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Factors Related to Medication Adherence in Hospitalized Older Patients as Assessed by Acute Care Nurses

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The purpose of this study was to identify factors that influence medication adherence in older patients as assessed by nurses in an acute care hospital in Japan. A total of 3271 nurses with at least 3 years of clinical experience working in an acute care hospital were included in the study. A questionnaire survey was conducted on one case of an older patient for whom the nurses were currently providing medication self-management support. 629 responses were received. The total medication adherence scores of older patients were found to be associated with age, use of neuropsychiatric medications, and caregiver intervention. The subfactors of medication adherence had different influencing factors and were associated with factors such as age, use of neuropsychiatric medications, pharmacist intervention, number of types of medications, and previous diseases.

Keywords: older patients, medication adherence, acute care hospitals, nurse, logistic regression analysis

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INTRODUCTION

Japan has become a hyper-aged society, and national healthcare expenditures are on the rise as the aging population increases. Medication expenses account for 17.8% of national medical expenses [1], and problems related to medication self-management, such as polypharmacy and leftover prescription medicines, have been identified as key issues. Older adults tend to have multiple diseases as they age, with approximately 80.2% of older adults having two or more diseases and 65% having three or more chronic diseases [2]. The number of diseases is strongly correlated with the number of prescribed medications [3], and older adults are more likely to have multiple medications. The greater the number of medications prescribed, the more complicated the multiple uses become for older adults. Medication adherence rates for hospitalized patients are low: 26.4% for those aged 65–74 and 23.7% for those aged 75 and older [4]. This suggests that many older patients have residual medications, making continuous self-management of medications difficult.

When leftover medication accrues, there are concerns about the risk of inadequate therapeutic effects and the occurrence of unexpected adverse events. Older patients forget to take their medications due to mistrust of them or a discrepancy in perception between them and their health care providers [5]. Therefore, it can be inferred that the relationship between older adults and health care providers and the older adults' own intention for treatment have

a significant impact. In order for healthcare professionals to support the self-management of medication by older adults, it is not sufficient to evaluate and support only the improvement of medication compliance. It is necessary to support medication adherence, which expresses the attitude that older adults themselves agree and accept the content of treatment and take on self-administration of medication of their own volition.

There are many factors that influence medication adherence among older adults, such as taking multiple prescription medicines, cognitive decline, health literacy, and the presence of caregivers [6]. Unfortunately, the evaluation indicators of medication adherence used in previous studies have been used synonymously with medication compliance, and the evaluations have been limited to whether or not prescription medicines are left unused and self-interrupted [7]. Therefore, it is necessary to accumulate research on medication adherence, including perspectives on the willingness of older adults and their collaboration with healthcare professionals. In this study, we investigated factors related to medication adherence using a new assessment tool that incorporates these perspectives.

The purpose of this study is to identify factors that influence medication adherence in older patients as assessed by ward nurses in an acute care hospital.

MATERIALS AND METHODS

Study design

This study is an association-validated cross-sectional study design.

Participants

This study included nurses with at least three years of clinical experience working in acute care hospitals with 200 or more beds.

Assessment of medication adherence in older adults requires multifaceted information gathering and assessment. Therefore, we considered nurses with at least 3 years of clinical experience who would be able to formulate a plan and develop nursing care based on their understanding of the current situation and anticipated future situations.

Study Period

November 18, 2019, to March 31, 2022.

Data Collection

Considering bias due to hospital size and region, a research cooperation request letter was sent to nursing departments of randomly selected acute care hospitals in Japan, requesting their cooperation in the study. The research cooperation request documents, questionnaires, and return envelopes were distributed to nurses working in the medical institutions who agreed to participate in the study. The questionnaires were collected by individual mail.

Questionnaires

1) Attributes of nurses

The personal attributes were the number of years of clinical experience of the nurses.

2) Attributes and characteristics of the older patients reported by the nurses

The attributes of the older patients recorded by the nurses were: age, main disease category, number of years with the main disease, and history of the disease.

3) Background on prescription medicines of older patients reported by the nurses

The following data were used: number of medication types, number of medications per day, forms of prescribed medications, use of neuropsychiatric drugs, duration of prescriptions, storage of prescribed medications, and interventions of non-nursing personnel in self-administration of medication.

4) Assessment tool of medication adherence for older adults

We used the "Medication-adherence assessment tool for older adults" [8] developed by Sakane *et al*. This tool consists of 6 factors and 40 items: "active participation in their treatment" (18 items), "stable medication compliance" (5 items), "medication behavior and stable life-style" (6 items), "health control ability with continuous medication" (4 items), "inhibitors of medication self-management" (4 items), and "capability of

medication record management" (3 items). The Cronbach's formula for each factor is as follows. Cronbach's alpha coefficients for each factor ranged from 0.725 to 0.950, confirming reliability, criterion-related validity, and construct validity [8]. The response method was a 5-point rating scale method with a range of 1 to 5.

Note that cases with a diagnosis of dementia and cases in which cognitive decline was clearly interfering with daily and social life were excluded.

Statistical Analysis

Descriptive statistics and frequency distributions of the subject's background, total and subfactor scores of the medication adherence assessment tool for the older adults were calculated. In order to examine the factors related to medication adherence, the total and subfactor scores of the medication adherence assessment tool were divided into two groups based on median values: high group "1" and low group "0". The demographics of the older patients with regard to diseases and medications were also divided into two groups ("1" for high or yes group, and "0" for low or no group), and univariate analysis with the X^2 test was conducted.

Because previous studies have shown that the incidence of adverse events increases with six or more medications [9], the number of medications was divided into two groups with a cutoff point of six medications. Binomial logistic regression analysis (forced entry method) was conducted using the total and subfactor scores from the medication adherence assessment tool as dependent variables, age, and number of medications as well as items for which $p < 0.05$ was obtained in univariate analysis as independent variables. In the analysis, the variance inflation factor was calculated among the items used as independent variables to confirm that there was no multicollinearity. The significance level was set at 0.05. IBM SPSS Statistics 28.0 was used for the analysis.

RESULTS

Participant demographics

Of the 3271 copies distributed, 629 responses were received (19.2% response rate). Of these, 464 data with no missing items in the 40 medication adherence assessment tools were considered valid responses (valid response rate 73.8%). The mean number of years of nursing experience of the subjects was 14.05 ± 9.09 years.

Demographics of the older patients in participants' responses

Table1 shows the demographics of the older patients who were the subjects of the participants' responses. The patients' ages ranged from 65–74 (27.8%), 75–85 (46.1%), and over 85 years old (20.7%). Gastrointestinal diseases were the most common primary diseases (22.8%), followed by cardiovascular diseases (15.7%), and musculoskeletal diseases and disorders (14.2%). The number of years of the main disease was less than 1 year for 43.3% and more than 1 year for 53.9%. A medical history was recorded for 90.1% of the patients, with the highest incidence in cardiovascular diseases (41.6%), followed by gastrointestinal diseases (26.7%) and metabolic diseases (17.9%).

The average number of medication types was 6.59 ± 3.43, and the average number of medications taken per day was 3.14 ± 0.98 times/day. Regarding prescribed oral medications, 98.9% of the patients were taking tablets, 29.7% capsules, and 27.1% dispersions. The percentage of patients using any kind of topical medication was 22.2%. 31.9% of the prescriptions were for a period of 14 days or longer. Regarding storage of prescription medications, 78.0% of the patients used a medicine bag, 15.7% used a pill box, and 9.5% used a medication calendar. Regarding the support system for medication self-administration, 41.4% of the respondents had family intervention, 20.7% had pharmacist intervention, and 3.0% had social worker intervention.

In addition, a chi-square test for the number of types of medications and the age of the older patients showed that the group of 75 years and over took significantly more medications.

Medication Adherence in older patients in participants' responses

The mean total score of the medication adherence assessment tool was 124.25 ± 32.03. For the sub-

Table 1. Demographics of the older patients in participants' responses (N = 464)

	Demographics	n (%)
Age	65-74	129 (27.8)
	≥75	310 (66.8)
	Non-response	25 (5.4)
Main disease(s)	Digestive diseases	106 (22.8)
	Cardiovascular diseases	73 (15.7)
	Musculoskeletal disorders	66 (14.2)
	Cancer	51 (11.0)
	Respiratory diseases	48 (10.3)
	Others	120 (25.9)
	Non-response	15 (3.2)
Number of years affected	<1 year	201 (43.3)
	≥1 year	250 (53.9)
	Non-response	13 (2.8)
Previous disease(s)[1)]	Having some kind of disease	418 (90.1)
	Digestive diseases	193 (41.6)
	Cardiovascular diseases	124 (26.7)
	Metabolic diseases	83 (17.9)
	Musculoskeletal disorders	62 (13.4)
	Respiratory diseases	70 (15.1)
Number of medications taken	≥6	229 (49.4)
	<6	206 (44.4)
	Non-response	29 (6.3)
Dose frequency	1-3 times/day	315 (67.9)
	≥4 times/day	140 (30.2)
	Non-response	9 (1.9)
Medication type[1)]	Taking tablets	457 (98.5)
	Taking capsule medication	137 (29.5)
	Taking powder dispensing	125 (26.9)
Using neuropsychiatric medication	Yes	177 (38.1)
	No	279 (60.1)
	Unknown/no response	8 (1.7)
Prescription period	< a week	310 (66.8)
	≥2 weeks	148 (31.9)
	Non-response	6 (1.3)
Medication storage[1)]	using medicine bag	362 (78.0)
	using pill box	73 (15.7)
	using medication calendar	44 (9.5)
Someone's intervention[1)]	support from pharmacists	96 (20.7)
	support from caregivers	14 (3.0)

Note. 1) Multiple responses

factors, the mean scores were 50.64 ± 16.82 for "active participation in their treatment", 17.04 ± 5.09 for "stable medication compliance", 21.95 ± 5.20 for "medication behavior and stable life-style", 13.44 ± 3.56 for "health control ability with continuous medication", 12.52 ± 4.46 for "inhibitors of medication self-management", 8.67 ± 3.62 for "capability of medication record management".

Factors Associated with Medication Adherence in older patients: Univariate Analysis (Table 2)

Significant differences were found in the total medication adherence scores for seven items. The group with musculoskeletal diseases/disorders as the main disease had a higher percentage of high adherence, while the groups with age, use of neuropsychiatric medications, and longer prescription periods had higher percentages of low adherence in the other categories.

Significant differences were found in the five sub-factors of medication adherence regarding "active participation in their treatment". A higher percentage of patients in the group with pharmacist intervention had higher scores in this subfactor. However, a higher percentage of older patients, those using neuropsychiatric medications, those with longer prescriptions, and those with intervention by social workers had lower scores in this subfactor. Significant differences were found in 6 items in "stable medication compliance". The groups aged 75 years or over, those who had the main disease for more than one year, and those who had a history of respiratory disease had a higher percentage of low scores for this subfactor. In the "medication behavior and stable life-style" group, there were significant differences in 9 items. The groups with musculoskeletal diseases and disorders as the main disease and with pharmacist intervention had a higher percentage of high scores for this subfactor. In the case of "health control ability with continuous medication", significant differences were found in five items. The groups of 75 years and over, those with more than 1 year of illness, and those with a history of respiratory disease had a higher percentage of high scores for this subfactor. Significant differences were found in 4 items in the "inhibitors of medication self-management" category, and in 3 items in

Table 2. Factors associated with medication adherence in older patients: a univariate analysis

Demographics	Medication adherence total score			"active participation in their treatment"			"stable medication compliance"			""medication behavior and stable life-style""			"health control ability with continuous medication"			"inhibitors of medication self-management"			"capability of medication record management"		
	High	Low	p	High	Low	p	High	Low	p	High	Low	p	High	Low	p	High	Low	p	High	Low	p
	n(%)	n(%)		n(%)	n(%)		n(%)	n(%)		n(%)	n(%)		n(%)	n(%)		n(%)	n(%)		n(%)	n(%)	
Age n = 439																					
65-74	85(38.6)	44(20.1)	***	88(40.7)	41(18.4)	***	72(35.8)	57(23.9)	**	72(37.1)	57(23.3)	**	74(35.6)	55(23.8)	**	75(36.9)	54(22.9)	**	77(36.0)	52(23.1)	**
≥75	135(61.4)	175(79.9)		128(59.3)	182(81.6)		129(64.2)	181(76.1)		122(62.9)	188(76.7)		134(64.4)	176(76.2)		128(63.1)	182(77.1)		137(64.0)	173(76.9)	
Main disease n = 449																					
Digestive disease	54(24.4)	52(22.8)	n.s.	58(26.9)	48(20.6)	n.s.	51(24.8)	55(22.6)	n.s.	37(19.1)	69(27.1)	*	43(20.8)	63(26.0)	n.s.	44(21.6)	62(25.3)	n.s.	46(21.3)	60(25.8)	n.s.
Other diseases	167(75.6)	176(77.2)		158(73.1)	185(79.4)		155(75.2)	188(77.4)		157(80.9)	186(72.9)		164(79.2)	179(74.0)		160(78.4)	183(74.7)		170(78.7)	173(74.2)	
Musculoskeletal disorder	40(18.1)	26(11.4)	*	34(15.7)	32(13.7)	n.s.	38(18.4)	28(11.5)	*	37(19.1)	29(11.4)	*	40(19.3)	26(10.7)	*	32(15.7)	34(13.9)	n.s.	36(16.7)	30(12.9)	n.s.
Other diseases	181(81.9)	202(88.6)		182(84.3)	201(86.3)		168(81.6)	215(88.5)		157(80.9)	226(88.6)		167(80.7)	216(89.3)		172(84.3)	211(86.1)		180(83.3)	203(87.1)	
Number of years affected n = 451																					
<1 year	101(45.7)	100(43.5)	n.s.	100(45.7)	101(43.5)	n.s.	102(49.8)	99(40.2)	*	97(50.3)	104(40.3)	*	106(51.5)	95(38.8)	**	96(46.6)	105(42.9)	n.s.	91(41.4)	110(47.6)	n.s.
≥1 year	120(54.3)	130(56.5)		119(54.3)	131(56.5)		103(50.2)	147(59.8)		96(49.7)	154(59.7)		100(48.5)	150(61.2)		110(53.4)	140(57.1)		129(58.6)	121(52.4)	
Previous disease n = 464																					
Digestive disease	58(25.7)	66(27.7)	n.s.	62(27.8)	62(25.7)	n.s.	55(26.2)	69(27.2)	n.s.	40(20.3)	84(31.5)	**	54(25.7)	70(27.6)	n.s.	50(23.8)	74(29.1)	n.s.	57(25.7)	67(27.7)	n.s.
No	168(74.3)	172(72.3)		161(72.2)	179(74.3)		155(73.8)	185(72.8)		157(79.7)	183(68.5)		156(74.3)	184(72.4)		160(76.2)	180(70.9)		165(74.3)	175(72.3)	
Respiratory diseases	25(11.1)	45(18.9)	*	29(13.0)	41(17.0)	n.s.	25(11.9)	45(17.7)	n.s.	18(9.1)	52(19.5)	**	19(9.0)	51(20.1)	***	24(11.4)	46(18.1)	*	28(12.6)	42(17.4)	n.s.
No	201(88.9)	193(81.1)		194(87.0)	200(83.0)		185(88.1)	209(82.3)		179(90.9)	215(80.5)		191(91.0)	203(79.9)		186(88.6)	208(81.9)		194(87.4)	200(82.6)	
Musculoskeletal disorder	29(12.8)	33(13.9)	n.s.	29(13.0)	33(13.7)	n.s.	22(10.5)	40(15.7)	n.s.	28(14.2)	34(12.7)	n.s.	25(11.9)	37(14.6)	n.s.	23(11.0)	39(15.4)	n.s.	17(7.7)	45(18.6)	***
No	197(87.2)	205(86.1)		194(87.0)	208(86.3)		188(89.5)	214(84.3)		169(85.8)	233(87.3)		185(88.1)	217(85.4)		187(89.0)	215(84.6)		205(92.3)	197(81.4)	
Number of medications taken n = 435																					
≥6	111(51.2)	118(54.1)	n.s.	105(49.5)	124(55.6)	n.s.	105(51.5)	124(53.7)	n.s.	105(55.3)	124(50.6)	n.s.	104(51.5)	125(53.6)	n.s.	105(52.5)	124(54.1)	n.s.	110(51.2)	119(54.1)	n.s.
<6	106(48.8)	100(45.9)		107(50.5)	99(44.4)		99(48.5)	107(51.9)		85(44.7)	121(49.4)		98(48.5)	108(46.4)		95(47.5)	111(47.2)		105(48.8)	101(45.9)	
Dose frequency n = 455																					
1-3 times/day	158(70.2)	157(68.3)	n.s.	158(71.5)	157(67.1)	n.s.	153(73.2)	162(65.9)	n.s.	137(70.3)	178(68.5)	n.s.	144(69.2)	171(69.2)	n.s.	152(73.8)	163(65.5)	n.s.	59(26.8)	154(65.5)	n.s.
≥4 times/day	67(29.8)	73(31.7)		63(28.5)	77(32.9)		56(26.8)	84(34.1)		58(29.7)	82(31.5)		64(30.8)	76(30.8)		54(26.2)	86(34.5)		161(73.2)	81(34.5)	
Using neuropsychiatric medications n = 456																					
yes	68(30.5)	109(46.8)	***	73(33.2)	104(44.1)	*	57(27.4)	120(48.4)	***	59(29.9)	118(45.6)	***	72(34.8)	105(42.2)	n.s.	64(30.6)	113(45.7)	***	74(33.5)	103(43.8)	*
no	155(69.5)	124(53.2)		147(66.8)	132(55.9)		151(72.6)	128(51.6)		138(70.1)	141(54.4)		135(65.2)	144(57.8)		145(69.4)	134(54.3)		147(66.5)	132(56.2)	
Prescription period n = 437																					
< a week	163(75.5)	147(66.5)	*	162(75.3)	148(66.7)	*	155(77.5)	155(65.4)	**	139(73.9)	171(68.7)	n.s.	151(75.1)	159(67.4)	n.s.	139(70.2)	171(71.5)	n.s.	150(71.1)	160(70.8)	n.s.
≥2 weeks	53(24.5)	74(33.5)		53(24.7)	74(33.3)		45(22.5)	82(34.6)		49(26.1)	78(31.3)		50(24.9)	77(32.6)		59(29.8)	68(28.5)		61(28.9)	66(29.2)	
Medication storage n = 461																					
using medicine bag	181(80.4)	181(76.7)	n.s.	177(79.7)	185(77.4)	n.s.	166(79.4)	196(77.8)	n.s.	153(78.1)	209(78.9)	n.s.	162(77.5)	200(79.4)	n.s.	168(80.0)	194(77.3)	n.s.	176(79.6)	186(77.5)	n.s.
no	44(19.6)	55(23.3)		45(20.3)	54(22.6)		43(20.6)	56(22.2)		43(21.9)	56(21.1)		47(22.5)	52(20.6)		42(20.0)	57(22.7)		45(20.4)	54(22.5)	
using medication calendar	15(6.7)	29(12.3)	*	16(7.2)	28(11.7)	n.s.	13(6.2)	31(12.3)	*	15(7.7)	29(10.9)	n.s.	14(6.7)	30(11.9)	n.s.	12(5.7)	32(12.7)	*	20(9.0)	24(10.0)	n.s.
no	210(93.3)	207(87.7)		206(92.8)	211(88.3)		196(93.8)	221(87.7)		181(92.3)	236(89.1)		195(93.3)	222(88.1)		198(94.3)	219(87.3)		201(91.0)	216(90.0)	
Someone's intervention n = 464																					
support from pharmacists	55(24.3)	41(17.2)	n.s.	57(25.6)	39(16.2)	*	51(24.3)	45(17.7)	n.s.	50(25.4)	46(17.2)	*	54(25.7)	42(16.5)	*	50(23.8)	46(18.1)	n.s.	49(22.1)	47(19.4)	n.s.
no	171(75.7)	197(82.8)		166(74.4)	202(83.8)		159(75.7)	209(82.3)		147(74.6)	221(82.8)		156(74.3)	212(83.5)		160(76.2)	208(81.9)		173(77.9)	195(80.6)	
support from caregivers	2(0.9)	12(5.0)	**	3(1.3)	11(4.6)	*	4(1.9)	10(3.9)	n.s.	2(1.0)	12(4.5)	*	4(1.9)	10(3.9)	n.s.	3(1.4)	11(4.3)	n.s.	5(2.3)	9(3.7)	n.s.
no	224(99.1)	226(95.0)		220(98.7)	230(95.4)		206(98.1)	244(96.1)		195(99.0)	255(95.5)		206(98.1)	244(96.1)		207(98.6)	243(95.7)		217(97.7)	233(96.3)	

Note. All items were chi-square tested. *p < 0.05, **p < 0.01, ***p < 0.001, n.s. = Not Significant
Responses that answered "no" or "unknown" were treated as missing values for each item, and percentages were calculated by excluding missing values.
Only items with significant differences are selected.

the "capability of medication record management" category.

Factors Associated with Medication Adherence in older patients: Multivariate Analysis (Table 3)

Factors associated with total medication adherence scores were age (OR = 0.40, 95%CI: 0.24–0.65), neuropsychiatric drug use (OR = 0.57, 95%CI: 0.36–0.89), and social worker intervention (OR = 0.17, 95%CI: 0.04–0.84). The subfactor "active participation in their treatment" was associated with age (OR = 0.33, 95%CI: 0.20–0.53) and pharmacist intervention (OR = 1.97, 95%CI: 1.16–3.36). The "stable medication compliance" was associated with age (OR = 0.58, 95%CI: 0.36–0.93) and use of neuropsychiatric drugs (OR = 0.47, 95%CI: 0.30–0.75). The "medication behavior and stable life-style" was associated with age (OR = 0.52, 95%CI: 0.32–0.83), number of medications (OR = 1.62, 95%CI: 1.03–2.54), history of respiratory disease (OR = 0.42, 95%CI: 0.22–0.81) and use of psychoneurotic drugs (OR = 0.53, 95%CI: 0.075). The results showed that the use of neuropsychiatric drugs (OR = 0.53, 95%CI: 0.34–0.84) was associated with the use of neuropsychiatric drugs. The "health control ability with continuous medication" was associated with age (OR = 0.54, 95%CI: 0.34–0.85), history of respiratory disease (OR = 0.50, 95%CI: 0.27–0.92), and pharmacist intervention (OR = 1.83, 95%CI: 1.09–3.07). The "inhibitors of medication self-management" were associated with age (OR = 0.59, 95%CI: 0.38–0.93), neuropsychiatric drug use (OR = 0.54, 95%CI: 0.35–0.82), and "capability of medication record management" (OR = 0.54, 95%CI: 0.34–0.84), and history of musculoskeletal disease and disability (OR = 0.35, 95%CI: 0.19–0.67).

DISCUSSION

1. Background on prescribing for older patients supported by acute care nurses

The results of this study showed that 49.4% of the older patients supported by nurses in acute care hospitals were taking six or more types of medication, accounting for about half of the total number of patients. According to Japanese statistical data, 26.2% of patients aged 65 years or over receiving

Table 3. Factors associated with medication adherence in older patients: a multivariate analysis

Dependent variable	Independent variable	β	Odds Ratio	95% Confidence Intervals		p
				lower limit	upper limit	
Medication adherence total score	Age 75+	-0.93	0.40	0.24	0.65	***
	Using neuropsychiatric medications	-0.56	0.57	0.36	0.89	*
	Support from caregivers	-1.75	0.17	0.04	0.84	*
"active participation in their treatment"	Age 75+	-1.12	0.33	0.20	0.53	***
	Support from pharmacists	0.68	1.97	1.16	3.36	*
"stable medication compliance"	Age 75+	-0.55	0.58	0.36	0.93	*
	Using neuropsychiatric medications	-0.74	0.47	0.30	0.75	**
"medication behavior and stable life-style"	Age 75+	-0.66	0.52	0.32	0.83	**
	Taking more than 6 medications	0.48	1.62	1.03	2.54	*
	History of respiratory disease	-0.86	0.42	0.22	0.81	**
	Using neuropsychiatric medications	-0.63	0.53	0.34	0.84	**
"health control ability with continuous medication"	Age 75+	-0.62	0.54	0.34	0.85	**
	History of respiratory disease	-0.70	0.50	0.27	0.92	*
	Support from pharmacists	0.60	1.83	1.09	3.07	*
"inhibitors of medication self-management"	Age 75+	-0.52	0.59	0.38	0.93	*
	Using neuropsychiatric medications	-0.62	0.54	0.35	0.82	**
"capability of medication record management"	Age 75+	-0.62	0.54	0.34	0.84	**
	History of musculoskeletal disorders	-1.04	0.35	0.19	0.67	**

Note. Binomial logistic regression analysis (forced entry method) was performed. *p < 0.05, **p < 0.01, ***p < 0.001
Responses that answered "no" or "unknown" were excluded from the analysis.
Only items with significant differences are selected.

in-hospital prescriptions were taking six or more prescription medications, which was significantly higher than the result of this study. It has been reported that the frequency of adverse events increases significantly when the number of medications exceeds six [9], and it can be inferred that half of the cases selected for this study were in a situation where the risk of adverse events was high.

The use of neuropsychiatric drugs accounted for 38.1% of all cases. It has been reported that 62.7% of inpatients in acute care wards have insomnia, and that prescription rates for sleeping pills and anti-anxiety drugs increase in parallel with age and number of comorbid physical illnesses in both men and women [10]. The Guidelines for Safe Pharmacotherapy of Older Adults 2015 [11] suggests that neuropsychiatric agents such as benzodiazepines, tricyclic antidepressants, and Parkinson's medications should be administered with particular caution to the older adults aged 75 and older. Especially with benzodiazepines, adverse events include falls and cognitive dysfunction, which are more likely to occur in older adults. [12].

Therefore, it can be inferred that older patients for whom nurses in acute care hospitals provide medication self-management support are often at high risk for adverse events and drug interactions caused by prescription medications.

2. Factors affecting medication adherence of older patients in hospital

The results of this study showed a negative association, with an odds ratio of about 0.4 times higher for the 75 years old and above age group than for the high medication adherence total score group. This is because as people get older, the number of types of medications they take increases, and cognitive, physical, and sensory functions decline, making self-management of medication difficult. Similarly, the odds ratio was about 0.6 times higher in the group using neuropsychiatric medications. Previous studies have also indicated that age [13], sleep disorder [14], and benzodiazepine use [15] were negatively associated with medication adherence, supporting the results of previous studies. Age and neuropsychiatric medications use were also negatively associated with a number of subfactors, including "stable medication compliance" and "inhibitors of medication self-management" as well. A significantly higher percentage of patients aged 75 years and older were taking 6 or more medications, suggesting a higher risk of drug-related adverse events. Furthermore, in cases where social workers intervene in the medication self-management of the older patients, it can be inferred that they have been provided with enhanced support, such as medication confirmation and medication setting, prior to their hospitalization. Therefore, it can be assumed that the group with pharmacist intervention had higher scores for "active participation in their treatment".

The subfactor "active participation in their treatment" indicates an attitude of active participation in treatment based on collaboration with healthcare professionals. Factors associated with high scores on this factor, besides age, were about 2.0 times the odds ratio in the pharmacist intervention group. The hospital pharmacist checks the patients' prescription and the medications they bring and meets with them to provide explanations and guidance regarding their medications [16]. In the pharmacist intervention group, the pharmacist provides more detailed explanations of prescription medications, which may help older patients acquire knowledge about medication and be convinced of the treatment plan and may also enhance their approach to treatment motivation. In addition, several previous studies have reported that pharmacist intervention improves medication adherence in older patients [17] [18]. Therefore, it is likely that scores for "active participation in their treatment" were higher in the group in which pharmacists intervened.

The "medication behavior and stable life-style" factor includes the ability to open medication packets, unpack, swallow, and have a stable lifestyle, which are fundamental to maintaining and improving medication adherence. In addition to age and use of neuropsychiatric medications, factors associated with this factor were about 1.6 times greater odds ratio for those taking a large number of medications and about 0.4 times greater odds ratio for those with a history of respiratory disease. Several previous studies have reported that multiple medications are a factor that decreases adherence [19-21]. On the other hand, however, some studies have reported

that a higher number of medications is associated with higher adherence [22], and previous studies have not been consistent. In this study, we hypothesized that the higher scores in the group with a larger number of medication types were because in many cases, older patients had a stable lifestyle and maintained the ability to open medication packets and swallow medications. On the other hand, in cases where there are some problems with medication behavior or lifestyle and social support systems, we assume that the health care providers reduce the number of medication types to facilitate medication self-management.

"Health control ability with continuous medication" is a factor that reflects the stability of symptoms and values that reflect the disease state and the match between life and medication therapy. Factors associated with a high score group for this factor, in addition to age, were about 0.5 times higher odds ratio in the group with a history of respiratory disease and about 1.8 times higher odds ratio in the group with pharmacist intervention. In adult asthmatics, the study reported that 70.5% of patients reported that their control worsened due to some seasonal condition [23]. In addition, in respiratory diseases, prescriptions include inhalers and pastes, and it is inferred that many patients self-administer medications, including such topical medications, over a long period of time. These results suggest that patients with respiratory disease often have difficulty controlling their symptoms, even if they maintain a certain level of medication adherence.

In the "capability of medication record management", the factors included managing prescription history by using a medication handbook and keeping records of physical condition and medication use. In addition to age, factors associated with this high group were about 0.4 times the odds ratio in the group with a history of musculoskeletal disease or disorder. It is assumed that many of those with a history of musculoskeletal disease or disability have reduced ADLs, including the ability to get up and move around. Therefore, it is thought that older patients with a low level of independence are more likely to have difficulty managing medication records. Furthermore, compared to chronic diseases of the circulatory system, such as hypertension, and metabolic diseases (including diabetes and dyslipidemia), it is considered that many cases do not require continuous record keeping because numerical values reflecting symptoms, such as blood pressure values and laboratory data, are not available.

Regarding the association between disease and medication adherence, older patients with a history of respiratory disease had lower medication adherence subfactor scores, while those with musculoskeletal disorder had higher scores. On the other hand, no significant associations were found among patients with cardiovascular, gastrointestinal, or metabolic diseases. Among the older patients included in this study, the percentage of patients suffering from multiple diseases exceeded 90%. In addition, gastrointestinal, cardiovascular, and metabolic diseases were more prevalent. Therefore, it was inferred that the characteristics of medication adherence by disease were less likely to be reflected.

Analysis between the two variables with total medication adherence scores and subfactor scores as dependent variables also showed significant associations between other factors such as primary disease, years of illness, and duration of prescription. However, these did not show significant odds ratios. It can be interpreted that these factors, although interrelated, were not direct factors.

3. Nursing support to maintain and improve medication adherence in the older patients

The results of this study revealed a variety of associated factors that influence medication adherence. We believe that risk prediction based on nurses' assessment is important to maintain and improve total and subfactor scores of adherence in older patients and to contribute to patient outcomes. Especially in cases over 75 years old or using neuropsychiatric medications, total scores and many subfactor scores tend to be lower. So, in cases where the relevant factors indicated in the results of this study apply, it is important for nurses to provide support for medication self-management after discharge, given the high risk of difficulties in continuing medication self-management.

A limitation of this study is that it is a cross-sectional study, which does not allow comparison of changes in medication adherence over time, includ-

ing from pre-hospitalization to post-discharge. In addition, recall bias may have occurred because nurses at the acute care hospital responded by recalling one older patient with whom they were currently involved in medication support.

When nurses support older patients taking neuropsychiatric medications, drug-induced adverse events and drug interactions may occur due to impaired liver and kidney function and multiple medications. Therefore, it is important to conduct a physical assessment of the patient to ensure that there are no signs of this. In addition, it is important to support in terms of medication behavior, compliance, motivation, according to the factors impeding medication self-management.

CONCLUSION

1. The total medication adherence scores of older patients who were involved in medication support by nurses in medical institutions were associated with age, use of neuropsychiatric medications, and intervention by social workers.
2. The subfactors of medication adherence had different influencing factors and were associated with factors such as age, use of neuropsychiatric medications, pharmacist intervention, number of types of medications, and history of medication use.

Ethical Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki. In addition, this study was approved by the Ethics Committee for Nursing Research of Shimane University School of Medicine (Approval No. 344).

Author Contribution

All authors contributed to the study conception, and data collection and analysis were performed by Kanako Sakane. The draft of the manuscript was written by Kanako Sakane. And all authors commented on the manuscript. All authors read and approved the final manuscript.

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Conflict of Interest

All authors confirm that there are no conflicts of interest to declare.

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