

Decreased tear volume in patients with metabolic syndrome: the Osaka study

Dry eye is highly prevalent worldwide and its incidence is known to increase with age. Several clinical studies have demonstrated reduced tear secretion in older people, indicating that lacrimal gland function decreases gradually with age.¹

It has been reported that Excess caloric intake accelerates the aging process, and

Table 1 Volume of tear secretion in patients with MetS or pre-MetS and those without MetS (non-MetS)

	MetS	pre-MetS	non-MetS	Total	p Value (MetS vs non-MetS)	p Value (MetS vs pre-MetS)
n (men:women)	47 (44:3)	56 (55:1)	264 (171:93)	367 (270:97)	–	–
Age 40–49 years	15	34	179	228	–	–
Age 50–64 years	32	22	85	139	–	–
Tear volume by Schirmer test	11.0±9.7	16.4±10.2	18.5±11.9	17.2±11.7	0.000	0.007
Age 40–49 years	15.2±10.8	17.6±11.3	20.5±11.8	19.7±11.8	0.095	0.493
Age 50–64 years	9.0±8.6	14.6±8.2	14.4±11.1	13.2±10.3	0.015	0.021
Prevalence of lacrimal gland hypofunction (Schirmer value ≤5 mm)	16 (34.0%)	10 (17.9%)	45 (17.0%)	71 (19.3%)	0.009	0.071

Values of $p < 0.05$ were considered significant and are highlighted in bold. Statistical analysis: t test. A Schirmer value < 5 mm indicated lacrimal gland hypofunction according to the dry eye workshop definition.⁶ Additional analysis about smoking is available as a supplemental table. MetS, metabolic syndrome.

conclude that MetS is associated with an increase in the incidence of lacrimal gland hypofunction. Thus, clinicians should be more aware of lacrimal gland hypofunction in MetS.

Motoko Kawashima,¹ Miki Uchino,¹ Norihiko Yokoi,² Murat Dogru,¹ Yuichi Uchino,¹ Aoi Komuro,² Yukiko Sonomura,² Hiroaki Kato,² Shigeru Kinoshita,² Kazuo Tsubota¹

¹Department of Ophthalmology, Keio University School of Medicine, Tokyo, Japan

²Department of Ophthalmology, Kyoto Prefectural University of Medicine, Kyoto, Kyoto, Japan

Correspondence to Dr Motoko Kawashima, Department of Ophthalmology, Keio University School of Medicine, 35 Shinanomachi, Shinjuku-ku, Tokyo 160-8582, Japan; motoko-k@a3.keio.jp

Contributors MU, NY, YU, MD, MK, SK, KT: conception and design of study; MK, MU: analysis and interpretation; MK, KT: writing the article; MK, KT: critical revision of the article; MU, NY, YU, MD, MK, AK, YS, HK, SK, DA, KT: final approval of the article; MU, NY, YU, MD, MK, AK, YS, HK: data of collection; MU, YU, NY, MD: provision of materials, patients or resources; MU, MK: statistical expertise.

Competing interests This study was a collaborative investigation with the Dry Eye Society. Provision of facilities, transport of equipment, data analysis and data management were supported by Santen Pharmaceutical Co, Osaka. The funding organisation had no role in the design or conduct of this research. The authors have no proprietary or commercial interest in any of the materials discussed in this article.

Patient consent Obtained.

Ethics approval Institutional Review Board of Ryogoku Eye Clinic Tokyo, Japan.

Provenance and peer review Not commissioned; externally peer reviewed.

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/bjophthalmol-2013-303953>)



OPEN ACCESS



Open Access
Scan to access more
free content

Open Access This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 3.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/3.0/>



To cite Kawashima M, Uchino M, Yokoi N, et al. *Br J Ophthalmol* 2014;**98**:418–420.

Received 4 July 2013
Revised 6 October 2013

increases the risks for age-related diseases.² Metabolic syndrome (MetS) is a complex disorder defined by a cluster of interconnected factors that increase the risk of atherosclerotic cardiovascular diseases and type 2 diabetes. Unfortunately, dry eye is often overlooked in this context and no study has investigated whether tear secretion decreases in MetS.

METHODS

A cross-sectional survey was conducted in 2011 among all employees of a company in Osaka, Japan (N=672; age range 26–64 years). Tear volume was measured using the Schirmer 1 method. Participants aged ≥ 40 years were also examined for MetS.³ MetS was diagnosed using the Japanese criteria defined in 2008. Briefly, the diagnostic criteria for MetS are as follows: waist circumference ≥ 85 cm for men and ≥ 90 cm for women, as an essential component, along with two or more other components; dyslipidemia (triglyceride level ≥ 150 mg/dL and/or high-density lipoprotein cholesterol (HDL-C) level < 40 mg/dL); hypertension (systolic blood pressure ≥ 130 mm Hg and/or diastolic blood pressure ≥ 85 mm Hg); or hyperglycaemia (fasting plasma glucose level ≥ 110 mg/dL). For the diagnosis of pre-MetS, a patient was required to fulfil the criterion of abdominal obesity and one of the other three MetS diagnosis criteria.

RESULTS

The survey response rate was 83.5% (561 of 672). Schirmer values were significantly lower in participants aged ≥ 50 years (13.1 \pm 10.3 mm, n=141) compared with those aged < 40 years and those in their 40s (21.5 \pm 11.4 mm in those aged < 40 years

(n=189, $p=0.000$) and 19.8 \pm 11.8 mm in those aged 40–49 years (n=231, $p=0.000$)).

Of the 372 participants aged ≥ 40 years, 367 underwent an examination for MetS. The prevalence of MetS was found to be 12.8% (47/367). The volume of tear secretion was significantly lower in the MetS group (11.0 \pm 9.7 mm) than in the non-MetS and pre-MetS groups ($p=0.000$, $p=0.007$, respectively). The prevalence of lacrimal gland hypofunction was significantly higher in the MetS group (34.0%) than in the pre-MetS and non-MetS groups (17.9% and 17.0%, respectively) (table 1).

COMMENT

Here, we confirmed an age-dependent decrease in tear secretion by showing reduced tear volume in participants aged ≥ 50 years compared with those aged 40–49 years. We also found that MetS influences tear secretion volume, since the prevalence of lacrimal gland hypofunction in the MetS group (34.0%) was approximately twofold that of the non-MetS group.

Due to genetic and environmental differences, the obesity rate in Japan is not as high as that in the West. However, the Japanese are reported to be more susceptible to damage from MetS than are the Europeans or Americans.⁴ Moreover, lifestyle changes among the Japanese have increased the prevalence of MetS, primarily in the working-age population. Furthermore, a previous study reported that 73% of those aged ≥ 60 years have dry eye, indicating a higher incidence of dry eye in the older Japanese population.⁵

Taken together, our study shows that aging is an important risk factor for dry eye and MetS may have an influence on the increasing prevalence of dry eye. We

Accepted 30 December 2013
Published Online First 16 December 2013

Br J Ophthalmol 2014;**98**:418–420.
doi:10.1136/bjophthalmol-2013-303953

REFERENCES

- 1 The epidemiology of dry eye disease: report of the Epidemiology Subcommittee of the International Dry Eye WorkShop (2007). *Ocul Surf* 2007;5:93–107.
- 2 Tsubota K, Kawashima M, Inaba T, *et al*. The era of antiaging ophthalmology comes of age: antiaging approach for dry eye treatment. *Ophthalmic Res* 2010;44:146–54.
- 3 Ministry of Health, Labour and Welfare. Specified Medical Checkup and Health Education for Metabolic syndrome (final edition) 2007. <http://www.mhlw.go.jp/bunya/kenkou/seikatsu> in Japanese).
- 4 Kadowaki T, Sekikawa A, Okamura T, *et al*. Higher levels of adiponectin in American than in Japanese men despite obesity. *Metabolism* 2006;55:1561–3.
- 5 Uchino M, Dogru M, Yagi Y, *et al*. The features of dry eye disease in a Japanese elderly population. *Optom Vis Sci* 2006;83:797–802.
- 6 The definition and classification of dry eye disease: report of the Definition and Classification Subcommittee of the International Dry Eye WorkShop (2007). *Ocul Surf* 2007;5:75–92.

Supplement table : Smoking affects schirmer value

Smoking	MetS			pre-MetS			non-MetS			total		
	No	Yes	<i>P</i>	No	Yes	<i>P</i>	No	Yes	<i>P</i>	No	Yes	<i>P</i>
N	30	17		37	19		218	46		285	82	
Tear volume by Schirmer test (mean±SD, mm) 2]	12.6±10.1	8.2±8.5	0.138	18.6±11.3	12.1±5.9	0.023	19.3±11.9	15.1±11.5	0.033	18.5±11.8	13.0±10.2	0.000
Schirmer value ≤ 5 mm)(N(%)) 1]	7 (23.3)	9 (52.9)	0.057	8 (21.6)	2 (10.5)	0.467	35 (16.1)	10 (21.7)	0.388	50 (17.5)	21 (25.6)	0.114
Schirmer value >5mm (N(%))	23 (76.7)	8 (47.1)		29 (78.4)	17 (89.5)		183 (83.9)	36 (78.3)		235 (82.5)	61 (74.4)	

Statistical analysis: 1) Fisher's exact test , 2) t-test