

# Changes in risk factors for severe low-back pain among caregivers in care facilities in Japan from 2014 to 2018

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**Abstract:** In Japan, the practice of the no-lift policy, which states that care recipients should be lifted with care equipment rather than by human power, has been increasing since around 2014. The purpose of this study was to examine whether severe low back pain (LBP) risk factors in caregivers changed between 2014 and 2018. A questionnaire survey targeting administrators and caregivers working in care facilities for the elderly was conducted in 2014 and 2018. A total of 612 facilities and 2,712 caregivers responded to the questionnaires in 2014, and 504 facilities and 3,478 caregivers completed the questionnaires in 2018. The percentage of caregivers who experienced severe LBP did not differ significantly between 2014 (37.3%) and 2018 (38.3%). However, the number of facilities that introduced care equipment for transfer increased in 2018. Moreover, the number of participants who received training on care methods and using care equipment increased. Lifting a facility resident using human power and taking an unsuitable posture were associated with severe LBP in 2014, but only taking an unsuitable posture was associated with severe LBP in 2018. As taking an unsuitable posture remains to be a primary risk factor for severe LBP, it needs to be addressed in care facilities.

**Key words:** No-lift policy, Care equipment, Low back pain, Caregiver, Care facility

## Introduction

Caregivers show a high prevalence of occupational low back pain (LBP)<sup>1–5</sup>. The number of caregivers experiencing occupational LBP increases yearly in Japan<sup>6</sup>. In a previous survey, we found that the risk factors for severe LBP among caregivers in care facilities for the elderly include lifting a

facility resident using human power and taking an unsuitable posture<sup>7</sup>. Other previous studies have also reported that handling a patient/resident and taking an unsuitable posture were the primary risk factors for LBP among caregivers<sup>8, 9</sup>. Many caregivers must handle a patient/resident and take awkward postures in transferring, bathing, and toileting, among others.

Care equipment, such as mechanical lifts, sliding boards, and sliding sheets, eliminates the need to lift a resident using human power. The use of care equipment helps to prevent LBP and to reduce back injuries among caregivers<sup>3, 5, 10–16</sup>. The care method of lifting a patient using care equip-

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ment, rather than using human power, is called the no-lifting or no-lift policy<sup>17-19</sup>). The number of local governments that have set a budget for care equipment and recommend using no-lifting care has increased since about 2014. Moreover, the number of care facilities that have introduced the use of mechanical lifts has gradually increased<sup>20</sup>). Accordingly, the practice of the no-lift policy has been increasing in Japan.

The revised Long-Term Care Insurance Act (Act No. 123 of 1997) established more stringent conditions for the elderly moving into care facilities since 2015 in Japan. The needing care level (NCL) of a resident can be classified into five categories, with level 1 indicating a low NCL and level 5 indicating an extremely high NCL. Before 2015, an elderly individual could move into a care facility with an NCL of  $\geq 1$ ; since 2015, this NCL requirement has increased to  $\geq 3$ . At present, residents of care facilities include elderly individuals who exhibit substantial impairment of activities of daily living and require almost full-scale nursing care. As a resident's NCL increases, the burden on caregivers becomes greater. Because of these changes in the environment surrounding care, the risk factors for LBP among caregivers would have reasonably changed since the survey we administered in 2014.

Therefore, this study aimed to determine the changes in risk factors for severe LBP among caregivers between 2014 and 2018. The results of the 2014 survey have already been reported<sup>7</sup>), whereas those of the 2018 survey are presented in this study.

## Methods

### *Research design*

This cross-sectional study was conducted in care facilities for the elderly in Japan in 2018. The same population who participated in our 2014 survey took part in this survey. However, the sampling facilities were randomly selected in each survey and thus differed between survey periods.

Overall, 6,940 care facilities are registered in the Japan Ministry of Health, Labour, and Welfare Publication System of Long-Term Care Service Information. Among these facilities, 1,000 located throughout Japan, from Hokkaido to Okinawa (sampling rate, 14.4%), were selected via random sampling. In 2017, the number of registered caregivers was 262,111. Eight caregivers who differed in terms of sex, age, and years of experience were selected per facility; overall, 8,000 individuals were selected (sampling rate, 3.1%). In addition, anonymous, self-administered questionnaires were distributed to the care facility administra-

tors and caregivers. In the 2014 survey, the questionnaires were distributed to 1,000 facilities and 5,000 caregivers (5 caregivers per facility).

### *Questionnaires*

The questionnaires in this survey were the same as those used in the 2014 survey. The questionnaire provided to administrators collected basic information regarding the care facility, occupational safety and health activities (OSHAs; Table 1), as well as the quantities and types of care equipment (Table 2). The questionnaire administered to caregivers gathered information regarding their basic characteristics, job stressors, LBP severity during the past year, OSHA (Tables 1 and 3), use of care equipment (Table 2), and care methods (Table 4). Information linking the questionnaires to a care facility or caregiver was not collected.

OSHA consists of typical activities that occur in care facilities in Japan. Although care methods are included in OSHA, they were divided in this study to distinguish the areas in which the administrator and caregiver could improve. "Training on care methods" and "training for the use of care equipment" consisted of several hours of instructor-led learning. "Promoting the use of care equipment" was to declare the use of care equipment by the administrator and instruct caregivers to use them. "Establishing an appropriate care method for each resident" represented formulating and providing appropriate work standards to residents. "Use of the manual for care methods" was to create an instruction manual on care methods for caregivers and let them use it. "Testing on care methods and use of care equipment" was to conduct a test to determine that the caregiver can provide care to residents by a safety method. "Regular evaluation regarding care methods and use of care equipment" involved the occupational physicians' and/or instructors' evaluation of care methods and use of care equipment during their monthly workplace inspection.

Basic information collected regarding the care facility included the number of caregivers and residents in the care facility, the average NCL of the residents, as well as the number of retired and absent caregivers during the previous year. Information collected on basic characteristics included sex, age, smoking status, qualification, total years of experience, work shifts, and a total number of working hours per week.

Job stressor questions were developed based on the job demands, job control, and worksite social support items of the Brief Job Stress Questionnaire<sup>21</sup>) (see the 2014 survey for details<sup>7</sup>). These items were measured using a 4-point scale. Job demands and job control combined three items

into one, with scores ranging from 3 (low stressor) to 12 (high stressor). Worksite social support combined six items into one, with scores ranging from 6 (low stressor) to 24 (high stressor).

LBP severity was divided into four grades based on the scheme devised by Von Korff *et al.*<sup>22</sup>: grade 0, no LBP; grade 1, LBP not interfering with work; grade 2, LBP interfering with work; and grade 3, LBP interfering with work and leading to sick leave. Of these, grades 0 and 1 were defined as nonsevere LBP, whereas grades 2 and 3 were defined as severe LBP.

Questions developed regarding the use of care equipment and care methods considered the use of care equipment, lifting a resident using human power, and taking an unsuitable posture in transferring and bathing tasks, as shown in Table 4. These questions were measured using a 5-point scale with the following responses: “always performed,” “often performed,” “sometimes performed,” “almost never performed,” and “completely never performed”; the responses were dichotomized in the analysis.

#### Procedure

All questionnaires were distributed by mail to the facility administrators beginning in October 2018. The administrators were instructed to distribute the questionnaires to eight caregivers. The completed questionnaires were collected from each individual by mail by December 2018. The 2014 survey period was from January to March 2014.

The administrators and caregivers were informed about the study plan, and their personal information, provided in writing, was protected; the participants provided written informed consent. The 2014 and 2018 studies conformed to the principles of the Declaration of Helsinki. The ethics board of the National Institute of Occupational Safety and Health of Japan approved this study (registration ID nos. H3002 and H2522, respectively).

#### Statistical analysis

We excluded questionnaires from administrators who failed to provide data regarding the number of caregivers and residents in the care facility from the analysis. We also excluded questionnaires from caregivers who failed to provide information regarding sex and age. We used the  $\chi^2$  test or unpaired *t* test to compare data from the 2014 and 2018 surveys. Logistic regression analysis was used to analyze the association between severe LBP and OSHA or care methods, as well as those between care methods and OSHA. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated for crude and model data. The

model included sex (male or female), age group (<30, 30–39, 40–49, or  $\geq 50$  years), smoking status (nonsmoking or smoking), job demands, job control, and worksite social support. The ORs and 95% CIs reported in the tables represent only the model’s values. SPSS Version 22 (IBM, USA) was used for statistical analysis, and the significance level was set at  $\leq 5\%$ .

## Results

In 2018, we collected administrator-completed questionnaires from 505 facilities (response rate, 50.5%) and caregiver-completed questionnaires from 3,565 individuals (response rate, 44.6%). Among these, data from 504 facilities and 3,478 caregivers were included in the analysis. In the 2014 survey, we collected the questionnaires from 615 facilities (response rate, 61.5%) and 2,751 individuals (response rate, 55.0%), and included data from 612 facilities and 2,712 caregivers in the analysis.

Tables 1 (implementation rates in care facilities) and 2 present the results of the questionnaires completed by the administrators. Table 1 (participation rates of caregivers) and 3–6 show the results of the questionnaires completed by the caregivers. The rates reported in the tables were calculated without missing values, unlike in our previous study<sup>7</sup>.

#### Basic information of care facilities and caregivers

In 2018, the number of caregivers (mean  $\pm$  standard deviation) in the care facilities was  $45.9 \pm 21.2$ , and the number of residents was  $76.0 \pm 29.5$ . The average NCL of the residents was  $4.0 \pm 0.3$ . The number of retired caregivers and that of absent caregivers during the previous year was  $6.3 \pm 5.8$  and  $0.8 \pm 1.4$ , respectively. In 2014, the number of caregivers was  $46.4 \pm 21.6$ , the number of residents was  $74.4 \pm 28.4$ , the average NCL of the residents was  $3.9 \pm 0.4$ , the number of retired caregivers was  $5.5 \pm 5.0$ , and the number of absent caregivers was  $0.9 \pm 1.3$ . Differences in the proportions of caregivers, residents, and absent caregivers between the 2014 and 2018 surveys were not significant. The average NCL ( $p=0.001$ ) and the number of retired caregivers ( $p=0.018$ ) in the 2018 survey were slightly higher than those in the 2014 survey.

A total of 1,331 male and 2,147 female caregivers participated in the 2018 survey. The mean age of the caregivers was  $39.3 \pm 10.6$  years (range, 18–77 years). Of these caregivers, 31.8% ( $n=1,095$ ) were smokers and 79.6% ( $n=2,758$ ) were certified care workers. A total of 52.9% ( $n=1,834$ ) of the participants had  $\geq 10$  years of work experience, which

represented the highest number of years of experience recorded in the survey. A total of 35.6% ( $n=1,199$ ) of the participants had three work shifts, which represented the highest number of shifts in the work-shift system recorded in the survey. A total of 42.0% ( $n=1,422$ ) of the participants worked from 40 to 45 hours per week, representing the highest number of weekly working hours recorded in the survey. The scores for job demands, job control, and worksite social support were  $9.5 \pm 1.8$ ,  $7.8 \pm 1.9$ , and  $14.5 \pm 3.7$ , respectively.

A total of 989 male and 1,723 female caregivers participated in the 2014 survey. The mean age of the caregivers was  $37.8 \pm 10.7$  years (range, 18–75 years). Of these caregivers, 33.4% ( $n=857$ ) were smokers and 75.7% ( $n=2,054$ ) were certified care workers. A total of 50.3% ( $n=1,360$ ) of the participants had 2 to 10 years of work experience, which represented the highest number of years of experience recorded in the survey. A total of 36.5% ( $n=963$ ) of the participants had three work shifts, which represented the highest number of shifts in the work-shift system recorded in the survey. A total of 44.0% ( $n=1,171$ ) of the participants worked from 40 to 45 hours per week, representing the highest number of weekly working hours recorded in the survey. The scores for job demands, job control, and worksite social support were  $9.5 \pm 1.9$ ,  $7.7 \pm 1.9$ , and  $13.5 \pm 3.6$ , respectively.

Differences in sex, smoking status, and job demands between the 2014 and 2018 surveys were not significant. Age ( $p<0.001$ ), the number of certified care workers ( $p<0.001$ ), job control ( $p=0.042$ ), and worksite social support ( $p<0.001$ ) in the 2018 survey were slightly higher than those in the 2014 survey. The proportions of caregivers who worked for  $\geq 10$  years ( $p<0.001$ ), who worked on the day shift ( $p=0.001$ ), and who worked  $\leq 40$  hours per week ( $p=0.040$ ) in the 2018 survey were slightly higher than those in the 2014 survey.

#### *Severe LBP among caregivers*

Of the caregivers who participated in the 2018 survey, 33.2%, 28.5%, 31.7%, and 6.6% had grade 0, grade 1, grade 2, and grade 3 LBP, respectively. A total of 61.7% ( $n=2,009$ ) of the caregivers had nonsevere LBP, whereas 38.3% ( $n=1,247$ ) had severe LBP. In the 2014 survey, 62.7% ( $n=1,578$ ) of the caregivers had nonsevere LBP, whereas 37.3% ( $n=940$ ) had severe LBP. There were no significant differences in severe LBP between the 2014 and 2018 surveys.

#### *OSHA in care facilities and participation rates of caregivers*

Table 1 presents the OSHA in care facilities and the participation rates of caregivers in 2014 and 2018. Compared with the data from the 2014 survey, the 2018 survey results revealed that care facilities had higher implementation rates for establishing a health committee ( $p<0.001$ ), workplace rounds of inspection ( $p<0.001$ ), appointments with an industrial physician ( $p<0.001$ ), appointments with a health supervisor ( $p=0.002$ ), training on care methods ( $p=0.026$ ), training for the use of care equipment ( $p=0.002$ ), promoting the use of care equipment ( $p<0.001$ ), testing on care methods and use of care equipment ( $p=0.022$ ), and regular evaluation regarding care methods and use of care equipment ( $p<0.001$ ).

The caregivers' participation rates for training on care methods ( $p<0.001$ ), training to use care equipment ( $p<0.001$ ), receiving instruction promoting the use of care equipment ( $p<0.001$ ), testing on care methods and use of care equipment ( $p<0.001$ ), as well as regular evaluation regarding care methods and use of care equipment ( $p<0.001$ ) in 2018 were higher than those in 2014. On the other hand, the care facility implementation rate ( $p=0.012$ ) and caregiver participation rate ( $p<0.001$ ) for establishing an appropriate care method for each resident in 2018 were lower than those in 2014.

#### *Introduction rates and number of care equipment in care facilities*

Table 2 presents the introduction rates and the number of care equipment in the care facilities in 2014 and 2018. Compared with the data from the 2014 survey, the results of the 2018 survey revealed higher introduction rates for mobile hoists ( $p<0.001$ ), assistance equipment for standing ( $p=0.005$ ), sliding boards ( $p<0.001$ ), sliding sheets ( $p<0.001$ ), and modular wheelchairs ( $p<0.001$ ). The number of sliding boards ( $p<0.001$ ), modular wheelchairs ( $p=0.034$ ), and powered adjustable beds ( $p=0.001$ ) per 100 residents in 2018 were higher than those in 2014.

#### *Associations between severe LBP with OSHA*

Table 3 presents the associations between severe LBP and OSAs, as examined using the logistic regression models observed in 2014 and 2018. We found that lack of regular evaluation regarding care methods and use of care equipment (OR: 1.44, 95% CI: 1.16–1.78), nonestablishment of an appropriate care method for each resident (OR: 1.29, 95% CI: 1.06–1.56), and nonuse of the manual for care methods (OR: 1.18, 95% CI: 1.01–1.39) were associated with severe LBP in 2018. The ORs were as low as  $<2.00$ . None of the OSAs was associated with severe LBP

**Table 1. Occupational safety and health activities in care facilities and the participation rates of caregivers**

	Implementation rates in care facilities					Participation rates of caregivers				
	2018 (n=504)		2014 (n=612)		<i>p</i>	2018 (n=3,478)		2014 (n=2,712)		<i>p</i>
	%	n	%	n		%	n	%	n	
Medical checkup	99.8	503	99.5	608	0.631	97.7	3,370	98.2	2,655	0.204
Medical examination of low-back pain	57.9	290	55.4	336	0.429	46.9	1,610	44.6	1,193	0.079
Establishing a health committee	92.6	465	83.9	509	<0.001	—	—	—	—	
Workplace round of inspection	88.0	439	77.1	458	<0.001	—	—	—	—	
Appointments with an industrial physician	88.7	446	76.2	462	<0.001	—	—	—	—	
Appointments with a health supervisor	93.6	468	88.1	533	0.002	—	—	—	—	
Training on care methods	94.6	436	90.9	552	0.026	68.9	2,335	62.7	1,628	<0.001
Training for the use of care equipment	58.6	273	49.0	294	0.002	45.9	1,570	38.4	1,001	<0.001
Promoting the use of care equipment	79.4	400	69.0	411	<0.001	64.3	2,199	51.3	1,353	<0.001
Establishing an appropriate care method for each resident	91.0	456	94.9	581	0.012	82.5	2,825	89.9	2,388	<0.001
Use of the manual for care methods	90.1	454	87.3	528	0.156	65.9	2,253	67.4	1,772	0.237
Testing on care methods and use of care equipment	8.7	44	5.2	31	0.022	13.0	442	4.5	118	<0.001
Regular evaluation regarding care methods and use of care equipment	43.4	208	30.2	181	<0.001	16.5	563	12.5	317	<0.001
Consultation on appropriate care methods and use of care equipment with the person in charge	60.7	303	54.9	329	0.057	69.3	2,362	71.5	1,886	0.065

**Table 2. Occupational safety and health activities in care facilities and the participation rates of caregivers**

	Introduction rates of care equipment					Number of care equipment per 100 residents		
	2018 (n=504)		2014 (n=612)		<i>p</i>	2018 (n=504)	2014 (n=612)	<i>p</i>
	%	n	%	n		Mean ± SD	Mean ± SD	
Mobile hoist	27.4	138	17.8	109	<0.001	2.5 ± 1.8	2.1 ± 1.7	0.103
Rail guide hoist in a bedroom	3.6	18	3.3	20	0.869	6.2 ± 9.3	5.7 ± 3.8	0.805
Rail guide hoist in a bathroom	10.7	54	9.5	58	0.548	1.8 ± 1.0	2.0 ± 1.8	0.606
Stationary hoist in a bedroom	2.8	14	2.1	13	0.559	5.5 ± 10.6	3.9 ± 5.8	0.639
Stationary hoist in a bathroom	40.1	202	37.3	228	0.354	3.0 ± 2.6	2.5 ± 2.1	0.061
Assistance equipment for standing	4.8	24	1.8	11	0.005	2.1 ± 1.6	2.7 ± 4.2	0.560
Sliding board	63.9	322	40.0	245	<0.001	5.2 ± 5.8	3.2 ± 3.4	<0.001
Sliding sheet	45.6	230	29.1	178	<0.001	6.0 ± 5.9	5.3 ± 6.7	0.267
Modular wheelchair	62.5	315	42.5	260	<0.001	17.5 ± 18.0	14.3 ± 17.7	0.034
Powered adjustable bed	89.1	449	87.1	533	0.311	80.2 ± 30.0	73.5 ± 30.7	0.001



**Table 3. Associations between severe LBP and occupational safety and health activities examined using the logistic regression models**

	Executing rates of caregivers (%)			Model <sup>a)</sup> in 2018			Model <sup>a)</sup> in 2014		
	2018	2014	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Medical checkup									
Received	97.7	98.2	0.204	1.00			1.00		
Not received	2.3	1.8		0.55	0.32–0.94	0.029	0.61	0.28–1.27	0.185
Medical examination of low-back pain									
Received	46.9	44.6	0.079	1.00			1.00		
Not received	53.1	55.4		1.08	0.93–1.25	0.297	0.95	0.80–1.13	0.577
Training on care methods									
Received	68.9	62.7	<0.001	1.00			1.00		
Not received	31.1	37.3		1.44	0.97–1.34	0.106	0.95	0.79–1.14	0.586
Training for the use of care equipment									
Received	45.9	38.4	<0.001	1.00			1.00		
Not received	54.1	61.6		1.05	0.90–1.22	0.532	0.93	0.78–1.12	0.449
Promoting the use of care equipment									
Received	64.3	51.3	<0.001	1.00			1.00		
Not received	35.7	48.7		1.13	0.97–1.32	0.109	1.15	0.96–1.37	0.125
Establishing an appropriate care method for each resident									
Performed	82.5	89.9	<0.001	1.00			1.00		
Not performed	17.5	10.1		1.29	1.06–1.56	0.010	0.92	0.69–1.23	0.585
Use of the manual for care methods									
Performed	65.9	67.4	0.237	1.00			1.00		
Not performed	34.1	32.6		1.18	1.01–1.39	0.035	1.13	0.93–1.36	0.217
Testing on care methods and use of care equipment									
Performed	13.0	4.5	<0.001	1.00			1.00		
Not performed	87.0	95.5		1.00	0.80–1.25	0.979	1.00	0.66–1.53	0.992
Regular evaluation regarding care methods and use of care equipment									
Received	16.5	12.5	<0.001	1.00			1.00		
Not received	83.5	87.5		1.44	1.16–1.78	0.001	1.22	0.92–1.62	0.167
Consultation on appropriate care methods and use of care equipment with the person in charge									
Consultation	69.3	71.5	0.065	1.00			1.00		
No consultation	30.7	28.5		1.12	0.96–1.32	0.157	0.98	0.81–1.19	0.849

<sup>a)</sup> Adjusted for sex, age group, smoking, job demand, job control, and worksite social support using logistic regression analyses. OR: odds ratio, 95% CI: 95% confidence interval.

in 2014. The proportions of caregivers trained on care methods ( $p<0.001$ ), the use of care equipment ( $p<0.001$ ), instruction promoting the use of care equipment ( $p<0.001$ ), testing on care methods and use of care equipment ( $p<0.001$ ), as well as regular evaluation regarding care methods and use of care equipment ( $p<0.001$ ) in 2018 were higher than those in 2014. On the other hand, the proportion of caregivers who established an appropriate care method for each resident in 2018 was lower than that in 2014 ( $p<0.001$ ).

#### *Associations between severe LBP with care methods*

Table 4 presents the associations between severe LBP and care methods, examined using the logistic regression models observed in 2014 and 2018. With ORs of  $\geq 2.00$  in 2018, taking an unsuitable posture while bathing (OR: 3.46, 95% CI: 2.44–4.90) and transferring (OR: 2.99, 95% CI: 2.10–4.26) were associated with severe LBP. With ORs of  $<2.00$  in 2018, lifting a resident using human power while transferring (OR: 1.57, 95% CI: 1.01–2.44) and bathing (OR: 1.44, 95% CI: 1.06–1.96) as well as the use of a

**Table 4. Associations between severe LBP and care methods examined using the logistic regression models**

	Executing rates of caregivers (%)			Model <sup>a)</sup> in 2018			Model <sup>a)</sup> in 2014		
	2018	2014	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
<b>Transfer</b>									
Use of a hoist									
Always, often, or sometimes	19.6	12.5	<0.001	1.00			1.00		
Completely or almost never	80.4	87.5		1.33	1.09–1.62	0.006	1.34	0.99–1.81	0.058
Use of a sliding board or a sliding sheet									
Always, often, or sometimes	46.3	27.5	<0.001	1.00			1.00		
Completely or almost never	53.7	72.5		1.12	0.97–1.31	0.135	1.08	0.88–1.33	0.451
Adjustment of the height and back support section of beds									
Always, often, or sometimes	85.4	83.1	0.014	1.00			1.00		
Completely or almost never	14.6	16.9		1.14	0.93–1.41	0.216	1.16	0.91–1.47	0.225
Lifting a resident using human power									
Completely or almost never	3.6	2.4	0.007	1.00			1.00		
Always, often, or sometimes	96.4	97.6		1.57	1.01–2.44	0.045	4.23	1.76–10.12	0.001
Taking an unsuitable posture									
Completely or almost never	8.3	8.1	0.851	1.00			1.00		
Always, often, or sometimes	91.7	91.9		2.99	2.10–4.26	<0.001	2.56	1.71–3.84	<0.001
<b>Bathing</b>									
Use of a hoist									
Always, often, or sometimes	51.8	43.5	<0.001	1.00			1.00		
Completely or almost never	48.2	56.5		1.14	0.98–1.33	0.092	1.28	1.06–1.54	0.011
Use of mechanical bathtub									
Always, often, or sometimes	89.3	91.5	0.004	1.00			1.00		
Completely or almost never	10.7	8.5		1.23	0.97–1.56	0.095	1.22	0.88–1.69	0.232
Lifting a resident using human power									
Completely or almost never	7.4	5.6	0.006	1.00			1.00		
Always, often, or sometimes	92.6	94.4		1.44	1.06–1.96	0.019	2.16	1.35–3.44	0.001
Taking an unsuitable posture									
Completely or almost never	9.2	8.8	0.683	1.00			1.00		
Always, often, or sometimes	90.8	91.2		3.46	2.44–4.90	<0.001	3.47	2.29–5.25	<0.001

<sup>a)</sup> Adjusted for sex, age group, smoking, job demand, job control, and worksite social support using logistic regression analyses. OR: odds ratio, 95% CI: 95% confidence interval.

hoist while transferring (OR: 1.33, 95% CI: 1.09–1.62) were associated with severe LBP. With ORs of  $\geq 2.00$  in 2014, lifting a resident using human power while transferring (OR: 4.23, 95% CI: 1.76–10.12) and bathing (OR: 2.16, 95% CI: 1.35–3.44), as well as taking an unsuitable posture while bathing (OR: 3.47, 95% CI: 2.29–5.25) and transferring (OR: 2.56, 95% CI: 1.71–3.84) were associated with severe LBP. With an OR of  $< 2.00$  in 2014, the use of a hoist while bathing (OR: 1.28, 95% CI: 1.06–1.54) was associated with severe LBP.

The proportions of caregivers who used a hoist ( $p < 0.001$ ) and a sliding board/sheet ( $p < 0.001$ ), who adjusted the bed height and the back support section ( $p = 0.014$ ), and who did not lift a resident using human power ( $p = 0.007$ ) while transferring in 2018 were higher than those in 2014. The proportions of caregivers who used a hoist ( $p < 0.001$ ) and who did not lift a resident using human power ( $p = 0.006$ ) while bathing in 2018 were higher than those in 2014. On the other hand, the proportion of caregivers who used a mechanical bathtub in 2018 was lower than that in 2014

( $p=0.004$ ). There were no significant differences in taking an unsuitable posture while transferring and bathing between the 2014 and 2018 surveys.

#### *Associations between care methods and OSHAs*

The associations between care methods and OSHAs were examined using logistic regression analysis, with each care method as a dependent variable and each OSHA as an independent variable. The dependent variables were “Refraining from lifting a resident using human power for transferring or bathing” and “Refraining from taking an unsuitable posture during transferring or bathing.”

Table 5 presents the associations between care methods and OSHAs, using logistic regression models observed in 2018. “Refraining from lifting a resident using human power for transferring or bathing” was associated with all but two OSHAs: establishing an appropriate care method for each resident and use of the manual for care methods. “Refraining from taking an unsuitable posture during transferring or bathing” was associated with all OSHAs, except one: testing on care methods and use of care equipment.

Table 6 presents the associations between care methods and OSHAs, using logistic regression models observed in 2014. “Refraining from lifting a resident using human power for transferring or bathing” was associated with three activities: training on care methods (transferring: OR: 2.02, 95% CI: 1.03–3.98, bathing: OR: 1.64, 95% CI: 1.07–2.50), receiving instruction promoting the use of care equipment (transferring: OR: 2.12, 95% CI: 1.15–3.92, bathing: OR: 1.63, 95% CI: 1.11–2.39), and establishing an appropriate care method for each resident (transferring: OR: 0.45, 95% CI: 0.21–0.94, bathing: OR: 0.58, 95% CI: 0.34–0.99). “Refraining from taking an unsuitable posture during transferring or bathing” was associated with two activities: training on care methods (transferring: OR: 1.43, 95% CI: 1.02–2.01), as well as consultation on appropriate care methods and use of care equipment with the person in charge (bathing: OR: 1.44, 95% CI: 1.01–2.07).

## **Discussion**

This study aimed to determine changes in severe LBP risk factors among caregivers in care facilities for the elderly between 2014 and 2018. The number of caregivers who experienced severe LBP did not differ significantly between the 2014 and 2018 surveys. However, the rates of introduction of care equipment as well as the rates of participation in OSHA involving care methods and care equipment in 2018 were higher than those in 2014 were. Lifting

a resident using human power and taking an unsuitable posture were strongly associated with severe LBP in 2014, whereas only taking an unsuitable posture was strongly associated with severe LBP in 2018.

In 2018, the number of facilities that introduced care equipment, such as mobile hoists, sliding boards, and sliding sheets, increased, as did the number of caregivers who received training for the use of care equipment and instruction promoting the use of care equipment. In addition, many OSHAs, including training on care methods, training for the use of care equipment, promoting the use of care equipment, testing on care methods and use of care equipment, regular evaluation regarding care methods and use of care equipment, as well as consultation on appropriate care methods and use of care equipment with the person in charge, were associated with a decrease in the incidence of lifting a resident using human power.

In 2014, only two activities, namely, training on care methods and promoting the use of care equipment, were associated with lifting a resident using human power. Previous studies reported that using care equipment limited lifting a resident using human power<sup>3, 5, 14</sup>) and helped to prevent LBP among caregivers<sup>3, 5, 10–16</sup>). In addition, an ergonomic program using care equipment and training on care methods prevented or alleviated LBP among caregivers<sup>5, 11–13, 23</sup>). Moreover, research has shown that training on care methods contributed to initiating appropriate care methods wherein a caregiver does not lift the resident<sup>11, 23</sup>). Data on the relationship between LBP and testing on care methods and use of care equipment, regular evaluation thereof, or consultation thereon with the person in charge have not been previously reported. However, training, instruction, assessment, and consultation for/with caregivers are essential in implementing the no-lift policy<sup>17, 18</sup>). Hence, the introduction of care equipment and the OSHA reduced the incidence of lifting a resident using human power in this study, thus eliminating it as a risk factor for severe LBP.

“Refraining from taking an unsuitable posture during transferring or bathing” was significantly associated with all OSHAs, except for testing on care methods and use of care equipment, in 2018. On the other hand, in 2014, this item was associated with only two OSHAs: training on care methods and consultation on appropriate care methods and use of care equipment with the person in charge. Our results indicate that awareness and the conduct of activities that could lead to an unsuitable posture have changed since 2014. However, taking an unsuitable posture has remained a primary risk factor for LBP, which we speculate is due to the lack of an effective means of avoiding an unsuitable



**Table 5. Associations between care methods and occupational safety and health activities examined using logistic regression models in 2018**

Independent variables	Model <sup>a)</sup> with "Refraining from lifting a resident using human power" as a dependent variable						Model <sup>a)</sup> with "Refraining from taking an unsuitable posture" as a dependent variable					
	Transfer			Bathing			Transfer			Bathing		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Training on care methods												
Not received	1.00			1.00			1.00			1.00		
Received	2.43	1.44–4.10	0.001	1.78	1.27–2.50	0.001	1.43	1.05–1.93	0.021	1.28	0.96–1.70	0.095
Training for the use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	2.73	1.82–4.11	<0.001	2.27	1.71–3.02	<0.001	1.53	1.18–1.97	0.001	1.46	1.14–1.86	0.003
Promoting the use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	2.30	1.42–3.73	0.001	2.17	1.55–3.03	<0.001	1.87	1.38–2.52	<0.001	1.72	1.29–2.29	<0.001
Establishing an appropriate care method for each resident												
Not performed	1.00			1.00			1.00			1.00		
Performed	1.81	0.94–3.52	0.078	1.53	0.99–2.36	0.055	2.45	1.51–3.97	<0.001	1.93	1.27–2.95	0.002
Use of the manual for care methods												
Not performed	1.00			1.00			1.00			1.00		
Performed	1.29	0.83–1.99	0.252	1.00	0.74–1.34	0.981	1.56	1.15–2.10	0.004	1.04	0.79–1.36	0.804
Testing on care methods and use of care equipment												
Not performed	1.00			1.00			1.00			1.00		
Performed	2.11	1.37–3.26	0.001	1.49	1.06–2.11	0.024	1.37	0.99–1.91	0.060	1.18	0.84–1.64	0.346
Regular evaluation regarding care methods and use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	3.31	2.24–4.88	<0.001	1.47	1.06–2.03	0.020	1.59	1.18–2.13	0.002	1.15	0.85–1.56	0.373
Consultation on appropriate care methods and use of care equipment with the person in charge												
No consultation	1.00			1.00			1.00			1.00		
Consultation	1.67	1.03–2.73	0.038	1.29	0.93–1.78	0.123	1.94	1.39–2.72	<0.001	1.21	0.90–1.61	0.207

<sup>a)</sup> Adjusted for sex, age group, smoking, job demand, job control, and worksite social support using logistic regression analyses. OR: odds ratio, 95% CI: 95% confidence interval.

**Table 6. Associations between care methods and occupational safety and health activities examined using logistic regression models in 2014**

Independent variables	Model <sup>a)</sup> with "Refraining from lifting a resident using human power" as a dependent variable						Model <sup>a)</sup> with "Refraining from taking an unsuitable posture" as a dependent variable					
	Transfer			Bathing			Transfer			Bathing		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Training on care methods												
Not received	1.00			1.00			1.00			1.00		
Received	2.02	1.03–3.98	0.041	1.64	1.07–2.50	0.023	1.43	1.02–2.01	0.036	1.35	0.98–1.85	0.066
Training for the use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	1.69	0.97–2.96	0.065	1.36	0.94–1.97	0.106	1.19	0.88–1.63	0.264	0.99	0.73–1.33	0.939
Promoting the use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	2.12	1.15–3.92	0.016	1.63	1.11–2.39	0.013	1.19	0.87–1.62	0.278	1.20	0.90–1.62	0.217
Establishing an appropriate care method for each resident												
Not performed	1.00			1.00			1.00			1.00		
Performed	0.45	0.21–0.94	0.033	0.58	0.34–0.99	0.048	0.86	0.51–1.45	0.577	0.99	0.59–1.66	0.977
Use of the manual for care methods												
Not performed	1.00			1.00			1.00			1.00		
Performed	1.07	0.58–1.98	0.826	1.16	0.77–1.75	0.475	0.93	0.67–1.29	0.681	1.01	0.74–1.39	0.933
Testing on care methods and use of care equipment												
Not performed	1.00			1.00			1.00			1.00		
Performed	1.59	0.55–4.56	0.393	1.78	0.87–3.67	0.115	0.95	0.46–1.94	0.884	1.30	0.70–2.41	0.401
Regular evaluation regarding care methods and use of care equipment												
Not received	1.00			1.00			1.00			1.00		
Received	1.78	0.89–3.55	0.101	1.56	0.95–2.56	0.081	1.21	0.79–1.88	0.384	1.22	0.80–1.84	0.357
Consultation on appropriate care methods and use of care equipment with the person in charge												
No consultation	1.00			1.00			1.00			1.00		
Consultation	1.57	0.78–3.18	0.206	0.97	0.64–1.47	0.895	1.18	0.82–1.69	0.373	1.44	1.01–2.07	0.044

<sup>a)</sup> Adjusted for sex, age group, smoking, job demand, job control, and worksite social support using logistic regression analyses. OR: odds ratio, 95% CI: 95% confidence interval.

posture, such as using care equipment to lift a resident.

For the associations between LBP with OSHAs, non-establishment of an appropriate care method for each resident, nonuse of the manual for care methods, and lack of regular evaluation regarding care methods and use of care equipment were associated with severe LBP in 2018. However, all these associations were weak. We did not find any direct association between severe LBP and OSHAs in either 2014 or 2018. On the other hand, OSHA was associated with care methods, and care methods were associated with severe LBP. These results indicate that OSHA has an indirect influence on the prevention of severe LBP.

There was no significant difference in severe LBP among caregivers between 2014 and 2018. The condition for moving to a care facility has increased to an NCL of  $\geq 3$  since 2015. In our surveys, NCL slightly increased from 3.9 to 4.0. We hypothesized that cases of severe LBP will increase after 2015; meanwhile, the practice of no-lifting care had gradually increased. Although further studies are required to consider this point, no-lifting care may have suppressed an increase in severe LBP cases.

Our 2014 and 2018 studies have limitations. Only eight caregivers per care facility in 2018 and five caregivers per care facility in 2014 were sampled, and the results might have been affected by sampling bias. In both surveys, the percentage of certified care workers accounted for approximately 80% of all caregivers. The certified care workers were more specialized than the other caregivers and might have been working with health awareness. Moreover, the actual contents of the training modules on care methods and for use of care equipment were not investigated. As the contents varied per care facility, they may have had different effects on preventing LBP among the caregivers.

In conclusion, the introduction of care equipment as well as the OSHA involving care methods and care equipment, addressed the gap in practice after 2014 based on the data we obtained in 2018. As a result, lifting a resident using human power is no longer considered a primary risk factor for LBP. However, taking an unsuitable posture is still a primary risk factor and thus requires further improvement in care facilities.

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## Author contributions

K.I. conceived the ideas; K.I. and M.S. collected the data; K.I. and M.T analyzed the data; K.I, M.S., and X.L. led the writing.

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