of treatment for hip injury (≥ 2 weeks)						
No	80 (23)	162 (47)	100 (29)	1	1	
Yes	3 (27)	8 (73)	0 (0)	2.14 (0.69–6.63)	1.30 (0.40–4.26)	
Education (years)						
≤ 9	28 (44)	28 (44)	7 (11)	1	1	1
10–12	39 (21)	96 (51)	54 (29)	0.33 (0.19–0.57)	0.59 (0.33–1.06)	0.64 (0.35–1.18)
≥ 13	16 (16)	46 (46)	39 (39)	0.22 (0.12–0.40)	0.47 (0.24–0.90)	0.50 (0.25–1.00)
<i>P</i> for trend				< 0.0001	0.030	0.056
Sports participation such as club activities in school						
No	54 (28)	98 (51)	40 (21)	1	1	1
Yes	29 (18)	72 (45)	60 (37)	0.49 (0.33–0.73)	0.67 (0.44–1.02)	0.62 (0.40–0.98)
Occupation (<i>N</i> = 348)						
Non-physical workers	66 (21)	156 (50)	88 (28)	1	1	
Physical workers	17 (45)	13 (34)	8 (21)	2.39 (1.26–4.53)	1.72 (0.88–3.37)	
Parity						
Nulliparous	7 (12)	23 (40)	28 (48)	1	1	1
Parous	76 (26)	147 (50)	72 (24)	2.80 (1.63–4.83)	2.02 (1.14–3.60)	1.96 (1.08–3.56)
Smoking (<i>N</i> = 352)						
Never	70 (24)	142 (49)	76 (26)	1	1	
Past	6 (19)	12 (39)	13 (42)	0.57 (0.28–1.14)	0.84 (0.40–1.74)	
Current	7 (21)	16 (48)	10 (30)	0.83 (0.42–1.64)	0.99 (0.49–2.04)	
Consumption of alcohol (<i>N</i> = 351)						
Never	63 (27)	119 (50)	54 (23)	1	1	
Past	4 (33)	5 (42)	3 (25)	1.14 (0.38–3.40)	1.88 (0.60–5.86)	
Current	16 (16)	45 (44)	42 (41)	0.46 (0.29–0.71)	0.68 (0.42–1.10)	

Table 2 (continued)

	Standing up <i>n</i> (%)			Crude OR (95% CI)	Age and OA stage-adjusted OR (95% CI)	Final model† (95% CI)
	Impossible (<i>N</i> = 83)	Can with support or assistance (<i>N</i> = 170)	Can (<i>N</i> = 100)			
Site of hip OA						
Unilateral	44 (23)	101 (53)	47 (24)	1	1	1
Bilateral	39 (24)	69 (43)	53 (33)	0.82 (0.56–1.22)	0.98 (0.65–1.49)	1.19 (0.77–1.83)
OA stage						
Pre-OA stage or initial stage	13 (14)	32 (36)	45 (50)	1		1
Advanced stage	15 (15)	54 (55)	29 (30)	1.94 (1.12–3.36)		1.38 (0.76–2.50)
Terminal stage	55 (33)	84 (51)	26 (16)	4.58 (2.74–7.66)		2.60 (1.46–4.62)
<i>P</i> for trend				< 0.0001		0.001

†Model included age, height and weight at diagnosis, education, sports participation in school, parity, site of hip OA, and OA stage as explanatory variables. Analysis based on sample of 353.

in stair-climbing: OR = 1.05, 95% CI = 0.57–1.94; heart disease, 1.10, 0.33–3.66; 0.85, 0.18–3.98; liver disease, 0.66, 0.19–2.30; 0.48, 0.11–2.20; tuberculosis, 1.21, 0.13–11.5; 2.55, 0.11–58.3; diabetes mellitus, 1.83, 0.69–4.87; 0.42, 0.13–1.39; cholelithiasis, 1.15, 0.23–5.65; 0.65, 0.09–4.78; gastrointestinal disease, 0.76, 0.34–1.69; 0.73, 0.27–1.96; depression, 3.63, 0.86–15.3; 0.74, 0.16–3.40; and asthma, chronic bronchitis, and pulmonary emphysema, 1.83, 0.47–7.07; 0.90, 0.17–4.67.

DISCUSSION

This study identified the factors associated with functional limitation of the two everyday living activities of female Japanese hip OA patients, standing up and stair-climbing. Old age and OA stage were associated with functional limitations of the two activities. The other associated factors differed by the kind of activity.

Shorter height showed an association with functional limitation in stair-climbing in this study. On the other hand, several reports have found that taller stature is a risk factor for primary hip OA.^{10,14,15} A study of Norwegian women considered that taller persons may be more predisposed to the development of OA than shorter persons because they do not have correspondingly thicker hip joint cartilage.¹⁴ However, the female Norwegian subjects of that study had a mean height of 163 cm, and the subjects in the present study had a mean height of 153.3 cm. The mean Japanese height is much lower than that of Westerners, so that the two studies cannot be compared. In our previous survey of male Japanese patients with knee OA, we found an association between lower height and knee pain.³⁷ A

possible interpretation is that, in the < 151.0 cm category, there is a larger ratio of knee and hip bend to height when stair-climbing, so that the action of climbing stairs involves greater burden on the hip joint in shorter persons. In addition, investigation of the association between acetabular dysplasia and low height may be necessary, because most subjects in our study had mortar acetabular dysplasia (which had been described in other studies^{2,3}).

Heavy weight is known to be a risk factor for knee OA, and our previous studies of Japanese people showed an association between heavy weight and knee OA.^{38,39} However, a consistent conclusion regarding the relationship between heavy weight and hip OA has not been reached. Several studies have shown that high BMI from a young age is a risk factor for hip replacement due to OA^{8,18} and for incident hip OA,¹⁶ but there was also a study that found no association.¹⁹ Regarding the association between BMI or weight at the time of the survey and hip OA, there are studies showing a positive association^{14–17} and studies in which no association was found.^{20–22} In the current study, present weight showed a significant association with standing up, but it was not significant for stair-climbing, so that the association depended on the nature of the action. This is probably because the way the load acts on the hip joint is different in standing up and stair-climbing. However, since the association is with present weight, the possibility of reversed cause and effect cannot be ruled out.

When examining risk factors for OA, it is important to investigate associations with BMI, because it is an indicator of obesity. However, in the examination of BMI alone, it is not possible to determine whether both

Table 3 Association between selected characteristics and functional limitation of newly diagnosed female hip osteoarthritis (OA) patients: stair-climbing

	Stair-climbing <i>n</i> (%)			Crude OR (95% CI)	Age and OA stage-adjusted OR (95% CI)	Final model† (95% CI)
	Cannot (<i>N</i> = 15)	Can with support or assistance (<i>N</i> = 232)	Can (<i>N</i> = 106)			
Age (years)						
< 54	1 (1)	60 (50)	59 (49)	1		1
54–66	1 (1)	78 (68)	36 (31)	2.05 (1.22–3.47)		1.04 (0.55–1.96)
≥ 67	13 (11)	94 (80)	11 (9)	11.0 (5.52–21.7)		4.81 (2.17–10.7)
<i>P</i> for trend				< 0.0001		0.0001
Height at diagnosis (cm)						
< 151.0	6 (5)	89 (78)	19 (17)	3.56 (2.02–6.27)	1.93 (1.03–3.62)	2.05 (1.02–4.12)
151.0–155.9	6 (5)	79 (66)	34 (29)	2.03 (1.20–3.44)	1.80 (1.00–3.22)	2.00 (1.08–3.68)
≥ 156.0	3 (3)	64 (53)	53 (44)	1	1	1
<i>P</i> for trend				< 0.0001	0.036	0.037
Weight at diagnosis (kg)						
< 50.5	7 (6)	73 (61)	40 (33)	1	1	1
50.5–57.9	5 (5)	77 (70)	28 (25)	1.34 (0.78–2.32)	1.27 (0.69–2.32)	1.55 (0.82–2.90)
≥ 58.0	3 (2)	82 (67)	38 (31)	1.00 (0.60–1.68)	1.25 (0.70–2.22)	1.72 (0.91–3.26)
<i>P</i> for trend				0.988	0.453	0.093
Body mass index at diagnosis (kg/m²)						
< 21.46	5 (4)	67 (57)	45 (39)	1	1	
21.46–24.38	7 (6)	78 (66)	33 (28)	1.63 (0.96–2.77)	1.32 (0.73–2.39)	
≥ 24.39	3 (3)	87 (74)	28 (24)	1.75 (1.02–2.98)	1.44 (0.79–2.60)	
<i>P</i> for trend				0.041	0.232	
History of treatment for hip injury (≥ 2 weeks)						
No	14 (4)	223 (65)	105 (31)	1	1	
Yes	1 (9)	9 (82)	1 (9)	3.26 (0.80–13.3)	2.00 (0.48–8.25)	
Education (years)						
≤ 9	7 (11)	50 (79)	6 (10)	1	1	1
10–12	6 (3)	126 (67)	57 (30)	0.25 (0.12–0.52)	0.55 (0.26–1.18)	0.64 (0.29–1.40)
≥ 13	2 (2)	56 (55)	43 (43)	0.15 (0.07–0.32)	0.38 (0.17–0.89)	0.42 (0.18–1.00)
<i>P</i> for trend				< 0.0001	0.026	0.041
Sports participation such as club activities in school						
No	11 (6)	135 (70)	46 (24)	1	1	1
Yes	4 (3)	97 (60)	60 (37)	0.52 (0.33–0.81)	0.83 (0.50–1.38)	0.92 (0.54–1.57)
Occupation (<i>N</i> = 348)						
Non-physical workers	12 (4)	205 (66)	93 (30)	1	1	
Physical workers	3 (8)	26 (68)	9 (24)	1.52 (0.72–3.17)	0.87 (0.39–1.96)	
Parity						
Nulliparous	0 (0)	32 (55)	26 (45)	1	1	1
Parous	15 (5)	200 (68)	80 (27)	2.32 (1.32–4.10)	1.44 (0.75–2.78)	1.41 (0.71–2.80)
Smoking (<i>N</i> = 352)						
Never	12 (4)	192 (67)	84 (29)	1	1	
Past	2 (6)	17 (55)	12 (39)	0.72 (0.34–1.53)	1.44 (0.62–3.33)	
Current	1 (3)	22 (67)	10 (30)	0.92 (0.44–1.95)	1.10 (0.47–2.55)	
Consumption of alcohol (<i>N</i> = 351)						
Never	12 (5)	163 (69)	61 (26)	1	1	
Past	1 (8)	7 (58)	4 (33)	0.80 (0.24–2.70)	1.76 (0.47–6.58)	
Current	2 (2)	60 (58)	41 (40)	0.52 (0.32–0.83)	1.01 (0.58–1.75)	

Table 3 (continued)

	Stair-climbing <i>n</i> (%)			Crude OR (95% CI)	Age and OA stage-adjusted OR (95% CI)	Final model† (95% CI)
	Cannot (<i>N</i> = 15)	Can with support or assistance (<i>N</i> = 232)	Can (<i>N</i> = 106)			
Site of hip OA						
Unilateral	8 (4)	126 (66)	58 (30)	1	1	1
Bilateral	7 (4)	106 (66)	48 (30)	1.02 (0.66–1.58)	1.42 (0.86–2.34)	1.71 (1.01–2.88)
OA stage						
Pre-OA stage	1 (1)	34 (38)	55 (61)	1		1
or the initial stage						
Advanced stage	2 (2)	67 (68)	29 (30)	3.64 (2.00–6.61)		2.90 (1.48–5.66)
Terminal stage	12 (7)	131 (79)	22 (13)	10.3 (5.63–18.8)		6.28 (3.19–12.4)
<i>P</i> for trend				< 0.0001		< 0.0001

†Model included age, height and weight at diagnosis, education, sports participation in school, parity, site of hip OA, and OA stage as explanatory variables. Analysis based on sample of 353.

or one of heavy weight or low height is associated with OA. Since height and weight were included in the final model, it was possible to clarify the associations between heavy weight and standing up and between low height and stair-climbing.

A prospective study is needed to determine whether physical activity prevents OA or whether physical activity is reduced because of OA. A cross-sectional study can examine data relating to exercise habits during early life, midlife and the present. Studies examining the associations between OA in later life and the degree of physical activity in the teens, 30s and 50s,²⁵ as well as the amount of exercise from leaving school until the present,⁹ have shown positive associations. There are reports of no association between current physical activity and hip OA.^{10,26} However, the influence that physical activity gives to a body might vary according to time, period and strength. Intense exercise transmits powerful forces to the joints and may perhaps speed up degeneration, but reasonable exercise strengthens the muscles and may therefore be useful in protecting the joints. One cohort study found that physical activities in women (particularly walking) had a preventive effect against OA.²⁷ The results of the present study suggest that participants in sports clubs at school have maintained function in standing up. This may be the effect that muscles were strengthened by exercises in school days.

Although parous women were significantly more likely to have functional limitation in standing up than nulliparous women, parous women were not more likely to have functional limitation in stair-climbing

than nulliparous women. A cohort study of middle-aged women (mean age 56 years) in England and Scotland found greater risk for hip replacement due to OA among women who had given birth to four or more children than among nulliparous women (relative risk = 1.10, 95% CI = 1.02–1.19).²³ This is probably because the proportion of a woman's life spent with excess weight due to pregnancy increases with the number of births, which greatly affects the joints, and also because a huge load is exerted on the hip at childbirth. However, a case-control study found no association between number of births and hip replacement due to OA.²⁴

In this study, persons who spent more years in education retained stair-climbing function. A recent study investigating the associations between hip OA and socio-economic factors in Germany showed that the postoperative functional evaluation outcome for total hip replacement was not good for widows/widowers, persons living alone, persons with a pension, or persons with fewer years in education.²⁸ A cohort study in Denmark found high income and more years in education had an inverse association with hospitalization due to hip OA.²⁹ A study in Asia found pain and physical function to be worse in hip OA patients with fewer years of education.³⁰ There was also a study investigating socioeconomic factors from the point of view of the individual (number of years of education, etc.) and of the community (social status, etc.).³¹ Persons with high income and education levels are likely to carry out appropriate health management, use recreational facilities and centers for the elderly, have opportunities for

good treatment, and possess the capacity for processing a range of information, and these may contribute to improving factors associated with hip OA (e.g., obesity, low levels of physical activity).

Bilateral OA was significantly associated with functional limitation in stair-climbing, but it was not associated with functional limitation in standing up. The load to the right and left joints may vary according to activity. OA stage was significantly associated with functional limitation in the present study. Naturally, it is expected that patients with bilateral OA and/or severe OA stage have functional limitations. These factors (site of OA, OA stage) were included in the final model. In this situation, low height, heavy weight, participation in sports such as club activities, and parity were significantly associated with functional limitations of hip OA.

This study had some limitations. Because there were few males registered in the study, we were not able to examine the factors associated with male hip OA patients. Old age showed an association with functional limitations in hip OA patients. There are similar reports of associations between old age and primary hip OA incidence and prevalence.^{5–8} However, functional limitation may also be affected by diseases other than hip OA accompanying old age. A previous study of elderly persons reported the attributable fractions of different diseases to functional limitation in stair-climbing as follows: knee OA 16.7%, depressive symptomatology 15.4%, stroke 12.8%, diabetes 9.8%, hip fracture 9.1%, congestive heart failure 7.6%, and chronic obstructive pulmonary disease 7.4%.⁴⁰ In the present study, the comorbidities of the subjects included cerebral stroke, high blood pressure, heart disease, liver disease, tuberculosis, diabetes mellitus, cholelithiasis, gastrointestinal disease, depression, and asthma, chronic bronchitis and pulmonary emphysema. The adjusted ORs of age were significantly associated with functional limitation, but the adjusted ORs of comorbidities were not associated with functional limitation. Since it was not possible to acquire data regarding knee OA, the effects of knee OA on the outcome could not be investigated. In this study, functional limitations in two everyday living activities, standing up and stair-climbing, were examined. However, further tasks, including the walk distance, need to be examined to evaluate functional limitations in everyday living activities. Furthermore, recall bias may be another potential limitation, because the severity of functional limitation and information about background factors including lifestyle were collected by a questionnaire completed by patients. In addition, it cannot be said that this sample represents the general

female population with OA. However, the findings were not limited to one area, because the study subjects were new patients of 15 hospitals in five districts. Finally, a limitation of the study is that, because of its cross-sectional nature, causality cannot be inferred.

In conclusion, the factors associated with functional limitation in female Japanese hip OA patients were identified. Some associated factors differed by the kind of activity. Heavy weight and parity were associated with functional limitation in standing up, whereas participation in sports such as club activities in school maintained function in standing up. Shorter height and bilateral OA were associated with functional limitation in stair-climbing. Old age and OA stage were associated with functional limitation of both activities.

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AUTHOR CONTRIBUTIONS

All authors provided comments on the drafts and have read and approved the final manuscript. K. Kondo contributed to study design, data management, statistical analysis, data interpretation and manuscript writing. S. Ohfuji, W. Fukushima, A. Maeda, M. Inui and S. Takahashi contributed to study design and data interpretation. M. Sofue, M. Itoman, T. Matsumoto, Y. Hamada, H. Shindo, Y. Takatori, H. Yamada, Y. Yasunaga, H. Ito, S. Mori, I. Owan, G. Fujii and H. Ohashi contributed to study design, data collection, outcome definition and data interpretation. S. Jingushi and Y. Hirota contributed to conception of the design, overall management, data interpretation and manuscript editing.

COMPETING INTERESTS

The authors declare no competing interests.

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