

Association between work content and musculoskeletal disorders among home caregivers: a cross-section study

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Received July 19, 2021 and accepted November 18, 2021

Published online in J-STAGE November 24, 2021

DOI <https://doi.org/10.2486/indhealth.2021-0160>

Abstract: In Taiwan, over 80% of home caregivers have experienced musculoskeletal disorders (MSD) in the past year. Although MSDs in health care workers have been discussed in existing literature (e.g., in nursing staff), there is limited understanding of the association between MSD and the work content of home caregivers. This study aimed to investigate the correlation between the work content and MSD of home caregivers. This cross-sectional study was conducted in long-term care units in central Taiwan. A structured questionnaire was used to collect data, including basic information, work content survey, and information from the Nordic Musculoskeletal Questionnaire. Logistic regression analysis was used to examine the association between work content and MSD. A total of 149 home caregivers with a mean age of approximately 50.97 ± 9.80 years were recruited for the study. The frequency of transfer of toilet and wheelchair was significantly associated with shoulder discomfort, upper back discomfort, and wrists/hands discomfort. In addition, the frequency of passive range of motion exercise was significantly associated with elbows discomfort. The results of this study indicated that the highest risk factor for MSD was transfer of toilet and wheelchair followed by passive range of motion exercise.

Key words: Work content, Musculoskeletal disorders, Home caregivers, Long-term care, Transfer

Introduction

As of 2018, 14% of Taiwan's population is over age 65, which suggests that one in seven people is an older adult¹. As the older adults population rapidly rises, the demand for

long-term care is also increasing rapidly with an increase in life expectancy, shorter hospital stays, and increased number of disabled people². In 2017, Taiwan's long-term care policy promoted a home-based aging-in-place service model that allows care recipients to stay in their familiar environments until their final years, which has led to an increased demand for home care attendants (HCAs). Unfortunately, there is not only a shortage of home caregivers in Taiwan but also a high turnover rate³. One of the key reasons for leaving the workplace is musculoskeletal disorder

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ders (MSD), especially in the lower back, shoulders, and upper back, caused by caregiving^{4, 5}). More than 80% of home caregivers in Taiwan have experienced MSD in the past year⁴), a prevalence rate significantly higher than that among health care workers in other countries—approximately 30% of caregivers Denmark and the United Kingdom have experienced MSD^{6, 7}). Therefore, if MSD is not taken seriously, it will be difficult to effectively reduce the turnover rate and improve quality of care, and it may further increase expenditures of the labor and safety departments⁸).

The incidence of MSD (or illness) among health care employees exceeds incidences within the manufacturing, construction, and mining industries^{9–11}). Previously, health care was even considered the riskiest occupational category for MSD^{12, 13}). According to a literature review⁸), over half (57%) of health care workers had MSD in the past year, and the most commonly affected body parts among home caregivers were shoulders (73%), neck (63%), lower back (59%), lower extremities (43%), and upper extremities (25%). However, this study also indicated that most previous studies have focused on the back and few have investigated the upper and lower extremities⁸). A recent study in Taiwan⁴) suggested that up to 88% of home caregivers had MSD in the past year, and the most commonly affected parts were the shoulders (67.4%), lower back (64.2%), and wrists/hands (56.6%). Therefore, in addition to investigating more body parts and reduce the risk of MSD, scholars should explore which home caregiver tasks may cause MSD.

The working environment of home care may vary greatly for each home. “Physical care” was the highest among the work content of home caregivers (37.6%), followed by household services and leisure activities¹⁴). The work content of home caregivers sometimes requires them to maintain the same posture for a long time (e.g., bathing), which can easily cause stress to the musculoskeletal system (e.g., the lower back)¹⁵). Manual manipulation (pushing or pulling) when providing physical care often carries a high risk of musculoskeletal disorders, such as when assisting with bed-to-wheelchair transfer^{4, 11}). The musculoskeletal stresses and shear forces are excessive during the process of assisting the care recipient to transfer¹⁶). The home caregiver also needs to assist the care recipient by bathing, sitting up in bed, passive range of motion exercise, rolling over, and patting the back. Each of these are physically taxing lifting movements that can cause MSD⁶). Lifting has long been considered a high-risk activity for MSD. Therefore, in many settings, such as long-term care facilities and nursing

homes, mechanical devices are often used to assist in reducing the risk of MSD¹⁷). However, mechanical devices are often unavailable in care recipients’ homes. Furthermore, the working environment of home care may vary greatly for each home, and home caregivers need to travel frequently in different spaces in the home. In Asia, the home space is generally smaller than that in Western countries, especially in the bathroom space¹⁸). Asians love to take a bath at home (install a bathtub), making the bathroom space even more cramped¹⁹). For example, in Taiwan, the general bathroom (including bathtub) space is only about 210 x 140 cm²⁰). Home caregivers often work in cramped or chaotic spaces (e.g., bedroom or bathroom environments in the home), and these uncomfortable spaces further increase the risk of MSD²¹).

Many countries have an aging population, so the demand for home caregivers increases every year. For home care, unlike facility care, the unique nature of the work environment exposes home caregivers to various accidents and unpredictable hazards, which are directly related to high turnover rates²²). Although there is existing literature that addresses the occupational safety (e.g., studies on MSD risk) of health care workers (e.g., nursing staff), there is still a limited understanding of home caregivers and the relation of their work content to MSD^{22, 23}). In summary, the main purpose of this study was to understand the work content of home caregivers and the prevalence of MSD in nine body parts and investigate the correlation between the work content and MSD. By exploring which work tasks may be risk factors for MSD, we can better ensure the occupational safety and physical health of caregivers.

Methods

Study design and participants

This study was a cross-sectional study with a structured questionnaire to collect data. The study was conducted between October 2019 and March 2020 at the long-term care units providing home care services in central Taiwan. A research assistant visited the unit in person to explain the study and obtain written consent from participants before distributing the questionnaire. The inclusion criteria included: (1) currently providing home care services and working for at least one year, (2) able-bodied with no significant physical impairment, and (3) able to complete and understand the questionnaire. Those under the age of 20, those with a history of mental illness or symptoms diagnosed by a physician, and foreign workers were excluded. The data collection procedure is summarized in Figure 1.

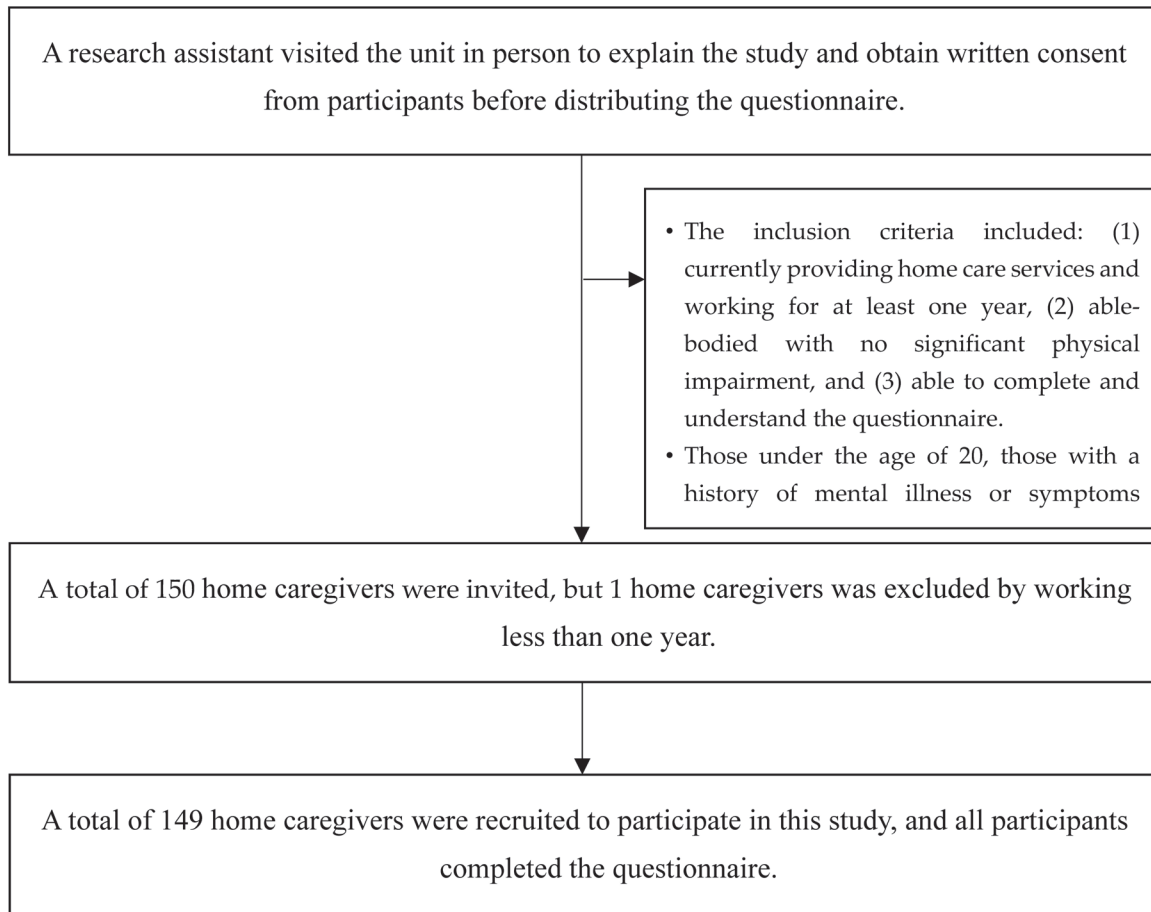


Fig. 1. Flow chart of the selection of participants.

Ethical approval for the study was obtained from the Central Regional Research Ethics Committee China Medical University (No. 108-074). The study used G-power software (3.1.0) to estimate the sample size. The type I error was set at 0.05, based on a power of 0.8 for the Logistic regression test, and the sample size was estimated to be 135 based on the incidence of shoulder discomfort and the odds ratio (OR) set in the previous literature⁴⁾.

Questionnaire

This questionnaire comprised three main parts. The first part collected basic information about the participants, including gender, age, BMI (body mass index), education level, marital status, dominant hand, whether they have children under the age of seven, main income earner, weekly exercise frequency, number of years worked, and using protective gear (e.g., waist protector). The second part collected information about the work content of home caregivers. The work content questionnaire was designed in reference to a previous study in Taiwan²⁴⁾ and investigated the frequency (average number of times per day) and effort

level (0–10 points, with 0 being no effort and 10 being all effort) of seven major tasks in the last month. The seven items included: transfer of bed and wheelchair, take a bath (not sponge bath), sit up in bed, passive range of motion exercise (moves the limb or body part around the stiff joint, and gently stretching muscles), transfer of toilet and wheelchair, turnover and pat the back, and take a sponge bath. The number of times for the items “transfer of bed and wheelchair” and “transfer of toilet and wheelchair” was calculated as one time for unidirectional transfer, such as one time for moving from bed to wheelchair.

The third part investigated the MSD of home caregivers. The Nordic Musculoskeletal Questionnaire (NMQ) was used in this study. It is a standardized musculoskeletal disorders questionnaire developed by Kuorinka, Jonsson²⁵⁾. The questionnaire includes nine body parts: neck, shoulders, upper back, elbows, lower back, hands/wrists, hips/thighs, knees, and ankles/feet. Subjects were surveyed for pain, soreness, numbness, tingling, or any discomfort in these nine parts in the past year. The questionnaire is easy to use because it has a human figure for assessing the part

Table 1. Participant's basic information (N=149)

| Characteristics | n | % |
|--|------------------|------|
| Gender | | |
| Male | 9 | 6 |
| Female | 140 | 94 |
| Age (mean \pm SD) | 50.97 \pm 9.80 | |
| <45 | 33 | 22.1 |
| \geq 45 | 116 | 77.9 |
| BMI (mean \pm SD) | 25.10 \pm 3.92 | |
| <24 | 65 | 43.6 |
| \geq 24 | 84 | 56.4 |
| Education level | | |
| Junior school (and below) | 26 | 17.4 |
| High school | 87 | 58.4 |
| University (and above) | 36 | 24.2 |
| Marital status | | |
| Single/divorced/separated | 39 | 26.2 |
| Married/cohabiting | 110 | 73.8 |
| Dominant hand | | |
| Left | 10 | 6.7 |
| Right | 139 | 93.3 |
| Have children | | |
| No | 144 | 96.6 |
| Yes | 5 | 3.4 |
| Main income earner | | |
| No | 58 | 38.9 |
| Yes | 91 | 61.1 |
| Weekly exercise frequency | | |
| 0 | 44 | 29.5 |
| 1–2 | 72 | 48.3 |
| \geq 3 | 33 | 22.1 |
| Number of years worked (mean \pm SD) | 6.96 \pm 5.00 | |
| <3 | 40 | 26.8 |
| \geq 3 | 109 | 73.2 |
| Using protective gear | | |
| No | 82 | 55.0 |
| Yes | 67 | 45.0 |
| Musculoskeletal discomfort | | |
| Neck | 48 | 32.2 |
| Shoulders | 62 | 41.6 |
| Upper back | 43 | 28.9 |
| Lower back | 66 | 44.3 |
| Elbows | 54 | 36.2 |
| Wrists/hands | 53 | 35.6 |
| Hips/thighs | 40 | 26.8 |
| Knees | 50 | 33.6 |
| Ankles/feet | 36 | 24.2 |

BMI: Body Mass Index

SD: Standard Deviation

of discomfort and only requires the participants to answer “yes” or “no” when pointed to the body part to express discomfort. The scale is a good psychometric measure for assessing MSD²⁶).

Statistical analysis

SPSS 25.0 for mac (IBM Corp., Armonk, NY) was used for data analysis in this study. First, descriptive statistics were used to present basic participant information, MSD prevalence (Table 1), frequency (average number of times per day), and effort level (Table 2) for the seven tasks.

When calculating the “frequency” and “effort level” for the seven tasks, the participants who were not engaged in the tasks were excluded. In addition, some symptom prevalence (such as osteoporosis) may be generally increased in participants who are more than 45 years old²⁷). Thus, we used the age of 45 as the cutoff point for age. According to the definition of the Ministry of Health and Welfare (Taiwan), a BMI of more than 24 kg/m² is considered overweight. Thus, in this study, 24 kg/m² was used as the cutoff point for BMI²⁸). Employees who have been working for more than three years may have higher risk of musculoskeletal discomfort than those who have worked for three years or less²⁹).

Next, Fisher's exact test was used to examine the correlation between the participants' basic information and the nine body parts of discomfort (Table 3). Additionally, to avoid the occurrence of false positives, we used the False Discovery Rate (FDR) method with the Benjamini-Hochberg to further clarifying the validity of the *p* values. Finally, logistic regression was used to examine the correlation between the seven tasks and nine body parts of discomfort. The nine body parts of discomfort were included in the logistic regression analysis as dependent variables (0: no discomfort, 1: discomfort), and the seven tasks were used as independent variables (average number of times per day). Each regression model was tested for co-linearity and the VIF of all the variables in the regression model was less than 10; thus, the co-linearity could be ignored³⁰). In addition, if there are any missing data in the questionnaire, this study will use the selection model method to control the bias of missing data.

Results

Descriptive statistics

A total of 149 home caregivers were recruited to participate in this study, and all participants completed the questionnaire. The basic information of the participants is shown in Table 1. The participants include 9 males and 140 females, with an average age of 51 years (age range: 22–69 years) and an average BMI of about 25.1. Most of the participants had an education level of high school or above (82.6%), were married or cohabiting (73.8%), were right-handed (93.3%), and had no children under 7 years of age (96.6%). Of these participants, more than half were the main income earners (61.1%), exercised more than once a week (70.4%), had been working in home care for more than 3 years (73.2%), and did not wear protective gear at work (55.0%). The incidence rates of MSD were (in de-

Table 2. The frequency and effort level of the seven tasks

| Tasks | Average number of times per day | | Average effort level of the work | |
|--|---------------------------------|------------------------------------|----------------------------------|------------------------------------|
| | mean \pm standard deviation | median value (interquartile range) | mean \pm standard deviation | median value (interquartile range) |
| Transfer of bed and wheelchair (n=147) | 4.7 \pm 3.4 | 4(2.0–7.0) | 6.1 \pm 1.4 | 6(4.0–8.0) |
| Take a bath (n=136) | 3.0 \pm 1.4 | 3(2.0–4.0) | 5.1 \pm 1.9 | 5(4.0–7.0) |
| Sit up in bed (n=110) | 2.0 \pm 1.1 | 2(1.0–3.0) | 5.1 \pm 1.8 | 5(4.0–7.0) |
| Passive range of motion exercise (n=91) | 1.8 \pm 0.9 | 1(1.0–2.0) | 5.1 \pm 2.0 | 5(4.0–7.0) |
| Transfer of toilet and wheelchair (n=64) | 1.8 \pm 1.0 | 1(1.0–2.0) | 6.9 \pm 1.8 | 7(4.0–8.0) |
| Turnover and pat the back (n=59) | 1.7 \pm 1.0 | 1(1.0–2.0) | 5.0 \pm 2.1 | 5(4.0–7.0) |
| Take a sponge bath (n=57) | 1.5 \pm 0.8 | 1(1.0–2.0) | 3.8 \pm 2.7 | 3(2.0–5.0) |

scending order): lower back (44.3%), shoulders (41.6%), elbows (36.2%), wrists/hands (35.6%), knees (33.6%), neck (32.2%), upper back (28.9%), hips/thighs (26.8%), and ankles/feet (24.2%).

The frequency (average number of times per day) and effort level of the seven tasks are shown in Table 2. The top three highest average daily tasks were: transfer of bed and wheelchair, take a bath, and sit up in bed. The highest effort level was for transfer of toilet and wheelchair, followed by transfer of bed and wheelchair; the effort level for the remaining items were close.

Fisher's exact test

The results of Fisher's exact test to examine the correlation between the participant's basic information and the nine body parts of discomfort are shown in Table 3. The results indicated that the presence of children under 7 years of age was significantly associated with neck discomfort ($p=0.04$). In addition, being the main income earner was significantly associated with upper back discomfort ($p=0.03$), which suggests that being the main income earner was associated with a lower incidence of upper back discomfort. Moreover, the results of the FDR test presented that the q -value of the former and the latter were equal to 0.36 and 0.27, respectively, suggesting that the two random variables were independent.

Logistic regression

The results of the logistic regression analysis of the correlation between tasks and body parts of discomfort are presented in Table 4. The results revealed that transfer of toilet and wheelchair was associated with shoulders discomfort (OR: 1.52, 95% CI = 1.02–2.27, $p=0.04$), upper back discomfort (OR: 1.57, 95% CI = 1.02–2.44, $p=0.04$), and wrists/hands discomfort (OR: 1.56, 95% CI = 1.03–2.34, $p=0.03$). Thus, a higher frequency of transfer of toilet and wheelchair led to a higher prevalence of shoulders, up-

per back, and wrists/hands discomfort. Furthermore, there was a significant association between passive range of motion exercise and elbow discomfort (OR: 1.42, 95% CI = 1.01–2.01, $p=0.04$), which suggests that a higher frequency of passive range of motion exercise resulted in a higher incidence of elbow discomfort.

Discussion

Home caregiving is expected to be one of the fastest growing occupations in the future. If their occupational safety is not taken seriously, an increasing number of people will suffer from work-related hazards^{2, 23}. The present study is probably one of the few studies that examine MSD from the perspective of the work content of home caregivers. This study found that work content was associated with MSD, which implies that the work may increase MSD risk. Although this study was a cross-sectional study which thus could not verify causality, this finding provides more information about the occupational safety of home caregivers. More than 40% (44.3%) of caregivers had a lower incidence of MSD in the past year than in previous related studies^{4, 8}. Possible reasons are younger age and shorter working years of study participants, which reduces the incidence of MSD. The incidence of discomfort was highest in lower back, shoulders, and elbows among the nine body parts, which is similar to the results of previous studies^{4, 8, 23} where the discomforts were concentrated above the waist. Many of the tasks performed by home caregivers require using the upper extremities, thus increasing the risk of injury above the waist⁴. The logistic regression results (Table 4) also revealed that the prevalence of these above-waist discomforts was related to the work content.

This study found that (Table 2) transfer of bed and wheelchair, taking a bath, and sitting up in bed were the most common tasks performed by home caregivers. From the above tasks, it was found that "transposing" the care

Table 3. The results of Fisher's exact test with FRD method to examine the difference between the participant's basic information and the nine body parts of discomfort

| Characteristics | Neck | | Shoulders | | Upper back | | Lower back | | Elbows | | Wrists/hands | | Hips/thighs | | Knees | | Ankles/feet | | | | |
|---------------------------|------|------------|-----------|-----------|------------|-----------|------------|-----------|--------|-----------|--------------|-----------|-------------|-----------|-------|-----------|-------------|-----------|---|------|--|
| | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | | | |
| Gender | | | | | | | | | | | | | | | | | | | | | |
| Male | 1 | 0.81 | 2 | 0.81 | 1 | 0.81 | 3 | 0.94 | 3 | 1.00 | 3 | 1.00 | 1 | 0.81 | 1 | 0.81 | 1 | 0.81 | 1 | 0.94 | |
| Female | 47 | | 60 | | 42 | | 63 | | 51 | | 50 | | 39 | | 49 | | 35 | | | | |
| Age | | | | | | | | | | | | | | | | | | | | | |
| <45 | 11 | 1.00 | 13 | 1.00 | 10 | 1.00 | 15 | 1.00 | 12 | 1.00 | 11 | 1.00 | 10 | 1.00 | 11 | 1.00 | 8 | 1.00 | | | |
| ≥45 | 37 | | 49 | | 33 | | 51 | | 42 | | 42 | | 30 | | 39 | | 28 | | | | |
| BMI | | | | | | | | | | | | | | | | | | | | | |
| <24 | 21 | 1.00 | 28 | 1.00 | 18 | 1.00 | 26 | 1.00 | 22 | 1.00 | 23 | 1.00 | 16 | 1.00 | 22 | 1.00 | 14 | 1.00 | | | |
| ≥24 | 27 | | 34 | | 25 | | 40 | | 32 | | 30 | | 24 | | 28 | | 22 | | | | |
| Education level | | | | | | | | | | | | | | | | | | | | | |
| Junior school (and below) | 11 | 0.52/0.83 | 12 | 0.81/0.83 | 9 | 0.76/0.83 | 14 | 0.56/0.83 | 8 | 0.77/0.83 | 11 | 0.60/0.83 | 8 | 0.83/0.83 | 12 | 0.41/0.83 | 8 | 0.83/0.83 | | | |
| High school | 25 | | 36 | | 23 | | 36 | | 32 | | 32 | | 24 | | 26 | | 18 | | | | |
| University (and above) | 12 | | 14 | | 11 | | 16 | | 14 | | 10 | | 8 | | 12 | | 10 | | | | |
| Marital status | | | | | | | | | | | | | | | | | | | | | |
| Single/divorced/separated | 12 | 1.00 | 47 | 1.00 | 10 | 1.00 | 20 | 1.00 | 13 | 1.00 | 13 | 1.00 | 13 | 1.00 | 13 | 1.00 | 9 | 1.00 | | | |
| Married /cohabiting | 36 | | 15 | | 33 | | 46 | | 41 | | 40 | | 27 | | 37 | | 27 | | | | |
| Dominant hand | | | | | | | | | | | | | | | | | | | | | |
| Left | 5 | 0.29/0.50 | 5 | 0.74/0.75 | 5 | 0.15/0.45 | 5 | 0.75/0.75 | 5 | 0.50/0.64 | 5 | 0.33/0.50 | 5 | 0.13/0.45 | 5 | 0.30/0.50 | 5 | 0.06/0.45 | | | |
| Right | 43 | | 57 | | 38 | | 61 | | 49 | | 48 | | 35 | | 45 | | 31 | | | | |
| Have children | | | | | | | | | | | | | | | | | | | | | |
| No | 44 | 0.04*/0.36 | 59 | 0.65/0.83 | 41 | 0.63/0.83 | 64 | 1.00/1.00 | 51 | 0.35/0.79 | 50 | 0.35/0.79 | 37 | 0.12/0.54 | 48 | 1.00/1.00 | 34 | 0.60/0.83 | | | |
| Yes | 4 | | 3 | | 2 | | 2 | | 3 | | 3 | | 3 | | 2 | | 2 | | | | |

Table 3. Continued

| Characteristics | Neck | | Shoulders | | Upper back | | Lower back | | Elbows | | Wrists/hands | | Hips/thighs | | Knees | | Ankles/feet | | | |
|---------------------------|------|-------------|-----------|-------------|------------|--------------|------------|-------------|--------|-------------|--------------|-------------|-------------|-------------|-------|-------------|-------------|-------------|--|--|
| | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | n | p/q | | |
| Main income earner | | | | | | | | | | | | | | | | | | | | |
| No | 20 | 0.72 / 0.93 | 24 | 1.00 | 23 | 0.03* / 0.27 | 26 | 1.00 | 23 | 0.49 / 0.88 | 22 | 0.73 / 0.93 | 18 | 0.45 / 0.88 | 23 | 0.22 / 0.88 | 16 | 0.44 / 0.88 | | |
| Yes | 28 | | 38 | | 20 | | 40 | | 31 | | 31 | | 22 | | 27 | | 20 | | | |
| Weekly exercise frequency | | | | | | | | | | | | | | | | | | | | |
| 0 | 17 | 0.52 / 0.65 | 22 | 0.32 / 0.65 | 16 | 0.41 / 0.65 | 23 | 0.25 / 0.65 | 20 | 0.16 / 0.48 | 21 | 0.13 / 0.48 | 14 | 0.63 / 0.65 | 18 | 0.43 / 0.65 | 10 | 0.65 / 0.65 | | |
| 1–2 | 22 | | 29 | | 18 | | 32 | | 26 | | 22 | | 17 | | 21 | | 16 | | | |
| ≥3 | 9 | | 11 | | 9 | | 11 | | 8 | | 10 | | 9 | | 11 | | 10 | | | |
| Number of years worked | | | | | | | | | | | | | | | | | | | | |
| <3 | 11 | 0.55 / 0.58 | 15 | 0.58 / 0.48 | 8 | 0.16 / 0.48 | 16 | 0.58 / 0.58 | 12 | 0.44 / 0.58 | 12 | 0.44 / 0.58 | 9 | 0.54 / 0.58 | 9 | 0.12 / 0.48 | 8 | 0.53 / 0.58 | | |
| ≥3 | 37 | | 47 | | 35 | | 50 | | 42 | | 41 | | 31 | | 41 | | 28 | | | |
| Using protective gear | | | | | | | | | | | | | | | | | | | | |
| No | 25 | 0.73 / 0.87 | 32 | 0.51 / 0.87 | 23 | 0.86 / 0.87 | 32 | 0.19 / 0.57 | 29 | 0.87 / 0.87 | 27 | 0.49 / 0.87 | 21 | 0.72 / 0.87 | 23 | 0.12 / 0.57 | 19 | 0.85 / 0.87 | | |
| Yes | 23 | | 30 | | 20 | | 34 | | 25 | | 26 | | 19 | | 27 | | 17 | | | |

BMI: Body Mass Index; q: q value
 * p<0.05

Table 4. The results of the logistic regression analysis of the correlation between tasks and body parts of discomfort

| | Neck | | Shoulders | | Upper back | | Lower back | | Elbows | | Wrists/hands | | Hips/thighs | | Knees | | Ankles/feet | | |
|-----------------------------------|------|--------|-----------|--------|------------|--------|------------|--------|--------|--------|--------------|--------|-------------|--------|-------|--------|-------------|--------|------|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | |
| Transfer of bed and wheelchair | 0.98 | 0.86 | 0.78 | 0.88 | 0.77 | 0.08 | 0.87 | 0.74 | 1.13 | 0.87 | 0.74 | 1.01 | 1.01 | 0.83 | 0.74 | 1.04 | 0.88 | 0.77 | 1.01 |
| Take a bath | 1.10 | 0.86 | 0.46 | 1.04 | 0.83 | 0.74 | 1.13 | 0.87 | 1.13 | 0.87 | 0.37 | 1.05 | 0.84 | 0.68 | 1.09 | 0.85 | 0.50 | 1.05 | 0.83 |
| Sit up in bed | 1.00 | 0.69 | 1.00 | 0.84 | 0.59 | 0.34 | 0.94 | 0.63 | 0.77 | 0.90 | 0.64 | 0.53 | 1.03 | 1.03 | 0.72 | 0.89 | 0.76 | 0.52 | 1.33 |
| Passive range of motion exercise | 1.26 | 0.89 | 0.20 | 1.33 | 0.95 | 0.10 | 1.27 | 0.87 | 0.22 | 1.33 | 0.95 | 0.09 | 1.42 | 1.01 | 0.04 | 1.29 | 0.91 | 0.15 | 1.12 |
| Transfer of toilet and wheelchair | 1.08 | 0.73 | 0.70 | 1.52 | 1.02 | 0.04 | 1.57 | 1.02 | 0.04 | 1.14 | 0.78 | 0.50 | 1.36 | 0.90 | 0.13 | 1.56 | 1.03 | 0.03 | 1.17 |
| Turnover and pat the back | 0.92 | 0.60 | 0.72 | 1.04 | 0.68 | 0.86 | 1.02 | 0.64 | 0.94 | 0.78 | 0.51 | 0.26 | 0.90 | 0.92 | 0.63 | 0.98 | 0.64 | 0.93 | 1.07 |
| Take a sponge bath | 0.69 | 0.43 | 0.12 | 0.92 | 0.62 | 0.68 | 0.68 | 0.41 | 0.13 | 1.05 | 0.71 | 0.82 | 0.79 | 0.59 | 0.27 | 0.72 | 0.47 | 0.15 | 0.86 |

* $p < 0.05$

recipient was common while providing care. Home caregivers are often faced with a large number of “transposing” needs without any assistive devices (e.g., suspension devices and electric lift beds)³¹. The lack of ergonomic transposing equipment for home caregivers may be a significant factor in the high (2-fold) incidence of MSD³². Transfer of toilet and wheelchair and transfer of bed and wheelchair were found to be the most taxing tasks for participants, which is consistent with previous research³³. The association between the care recipient’s transposing activities and MSD (back pain) is well established^{34, 35}. In Taiwan, a 90-hour training course is required to become a home caregiver. Yet, due to short training hours and lack of aids, time, and manpower, caregivers often have to transpose the care recipient in awkward positions. Furthermore, caregivers are burdened with many demands, such as lifting the heavy care recipient, taking them to and from bed, and bathing the care recipient, all of which increase the risk of MSD^{36, 37}.

Table 4 shows that transfer of toilet and wheelchair is a risk factor for MSD (including shoulders, upper back, and wrists/hands). Previous studies^{38, 39} suggest that the rising frequency of transposing patients increases the risk of shoulder, neck, back, and hand/wrist injuries. Transposing in a toilet (toilet and wheelchair) differs from that in general rooms. When transposing in a toilet, which is a narrow space, it is easy to form an unnatural posture. In the process of transposing the care recipient, it is easy to lean forward with both hands to support the weight of the care recipient, which causes the shoulders and neck to be contracted for a long time and easily overloads the muscles and tendons in the stressed parts and causes injuries⁴⁰. Moreover, during the transfer process, the caregiver’s back often works unassisted in an unnatural position, which can easily cause back injuries⁴¹. Many care recipients do not have toilets with raised seats, armrests, or suspension devices, which makes transfer of bed and wheelchair more likely to overload the hands of the caregivers and cause hand injuries than other care activities (e.g., turnover and patting back, bathing). Therefore, extra attention should be paid to prevent hand injuries in home caregivers.

Further, this study indicates that passive range of motion exercise is a risk factor for MSD (elbows). The correlation between passive range of motion exercise and MSD has rarely been studied previously. In 2017, when Taiwan’s long-term care policy was promoted, passive range of motion exercise was included as one of the tasks of home caregivers. Due to limb weakness or abnormal tension, bedridden care recipients are often unable to actively extend their joints to their maximum angle. Over time, joints may be-

come contracted and deformed and cause pain and inconvenience during transposing and cleaning. Thus, home caregivers need to use passive range of motion exercise to help maintain the range of motion of the care recipients’ limbs. When performing passive range of motion exercise, excessive pushing and pulling movements of the arm, repetitive forearm rotation, prolonged grasping, or overuse of the wrist extensor muscles can cause painful symptoms, such as radial tunnel syndrome or lateral epicondylitis^{42, 43}. Prolonged overuse of the elbow joint can easily cause cartilage wear and inflammation, resulting in chronic inflammation of the elbow joint⁴⁴. Therefore, it is important to remind home caregivers to avoid repetitive and excessive use of the forearm or wrists (overuse of the wrist extensor muscles), warm up before carrying, use body strength to assist the arm, and recuperate and wear protective gear after an injury⁴³.

Several limitations should be considered while interpreting the results of this study. First, the participants of this study were all from long-term care units that provide home care services in central Taiwan and were current home caregivers. This study did not include those who had left the service, thus limiting interpretative power. Second, data in this study were collected through self-administered questionnaires, and participants may have recall bias or social desirability bias, which affects the authenticity of the questionnaire data. Third, the study collected basic data that may affect the dependent variables. Data related to the patient (or their family) were not collected (such as working environment), which may also affect the interpretative power. Fourth, the posture and manner in which the caregiver cared for or transposed the care recipient (e.g., unassisted or with an assistive device) was one of the factors that influenced MSD, and this study did not control for this factor. Moreover, due to the workload changes every time, the relationship with the symptoms may not be detected by simply using the average number of times per day as in this study. Finally, this study is a cross-sectional study, whereas MSD is a cumulative result over time. Therefore, it is not possible to explain the causality. We suggest that future studies be longitudinal and use objective instrumentation and on-site observations of transposing posture and frequency to collect more care recipient data. Despite these limitations, this study provides important information about the work content of home caregivers and its association with MSD. The results assist relevant organizations or professional home caregivers in better understanding the possible effects of their work content on their physical health.

Conclusion

According to the results of this study, the prevalence rate of MSD among home caregivers was over 40%; the top three affected body parts were the lower back, shoulders, and elbows. The most frequent tasks were transfer of bed and wheelchair, taking a bath, and sitting up in bed; the most laborious tasks were transfer of toilet and wheelchair. The highest risk factors for MSD were transfer of toilet and wheelchair, followed by passive range of motion exercise. Therefore, home caregivers and professionals need to examine these risk factors and develop relevant countermeasures and preventive efforts.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

This work was funded by grants from the Ministry of Science and Technology, Taiwan (MOST 109-2314-B-468-009 -MY2), and Asia University, Taiwan (ASIA-109-CMUH-08; ASIA-110-CMUH-23). We thank all the participants and research assistants for their contribution to the study.

Data Accessibility Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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