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CLINICAL INVESTIGATION

T. Hikichi · A. Yoshida
Y. Fukui · T. Hamano
M. Ri · K. Araki
K. Horimoto · E. Takamura
K. Kitagawa · M. Oyama
Y. Danjo · S. Kondo
H. Fujishima · I. Toda
K. Tsubota

Prevalence of dry eye in Japanese eye centers

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T. Hikichi[1] · A. Yoshida
Department of Ophthalmology,
Asahikawa Medical College,
Nishikagura 4-5, Asahikawa 078, Japan

T. Hikichi (✉)
Schepens Retina Associates,
100 Charles River Plazza,
Boston MA 02114, USA,
Tel. +1-617-523-7800

T. Hikichi · Y. Fukui
Department of Ophthalmology,
Kushiro Red Cross Hospital,
Kushiro, Japan

T. Hamano · M. Ri · K. Araki
K. Horimoto
Department of Ophthalmology,
Osaka Seamen's Insurance Hospital,
Osaka, Japan

E. Takamura
Department of Ophthalmology,
Tokyo Women's Medical College,
Tokyo, Japan

K. Kitagawa · M. Oyama
Department of Ophthalmology,
Kanazawa Medical College,
Kanazawa, Japan

Y. Danjo
Department of Ophthalmology,
Osaka National Hospital,
Osaka, Japan

S. Kondo
Department of Ophthalmology,
Kumamoto University
Faculty of Medicine, Kumamoto, Japan

H. Fujishima · I. Toda · K. Tsubota
Department of Ophthalmology,
Tokyo Dental College,
Ichikawa General Hospital, Ichikawa,
Japan

H. Fujishima · K. Tsubota
Department of Ophthalmology,
Kameda General Hospital
Makuhari Clinic, Chiba, Japan
[1]offprint requests

Abstract ● Background: The purpose of the investigation was to ascertain the prevalence of dry eye in new outpatients. ● Methods: A total of 2127 consecutive new outpatients seen in eight Japanese centers from April 1992 to January 1993 underwent comprehensive examinations, including double vital staining and measurement of tear film break-up time, basal tear secretion, and tear clearance. Dry eye was diagnosed if patients had abnormalities of both the tear film and the ocular surface. ● Results: Three hundred fifty-nine patients (17%) had dry eye. There was no seasonal pattern for dry eye. The condition was significantly more common in Tokyo than in suburban areas ($P < 0.01$). The prevalence of dry eye in visual display terminal (VDT) users and contact lens (CL) wearers was significantly higher than in non-VDT users and non-CL wearers ($P < 0.05$ and $P < 0.02$, respectively). ● Conclusion: Our findings suggest that dry eye is one of the most common ocular disorders encountered by physicians. Furthermore, if patients use VDTs or wear CLs, the likelihood of dry eye occurring is higher.

Introduction

In 1991, nearly 25 million employees in the United States reportedly used video display terminals (VDTs) in the workplace, and the number continues to increase [6]. Many persons have complained of ocular fatigue after prolonged periods in front of VDTs, in part prompting enactment of legislation regulating the use of these devices [18]. Because dry eye is a major cause of ocular fatigue [16], the use of VDTs is believed to exacerbate desiccation of the ocular surface. Indeed, VDTs have been associated with a decreased blink rate and an increased tear evaporation rate, both of which could contribute to dry eye development [18].

Until several years ago, the term dry eye implied only tear volume deficiency, which was associated mainly with Sjögren's syndrome [1]. With heightened awareness

of dry eye, however, the term now includes a variety of tear film abnormalities arising from multiple causes, such as aqueous or mucin deficiency, lipid abnormality, impaired lid function, or corneal or conjunctival epitheliopathy [3, 4, 10, 13]. As the definition of dry eye broadens, there will be more patients who can be considered to suffer from the condition.

While information on the prevalence of dry eye is thus of considerable epidemiologic interest with potential diagnostic and treatment ramifications, to the best of our knowledge, no prevalence study has ever been undertaken. We report here the findings of an investigation into the prevalence of dry eye in new outpatients in Japanese eye centers.

Patients and methods

All new outpatients, excluding 89 patients referred for complaints of dry eye and all patients less than 10 years old, were examined in the Departments of Ophthalmology of Kumamoto University Faculty of Medicine, Osaka National Hospital, Osaka Seamen's Insurance Hospital, Kanazawa Medical University, Tokyo Women's Medical College, Kameda General Hospital Makuhari Clinic, Tokyo Dental College Ichikawa General Hospital, and Kushiro Red Cross Hospital in April, June, and October 1992 and January 1993. A total of 15 investigators participated.

The 2127 patients enrolled in the study included 1277 females and 850 males ranging in age from 10 to 92 years (median 47 years; Fig. 1). They all gave informed consent, and were asked to record their complaints on questionnaires before their physical examinations (Table 1).

All subjects had complete ocular examinations that were performed on the same day and in the following order: (1) double vital staining [16] (free of preservative and topical anesthesia, 1% rose bengal – 1% fluorescein mixed solution, 2 μl volume instilled by micropipette) with intensities scored according to van Bijsterveld's method [19] and tear film break-up time (BUT), (2) cotton thread test [9], and (3) the basal tear secretion measurement and fluorescein dilution test performed as previously reported [14]. A 10-μl drop of 0.5% fluorescein in oxybuprocaine (Benoxyl, Santen Pharmaceutical, Osaka, Japan) drops was instilled by micropipette. Five minutes later, the Schirmer test was performed for 5 min and the rate of fluorescein dilution was determined by comparing Schirmer strip color with standards. To avoid investigator bias, the examiners had no prior knowledge of the questionnaire results. The same diagnostic criteria and materials were used in each center to prevent the results from varying among the clinics. The diagnostic criteria and materials were well known by every participating investigator from the study onset, and every effort was made to avoid diagnostic variability among investigators.

Table 1 Criteria for diagnosing dry eye. Patients who fulfilled all three criteria were considered to have dry eye

1. Chronic symptoms
   More than one of the following items on questionnaire:
   (1) eye fatigue, (2) eye discharge, (3) foreign body sensation, (4) heavy sensation, (5) dry sensation, (6) uncomfortable sensation, (7) pain, (8) excess tearing, (9) blurred vision, (10) itching, (11) sensitivity to bright light, (12) redness
2. Vital staining test
   Rose bengal score ≥ 3 or fluorescein score ≥ 1
3. Tear evaluation test
   Tear film break-up time ≤ 5 s, Schirmer test with anesthesia ≤ 5 mm, cotton thread test ≤ 10 mm, or tear fluid dilution test $\leq$x4

Exclusions
Trichiasis, foreign bodies

Dry eye was diagnosed if a patient had any symptoms, was positive for at least one of the two vital staining tests, and was positive for at least one of the four tear dynamics tests (Table 1). These dry eye cases corresponded to grade 2 (moderate) or 3 (severe) of the classification of Lemp and Chacko [13].

For the purposes of determining regional patterns, the Tokyo results included patients from Tokyo Women's Medical College, Kameda General Hospital Makuhari Clinic, and Tokyo Dental College; the Osaka results included patients from Osaka National Hospital and Osaka Seamen's Insurance Hospital.

The chi-square test and the Mann-Whitney *U*-test were used for statistical analysis.

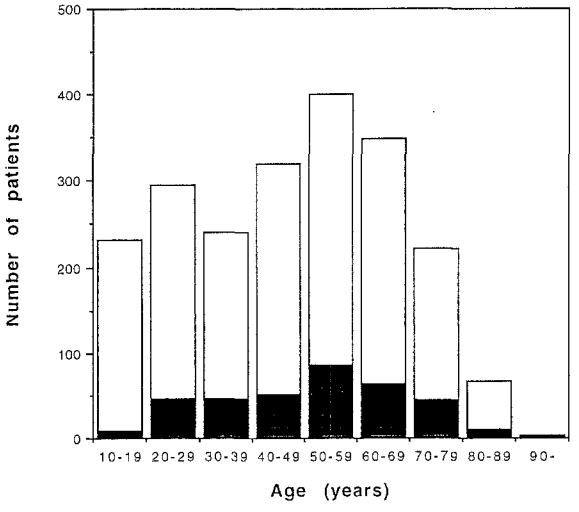

Fig. 1 Age distribution of patients. *Black bars* Patients with dry eye, *white bars* patients without dry eye

Results

Of 2127 patients, 359 (17%; 257 females, 102 males; median age 51 years, range 11–90 years) had dry eye. The prevalence of dry eye was significantly higher in females (20%) than in males (12%) ($P < 0.01$).

Figure 2 shows the prevalence of dry eye in each decade of life. Dry eye was significantly less common in the second decade (4%, 9/232) than in the third to ninth decades (15%, 46/297; 19%, 46/241; 16%, 52/320; 22%, 86/399; 18%, 64/348; 20%, 44/221; and 17%, 11/66, respectively) ($P < 0.01$). One of the three patients in the tenth decade of life had dry eye.

The prevalence of dry eye in April, June, October, and January, respectively, was as follows: 16% (96/611), 16% (102/631), 18% (84/480), and 18% (74/405). There was no significant seasonal variation.

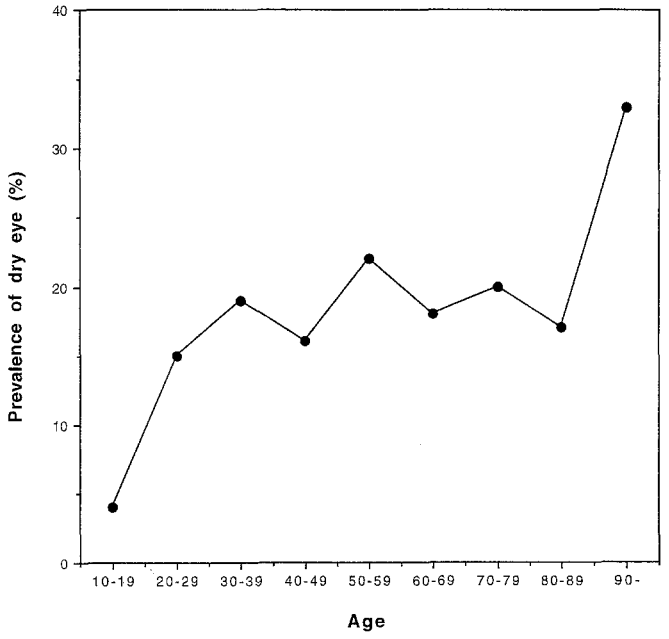

Fig. 2 The prevalence of dry eye as a function of patient age. Dry eye was significantly less common in the second decade of life than in the third to ninth decades ($P < 0.01$)

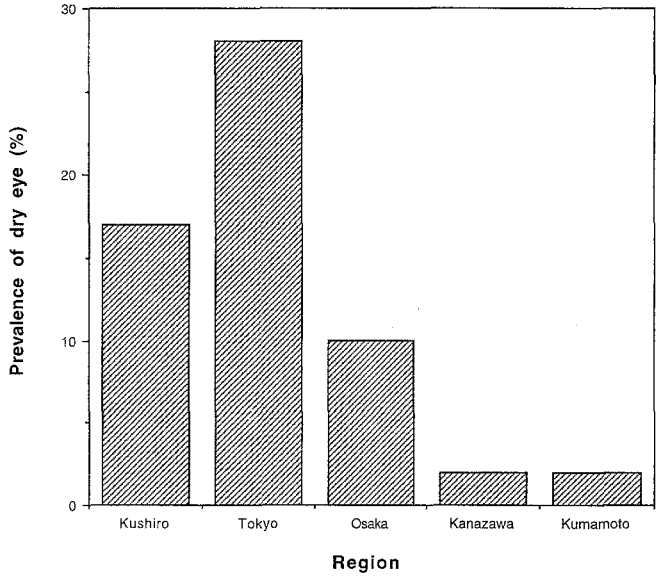

Fig. 3 The prevalence of dry eye according to location. The prevalence was significantly higher in Tokyo than in the other regions ($P < 0.01$)

In Tokyo, the prevalence of dry eye among new outpatients was 28% (219/786), which was significantly higher than in other regions ($P < 0.01$). The prevalence of dry eye in the other regions was as follows: Kushiro, 17% (84/508); Kanazawa, 2% (1/55); Osaka, 10% (47/456); and Kumamoto, 2% (8/322) (Fig. 3).

Of all patients, 133 (6%) used VDTs (median age 49 years) and 165 (8%) wore contact lenses (CL; median age 30 years). Of the VDT users, 30 (23%) had dry eye (median age 51 years), while of the CL wearers, 41 (25%) had dry eye (median age 34 years). The prevalence of dry eye in VDT users and in CL wearers was significantly higher than in non-VDT users and non-CL wearers ($P < 0.05$ and $P < 0.02$, respectively).

Discussion

We have shown that as many as 17% of outpatients in general eye clinics have some signs or symptoms of dry eye. This is much higher than the prevalence of cataract (12.3%) or open-angle glaucoma (1.9%) in the Framingham Eye Study [11]. The patient populations of the two studies differed, and it is uncertain how accurately our subjects represent the general population. Nevertheless, this first study of the prevalence of dry eye demonstrates that the disease is widespread, probably much more so than previously thought.

Patients with dry eye are reportedly extremely sensitive to environmental changes [3, 4, 10, 13, 15, 17]. In Japan, the temperature and humidity vary considerably by season. However, in the current series, the prevalence of dry eye did not differ significantly by season. On the other hand, the prevalence was significantly higher in Tokyo, which is one of the largest urban areas in the world and is plagued by air pollution. Moreover, many urban employees are white collar workers, who are much more likely to use VDTs and be in air-conditioned workplaces than are their blue collar counterparts. In our study, it was the indoor rather than the outdoor environment that tended to cause or exacerbate dry eye disease.

Our findings of an association between CL use and dry eye are consistent with previous reports [2, 4, 5, 7, 8, 12]. The prevalence of dry eye in VDT users and CL wearers was significantly higher than in non-VDT users or non-CL wearers. In our study, the median ages of VDT users and CL wearers were lower than that of the total patient population. However, since the prevalence of dry eye was not significantly different among the third to ninth decades of life, the differences in median age should not influence the prevalence of dry eye in each group.

Because our subjects do not represent a random sampling, we cannot determine the prevalence of dry eye in the general population. However, our findings do suggest that dry eye is one of the most common ocular disorders encountered by physicians. Furthermore, if patients use VDTs or wear CLs, the likelihood of dry eye occurring is higher. Ophthalmologists and other clinicians should be aware of the increasing prevalence of dry eye.

Further studies must be conducted to investigate the importance of iatrogenic risk factors for dry eye, such as use of sleeping pills or eye drops containing preservatives.

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