

Aims and objectives. To describe what effects low back pain has on the daily lives of female family caregivers and to elucidate the caregiving factors associated with its development.

Background. Low back pain is a common musculoskeletal symptom in caregivers. However, few detailed studies have examined the association of low back pain with the daily lives of female family caregivers or which caregiving activities lead to their low back pain. The elucidation of these issues will contribute to the prevention and treatment of their low back pain.

Design. A cross-sectional study.

Methods. Japanese female family caregivers ($n = 156$) completed a self-administered questionnaire assessing lifestyle, health status, daily activity, and caregiving situation. Correlation analysis measured the association between low back pain and daily activity. Logistic regression analysis identified care activities related to low back pain.

Results. Thirty-five (22.4%) participants almost always experienced low back pain. The severity of low back pain was significantly and positively associated with difficulty in daily activities, especially bending and extending the lower back. As for care situation factors and caregiving activities, night care, assisting the family member to stand up and to lie down, dealing with problem behaviors, and taking medication were associated with the development of low back pain. After reclassifying the respective caregiving activities, those involving body repositioning and those mainly performed in a static position showed significant associations.

Conclusions. Low back pain in female family caregivers negatively affects their daily activities and certain caregiving activities are involved in the development of low back pain.

Relevance to clinical practice. Clinical nurses understand the situation of female caregivers and could prevent the development of low back pain with early intervention by providing adequate strategies to alleviate the burden of identified care activities related to low back pain.

Keywords: female family caregiver, low back pain, daily activity, caregiving activity, Japan

What does this paper contribute to the wider global clinical community?

- Female family caregivers are limited in daily living activities due to low back pain.
- Of a variety of caregiving activities, assisting the family member to stand up, dealing with problem behaviors, activities involving body repositioning, and activities mainly performed in a static position are associated with the development of low back pain.
- The findings contribute to the planning of effective strategies to ease low back pain and to increase daily activity in female family caregivers.

INTRODUCTION

While low back pain (LBP) is frequently work-related, its specific cause can be difficult to determine because degenerative changes in intervertebral discs can also cause LBP (Riihimäki 1991). Work-related causes of LBP can be physical, including physical fatigue from work activities or the posture in which the work is performed. Additionally, LBP can be psychological, related to work stress, as is often seen in nursing and caregiving (Fujimura *et al.* 1995, Karahan *et al.* 2009, Ribeiro

et al. 2012, Yeung 2012). With the aging of developed societies, the number of caregivers caring for elderly people at home is growing (Jang *et al.* 2010, de Meijer *et al.* 2015, Hiel *et al.* 2015). Accompanying this growth, a variety of health problems are occurring in home caregivers, such as LBP and aching shoulders (Tong *et al.* 2003, Okuda *et al.* 2004), diseases of the circulatory system (Von *et al.* 2010), and depressive symptoms (Kaya *et al.* 2010, Cabral *et al.* 2014).

BACKGROUND

It has been found that musculoskeletal symptoms such as LBP in female caregivers in the home are related to such factors as feelings of the burden of care, decline in mental health due to depressive symptoms, and type of care activity (Tong *et al.* 2003, Kenny *et al.* 2014). At the same time, it is known that for some women, symptoms of chronic pain, such as LBP, can affect their feelings of being burdened and of anxiety, regardless of whether they are involved in caregiving (Rives & Douglass 2004, Yeung 2012, Bener *et al.* 2013). Comparative investigations of caregiving and non-caregiving groups have shown that participants of caregiving groups reported a significantly higher percentage of LBP (Okuda *et al.* 2004, Hori *et al.* 2011). Furthermore, Tong *et al.* (2003) found that the prevalence of LBP was higher in participants who had to provide care in the form of physical assistance.

Musculoskeletal health problems in caregivers are an extremely serious health issue. These health problems not only affect the continuity of care (Moens *et al.* 1993, Feng *et al.* 2007) but also lead to a decline in caregivers' quality of life (QoL) (Bener *et al.* 2011) and the possibility that

caregivers eventually may need care themselves. The literature suggests that alleviating caregivers' musculoskeletal symptoms may lead to improvement in their physical and psychological QoL; but when considering how to alleviate these symptoms, one has to understand the underlying cause, that is, which caregiver activities are involved in the occurrence of specific musculoskeletal symptoms. However, detailed studies of the subject are unavailable in the literature. Thus, we defined family caregivers as anyone (family members including adult children, spouses, parents, and siblings) who provides any type of physical and/or emotional care for an ill or disabled loved one at home and conducted the present study of LBP, a frequent caregiver complaint, to shed light on the questions of (1) what effect LBP has on the daily lives of female caregivers providing care at home for a family member, and (2) which health-related behaviors and caregiving factors (such as care situation and caregiving activities) affect LBP in these women. We also consider which health-related behaviors and approaches to caregiving could avert the development of musculoskeletal symptoms and prevent a decline in caregivers' QoL.

METHODS

Participants

The participants were 156 women providing home care for a family member certified under the Long-Term Care Insurance System. To request cooperation with the study, we paid visits to local elderly care management centers (officially called *Chi-Iki Hōkatsu Shien Sentā* or “Community General Support Centers”) as well as to the managers of local in-home long-term care support

businesses (*kyotaku kaigo shien jigyo-sho*). We asked the care managers from each establishment consenting to participate to deliver letters to female family caregivers explaining the study and requesting participation. We distributed survey questionnaires to those caregivers agreeing to participate. Excluded from participation were (1) caregivers of family members admitted at the time into a long-term care facility or hospital, (2) caregivers of family members without certification from the Long-Term Care Insurance System, and (3) caregivers who did not have the required ability to comprehend the questionnaire and had difficulty filling out the survey. We were able to obtain cooperation from nine in-home long-term care support businesses and from two Local Elderly Care Management Centers to distribute 211 questionnaires. Of the 193 questionnaires returned (response rate 91.5%), we were able to use 156 for the analysis (valid response rate 73.9%).

Data collection

In order to understand the mental and physical characteristics, and daily activities, related to LBP in female family caregivers, in addition to some basic attributes, we collected data on their physical attributes, health status, the care situation, and daily activities. For the physical attributes, we asked for each participant's height and weight, from which we calculated their body mass index (BMI), and whether they were experiencing menopause. The health status questions covered such data points as to whether they had any significant illnesses, their average amount of sleep, their employment type, whether they had LBP, and their daily activities. Regarding LBP symptoms, participants answered the question "Do you have stiffness or pain in your lower back?" by choosing

from five subjective responses: never, once in a while, sometimes, almost always, or always.

Participants were asked to rate 16 daily activities on a four-point scale: no difficulty, a little difficult, quite difficult, or too difficult to do. The activities included 10 mainly indoor activities (miscellaneous housework like vacuuming, bending over to pick things up from the floor, bending and extending your lower back, making meals and washing dishes, reaching up to take heavy things down from shelves, standing without moving, washing and drying yourself, washing your hair, sitting down on and standing up from the toilet, and getting into/out of bed) and six mainly outdoor activities (going shopping, going up and down stairs, taking the bus or train, carrying heavy things, walking on flat ground, and closing or opening car doors).

The survey items regarding caregiving included the basic attributes of the family member being cared for and the care situation, including gender and age, relationship to the care receiver, illnesses, nursing care level (Ministry of Health, Labour and Welfare 2002), duration of care, and care time per day. Participants were also asked to rate the frequency of provision of 21 caregiving activities. These activities were bathing, using the bathroom or commode, using a bedpan or urinal, diaper changing, eating, gastrostomy/other tube feeding, dressing, sponge bathing, tooth brushing, face washing, turning in bed, getting up, lying down, standing up, transferring to and from a wheelchair or chair, moving around indoors, moving around outdoors, going out in a wheelchair, taking medication, drying futons/changing sheets, and dealing with problem behaviors. In this study, “problem behaviors” referred to behaviors that made the caregiver feel that it was difficult to maintain care; for example, symptoms related to dementia, such as hallucinations (visual or

auditory), wandering, or abusive language and behavior. For each caregiving activity, the participant responses were categorized as either “activity-yes” (always, sometimes) or “activity-no” (once in a while, never).

Based on previous studies (Fujimura *et al.* 1995, Minematu 2007, Yeung 2012), we created activity categories for the 21 caregiving activities based on activity type and posture used for the activity. “Activities involving hygiene” consisted of five activities: bathing, dressing, sponge bathing, face washing, and tooth brushing. “Activities involving excretion” consisted of three activities: using the bathroom or commode, using a bedpan or urinal, and diaper changing. “Activities requiring overall strength” comprised 12 activities: bathing, using the bathroom or commode, using a bedpan or urinal, diaper changing, turning in bed, getting up, lying down, standing up, transferring to and from a wheelchair or chair, moving around indoors, moving around outdoors, and going out in a wheelchair. “Activities involving body repositioning” consisted of three items: turning in bed, sitting up, and lying down. “Activities involving walking” included three items: standing up, moving around indoors, and moving around outdoors. “Activities involving a wheelchair” consisted of two items: transferring to and from a wheelchair or chair and going out in a wheelchair.

We created three posture categories to which we assigned some of the caregiving activities according to the posture used to perform it. For “activities mainly performed bending forward,” we selected seven activities: bathing, using the bathroom or commode, using a bedpan or urinal, diaper changing, sponge bathing, tooth brushing, and face washing. For “activities mainly performed holding a person up while moving,” we selected three activities: using the bathroom or commode,

standing up, and transferring to and from a wheelchair or chair. For “activities mainly performed in a static position,” we selected three activities: eating, gastrostomy/other tube feeding, and taking medication. Finally, we compared the actual number of caregiving activities that caregivers performed using their total number of “yes” activities, without regard for the intensity of the activities performed.

Statistical analysis

Cronbach’s alpha was calculated to determine the internal consistency of the 21 questions concerning caregiving activity. The internal consistency for these items was good (Cronbach’s alpha = 0.883). We categorized the participants into LBP and non-LBP groups based on the following definition in order to shed light on what elements of the care situation, and which activities, related to severe LBP. Participants who replied “almost always” or “always” to the question “Do you have stiffness or pain in the lower back?” were assigned to the LBP group and those who replied “never,” “once in a while,” or “sometimes” were assigned to the non-LBP group. Next, we compared the physical characteristics and health-related behaviors of the two groups. For categorical data, we used chi-square tests and for continuous data, we used *t*-tests. Multivariate logistic regression was performed with LBP status as the dependent variable and care situation factors and caregiving activities as the independent variables. The odds ratios for the relationships between each care-related factor and LBP status were estimated with a 95% confidence interval. Next, we calculated the odds ratios adjusting for three variables (age, BMI, and menopause status), which

were further adjusted for the stress variable, all with a 95% confidence interval. We used a significance level of 5% and a borderline significance level of 10% (i.e., $0.05 < p < 0.1$). The SPSS 22.0J for Windows software was used for the analysis.

Ethical considerations

When we distributed the questionnaires, we obtained informed consent by providing a written explanation that participation in the study was voluntary, that declining to participate was in no way disadvantageous, and that confidentiality would be maintained regarding the collection and handling of the data for the study.

This study was conducted with the approval of the Ethics Committee of the Nagoya University Graduate School of Medicine (approval number 13-168).

RESULTS

Demographic and physical characteristics of the female caregivers

Table 1 shows a summary of the data collected from the female family caregivers. The mean age was 65.4 years (*SD* 10.4). Of the principal illnesses in the caregivers' past and present clinical histories, high blood pressure had the highest prevalence with 52 people (33.3%). For various musculoskeletal disorders (lower limb bone fractures or degenerative arthritis, osteoporosis, spinal compression fractures, or scoliosis), the percentage of participants reporting each type ranged from 10–20%. About 20% of the participants reported experiencing LBP daily: 20 (12.5%) responded

“always” and 15 (8.9%) reported “almost always.” Regarding the care situation factors, looking at the duration of care, 105 (67.3%) of the participants reported providing care for three years, which is close to 70% of the total, and 20% provided care almost all day long. The mean age of the care receivers was 82.4 years (*SD* 8.2). For the nursing care level, 97 (62.2%) needed light nursing care and 59 (37.8%) needed heavy nursing care. Regarding illnesses, 64 (26.8%) reported dementia as the principal illness and 56 (23.4%) reported cerebrovascular disease, such as a stroke or cerebral hemorrhage.

Low back pain and daily activity

Table 2 shows the relationship between LBP severity and the degree to which the caregivers’ daily activities were inhibited. The highest percentage of participants who responded either “quite painful” or “too painful to do” was 26.3% for “carrying heavy things.” The next highest was 14.1% for “going up and down stairs,” followed by 11.6% for “reaching up to take heavy things down from shelves,” and 10.9% for “miscellaneous housework, such as vacuuming.” Of the 16 daily activities, 14 had a significant positive relationship with LBP severity. The correlations were particularly high for the indoor activities of “bending and extending the lower back” ($r = 0.44$), “bending over to pick things up from the floor” ($r = 0.36$), “miscellaneous housework, such as vacuuming” ($r = 0.36$), and for the outdoor activities of “carrying heavy things” ($r = 0.37$) and “going shopping” ($r = 0.32$).

Basic attributes and health-related behaviors by low back pain status

Table 3 shows a comparison of the basic attributes and health-related behaviors for the LBP and non-LBP groups of participants. There were no significant differences between the groups for age, height, weight, menopause status, or employment status. However, the difference in BMI was significant, with the BMI in the LBP group (mean 22.5 kg/m², *SD* 3.2) being higher than in the non-LBP group (mean 21.3 kg/m², *SD* 4.42). The percentage of participants experiencing stress was high in both groups at over 70%. However, while this was higher for the LBP group (85.7%) than the non-LBP group (76.0%), the difference was not statistically significant ($p = 0.22$).

Care situation factors and caregiving activities related to low back pain

Table 4 shows the odds ratios with 95% confidence intervals for the relationships between care situation factors and caregiving activities and LBP status. For the care situation factors, after all multivariate adjustments, a borderline significant positive relationship was shown only for night care (2.16 [0.96–4.88]) ($p = 0.06$). Although the percentage of participants complaining of LBP was high for those caring for family members with dementia or with a need for heavy nursing care and when the duration of care was 10 years or more, the differences were not statistically significant. Of the 21 caregiving activities studied, 17 were shown to have a positive relationship with LBP. Of those 17, assisting the family member to stand up (2.26 [1.02–5.01]) and dealing with problem behaviors (3.41 [1.30–9.00]) showed significant positive relationships with LBP. Assisting the family member to lie down (2.28 [0.95–5.49]) and to take medication (2.10 [0.94–4.71]) showed positive relationships that were borderline significant ($p = 0.07$). Although the percentage of

caregivers complaining of LBP was lower in those caring for a family member needing gastrostomy/other tube feeding (16.7%) than those not needing to perform such caregiving activity (22.7%), the difference was not statistically significant ($p = 0.46$).

Each of the caregiving activity categories we created showed a positive relationship with LBP. Of these, there was a significant relationship with activities involving repositioning the body (2.26 [1.00–5.11]) and those mainly performed in a static position (2.48 [1.08–5.74]). For activities involving holding a person up while moving (1.97 [0.89–4.33]), the relationship was borderline significant ($p = 0.09$). By dividing the total of caregiving activities (1–21) that caregivers performed into terciles and calculating the odds ratio for LBP in each, it was revealed that there was a trend ($p = 0.09$) for the LBP odds ratio to increase as caregivers performed a larger number of activities.

DISCUSSION

Our study was conducted to examine the effects of LBP on the daily lives of female family caregivers and to elucidate the caregiving factors associated with its development. Previous studies have shown that 42–71.1% of caregivers have LBP (Tong *et al.* 2003, Kaya *et al.* 2010). Among the female family caregivers of this study, 80% complained of LBP and 20% experienced LBP on a daily basis. When looking at 16 daily activities in order to understand how caregivers were affected, we found significant positive relationships between LBP severity and the degree to which 14 of these activities were inhibited. The indoor activities affected included motions such as bending and extending the lower back, picking things up or reaching to take things down from a shelf, as well as

activities that involve these motions, like cooking and general housework. The outdoor activities affected included going shopping, carrying heavy things, going up and down stairs, and standing still—activities that are relevant to the use of public institutions. These results were similar to the findings of a few studies that investigated the relationship between workers' LBP and restrictions in their daily activities (Riihimäki 1991, Rives & Douglass 2012). In a study investigating the indoor surroundings of caregivers who provided care for disabled children, Düger *et al.* (2003) reported that the locations of electric outlets and switches, and the heights of shelves, related to caregiver LBP. This result suggested that a way to mitigate LBP in female caregivers might be to consider how spaces in the home are used and to adjust the locations of shelves and outlet heights.

As to the relationship between care situation factors and LBP, a positive relationship between night care and LBP was borderline significant. The relationship between night care and workers' LBP was also investigated in a previous study by Tomioka and Matsunaga (2007) of people working in long-term care facilities. In a study of 280 family caregivers performing night care, Naruse *et al.* (2012) found that providing physical care for a family member during the night and dealing with dementia-related problem behavior led to lack of sleep in caregivers. According to Okuda *et al.* (2004), when sleep-deprived caregivers perform a large number of caregiving activities day and night, fatigue accumulates, which further increases strain on the body. In studies investigating LBP in caregivers providing care at home and in professional long-term care workers (Bardak *et al.* 2012, Yeung 2012), LBP was related to the duration of care and the severity of care receivers' symptoms. This is consistent with our study in which the percentage of individuals

complaining of LBP among caregivers providing care for 10 years or more was higher (36.8%) than that of individuals providing care for less than 3 years (19.6%).

The most interesting result in this study was that dealing with problem behavior had the strongest relationship with LBP. In the literature, there have been no studies of this relationship. However, it has been reported that dealing with problem behavior raises cardiovascular risk due to increased caregiver stress (Von *et al.* 2010, Cabral *et al.* 2014). In a study investigating feelings of the burden of care in caregivers of patients with dementia, Rosas-Carrasco *et al.* (2014) found that the caregivers' feelings of burden were related to dealing with problem behaviors and to sleep deprivation due to night care. These studies suggest that there might be a mechanism in the brain that functions to exacerbate the symptoms of LBP when, in addition to the physical burden of dealing with problem behavior, tension and irritation from having to deal with its unpredictability may create stress, resulting in psychological strain and pressure for caregivers (Hoogendoorn *et al.* 2000). These results provide a new perspective for thinking about ways to prevent or mitigate LBP in family caregivers.

For our analyses, we grouped caregiving activities by activity type and by the posture used to perform them. The study's results support the findings of previous studies indicating a significant relationship between LBP and caregiving activities requiring a comparatively large amount of strength, such as helping the family member to lie down or stand up (Minematu 2007, Karahan *et al.* 2009, Yeung 2012). The result also support the findings of numerous studies that have shown a relationship between LBP and caregiving activities related to body repositioning,

such as turning a person in bed (Fujimura *et al.* 1995, Feng *et al.* 2007). The study also replicated the finding of a relationship between LBP and caregiving activities performed mainly in a static posture. In a review of the literature on LBP in 1991, Riihimäki reported that sitting in the same position for many hours, as in office work, led to the appearance of LBP symptoms. Static postures for the participants in this study were seen in nutrition-related caregiving activities, such as assistance with eating and tube feeding. Although these activities are performed with a little movement, the mechanism underlying the appearance of LBP symptoms was believed to be similar to that governing the feelings that result from holding the same posture continuously. The reason for the relationship observed between LBP and assisting with taking medication is not clear. However, feelings of burden regarding the importance of continuity in administering medication and occasionally having to deal with problems, such as the family member's refusal to cooperate, can cause stress (Cárdenas-Valladolid *et al.* 2010), which may raise caregiver awareness of their LBP.

As suggested in this study, LBP can lead to a decline in QoL for female family caregivers. In addition, the study's results suggest that health-related behaviors and care skills may contribute to the prevention and mitigation of LBP in this population. One of the ostensible causes of LBP is insufficient exercise (Handschin & Spiegelman 2008). However, the amount of activity in caregivers' daily lives may already be adequate. In fact, over-work may be a cause of LBP. It is feasible that because the participants in the study were women, who typically have less muscle strength than men do, and because they performed these activities over long periods without adequate knowledge

of care techniques, all of the body's muscles and joints, as well as the lower back, may have been chronically affected. Furthermore, the stress of dealing with problem behavior and providing night care may have exacerbated these caregivers' LBP. Therefore, what is needed in order to address LBP in female family caregivers are approaches that take into consideration aspects of a caregiver's daily life, such as her mental and physical health and her care environment, rather than treatment approaches that only temporarily alleviate symptoms. Mental health interventions for caregivers are thought to be especially important in the mitigation of LBP. For example, behavioral interventions based on psychological approaches, such as cognitive behavioral therapy, may be necessary (Kitahara *et al.* 2006, Carpenter *et al.* 2012, Pincus *et al.* 2015). When a female caregiver is caring for a family member with problem behaviors or she has to provide night care, particular consideration should be given to enlisting a relief caregiver to mitigate her stress (Barbosa *et al.* 2011) and to looking into professional and informal services for additional assistance (Lui *et al.* 2012). In addition, for caregivers with little muscular strength and limited care techniques, classes need to be offered for exercises that can be done at home in order to build and maintain muscular strength as well as for the enhancement of long-term care skills and knowledge.

This study has several strengths and limitations. Regarding its strengths, we investigated the frequency of each specific caregiving activity and then categorized them by activity type and by the posture used to perform the activity. As a result, we were able to show not only which caregiving activities were related to LBP, but also which postures. By including dealing with problem behavior among the caregiving activities, we were able to demonstrate a new relationship to LBP. However,

regarding the limitations, because the study was cross-sectional, nothing could be learned about cause and effect relationships explaining the factors that contribute to LBP in female family caregivers. In addition, due to LBP, some caregivers might have refrained from performing some caregiving activities, which may have weakened the relationship between those activities and LBP. Only female caregivers were studied, so it is unknown whether the results apply to male caregivers, who have more muscular strength. Looking across the world, societies are aging, and many countries have issues concerning long-term care. However, because the participants in this study were all Japanese, the results may not apply to other countries with different physiques, living environments, and social systems. In the future, similar studies need to be conducted in other countries to show which points may be in common or different for the factors linked to LBP.

CONCLUSION

We found that LBP had an overall negative effect on the daily lives of female family caregivers in Japan. Furthermore, the caregiving activities related to their LBP were shown to be assisting the family member to stand up, dealing with problem behavior, activities involving body repositioning, and activities mainly performed in a static posture, regardless of the caregiver's age and BMI.

RELEVANCE TO CLINICAL PRACTICE

Our findings suggest that clinical nurses would be well positioned to understand the overall caregiving situation of female caregivers and could prevent the development of LBP by early

intervention in family caregivers who perform care activities contributing to LBP. Moreover, nurses could assist in implementing adequate strategies to alleviate the burden of identified care activities related to LBP in female caregivers with LBP. Psychosocial support, proper introduction of caregiving services, adequate exercise preventing decline in muscular strength, and education about appropriate care techniques are recommended as intervention strategies. These approaches could lead to increased daily activity among female family caregivers.

References

- Barbosa A, Figueiredo D, Sousa L & Demain S (2011) Coping with the caregiving role: differences between primary and secondary caregivers of dependent elderly people. *Aging and Mental Health* **15**, 490-499.
- Bardak AN, Erhan B & Gündüz B (2012) Low back pain among caregivers of spinal cord injured patients. *Journal of Rehabilitation Medicine* **44**, 858-861.
- Bener A, Verjee M, Dafeeah EE, Falah O, Al-Juhaishi T, Schlogl J, Sedeeq A & Khan S (2013) Psychological factors: anxiety, depression, and somatization symptoms in low back pain patients. *Journal of Pain Research* **6**, 95-101.
- Cabral L, Duarte J, Ferreira M & dos Santos C (2014) Anxiety, stress and depression in family caregivers of the mentally ill. *Atencion Primaria* **46**, 176-179.
- Cárdenas-Valladolid J, Martín-Madrado C, Salinero-Fort MA, Carrillo de-Santa Pau E, Abánades-Herranz JC & de Burgos-Lunar C (2010) Prevalence of adherence to treatment in

homebound elderly people in primary health care: a descriptive, cross-sectional, multicentre study.

Drugs and Aging **27**, 641-651.

Carpenter KM, Stoner SA, Mundt JM & Stoelb B (2012) An online self-help CBT intervention for chronic lower back pain. *Clinical Journal of Pain* **28**, 14-22.

de Meijer C, Bakx P, van Doorslaer E & Koopmanschap M (2015) Explaining declining rates of institutional LTC use in the Netherlands: a decomposition approach. *Health Economics* **24**, 18-31.

Düger T, Yilmaz O, Aki E, Kayihan H & Karaduman A (2003) The environmental barriers of children with Muscular Dystrophies and its effect on mother's low back pain. *Disability and Rehabilitation* **25**, 1187-1192.

Feng CK, Chen ML & Mao IF (2007) Prevalence of and risk factors for different measures of low back pain among female nursing aides in Taiwanese nursing homes. *BMC Musculoskeletal Disorders* **8**, 52. Available at: <http://www.biomedcentral.com/1471-2474/8/52> (accessed 1 June 2015).

Fujimura T, Yasuda N & Ohara H (1995) Work-related factors of low back pain among nursing aides in nursing homes for the elderly. *Sangyo Eiseigaku Zasshi* **37**, 89-98.

Handschin C & Spiegelman BM (2008) The role of exercise and PGC1 α in inflammation and chronic disease. *Nature* **454**, 463-469.

Hiel L, Beenackers MA, Renders CM, Robroek SJ, Burdorf A & Croezen S (2015) Providing personal informal care to older European adults: should we care about the caregivers' health? *Preventive Medicine* **70**, 64-68.

Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW & Bouter LM (2000) Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine* **25**, 2114-2125.

Hori Y, Hoshino J & Suzuki K (2011) Physical and psychological health problems among Japanese family caregivers. *Nagoya Journal of Medical Science* **73**, 107-115.

Jang SN, Avendano M & Kawachi I (2012) Informal caregiving patterns in Korea and European countries: A cross-national comparison. *Asian Nursing Research* **6**, 19-26.

Karahan A, Kav S, Abbasoglu A & Dogan N (2009) Low back pain: prevalence and associated risk factors among hospital staff. *Journal of Advanced Nursing* **65**, 516-524.

Kaya K, Unsal-Delialioglu S, Ordu-Gokkaya NK, Ozisler Z, Ergun N, Ozel S & Ucan H (2010) Musculo-skeletal pain, quality of life and depression in mothers of children with cerebral palsy. *Disability and Rehabilitation* **32**, 1666-1672.

Kenny P, King MT & Hall J (2014) The physical functioning and mental health of informal carers: evidence of care-giving impacts from an Australian population-based cohort. *Health and Social Care in the Community* **22**, 646-659.

Kitahara M, Kojima K & Ohmura A (2006) Efficacy of interdisciplinary treatment for chronic nonmalignant pain patients in Japan. *The Clinical Journal of Pain* **22**, 647-655.

Lui MH, Lee DT, Greenwood N & Ross FM (2012) Informal stroke caregivers' self-appraised problem-solving abilities as a predictor of well-being and perceived social support. *Journal of Clinical Nursing* **21**, 232-242.

Minematu A (2007) Understanding and prevention of low back pain in care workers. *Journal of the Japanese Physical Therapy Association* **10**, 27-31.

Ministry of Health, Labour and Welfare (2002) Long-term Care Insurance in Japan. Available at: <http://www.mhlw.go.jp/english/topics/elderly/care/2.html> (accessed 30 October 2015).

Mizutani M, Suzuki C, Omichi Y, Sakurai H, Morimoto A, Nishihara M, Ushida T, Arai YC & Sato J (2012) Psychotherapy for chronic pain in multidisciplinary pain center: its indication and its effect. *Pain Research* **27**, 175-188.

Moens GF, Dohogne T, Jacques P & Van Helshoecht P (1993) Back pain and its correlates among workers in family care. *Occupational Medicine* **43**, 78-84.

Naruse T, Nagata S, Taguchi A, Kuwahara Y & Murashima S (2012) Characteristics of family caregivers with sleep dissatisfaction in Japan: identification using CHAID dendrograms. *BioScience Trends* **6**, 10-18.

Okuda M, Umemura M, Yamami N, Ogihara R, Mano Y, Hosaka T, Mizuno E & Aoyagi M (2004) A study on fatigue and health disturbance in caregivers of the elderly at home. *Japanese Journal of Primary Care* **27**, 9-17.

Pincus T, Anwar S, McCracken LM, McGregor A, Graham L, Collinson M, McBeth J, Watson P, Morley S, Henderson J, Farrin AJ & the OBI Trial Management Team (2015) Delivering an Optimised Behavioural Intervention (OBI) to people with low back pain with high psychological risk: results and lessons learnt from a feasibility randomised controlled trial of Contextual Cognitive Behavioural Therapy (CCBT) vs. physiotherapy. *BMC Musculoskeletal Disorders* **16**, 147.

Ribeiro SB, Córdia MCG & Almeida LC (2012) Biomechanical and organizational risk and prevalence of low back pain in the old adults caregivers of a nursing home in Joao Pessoa/PB. *Work* **41**, 1933-1939.

Riihimäki H (1991) Low-back pain, its origin and risk indicators. *Scandinavian Journal of Work, Environment and Health* **17**, 81-90.

Rives PA & Douglass AB (2004) Evaluation and treatment of low back pain in family practice. *The Journal of the American Board of Family Practice* **17**, 23-31.

Rosas-Carrasco Ó, Guerra-Silla M de G, Torres-Arreola L del P, García-Peña C, Escamilla-Jiménez CI & González-González C (2014) Caregiver burden of Mexican dementia patients: the role of dysexecutive syndrome, sleep disorders, schooling and caregiver depression. *Geriatrics & Gerontology International* **14**, 146-152.

Tomiooka K & Matsunaga I (2007) The actual condition of musculoskeletal disorders of workers working at new special nursing homes for the aged in Osaka Prefecture: comparison of musculoskeletal disorder between manager's awareness and care workers' complaints by questionnaire survey. *Sangyo Eiseigaku Zasshi* **49**, 216-222.

Tong HC, Haig AJ, Nelson VS, Yamakawa KS, Kandala G & Shin KY (2003) Low back pain in adult female caregivers of children with physical disabilities. *Archives of Pediatrics and Adolescent Medicine* **157**, 1128-1133.

Von Känel R, Mausbach BT, Dimsdale JE, Mills PJ, Patterson TL, Ancoli-Israel S, Ziegler MG, Roepke SK, Allison M & Grant I (2010) Problem behavior of dementia patients predicts low-grade

hypercoagulability in spousal caregivers. *Journals of Gerontology Series A Biological Sciences and Medical Science* **65**, 1004-1011.

Yeung SS (2012) Factors contributing to work related low back pain among personal care workers in old age. *Work* **41**, 1873-1883.

Table 1 Characteristics of female caregivers and care receivers

	<i>n</i> (%), Mean ± SD
Caregiver data summary	
Age (years)	65.4 ± 10.4
Height (cm)	153.5 ± 5.8
Weight (kg)	50.9 ± 11.0
Body mass index (kg/m2)	21.6 ± 4.2
Menopause	
Yes	138 (88.5%)
No	18 (11.5%)
Average hours of sleep	6.0 ± 1.5
Employment	
Full-time	18 (11.5%)
Part-time	28 (18.0%)
Housewife	83 (53.2%)
None	27 (17.3%)
Health status	
Principal illnesses (past and present clinical history)	
High blood pressure	52 (33.3%)
Lower limb bone fractures/degenerative arthritis	32 (20.5%)
Osteoporosis	23 (14.7%)
Spinal compression fractures/scoliosis	16 (10.3%)
Diabetes/other cardiovascular disease	13 (8.3%)
Rheumatoid arthritis/other arthritic condition	11 (7.1%)
Depressive symptoms	11 (7.1%)
Other	26 (16.7%)
Low back pain	
Never	34 (21.8%)
Once in a while	52 (33.3%)
Sometimes	35 (22.4%)
Almost always	15 (9.6%)
Always	20 (12.8%)
Care situation	
Duration of care (years)	
Less than 3	51 (32.7%)
3 to less than 5	42 (26.9%)

	5 to less than 10	44 (28.2%)
	10 or more	19 (12.2%)
Care time per day		
	Almost all day	30 (19.2%)
	Approximately half a day	27 (17.3%)
	Approximately 2–3 hours	22 (14.1%)
	When needed	75 (48.1%)
	Other	2 (1.3%)
Living together with anyone other than care receiver		
	Yes	141 (90.4%)
	No	15 (9.6%)
Relationship to care receiver		
	Own parent	56 (35.9%)
	Spouse's parent	25 (16.0%)
	Spouse	70 (44.9%)
	Child	2 (1.3%)
	Sibling	3 (1.9%)
Care receiver data summary		
	Average age (years)	82.4 ± 8.2
	Average height (cm)	154.6 ± 10.7
	Average weight (kg)	51.8 ± 10.5
	Body mass index (kg/m ²)	21.6 ± 3.7
Gender		
	Male	84 (53.8%)
	Female	72 (46.2%)
Nursing care level (support required level 1–2 and care level 1–5)		
	Light care (less than 3)	97 (62.2%)
	Heavy care (3 or above)	59 (37.8%)
Principal illnesses (multiple responses possible)		
	Cerebrovascular disease (stroke, cerebral hemorrhage)	56 (23.4%)
	Dementia	64 (26.8%)
	Musculoskeletal disease (bone fractures, arthritis, rheumatoid arthritis, etc.)	34 (14.2%)
	Parkinson's disease	11 (4.6%)
	Cancer	8 (3.3%)
	Chronic respiratory disease	6 (2.5%)
	Chronic renal failure	6 (2.5%)
	Other disease	54 (22.6%)

Table 2 Relationships between daily activities and low back pain among Japanese female family caregivers

	No difficulty <i>n</i> (%)	A little difficult <i>n</i> (%)	Quite difficult <i>n</i> (%)	Too difficult <i>n</i> (%)	Spearman's correlation coefficient
Activities mainly indoors					
1. Bending and extending the lower back	85 (54.5%)	57 (36.5%)	11 (7.1%)	3 (1.9%)	0.44*
2. Bending over to pick things up from the floor	97 (62.2%)	46 (29.5%)	7 (4.5%)	6 (3.8%)	0.36*
3. Miscellaneous housework, such as vacuuming	87 (55.8%)	52 (33.3%)	12 (7.7%)	5 (3.2%)	0.36*
4. Making meals, washing dishes	111 (71.2%)	36(23.1%)	7 (4.5%)	2 (1.3%)	0.29*
5. Reaching up to take heavy things down from shelves (e.g., a bag of sugar)	98 (62.6%)	40 (25.6%)	14 (9.0%)	4 (2.6%)	0.28*
6. Getting into/out of bed (including a futon on the floor)	128 (82.1%)	24 (15.4%)	4 (2.6%)	0 (0%)	0.27*
7. Washing and drying yourself	132 (84.6%)	19 (12.2%)	5 (3.2%)	0 (0%)	0.21*
8. Washing your hair	138 (88.5%)	12 (7.7%)	5 (3.2%)	1 (0.6%)	0.19*
9. Sitting down on, and standing up from, the toilet	140 (89.7%)	15 (9.6%)	1 (0.6%)	0 (0%)	0.16
Activities mainly outdoors					
10. Carrying heavy things	62 (39.7%)	53 (34.0%)	27 (17.3%)	14 (9.0%)	0.37*
11. Going shopping	119 (76.3%)	28 (17.9%)	8 (5.1%)	1 (0.6%)	0.32*
12. Going up and down stairs	95 (60.9%)	39 (25.0%)	21(13.5%)	1 (0.6%)	0.26*
13. Standing without moving	113 (72.4%)	34 (21.8%)	9 (5.8%)	0 (0%)	0.22*
14. Taking the bus or train	130 (83.3%)	17 (10.9%)	3 (1.9%)	6 (3.8%)	0.16*
15. Walking on flat ground	136 (87.2%)	16 (10.3%)	4 (2.6%)	0 (0%)	0.19*
16. Closing or opening car doors	149 (95.5%)	5 (3.2%)	2 (1.3%)	0 (0%)	0.05

*Significant at $p < 0.05$

Table 3 Comparison of basic attributes and health-related behaviors between female caregivers with and without low back pain

		LBP group (<i>n</i> = 35)	Non-LBP group (<i>n</i> = 121)	<i>p</i> -value
		Mean ± SD, <i>n</i> (%)	Mean ± SD, <i>n</i> (%)	
Basic attributes and physical indicators				
Age (years)		66.1 ± 12.6	65.2 ± 9.7	0.66
Height (cm)		153.0 ± 5.5	153.7 ± 5.9	0.55
Weight (kg)		52.6 ± 7.8	50.4 ± 11.8	0.19
Body mass index (kg/m2)		22.5 ± 3.2	21.3 ± 4.4	0.08*
Menopause				
	Yes	29 (82.9%)	109 (90.1%)	0.24
	No	6 (17.1%)	12 (9.9%)	
Employed				
	Yes	10 (28.6%)	37 (30.6%)	0.82
	No	25 (71.4%)	84 (69.4%)	
Health-related behaviors				
Average hours of sleep		6.0 ± 2.2	6.1 ± 1.2	0.84
Regularly eating three meals/day				
	Yes	29 (82.9%)	113 (93.4%)	0.06*
	No	6 (17.1%)	8 (6.6%)	
Exercise (30 min or more/session, at least twice per week)				
	Yes	12 (34.3%)	42 (34.7%)	0.96
	No	23 (65.7%)	79 (65.3%)	
Alcohol				
	Yes	10 (28.6%)	26 (21.5%)	0.38
	No	25 (71.4%)	95 (78.5%)	
Smoking				
	Yes	1 (2.9%)	2 (1.7%)	0.54
	No	34 (97.1%)	119 (98.3%)	
Stress (Did you feel stressed during the last month?)				
	Yes	30 (85.7%)	92 (76.0%)	0.22
	No	5 (14.3%)	29 (24.0%)	

*Borderline significant at $0.05 < p < 0.1$

Age, height, weight, body mass index, and average hours of sleep were analyzed using t-tests. Otherwise, chi-square tests were used, except for smoking, for which Fisher's exact test was used. LBP, low back pain.

Table 4 Logistic regression results: Factors relating to low back pain in female family caregivers

	Participants (<i>n</i>)	Percentage of participants with LBP (<i>n</i> , %)	Crude odds ratio (95% CI)	Odds ratio adjusted for age, body mass index, and menopause (95% CI)	Odds ratio adjusted for age, body mass index, menopause, and stress (95% CI)
Care situation factors					
Dementia					
No	92	18/92 (19.6%)	1.00	1.00	1.00
Yes	64	17/64 (26.6%)	1.49 (0.7–3.17)	1.53 (0.69–3.36)	1.48 (0.67–3.28)
Nursing care levels according to the long-term care insurance system in Japan					
Light care levels (support required level 1–2 and care required level 1–2)	97	20/97 (20.6%)	1.00	1.00	1.00
Heavy care levels (care required level 3–5)	59	15/59 (25.4%)	1.31 (0.61–2.82)	1.06 (0.48–2.36)	1.05 (0.47–2.34)
Duration of care (years)					
Less than 3	51	10/51 (19.6%)	1.00	1.00	1.00
3 to less than 5	42	10/42 (23.8%)	1.28 (0.48–3.45)	1.11 (0.39–3.13)	1.14 (0.40–3.24)
5 to less than 10	44	8/44 (18.2%)	0.91 (0.33–2.56)	0.78 (0.27–2.26)	0.74 (0.25–2.18)
10 or more	19	7/19 (36.8%)	2.39 (0.75–7.63)	2.44 (0.74–8.10)	2.51 (0.75–8.43)
All-day care					
No	126	27/126(21.4%)	1.00	1.00	1.00
Yes	30	8/30 (26.6%)	1.33 (0.53–3.33)	1.34 (0.53–3.42)	1.32 (0.52–3.39)
Night care					
No	104	18/104(17.3%)	1.00	1.00	1.00
Yes	52	17/52 (32.7%)	2.32 (1.07–5.02)**	2.25 (1.00–5.06)**	2.16 (0.96–4.88)*
Living together					
No	15	4/15 (26.7%)	1.00	1.00	1.00
Yes	141	31/141(22.0%)	0.78 (0.23–2.60)	0.72 (0.19–2.70)	0.76 (0.20–2.85)
Care activities					
1. Bathing					
No	110	24/110 (21.8%)	1.00	1.00	1.00
Yes	46	11/46 (23.9%)	1.13 (0.50–2.54)	1.04 (0.45–2.43)	1.05 (0.45–2.45)
2. Using bathroom or commode					
No	105	20/105(19.0%)	1.00	1.00	1.00
Yes	51	15/51 (29.4%)	1.77 (0.82–3.84)	1.63 (0.73–3.64)	1.59 (0.71–3.57)

3. Using bedpan or urinal						
No	137	30/137 (21.9%)	1.00	1.00	1.00	
Yes	19	5/19 (26.3%)	1.27 (0.43–3.82)	1.02 (0.32–3.22)	0.94 (0.29–3.01)	
4. Diaper changing						
No	102	23/102 (22.5%)	1.00	1.00	1.00	
Yes	54	12/54 (22.2%)	0.98 (0.45–2.17)	0.84 (0.37–1.91)	0.83 (0.36–1.90)	
5. Eating						
No	133	28/133 (21.1%)	1.00	1.00	1.00	
Yes	23	7/23 (30.4%)	1.64 (0.62–4.38)	1.53 (0.56–4.16)	1.51 (0.55–4.15)	
6. Gastrostomy/other tube feeding						
No	150	34/150 (22.7%)	1.00	1.00	1.00	
Yes	6	1/6 (16.7%)	0.68 (0.08–6.04)	0.46 (0.05–4.60)	0.43 (0.04–4.19)	
7. Dressing						
No	69	14/69 (20.3%)	1.00	1.00	1.00	
Yes	87	21/87 (24.1%)	1.25 (0.58–2.69)	0.99 (0.44–2.20)	1.00 (0.45–2.25)	
8. Sponge bathing						
No	97	20/97 (20.6%)	1.00	1.00	1.00	
Yes	59	15/59 (25.4%)	1.31 (0.61–2.82)	1.22 (0.55–2.70)	1.19 (0.53–2.66)	
9. Tooth brushing						
No	115	23/115 (20.0%)	1.00	1.00	1.00	
Yes	41	12/41 (29.3%)	1.66 (0.73–3.73)	1.51 (0.65–3.49)	1.54 (0.66–3.57)	
10. Face washing						
No	114	21/114 (18.4%)	1.00	1.00	1.00	
Yes	42	14/42 (33.3%)	2.21 (0.99–4.92)**	1.83 (0.80–4.20)	1.88 (0.81–4.33)	
11. Turning in bed						
No	143	30/143 (21.0%)	1.00	1.00	1.00	
Yes	13	5/13 (38.5%)	2.35 (0.72–7.72)	1.99 (0.58–6.79)	1.95 (0.57–6.70)	
12. Getting up (from a reclining position)						
No	119	24/119(20.2%)	1.00	1.00	1.00	
Yes	37	11/37 (29.7%)	1.68 (0.73–3.86)	1.59 (0.68–3.72)	1.61 (0.69–3.76)	
13. Lying down						
No	124	23/124 (18.5%)	1.00	1.00	1.00	
Yes	32	12/32 (37.5%)	2.64 (1.13–6.15)**	2.32 (0.97–5.57)*	2.28 (0.95–5.49)*	
14. Standing up (from a seated position)						
No	106	18/106 (17.0%)	1.00	1.00	1.00	
Yes	50	17/50 (34.0%)	2.52 (1.16–5.46)**	2.37 (1.085.21)**	2.26 (1.02–5.02)**	
15. Wheelchair transferring						
No	119	24/119 (20.2%)	1.00	1.00	1.00	
Yes	37	11/37 (29.7%)	1.68 (0.73–3.86)	1.42 (0.60–3.37)	1.44 (0.60–3.46)	
16. Moving around (indoors)						

No	106	30/106 (28.3%)	1.00	1.00	1.00
Yes	20	5/20 (25%)	1.18 (0.40–3.50)	1.24 (0.41–3.76)	1.18 (0.39–3.60)
17. Moving around (outdoors)					
No	100	23/100 (23%)	1.00	1.00	1.00
Yes	56	12/56 (21.4%)	0.91 (0.41–2.01)	1.00 (0.45–2.26)	0.97 (0.43–2.20)
18. Going out in a wheelchair					
No	104	21/104 (20.2%)	1.00	1.00	1.00
Yes	52	14/52 (26.9%)	1.46 (0.67–3.17)	1.36 (0.61–3.03)	1.42 (0.63–3.19)
19. Taking medication					
No	74	12/74 (16.2%)	1.00	1.00	1.00
Yes	82	23/82 (28.0%)	2.01 (0.92–4.41)*	2.09 (0.94–4.67)*	2.10 (0.94–4.71)*
20. Problem behavior					
No	131	24/131 (18.3%)	1.00	1.00	1.00
Yes	25	11/25 (44%)	3.50 (1.42–8.66)***	3.57 (1.37–30)***	3.41 (1.30–9.00)**
21. Drying futons/changing sheets					
No	12	3/12 (25.0%)	1.00	1.00	1.00
Yes	144	32/144 (22.2%)	0.86 (0.22–3.35)	1.04 (0.25–4.26)	1.00 (0.24–4.16)
Care activity categories					
Activities involving hygiene					
No	53	9/53 (17.0%)	1.00	1.00	1.00
Yes	103	26/103 (25.2%)	1.65 (0.71–3.84)	1.49 (0.62–3.59)	1.58 (0.65–3.82)
Activities involving excretion					
No	82	15/82 (18.3%)	1.00	1.00	1.00
Yes	74	20/74 (27.0%)	1.65 (0.77–3.54)	1.37 (0.62–3.01)	1.35 (0.61–2.98)
Terciles for activities requiring overall strength					
1	45	10/45 (22.2%)	1.00	1.00	1.00
2	63	10/63 (15.9%)	0.66 (0.25–1.75)	0.70 (0.26–1.90)	0.72 (0.27–1.95)
3	48	15/48 (31.3%)	1.59 (0.63–4.04)	1.52 (0.59–3.89)	1.51 (0.58–3.88)
(Trend test)			$p = 0.28$	$p = 0.35$	$p = 0.36$
Activities involving body repositioning					
No	114	20/114 (17.5%)	1.00	1.00	1.00
Yes	42	15/42 (35.7%)	2.61 (1.18–5.78)**	2.27 (1.01–5.12)**	2.26 (1.00–5.11)**
Activities involving walking					
No	77	16/77 (20.8%)	1.00	1.00	1.00
Yes	79	19/79 (24.1%)	1.21 (0.57–2.57)	1.29 (0.60–2.80)	1.24 (0.57–2.71)
Activities involving a wheelchair					
No	95	18/95 (18.9%)	1.00	1.00	1.00
Yes	61	17/61 (27.9%)	1.65 (0.77–3.53)	1.59 (0.73–3.46)	1.63 (0.75–3.58)
Activity posture categories					
1) Activities mainly performed bending forward					

No	55	9/55 (16.4%)	1.00	1.00	1.00
Yes	101	26/101 (25.7%)	1.77 (0.76–4.11)	1.53 (0.64–3.65)	1.59 (0.66–3.80)
2) Activities mainly performed holding a person up while moving					
No	86	14/86 (16.3%)	1.00	1.00	1.00
Yes	70	21/70 (30.0%)	2.20 (1.02–4.75)**	2.00 (0.91–4.39)*	1.97 (0.89–4.33)*
3) Activities mainly performed in a static position					
No	69	10/69 (14.5%)	1.00	1.00	1.00
Yes	87	25/87 (28.7%)	2.38 (1.05–5.38)**	2.46 (1.07–5.67)**	2.48 (1.08–5.74)**
Terciles for total number of activities performed (1–21)					
1	57	9/57 (15.8%)	1.00	1.00	1.00
2	50	10/50 (20.0%)	1.33 (0.49–3.60)	1.30 (0.47–3.56)	1.36 (0.49–3.76)
3	49	16/49 (32.7%)	2.59 (1.02–6.55)**	2.24 (0.87–5.80)*	2.24 (0.86–5.83)*
(Trend test)			$p = 0.04$	$p = 0.09$	$p = 0.09$

* $0.05 < p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

CI, confidence interval; LBP, low back pain.