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)² ¹. The number of caregivers experiencing occupational LBP increases yearly in Japan². 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 posture². Other previous studies have also reported that handling a patient/resident and taking an unsuitable posture were the primary risk factors for LBP among caregivers² ¹. 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 caregivers² ¹.

The care method of lifting a patient using care equip-

ment, rather than using human power, is called the no-lift-

ing or no-lift policy² ¹. 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 increased². 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 necessity to care for residents (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 ≥1; since 2015, this NCL requirement has increased to ≥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 reported²; the areas 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 frameworks 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 were selected for the study. 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 administrators 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 Questionnaire²⁶ (see the 2014 survey for details²⁵). 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.7): grade 0, no LBP; grade 1, LBP not interfering with work; grade 2, 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: 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 t-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 ≥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 ≤0.05.

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%), 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.

Basic information of care facilities and caregivers

In 2018, the number of caregivers (mean ± standard deviation) in the care facilities was 45.9 ± 21.2, and the number of residents was 76.0 ± 29.5. The average NCL of the caregivers was 37.8 ± 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, whereas 7.6% (n=198) of the participants had more than 10 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 ± 1.8, 7.8 ± 1.9, and 14.5 ± 3.7, respectively.

A total of 980 male and 1,723 female caregivers participated in the 2014 survey. The mean age of the caregivers was 33.4 ± 10.7 years (range, 21–66 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, whereas 7.6% (n=198) of the participants had more than 10 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 ± 1.9, 7.7 ± 1.9, and 13.5 ± 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 ≥10 years (p=0.001), who worked on the day shift (p=0.001), and who worked ≤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=2,099) 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.

OSHAs 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 OSHAs, 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 0.001. None of the OSHAs was associated with severe LBP.
Table 2. 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) | p | 2018 (n=3,478) 2014 (n=2,712) | p |
| % | n | % | n | % | n | % | n | p |
| 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 | 1,690 | 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 | 2,199 | 51.3 | 1,353 | <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 | 2,825 | 89.9 | 2,388 | <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 | 87.4 | 442 | 45.4 | 311 | 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 3. Associations between severe LBP and occupational safety and health activities examined using the logistic regression models

| Executing rates of caregivers (%) | OR 95% CI | p |
|----------------------------------|-----------|---|
| Medical checkup | Received | 97.7 | 2018 | 98.2 | 2014 | 0.204 | 1.00 |
| Not received | 2.3 | 1.8 | 0.05 | 0.55 | 0.32–0.94 | 0.029 | 1.00 |
| Medical examination of low-back pain | Received | 46.9 | 2018 | 44.6 | 2014 | 0.079 | 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 | 2018 | 62.7 | 2014 | <0.001 | 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 | 2018 | 38.4 | 2014 | <0.001 | 1.00 |
| Not received | 54.1 | 61.6 | 1.05 | 0.90–1.22 | 0.532 | 0.93 | 0.78–1.12 | 0.449 |
| Establishing a health committee | Received | 64.3 | 2018 | 53.1 | 2014 | <0.001 | 1.00 |
| Not received | 35.7 | 48.7 | 1.13 | 0.97–1.32 | 0.109 | 1.15 | 0.96–1.37 | 0.125 |
| Treatment for the use of care equipment | Received | 82.5 | 2018 | 89.9 | 2014 | <0.001 | 1.00 |
| Not received | 17.5 | 10.1 | 1.29 | 1.06–1.56 | 0.010 | 0.92 | 0.69–1.23 | 0.585 |
| Establishing an appropriate care method for each resident | Received | 65.9 | 2018 | 67.4 | 2014 | 0.237 | 1.00 |
| Not received | 34.1 | 32.6 | 1.18 | 1.01–1.39 | 0.035 | 1.13 | 0.93–1.36 | 0.217 |
| Use of a powered adjustable bed | Received | 89.1 | 2018 | 87.1 | 2014 | 0.001 | 1.00 |
| Not received | 10.9 | 12.9 | 0.84 | 0.59–1.22 | 0.258 | 1.17 | 0.73–1.86 | 0.419 |
| Sliding sheet | Received | 45.6 | 2018 | 37.3 | 2014 | <0.001 | 1.00 |
| Not received | 54.4 | 62.7 | 0.73 | 0.52–1.03 | 0.076 | 0.99 | 0.76–1.29 | 0.946 |
| Winter slide | Received | 8.7 | 2018 | 12.3 | 2014 | <0.001 | 1.00 |
| Not received | 91.3 | 87.7 | 0.62 | 0.41–0.93 | 0.026 | 1.00 | 0.69–1.48 | 0.882 |
| Home rail | Received | 7.1 | 2018 | 12.3 | 2014 | <0.001 | 1.00 |
| Not received | 92.9 | 87.7 | 0.65 | 0.42–0.99 | 0.038 | 1.00 | 0.69–1.48 | 0.882 |
| Extrusion | Received | 6.5 | 2018 | 12.3 | 2014 | <0.001 | 1.00 |
| Not received | 93.5 | 87.7 | 0.64 | 0.41–0.94 | 0.027 | 1.00 | 0.69–1.48 | 0.882 |

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. ORs of e2.00 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. ORs of e2.00 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 method for each resident in 2018 was lower than that in 2014 (p<0.001).

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

| Transfer | 2018 (%) | 2014 (%) | OR | 95% CI | p     | OR | 95% CI | p     |
|----------|----------|----------|----|--------|-------|----|--------|-------|
| 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 |
| Bathing | Use of a hoist | 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 | 0.965 | 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 |

*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.

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 2014 and 2018 surveys.

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 2014 and 2018 surveys. However, the rates of introduction of care equipment as well as the rates of participation inOSHAs involving care methods and care equipment in 2018 were higher than those in 2014. 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, promotion of 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 the risk factors among caregivers in care facilities for the elderly in implementing the no-lift policy.

In 2018, the number of facilities that introduced care methods and OSHAs, 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, promotion of 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 the risk factors among caregivers in care facilities for the elderly in implementing the no-lift policy.
Table 5. Associations between care methods and occupational safety and health activities examined using logistic regression models in 2014

| Independent variables | Model 1) with \("Refusing to lift a resident using human power\) as a dependent variable | Model 2) with \("Refusing to taking an unsuitable posture\) as a dependent variable |
|-----------------------|-----------------------------------------------------------------|----------------------------------|
|                        | Transfer Bathing                                               | Transfer Bathing                 |
|                        | OR 95% CI p                                                     | OR 95% CI p                      |
| Training on care methods | Not received 1.00 1.00 1.00                                     | Not received 1.00 1.00 1.00       |
|                        | Received 2.43 1.44-4.10 0.001 1.78 1.27-2.50 0.001            | 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             |
|                        | Not received 1.00 1.00 1.00                                     | Not received 1.00 1.00 1.00       |
|                        | Received 2.30 1.42-3.73 0.001 2.17 1.55-3.03 <0.001          | 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            |
|                        | Not received 1.00 1.00 1.00                                     | Not received 1.00 1.00 1.00       |
|                        | Performed 1.57 0.78-3.18 0.206 1.00 0.74-1.34 0.004          | Performed 1.07 0.58-1.98 0.028   |
|                        |                                                                 | 1.16 0.77-1.75 0.475             |
|                        |                                                                 | 0.93 0.67-1.20 0.681             |
|                        |                                                                 | 1.01 0.74-1.39 0.933             |
|                        | Not performed 1.00 1.00 1.00                                   | Not performed 1.00 1.00 1.00      |
|                        | Performed 2.12 1.15-3.92 0.016 1.63 1.11-2.39 0.013          | 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             |
|                        | Not performed 1.00 1.00 1.00                                   | Not performed 1.00 1.00 1.00      |
|                        | Performed 0.45 0.21-0.94 0.033 1.00 0.74-1.34 0.004          | Performed 1.59 0.55-4.56 0.393   |
|                        |                                                                 | 1.78 0.87-3.67 0.115             |
|                        |                                                                 | 0.93 0.46-1.94 0.884             |
|                        |                                                                 | 1.30 0.70-2.41 0.401             |
|                        | Not performed 1.00 1.00 1.00                                   | Not performed 1.00 1.00 1.00      |
|                        | Performed 1.78 0.89-3.55 0.101 1.56 0.95-2.56 0.081          | Performed 1.57 0.78-3.18 0.206   |
|                        |                                                                 | 1.56 0.95-2.56 0.081             |
|                        |                                                                 | 1.21 0.79-1.88 0.384             |
|                        |                                                                 | 1.22 0.80-1.84 0.357             |
|                        | Not received 1.00 1.00 1.00                                   | Not received 1.00 1.00 1.00       |
|                        | Consultation 1.67 1.03-2.73 0.038 1.29 0.93-1.78 0.123      | Consultation 1.57 1.07-2.31 0.098 |
|                        |                                                                 | 1.94 1.38-2.72 <0.001            |
|                        |                                                                 | 1.15 0.85-1.56 0.373             |
|                        | No consultation 1.00 1.00 1.00                                 | No consultation 1.00 1.00 1.00    |
|                        | Consultation 1.67 1.03-2.73 0.038 1.29 0.93-1.78 0.123      | Consultation 1.57 1.07-2.31 0.098 |
|                        |                                                                 | 1.94 1.38-2.72 <0.001            |
|                        | No consultation 1.00 1.00 1.00                                 | No consultation 1.00 1.00 1.00    |
|                        | Consultation 1.67 1.03-2.73 0.038 1.29 0.93-1.78 0.123      | Consultation 1.57 1.07-2.31 0.098 |
|                        |                                                                 | 1.94 1.38-2.72 <0.001            |

Note: \(\text{OR} = \text{odds ratio}, 95\% \text{ CI} = \text{95\% confidence interval}\).
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 ≥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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