

Original Article

## A survey of physical and occupational therapists' views on lumbar loading movements

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**Abstract.** [Purpose] To identify the lumbar loading movements necessary in clinical practice. [Participants and Methods] A questionnaire survey was conducted among physical and occupational therapists in Japan. There were no exclusion criteria regarding the number of years of experience, age, or field of employment. The participants were randomly selected and administered the questionnaire. They were asked to list and rank the lumbar loadings they considered necessary. [Results] A total of 739 respondents participated in the survey. The results of this nationwide survey indicated that the lifting movement of heavy objects in the trunk flexion position was the most common movement (for 354 participants). [Conclusion] The main loading movements of the lumbar spine were reported to be heavy lifting movements (in the trunk flexion position) and trunk rotation movements. As perspectives, we aim to conduct an analytical study of some of lumbar spine loading movements outlined in this study, using a musculo-skeletal simulator and electromyography.

**Key words:** Lumbar load, Questionnaire, Trunk flexion position

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### INTRODUCTION

In recent years, the number of patients with low-back pain has increased due to the influences of daily life and the working environment. According to the Ministry of Health, Labor and Welfare (MHLW) National Basic Survey<sup>1)</sup>, which included 217,179 households in 2019, the complaints on back pain were most common in males than in females. Both males and females were found to experience back pain, which is considered common as 60%–80% of adults experience low-back pain at least once in their lives<sup>2)</sup>. Mechanical load on the lumbar spine is one of the factors responsible for the development of lumbar diseases<sup>3)</sup>. However, the extent to which the burden on the lumbar spine causes low-back pain has not been completely elucidated, and the type of motion that induces stress to the lumbar spine has not yet been determined.

Previous studies demonstrated a strong association between frequent heavy-lifting movements and low-back pain disorders<sup>4)</sup>. Sato et al. developed a pressure transducer and investigated the mechanical load on the lumbar spine by measuring

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the change in the pressure of the lumbar intervertebral disc due to trunk flexion. They reported that the load on the lumbar spine has a close interrelationship with lumbar alignment<sup>5</sup>). However, from the perspective of physical and occupational therapies, we think that the movements analyzed as lumbar spine loading movements in previous studies are different from those analyzed by physical and occupational therapists in clinical practice. In clinical practice, it is necessary to instruct patients to perform specific daily life activities, such as grabbing objects from high places, picking up nonheavy objects from the floor, moving on the floor, getting up, and washing the face, to prevent overloading on the lumbar spine. However, we conducted a literature review and found no previous studies that validated the stress on the lumbar spine for the listed movements in clinical practice. In some cases, the content of previous research had not been applied to actual Activities of Daily Living instructions. In addition, there were differences between the loading movements and those imagined by the lumbar physical and occupational therapists. However, to the best of our knowledge, no research studies on these differences exist. We believed that Activities of Daily Living instructions would change by eliminating the discrepancy between the ideas of physical and occupational therapists and previous studies. To apply the analysis results of lumbar spine loading in clinical practice, it is important to elucidate the lumbar spine loading motion considered by physical and occupational therapists and analyze its motion after the clarification. To identify the lumbar-loading movements, which are necessary for clinical practice, a questionnaire was compiled for a survey among many physical and occupational therapists, and the therapists were asked to list and rank the lumbar-loading movements they considered.

This study aimed to select the lumbar-loading movements intended for analysis. The analyses of the relevant motions will be conducted in a future study. By selecting movements from the survey results, we believe we can analyze the movements that physical and occupational therapists need when Activities of Daily Living instructions.

The primary purpose of this study is to clarify what movements are considered lumbar-loading movements by many physical and occupational therapists. The significance of this study is that by selecting movements to be analyzed from the survey results, it is possible to make the movement analysis necessary for clinical practice.

## PARTICIPANTS AND METHODS

A questionnaire survey was conducted, and the participants were physical and occupational therapists in Japan. There were no exclusion criteria for years of experience, age, or field of employment. The participants were randomly selected and administered.

We compiled a web-based questionnaire using the Google Form function, and the survey was conducted from November 1, 2020, to March 31, 2021 (Fig. 1). The questionnaire included questions regarding the years of experience, age, gender, type of occupation, field of employment, area of employment, and movements that were considered to impose lumbar spine load in daily life. As the last question (movements responsible for imposing load), the respondent was able to write without any limitation. The responses to questions were dependent on the participants' discretion, and there were no questions that requested names or workplaces, or personally identifiable information.

The study was evaluated for approval by the Ethics Committee of the Kyushu Institute of Technology. Nevertheless, this application for approval was considered unnecessary as this study was also evaluated by the MHLW. Informed consent was obtained from all participants.

## RESULTS

In total, 738 participants responded to the questionnaire. The average years of experience were  $7.2 \pm 6.6$  years. The median (and quartiles) was 5 (2.0–11.0) years (Table 1). The minimum and maximum years of experience were 1 and 41 years, respectively. The average age was  $30.1 \pm 7.6$  years. The median (and quartiles) was 28 (24.0–35.0) years old (Table 1). The minimum and maximum ages were 21 and 61 years old, respectively. The maximum age was 61 years old. The numbers of males and females were 468 and 270, respectively. The number of physical and occupational therapists were 513 and 225, respectively (Table 2). The total number of responses was 1,840, and the number of actions listed was 104. The number of participants who performed lifting motions with heavy objects that induced trunk flexion was the highest (354 respondents), followed by those who experienced trunk rotation (104 respondents); others consisted of those who lifted heavy objects in the standing position (70 respondents), grabbed objects from high places (65 respondents), and picked up objects from the floor (59 respondents), as presented in Table 3. There were other comments, such as orthostatic movements.

## DISCUSSION

We focused on the fact that no studies have conducted questionnaire surveys on physical and occupational therapists for lumbar-loading movements. The primary aim of this study was to select the analysis movements according to the thoughts of the physical and occupational therapists.

The most common lumbar-loading motion in this study was the lifting up of heavy objects in the trunk flexion position. The motion of lifting up objects which requires complex spine movements is a frequently performed motion in daily life. Even if the object is small and light, the repetition of this movement can cause back pain. The lifting up and carrying of lug-

Questionnaire for lumbar loading movements

(Years of experience :        ) (Age(y) :        ) (Gender :        ) (Type of occupation :        )

The purpose of this study is to connect to research on ADL instruction, etc. In this study, I need physical and occupational therapists to tell me what movements put stress on the lumbar spine. That's why I need your help with this survey. Please answer the question.

Question 1: Which of the following options would you classify your workplace as?

- Acute care Hospital    · Convalescent Hospital    · Chronic phase Hospital    · Personal Hospital
- Educational institution    · Nursing care

Question 2: What is your work district?

- Kyushu,Okinawa region    · Chugoku region    · Shikoku region    · Kinki region    · Kanto region
- Tohoku region    · Hokkaido region

Question 3: Please describe the movements in your daily life that have a high lumbar load. If possible, please state the reason for the description.

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Question 4: Does your facility use pamphlets during ADL and relapse prevention instruction?If your facility does not use them, why not? Please also tell us why.

Thank you very much for your cooperation.

**Fig. 1.** Survey.

**Table 1.** Years of experience and age (n=738 [Males: 468, Females: 270])

	Average value	Median	Quartile	Minimum value	Maximum value
Years of experience (years)	7.2 ± 6.6	5	2.0–11.0	1	41
Age (years)	30.1 ± 7.6	28	24.0–35.0	21	61

**Table 2.** Types of work (n=738)

	Males (468)	Females (270)
Physical therapists	355	158
Occupational therapists	113	112

**Table 3.** Lumbar-loading motion results (n=738 [Total responses: 1,840])

Ranking	Movements	Number of participants (%)
1st	Lifting up heavy objects in the trunk-flexion position	354 (15.5)
2nd	Trunk rotation	104 (4.6)
3rd	Holding heavy objects in the standing position	70 (3.1)
4th	Grabbing objects from high places	65 (2.8)
5th	Picking up objects from the floor	59 (2.6)
6th	Sitting up motion	53 (2.9)
7th	Driving for long hours	52 (2.8)
8th	floor-based motion	49 (2.7)
9th	kitchen motion	43 (2.3)

gaze is an important factor in the development of occupational back pain. According to reports that have used motion capture to estimate the load on the intervertebral discs, a gradual change from good posture to thoracic kyphosis has been shown to increase the load as time passes<sup>6)</sup>. In general, the thoracic kyphosis angle increases as the trunk flexion angle increases. Furthermore, holding heavy objects increases trunk muscle activity and stresses the lumbar spine. In addition, physical and occupational therapists know this process well. Therefore, the most common factor was the holding of heavy objects in the trunk flexion position, as mentioned by the respondents.

It has been reported that trunk rotation movements increased the lumbar load and the risk of developing lumbar disorders<sup>7)</sup>. A total of 5,185 workers aged between 19 and 59 years were interviewed about their work activities and asked whether they experienced low-back pain in the year prior to the interview. As a result, they reported that trunk rotation, trunk flexion, and trunk extension were the highest risk factors among the five selected ones<sup>8)</sup>. This risk has been reported to increase by 1.51 to 2.28 times compared with those who did not perform trunk rotation movements<sup>9)</sup>. Therefore, it is considered that many similar opinions have been enumerated in this study because the burden on the lumbar spine due to trunk rotation movements has been reported in many previous studies. In addition, many respondents listed the lumbar-loading by rotating the trunk as they learned about the risks of trunk rotation to the lumbar spine during the training period.

We considered the reasons for the lifting up and holding of heavy objects in the standing position as follows. In previous studies, pressure gauges were inserted invasively, directly into the lumbar intervertebral disc, and the compressive forces of the intervertebral disc were measured during the standing and sitting positions or heavy-lifting movements<sup>10-12)</sup>. In these studies, the compressive forces of the intervertebral disc in the resting upright posture were reported to be in the range of 0.27–0.97 MPa. Large strains on the lumbar spine can cause irreversible damages, as indicated by the NIOSH criteria for the compressive force on the disk<sup>13)</sup>. Therefore, in previous studies, the lumbar spine burden caused by high-stress movements, such as heavy-lifting and transfer assistance<sup>14, 15)</sup>, was investigated. The results of previous studies indicated that the lifting up and holding of heavy objects in the standing position increased the compressive force of the intervertebral disc and may have caused low-back pain. Smith et al. investigated the relevance between complaints of low-back pain and the trunk in the standing position and the position of the pelvic girdle in two dimensions in 766 male and female adolescents. As a result, they reported that extended trunk and anterior pelvic tilt were the postures with the least amount of low-back pain<sup>16)</sup>. Additionally, Dolphens et al. examined the relevance between complaints of low-back pain and joint angles, as well as body segment positions in the sagittal plane in 1196 male and female adolescents. Consequently, they reported that a good posture was achieved when the head, trunk, and pelvic girdle were positioned on the line of gravity in the standing posture<sup>17)</sup>. The position of the head, trunk, pelvis, and other parts of the body diverged from the line of gravity when holding heavy objects in the standing position, and this was thought to be responsible for lumbar load increases.

In contrast to the previous studies, many respondents mentioned the lumbar-loading motions involved when they grabbed objects from high places. Most previous studies targeted the young to middle-aged adult participants when they considered lumbar-loading movements. Conversely, physical and occupational therapists often work for the elderly in clinical sites, and this is the reason for the difference with past studies. Elderly people will more likely develop kyphotic spinal deformities. It was reported that 21% of the elderly<sup>18)</sup>, 62% of the elderly<sup>19)</sup>, and 100 of 105 patients<sup>20)</sup> had thoracolumbar kyphotic postures. Takemitsu<sup>21)</sup> reported that physiological kyphosis increased to some extent as a function of age in humans; however, the rate of increase was elevated after the age of 60 in males and 50 in females. Elderly people with thoracolumbar kyphosis always maintain the trunk flexion by postural changes and have few opportunities to assume the trunk extension position. The mobility of the spine was reported to be limited only in extension, but not in flexion<sup>22)</sup>. Therefore, many physical and occupational therapists considered that extension movements caused stresses when people grabbed objects from a high place.

Regarding the actions of picking up objects from the floor, the following reasons were considered. Akahashi et al. reported that there was a linear relation between the angle of trunk inclination and the load on the lumbar spine, the abdominal muscles were less involved, and the back muscles were mainly involved in the relation between the trunk flexion movement and the muscle activities of the trunk muscles<sup>23)</sup>. In the results obtained in the study conducted by Takahashi et al., when the upright

position at non-weight-bearing was set to 100%, the load to the intervertebral disc was increased to up to 360% at 30° of forward flexion at non-weight-bearing, and loading with weights increased the load on the intervertebral disc to up to 430% at 30° of forward flexion. Based on these facts, it is considered that the lumbar spine is subjected to a great deal of loading even in the activities of daily living. Therefore, the movements associated with the grabbing, picking, and lifting up of objects from the floor were noted extensively in the questionnaire survey.

In previous studies, the loading motion to the lumbar spine was reported to be a heavy-lifting motion in the trunk flexion position and a trunk rotation motion, and there was no difference between the results of past studies and this study. Many previous studies have analyzed these movements to elucidate the load on the lumbar spine. Unlike past studies, this study investigated the considerations of physical and occupational therapists on lumbar-loading movements before analyzing the movements. By conducting a survey, we were able to identify the movements associated with the grabbing of objects from high places and the lifting up of objects from the floor, which had not been investigated as lumbar-loading movements in previous studies. These are the movements that physical and occupational therapists actually teach. Analysis of lumbar spine loading can be used to guide instruction.

In the future, we will conduct an analysis of some of the lumbar spine loading motions referred to in this study using a musculoskeletal simulator and electromyography and rank the lumbar-loading movements. The top five ranked movements will be included in the analysis. Subsequently, we will investigate whether there is a difference between the ranking of lumbar-loading movements determined by the opinions of physical and occupational therapists and the ranking of lumbar-loading movements determined by the results of analysis of lumbar-loading movements. It is also considered to be a reference material when preparing manuals and other documents.

The results of the ranking will be used as a reference to consider the contents of movement instruction, with the aim of improving the quality of movement instruction.

### *Conflicts of interest*

No conflicts of interest.

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