

Original Research

## Impaired daily activities of outpatients with diabetic neuropathy

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### Abstract

**Objective:** This study was aimed to clarify relationship between sign, symptom and impaired daily activities with diabetic neuropathy, and to coping with of impaired daily activities. **Methods:** We enrolled 57 outpatients aged 70 years or younger who had diabetes mellitus. We confirm the sign of diabetic neuropathy and data were collected from self-described questionnaires and medical records. Evaluation included Michigan Neuropathy Screening Instrument (MNSI) for diabetic neuropathy sign and symptom and the Japanese language version of Brief Pain Inventory (BPI) for pain (numbness), with impaired daily activities statistical analyses. Patients were allowed to freely describe specific coping or cares against each impaired daily activities due to diabetic neuropathy, which were analyzed qualitatively.

**Results:** Patients with type 2 diabetes had severer symptoms than those with type 1 diabetes, but had similar diabetic neuropathy sign or symptom, or other background. The extents of diabetic neuropathy were but significantly correlated with the scores for general activities, gait ability, normal work, and relations with other people ( $p < 0.05$ ). The symptoms were to moderately correlated with the scores for general activities, mood, gait ability, normal work, sleep, and enjoyment of life ( $p < 0.01-0.05$ ). No solutions against those symptoms were noted in 68.4% of patients. Our results suggest that nurses should evaluate sign, symptoms, and impaired daily activities with diabetic neuropathy, and support patients to cope with those problems together.

**Key words:** diabetic neuropathy, sign, symptom, impaired daily activities

### Introduction

In a status survey involving diabetic patients, the incidence of diabetic neuropathy was 37% ; the value was higher than those of diabetic retinopathy and nephropathy, at 23 and 14%, respectively. Among those in their seventies, it reached 42% (the Journal of Japan Physicians Association, 2001). It reported that chronic neuropathy, mainly manifested as unpleasant numbness, appears earlier than the 2 other major complications of diabetes, and it is observed in approximately 30% of Japanese patients with diabetes (Sato, 2007).

In some cases, early-stage diabetic neuropathy does not cause subjective symptoms, leading to delays in diagnosis and the initiation of treatment. Therefore, the necessity of comprehensively assessing diabetic signs, such as the status of

glucose control, tendon reflexes, and vibratory, tactile, and pressure senses, in addition to subjective symptoms, to determine appropriate treatment and care approaches has been noted (Konya, 2007), although the condition of diabetic neuropathy is not sufficiently assessed based on signs or symptoms in daily medical or nursing care services at present (Honda et al., 2003).

The patients' tendency to report their subjective symptoms on diagnosis only when such symptoms have progressed, and may cause distress, regarding this as preventing early diagnosis, as well as the early initiation of treatment (Hata et al. 2008). As delays in diagnosis, treatment, or the provision of appropriate care may result in serious situations, such as lower-extremity amputation due to gangrene of the foot (Hata et al. 2008 ; Kawano, 2002), foot care to prevent the development of ulcers, infection,

and gangrene of the foot is being promoted. On the other hand, pain and numbness have been reported to influence the overall health status of patients with diabetic neuropathy, covering mobility, self-management, anxiety, and depression (Hoffman, 2010). This indicates the necessity of providing nursing care to address both the physical and mental aspects of health, as diabetic neuropathy interferes with not only patients' physical conditions, but also their psychological states and daily activities. However, up to the present, the management of patients with diabetic neuropathy has been focused on foot care, and the severity of such neuropathy, its influences on patients' daily activities, or the contents of nursing care needed by them have remained unclear.

Regarding the actual conditions of patients with symptoms of diabetic neuropathy, only a limited number of studies revealed the presence of impaired daily activities, including sleep, in approximately 70% of such patients (Akazawa et al. 2001), and a correlation between the degree of neuropathic signs and their QOL (Geets, 2009), without fully clarifying their conditions. In addition, there has been no report examining the severity of diabetic neuropathy based on both signs and symptoms, and indicating correlations among these and impaired daily activities. Patients' behavior to cope with neuropathy has also not been fully examined. Under these circumstances, it may be important to comprehensively assess the severity of diabetic neuropathy based on signs and subjective symptoms, and clarify their relationships with impaired daily activities as a basis for effective nursing care.

## Objective

This study examined patients with diabetic neuropathy to clarify the degrees of their neurological signs and symptoms, relationships among these and impaired daily activities, and detailed methods used by them to manage such symptoms, with a view to obtaining basic data for nursing care to promote understanding of distress in such patients and daily care for them, and improve their QOL (quality of life).

## Methods

### 1. Definition of Terms

1) Patients with diabetic neuropathy: those diagnosed with the disease based on the simplified diagnostic criteria of diabetic poly-

neuropathy, established (Yagihashi, 2002).

- 2) Signs and symptoms of diabetic neuropathy: the former are objectively confirmable, and measured based on the Achilles reflex and vibratory, tactile, and pressure senses, while the latter are represented by subjective pain or numbness.
- 3) Impaired daily activities: a state or degree of disturbance of daily life, interfering with activity areas, such as ⟨moods/emotions⟩, ⟨gait⟩, ⟨usual work⟩, ⟨interpersonal relationships⟩, and ⟨sleep⟩, as well as ⟨enjoying⟩ these activities.

### 2. Subjects

The study involved 57 diabetic patients aged 70 or younger, who had been diagnosed with diabetic neuropathy based on the simplified diagnostic criteria of diabetic polyneuropathy established (Yagihashi, 2002), and were receiving outpatient treatment. All of them were able to appropriately fill in a questionnaire sheet. Patients currently undergoing dialysis or those with proliferative-stage diabetic retinopathy or cerebrovascular disease were excluded.

### 3. Data collection

The patients were introduced by the doctor in charge. With their consent obtained after explanations of the study objective and methods, a questionnaire survey was conducted. Their responses were collected on the spot. Data regarding diabetes treatment and related examination were collected from medical records with cooperation from patients and the study facility.

### 4. Study items and measurement instruments

- 1) Subject backgrounds: the patients' attributes were examined using an original self-administered questionnaire sheet.
- 2) Signs of diabetic neuropathy: they were assessed using the Michigan Neuropathy Screening Instrument (MNSI), developed by the Diabetic Research and Training Center, University of Michigan (2000) to rate the following conditions by giving a score of 0 or 1: changes in the appearance of the foot, such as deformities, dry skin, callus, infection, and fissure; the presence/absence of ulcers; and the Achilles reflex and vibratory, tactile, and pressure senses (monofilament test).
- 3) Symptoms of diabetic neuropathy (levels of pain and numbness) and impaired daily activities: they were assessed using a Japanese version of the BPI (Brief Pain Inventory),

developed by the Pain Research group of the University of Wisconsin (1989) to assess pain and impaired daily activities, and translated into Japanese (Uki et al. 1998). The assessment sheet is filled out by subjects to rate : 8 items related to the levels and sites of pain and numbness and the effects of pharmacotherapy ; and 7 items related to the levels of influence of pain and numbness on daily activities, adopting an 11-level Likert scale from 0 to 10. The scale was used with the permission of the developer of the Japanese version.

- 4) In free-description sections, the patients freely described the details of their impaired daily activities due to diabetic neuropathy, methods to manage them, and demands on medical professionals related to care for such neuropathy.

## 5. Analysis

For statistical analysis, the statistical software SPSS ver. 23 for Windows was used, while setting the significance level at 5 %.

- 1) Descriptive, statistical analysis of the patients' scores related to backgrounds, neurological signs/symptoms, and impaired daily activities was performed to examine their situations.
- 2) The relationships among background factors, neurological signs, and symptoms, between neurological signs and symptoms, and among neurological signs, symptoms, and impaired daily activities were examined using Spearman's rank correlation coefficient, while comparisons between males and females and between the 2 types of diabetes were performed using the Mann-Whitney U test.

- 3) Content analysis was performed to examine the patients' free descriptions regarding their methods to manage their own neuropathic symptoms and demands on medical professionals.

## Ethical Considerations

When requesting the medical institution to cooperate with this study, the person responsible and doctor in charge were provided with explanations of the study objective and methods to obtain their agreement. The patients who cooperated were provided with written and oral explanations of the study objective, methods, and condition ensuring no disadvantageous treatment after refusal or withdrawal. The study was also conducted with approval of the Research Ethics Committee of the Faculty of Nursing, A-University.

## Results

### 1. Subject backgrounds

Table 1 shows subject backgrounds. The mean age of the 57 patients was  $59.6 \pm 7.5$ . Type 1 and 2 diabetes were present in 9 (15.8%) and 42 (73.7%), respectively. The mean disease duration was  $16.7 \pm 9.1$  years. To treat diabetes, all patients were receiving diet therapy, and 55 (96.5%) had also been instructed to perform therapeutic exercise. When focusing on pharmacotherapy, 25 (43.9%) were treated with oral hypoglycemic medications combined with insulin therapy ; while a total of 36 (63.2%) were receiving combination or non-combination insulin therapy, the number of

Table 1 Subject Backgrounds

Item		Mean=SD n (%)	
Attributes	Age	59.6=7.5	
	Sex		
	Male	32 (56.1)	
	Female	25 (43.9)	
Type of diabetes	Type 1	9 (15.8)	
	Type 2	42 (73.7)	
	Unclear	6 (10.5)	
Disease duration (years)		16.7=9.1	
Status of care	Methods of diabetes treatment		
	Diet therapy	Yes 57 (100)	
	Exercise therapy	Yes 55 (96.5)	
	Pharmacotherapy	Oral medications only	21 (36.8)
		Insulin only	11 (19.3)
Oral medications+insulin		25 (43.9)	
Oral medications for neuropathy	Yes	27 (47.4)	
	No	30 (52.6)	
HbA1c		8.2=1.4	
BMI		25.2=4.7	

those treated with oral neuropathy improvers was limited to 27 (47.4%). The mean HbA1c level was  $7.9 \pm 4.7\%$ , revealing poor glucose control, and the mean BMI value was  $25.2 \pm 4.7$ . Among the 27 (47.4%) patients treated with diabetic neuropathy improvers, 19 (70.3%) were using combined or non-combined aldose reductase inhibitors.

**2. Statuses of neurological signs, symptoms, and impaired daily activities, and methods to manage them**

1) Statuses of neurological signs, symptoms, and impaired daily activities

Table 2 shows items and scores related to neurological signs, symptoms, and impaired daily activities.

2) Methods to manage pain and numbness

Table 3 shows the patients' methods to manage their own pain and numbness, represented by: bathing: 7 (12.3%); exercise/stretching: 4 (7%); and electrically warming the feet: 4 (7%). There was also a patient continuously taking oral medications to prevent the deterioration of neuropathic symptoms, while 39 (66.7%) answered that they did not perform any particular management; some of the latter mentioned that they gave up such management, as their symptoms did not improve.

The patients' care-related demands, with the following contents: [seeking explanations of neuropathy]: 5 (19.2%); [wishing to learn about methods of neuropathy treatment]: 5 (19.2%); [wishing to learn about methods to alleviate symptoms]: 5 (19.2%); [wishing to undergo an examination for neuropathy]: 5 (19.2%); and [expecting professional approaches to improve symptoms]: 2 (2.0%).

Table 2 Scores Related to Neurological Signs, Symptoms, and Impaired Daily Activities n=57

	Item	Mean ± SD
Signs	Total MNSI score	6.0 ± 1.5
	Monofilament test score	1.1 ± 0.3
Symptoms	Highest levels of pain and numbness	4.1 ± 2.1
	Lowest levels of pain and numbness	2.8 ± 2.2
	Mean levels of pain and numbness	3.8 ± 1.9
	Currently perceived levels of pain and numbness	3.8 ± 2.2
Areas of impaired daily activities	Overall daily activities	2.2 ± 2.5
	Moods/emotions	1.5 ± 1.8
	Gait abilities	2.7 ± 2.6
	Usual work	2.3 ± 2.7
	Interpersonal relationships	0.9 ± 1.7
	Sleep	2.2 ± 2.6
	Enjoying daily activities	2.2 ± 2.5

Table 3 Methods of Pain and Numbness Management (multiple answers allowed)

Method	Number of persons	%
Bathing	7	12.3
Exercise/stretching	4	7.0
Electrically warming the feet	4	7.0
Self-massage (self-taught style)	3	5.3
Using massage services	3	5.3
Using supporters	1	1.8
Foot care	1	1.8
Dietary improvement	1	1.8
Continuously taking oral medications	1	1.8
Sufficient rest	1	1.8
Nothing in particular	39	68.4

3) Correlations among neurological signs, symptoms, background factors, and the status of care

Neither neurological signs nor symptoms were correlated with the age, history of diabetes, or HbA1c level. In contrast, the BMI was significantly, but weakly correlated with the highest levels of pain and numbness.

On comparison of neurological signs and symptoms, there were no sex differences in related scores. When comparing them based on the type of diabetes, patients with type 2 compared with type 1 diabetes showed markedly higher scores for all symptom-related items. Furthermore, on comparison between those using and not using oral neuropathy improvers, there were no significant differences in sign- or symptom-related scores.

**3. Correlations among neurological signs, symptoms, and impaired daily activities**

The monofilament test did not reveal a significant correlation between neurological symptoms and impaired daily activities. In contrast, MNSI scores related to neurological signs were correlated with ⟨overall daily activities⟩, ⟨gait abilities⟩, ⟨usual work⟩, and ⟨interpersonal relationships⟩.

Regarding the relationship between neuropathic symptoms and impaired daily activities, the highest levels of pain and numbness showed a correlation with ⟨overall daily activities⟩, ⟨gait abilities⟩, ⟨sleep⟩, and ⟨enjoying daily activities⟩. They were also correlated with ⟨moods/emotions⟩ and ⟨usual work⟩. The lowest levels of pain and numbness were only correlated with ⟨enjoying daily activities⟩, while the medium and currently perceived levels of pain and numbness were correlated with ⟨overall daily activities⟩,

Table 4 Comparison of Neurological Signs and Symptoms Based on the Type of Diabetes n=51

Neurological signs and symptoms		Type of diabetes		
		n (%)		p-value
		Type 1	Type 2	
		9 (17.6)	42 (82.4)	
Neurological Signs	MNSI scores	23.29	26.56	n.s.
	Monofilament test values	25.56	26.10	n.s.
Symptoms	Highest levels of pain and numbness	16.44	28.05	0.033
	Lowest levels of pain and numbness	17.00	27.93	0.045
	Mean levels of pain and numbness	15.22	28.31	0.015
	Currently perceived levels of pain and numbness	16.61	28.01	0.035

Mann-Whitney U test  $p < 0.05$ , n. s.=not significant

Table 5 Correlations among Neurological Signs, Symptoms, and Impaired Daily Activities

	Impaired Daily Activities						
	Overall daily activities	Moods/emotions	Gait abilities	Usual work	Interpersonal relationships	Sleep	Enjoying daily activities
Total MNSI score	0.267**	0.034	0.305*	0.299*	0.290*	0.209	0.255
Monofilament test score	0.062	-0.147	-0.045	-0.090	-0.207	-0.047	-0.084
Highest levels of pain and numbness	0.437**	0.286**	0.434**	0.380**	0.258	0.495**	0.446**
Lowest levels of pain and numbness	0.226	0.051	0.194	0.169	0.040	0.193	0.268*
Mean levels of pain and numbness	0.438**	0.107	0.493**	0.411**	0.132	0.398**	0.385**
Currently perceived levels of pain and numbness	0.343**	0.078	0.423*	0.416**	0.058	0.274*	0.405**

Spearman's rank correlation coefficients \*Significance level : 5% (both sides) \*\* Significance level : 1% (both sides)

⟨gait abilities⟩, ⟨usual work⟩, ⟨sleep⟩, and ⟨enjoying daily activities⟩. The symptoms did not show a correlation with ⟨interpersonal relationships⟩ as an area of impaired daily activities (Table 5).

## Discussion

The characteristics of neuropathic signs and symptoms, significance of confirming them, in addition to impaired daily activities, and effective nursing approaches for patients with diabetic neuropathy are discussed as follows :

### 1. Characteristics of neuropathic signs and symptoms

In patients with type 2 diabetes, the degree of neuropathic symptoms was significant, regardless of the level of pain or numbness.

An increased incidence of a reduced/loss of the Achilles reflex when glucose control was poor (Ikeda, 2006). The treatment of diabetic neuropathy is based on the maintenance of strict glucose control from the early stages. In this respect (Hata, 2008), appropriate glucose control may be important for diabetic patients without the onset of neuropathy as a preventive measure.

Further studies are needed, as variations in the severity of neuropathy and status of treatment, as

well as those among individuals, due to differences in the pathological condition of diabetic neuropathy without a clear onset may have influenced the results in a complex manner. Furthermore, the absence of a correlation between neuropathic signs and symptoms indicated that the former do not necessarily represent the degree of the latter.

### 2. Significance of confirming neuropathic signs, symptoms, and impaired daily activities

The patients' subjective symptoms such as pain and numbness are important, as they indicate the presence of neuropathy, but doctors and medical staff should also examine whether such symptoms accurately represent the actual condition of the disease, and, therefore, it is necessary to simultaneously confirm neurological signs and symptoms, and also pay attention to impaired daily activities (Yagihashi, 2007). In the present study, neuropathic signs showed a correlation with ⟨overall daily activities⟩, ⟨gait abilities⟩, ⟨usual work⟩, and ⟨interpersonal relationships⟩. In contrast, symptoms showed a correlation with ⟨overall daily activities⟩, ⟨gait abilities⟩, ⟨sleep⟩, and ⟨enjoying daily activities⟩, and a correlation with ⟨moods/emotions⟩ and ⟨usual work⟩. Interestingly, subjective symptoms reflected ⟨sleep⟩ and ⟨enjoying daily activities⟩, which were not correlated with neuropathic signs as objective

indices, and areas of impaired daily activities other than 〈moods/emotions〉. This supports the significance of assessing neuropathic signs and symptoms, and confirming the presence/absence of impaired daily activities.

### 3. Effective nursing approaches for patients with diabetic neuropathy

#### 1) Comprehensively assessing neurological signs, symptoms, and impaired daily activities

The patients' care-related demands on medical professionals were mainly described as [seeking explanations of neuropathy] and [wishing to undergo the examination of neuropathy], revealing their wish to confirm these items together with medical professionals. The care approaches for some patients, focusing on their physical senses, and reported that they began to pay more attention to such senses, and showed responses, including: observing, touching, examining, and caring for their own bodies, showing them to nurses, perceiving and describing their current physical conditions, and describing their past (Yoneda, 2003). The comprehensive assessment of neurological signs, symptoms, and impaired daily activities by nurses may also be a physical sense-focused care approach. Such care should aim to lead patients, who have given up management, to face and develop an interest in their own bodies.

#### 2) Supporting patients to appropriately cope with their own symptoms and impaired daily activities

Neuropathic symptoms were correlated with 〈sleep〉, 〈overall daily activities〉, and 〈enjoying daily activities〉, suggesting their influences on the quality of patients' daily activities. Therefore, support for appropriate sleep, measures to address gait disturbance in daily activities, and counseling and other commitments to understand distress in daily life may be necessary. The importance of improving patients' skills to cope with the symptoms of diabetic neuropathy, such as using appropriate drugs, including antidepressants, and relaxation techniques (Mann, 2009). However, in the present study, approximately 70% of the patients were not using any measure to address such symptoms. There were also a large number of patients who had given up management, as there had been no improvement through treatment and pharmacotherapy despite their expectation. On the other hand, some of them described their demands on medical professionals as: [wishing to learn about methods of neuropathy treatment], [wishing to learn about

methods to alleviate symptoms], or [expecting professional approaches to improve symptoms], indicating the importance of providing support, such as counseling, to help these patients become able to effectively manage their symptoms and impaired daily activities. In addition, it may be necessary to examine appropriate measures to support medical professionals to: understand the distress faced by patients with diabetic neuropathy in their daily lives; comprehensively assess their conditions together with them; and provide approaches to prevent the development and progression of diabetic complications.

### Conclusion

A questionnaire survey was conducted, involving 57 patients aged 70 or younger and receiving outpatient treatment for diabetes, to examine their neurological test values, neuropathic symptoms (levels of pain and numbness, impaired daily activities, methods to manage such symptoms, and demands on medical professionals. BMI showed a correlation with the highest levels of pain and numbness. On comparison based on the type of diabetes, patients with type 2 compared with type 1 diabetes showed markedly higher symptom-related scores. Regarding the relationships among neurological signs, symptoms, and impaired daily activities, there was no correlation between signs and symptoms, indicating that the former do not necessarily represent the degree of the latter. MNSI scores related to neurological signs were correlated with 〈overall daily activities〉, 〈gait abilities〉, 〈usual work〉, and 〈interpersonal relationships〉, while a correlation was observed between symptoms, excluding the lowest level of pain, and areas of impaired daily activities such as 〈overall daily activities〉, 〈moods/emotions〉, 〈gait abilities〉, 〈sleep〉, and 〈enjoying daily activities〉.

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