# Relationship between low back pain and health-related quality of life in Japanese hemodialysis patients with locomotive syndrome

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Abstract

The aim of the present study was to investigate the relationship between low back pain (LBP) and health-related quality of life (HRQOL) in patients on chronic hemodialysis with locomotive syndrome (LS). Ninety-four hemodialysis patients (54 men and 40 women, aged 72.8 ± 10.2 years) with LS by "Loco-Check", which was established by the Japanese Orthopedic Association, were enrolled in this cross-sectional study. The relationship between LBP and HRQOL by EuroQOL-5D (EQ-5D) was evaluated. Thirty-eight patients (40.4%) had LBP. EQ-5D scores were significantly lower in patients with LBP than in those without LBP even after adjustments for confounding factors. A multiple regression analysis identified LBP, age, and history of diabetic mellitus as factors influencing EQ-5D scores in patients on chronic hemodialysis with LS. These results suggest that preventing and attenuating LBP may improve HRQOL in patients on chronic hemodialysis with LS.

Key words
chronic hemodialysis, health-related quality of life (HRQOL), low back pain, loco-check, locomotive syndrome

## 1. Introduction

End-stage renal failure has become a public health issue in Japan. The number of patients on chronic hemodialysis (CHD) has increased to more than 330,000. Furthermore, the average starting age of hemodialysis was 69.7 years in 2017, but is now also increasing (The Japanese Society for Dialysis Therapy n.d.). Health-related quality of life (HRQOL) was previously shown to be significantly lower in patients on CHD than in average individuals (Mapes et al 2003). Many factors affect HRQOL in patients on CHD. We previously reported that physical activity on non-hemodialysis days was closely associated with HRQOL (Katayama et al 2014). The percentage of sedentary behavior in daily physical activity was found to be approximately 74%, and sedentary behavior negatively correlated with HRQOL in a cross-sectional study (Hishii et al 2018).

The Japanese Orthopedic Association established "Locomotive syndrome (LS)" in 2007, which is characterized by locomotive organs disability that ultimately results in patients becoming bedridden (Nakamura and Ogata 2016). "Loco-Check" is a simple questionnaire prepared by the Japanese Orthopedic Association that predicts LS (Nakamura 2012). HRQOL and physical function were significantly lower in subjects with LS by Loco-Check than in those without LS (Asakura et al 2016, Kataoka et al 2019). Patients on CHD are characterized by an older age, lower nutrition status, and lower physical activity level, resulting in falls and fractures (Johansen 2007). The prevalence of LS in patients on CHD is expected to be higher than that in average individuals (Kitamura et al 2018).

Low back pain (LBP), which is more common in CHD patients than in average individuals in Japan, is also regarded as an important factor affecting HRQOL (Cristofolini et al 2008). We previously reported that LBP was closely associated with psychological distress in CHD patients (Hishii et al 2016). Taken together, previous studies have reported that having LBP and LS lead to lower HRQOL. However, the relationship between LBP and HRQOL in patients on CHD, particularly those with LS, remains unclear.

Therefore, in this cross-sectional study, we investigated the relationship between LBP and HRQOL in patients on CHD with LS.

## 2. Methods

### 2. 1 Subjects

Ninety-four patients (54 men and 40 women, aged 72.8 ± 10.2 years) on CHD among 143 patients, were voluntarily enrolled in this cross-sectional study. The 94 enrolled patients met the following criteria: (1) they underwent hemodialysis at Innoshima General Hospital, Onomichi, Japan between September 2016 and September 2018; (2) they underwent clinical measurements including HRQOL, the presence of LBP and LS, and (3) they provided written informed consent to participate in this study.

Ethical approval for the present study was obtained from the Ethics Committee of Innoshima General Hospital, Onomichi, Japan (H27.12.25, H28.12.9, H29.12.4).

### 2. 2 Clinical parameters and measurements

We examined the following clinical parameters: sex, age, height (cm), body weight (dry weight; kg), body mass index (BMI; kg/m$^2$), duration of hemodialysis (months), cause of hemodialysis [diabetes mellitus (DM) or other diseases], blood examinations, concurrent illness including LBP, LS, and HRQOL, as previously described (Asakura et al 2016, Kataoka et al 2019).

LS was defined using "Loco-Check", which was developed by the Japanese Orthopedic Association (Ishibashi 2018). LS was defined by an answering of "yes" to any of the 7 questions included. LBP was defined by medical clinical records according to a previous study (Hishii et al 2016). More detailed assessments of LBP, such as its cause and duration, were not performed. HRQOL was evaluated by EuroQOL-5D (EQ-5D Japanese version), as described previously (Hishii et al

2018, Katayama et al 2014).

2. 3 Statistical analysis

Data are expressed as the mean ± standard deviation (SD). Comparisons of clinical parameters between CHD patients having LS with and without LBP were performed by the unpaired t-test, chi-square test and Fisher's exact test. An analysis of covariance (ANCOVA) was used to adjust for sex, age, BMI, duration of HD, history of DM, and a p value < 0.05 was considered to be significant. We performed a multiple regression analysis to identify which factors affected EQ-5D scores in patients on CHD with LS. The variance inflation factor (VIF) was calculated to evaluate multicollinearity. Statistical analyses were performed using JMP13.0 and JMP Pro 14.2 software (SAS Institute., Cary, NC, USA).

## 3. Results

Thirty-eight out of 94 CHD patients with LS (40.4%) had LBP. The average EQ-5D score was 0.677 ± 0.277 (Table 1).

Table 2 shows a comparison of parameters between LS patients with and without LBP. EQ-5D scores were significantly higher in LS patients without LBP than in those with LBP.

Table 1. Clinical characteristics of 94 patients on hemodialysis

| Variables | Total (N = 94) | Minimum | Maximum |
|---|---|---|---|
| Women, n (%) | 40 (42.6) | | |
| Age (years) | 72.8 ± 10.2 | 47.0 | 92.0 |
| Height (cm) | 156.9 ± 8.7 | 137.3 | 175.6 |
| Body weight (dry weight) (kg) | 54.1 ± 11.2 | 33.3 | 104.8 |
| Body mass index (kg/m$^2$) | 21.9 ± 3.5 | 16.1 | 35.8 |
| Duration of hemodialysis (months) | 79.5 ± 97.4 | 2.0 | 390.0 |
| **Chronic disease** | | | |
| Hypertension, n (%) | 86 (91.5) | | |
| Diabetes mellitus, n (%) | 40 (42.6) | | |
| Dyslipidemia, n (%) | 39 (41.5) | | |
| Low back pain, n (%) | 38 (40.4) | | |
| Knee pain, n (%) | 14 (15.1) | | |
| **EQ-5D scores** | 0.677 ± 0.277 | -0.331 | 1.000 |

Values are shown as the mean ± standard deviation or n ( % )

Table 2. Comparison of clinical parameters between patients on hemodialysis with and without low back pain

| | Low back pain ( + ) (n = 38) | Low back pain ( − ) (n = 56) | $p$ | $p^1$ | $p^2$ |
|---|---|---|---|---|---|
| Women, n (%) | 16 (40.0) | 24 (60.0) | 0.942 | | |
| Age (years) | 73.7 ± 1.7 | 72.1 ± 1.4 | 0.525 | | |
| Height (cm) | 157.3 ± 1.4 | 156.7 ± 1.2 | 0.717 | | |
| Body weight (dry weight) (kg) | 53.5 ± 1.8 | 54.5 ± 1.5 | 0.672 | | |
| Body mass index (kg/m$^2$) | 21.4 ± 0.6 | 22.2 ± 0.5 | 0.300 | | |
| Duration of hemodialysis (months) | 99.6 ± 15.6 | 65.8 ± 12.9 | 0.099 | | |
| Hypertension, n (%) | 33 (86.8) | 53 (94.6) | 0.262 | | |
| Diabetes mellitus, n (%) | 16 (42.1) | 24 (42.9) | 0.942 | | |
| Dyslipidemia, n (%) | 19 (50.0) | 20 (35.7) | 0.168 | | |
| Knee pain, n (%) | 7 (18.4) | 7 (12.5) | 0.450 | | |
| EQ-5D scores | 0.576 ± 0.043 | 0.746 ± 0.036 | **0.003** | **0.007** | **0.014** |

Values are shown as the mean ± standard deviation or n ( % )

$p^1$ : by ANCOVA adjusted for age, sex, body mass index

$p^2$ : by ANCOVA adjusted for age, sex, body mass index, duration of hemodialysis, history of diabetes mellitus

These relationships remained after adjustments for confounding factors, such as age, sex, BMI, duration of hemodialysis, and the presence of DM (Table 2).

We then compared subcategories of the EQ-5D questionnaire between patients with and without LBP on CHD having LS (Table 3). Significant differences in usual activity ($p = 0.049$) and anxiety/depression ($p = 0.011$), but not in pain/discomfort, were noted between the two groups.

We then investigated what factors affected EQ-5D scores in LS patients on CHD using a multiple regression analysis. We used EQ-5D scores as the dependent valuable, and age, sex, BMI, duration of hemodialysis, presence of DM, and LBP as independent valuables, which were considered to be critically important. Age, the presence of DM, and LBP (standardized $\beta = -0.228$, $p = 0.014$) were significantly important factors for EQ-5D scores, even after adjustments for confounding factors, with a VIF value < 5.0 (Table 4).

Table 3. Comparison of the EQ-5D sub-scale between hemodialysis patients with and without low back pain

| EQ-5D sub-scale | Low back pain (＋) (n = 38) | Low back pain (－) (n = 56) | *p* |
|---|---|---|---|
| **Mobility** | | | |
| No problem | 9 (23.7%) | 23 (41.1%) | 0.155 |
| Moderate problem | 27 (71.1%) | 32 (57.1%) | |
| Extreme problem | 2 (5.3%) | 1 (1.8%) | |
| **Self-care** | | | |
| No problem | 25 (65.8%) | 42 (75.0%) | 0.219 |
| Moderate problem | 9 (23.7%) | 13 (23.2%) | |
| Extreme problem | 4 (10.5%) | 1 (1.8%) | |
| **Usual activities** | | | |
| No problem | 15 (39.5%) | 34 (60.7%) | **0.049** |
| Moderate problem | 17 (44.7%) | 20 (35.7%) | |
| Extreme problem | 6 (15.8%) | 2 (3.6%) | |
| **Pain / discomfort** | | | |
| No problem | 16 (42.1%) | 25 (44.6%) | 0.140 |
| Moderate problem | 19 (50.0%) | 31 (55.4%) | |
| Extreme problem | 3 (7.9%) | 0 (0.0%) | |
| **Anxiety / depression** | | | |
| No problem | 21 (55.3%) | 45 (80.4%) | **0.011** |
| Moderate problem | 14 (36.8%) | 11 (19.6%) | |
| Extreme problem | 3 (7.9%) | 0 (0.0%) | |

Number of subjects (%)

Table 4. Multiple regression analysis between EQ-5D scores and clinical parameters

| Independent variables | Standardized *β* | *SE* | *p* | VIF |
|---|---|---|---|---|
| Age (years) | -0.360 | 0.003 | **< 0.001** | 1.08 |
| Sex (Men / Women) | -0.115 | 0.050 | 0.208 | 1.02 |
| Body mass index (kg/m$^2$) | 0.152 | 0.008 | 0.112 | 1.12 |
| Duration of hemodialysis (months) | -0.188 | 0.000 | 0.057 | 1.19 |
| Diabetes mellitus (+ / －) | -0.199 | 0.051 | **0.033** | 1.05 |
| Low back pain (+ / －) | -0.228 | 0.051 | **0.014** | 1.05 |

Adj $R^2 = 0.256$, $p < 0.001$

$p < 0.05$ indicated in bold.

SE: standard error, VIF: variance inflation factor

## 4. Discussion

This is the first study to investigate the relationship between LBP and HRQOL in Japanese patients on CHD with LS, and the results obtained revealed that age, the presence of DM, and LBP were important factors for HRQOL in LS patients on CHD.

Previous studies reported that aging and DM aggravated HRQOL (Sakamaki et al 2006, Saleh et al 2015). Sakamaki et al. showed that EQ-5D scores were significantly lower in 220 patients with type 2 DM aged 70 years or older than in those aged 59 years or younger (Sakamaki et al 2006). Seleh et al (2015) found that patients with type 2 DM had problems associated with pain/discomfort, anxiety/depression, mobility and usual activities by using EQ-5D. In the present study, 76 patients were 65 years or older (80.9%), and 40 patients had DM (42.6%). Furthermore, age and the presence of DM were important factors for HRQOL, as reported previously. Difficulties are associated with compensating for the effects of aging and clinical therapy because they may be major contributors affecting the status of DM in patients on CHD.

The prevalence of LBP in Japan was previously reported to be 30.6% (men 29.2%, women 31.8%) in 2966 subjects (age: 51.1 ± 15.8 years), it increased with age, and was higher in men than in women (The national survey report on low back pain in 2003 2011). The prevalence of LBP in the present study was 40.4% (38 patients), which was higher than that previously reported in average individuals (Cristofolini et al 2008, Kesikburn et al 2018). Patients in the present study were older and all had LS and CHD. Patients on CHD have to lie in the supine position for approximately 4 hours per day and 3 times per week, which may have contributed to the higher prevalence of low back pain in the present study. In addition to the effects of aging, the factors such as prolonged holding posture for treatment and restriction of physical activity may induce involvement in the development of LS in CHD patients, although the present study could not prove it.

Regarding the relationship between LBP and HRQOL, Kesikburn et al. reported that aging, BMI, and smoking were closely associated with LBP, resulting in lower HRQOL (Kesikburun et al 2018). In this study, the difference in EQ-5D score with and without LBP was similar to the previous study comparing HRQOL with and without LS in DM patients (Asakura et al 2016) and obstructive sleep apnea syndrome patients (Kataoka et al 2019). In Japan, according to the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36), HRQOL was significantly lower in subjects with LBP than in those without LBP among middle-aged women (Muraki et al 2010), workers (Tominaga et al 2003) and community dwelling people (The national survey report on low back pain in 2003). Pain is generally accepted to directly and/or indirectly reduce HRQOL. However, among patients on CHD, the relationship between LBP and HRQOL remains unclear in those with LS. In the present study, we found that the prevalence of LBP was higher and closely associated with low HRQOL in LS patients on CHD, even after adjustments for confounding factors. Furthermore, it is important to note that in a sub-analysis of EQ-5D scores, the components of usual activity and anxiety/depression, but not pain/discomfort, were associated with LBP. Saito et al. reported that longer sedentary behavior and shorter physical activity were closely associated with LBP in 932 elderly Japanese subjects (Saito et al 2015). We also previously showed that LBP was closely associated with psychological distress (Hishii et al 2016). Based on these findings and the present results, HRQOL may be improved in patients on CHD through not only pain treatments, but also physical activity programs and mental health care.

There are some limitations that need to be addressed. The present study was cross-sectional in nature with a small sample size (n = 94). Furthermore, it was conducted at only one hospital with older subjects (80.9% patients were 65 years

or older), suggesting that our results represent only general patients on CHD. In addition, LBP was assessed according to medical clinical records. Therefore, further details on LBP, such as its cause, duration, and medication, were not accurately evaluated. Moreover, the mechanisms contributing to the relationship between LBP and HRQOL have not yet been elucidated.

In conclusion, the present results suggest that the amelioration of LBP may prevent the decline observed in HRQOL in patients on CHD with LS. Further large-sample and prospective intervention studies to attenuate LBP are needed for Japanese patients on CHD with LS.

Conflicts of interest

The authors have no conflicts of interest to report.

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## References

Asakura R, Miyatake N, Dokai Mochimasu K et al (2016). Comparison of health-related quality of life between type 2 diabetic patients with and without locomotive syndrome. Environ Health Prev Med 21, 356-360. DOI: 10.1007/s12199-016-0537-z

Cristofolini T, Draibe S and Sesso R (2008). Evaluation of factors associated with chronic low back pain in hemodialysis patients. Nephron Clin Pract 108(4), c249-255. DOI: 10.1159/000124328

Hishii S, Miyatake N, Nishi H et al (2016). Psychological distress between chronic hemodialysis patients with and without low back pain. Environ Health Prev Med 21, 487-491. DOI: 10.1007/s12199-016-0573-8

Hishii S, Miyatake N, Nishi H et al (2018). Relationship between sedentary behavior and health-related quality of life in patients on chronic hemodialysis. Acta Med Okayama 72(4), 395-400. DOI: 10.18926/AMO/56177

Ishibashi H (2018). Locomotive syndrome in Japan. Osteoporosis Sarcopenia 4, 86-94. DOI: 10.1016/j.afos.2018.09.004

Johansen K (2007). Exercise in the end-stage renal disease population. J Am Soc Nephrol 18, 1845-1854. DOI: 10.1681/ASN.2007010009

Kataoka H, Miyatake N, Ichikawa H et al (2019). Sub-analysis of the prevalence of locomotive syndrome and its relationship with health-related quality of life in patients with obstructive sleep apnea syndrome as classified by age and sex. Sleep and Biological Rhythms 17, 149-153.

Katayama A, Miyatake N, Nishi H et al (2014). Evaluation of physical activity and its relationship to health-related quality of life in patients on chronic hemodialysis. Environ Health Prev Med 19, 220-225. DOI: 10.1007/s12199-014-0380-z

Kesikburun B, Eksioglu E, Akdag I et al (2018). Low back pain in hemodialysis patients: Risk factors and its impact on health-related quality of life. Turk J Phys Med Rehab 64, 66-71. DOI: 10.5606/tftrd.2018.1016

Kitamura Y, Imai R, Watanabe K et al (2018). Clinical research of locomotive syndrome and musculoskeletal ambulation disability symptom complex in Tojinkai hospital. Kidney and Dialysis 84(Suppl), 101-103 (in Japanese).

Mapes DL, Lopes AA, Satayathum S et al (2003). Health-related quality of life as a predictor of mortality and hospitalization: the Dialysis Outcomes and Practice Patterns Study (DOPPS). Kidney Int 64(1), 339-349. DOI: 10.1046/j.1523-1755.2003.00072.x

Muraki S, Akune T, Oka H et al (2010). Impact of knee and low back pain on health-related quality of life in Japanese women: the Research on

Osteoarthritis Against Disability (ROAD). Mod Rheumatol 20, 444-451. DOI: 10.1007/s10165-010-0307-5

Nakamura K (2012). Locomotive syndrome. Jap j geriat 49, 393-401 (in Japanese).

Nakamura K and Ogata T (2016). Locomotive Syndrome: Definition and management. Clinic Rev Bone Miner Metab 14, 56-67. DOI: 10.1007/s12018-016-9208-2

Saito T, Sakita M and Kumagai S (2015). Combination risk to chronic low back pain of physical activity and sedentary behavior. Jpn J Phys Fitnes Sports Med 64, 435-442. DOI: 10.7600/jspfsm.64.435

Sakamaki H, Ikeda S, Ikegami N et al (2006). Measurement of HRQL using EQ-5D in patients with type 2 diabetes mellitus in Japan. Value Health 9, 47-53. DOI: 10.1111/j.1524-4733.2006.00080.x

Saleh F, Ara F, Mumu SJ et al (2015). Assessment of health-related quality of life Bangladeshi patients with type 2 diabetes using the EQ-5D: a cross-sectional study. BMC Res Notes 8, 497. DOI: 10.1186/s13104-015-1453-9

The Japanese Society for Dialysis Therapy (n.d.). https://docs.jsdt.or.jp/overview/file/2017/pdf/2.pdf (accessed: 2019-6-10).

The national survey report on low back pain in 2003 (2011). https://www.joa.or.jp/media/comment/pdf/lumbago_report_030731.pdf (accessed: 2019-6-29).

Tominaga T, Kunishi Y, Kido K (2003). A epidemiologic study for occupational low back pain and quality of life in laborers. Japanese Journal of Occupational Medicine and Traumatology 51, 423-427.

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