Journal of the Academic Society for Quality of Life (JAS4QoL)

2016 Vol. 2(2) 3:1-8

A Study of the Quality-of-Life (QoL) in Japanese Cedar Pollinosis Patients: Relationships between QoL and Airborne Pollen Levels

Yuri OUCHI[1*]
[1] Faculty of Nursing, Takarazuka University
y-oouchi@takara-univ.ac.jp
Citation: OUCHI, Y.; *JAS4QoL* **2016,** *2(2) 3*:1-8.
Online: http://as4qol.org/?p=1615#art3
Received Date:May 1, 2016 Accepted Date:May 13, 2016 Published: June 31, 2016

JAS4QoL

Full Paper

A Study of the Quality-of-Life (QoL) in Japanese Cedar Pollinosis Patients: Relationships between QoL and Airborne Pollen Levels

Yuri OUCHI[1*]
[1] Faculty of Nursing, Takarazuka University
y-oouchi@takara-univ.ac.jp

Abstract

The number of Japanese cedar pollinosis (JCP) patients has increased acutely recently, exceeding 30% of the population. The increase in JCP has been especially marked among younger age-groups. When a person is once affected by JCP, he/she has to undergo lifetime treatment. Dependent on the severity of JCP symptoms, a decrease in the quality of life (QoL) is accompanied with increased daytime sleepiness. This study investigated the correlations between JCP symptoms, QoL, and treatment methods in a 5-year period (2008-2012), where the yearly airborne pollen (AP) levels were different. **Methods:** During the seasons of peak AP levels between 2008-2012, a standard QoL questionnaire for allergic rhinitis (JRQLQ), and the JRQLQ-1-ESS survey (consisting of the Epworth sleepiness scale or ESS) was conducted in 1684 CJP patients, who visited 8 otorhinolaryngology centers for diagnosis/treatment in Osaka and Hyogo prefectures. **Results:** Our study revealed yearly prefecture AP levels in ascending order over the 5-yr period (particulates/cm^2) as follows: 2010 (302), 2012 (1147), 2008 (1468), 2011 (1988), and 2009 (4900). Allergic rhinoconjunctivitis and QoL exacerbated with an increase in AP levels, demonstrating obviously high correlations between the symptom severity and QoL with AP levels. Furthermore, with regard to AP-medication behavior relationships, the symptomatic severity was especially high in years where the AP levels were high, accompanied by parallel increased demands for medication therapies. Additionally, the over-the-counter (OTC) product-treated group manifested elevated QoL impairments and sleepiness compared with prescription-treated patients. Future treatments with appropriate medical therapies would probably accelerate improvement of symptoms and QoL.

Keywords: Japanese cedar pollinosis, pollen count, QoL, Epworth Sleepiness Scale

A Study of the Quality-of-Life (QoL) in Japanese Cedar Pollinosis Patients: Relationships between QoL and Airborne Pollen Levels

Citation: OUCHI, Y.; *JAS4QoL* **2016**, *2(2) 3*:1-8.

Available online at
http://as4qol.org/?p=1615#art3

Received: May 1, 2016
Accepted: May 13, 2016
Published: June 31, 2016

1. Introduction

Allergic rhinitis (AR), commonly known as hay fever, is a mucous membrane type-I allergic reaction of the immunosystem. AR is divided into two major types: perennial and seasonal allergic rhinitis (SAR). SAR symptoms, which may be induced in spring, summer and early fall, are usually caused by allergic sensitivity to airborne mold spores or to airborne pollens (APs) from grass, trees and weeds. Perennial allergic rhinitis symptoms, which may manifest year-round, is generally caused by excreta or carcasses of dust mites and cockroaches, pet hair, dander, or mold. It has been known that underlying food allergies rarely cause perennial nasal symptoms.

Pollen allergens are one of the major causes of SAR, resulting in repeated sneezes, itching, nasal blockage or congestion. In addition to these major symptoms, runny nose, itchy eyes, mouth or skin, red and teary eyes are the accompanying common rhinoconjunctivitis symptoms, and many patients eventually become plagued with fatigue (often reported as being due to poor quality sleep or poor Epworth sleepiness scale (ESS) as a result of nasal obstruction).

In Japan, incidences of allergies were first most frequently induced by hogweed/ragweed (Ambrosia, Erigeron and Heracleum of artemisiifolia), orchard grass (Dactylis glomerata), Japanese cedar (Cryptomeria japonica), followed by their pollens in the later-half of the 1960s. Japan cedar pollinosis (JCP), however, became rampant in the later-half of the 1970s. As it is basically incurable and even treating symptoms with known natural remedies only offers a poor prognosis, people affected by these allergies have to undergo seasonal depressions in their lives; the detrimental physical and mental suffering accompanied by social discomfort were immeasurable. As a result of yearly cumulative increase in pollinosis patients, the incidence has increased to as high as 30% of the population in recent years (yr).[1] Of this affected population, the JCP incidence has surpassed 26%, and impacted the populace has reached the point where it has become a matter of national importance: the concomitant QoL decrease and attenuation of student performance and productivity of workers are considered as important social priorities.[2,3]

One of the causes for the increased JCP incidence may be due to an increased number of humans with immunodeficient or allergic predispositions, although the substantial influence of environmental factors cannot be discounted. Japanese cedar (JC) trees were planted all over Japan after the World War II to supply construction materials, material used for control floods and soil erosion and mountain/forest management in nation-building. As a result, 30-yr-old high pollen-yielding trees occupied many of the JC-forested areas by the later-half of the 1960s.[1] Due to repeated exposure to JC pollens, the human immunosystems in many Japanese were sensitized, and JCP onsets were observed in many younger age-groups in Japan. As treatment with natural products was ineffective, the number of patients began to accumulate, causing an exponential increase in the national JCP incidence over time. Due to climatic change in the summer of 2014, AP levels peaked around January–May in 2015. In other words, AP levels and seasons - which are unpredictable – are much dependent on and vary according to geographical and time factors. With the increase in AP levels, allergic rhinoconjunctivitis and other symptoms not only exacerbate but also QoL also decreased to ultimately result in poor quality sleep.[4]

The mainstream JCP treatment involves drug therapy: viz., JCP patients were initially treated to improve symptomatic effects and QoL, with efficacy eventually established in numerous cases.[5,6] However, JCP patients who did not seek prescription-based medication (PBM) treatment ended up using over-the-counter (OTC) products per se. The present study investigated the differences, correlations, and effects of pollinosis symptoms, QoL, and treatment methods over a 5-yr period (2008-2012) where the AP levels varied.

2. 2. Methods

2.1 Investigation period

JCP patients, who visited 8 otorhinolaryngology centers in Osaka and Hyogo prefectures during the peak AP time-intervals during the 5-yr study period (March 10-21, 2008; March 2-14, 2009; March 5-30, 2010; March 7-21, 2011; and March 9-23, 2012), participated in the study with written consented. AP levels were monitored using a pollen-counting device at Osaka University (Fig. 1). Participant-sampling of the first 100 patients was executed by selecting patients in the visiting order to the otorhinolaryngology centers from the start of the investigation period at the respective centers. Additionally,

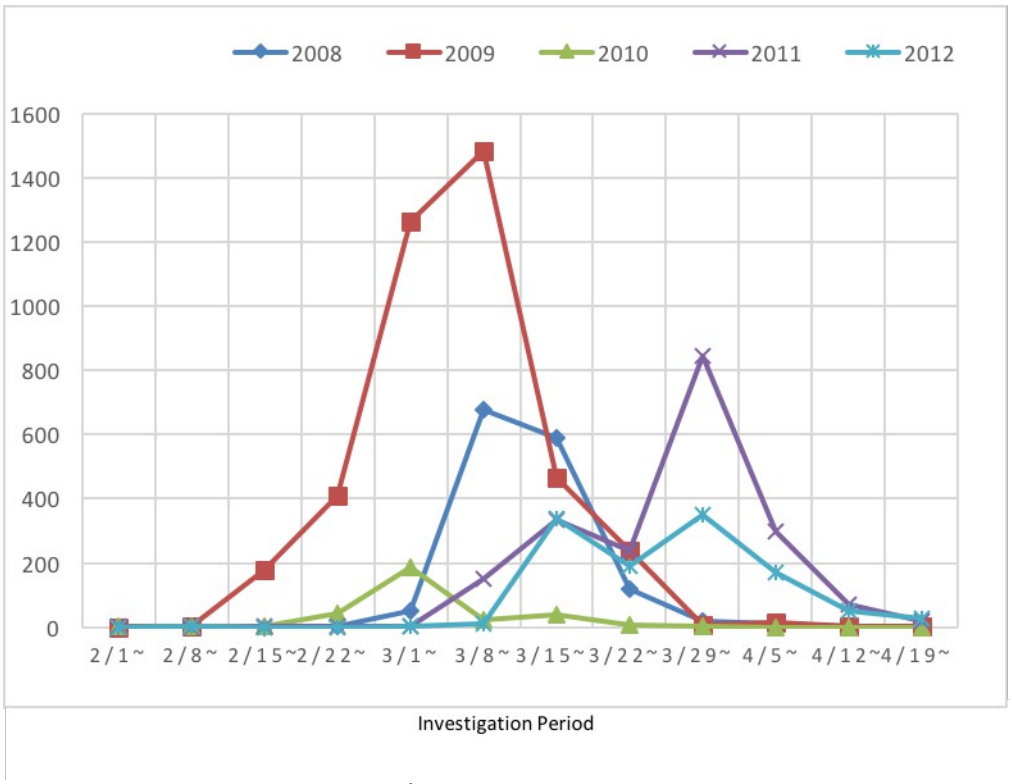

Fig. 1: Airborne pollen counts (APCs: particulates/cm^3) and investigational intervals (month/day~) for 2008 (diamond; blue), 2009 (square; red), 2010 (triangle; green), 2011 (cross; purple), and 2012 (asterisk; teal) in the 5-yr study.

sampling of JCP patients (between the age of 15-75 yr), who were able to fill out the questionnaire, were enrolled for the study. Note that only patients first selected for the study were followed up throughout the 5-yr study period; however, patient particulars were not identified due to ethical consideration, and therefore comparisons between individuals were not performed.

2.2 Indexes under investigation

JRQLQ No. 1 (JRQLQ-1) comprising subjective daytime sleepiness using the ESS was monitored by asking the patients per se to fill out the questionnaire (JRQLQ-1-ESS, or JRQLQ No. 1 survey on ESS). Questionnaires missing any one item of the JRQLQ-1-ESS questionnaire were omitted from the study.

a) JRQLQ-1

JRQLQ-1[7] employed for monitoring the severity and JCP-specified QoL (with items filled out by the patients) included 3 categories: I) rhinoconjunctivitis symptoms in the recent 1-2 weeks; II) QoL; and III) general health condition

b) ESS

Of the various daytime sleepiness items monitored by the ESS inventor, Murray W. Johns,[8] 8 indexes were used for determining the subjective sleepiness in this study. The total score of aforesaid 8 items (*https://www.sf-36.jp/qol/ess.html*) determined the degree of sleepiness: viz., the higher the score the higher degree of sleepiness.

2.3 Data Analysis

The rank-sum order was first determined using the Kruskal-Wallis test, followed by the Wilcoxon-Mann Whitney test. QoL and ESS scores between any 2 groups were analyzed with the non-paired Student t-test. The one-way ANOVA analysis was used for multiple-group comparison before Bonferroni correction. The Pearson's product-moment correlation coefficient was employed for correlation analysis. Significant differences where $p<0.05\%$ on bilateral analysis were considered significant.

2.4 Ethical Consideration

Answering the questionnaire in the present study was optional and without the interference of a

Table 1: Background particulars of participants for the 5 years studied (2008-2012)

	Study year:	2008	2009	2010	2011	2012
		No. of patients (%)				
Total		294	394	303	341	352
Gender	Male	102(34.7)	142(36.0)	97(32.0)	111(32.6)	132(37.5)
	Female	183(62.2)	236(59.9)	196(64.7)	227(66.6)	216(61.4)
	Unknown	9(3.1)	16(4.1)	10(3.3)	3(0.9)	4(1.1)
Age (yr)	Mean±SD	39.9±13.4	39.4±13.1	39.5±13.6	41.6±13.2	39.3±15.2
	< 19	24(8.2)	29(7.4)	23(7.6)	24(7.0)	44(12.5)
	20〜29	37(12.6)	55(14.0)	34(11.2)	39(11.4)	50(14.2)
	30〜39	87(29.6)	105(26.6)	70(23.1)	82(24.0)	80(22.7)
	40〜49	86(29.3)	125(31.7)	81(26.7)	105(30.8)	87(24.7)
	50 and above	58(19.7)	77(19.5)	90(29.7)	88(25.8)	87(24.7)
	Unknown	2(0.7)	3(0.8)	5(1.7)	3(0.9)	4(1.1)
Disease period	From 2014	6(2.1)	17(4.3)	7(2.3)	4(1.2)	6(1.7)
	From 2013	5(1.7)	13(3.3)	11(3.6)	5(1.5)	11(3.1)
	2〜3 yr ago	53(18.4)	60(15.2)	32(10.6)	41(12.0)	47(13.4)
	4〜5 yr ago	46(16.0)	71(18.0)	56(18.5)	52(15.2)	60(17.0)
	> 6 yr ago	178(61.8)	226(57.4)	192(63.4)	236(69.2)	222(63.1)
	Mean* disease period >6 yr ago	15.9±10.3	15.4±9.3	16.5±7.3	16.6±7.6	16.8±7.8
	Unknown	6(2.0)	7(1.8)	5(1.7)	3(0.9)	6(1.7)
Employment status	Company	93(31.6)	134(34.0)	96(31.7)	120(35.2)	122(34.7)
	Self-employed	22(7.5)	36(9.1)	28(9.2)	22(6.5)	20(5.7)
	Part-timer	67(22.8)	89(22.6)	67(22.1)	70(20.5)	62(17.6)
	Home-maker	50(17.0)	56(14.2)	54(17.8)	69(20.2)	61(17.3)
	student	31(10.5)	37(9.4)	25(8.3)	27(7.9)	55(15.6)
	Others	17(5.8)	20(5.1)	18(5.9)	13(3.8)	18(5.1)
	Unknown	14(4.8)	22(5.6)	15(5.0)	20(5.9)	14(4.0)

**: mean plus/minus S.D.*

third party. Anonymous questionnaires were collected without hints of personal identification. Data were then analyzed and statistically treated only with regard to the intended purposes of the present study. Data analyses were treated with the strictest confidentiality, and were appropriately disposed of after the study.

3. Results

3.1 (Japanese Cedar) airborne pollen (AP) levels

The AP levels (particulates/cm^2) for the 5-yr study period were as follows: 2008 (1468), 2009 (4090), 2010 (302), 2011 (1988), and 2012 (1147) with the mean AP level/year calculated as 1799. The mean AP levels scored the highest and lowest in 2009 and 2010, respectively.

3.2 Background particulars of participants

The numbers (females in %) of participants registered for the 5-yr study period (age-range: 39.3-41.6 yr) were as follows: 294 (62.2%), 394 (59.9%), 303 (64.7%), 341 (66.6%), and 352 (61.4%) for calendar yr 2008, 2009, 2010, 2011, and 2012, respectively. No significant differences in the gender, age, length of diseased period, and employment were noted based on their background particulars (Table 1).

3.3 Time-related symptomatic comparison of JCP patients

The total (rhinoconjunctivitis) symptomatic scores (TSSs) of JCP patients were significantly higher in 2009 ($p<0.01$) and 2010 ($p<0.05$) (vs all study yr), yielding attenuated symptoms of mild sneezes and

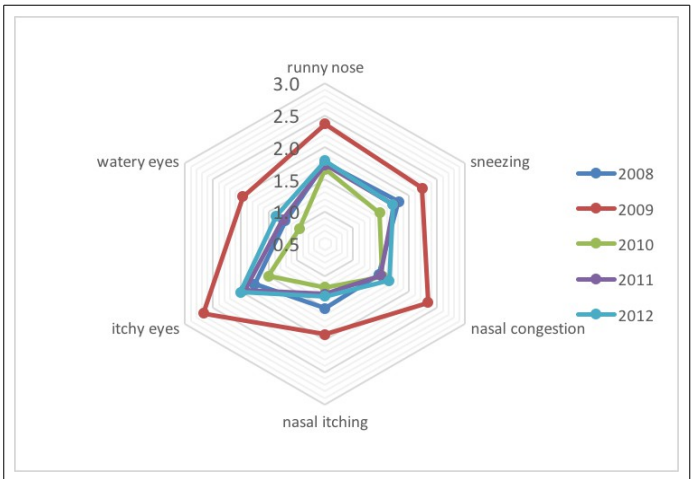

Fig. 2: Comparison of total (rhinoconjunctivitis) symptomatic scores (TSSs) for the 5-yr study period (2008-2012). Rhinoconjunctivitis symptoms included watery eyes, itchy eyes, nasal itches, nasal congestion, and sneezes. Note that One-dimensional distribution dispersal analysis indicates significant differences in 2009 ($p<0.01$; red line) and 2012 ($p<0.05$; teal) vs all other yr for all and certain (sneezes and rhino-itches) in TSSs.

rhino-itches (Fig. 2). The mean total TSSs (study yr) were: 9.48 (2008), 13.42 (2009), 7.78 (2010), 8.55 (2011), and 9.84 (2012), indicating that calenda r yr with more AP counts showed higher TSSs. In other words, 2009 inflicted significantly ($p<0.01$) greater symptomatic exacerbations than o t h e r yr, while 2010 showed s ignificantly ($p<0.05$) mild symptomatic scores (Fig. 2).

With regard to the respective QoL aspects, significant ($p<0.001$) impairments related to outdoor activities accompanied by significant ($p<0.05$) unwanted effects on other physical (such as sleep, social, daily) and mental activities were observed in 2009, indicating that lower AP levels tended to produce lower QoL scores (Fig. 3). The total scores of the respective QoL aspects registered 14.44 (yr: 2008), 21.63 (2009), 13.07 (2010), 12.10 (2011), and 15.10 (2012), with 2009 inflicting the most severe impairments on QoL in the 5-yr study.

On investigating the correlations of AP levels with TSS and total overall QoL scores (Fig. 4), both indexes were elevated when AP levels were high, indicating that TSS and total overall QoL scores were positively correlated with the AP levels: viz., the Pearson's correlation coefficients of TSS and total overall QoL scores were r=0.9053 (p=0.0344) and r=0.8282 (p=0.0832) respectively, where stronge r QoL-impairing effects were established with higher AP levels.

Based on Johns' definition of daytime sleepiness,[8] the ESS scores were categorized according to severity, the effects the normal group in 2009 were not significant. Based on the total ESS scores and gender investigated (Fig. 5), the total ESS scores (study yr) were 9.7 (yr: 2008), 10.2 (2009), 9.5 (2010), 9.7 (2011), and 9.8 (2012), indicating that greater significant ($p<0.05$) sleepiness was reported in female than male JCP patients.

In addition, with respect to medications taken, participants were divided into 3 major categories: the non-treatment (NT; 46.7%), prescribed oral medication-treated (PMT; 47.6%), and the oral OTC-treated (OTC; 5.7%) groups. When medica-t i o n behavior of the respective groups (ESS scores) was analyzed, the NT (9.8), PM T (9.6) and OTC (10.4) groups demonstrated that the OTC group suffered the most. The mean ages of JCP patients for the respective groups were 38.0 (OTC group), 40.0 (N T group), and 41.6 (PMT group) yr, showing clearly that patients in the O T C group i ndicated s ignificantly ($p<0.05$) younger than the other 2 groups. When TSSs were group-compared, the OTC group indicated the most unwanted tendency in all yr studied (Fig. 6). In a simila r development, the total overall QoL scores of the OTC group indicated the highest QoL impairments in 2008, 2009, and 2012. Furthermore, the OTC group manifested unfavorable values in total QoL scores for all yr studied, except 2010 (Fig. 7).

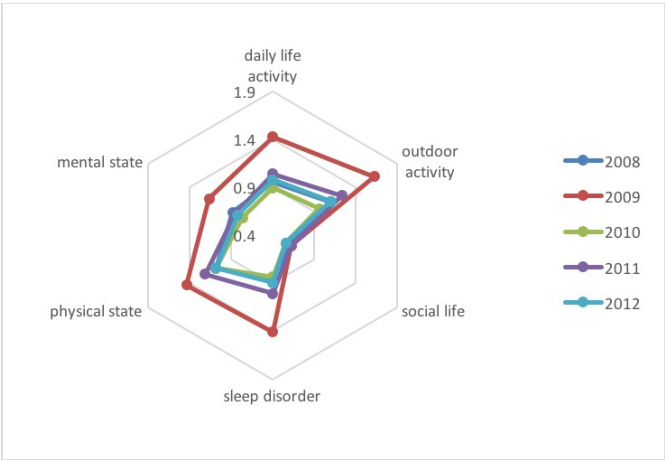

Fig. 3: QoL scores for the various aspects: comparison for the 5-yr study (2008-2012). Note that one-dimensional distribution dispersal analysis indicates significantly ($p<0.01$) higher scores were registered in 2009 vs all other yr (all QoL aspects), and t h e distribution of QoL scores of 2008 (dark blue) approximately overlapped with those of 2012 (teal). The mental (not radiant, depressive, anxious, and life dissatisfaction), physical (tired, fatigue)), sleeping (with disorders), social life not associating with others, withdrawn, sensitive of the presence of others), outdoor activity (reduced going out, doing sports, field activities), and daily life activity (disorders in study, work, housework; reduced concentration, thinking, reading and memory efforts) were compared statistically.

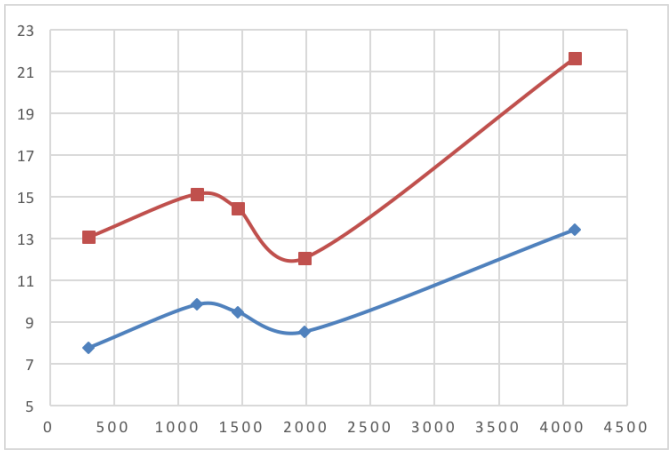

Fig. 4: Relationships between total symptomatic (blue) scores (TTS) and total QoL (red) scores with AP levels. Correlation coefficients of Pearson's scores indicate total QoL and TSS scores as r=0.8282 (p=0.0832) and r=0.9053 (p=0.0344), respectively.

4. Discussion

With regard to total symptomatic scores (TSSs), the severity depended on the AP levels: viz., study yr with high AP levels resulted in severest symptoms, while that with low AP levels reflected mild symptoms in patients. However, severity was not dependent on AP levels in study yr with moderate AP dispersals. As such, a high percentage of students below the age of 19 yr were affected in 2012 compared with other yr. In JCP (or AR) patients, the younger the age-group, the more severe were the symptoms, thus resulting in lower academic achievements in our study.[3] Additionally, the QoL scores exacerbated proportionally to yield considerable QoL impairments in yr with high AP levels. However, QoL excelled in 2011 when the AP levels were at their second high est levels. When viewed from the correlation perspective with the AP level; even when significant symptomatic effects were reduced, non-correlation effects between the AP levels and QoL may considered to be possible. Difference in the background particu lars of patients could serve as one of the possible reasons for this discrepancy, suggesting that the effect of AP dispersal pattern could be substantially marked. Note that the peak AP was delayed in 2011 when compared with other yr. Interactive and relevant factors such as the relative AP levels, symptoms and QoL were important; however, whether pollens were gradually released, or were released en masse, and the AP dispersal pattern were factors critical for inducing symptomatic changes and thereof resulted in different QoL outcomes. Because of yearly changes in the AP pattern due to the global environmental changes (weather, temperature and wind direction, etc.), it is important to be able to predict the AP levels on a yearly basis. Future accurate and concrete information of AP levels disseminated by the mass media i s desirable. Additionally, individual sensitivity is also associated with the two symptom-exacerbating factors of pollinosis (i.e. high AP levels, and meager CP-pooling). As we did not examine individual CP sensitivity in this study, attention on this aspect is warranted in future study.

Based on the normal Johns ESS value of 5.9,[8] the ESS scores for all study yr were high: viz., ca. 50% o f JCP patients suffered from moderate–severe ESS. Additionally, daytime sleepiness was reported in study yr with high AP levels. AR patients have been reported to experience more daytime sleepiness than normal individuals.[9] The present findings on JCP patients were comparable to that reported by Boris,[9] where JCP patients registered ESS of 6.8±2.7 and 8.2±3.4 before and during the AP dispersal season, respectively. In the present study, subjects were studied during the AP dispersal seasons, and daytime sleepiness has been reported to to increase during the AP dispersal seasons.[10] Therefore, studies and appropriating AR-preventive treatment of daytime sleepiness before AP dispersal season are warranted.

JCP treatment generally recommends early-stage treatment prior to AP dispersal: viz., the more frequent/regular the medication us e during the early-stage, the more the symptomatic severity is reduced.[11] However, 46.7% of the non-treatment (NT) group indicated symptomatic attenuation in this study. In fact, patients were not informed or were not aware of the necessity of m e d i c a t i o n p r e t r e a t m e n t, probably due to not having visited hospitals/clinics as a result of time constraint related to work and other factors. In addition, the OTC group indicated higher ESS scores than the PMT group, along with more intense and longer daytime sleepiness accompanied by poor TSS and QoL scores. OTC treatment,

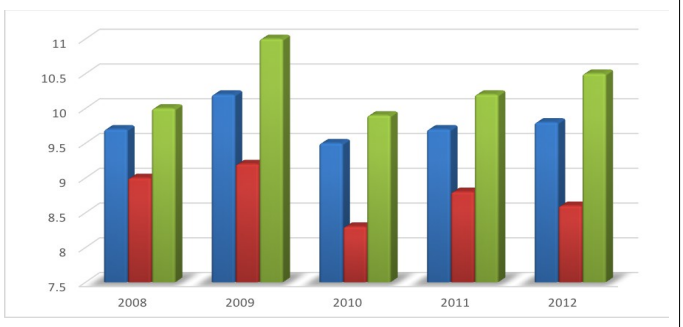

Fig. 5: Comparison of total ESS scores (ordinate) between gender in the 5-yr study (2008-2012).

Note that significant (p <0.05) differences in total ESS scores between male (red) and female (green) of all participants (blue) were verified with the non-paired t-test.

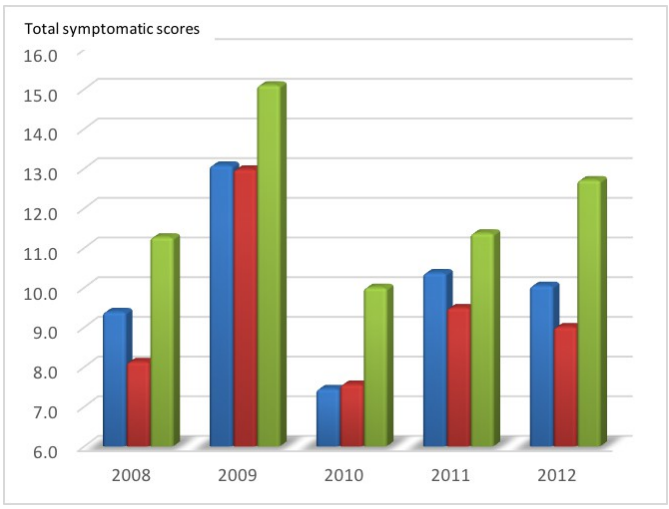

Fig. 6: Correlation of total symptomatic scores (TSS) with treatment behavior of patients. Compared with the non-treatment (NT; blue) and prescription-based treatment (PMT: red) groups, the OTC (green) group suffered the most unwanted symptomatic tendency in all yr studied.

where first-generation anti-histaminics are common, is more likely to yield adverse central nervous system depressive effects accompanied by sleepiness. As such, exacerbated symptoms with elevated QoL impairments have been observed compared with patients treated with prescribed medications.[12] Furthermore, patients in the younger age-groups tended to be in the OTC group. Although the purchase and use of OTC for quick relief may be advantageous in terms of convenience, availability and economic viability, it is desirable that proper professional advice on the dosage, use, and choice of products (including expected adverse effects) be provided to this younger cohort.

All in all, over all the yr studied, those visiting clinic/hospitals for diagnosis nd treatment were more likely to be female than male. This could be due to better access to diagnosis, medication, treatment options on the part of part-time worker and home-makers (who are usually female) compared to male patients who may experience greater time constraints related to work and similar factors. As a result, male JCP patients are more likely to be in the NT group.

Based on the present study, we surmise that when pollinosis symptoms exacerbated, patients tended to lose mental concentration, reduce outdoor activity, and experience impairments in their daily life. Visiting clinics/hospitals before AP dispersal onset or season, regular follow-up visits as outpatients to clinics/hospitals, and other daily countermeasures against pollinosis (e.g. wearing a mask/google when going outdoors, using clothing that resists pollen adherence, handwashing, cleaning living areas, and other efforts to reduce AP levels in and out of the home) are necessary to reduce unwanted symptoms and AP-induced sufferings in JCP patients.

However, several limitations were encountered in our study: i) study on the same participants was not able to follow-up throughout the study period, and therefore introducing inevitable bias in the study; and ii) the exact work conditions and socio-economical position of the participants were not revealed by the questionnaire. As previous studies have pointed out the effects of residence site, educational level, and physical habits on physical condition on the physical condition, QoL, and medication type used,[14-16] re-designing a more useful questionnaire to facilitate providing more relevant factors without placing burden on participants, and thereby yielding more comprehensive and concrete results, is required in future study.

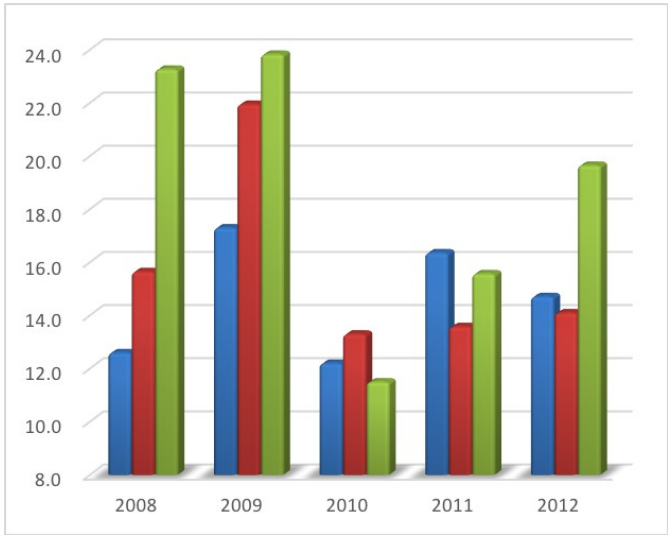

Fig. 7: Correlation of total QoL scores (ordinate) with treatment behavior of participants indicted that the oral OTC-treated group (OTC; green) manifested an unfavorable tendency compared with the non-treatment (NT; blue) and prescription-based treatment (PMT; red) in total QoL scores for all yr (2008-2012) studied, except 2010.

5. Conclusions

JCP, a chronic and intractable disease, affects 30% of the Japanese population. The age of onset is fast becoming lower than before, and the number of JCP patients is bound to increase with time under the present conditions: JCP is indeed a disease of high medical concern. The present study found that symptomatic exacerbation, greater QoL impairments, along with elevated daytime sleepiness accompanied increases in AP levels. As symptomatic severity exacerbates without JCP treatment, it is desirable that affected pa-

tients should obtain more accurate and reliable information on AP levels, and visit relevant clinics/hospitals for early-stage treatment with adoption of individually designed preventive daily self-care methods prior to AP dispersal onset or season.

6. References

1. Practical Guideline for the Management of Allergic Rhinitis in Japan, Making Committee of Practical Guideline for the Management of Allergic Rhinitis in Japan. Life Science Co, Tokyo(2013).
2. Nobuaki H, Hideaki S, Tsuyoshi U, et al. Snoring, daytime sleepiness, and nasal obstruction with or without allergic rhinitis. Otolarygol Head and Surgery 2008; 134(12): 1254-7.
3. Jauregui I, Mullol J, Davila I, et al. Allergic rhinitis and school performance. J Investing Allergol Clin Immunol 2009; 19: 32-9.
4. Shintaro C : Examination about the quality of the sleep in the chronic allergic rhinitis patient. Sleep medicine Japan 2 : 337-342, 2008
5. Kanzaki A, Aoyanagi T, Ikari T, et al. Examination of the primary care effect in plural age of Talion in the cedar pollinosis. Progress in Medicine 2008;28:2245-2252.
6. Tsukada K, Fukuoka K, Usami S. The effectiveness of Ebastine for chronic allergic rhinitis-Examination using JRQLQ. Journal of New Remedies & Clinics 2008;57:1483-1491.
7. Okuda M, Ohkubo K, Goto M, et al : Comparative study of two Japanese rhinoconjunctivitis quality-of-life questionnaires. Acta Oto-Laryngologica 2005 ; 125 : 736-744.
8. Murray W. Johns. A New Method for Measuring Daytime Sleepiness: The Epworth Sleepiness Scale. Sleep 1991; 14(6): 540-545.
9. Boris A stuck, Julia Czajkowski, Anna-Eva Hanger, et al. Change in daytime sleepiness, quality of life, and objective sleep patterns in seasonal allergic rhinitis: a controlled clinical trial. J Allergy clin Immunol 2004; 113:663-668
10. Nobuo O, Yusuke S, Takanari G, et al: QOL and sleep disorder of the ceda r pollinosis patient. Allergology & Immunclogy 2010 ; 17(2) : 90-97
11. Momoha K, Junko Y, Yuri S, et al. The effectiveness of the pranlukast primary care for the cedar pollinosis (the third report). Allergology & immunology 2010;17(11) : 98-106.
12. Yuksel H, Sogut A, Yilmaz H, et al. Sleep Actigraphy evidence of improved sleep after treatment of allergic rhinitis. Annals of Allergy, Asthma, and Immunology 2009; 103(4): 290-4.
13. Muliol J, Maurer M, Bousquet J. Sleep and allergic rhinitis. Journal of Investigational Allergology and Clinical Immunology 2008; 18(6): 415-9.
14. Storms W. Allergic rhinitis-induced nasal congestion: its impact on sleep quality. Primary Care Respiratory Journal 2008; 17(1): 7-18.
15. Craig TJ, Ferguson BJ, Krouse JH. Sleep impairment in allergic rhinitis, rhinosinusitis, and nasal polyposis. American Journal of Otolaryngology 2008; 29(3): 209-17.
16. Polosa Riccardo, Russo Cristina, Caponnetto Pasquale, et al. Greater severity of new onset asthma in allergic subjects who smoke: a 10-year longitudinal study. Respiratory Research 2011;24(12):12-16.