《 Original Article 》

Factors influencing adherence to medication based on questionnaire survey

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Over the past few years, home medical care and chemotherapy on an outpatient basis have been promoted, and pharmacists at community pharmacies are being asked to strictly manage patient adherence to their medication. The current study examined "factors that influence adherence to medication" as a potential source of information for use in clinical settings.

Patients visiting community pharmacies were surveyed and their responses were analyzed. Responses were simply tallied and univariate analysis was performed to examine factors related to the attitudes of patients who failed to take their medication. Several significant variables were identified, so multiple logistic regression analysis of these significant variables was performed.

Of the respondents, 33.7% answered that they failed to take their medication at least once a month. Results revealed that dining out, having a job, and the number of medication types one was taking led to decreased adherence to medication. Results suggested that pharmacists need to routinely collect information regarding these factors through interviews or an initial patient questionnaire.

1 Introduction

Over the past few years, home medical care has expanded and chemotherapy (including that involving oral anticancer drugs) is increasingly being administered on an outpatient basis. As a result, drug therapy has shifted from medication administered during hospitalization to medication administered on an outpatient basis. According to a rough estimate, the cost of medication left by patients who forget to take it or who fail to take all of that medication amounts to about 50 billion yen per year[1]. In order to organize medications and reduce medical expenses, the medical fee that

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was revised in 2012 explicitly states that patients be asked about remaining medications as part of management of medication history and providing instructions on taking medication. This stipulation reaffirms the pharmacist's expert role in ensuring adherence to medication.

 Community pharmacies collect information from customers through interviews or, if this is the customer's first visit, an initial patient questionnaire. However, there is no prescribed form for the initial patient questionnaire, and a report have noted that medication history is not adequately assessed in light of requirements that must be met when pharmacists charge a fee for management of medication history and providing instructions on taking medication. Thus, the Japan Pharmaceutical Association has published a sample initial patient questionnaire[2]. Among the questions regarding meals, the sample form only asks "Do you take meals regularly?" and specific foods (e.g. grapefruit juice, natto, alcohol, and coffee). And it does not ask about meal frequency or dining out.

 Previous studies on adherence to medication have cited several factors that decrease adherence, including adverse reactions, frequent doses, and taking numerous medications[3-8]. Moreover, studies have also revealed that conditions at work and meal consumption (or lack thereof) also influence adherence to medication[9].

 The aim of this study was conducted to examine the hypothesis that "the dietary habits or working conditions of patients are related to adherence to medication" and to investigate the factors that influence adherence to medication, i.e. reasons for failing to take one's medication. Moreover, this study examined issues with conventional interviews and initial patient questionnaires.

2 Materials and Methods

1. Subjects and methods

 Data from a survey were used. The survey was conducted at 10 pharmacies that take National Health Insurance throughout Kanagawa Prefecture. In principle, the survey is conducted every 6 months to gauge patient satisfaction and to improve the ability of pharmacy personnel to provide instructions on taking medication.

 The survey was conducted from February 12 to 28, 2013. The survey took 1 hour and was conducted during non-peak hours so as to avoid interrupting outpatient services. New patients would need to fill out an initial patient questionnaire; given the imposition that the survey would place on them, new patients were excluded. Only returning patients served as potential subjects. Potential subjects were asked to participate in this study; those who consented were given the questionnaire, which they completed while waiting to have their prescription filled. To ensure completely voluntary cooperation, the questionnaire was anonymous.

2. Items studied

 The items studied are shown in Table 1.

Table 1   Items studied and tallying of responses

Items		Respondents or median	(maximum-minimum)
1. Attribute of respondents			
a) Sex (n=372)	male	184	
b) Age groups (n=384)	< 20 years old	2	
	20s	13	
	30s	21	
	40s	48	
	50s	57	
	60s	130	
	70s	84	
	≥ 80 years old	29	
c) Presence or absence of job (n=348)	presence	167	
d) Number of medication types (n=361)		3	(0-21)
2. Meals			
a) Frequency of meals per day (n=369)		3	(1-4)
b) Presence or absence of dining out per week (n=364)	presence	222	
3. The attitudes of patients who failed to take medications			
a) Frequency of failed to take medications (n=383)	none	175	
	once a year	34	
	once every 2-3 months	45	
	once or twice a month	79	
	once or twice a week	40	
	three or four times a week	6	
	five or six times a week	0	
	once daily	4	
b) Reasons or conditions for failing to take medications (n=245)	having no symptoms	33	
	lack of meal	9	
	forgetting to bring medications	41	
	seeing someone when taking medication	0	
	poor physical condition	5	
	feeling burdened	2	
	carrying no water	2	
	drinking alcohol	5	
	complicated method of medication administration	1	
	frequent need to take the medication	0	
	many types of medications	2	
	difficulty in administering the medication	0	
	forgot inadvertently	109	
	not realizing the necessity to take medication	2	
	putting off taking medications	34	
4. Dispensed medication that is currently taken			
a) Understanding dosage and administration method (n=377, multiple answer)	have it memorized	310	
	refer to drug information sheet	89	
	refer to drug envelope	107	
	using mobile phone	5	
	refer to medicine notebook	30	
	relying on the understanding of others	20	
b) Number of administrations (n=364)	once a day	114	
	twice a day	99	
	three times a day	142	
	four times a day	9	
	five times a day	0	
c) When to take medicines (n=367, multiple answer)	right after waking up	22	
	in the morning	329	
	in the afternoon	143	
	in the evening	250	
	at bedtime	106	
	as needed	15	
d) Time to take medicines (n=358, multiple answer)	before meals	36	
	right before meals	9	
	right after meals	16	
	after meals	329	
	2 hours after meals	9	

3. Examining factors related to the attitudes of patients who failed to take their medication

In order to examine factors related to the attitudes of patients who failed to take their medication, patients were classified depending on the frequency or infrequency of adherence to their medication. Patients who "properly took their medication," those who "failed to take their medication once a year," and those who "failed to take their medication once every 2–3 months" were classified as "patients who adhered to their medication." Patients who frequently failed to take their medication (including those who failed to take their medication "1–2 times a month") were classified as "patients who failed to adhere to their medication." This classification was based on the calculation that showed that achieving adherence to medication (95% or higher) in patients taking anti-HIV agents[10], which typically require a high level of adherence to medication. At the lowest daily dosage of once a day, a patient is allowed to forget to take his or her medication once a month. Patients were scored from 1–8 points based on 8 age groups (under the age of 20, 20s, 30s, 40s, 50s, 60s, 70s, and age 80 or older). The frequency distribution of scores was tested for normality. If it was not normal, then scores were converted into binary data, i.e. scores above and below the median score, and those data were analyzed. The number of times one dined out per week was analyzed as the presence or absence of dining out. Data were statistically processed in accordance with the following procedures.

Univariate analysis was performed with the attitudes of patients who often failed to take their medication serving as a response variable and respondent characteristics and other responses serving as explanatory variables. The significance level was less than 0.05.

JMP®11.2 (SAS Institute) was used to statistically analyze data in this study.

4. Identifying factors related to the attitudes of patients who failed to take their medication

Confounding factors were excluded. When univariate analysis identified several significant variables, procedures were followed to identify trends common to patients who often failed to take their medication. Multiple logistic regression analysis using a stepwise procedure (forward selection: selection criterion: $p<0.25$) was performed with significant variables serving as explanatory variables.

JMP®11.2 (SAS Institute) was used to statistically analyze data in this study.

5. Privacy considerations

In order to safeguard the personal information of respondents to this survey, the questionnaire was anonymous. Moreover, a confidentiality agreement was concluded when information was disclosed to joint research institutions. Subjects were informed in writing that they could not be individually identified from their responses and that their responses would not be disclosed to their primary physician.

3　Results

1. Tallying of responses

Three hundred and eighty-four questionnaires were distributed and 384 were returned, for a response rate of 100%. Tallies of questionnaires are shown in Table 1, Fig. 1 and Fig. 2. Respondents

consisted of an almost even number of males and females. The median score for the age group was 6 points (60s), so the frequency distribution was not normal. Respondents who were working almost equaled those who were not working. Respondents were taking a median of 3 medication types (minimum: 0 types, maximum: 21 types). Twenty-five to 75% of respondents were taking 2–5 medication types, and the mode was 2 medication types. Kurtosis was 5.9 (so it exceeded 3) and skewness was 1.7. Outliers were present at higher values, and the distribution may have been biased. Of the 384 total respondents, 66.1% (254 respondents) were "patients who adhered to their medication." The most frequent reason or circumstance for failing to take one's medication was "forgetting to take medications inadvertently" (28.4%, 109 respondents), followed by "forgetting to bring medications" (10.7%, 41 respondents), and "putting off taking medications" (8.9%, 34 respondents).

When asked about how well they understood the dosing and dose of the medication they were taking, the vast majority of respondents (80.1%, 310 respondents) answered that they "have it memorized" while 27.9% (107 respondents) answered that they "refer to drug envelope". Thirty-seven percent of respondents (142 respondents) were taking medication "three times a day" while 29.7% (114 respondents) were taking medication "once a day". The timing of medication was most often "in the morning", and medication was most often taken "after meals".

2. Examining factors related to the attitudes of patients who failed to take their medication
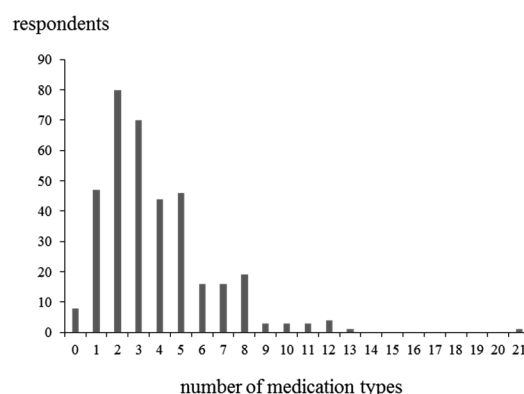

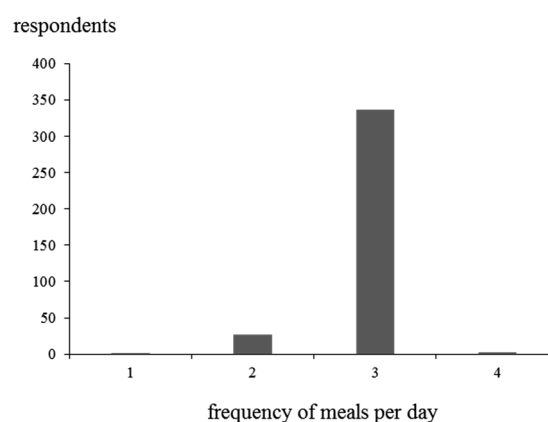Fig. 1   Number of medication types

Fig. 2   Frequency of meals per day

Results of examining factors related to the attitudes of patients who failed to take their medication are shown in Table 2 and Fig. 3. Significant differences in responses to 4 items with nominal scales—age group ($p=0.0185$), the presence or absence of working ($p=0.0002$), taking medication before bed ($p=0.0489$), and the presence or absence of dining out ($p=0.0005$)—were noted (Table 2). Responses regarding number of medication types on a continuous scale yielded a regression equation as shown in Fig. 3. The regression coefficient was negative, so patients taking numerous medication types were less likely to fail to take their medication. Testing of the model overall resulted in $p=0.0007$, so the regression

equation was significant.

In other words, univariate analysis revealed that individuals who realized that they had failed to take their medication tended to be younger, they tended

Table 2　The relationship between the presence or absence of adherence to medication and items studied (these were significantly different items in univariate analysis)

Items		Adherence to medication		χ^2-value	p-value
		Poor (n=129)	Good (n=254)		
Age group (median score 6)	≧ score 6 (60s)	71	171	5.550	0.0185 *
	＜ score 6 (60s)	58	83		
	non-respondent	0	0		
Presence or absence of job	presence	73	93	14.10	0.0002 ***
	absence	45	136		
	non-respondent	11	25		
When to take medicines: at bedtime	presence	28	78	3.88	0.0489 *
	absence	97	164		
	non-respondent	4	12		
Presence or absence of dining out per week	presence	93	129	11.98	0.0005 ***
	absence	34	107		
	non-respondent	2	18		

Chi-square test
*p<0.05, ***p<0.001 : Statistically significant differences between the preparations.

Items	Estimate	Standard error	χ^2-value	p-value
Segment	-0.088	0.207	0.18	0.6703
Number of medication types	-0.164	0.052	10.08	0.0015 **

Whole model test: χ^2-value=11.58, p-value=0.0007
**p<0.01 : Statistically significant differences between the preparations.
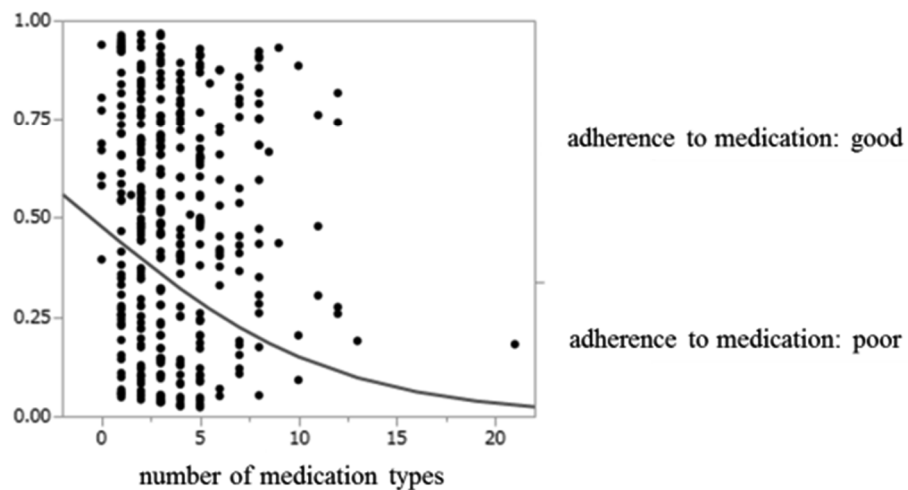Logit(p) = -0.088 - 0.164 × number of medication types

Fig. 3　The relationship between the presence or absence of adherence to medication and items studied (these were significantly different items in univariate analysis)

to work, they tended to take fewer number of medication types, they tended to take that medication before bed, and they tended to dining out at least once a week.

3. Identifying factors related to the attitudes of patients who failed to take their medication

Univariate analysis identified 5 significant variables (age group, the presence or absence of working, number of medication types, taking medication before bed, and the presence or absence of dining out). In order to identify factors

negative slope had on results was determined. In addition, the values represented the degree of influence. Estimates for dining out more than once weekly and working were positive, so individuals who dining out at least once a week, individuals who worked, failed to take their medication. In contrast, the estimate for the number of medication types was negative, so individuals taking fewer number of medication types failed to take their medication.

Odds ratios revealed that individuals who dining out at least once a week were about 2.2 times (odds

Table 3   Results of stepwise regression analysis

Factor	Parameter estimates				Odds ratio	95% Confidence interval
	Estimate	Standard error	χ^2-value	*p*-value		
Presence or absence of dining out per week (1: presence)	0.390	0.134	8.46	0.0036 **	2.18	(1.30-3.72)
Presence or absence of job (1: presence)	0.338	0.126	7.16	0.0074 **	1.97	(1.20-3.24)
Number of medication types	-0.139	0.057	6.04	0.0140 *	0.87	(0.77-0.97)
Segment	-0.208	0.234	0.79	0.3736		

**p<0.01, *p<0.05: Statistically significant differences between the preparations.

> Whole model test: χ^2-value=28.98, *p*-value<0.0001
> LOF (Lack of Fit): χ^2-value=52.78, *p*-value=0.1230
> Area under the ROC (receiver operating characteristics) curve=0.672

related to the attitudes of patients who failed to take their medication, multiple logistic regression analysis using a stepwise procedure was performed with those 5 variables as explanatory variables, and results are shown in Table 3. Significant differences in the presence or absence of dining out (result of a chi-squared test: 8.46, *p*=0.0036), the presence or absence of working (result of a chi-squared test: 7.16, *p*=0.0074), and number of medication types (result of a chi-squared test: 6.04, *p*=0.0140) were noted. The slope of the regression equation for estimates was determined and the direction of the influence that a positive or

ratio: 2.18, 95% confidence interval: 1.30–3.72) more likely to fail to take their medication than were individuals who did not dining out. Individuals who worked were about 2.0 times (odds ratio: 1.97, 95% confidence interval: 1.20–3.24) more likely to fail to take their medication.

4   Discussion

Adherence to medication has previously been assessed through methods such as measurement of drug concentration in the blood or urine, directly observing patients take medication, self-reports,

surveys of family members, and counting the amount of remaining medication[11,12]. The current study assessed adherence to medication based on certain attitudes of patients who failed to take their medication based on self-reports using a questionnaire. Results indicated that about 34% of patients "failed to adhere to their medication", while most patients adhered to their medication. That said, some respondents might have limited awareness of the need to take their medication despite failing to take their medication. A small proportion of respondents answered that they "failed to adhere to their medication" since may answered that they properly took their medication.

Results of univariate analysis indicated that individuals who realized that they had failed to take their medication tended to be younger, they tended to be working, they tended to take fewer number of medication types, they tended to take medication before bed, and they tended to dining out at least once a week.

Patients tend to be prescribed more medications as they grow older[13], so adherence presumably becomes a habit. Results of the 2014 National Survey of Family Income and Expenditures by the Statistics Bureau of the Ministry of Internal Affairs and Communications revealed that the proportion of expenditures on "dining out" tended to decrease as families grew older[14]. A large proportion of younger-age individuals work, they allocate little time for household chores, they become hungry when they finish work, and they dine out for social reasons. Such factors presumably lead to decreased adherence to medication.

Multiple logistic regression analysis of the aforementioned factors was performed using a stepwise procedure. Results revealed that principal factors were the presence or absence dining out, the presence or absence of working, and number of medication types. "Completely forgetting to take one's medication", "forgetting to bring one's medication", and "putting off taking one's medication" were leading reasons or circumstances for failing to take one's medication. Individuals did not take their medication at a time that suited them.

Working, being busy, and forgetting to bring one's medication can readily decrease adherence to medication. Making a habit of taking one's medication is crucial, regardless of external reasons or circumstances. To that end, pharmacists need to be involved. The presence or absence regular meals was believed to influence adherence to medication[9,15], but the current study revealed that the presence or absence dining out influences adherence to medication. The presence or absence regular meals and the presence or absence dining out are items that need to be determined.

Based on the aforementioned findings, questions about dining out need to be included in initial visit questionnaires and interviews, and information needs to be routinely collected from patients. Patients may be taking prophylactic medication for a chronic condition such as hypertension, diabetes mellitus, or a lipid abnormality even though they have no subjective symptoms[16]. The disappearance of symptoms or improved laboratory results can lead to decreased adherence to medication. In addition, involvement in treatment[17], awareness of one's condition, and one's attitudes towards treatment[18] influence adherence to medication, so a patient's view on the significance of his or her adherence to medication needs to be ascertained, and adherence to medication needs to be explained to the patient. Forgetting to take medication while

dining out or because of work might be concluded by a pharmacist as "unavoidable this time" or "forgetting this time is not a major problem". If this intensifies, a patient with a chronic condition might need to take an increased dose or take additional medication or complications might develop. Thus, information on individual patients must be carefully collected and assessed.

The current questionnaire was anonymous, so individual respondents could not be identified. This precluded determination of a relationship to certain conditions, medications taken, or the duration of administration. Thus, there are limits to the use of the current results. Moreover, questions about reasons or circumstances for failing to take one's medication were often unanswered. Individuals who answered that they failed to take their medication outnumbered those who answered that they properly took their medication, so better questions need to be devised.

In the future, the current authors will use data, including medications taken and the duration of administration, to examine medications taken by patients based on prescription claims. That work should prove of use in clinical settings.

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