Original Article

Relationship among motor function, ADL disability, and psychological concerns in elderly people with locomotive disorders

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ARTICLE INFO

ABSTRACT

Background: Locomotive disorders are one of the main causative pathologies for the condition requiring assistance on activities of daily living (ADL). Although psychological concerns such as feeling of depression and anxiety are prevalent in elderly people, the causal relation among motor function, ADL disability, and psychological concerns is controversial.

Purpose: Purpose of this study was to investigate causal relationship among motor function, ADL disability, and psychological concerns in elderly people with locomotive disorders.

Methods: The data for this study were from a community-dwelling sample of 314 elderly persons with locomotive disorders aged 65 and older who visited orthopedic clinics and/or affiliated institutions. Motor function was assessed by one-leg standing time with eyes open, leg extension power and grip power. We assessed ADL disability using the 25-question Geriatric Locomotive Function Scale (GLFS-25), and psychological concerns by three self-reported questions. We constructed two models and tested fitness of the models to the data using a structural equation modeling (SEM). Model 1: motor function affects ADL disability and ADL disability affects psychological concerns, Model 2: motor function affects psychological concerns and psychological concerns affects ADL disability.

Results: The fit indices were chi-square = 23.152 (p = 0.081), RMSEA = 0.042, GFI = 0.981, AGFI = 0.955, CFI = 0.987 for Model 1, and chi-square = 84.583 (p < 0.001), RMSEA = 0.119, GFI = 0.935, AGFI = 0.854, CFI = 0.892 for Model 2. These fit indices indicated a good fit of the model 1 and inadequate fit of model 2 to the data.

Conclusion: Decline of motor function contributed toward psychological concerns via ADL disability in elderly people with locomotive disorders.

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1. Introduction

Ageing is associated with declining of physical function and increasing chance of disabilities on activities of daily living (ADL). More than 6 million persons were certified as Long-term Care Insurance (LTCI) services users as of Feb. 2016 [1].

Elderly persons requiring LTCI services because of fracture/fall and joint disorders were 22.7% of total LTCI service users [2]. Locomotive Syndrome (Los) is a concept proposed by Japan Orthopedic Association (JOA) which refers to conditions under which the elderly people require care services or they may soon require care services because of problems of the locomotive organs [3]. The total number of individuals with LoS between the 40s and 70s in Japan was estimated to be 7.5 million [4]. LoS is one of the main causes for candidates of care-needs in LTCI of Japan [5]. Elderly persons with locomotive disorders complain of physical symptoms on locomotor organ, suffer from decline of motor function and experience disability in daily activities. Relationships among clinical symptoms, physical function and the 25-question Geriatric Locomotive Function Scale (GLFS-25) score were reported [6,7].

The concept of LoS consisted of the presence of symptoms related to locomotive organ disorders, decline of motor function, and ADL disabilities [5]. In addition to the presence of physical symptoms, motor dysfunction, and ADL disabilities, depression in elderly people with locomotive disorders was reported [8,9].

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Several physical performance tests were proved to be valid for identification or monitoring the severity of LoS by revealing relationships between motor function and ADL disabilities [10,11].

Relation between physical performance and ADL disability were reported based on systematic review of 22 studies [12]. Evidences of association between decline of physical function and depression in community-dwelling elderly people [13], in people using nursing care services [14], and in people with specific medical conditions, for example rheumatoid arthritis [15] and chronic low back pain [16] have been documented.

The causal relationship among performance-based motor function, ADL disability, and depression in women aged 65 and over was reported [17].

Studying relationship among physical performance, depression, and ADL disability may be useful to develop an intervention plan for the prevention of ADL disability in elderly people with locomotive disorders.

The aim of this article is to report the causal relationship among motor function, ADL disability, and psychological concerns in elderly people with locomotive disorders.

2. Methods

2.1. Study design

We collected data four times in a prospective cohort study on the disablement process of locomotive disability and the development of guideline for locomotive disability prevention ('LDP study supported by a Sciences Research Grant from the Ministry of Health, Labor and Welfare, Japan (H21-Choju-G006)'). We used the data collected in the initial survey in this study. Three hundred and fourteen participants were recruited from five orthopedic clinics and affiliated nursing care facilities. Participant inclusion and exclusion criteria are shown in Table 1.

2.2. Ethics statement

Written informed consent was obtained from all participants, and the institutional review board of JOA approved all study protocols.

2.3. Functional measurement

2.3.1. One leg standing time with eyes open

One-leg standing test measures the time for which the subject can stand on one leg with their eyes open. We measured the time two times for each leg and the longest time was used for analysis.

2.4. Leg extension power

Leg extension power was measured using a previously described device [18]. Leg-extension power was measured on both legs and the stronger value was corrected by body weight and used for analysis.

2.5. Grip power

Grip power was measured on each hand using a dynamometer and the stronger value was used for analysis data.

2.6. ADL disability

We evaluated ADL disability using GLFS-25 [6].

GLFS-25 is self-administered questionnaire consisting of 25 questions including questions regarding pain, self-care, mobility, locomotion, housework, social activity, and anxiety. Responses to individual question are graded from 0 to 4: no impairment (0 points: Not difficult to do), mild impairment (1 points: mildly difficult to do), moderate impairment (2 points: moderately difficult to do), considerable impairment (3 points: considerably difficult to do) and severe impairment (4 points: extremely difficult to do) and then arithmetically added to produce a total score. A range of the total score is from 0 to 100. The GLFS-25 scale was proved to reflect the symptoms on locomotive organs, declined motor function and physician-judged grade of functioning on daily life [19].

To identify factors underlining ADL disability, we performed an exploratory factor analysis using the maximum likelihood estimation procedure and Promax rotation, and identified 4 factors. Factor 1 consisted of the items regarding activities related to self-care and mobility, factor 2 consisted of the items regarding activities related to housework and locomotion, factor 3 consisted of the items related to anxiety, and factor 4 consisted of the items related to

Table 1
Inclusion criteria and exclusion criteria.

Inclusion criteria:
1. Age ≥65 years (either gender)
2. Any one of the following four criteria
   1) Complaints related to the legs or spine without disability in walking or leaving the home (outpatients).
   2) Complaints related to the legs and spine, and slight disabilities in walking and leaving the home (outpatients).
   3) Slight disability in walking due to locomotive organ disorders (users of long-term care services).
   4) Complaints related to the upper extremities without disability in walking or leaving the home (outpatients at orthopedic clinics).
3. Ability to answer the 25-question Geriatric Locomotive Function Scale questionnaire without assistance.
4. Consent to the radiographic examination of the knees and spine.
5. Consent to the examination of the serum vitamin D and hyaluronic acid levels.
6. Consent to participate in the following motor function tests: one-leg standing test, grip power, leg extension power, 100-step test, and trunk forward bending test.

Exclusion criteria:
1. Inability to stand up from a chair or bed.
2. Disability in walking or locomotion because of neurological disease requiring admission treatment.
3. Severe pulmonary, renal, coronary, or hepatic disease.
4. Mental illness.
5. Past history of stroke within the preceding 6 months.
6. Past history of myocardial infarction within the preceding 6 months.
7. Past history of fracture of a lower extremity within the preceding 6 months.
8. Current treatment for acute trauma.
9. Other reasons determined by the attending physician

pain. We excluded the items regarding pain from factor 1 and 2, and created measured variables reflecting ADL disabilities for SEM analysis. We excluded the items regarding pain and anxiety because the aim of this study was to investigate relation among motor function, psychological concerns, and ADL disability. The variables were named 'housework/locomotion' and 'self-care/mobility' respectively. The items related to housework/locomotion corresponded to the items in domain regarding social activities that were reported as construct structure of GLFS-25 by Seichi et al. [6]. The items related to self-care/mobility corresponded to the items in the domain regarding usual care and movement-related difficulties. We calculated the total score of housework/locomotion and self-care/mobility, and used them as measured variables in SEM analysis (Table 2).

2.7. Psychological assessment

For measuring psychological concerns, we used the following questions:

  i) 'In the last 1 month, how often did you feel depressed?' (Depression).
  ii) 'In the last 1 month, were you bothered by things that you used to do easily?' (Bothersome).
  iii) 'In the last 1 month, did you have occasions to think yourself worthless?' (Worthless).

Participants were given the following response choices to questions i) and iii); 'never' (1 point), 'occasionally' (2 points), 'sometimes' (3 points), 'frequently' (4 points), and 'usually' (5 points). Response choices to question ii) were 'none' (1 point), 'a few' (2 points), 'several' (3 points), 'many' (4 points), and 'great many' (5 points).

Cronbach's alpha for three questions was 0.64.

The questions of 'Bothersome' and 'Worthless' were obtained by reference to 'Kihon check list' for evaluating the elderly people with a risk of requiring nursing care developed by the Japanese Ministry of Health, Labour and Welfare [20]. The 'Kihon check list' was confirmed to be valid for frailty screening [21].

H.M. Chochinov et al. reported that results of answer to a single-item interview ('Are you depressed?') could identify people who was depressed [22]. Additionally, there were the reports that described efficacy of brief screening measure for depression

[23,24]. According to these reports, we considered that those three questions were valid to find people with psychological concerns.

2.8. Statistical analysis

We hypothesized two causal models and tested a goodness of fit using AMOS software for the structural equation modelling (SEM). Data of 306 participants with no missing values were used for SEM analysis.

The first model was that motor function affects ADL disability and ADL disability affects psychological concerns. The second model was that motor function affects psychological concerns and psychological concerns affects ADL disability.

The models included the following three latent variables: 'Motor function', 'ADL disability' and 'psychological concerns' and three measurement submodels. Indicators of latent variable 'Motor function' were records of 'One-leg standing time', 'Leg-extension power' and 'Grip power'. Indicators of 'ADL disability' were the total scores of 'housework/locomotion' and 'self-care/mobility'. Indicators of 'psychological concerns' were the response scores to three questions.

Maximum likelihood estimation was used to estimate the standardized parameters of the model. The fit of the model for the observed data was assessed with the chi-square statistic, root mean square error of approximation (RMSEA), goodness of fit index (GFI), adjusted goodness of fit index (AGFI) and comparative fit index (CFI).

We assessed goodness of fit according to the following criteria: chi-square value greater than 0.05, RMSEA of less than 0.05, GFI, AGFI and CFI with a value above 0.90 indicate a good fit.

The Statistical Package for Social Science (SPSS®, version 20, IBM Inc.) and Amos 20 (IBM Inc.) were used for the statistical analyses.

3. Results

3.1. Characteristics of participant

Participants were 80 in male and 234 in female. Mean age was 75.9 years (SD: 6.3) in men, 77.9 yeas (SD: 8.0) in women (range: 65–93). The diagnoses for these participants were knee osteoarthritis (136), osteoporosis (67), spinal canal stenosis (58), spinal spondylosis (54), and multiple diagnoses (133). Among this participant group, 268 had comorbidity such as hypertension or

Table 2
Factor analysis of 17 questions of the 25-question Geriatric Locomotive Function Scale (GLFS-25) associated with ADL.

Questions of the GLFS-25		Factor 1	Factor 2	Cronbach's alpha
		Housework/Locomotion	Self-care/Mobility	
Q21.	To what extent has it been difficult to perform sports activity?	.821		
Q13.	To what extent has it been difficult to walk briskly?	.777		.901
Q15.	How far can you keep walking without rest?	.765		
Q17.	To what extent has it been difficult to carry objects weighing approximately 2 kg?	.731		
Q18.	To what extent has it been difficult to go out using public transportation?	.711		
Q12.	To what extent has it been difficult to go up and down stairs?	.677		
Q20.	To what extent have load-bearing tasks and housework been difficult?	.640		
Q19.	To what extent have simple tasks and housework been difficult?	.430		
Q16.	To what extent has it been difficult to go out to visit neighbors?	.410		
Q 8.	To what extent has it been difficult to put on and take off shirts?		.820	.882
Q 9.	To what extent has it been difficult to put on and take off trousers and pants?		.797	
Q14.	To what extent has it been difficult to keep yourself neat?		.780	
Q10.	To what extent has it been difficult to use the toilet?		.719	
Q11.	To what extent has it been difficult to wash your body in the bath?		.629	
Q 5.	To what extent has it been difficult to get up from a bed or lie down?		.558	
Q 7.	To what extent has it been difficult to walk inside the house?		.553	
Q 6.	To what extent has it been difficult to stand up from a chair?		.491	

diabetes. The number of participants complaining of low back pain was 212, gluteal pain 44, sciatic pain 44, and knee pain 203. The number of participants who reported severe pain on neck and arm was 6, severe pain on back was 5, severe pain on legs was 6, and severe pain in moving his/her body was 2. The number of participants using LTCI services was 127. Detailed data on participants' characteristics were reported elsewhere [7].

3.2. Distributions of each parameter

3.2.1. Motor function

The mean, SD, and median were 21.7 s. 22.0, 11 for one-leg standing time, 56.5 kg, 31.3, 51 for leg extension power, 20.8 kg, 6.9, and 20 for grip power. The body weight-corrected mean and SD for leg extension power were 1.0 kg and 0.53 kg per kg body weight.

3.2.2. ADL disability

The mean, SD, and median of the GLFS-25 were 23.0, 15.79, and 19.5.

The mean, SD, and median were 11.8, 7.9, and 10.0 for 'housework/locomotion'. The score of 'housework/locomotion' ranged from 1 to 37. The mean, SD, and median were 3.4, 4.1, and 2.0 for 'self-care/mobility'. The score of 'self-care/mobility' ranged from 0 to 20.

Participants who reported difficulty (reported mild or moderate or considerable or extreme difficult) to more than one of self-care/mobility items were 217 (70.9%), housework/locomotion' were 306 (100%) in number. Mean score of participants was larger than the standard values of GLFS-25 that was reported by Seichi et al. [5] suggesting that participants experienced moderate difficulty on ADL.

3.3. Psychological concerns

Participants who felt depressed sometimes, or frequently, or usually were 70 in number (20.5%). The mean, SD, and median score on response to 'Depression' were 1.8, 0.9 and 2.0.

Participants who were bothered by several things, or many things, or great many things were 106 in number (34.0%). The mean, SD, and median score on response to 'Bothersome', were 2.0, 1.0 and 2.0.

Participants who thought themselves as worthless sometimes, or frequently or usually were 36 in number (11.6%). The mean, SD, and median score on response to 'Worthless', were 1.5, 0.8 and 1.0.

3.4. Assessment of causal model

3.4.1. Model 1

Fig. 1 showed the results of SEM analysis for model 1. A single-headed arrow between two circles represents a causal relation. Numerals on arrows represented standardized regression coefficient. Numerals on boxes and circles represented square of the multiple correlation coefficient (R^2). The model fit indices were chi-square = 23.152 (p = 0.081), RMSEA = 0.042, GFI = 0.981, AGFI = 0.955, CFI = 0.987. These fit indices indicated a good fit of the model 1 to the data.

3.4.2. Model 2

The model fit indices for model 2 were chi-square = 84.583 (p < 0.001), RMSEA = 0.119, GFI = 0.935, AGFI = 0.854, and CFI = 0.892. Chi-square probability value was statistically significant and RMSEA was bigger than 0.05, indicating a poor fit of model 2 to the data (Fig. 2).

4. Discussion

ADL disability is main cause of care needs in elderly people. Degree of ADL disability closely related to care-needs for people for LTCI. Relationship between ADL disability and decline of physical capacity in elderly people with Locomotive disorders were reported [25]. Determination of causal relation between ADL disability and psychological concerns may be informative to develop intervention strategy contributing to the control of the rapid increase of LTCI cost.

Causal relationships among physical function, depression, and ADL disability were controversial. Penninx reported the flows from depression to ADL disability [26]. The flows from ADL disability to depression were reported by Gayman et al. [27] and Katt et al. [28].
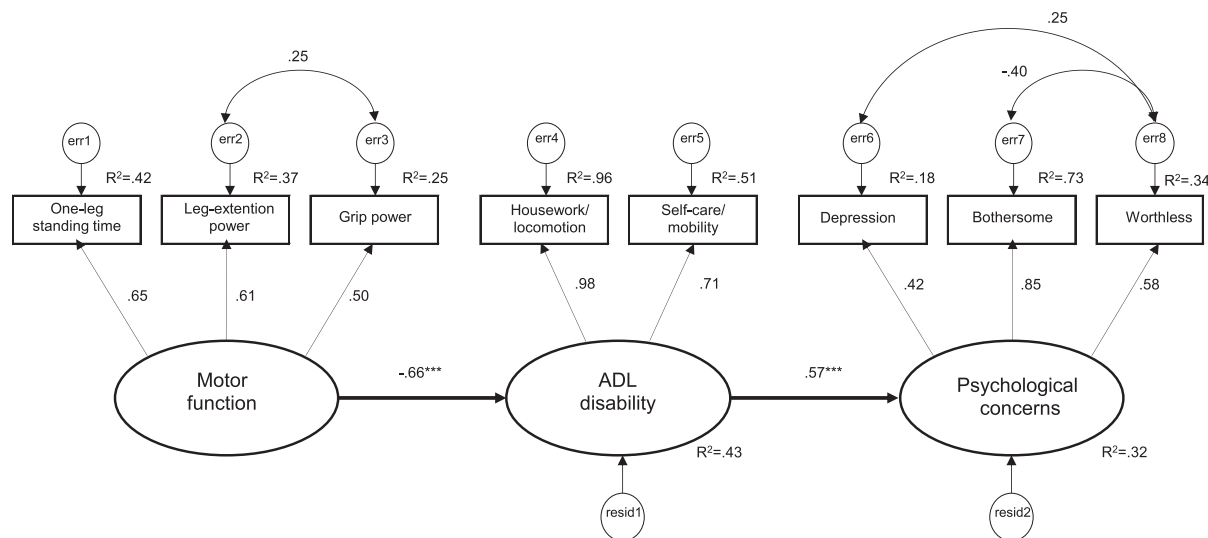
Fig. 1. Results of SEM analysis for model 1. Hypothesis model: Motor function affects ADL disability (standardised regression coefficient = −0.66), and ADL disability affects psychological concerns (standardised regression coefficient = 0.57) in elderly people with locomotive disorders. Chi-square = 23.152, p = 0.081, RMSEA = 0.042, GFI = 0.981, AGFI = 0.955, CFI = 0.987. A single-headed arrow between two circles represents a causal relation. Numerals on arrows represent standardised regression coefficient. Numerals on boxes and circles present square of the multiple correlation coefficient (R2). ***: indicate statistically significant standardised regression coefficient, p < 0.001.
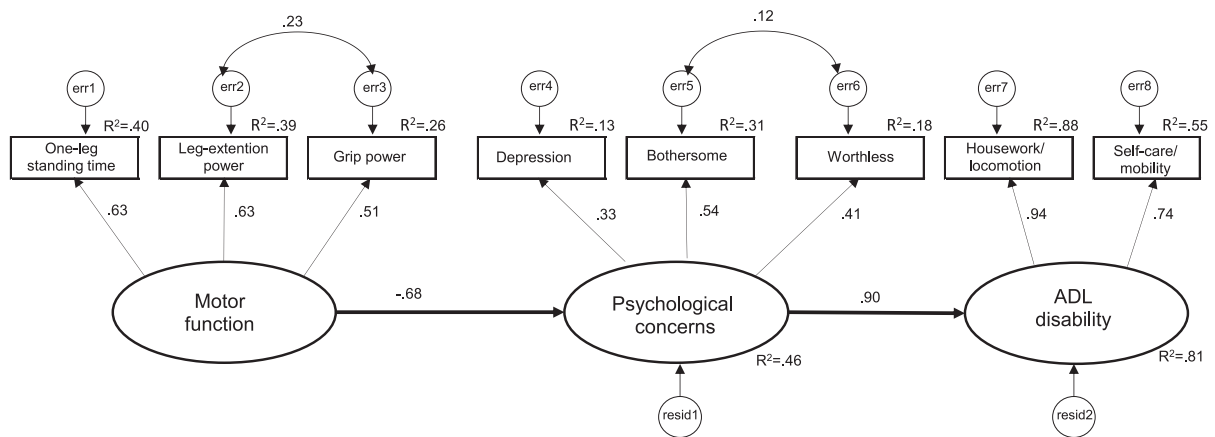
Fig. 2. Results of SEM analysis for model 2. Hypothesis model: Motor function affects psychological concerns and psychological concerns affects ADL disability. Chi-square = 84.583, p < 0.001, RMSEA = 0.119, GFI = 0.935, AGFI = 0.854, CFI = 0.892. Chi-square probability value was statistically significant and RMSEA was bigger than 0.05, indicating a poor fit of model 2 to the data.

Longitudinal studies in which participants were assessed at multiple time-points supported both hypotheses that ADL disability contributes to depression and depression contributes to ADL disability suggesting reciprocal relationship between depression and ADL disability [29,30].

Weil et al. reported the flows from function to depression with physical difficulties to serve as a significant mediator [17]. Results of our study supported the findings reported by Weil et al.

This paper reported the process of development of depression based on cross-sectional study data. The level of psychological concerns at present study may contribute to the level of disability at later follow-up point. There will be occasions that people with ADL disability are more depressed than those without ADL disability and depressed people require more support for ADL than non-depressed people.

Reduction of depression and anxiety may contribute to the prevention of ADL disability and/or slow down the process of deterioration of ADL disability. It is necessary to contain repeated assessment of psychological concerns and ADL disability in treatment regimen for Locomotive disorders.

4.1. Limitations of this study

Our limitations in current study were follows:

Psychological concerns were assessed using 3 questions asking the feeling of depression, worthless, and bothersome with 5 graded responses. Tests of reliability and validity of the set of 3 questions to assess psychological concerns are necessary to generalize the notion obtained from present study.

As analysis was conducted on cross-sectional data of relatively small number, further studies using considerably large numbers of participants are necessary to specify the components or aspects of ADL disability and psychological concerns and to assess the extent to which psychological concerns and physical function contribute to ADL disability.

5. Conclusion

Present study demonstrated the existence of causal relationship among motor function, ADL disability, and psychological concerns in elderly people with locomotive disorders. Reduction of depression and anxiety may contribute to the prevention of disability and/or slow down the process of deterioration of disability. It is necessary to contain repeated assessment of physical function, psychological concerns and ADL disability in treatment regimen for Locomotive disorders.

Conflict of interest

No benefits in any form have been or will be received from any commercial party related directly or indirectly to the subjects of this article. We have no conflict of interest to disclose.

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