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Original Article

Relationship between psychosocial factors and objective physical function in special needs school staff members suffering from low back pain

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Abstract: Physical function impairment in patients with low back pain (LBP) occurs due to the influence of psychosocial factors. Only a few studies have objectively evaluated physical function. We aimed to objectively assess the physical functions of individuals subjects with LBP, and clarify the association between physical function and psychosocial factors. We enrolled 411 individuals with LBP working in special needs schools. We examined their degree of pain, and the psychosocial factors strength through the STarT Back Tool, which categorized them into the low-risk, medium-risk, and high-risk groups. We assessed their abdominal muscle endurance, lower limb muscle strength, and hip joint flexibility. The relationships between these physical functions and psychosocial factors were analyzed by logistic regression models. Those in the high-risk group had significantly lower abdominal muscle and lower limb muscle strength (p<0.001). After adjusting for confounding factors, the odds ratios of the high-risk compared to the low-risk group for low abdominal muscle endurance, lower limb muscle strength, and restricted right and left Straight Leg Raising were 5.47, 3.14, 2.65, and 3.12, respectively (95% CIs: 2.35–12.74, 1.43–6.89, 1.08–6.55, and 1.20–8.11, respectively). Therefore, the low physical function observed in the high-risk group was associated with their psychosocial factors.

Key words: Special needs school, Staff members, Low back pain, Psychosocial factors, Physical function, STarT Back Tool

Introduction

Low back pain (LBP) is a major health issue in developed and developing countries, affecting individuals of all socio-economic statuses[1, 2]. In Japan, LBP has been an ongoing social burden for the past 10 yr at least. It has been the major presenting complaint and is the second most common reason for hospital visits after high blood pressure[3]. According to the "Preventative Measure Guidelines for Back Pain at Work"[4], the LBP occurrence rate is decreasing annually in individuals working in the construction and manufacturing industries. However, the number of individuals with LBP working in the healthcare sector, such as nurses and caregivers, is increasing[4]. Given the similarities in terms of the working profile rendering assistance, employees in special needs schools are of no exception. These staff members need education and nursing care skills, such as toilet assistance and transfer

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assistance, as special needs schools are considered to be a stressful workplace physically and mentally. Therefore, many staff members complain of facing LBP[5–7], and it is necessary to take measures to reduce this phenomenon.

Current treatment algorithms involving pharmacotherapies and ergonomics failed to adequately resolve LBP. Interestingly, treatments encompassing a multifaceted approach that considers the psychosocial aspects are needed[8]. Regarding the connection between LBP and psychosocial factors, Picavet *et al.*[9] reported that excessive unease and apprehension toward the pain are factors giving rise to prolonged complaints and increased risk of physical function impairment. In addition, Waddell and Burton[10] reported that psychosocial factors are an important cause of delay in physical function restoration. Therefore, it is clear that the associated impairment of physical functions with LBP is attributed to the influence of psychosocial factors.

While evaluation of physical function impairment is often based on subjective complaints through questionnaires, objective measurements, such as trunk and lower limb muscle strength and lower limb flexibility evaluations, should be performed[11]. Among the reports published to date, there are only a few that evaluated the link between objective physical functions and psychosocial factors[12]. Clarifying the effects of psychosocial factors on the functionality of specific muscles and joints can be considered when deciding which treatments and selection of personalized exercises should be performed in patients with LBP.

Therefore, our aim was to shed light on the connection between objective physical functions and psychosocial factors, by including individuals working in special needs schools suffering from LBP.

Subjects and Methods

Research design

A cross-sectional survey was implemented through an LBP prevention course targeting staff members at 16 special needs schools, which were selected among many such schools (46 in total) in Osaka Prefecture.

Participants

This research enrolled individuals who participated in a LBP prevention course held from April 2016 to March 2018. Among the enrolled 1,757 staff members from the 16 schools (seven and nine for people with physical and intellectual disabilities, respectively), 686 individuals were eligible. Among them, 421 patients met the inclusion criteria, as they had suffered from LBP for ≥3 months. Date on age, height, weight, and work history of the participants were collected by a self-administered questionnaire. The approvals to perform this study were obtained from the hospitals' ethics committees (No. 2019003). Detailed explanations were provided to the participants in oral and written form, and their consent was obtained.

Measurements

Determining the presence of LBP and evaluating the level of pain

Following Japan's Back Pain Treatment Guidelines[13], LBP was diagnosed when the participants answered "Yes" to the question "Do you currently have LBP in your daily life and at work?" and their pain was derived from the part within the dorsal region from the 12th rib to the subgluteal fold. Further, a Numerical Rating Scale was used to determine the level of pain, with the scale ranging from 0 (absolutely no pain) to 10 (severest pain experienced so far). The scale is considered to be highly reliable and relevant, making it easy to use in the clinical setting[14].

STarT Back Screening Tool (SBST)

The SBST has been globally recommended for use in evaluating psychosocial risks[15]. It is a nine-item questionnaire designed to screen prognostic indicators in primary care patients with LBP, predicting their recovery from long-term impairment due to LBP[16]. Items 1–4 and 5–9 evaluated physical and psychosocial factors, respectively. The questions revolved around approximately eight elements: inconvenience, leg pain, concomitant pain, physical impairment, destructive symptoms, apprehension, unease, and depression. The Japanese version was used in this research, utilizing its highly reliable and rational measurement scale[17]. The participants were divided into three groups according to their scores as follows: those with a total score of ≤3, total score ≥4 with a psychosocial sub-score of ≥4, and psychosocial sub-scores of ≤3, were classified into the low-risk, medium-risk, and high-risk groups, respectively.

Evaluation of physical functions

The Kraus-Weber test (KW) was used to evaluate abdominal and dorsal muscle endurance[18]. The KW test is an evaluative index for trunk muscular strength and endurance. It comprises two, three, two, and one tests for abdominal muscle instantaneous forces, abdominal muscle endurance, dorsal muscle endurance, and back and hamstring flexibility, respectively. In our study, we utilized the tests that focused on muscle endurance. The maximum holding time was 60 s, and the time the participants could hold the above limb position was recorded. The abdominal muscle endurance was in the 45° hip flexion and 90° knee flexion supine position, and the upper body was deflected by approximately 25°, while the ankle joint was supported by others. The dorsal muscle was in the prone position, and the upper body was deflected by approximately 25°, while the ankle joint was supported by others.

In terms of lower limb muscular strength evaluation, simple and reproducible measurement items were selected. We followed the method conducted by Csuka and McCarty[19], which involved a sit-to-stand test with a 40-cm folding chair. The participants were first instructed to adopt a resting sitting posture, with both legs spread to shoulder-width distance and arms folded across the chest. When given the signal, the participants stood with hip and knee joints completely extended and, then, immediately returned to their original sitting posture. They were instructed to repeat this procedure 10 times, as quickly as possible.

The hip joint range of motion was measured according to the Japanese Orthopedic Association guidelines. Especially, we used the Straight Leg Raising (SLR) test, involving hip joint flexion and hip joint internal and external rotations[20]. This measurement method was chosen, because it is a simple, reproducible, and sensitive method to define the angle. The SLR test measured the hip flexion angle in the supine and knee extension positions having the basic axis as a line parallel to the trunk and the axis of movement as the femur. The angle of hip flexion measured the hip flexion angle in the supine and knee flexion positions having the basic axis as a line parallel to the trunk and the axis of movement as the femur. The Internal and external rotations of the hip joint were measured in the supine position at a knee flexion of 90° having the basic and translation axes as the vertical line down from the patella and as the median line of the lower leg, respectively.

Statistical analysis

The participants were divided int the low-, medium-, and high-risk groups according to the SBST evaluation score of psychosocial factors. Then, comparisons were made to correlate each group to the corresponding measured degree of physical function in terms of the three indicators. For an interval scale, we performed a one-way analysis of variance (ANOVA), followed by a multiple comparison test according to the Tukey method of the LBP functional scale. For a nominal scale, a χ^2 test was used. Each measured item was binarized and the three groups were compared using the χ^2 test. To classify the levels of pain, the categorical scale reported by Serlin *et al.*[21] was used. A pain scale ≥5 was considered as elevated pain. Case of abdominal muscle endurance of <30 s were allocated to the reduced muscular strength group (median of KW test criteria), as well as those of dorsal muscle endurance of <60 s (maximum of KW test criteria) and lower limb muscular strength >15 s (using the upper quartile). For hip joint flexibility assessed by the Japan Orthopedic Association's SLR test, as aforementioned[22], cases with leg raises of <90°, flexion of <125°, and internal and external rotation of <45° were categorized in the reduced flexibility group.

Data from each of the binarized measured items were treated as outcomes. A multiple logistic analysis using the forced entry method was performed to identify whether the psychosocial risk factors could be predicted by individual characteristics. The covariates included age (20s, 30s, 40s, 50–60s), sex (male, female), body mass index (thin: <18.5 kg/m^2; normal: 18.5–25 kg/m^2; overweight:>25 kg/m^2), years of dependency (<10 yr, 10–20 yr, >20 yr), and type of class undertaken in the school (physical and/or intellectual disabilities). The adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. JMP Version 14 (SAS Institute, Inc., Cary, NC, USA) was used for statistical analysis. The level of statistical significance was set at $p<0.05$.

Results

Out of the 421 participants, one pregnant participant and nine with invalid SBST responses were excluded. The remaining 411 were subjected to analysis (Fig. 1).

Of these, 306, 65 and 40 were included in the low-risk, medium-risk and high-risk groups, respectively. Comparison of individual characteristics among the three groups showed that age and years of dependency were significantly higher in the medium and high-risk groups than in the low-risk group ($p<0.001$, Table 1). In terms of comparing psychosocial factors with pain levels and physical functions among the three groups, the percentage of participants with high levels of pain was significantly higher in the medium-risk and high-risk groups than in the low-risk group. Moreover, the abdominal muscle endurance and lower extremity muscle strength were significantly lower in the high-risk group than in the low-risk and medium-risk groups ($p<0.01$, Table 2).

Comparison after binarization of each of the measured outcomes among the three groups showed the similar re-

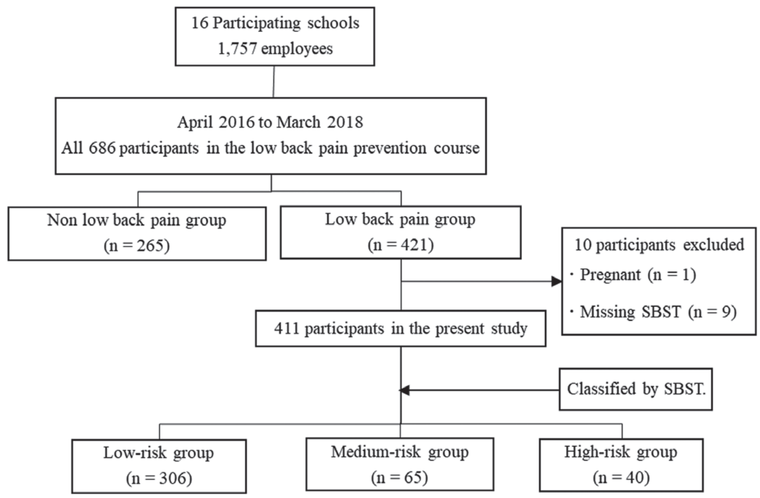

Fig. 1. Flowchart of participant selection through the study.
SBST: STarT Back Screening Tool.

Table 1. Characteristics of study participants

	Total (n=411)	Low-risk group (n=306)	Medium-risk group (n=65)	High-risk group (n=40)	*p*-value§
Age (yr)	43.6 ± 11.8	42.0 ± 11.7	48.4 ± 10.6**	48.5 ± 10.8**	<0.001
Sex					
Male	162	126	24	12	
Female	249	180	41	28	0.358
Height (cm)	164.1 ± 8.9	164.5 ± 9.0	162.7 ± 8.7	163.6 ± 8.3	0.314
Weight (kg)	60.8 ± 12.1	60.7 ± 11.9	60.1 ± 12.7	62.9 ± 13.1	0.493
BMI (kg/m^2)	22.4 ± 3.4	22.3 ± 3.3	22.6 ± 3.8	23.3 ± 3.5	0.198
Work experience (yr)	13.8 ± 11.9	12.4 ± 11.3	18.1 ± 12.9**	17.9 ± 12.2**	<0.001

BMI: body mass index.
The numerical value indicates the average value ± standard deviation or the number of participants.
§Comparisons among the low-risk group, medium-risk group and high-risk group using a one-way analysis of variance test or χ^2 test.
Comparison with low-risk group (Tukey's method). $^{**}p<0.01$.

sults (Table 3). The percentage of participants with a high degree of pain was significantly higher in the medium-risk and high-risk groups than in the low-risk group ($p<0.01$). The percentage of participants with weak abdominal muscle endurance and lower limb muscular strength was significantly higher in the high-risk group than in the low-risk group ($p<0.01$). Further, the percentage of participants with weak left SLR was significantly lower in the high-risk group than in the medium-risk group ($p<0.05$).

From the multiple logistic regression analysis, the pain levels in the medium-risk and high-risk groups were found to be significant compared to those in the low-risk group (OR: 5.91 [95% CI: 3.08–11.36] and 10.74 [CI: 4.51–25.58], respectively). In addition, the influences on physical function were also significant in the high-risk compared to those in the low-risk group ($p<0.05$), as observed in the following variables: abdominal muscle endurance (adjusted OR: 5.47, 95% CI: 2.34–12.73), lower limb muscular strength (adjusted OR: 3.14, 95% CI: 1.43–6.88), restricted right SLR (adjusted OR: 2.65, 95% CI: 1.07–6.55), and left SLR (adjusted OR: 3.12, 95% CI: 1.20–8.11). However, no significant difference was observed in the comparison of these variables between the medium-risk and low-risk groups (Table 4).

Discussion

Some studies have been reported[23, 24] on the connections between psychosocial factors and physical and functional impairment. Nevertheless, in many cases, the

Table 2. Pain and motor functions of the study participants included in the SBST risk groups

	Low-risk group (n=306)	Medium-risk group (n=65)	High-risk group (n=40)	*p*-value§
Pain level	3.5 ± 1.8	5.1 ± 2.1**	5.9 ± 1.8**	<0.001
Abdominal muscle endurance (s)	45.1 ± 18.4	41.4 ± 20.7	30.1 ± 17.7**††	<0.001
Dorsal muscle endurance (s)	59.3 ± 4.4	59.7 ± 1.8	59.4 ± 2.3	0.815
Lower limb muscular strength (s)	12.6 ± 3	12.9 ± 3.2	15.2 ± 4.4**††	<0.001
Right SLR (°)	82.1 ± 16.5	82.2 ± 16.7	77.4 ± 9.7	0.254
Left SLR (°)	82.6 ± 15.6	82.2 ± 17.3	76.5 ± 10.8	0.092
Right flexion (°)	132.1 ± 10.0	130.7 ± 13.0	130.2 ± 8.5	0.441
Left flexion (°)	132.5 ± 9.6	130.2 ± 12.6	131.4 ± 9.2	0.287
Right internal rotation (°)	43.1 ± 12.8	42.6 ± 12.2	45.0 ± 13.5	0.675
Left internal rotation (°)	43.7 ± 12.5	44.5 ± 12.4	42.8 ± 15.5	0.829
Right external rotation (°)	54.3 ± 10.1	52.8 ± 11.0	52.0 ± 9.5	0.303
Left external rotation (°)	55.0 ± 9.9	52.7 ± 9.8	53.5 ± 7.7	0.218

SBST: STarT Back Screeing Tool; SLR: straight leg raising.
The numerical value indicates the average value ± standard deviation.
§Comparisons among the low-risk group, medium-risk group and high-risk groups using a one-way analysis of variance.
Comparison with the low-risk group (Tukey's method). ** p<0.01.
Comparison with medium-risk group (Tukey's method). †† p<0.01.

Table 3. Pain and motor functions of study participants included in the SBST risk groups: the results of binarization of each item

	Low-risk group (n=306)	Medium-risk group (n=65)	High-risk group (n=40)	*p*-value§
Pain level (≥5)	83 (27.9)	41 (65.1) **	29 (78.9) **	<0.001
Abdominal muscle endurance (≤30 s)	66 (21.5)	18 (27.6)	21 (52.5) **	<0.001
Dorsal muscle endurance (≤60 s)	8 (2.6)	1 (1.5)	2 (5.0)	0.627
Lower limb muscular strength (≤15 s)	63 (20.5)	13 (20.0)	17 (42.5) **	<0.001
Right SLR (≤90°)	179 (58.5)	32 (49.2)	28 (70.0)	0.092
Left SLR (≤90°)	183 (59.8)	32 (49.2)	29 (72.5) †	0.049
Right flexion (≤125°)	50 (16.3)	13 (20.0)	9 (22.5)	0.354
Left flexion (≤125°)	46 (15.0)	13 (20.0)	5 (12.5)	0.374
Right internal rotation (≤45°)	125 (40.8)	26 (40.0)	14 (35.0)	0.794
Left internal rotation (≤45°)	130 (42.4)	19 (29.2)	15 (37.5)	0.284
Right external rotation (≤45°)	31 (10.1)	6 (9.2)	5 (12.5)	0.837
Left external rotation (≤45°)	23 (7.5)	8 (12.3)	2 (5.0)	0.246

SBST: STarT Back Screeing Tool.
Numerical values are displayed as n (%).
§Comparisons among the low-risk group, medium risk and high risk groups using a χ^2 test.
Comparison with the low-risk group. ** p<0.01.
Comparison with the medium-risk group. † p<0.05.

Table 4. Results of logistic regression analyses on intensity of pain and motor function of participants included in the SBST risk groups

	Medium-risk group			High-risk group		
	Adjusted odds ratio	95% CI	*p*-value	Adjusted odds ratio	95% CI	*p*-value
Pain level (≥5)	5.91	3.08–11.36	<0.001	10.74	4.51–25.58	<0.001
Abdominal muscle endurance (≤30 s)	1.46	0.68–3.13	0.328	5.47	2.34–12.73	<0.001
Dorsal muscle endurance (≤60 s)	0.77	0.09–6.57	0.817	2.21	0.41–11.85	0.354
Lower limb muscular strength (≤15 s)	0.79	0.35–1.77	0.576	3.14	1.43–6.88	0.004
Right SLR (≤90°)	0.75	0.38–1.48	0.414	2.65	1.07–6.55	0.034
Left SLR (≤90°)	0.70	0.35–1.37	0.302	3.12	1.20–8.11	0.019
Right flexion (≤125°)	1.41	0.60–3.29	0.427	1.80	0.70–4.62	0.222
Left flexion (≤125°)	1.93	0.85–4.38	0.112	0.91	0.30–2.70	0.858
Right internal rotation (≤45°)	1.26	0.61–2.59	0.528	0.88	0.38–2.03	0.770
Left internal rotation (≤45°)	0.54	0.25–1.17	0.121	0.89	0.39–2.03	0.788
Right external rotation (≤45°)	0.80	0.28–2.29	0.681	1.07	0.36–3.16	0.896
Left external rotation (≤45°)	1.42	0.52–3.89	0.491	0.53	0.11–2.50	0.429

SBST: STarT Back Screeing Tool; CI: confidence interval; SLR: straight leg raising.
An odds ratio with 95%CI was calculated for the low-risk group, as a reference.
Adjusted for age (20s/30s/40s/50–60s), sex (male/female), BMI (<18.5/18.5–24.9/≥25), years of dependency (<10/10–19/≥20 yr), and type of class undertaken in the school (physical/intellectual disabilities).

evaluations relied on subjective complaints through questionnaires, with limited evaluative research using objective indicators, such as those included in our study[12]. Subjective evaluation is biased toward the views of the sufferer, in contrast to objective evaluations where reproducibility is high regardless of different accessors. Therefore, evaluation using objective indicators for physical impairment is important to avoid subjective biases.

Thus, to our knowledge, this research was the first that evaluated physical functions using objective indicators, by enrolling participants who worked in special needs schools and suffered from LBP. Especially, we studied the link of physical functions with psychosocial factors. We found that there was a high percentage of those included in the high-risk group who had lower abdominal muscle endurance, limb muscular strength, and SLR test scores, compared to that of those in the low-risk group. The multiple logistic regression analysis also suggested that psychosocial factors were linked to the aforementioned physical function impairments.

Leeuw *et al.*[25] reported that, with the onset of LBP, the fear of pain and the resulting fear of movement causes disruption to daily living activities and physical function. Our findings indicated that individuals of the high-risk group, involving those featuring strong psychosocial factors, would experience higher fear of discomfort and pain compared to those included in the low-risk group. Therefore, they may have a higher tendency to excessively restrict movement, leading to functional weakness and stiffness. This has been demonstrated in our research by the reduced abdominal muscle endurance and lower limb muscular strength and range of motion, as revealed by the SLR test.

O'Sullivan *et al.*[26] reported that prolonged periods of sitting are accompanied by reduced abdominal muscle endurance and reduced level of daily living activities. According to den Ouden *et al.*[27], a significant correlation between the amount of daily living activity and lower limb muscular strength was observed. Based on these factors, a link can be inferred between decreased activity and decreased physical function. However, no significant difference was observed in any of the measured physical function items for the medium-risk group compared to those of the low-risk group. Therefore, there could be a mild influence of psychosocial factors on individuals in the medium-risk group. Especially, the degree of inactivity was not as high as that observed in participants included in the high-risk group.

Furthermore, no link was recognized between psychosocial factors and dorsal muscle endurance and hip joint flexibility (flexion, internal and external rotation). Although previous studies[28, 29] have reported that patients with LBP with strong, phobic avoidance of pain presented reduced dorsal muscle endurance, this connection was not found in our research. The latter was attributed to the performed procedure, as we halted measurements at a maximum of 60 s without considering the worsening of LBP, in contrast with measurements up to the maximum value performed in the previous studies[28, 29]. As the flexion, and internal/ external rotation movements of the hip joints are rarely involved in the typical lifting and forward-leaning actions performed by special needs school staff members, we can assume that these physical functions would not be influenced.

In our study, we showed that physical functions, such as abdominal muscle endurance, lower extremity muscle strength, and hip flexibility, also differed among the participants included in different SBST risk groups. In recent years, aerobic exercise has been recommended as an exercise therapy for patients with LBP who have strong psychosocial factors[30–34]. Aerobics are recommended because they help to recover the pain modulatory function of the central nervous system that was previously negatively affected by psychosocial factors[35]. Therefore, we consider that patients with LBP and strong psychosocial factors may be benefited from combining aerobic exercise with exercise therapy to strengthen the core muscles and improve the lower limb muscle strength and hip flexibility.

The strengths of this study included its clarification, through evaluation using objective indicators, of the link between psychosocial factors and physical functions, and the effective impact on individuals working in special needs schools suffering from LBP.

However, there were several limitations that should be mentioned. First, as only participants treated LBP were included, the pain symptoms were subjective and, without proper diagnoses from physicians, organic issues, such as lumbar spondylosis or lumbar disk hernias, were not clearly delineated. Second, as this research was cross-sectional, it was not possible to illustrate a temporal relation between psychosocial factors and physical functions. Finally, the definition of physical function was not completely elucidated, as elements, such as spinal alignment and mobility, were overlooked in this research. Thus, a longitudinal study should be conducted to further investigate the relationship between psychosocial factors and assessment using objective indicators for special needs school employees. In addition, physical mechanisms, such as spinal alignment and spinal mobility, need to be examined in the future.

Conclusion

After including individuals working in special needs school who suffered from LBP, we objectively evaluated physical functions and elucidated the link between these functions and psychosocial factors. We showed that abdominal muscle endurance, lower limb muscular strength, and hip joint flexibility were lower in the participants included in the high-risk group than in those in the lower-risk group. Given that individuals of the high-risk group tend to be associated with strong psychosocial factors, there is a possibility of alleviating their LBP by implementing a combination of exercise therapies that aim at reinforcing the trunk muscle, limb strength, and improving hip joint flexibility.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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