

## 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.<sup>1</sup>

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	<b>0.000</b>	<b>0.007</b>
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	<b>0.015</b>	<b>0.021</b>
Prevalence of lacrimal gland hypofunction (Schirmer value ≤5 mm)	16 (34.0%)	10 (17.9%)	45 (17.0%)	71 (19.3%)	<b>0.009</b>	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.<sup>6</sup> 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.

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increases the risks for age-related diseases.<sup>2</sup> 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  $\geq 40$  years were also examined for MetS.<sup>3</sup> MetS was diagnosed using the Japanese criteria defined in 2008. Briefly, the diagnostic criteria for MetS are as follows: waist circumference  $\geq 85$  cm for men and  $\geq 90$  cm for women, as an essential component, along with two or more other components; dyslipidemia (triglyceride level  $\geq 150$  mg/dL and/or high-density lipoprotein cholesterol (HDL-C) level  $< 40$  mg/dL); hypertension (systolic blood pressure  $\geq 130$  mm Hg and/or diastolic blood pressure  $\geq 85$  mm Hg); or hyperglycaemia (fasting plasma glucose level  $\geq 110$  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  $\geq 50$  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  $\geq 40$  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  $\geq 50$  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.<sup>4</sup> 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  $\geq 60$  years have dry eye, indicating a higher incidence of dry eye in the older Japanese population.<sup>5</sup>

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

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**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