Prevalence of and related risk factors in oral mucosa diseases among residents in the Baoshan District of Shanghai, China

Jianing Lou[1], Lin Liu[2,5], Qi Zhou[3], Binbin Lou[1], Zengtong Zhou[4], Yuan Fan[2,5*]

[1] Department of Stomatology, Shanghai General Hospital of Nanjing Medical University, Shanghai 201620, P. R. China

[2] Jiangsu Key Laboratory of Oral Diseases, Nanjing Medical University, Nanjing, P. R. China

[3] Medical Association Office of Shanghai Baoshan District; Shanghai 201900, P. R. China

[4] Department of Oral Medicine, Shanghai Key Laboratory of Stomatology, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai 200011, P. R. China

[5] Department of Oral Medicine, Affiliated Hospital of Stomatology, Nanjing Medical University, Nanjing, P. R. China

Corresponding Author:
Yuan Fan
Jiangsu Key Laboratory of Oral Diseases, Nanjing Medical University, Nanjing, China
Email address: fanyuan@njmu.edu.cn

Abstract

Background: Oral mucosal diseases (OMDs) encompass a variety of different types of diseases. Our aim was to evaluate the prevalence and related risk factors of OMDs among residents in the Baoshan District of Shanghai, China, and provide a scientific basis for prevention and control strategies.

Methods: A sample of 653 residents aged 17 to 92 years from the Baoshan community was investigated in 2014. Each resident was surveyed by questionnaire to evaluate their oral mucosa and oral mucosa examinations were conducted. We followed up with 607 residents in 2018. All data were statistically analyzed using the SPSS 25.0 software package (Chicago, IL, USA) at the general population, gender and age levels. A X^2 test was used to compare rates of risk factors and logistic regression analysis was used to detect the correlation between disease and risk factors.

Results: The prevalence rate of OMDs was found to be 9.19%-9.56% (2014-2018). The most common OMDs were atrophic glossitis (1.84%), recurrent aphthous ulcer (RAU, 1.68%), burning mouth syndrome (BMS, 1.38%), oral lichen planus (OLP, 1.23%) and traumatic ulcers (1.23%). The prevalence of RAU and BMS in different age groups was significantly different. Tobacco and alcohol use and psychological factors in the OMDs group were higher than the no-OMDs group. Systemic diseases including diabetes mellitus (DM) was significantly relevant to OLP.

Conclusion: Age, tobacco and alcohol use, and psychological factor correlated strongly with the occurrence and development of OMDs, and they should be the focus of primary prevention. General epidemiological studies suggested that OLP was closely related to DM.

Keywords: Diabetes mellitus, epidemiology investigation, oral lichen planus, oral mucosal diseases, prevalence rate, risk factors

53 **Introduction:**

54 Oral mucosal diseases (OMDs) occur in the oral mucosa and most of them are associated with

55 systemic diseases (Porter, Mercadante & Fedele, 2017). The various kinds of OMDs include

56 recurrent aphthous ulcer (RAU), burning mouth syndrome (BMS), oral lichen planus (OLP), oral

57 leukoplakia (OLK), oral erythroplakia (OE), traumatic ulcers, and so on. Except for traumatic

58 ulcers, the etiology of most OMDs is unknown. Some of these diseases have potential

59 malignancies that seriously affect quality of life and are even fatal. Oral Potentially Malignant

60 Disorders (OPMDs) refers to diseases that may cause oral cancer (Wang et al., 2014; Dionne et

61 al., 2015). OLP is a common OPMDs, with a prevalence rate of 0.1%-4.0% (Kurago, 2016) and

62 a cancerization rate of 0%-12% (van der Meij, Schepman & van der Waal, 2003). OLK is

63 another common OPMDs, with a cancerization rate of 10-30% and an average time to cancer

64 onset of 4.0-8.1 years (Petti, 2003; Warnakulasuriya et al., 2011). OE is the most cancer-prone

65 OPMDs, with a cancerization rate as high as 50% (Villa, Villa & Abati, 2011).

66   Most of the causes of OPMDs are complex, and their pathogenesis and cancerous

67 mechanism are unclear. Generally, there are no specific treatments and no effective chemical

68 prophylaxis drugs for cancer (Ribeiro et al., 2010; van Monsjou et al., 2013). OPMDs have a

69 poor prognosis and the overall cancerization rate is close to 4.32% (Wang et al., 2014). Due to

70 the prolonged course of the disorder, and the risk of cancer, patients often suffer physical and

71 mental pain. Early diagnosis of OPMDs is of great significance for the prevention of oral

72 malignant tumors (McCullough, Prasad & Farah, 2010; Amagasa, Yamashiro & Uzawa, 2011).

73   Shanghai, with a population of more than 24 million, was chosen as the location of the

74 study because work stress, mental stress, environmental changes, dietary changes and accelerated

75 life rhythms are thought to increase the prevalence of OMDs. Therefore, it is of great interest to

76 understand the epidemiological characteristics of OMDs in this city and analyze the risk factors

77 associated with those diseases. Early prevention and treatment of OMDs and early detection of

78 high-risk groups of oral cancer will improve people's quality of life.

79   The prevalence of OMDs was studied in a cross-sectional study using general

80   epidemiology. Our subjects were either selected from the general population in the Shanghai

81   region or were oral outpatients. There is currently little available data on the OMDs in the

82   Shanghai population. In the last 30 years, epidemiological investigations of OMDs have been

83   mostly based on analysis of clinical data, or case-controlled studies (Ikeda et al., 1995; Mumcu et

84   al., 2005; Splieth et al., 2007; Pentenero et al., 2008; Mansour Ghanaei et al., 2013; Do et al.,

85   2014;).

86   Little work has been done in the epidemiology of OMDs, especially descriptive

87   epidemiology; most previous studies are investigations of specific age groups or special diseases

88   (Xu et al., 1981; Qi, 2008). In order to make an accurate diagnosis of an OMD, good theoretical

89   knowledge and sufficient clinical experience was required, especially considering the low

90   prevalence of OMDs in the general population and large sample size in the survey.

91   In this article, we report on the epidemiological characteristics of OMDs in the Baoshan

92   District of Shanghai, analyze the risk factors of the diseases to better understand prevalence and

93   epidemic characteristics, and establish a scientific basis for the prevention and treatment of

94   OMDs.

95

Materials and methods:

Research objectives

98   We used multistage stratified random sampling and field surveys to investigate the population of

99   the Baoshan District of Shanghai in 2014. Four neighborhood committees were selected by a

100   random cluster method, and entire families were selected for oral examination according to

101   house number. We calculated maximum sample size using the OMD prevalence rate of 14.93%

102   (range 14.93-29.3% according to Xu et al., 1981;Cao et al., 1988). The formula [$n = t^2 * p / d$

103   $(1 - P)^2$, $p = 14.93\%$, $d = 0.1 * p$, take $\alpha = 0.05$, $t = 1.96$] yielded a theoretical figure of 2189

104   people. Unfortunately, this study was only able to sample 653 people. We conducted follow up

105   with patients 4 years later to assess the long-term effects of persistent risk factors on the course

106   of the disease. The procedures were approved by the Ethical Committee of the Stomatological

107   Hospital Affiliated to Nanjing Medical University (PJ2014-132) and the ethical committee of

108   Shanghai First People's Hospital (2019KY063).

109

110   ***Questionnaire design and oral mucosa examination***

111   The survey was prepared according to the World Health Organization's (2013, WHO) oral health

112   assessment form guidelines. It was designed to evaluate the condition of the oral mucosa. The

113   questionnaire includes demographics (name, gender, age, nationality, place of birth, length of

114   residence in Shanghai, education level, marital status, occupation, etc.), smoking habits (current,

115   former or never), drinking habits (current, former or never), systemic disease (diabetes,

116   hypertension, coronary heart disease and cerebrovascular diseases), and mental status (stress,

117   anxiety). For the purposes of the survey, we considered systemic disease to be identified if the

118   resident was diagnosed by a doctor. Gestational diabetes was not included in this survey.

119   Oral mucosa examination followed the clinical diagnostic criteria proposed by the WHO

120   (Kramer et al., 1980). Portable halogen lamps, disposable retractors, and mouth mirrors were

121   used in this study. When performing oral mucosa examinations, the intraoral and perioral

122   mucosa and soft tissue were comprehensively examined for each subject in the following

123   systematic order: lip, corner of mouth, cheek, tongue, bottom of mouth, hard and soft palate,

124   alveolar ridge and gingiva. When residents were clinically diagnosed with OPMDs, including

125   OLP or OLK, we referred them to our hospital for laboratory tests and biopsies. Expert

126   pathologists confirmed the final diagnosis. Informed consent was obtained prior to the initiation

127   of the examination. Inspectors were trained to ensure that guidelines for observation were

128   interpreted uniformly and that mucosal diseases were documented correctly. Calibration

129   exercises were repeated every month. Ten inspectors participated in the study, six of those

130   participated throughout the whole study.

131

132   ***Statistical methods:***

133   All data were analyzed statistically using the SPSS 25.0 software package (Chicago, IL, USA).

134   Two people were responsible for data entry and analysis. A X^2 test was used to compare the rates

135   of risk factors. Logistic regression analysis was used to detect correlation between disease and

136   risk factors. Results were considered significant if $p < 0.05$.

137

138   **Results:**

139   *Survey results*

140   A total of 653 permanent residents were surveyed in 2014, including 337 males and 316 females.

141   We followed up with approximately 93% of those residents in the 2018 survey: 607 residents

142   (311 men and 296 women). The remaining 7% were lost to follow up.

143   The education levels of the test subjects were mainly middle school (and below) level,

144   mostly retired people. The average age of the respondents in 2014 was 66.05 years old (17-92),

145   and the average age in 2018 was 67.38 years old (18-91).

146

147   *Prevalence of OMDs*

148   In the 2014 survey, a total of 60 people (9.19%) had OMDs, which included 12 cases of atrophic

149   glossitis (1.84%), 11 cases of RAU (1.68%), nine cases of burning mouth syndrome (BMS)

150   (1.38%), eight cases of OLP (1.23%), eight cases of traumatic ulcer (1.23%), six cases of

151   furrowed tongue (0.92%), three cases of geographic tongue (0.46%), one case of cheilitis

152   (0.15%), one case of angular cheilitis (0.15%) and one case of leukoplakia (0.15%). The results

153   showed that the OMDs were mostly localized at the back of tongue, buccal mucosa, labial

154   mucosa and gingival (gums).

155   In 2018, 58 people (9.56%) had OMDs (46 people were lost to follow-up, which included

156   41 with no OMDs and five with OMDs). Compared to 2014, there were ten cases of decreased

157   OMDs and nine cases of new OMDs as follows: 11 cases of atrophic glossitis (1.81%, one case

158   lost, no new), nine cases of RAU (1.48%, two cases lost, no new), seven cases with furrowed

159   tongue (1.15%, none lost, one new), nine cases of OLP (1.48%, none lost, one new case of DM),

160   seven cases of traumatic ulcer (1.15%, none lost, eight cases of decrease, seven case new), one

161   case of geographic tongue (0.16%, one lost, one case of decrease). One case each of cheilitis,

162   angular cheilitis and leukoplakia (0.16%, none lost, no increase, no decrease).

163

164   ***Distribution of diseases in males and females and in different age groups in 2014***

165   The prevalence rate in females was higher than in males in cases of RAU, BMS and OLP

166   (p<0.05; Figure 1). In addition, the overall prevalence of OMDs in females was also higher than

167   in men (p<0.05). The cases of RAU and BMS were statistically significant in different age

168   groups. The prevalence of RAU in 15-29 year-olds and 30-39 year-olds was significantly higher

169   than that in the older age groups (50-59, 60-69, 70-79) (p<0.01), but there was no significant

170   difference between the two groups (p>0.05). We found BMS more frequently in people over 40

171   years old, prevalence increased with age, and was significantly higher in the 70-79 age group

172   than in the 40-49 group (p<0.01). OLP was detected in the population over 40 years old, and

173   there was no significant difference among age groups (Figure 2).

174

175   ***Effect of living habits and mental state on OMDs in 2014***

176   Respondents generally had a light diet. There were 107 (16.39%) smokers (people who had

177   smoked for over three years) and 93 (14.24%) who were drinkers (millet wine and beer). The

178   rate of smoking (p=0.01) and alcohol consumption (p=0.00003) in persons with OMDs was

179   higher compared to those with no OMDs (Figure 3). Our survey showed that 87 people were had

180   mental anxiety and 24 people felt higher than normal stress in life. Those with OMDs were had a

181   higher rate of anxiety compared to those with no OMDs (p=0. 0002). However, there was no

182   statistically significant difference in stress between persons with OMDs and no OMDs (p=0.

183   903) (Figure 4). The sample group included 97.5% people in a stable family relationship, 28.1%

184   with no friends and 36.8% having a little interpersonal communication. The vast majority

185   (96.2%) of respondents had no adverse life experiences in past 12 months.

186

187   *Analysis of risk factors related to OMDs and OLP in 2014*

188   This study found that there was no significant difference in the prevalence of OMDs between

189   men and women in the population of Baoshan, Shanghai. It also found that the occurrence and

190   prevalence of OMDs, particularly atrophic glossitis, RAU, BMS and OLP, were positively

191   correlated with increasing age among residents.

192   The study also found that rates of smoking, drinking and mental anxiety in the OMD

193   population were significantly higher than in the healthy population, but that there was no

194   statistical difference. Systemic diseases, such as cardiovascular and cerebrovascular hypertension

195   (p=0.025) and metabolic diseases or diabetes (p=0.028), were closely related to OMDs. Systemic

196   diseases such as cardiovascular and cerebrovascular hypertension (p=0.025), and metabolic

197   diseases diabetes (p=0.028) were closely related to OMDs.   The investigation group theorized

198   that the high number of elderly patients would have proportionally higher incidence of dental

199   cavities and removable dentures and presumed that incidence of traumatic ulcers would also

200   increase proportionally (Table 1).

201   OLP was more common in the elderly age group (40-60 years) and occurred in more

202   females than males. In this study, OLPs mostly occurred in the buccal region. The cause of OLP

203   is complex and still unknown. The WHO defines OLP as a potentially malignant disease of the

204   oral mucosa. Currently, there is no specific treatment for OLP in clinical practice. As a result, the

205   course of the disease is prolonged and the condition often recurs. OLP may develop into cancer,

206   which has a vital impact on patients' physical and mental health. The results of the general

207   epidemiological investigation showed that there were eight community residents (1.23%) with

208   OLP: two males and six females (male to female ratio 1:3). OLP was significantly associated

209   with age, smoking and diabetes mellitus (p<0.01) (Table 2).

210

211   **Discussion:**

212   In this survey, we found that the prevalence rate of OMDs in the Shanghai region varied from

213   9.19% (2014) to 9.56% (2018). The most prevalent OMDs were incidence atrophic glossitis,

214   RAU, BMS and OLP. Other surveys in Shanghai have found higher OMD prevalence rates: Xu

215   et al. (1981) found a prevalence rate in 1978 of 14.93%; Cao et al. (1988) found a prevalence

216   rate in the over 60s age group of 29.3%; and a large-scale epidemiological investigation

217   conducted by Feng et al. (2015) among 11,054 people in 2012 found a prevalence rate of 10.8%.

218   Work, psychological stress, environmental changes, changes in diet structure and the

219   accelerated pace of life are all thought to lead to an increased prevalence of the OMD condition.

220   In our study, OMDs were positively correlated with age, which supports the findings of

221   Cao et al. (1988). Therefore, preventive measures should be commensurate with the risk factor of

222   increasing age. Atrophic glossitis occurred mainly in the elderly over 60 years of age in our

223   study, which was consistent with its etiology: chronic anemia, lack of nicotinic acid, Sjogren's

224   syndrome and Candida infection. Among people aged 30-39 years, there has been a significant

225   increase in the prevalence of RAU which occurs in more female patients than male patients.

226   OLP and BMS also occurred in the older age group (40-60), and more women than men

227   were ill.

228   In 2014, eight residents with traumatic ulcers were recommended treatment at the time of

229   the first examination. During the 2018 follow-up, all eight patients dealt with trauma factors and

230   their ulcers had disappeared. It indicated that community epidemiological surveys have, in

231   addition to a diagnostic function, a preventative function that may contribute to the early

232   treatment of residents, reduce cancer risk, and limit the number of untreated ulcers. The follow-

233   up indicated that early prevention and control of mucosal diseases was of great significance.

234   Seven new cases of traumatic ulcers found in the current investigation were treated and the

235   patients were informed of the risks. Many of the interviewees were elderly people with high rates

236   of dental cavities and periodontitis. The elderly lacked the awareness to treat cavities and

237   maintain dentures. As a result of the study, detection rates of traumatic ulcers increased, in

238   particular, those occurring at the denture base covering the gums and palate areas. Glossy,

239   traumatic ulcers were associated with residual roots and crowns. With continuous improvement

240   in living standards, the rate of visits to medical centers to treat traumatic ulcers has gradually

241   increased.

242   Our study showed that OMDs in patients who smoke, drink and experience anxiety were

243   higher than those who were healthy. Many studies have confirmed that tobacco and alcohol are

244   closely related to OMDs and are risk factors for OMDs (Shulman, Beach & Rivera-Hidalgo,

245   2004; Dundar & Ilhan Kal, 2007; Pentenero et al., 2008; Mohamed & Janakiram, 2014). In past

246   surveys, the prevalence of BMS was extremely low and rarely detected. However, the present

247   survey found that the prevalence of BMS increased in middle-aged and older women in the

248   perimenopausal and postmenopausal stages, and was accompanied by obvious changes in

249   psychological and mental state. This might be due to the gradual acceleration of the pace of life

250   in recent years, and subsequent increase in psychological problems. The causes of many

251   diseases, especially chronic diseases, are no longer a simple biological factor, but also include

252   many social, environmental and psychological factors. Alcohol, tobacco, stress and mental

253   factors associated with the occurrence and development of OMDs should be the focus of primary

254   prevention (O'Sullivan, 2011; Mendes et al., 2012).

255   It is noteworthy that the 4-year follow-up of community residents with OMDs suggested

256   that systemic metabolic diseases, such as DM, were closely related to OPMDs, such as OLP.

257   This result is consistent with the results of a large-scale oral health epidemiological investigation,

258   in which we participated, in 2012 in Shanghai (Feng et al., 2015). The OMD group is comprised

259   of many oral diseases and their prevention and control is difficult. At present, prevention and

260   treatment of OMDs are still the main factors in the three-levels of disease control.

261

Conclusion:

263   Early prevention and control of mucosal disease is of great importance. It is necessary to

264   better understand the prevalence of OMDs among Shanghai residents, and to carry out effective

265   intervention activities through better health education, policy formulation and the creation of a

266   supportive environment. Further, there is a need to reduce related risk factors, to promote the

267 health of oral mucosa, and to improve the quality of life of the population. Finally, we consider it

268 imperative to elevate the importance of primary prevention and treatment of OMDs.

269

Funding:

271 1. Science and technology development fund project of Baoshan, Shanghai (12E62)

272 2. The national natural science foundation of China- youth project (30700944)

273 3. The science research project of Shanghai health bureau (2012092)

274 4. The National clinical key specialty construction project (2013-544)

275 5. The National Institutes of Health (USA) Research Grant (R01 DK110273-01A1)

276 6. National Natural Science Foundation of China (81970941)

277 7. A Project Funded by the Priority Academic Program Development of Jiangsu Higher

278 Education Institutions (PAPD 2018–87)

279

Acknowledgements:

281 We thank all the physicians from the Department of Oral Mucosal Diseases, Ninth People's

282 Hospital, Shanghai Jiao Tong University School of Medicine and Friendship Street Community

283 Health Service Center of Shanghai Baoshan District for Participating in our epidemiological

284 survey and performing the oral mucosal examination.

285

Disclosure:

287 The author reports no conflicts of interest in this work.

288

289

References:

291 Amagasa T, Yamashiro M, Uzawa N. 2011. Oral premalignant lesions: from a clinical

292   perspective. *Int J Clin Oncol* 16:5-14. DOI: 10.1007/s10147-010-0157-3.

293 Cao HK, Le FY, Chen JH, Lu H, Shi HB, Shen ZY, Hu HF, Jin WC, Hu LY, Tang GY, Chen

294   YP. 1988. Epidemiological study on oral mucosal diseases of 3,091 elderly people in

295   Shanghai. *Oral Med* 8:169-171.

296 Dionne KR, Warnakulasuriya S, Zain RB, Cheong SC. 2015. Potentially malignant disorders of

297   the oral cavity: current practice and future directions in the clinic and laboratory. *Int J*

298   *Cancer* 136:503-515. DOI: 10.1002/ijc.28754.

299 Do LG, Spencer AJ, Dost F, Farah CS. 2014. Oral mucosal lesions: findings from the Australian

300   National Survey of Adult Oral Health. *Aust Dent J* 59:114-120. DOI: 10.1111/adj.12143.

301 Dundar N, Ilhan Kal B. 2007. Oral mucosal conditions and risk factors among elderly in a

302   Turkish school of dentistry. *Gerontology* 53:165-172. DOI: 10.1159/000098415.

303 Feng J, Zhou Z, Shen X, Wang Y, Shi L, Hu Y, Sun H, Liu W. 2015. Prevalence and distribution

304   of oral mucosal lesions: a cross-sectional study in Shanghai, China. *J Oral Pathol Med*

305   44:490-494. DOI: 10.1111/jop.12264.

306 Ikeda N, Handa Y, Khim SP, Durward C, Axell T, Mizuno T, Fukano H, Kawai T. 1995.

307   Prevalence study of oral mucosal lesions in a selected Cambodian population. *Community*

308   *Dent Oral Epidemiol* 23:49-54.

309 Kramer IR, Pindborg JJ, Bezroukov V, Infirri JS. 1980. Guide to epidemiology and diagnosis of

310   oral mucosal diseases and conditions. World Health Organization. *Community Dent Oral*

311   *Epidemiol* 8:1-26. DOI: 10.1111/j.1600-0528.1980.tb01249.x.

312 Kurago ZB. 2016. Etiology and pathogenesis of oral lichen planus: an overview. *Oral Surg Oral*

313   *Med Oral Pathol Oral Radiol* 122:72-80. DOI: 10.1016/j.oooo.2016.03.011.

314 Mansour Ghanaei F, Joukar F, Rabiei M, Dadashzadeh A, Kord Valeshabad A. 2013. Prevalence

315   of oral mucosal lesions in an adult Iranian population. *Iran Red Crescent Med J* 15:600-

316   604. DOI: 10.5812/ircmj.4608.

317 McCullough MJ, Prasad G, Farah CS. 2010. Oral mucosal malignancy and potentially malignant
318   lesions: an update on the epidemiology, risk factors, diagnosis and management. *Aust*
319   *Dent J* 55 Suppl 1:61-65. DOI: 10.1111/j.1834-7819.2010.01200.x.
320 Mendes DC, Poswar Fde O, de Oliveira MV, Haikal DS, da Silveira MF, Martins AM, De Paula
321   AM. 2012. Analysis of socio-demographic and systemic health factors and the normative
322   conditions of oral health care in a population of the Brazilian elderly. *Gerodontology*
323   29:e206-214. DOI: 10.1111/j.1741-2358.2010.00446.x.
324 Mohamed S, Janakiram C. 2014. Recurrent aphthous ulcers among tobacco users- hospital based
325   study. *J Clin Diagn Res* 8:ZC64-LC66. DOI: 10.7860/JCDR/2014/10368.5145.
326 Mumcu G, Cimilli H, Sur H, Hayran O, Atalay T. 2005. Prevalence and distribution of oral
327   lesions: a cross-sectional study in Turkey. *Oral Dis* 11:81-87. DOI: 10.1111/j.1601-
328   0825.2004.01062.x.
329 O'Sullivan EM. 2011. Prevalence of oral mucosal abnormalities in addiction treatment centre
330   residents in Southern Ireland. *Oral Oncol* 47:395-399. DOI:
331   10.1016/j.oraloncology.2011.03.003.
332 Pentenero M, Broccoletti R, Carbone M, Conrotto D, Gandolfo S. 2008. The prevalence of oral
333   mucosal lesions in adults from the Turin area. *Oral Dis* 14:356-366. DOI:
334   10.1111/j.1601-0825.2007.01391.x.
335 Petti S. 2003. Pooled estimate of world leukoplakia prevalence: a systematic review. *Oral Oncol*
336   39:770-780.
337 Porter SR, Mercadante V, Fedele S. 2017. Oral manifestations of systemic disease. *Br Dent J*
338   223:683-691. DOI: 10.1038/sj.bdj.2017.884.
339 Qi XQ. 2008. *Report of Third National Survey of Oral Health Status in China*. Beijing: People's
340   Medical Publishing House.
341 Ribeiro AS, Salles PR, da Silva TA, Mesquita RA. 2010. A review of the nonsurgical treatment
342   of oral leukoplakia. *Int J Dent* 2010:186018. DOI: 10.1155/2010/186018.

343 Shulman JD, Beach MM, Rivera-Hidalgo F. 2004. The prevalence of oral mucosal lesions in
344   U.S. adults: data from the Third National Health and Nutrition Examination Survey,
345   1988-1994. *J Am Dent Assoc* 135:1279-1286.
346 Splieth CH, Sumnig W, Bessel F, John U, Kocher T. 2007. Prevalence of oral mucosal lesions in
347   a representative population. *Quintessence Int* 38:23-29.
348 van der Meij EH, Schepman KP, van der Waal I. 2003. The possible premalignant character of
349   oral lichen planus and oral lichenoid lesions: a prospective study. *Oral Surg Oral Med*
350   *Oral Pathol Oral Radiol Endod* 96:164-171. DOI: 10.1016/S1079210403003056.
351 van Monsjou HS, Wreesmann VB, van den Brekel MW, Balm AJ. 2013. Head and neck
352   squamous cell carcinoma in young patients. *Oral Oncol* 49:1097-1102. DOI:
353   10.1016/j.oraloncology.2013.09.001.
354 Villa A, Villa C, Abati S. 2011. Oral cancer and oral erythroplakia: an update and implication for
355   clinicians. *Aust Dent J* 56:253-256. DOI: 10.1111/j.1834-7819.2011.01337.x.
356 Wang YY, Tail YH, Wang WC, Chen CY, Kao YH, Chen YK, Chen CH. 2014. Malignant
357   transformation in 5071 southern Taiwanese patients with potentially malignant oral
358   mucosal disorders. *BMC Oral Health* 14:99. DOI: 10.1186/1472-6831-14-99.
359 Warnakulasuriya S, Kovacevic T, Madden P, Coupland VH, Sperandio M, Odell E, Moller H.
360   2011. Factors predicting malignant transformation in oral potentially malignant disorders
361   among patients accrued over a 10-year period in South East England. *J Oral Pathol Med*
362   40:677-683. DOI: 10.1111/j.1600-0714.2011.01054.x.
363 World Health Organization. 2013. *Oral health surveys: basic methods*. Fifth edition. Niigata:
364   Niigata University.
365 Xu GQ, Shi HB, Qiu XY, Tang H. 1981. A report on oral mucosal diseases in 18,769 Shanghai
366   residents. *Stomatology* 1:26-29.
367
368
369

370

Figure Legends

372   **Figure 1.** Prevalence distribution of different types of OMDs among residents of different

373   genders.

374   **Figure 2.** Prevalence of different types of OMDs among residents of different age groups.

375   **Figure 3.** Risk factors of oral mucosal disease in community residents - smoking and drinking

376   habits.

377   **Figure 4.** Influence of mental state on OMDs of community residents.

378   **Table 1.** Analysis of risk factors for OMDs

379   **Table 2.** Analysis of risk factors for OLP

380

Table 1. Analysis of risk factors for OMDs

* univariate logistic regression

** multivariate logistic regression

1 **Table 1.** Analysis of risk factors for OMDs

	variable	case	control	Unadjusted OR* (OR 95%CI)	p value*	Unadjusted OR** (OR 95%CI)	p value**
age	≥60	34(6.4)	495(93.6)	0.893(0.113-7.03)	0.914		
	40-59	5(7.4)	63(92.6)	1.032(0.111-9.581)	0,978		
	＜40	1(7.1)	13(92.9)	1			
smoking	yes	5(7.0)	66(93.0)	1.107(0.417-2.934)	0.839		
	ex	2(8.0)	23(92.0)	1.27(0.287-5.62)	0.753		
	no	33(6.40)	482(93.6)	1			
drink	yes	3(4.7)	61(95.3)	0.666(0.199-2.225)	0.509		
	ex	0(0.0)	9(100.0)	0(0)	0.999		
	no	37(6.9)	501(93.1)	1			
hypertension	yes	14(4.7)	287(95.3)	0.533(0.273-1.041)	0.066	0.45(0.224-0.906)	0.025
	no	26(8.4)	284(91.6)	1			
diabetes	yes	10(10.5)	85(89.5)	1.906(0.899-4.042)	0.093	2.41(1.098-5.294)	0.028
mellitus	no	30(5.8)	486(94.2)	1			
coronary heart	yes	4(5.2)	73(94.8)	0.758(0.262-2.192)	0.609		
disease	no	36(6.7)	498(93.3)	1			
cerebrovascular	yes	3(8.8)	31(91.2)	1.412(0.412-4.837)	0.582		
disease	no	37(6.4)	540(93.6)	1			

2 * univariate logistic regression

3 ** multivariate logistic regression

Table 2. Analysis of risk factors for OLP

* univariate logistic regression

** multivariate logistic regression

1   **Table 2.** Analysis of risk factors for OLP

☐	variable	case	control	Unadjusted OR* (OR 95%CI)	p value*	Unadjusted OR** (OR 95%CI)	p value**
age	≥60	5(0.9)	524(99.1)	0.124(0.014-1.138)	0.065	0.030(0.002-0.396)	0.008
	40-59	3(4.4)	65(95.6)	0.6(0.058-6.230)	0.669	0.286(0.022-3.717)	0.339
	＜40	1(7.1)	13(92.9)	1			
smoking	yes	3(4.2)	68(95.8)	4.5(1.052-19.252)	0.043	8.732(1.773-43.013)	0.008
	ex	1(4)	24(96)	4.25(0.478-37.812)	0.194	4.497(0.368-55.002)	0.239
	no	5(1)	510(99)	1			
drink	yes	2(3.1)	62(96.9)	2.447(0.497-12.04)	0.271		
	ex	0(0)	9(100)	0(0)	0		
	no	7(1.3)	531(98.7)	1			
hypertension	yes	6(1.9)	304(98.1)	0.51(0.126-2.058)	0.344		
	no	3(1)	298(99)	1			
diabetes	yes	5(5.3)	90(94.7)	7.111(1.874-26.988)	0.004	14.083(2.958-67.05)	0.001
mellitus	no	4(0.8)	512(99.2)	1		1	
coronary heart	yes	1(1.3)	76(98.7)	0.865(0.107-7.014)	0.892		
disease	no	8(1.5)	526(98.5)	1			
cerebrovascular	yes	1(2.9)	33(97.1)	2.155(0.262-17.747)	0.475		
disease	no	8(1.4)	526(98.6)	1			

2   * univariate logistic regression

3   ** multivariate logistic regression

Figure 1

Figure 1. Prevalence distribution of different types of OMDs among residents of different genders.
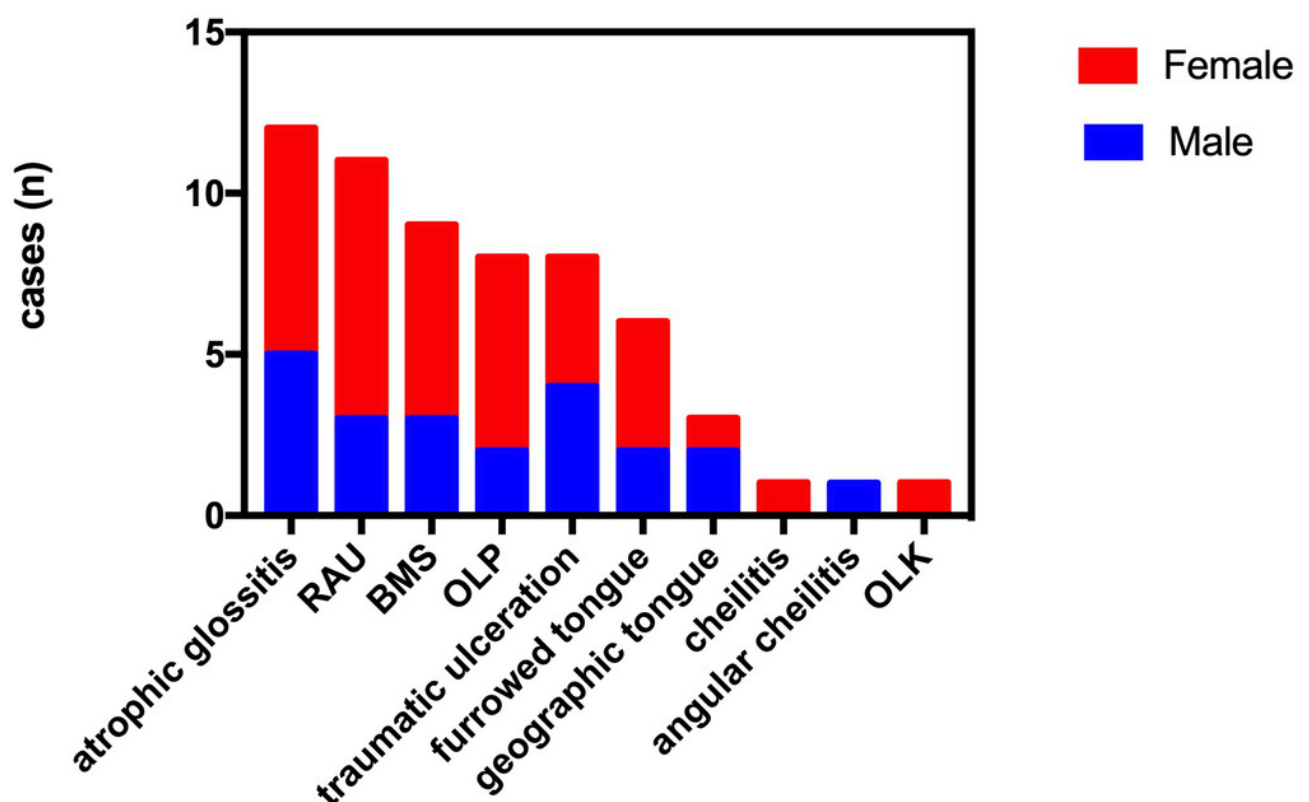
Figure 2

Figure 2. Prevalence of different types of OMDs in residents of different age groups (disease prevalence trend of residents of different ages.
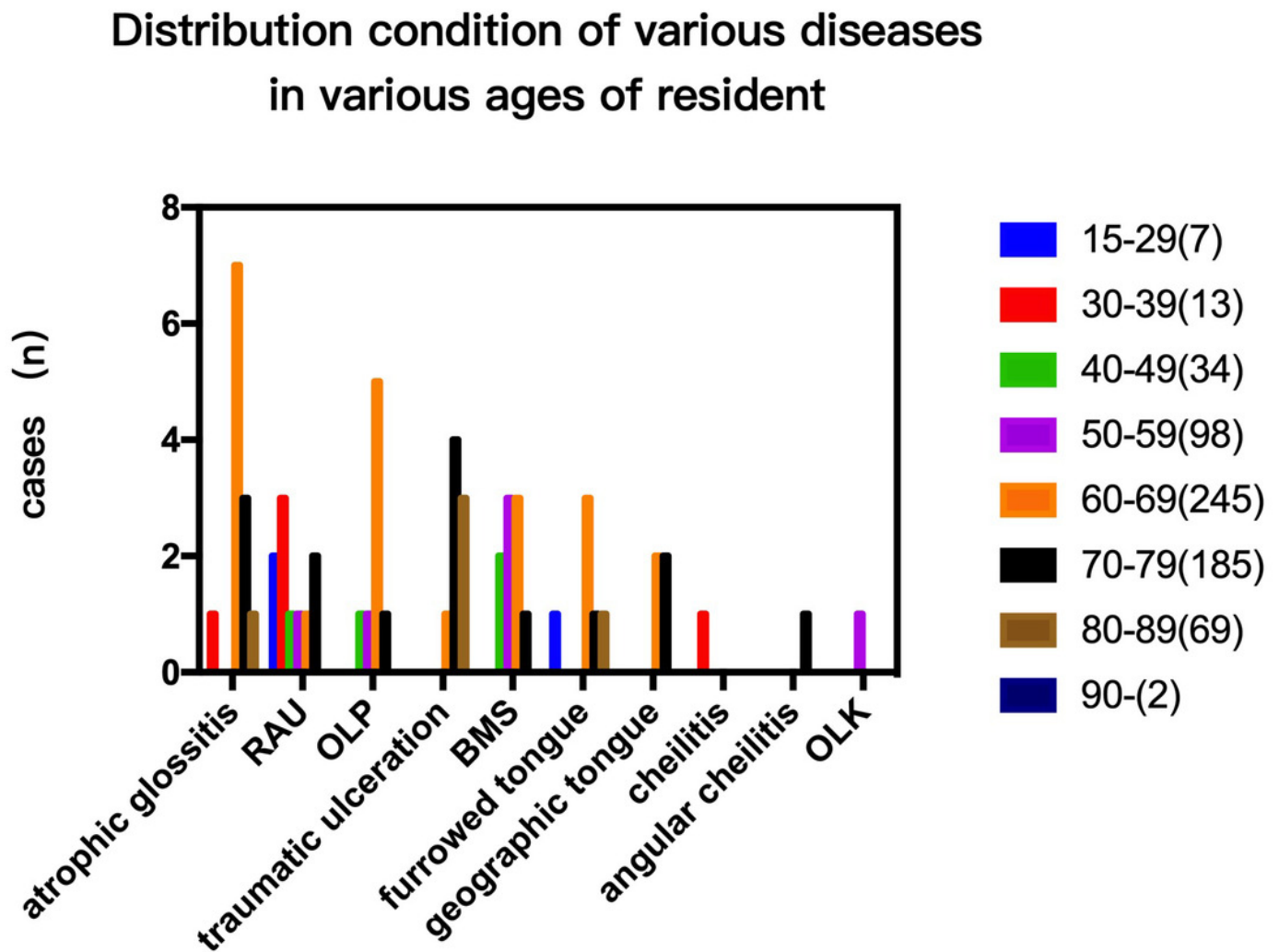
Figure 3

Figure 3. Risk factors of oral mucosal disease in community residents - smoking and drinking habits.
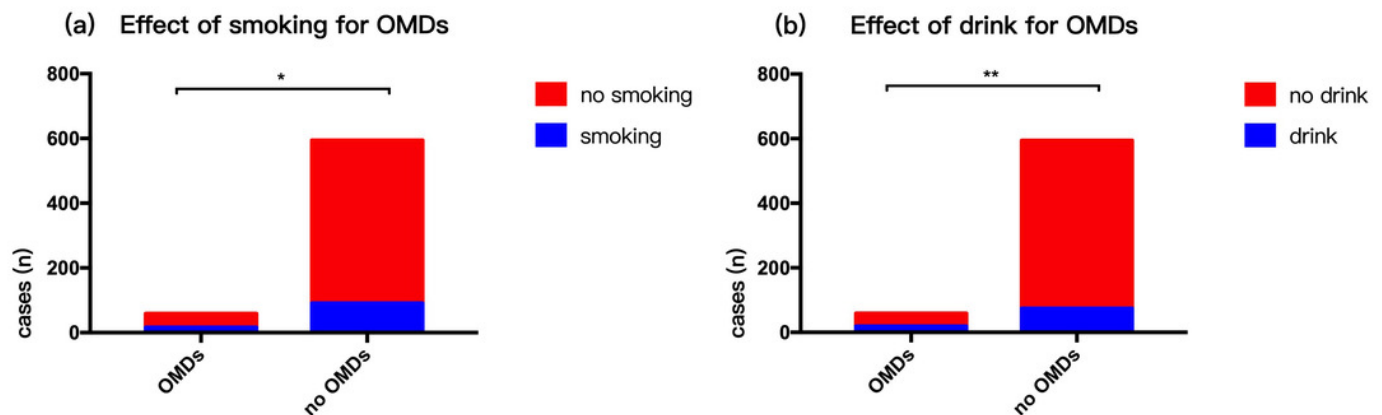
Figure 4

Figure 4. Influence of mental state on OMDs of community residents.