



## Characterization of socioeconomic status of Japanese patients with atopic dermatitis showing poor medical adherence and reasons for drug discontinuation



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### ABSTRACT

**Background:** Patients' high adherence to medication is indispensable for the management of skin diseases including atopic dermatitis. We previously showed poor medication adherence in Japanese dermatological patients.

**Objective:** This study was conducted to determine the level of adherence to oral or topical medication in Japanese patients with atopic dermatitis, attempting to characterize the socioeconomic status of those patients with poor adherence.

**Methods:** A web questionnaire survey on demographic data as well as adherence level was conducted on patients registered in the monitoring system. Adherence level was assessed with Morisky Medication Adherence Scale-8 (MMAS-8). Among a total of 3096 respondents with dermatological disorders, data of 1327 subjects with atopic dermatitis were extracted and analyzed.

**Results:** More than 80% of subjects felt that both oral and topical medications were safe and efficacious, while less than 60% of them were satisfied with their treatment. Levels of adherence to oral and topical

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treatments were evaluated with MMAS-8, giving scores of 4.6 and 4.2, respectively. Demographic factors such as gender, marital status, state of employment, alcohol consumption, frequency of hospital visits, and experience of drug effectiveness had a significant impact on the degree of adherence to treatment. **Conclusion:** Medication adherence level in Japanese subjects with atopic dermatitis was relatively low compared with that of other chronic diseases. Our survey has characterized patients with poor adherence, who are good targets for interventions to maximize potentially limited healthcare resources.

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## 1. Introduction

In the management of skin diseases, not only the prescription of appropriate drugs by clinicians but also the enhancement of patient adherence to medication is important. Recent studies highlighted poor adherence to medication in patients with chronic inflammatory diseases, such as hypertension, diabetes, and inflammatory bowel diseases [1–3]. A low level of motivation to adhere to medication has also been reported in patients with atopic dermatitis [4], psoriasis [5], urticaria [6], and acne [7].

Previously, we assessed the adherence to oral and topical medications using a translated Japanese version of Morisky Medication Adherence Scale-8 (MMAS-8) in 3096 Japanese subjects with skin diseases including atopic dermatitis, urticaria, psoriasis, and tinea [8]. In that study, adherence level was classified as high, medium, or low according to the MMAS-8 score [8]. We found that the overall high, medium, and low adherence rates were 9.5%, 24.2%, and 66.3% for oral medication, and 6.9%, 17.7%, and 75.5% for topical medication, indicating poor adherence to medication in patients with skin diseases. In the current study,

**Table 1**  
Demographic data of study subjects with atopic dermatitis ( $n = 1327$ ).

Characteristics		<i>n</i>	(%)	
Age, mean (SD) [min–max], years		41.3 (11.1) [18–85]		
Gender	Male	559	42.1	
	Female	768	57.9	
Marital state	Married	597	45	
	Unmarried	730	55	
Annual income	≥6 million yen	411	37.1	
	<6 million yen	696	62.9	
Employment	Employed	877	69.4	
	Unemployed	387	30.6	
Education	University graduate	670	50.6	
	Not university graduate	653	49.4	
Smoking	Smoker	227	17.2	
	Non-smoker	1094	82.8	
Alcohol	≥Once a month	773	58.5	
	<Once a month	548	41.5	
Frequency of hospital visits	≥Once a half year	1226	92.4	
	<Once a half year or unknown	101	7.6	
Main healthcare institution	University hospital	58	4.4	
	Municipal hospital	216	16.4	
	Private clinic or other	1044	79.2	
Oral medication	Experience of drug effectiveness	Yes	720	78.3
		No	199	21.7
	Experience of adverse events	Yes	163	17.7
		No	756	82.3
Topical medication	Experience of drug effectiveness	Yes	1158	89.6
		No	134	10.4
	Experience of adverse events	Yes	247	19.1
		No	1045	80.9
Overall satisfaction to treatment	≥Satisfied	749	56.4	
	<Satisfied	578	43.6	
Adherence, mean (SD) [min–max]	Oral medication	4.6 (2.0) [0–8]		
	Topical medication	4.2 (2.0) [0–8]		
Cronbach's Alpha of adherence measure	Oral medication	0.712		
	Topical medication	0.706		

we further examined subjects with atopic dermatitis in order to characterize the socioeconomic status of patients with poor adherence.

## 2. Material and methods

### 2.1. Setting and study population

This study was conducted among patients registered in a monitoring system established by Macromill Inc., as previously described [8]. In brief, a total of 3096 eligible patients [atopic dermatitis ( $n = 1327$ ), urticaria ( $n = 751$ ), psoriasis ( $n = 237$ ), or tinea ( $n = 781$ )] were enrolled. Our web-based questionnaire included the following items: age, sex, marital status, annual income, employment status, educational status, smoking habit, alcohol consumption, frequency of hospital visits, main healthcare institution, oral or topical medication, experience of effectiveness of oral or topical medication, experience of adverse events associated with oral or topical medication, overall satisfaction with treatment, and the translated Japanese version of MMAS-8 for oral or topical medication [8].

According to the MMAS-8 score (ranging from 0 to 8) (Supplemental Fig. 1), adherence was categorized as high (score: 8), medium (score: 6, 7), or low (score: <6) [9].

### 2.2. Statistical analysis

Descriptive statistics were used to describe the demographics and disease classification of the patients and their medication adherence scores, as previously described [8]. Proportions and frequencies for categorical variables were calculated, while means and standard deviations were calculated for continuous variables. The characteristics of the whole sample and of the adherent groups produced by the MMAS-8 score are presented. The chi square ( $\chi^2$ ) test for categorical variables or analysis of variance (ANOVA) for continuous variables was used to evaluate the difference of study variables among the three adherence groups. Internal consistency was assessed using Cronbach's alpha. Known group validity was assessed through the association of item and MMAS categories by using correlation coefficient and covariance. All analyses were performed using STATA version 9. The significance level was set at  $p < 0.05$ .

## 3. Results

### 3.1. Presentation of patients' demographics and treatment landscape

Table 1 summarizes the demographics and treatment landscape for all patients with atopic dermatitis ( $n = 1327$ ). In terms of the gender of the patients, 42.1% were male and 57.9% were female. Demographic data, such as marital status, annual income level, employment status, education level, and smoking and drinking habits, were tallied. The current status of clinical visits was assessed: 92.4% of the total subjects visited hospital more than once every six months, and 79.2% of the total subjects consulted private clinics. As for the treatment landscape, self-assessment of both efficacy and adverse events of medication was performed, which revealed that more than 80% of the subjects felt that both oral and topical medications were safe and efficacious. However, questions regarding their satisfaction with their treatment found that only 56.4% of the subjects were satisfied. Adherence levels to oral and topical treatments were scored with MMAS-8, which were 4.6 and 4.2, respectively. Reliability verification with Cronbach's alpha was performed. The values of consistency of MMAS-8 scoring for oral and topical treatments were 0.712 and 0.705, respectively,

indicating the validity of the translated Japanese version of MMAS-8.

### 3.2. Level of adherence to treatment with oral and topical medications

Next, the level of adherence was compared between oral and topical medications (Table 2). In those with oral medication, the proportions of subjects in the high-, medium-, and low-adherence groups were 8.1%, 19.7%, and 72.3%, respectively. In those with topical medication, these proportions were 5.9%, 17.3%, and 76.9%, respectively. When adherence scores were compared between oral and topical medications, the adherence score to topical medication was significantly lower than that to oral medication ( $p = 0.03$ ).

### 3.3. Difference of study variables among the three adherence levels

Next, the association of each variable with the adherence score were assessed (Tables 3, 4). In terms of those with oral medication, factors such as marital status, alcohol consumption, and experience of drug effectiveness had a significant impact on the degree of adherence to treatment (Table 3). Being married, alcohol consumption less than once a month, and the experience of oral drug effectiveness were factors associated with higher adherence to oral medication ( $p < 0.001$ ,  $p = 0.004$ , and  $p = 0.008$ , respectively) (Table 3). When the subjects were divided along gender lines, married male subjects had a high adherence level (Table 5, Supplemental Tables 2, 3). The experience of adverse events associated with taking oral medication did not affect the adherence level ( $p = 0.999$ ) (Table 3). In terms of those with topical medication, factors such as gender, state of employment, and frequency of hospital visits had a significant impact on the degree of adherence to treatment (Table 4). Male subjects, employed individuals, and those visiting hospital more than once every six months were factors associated with higher adherence to topical medication ( $p = 0.002$ ,  $p = 0.002$ , and  $p = 0.029$ , respectively) (Table 4). Neither experience of drug effectiveness nor adverse events affected the score of adherence to topical medication, with statistical significance (Table 4).

### 3.4. Barriers to higher medication adherence: from patients' perspectives

To assess the barriers to higher medication adherence, we investigated the reasons for discontinuing drug use without being instructed to do so by a physician (Tables 6, 7). For oral medication, forgetfulness (42.4%) and feeling better (39%) were the major reasons for not taking medicines (Table 6). Although uncommon overall, alcohol consumption was a reason for not taking medicines in a relatively high percentage of subjects with atopic dermatitis or tinea unguis (Table 6). For topical medication, messiness of treatment (42.1%), forgetfulness (45.8%), and feeling better (35%) were the major reasons for forgetting to take such medication (Table 7). The rates of a shortage of drugs and feeling worse as reasons for not taking medication were relatively high while the rate of feeling that the drugs were ineffective was relatively low in

**Table 2**

Adherence levels by the type of medications among study subjects with atopic dermatitis.

	High <i>n</i> (%)	Medium <i>n</i> (%)	Low <i>n</i> (%)	<i>p</i> -value
Oral medication ( <i>n</i> = 919)	74 (8.1)	181 (19.7)	664 (72.3)	0.030
Topical medication ( <i>n</i> = 1292)	76 (5.9)	223 (17.3)	993 (76.9)	

**Table 3**  
Prevalence of study variables for the three adherence levels among study subjects with atopic dermatitis: oral medication (n=919).

Characteristics		High adherence n = 74 (8.1%)	Medium adherence n = 181 (19.7%)	Low adherence n = 664 (72.3%)	p-value
Age, mean (SD), years		40.2 (10.3)	43.6 (11.2)	40.8 (10.9)	0.008
Gender n (%)	Male	37 (9.1)	86 (21.1)	284 (69.8)	0.307
	Female	37 (7.2)	95 (18.6)	380 (74.2)	
Marital status n (%)	Married	51 (11.9)	87 (20.3)	290 (67.8)	<0.001
	Unmarried	23 (4.7)	94 (19.1)	374 (76.2)	
Annual income n (%)	≥6 million yen	23 (8.1)	62 (21.8)	199 (70.1)	0.603
	<6 million yen	38 (8.1)	89 (18.9)	345 (73.1)	
Employment n (%)	Employed	55 (8.9)	123 (19.8)	443 (71.3)	0.235
	Unemployed	16 (6.4)	42 (16.8)	192 (76.8)	
Education n (%)	University graduate	33 (7.1)	92 (19.8)	340 (73.1)	0.541
	Not university graduate	41 (9.1)	88 (19.5)	322 (71.4)	
Smoking n (%)	Smoker	13 (7.8)	30 (18.1)	123 (74.1)	0.828
	Non-smoker	61 (8.1)	150 (20.0)	538 (71.8)	
Alcohol n (%)	≥Once a month	34 (6.3)	96 (17.6)	414 (76.1)	0.004
	<Once a month	40 (10.8)	84 (22.6)	247 (66.6)	
Frequency of hospital visits n (%)	≥Once a half year	71 (8.2)	173 (19.9)	624 (71.9)	0.691 <sup>a</sup>
	< Once a half year or unknown	3 (5.9)	8 (15.7)	40 (78.4)	
Main healthcare institution n (%)	University hospital	5 (10.4)	13 (27.1)	30 (62.5)	0.059 <sup>a</sup>
	Municipal hospital	18 (12.0)	33 (22.0)	99 (66.0)	
	Private clinic or other	49 (6.9)	133 (18.6)	532 (74.5)	
Experience of drug effectiveness n (%)	Yes	66 (9.2)	150 (20.8)	504 (70.0)	0.008
	No	8 (4.0)	31 (15.6)	160 (80.4)	
Experience of adverse events n (%)	Yes	13 (8.0)	32 (19.6)	118 (72.4)	0.999
	No	61 (8.1)	149 (19.7)	546 (72.2)	
Overall satisfaction to treatment n (%)	≥Satisfied	46 (8.8)	114 (21.7)	365 (69.5)	0.102
	<Satisfied	28 (7.1)	67 (17.0)	299 (75.9)	

<sup>a</sup> Fisher's exact test.

atopic dermatitis compared with those in other skin diseases (Table 7).

#### 4. Discussion

In this study, the actual medication adherence levels of Japanese patients with atopic dermatitis and their reasons for

drug discontinuation were examined. This is the first study characterizing patients with atopic dermatitis using MMAS-8.

Previously, overall adherence levels in Japanese dermatological patients were compared among atopic dermatitis, urticaria, psoriasis, and tinea [8]. The results showed a significantly lower level of adherence to oral medication in subjects with atopic dermatitis than in other diseases [8]. Atopic dermatitis severely

**Table 4**

Prevalence of study variables for the three adherence levels among study subjects with atopic dermatitis: Topical medication (n = 1292).

Characteristics		High adherence n = 76 (5.9%)	Medium adherence n = 223 (17.3%)	Low adherence n = 993 (76.9%)	p-value
Age, mean (SD), years		42.2 (9.5)	42.2 (12.3)	41.0 (10.9)	0.225
Gender n (%)	Male	38 (7.0)	114 (21.0)	391 (72.0)	0.002
	Female	38 (5.1)	109 (14.6)	602 (80.4)	
Marital status n (%)	Married	35 (6.0)	114 (19.6)	433 (74.4)	0.123
	Unmarried	41 (5.8)	109 (15.4)	560 (78.9)	
Annual income n (%)	≥6 million yen	26 (6.5)	67 (16.7)	309 (76.9)	0.785
	<6 million yen	41 (6.0)	124 (18.3)	514 (75.7)	
Employment n (%)	Employed	64 (7.5)	144 (16.9)	644 (75.6)	0.002
	Unemployed	9 (2.4)	69 (18.3)	299 (79.3)	
Education n (%)	University graduate	37 (5.6)	116 (17.7)	504 (76.7)	0.880
	Not university graduate	39 (6.2)	107 (17.0)	485 (76.9)	
Smoking n (%)	Smoker	11 (5.1)	36 (16.5)	171 (78.4)	0.766
	Non-smoker	65 (6.1)	187 (17.5)	816 (76.4)	
Alcohol n (%)	≥Once a month	39 (5.2)	128 (17.0)	584 (77.8)	0.386
	<Once a month	37 (6.9)	95 (17.8)	403 (75.3)	
Frequency of hospital visits n (%)	≥Once a half year	72 (6.0)	215 (18.0)	908 (76.0)	0.029
	<Once half year or unknown	4 (4.1)	8 (8.3)	85 (87.6)	
Main healthcare institution n (%)	University hospital	4 (7.1)	9 (16.1)	43 (76.8)	0.489 <sup>a</sup>
	Municipal hospital	11 (5.2)	45 (21.4)	154 (73.3)	
	Private clinic or other	61 (6.0)	167 (16.4)	789 (77.6)	
Experience of drug effectiveness n (%)	Yes	72 (6.2)	204 (17.6)	882 (76.2)	0.161
	No	4 (3.0)	19 (14.2)	111 (82.8)	
Experience of adverse events n (%)	Yes	11 (4.5)	42 (17.0)	194 (78.5)	0.553
	No	65 (6.2)	181 (17.3)	799 (76.5)	
Overall satisfaction to treatment n (%)	≥Satisfied	52 (7.2)	124 (17.1)	548 (75.7)	0.080
	<Satisfied	24 (4.2)	99 (17.4)	445 (78.4)	

<sup>a</sup> Fisher's exact test.

impairs patients' work/classroom productivity [10]. Enhancing patients' motivation to take medication is very important because it will improve their quality of life and their productivity and thus increase socioeconomic activity. In the present study, mean MMAS-8 scores for oral and topical medications were 4.6 and 4.2, respectively (Table 1). The MMAS-8 score for oral medication

was lower than that for psoriasis (5.2), another common type of chronic dermatitis, while the topical score was comparable to that of psoriasis (4.3) [8,11]. Mean MMAS-8 scores for other chronic diseases such as osteoporosis and asthma were 6.2 and 5.4, respectively [12,13]. Our first attempt to assess adherence in cases of atopic dermatitis by using MMAS-8 has clearly shown that the

**Table 5**  
Prevalence of marital status for the three adherence levels divided along gender lines.

Gender	Characteristics	High adherence n (%)	Medium adherence n (%)	Low adherence n (%)	p-value
Male	Oral medication	37 (9.1)	86 (21.1)	284 (69.8)	<0.001
		Married	29 (15.5)	38 (20.3)	
	Unmarried	8 (3.6)	48 (21.8)	164 (74.6)	
	Topical medication	38 (7.0)	114 (21.0)	391 (72.0)	
Married		21 (8.4)	59 (23.7)	169 (67.9)	
Unmarried	17 (5.8)	55 (18.7)	222 (75.5)		
Female	Oral medication	37 (7.2)	95 (18.6)	380 (74.2)	0.143
		Married	22 (9.1)	49 (20.3)	
	Unmarried	15 (5.5)	46 (17)	210 (77.5)	
	Topical medication	38 (5.1)	109 (14.6)	602 (80.4)	
		Married	14 (4.2)	55 (6.5)	
	Unmarried	24 (5.8)	54 (13.0)	338 (81.3)	

level of adherence of Japanese patients with atopic dermatitis is poor for both oral and topical medications. There is some evidence to support this finding. Krejci-Manwaring et al. reported poor adherence to topical medication in children with atopic dermatitis [14]. Moreover, Feldman et al. reported that the level of adherence to topical medication in an atopic dermatitis group was lower than that in a psoriasis group or a hand dermatitis group [15]. In these previous studies, adherence to topical medication was high around the time of office visits, but rapidly decreased soon after [14,15]. Thus, the most important issue here is how to offer effective motivation for using medication, ensuring that patients visit hospitals sufficiently often.

Demographic/clinical information related to a lower adherence level might provide a helpful perspective to grasp the characteristics of patients who need special attention. Wilke et al. assessed the adherence level in German patients with medication, revealing that being relatively young, having chronic disease, and number of medications to be taken were factors explaining non-adherence [16]. In the field of dermatology, Richmond et al., who assessed the adherence level of new patients in a dermatology clinic at the University of Miami, reported that the reasons for poor adherence to medication were lack of time and poor insurance coverage for medication [17]. From the results of our study, marital status, alcohol consumption, and experience of drug effectiveness had an influence on the level of adherence to oral medication (Table 3). On the other hand, factors such as gender, employment status, and frequency of hospital visits had a large impact on the level of adherence to topical medication (Table 4). Interestingly, the factors affecting adherence differed between oral and topical medications. Marital status influenced oral medication adherence, but not that for topical medication. Moreover, being married and male was a factor related to a higher adherence level for oral medication (Table 5), suggesting the favorable effects of distinctive living environment of married individuals on their adherence to oral medication. We can imagine some conceivable living environment affecting adherence. It assumed that married men might be encouraged to take oral medication by their wives. Therewith, they may be supported to lead a well balanced and regulated life. Married male may also have a higher interest in his own health from a sense of responsibility to maintain his family [18]. Indeed, association of marital status and cancer screening participation has been reported [19,20]. Alternatively, the unmarried group may have included more young people, who usually show lower adherence [8]. To verify this hypothesis, we examined married and unmarried subjects separately (Supplemental Tables 4 and 5).

To our surprise, mean age was higher in unmarried subjects than in married ones. Thus, being married was a beneficial factor for oral medication adherence in males with atopic dermatitis, which was not related to their age. Similarly, unmarried patients were reported to be at high risk of non-adherence to medication in cases of heart failure and hypertension [21,22]. In contrast, being married negatively influenced adherence to medication in cases of gastroesophageal reflux disease [23] or had no impact on adherence in those with chronic obstructive pulmonary disease [24] and rheumatoid arthritis [25]. In our previous assessment of all dermatological diseases, marital status had no influence on the level of adherence to both oral and topical medications [8]. Although the impact of marital status on medication adherence varies among different diseases, this demographic factor may be important for determining adherence levels in atopic dermatitis. We currently do not know why married status showed beneficial impacts only on patients with AD, but not on those with other skin diseases. We could only speculate that different temperaments of patients with different diseases (at least for AD, psoriasis and urticaria) [26] might possibly cause such a difference. Gender and employment status were factors influencing topical medication adherence, which was unique to atopic dermatitis (Table 4) [8,11]. Patients drinking alcohol less than once a month showed a higher adherence to oral medication than those who drank more. Doctors often advise the patients not to take oral medicine with alcohol. Some patients may refrain from taking medicine instead of stopping drinking. Indeed, alcohol consumption was a reason for not taking medicines in a relatively high percentage of subjects with atopic dermatitis (Table 6). In subjects with atopic dermatitis, experience of drug effectiveness contributed to high adherence levels for oral medication, while a low frequency of hospital visits was associated with poor adherence to topical medication (Tables 3, 4). These items were not among the factors influencing the levels of adherence to oral or topical medication in Japanese subjects with psoriasis [8,11], indicating that these items can also be unique influential factors in atopic dermatitis. Experience of the effectiveness of oral medication may well generate a high motivation to maintain treatment. Regarding hospital visits, it may be natural that patients with low adherence go to see doctors less frequently. We should take advantage of the high rate of topical treatment adherence on and near days of clinical visits [14,15] in order to increase motivation to maintain medication use and ensure good control of the disease.

To improve low adherence to medication, it is important to determine the reasons why patients discontinue the use of drugs. In our study, messiness of drug use, forgetfulness, and self-assessment

**Table 6**  
Reasons for discontinuing oral drug without directions from a physician (multiple answers allowed).

Disease	<i>n</i>	Messiness of treatment	Forgetfulness	Being busy	Alcohol consumption	Feeling drugs were ineffective	Shortage of drugs	Skipping a meal	Difficulty of taking drugs (size, form, and taste)	Feeling better	Feeling sick	Concern about side effects	Other
	286	22.7	39.9	14.7	8.4	15.7	12.2	7.3	2.8	38.8	2.4	15.4	11.5
Atopic dermatitis	177	22.6	42.4	16.9	11.3	16.9	13.6	8.5	2.8	39	2.8	15.3	6.8
Urticaria	75	18.7	33.3	10.7	2.7	13.3	10.7	5.3	2.7	48	1.3	14.7	18.7
Psoriasis	13	23.1	30.8	15.4	0	23.1	15.4	7.7	0	30.8	7.7	15.4	23.1
Tinea pedis	14	50	42.9	14.3	7.1	7.1	0	0	7.1	7.1	0	14.3	14.3
Tinea unguium	7	14.3	57.1	0	14.3	14.3	14.3	14.3	0	14.3	0	28.6	28.6

Gray column shows the number of cases. Figures in the other columns show the percentage relative to total number of cases with each disease.

**Table 7**  
Reasons for discontinuing the topical drug without directions from a physician (multiple answers allowed).

Disease	<i>n</i>	Messiness of treatment	Forgetfulness	Being busy	Too high frequency of use	Too many different medications	Feeling drugs were ineffective	Shortage of drugs	Inaccessible locations	Feeling better	Feeling sick	Feeling worse	Concern about side effects	Other
	689	45.3	49.2	23.8	12	2.6	9.7	15.1	9.3	32.9	6.8	2.5	8.9	6.8
Atopic dermatitis	349	42.1	45.8	26.6	14.3	2.9	5.7	18.6	9.7	35	8.6	3.4	10.9	8.3
Urticaria	124	36.3	47.6	14.5	7.3	2.4	16.1	16.1	8.1	29	8.9	2.4	10.5	8.1
Psoriasis	73	56.2	47.9	27.4	11	6.8	9.6	12.3	16.4	32.9	2.7	0	11	5.5
Tinea pedis	76	57.9	56.6	27.6	9.2	0	11.8	7.9	5.3	40.8	5.3	0	2.6	1.3
Tinea unguium	67	52.2	62.7	17.9	13.4	0	16.4	6	6	20.9	0	3	0	4.5

Gray column shows the number of cases. Figures in the other columns show the percentage relative to total number of cases with each disease.

of an improvement in one's condition were the major reasons for discontinuation (Tables 6, 7). Similar results were reported from a Spanish survey on the adherence levels of subjects with atopic dermatitis [4]. In this report, most patients discontinued treatment when their symptoms subsided. Moreover, they occasionally forgot to use topical medicines [4]. Such trends should be remedied because subclinical inflammation in a treated area that cannot be detected by the patient is related to repeated recurrence of this disease and maintenance therapy has been considered important to prevent recurrence [27]. Thus, advising patients to continue topical treatment even after they think their skin lesions have cleared up is regarded helpful to avoid recurrence. The reason for not using medicines of a shortage of drugs was relatively common and the feeling that their drugs were ineffective was relatively uncommon in atopic dermatitis compared with those in the other skin diseases (Table 7). It is thus also important to encourage patients to visit hospital before they run out of drugs.

The contents of the explanations by the patients' doctors were also examined (Supplemental Table 6). We found that many patients with atopic dermatitis received an insufficient explanation about both the nature of the disease and the required therapy duration compared with those with other skin diseases. By contrast, more patients with atopic dermatitis received an explanation about factors that could exacerbate their condition and the importance of an adequate diet and lifestyle improvement. Medical staff should attempt to give patients clear goals in each therapeutic phase and an indication of the likely therapeutic duration.

There were some limitations in our study. We did not meet the patients in person and confirm the self-reported diagnosis. In addition, besides the limited number of study subjects, disease severity and presence of complications were not considered in this survey. The severity of dermatitis would influence the adherence. Improving adherence levels will make skin condition better, which, in turn, may induce a better adherence. Although this virtuous circle should be pursued, there are not enough data for discussion in this study. There is also a risk of population bias because this study is based on an internet survey. Nevertheless, we believe that the results provided by our survey contain valuable information for the management of atopic dermatitis. We have clarified the socioeconomic status of patients showing poor medical adherence and the reasons for drug discontinuation, which is useful to find good targets for intervention and to make the best use of potentially limited healthcare resources.

### Conflict of interest

The authors have no conflicts of interest to declare.

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### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.jdermsci.2015.05.010>.

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