SELF-PERCEIVED ORAL MALODOR, SMOKING AND ORAL HYGIENE PRACTICES AMONG DENTAL STUDENTS IN THE EASTERN PROVINCE OF SAUDI ARABIA

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ABSTRACT

Objective of the study was to evaluate self-perceived oral malodor (OM), and to correlate this with oral hygiene practices among Saudi dental students in the College of Dentistry at the Imam Abdulrahman Bin Faisal University (IAU), in the Eastern Province of Saudi Arabia.

A self-administered questionnaire was distributed among dental students. The questionnaire contained three parts, comprising socio-demographic factors, subject's perceptions of OM, and the social effects thereof. Informed consent was obtained. The associations between OM and different variables were explored using analytical statistics (Chi square test and Multiple logistic regression analysis). Statistical significance was determined using a 95% confidence interval (CI).

From a total of 372, 244 subjects responded, giving a response rate of 66%. Of these, 225 questionnaires were successfully completed and included in the data analysis. 109 students (48.5%) were males and 116 (51.5%) were females. The mean age of the subjects was 21.01 ± 1.33 years (range=19 -25 years). Almost 95% of the subjects reported self-perceived OM. The mean self-assessment OM score was calculated to be 3.66 ± 1.87. Factors significantly associated with the severity of OM were after waking up and interfering with social life ($p<0.002$ and 0.001 respectively). Logistic regression analysis showed only the regular use of toothpick to be significantly associated with severity of OM ($p=0.035$). A self-assessment of moderate OM was found more in males than females associated with cigarette smoking (OR=2.046). Severity of OM, associated with cleaning of tongue coating regularly or sometimes, was equally found in males and females (OR=0.715).

A high prevalence of Oral Malodor existed among dental students. It is recommended they should receive appropriate professional diagnosis and management thereof. The regular use of dental floss and removal of tongue coating can significantly reduce OM. Future studies should correlate self-perceived OM with objective clinical examination methods to manage OM.

Key words: *Oral malodor, Dental students, Smoking, Oral Hygiene, Saudi Arabia.*

INTRODUCTION

Halitosis, also called fetor ex ore, fetor oris, foul breath, breath malodor, and oral malodor (OM), is a perceived problem in different cultures and societies of the world.[1] OM can become a social handicap whereby the self-perception of OM, which includes a multifactorial, psycho-physiological issue, is closely related to an individual's body image and psychopathological profile.[2] This includes people suffering from pseudo halitosis (the condition is clinically absent), denied halitosis (do not accept the existence of the condition),[3] and halitophobia (having an exaggerated fear of halitosis).[4]

Several causes of OM have been described, however the identification of the actual cause is sometimes difficult.[1] OM is mainly attributed to odorous substances which may originate from intra-oral, extra-oral and transitory factors.[1,2,5] The majority of OM originates from intra-oral sources (80%–90%)[6] and/or from nasopharyngeal pathology.[1] Intra-oral sources include poor oral hygiene, improper cleaning of dentures, deep carious lesions, necrotic pulpal exposure, periodontal disease,

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peri-implant disease, mucosal ulcers, food debris and tongue coating.[7,8] Tongue coating as an intra-oral source has been described to be most common in otherwise healthy individuals, with the odor arising from the dorsoposterior aspect of the tongue.[9] A common source of intra-oral odorous substances is sulfur-containing substances present in saliva, gingival crevicular fluid, blood, and cells.[10] Microorganisms inhabiting the oral cavity, such as *Treponema denticola, Porphyromonas gingivalis, Porphyromonas endodontalis, Prevotella intermedia, Bacteroides loescheii, Enterobacteriaceae, Tannerella forsythensis, Centipeda periodontii, Eikenella corrodens,* and *Fusobacterium nucleatum*,[11] interact with these sulfur-containing substances, and so produce volatile sulfide compounds (VSC), especially hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), and dimethylsulfide [$(CH_3)_2S$].[12] These VSC are considered as the main sources of intra-oral OM.[8]

Extra-oral sources include pulmonary disease, gastrointestinal problems, kidney diseases, sinusitis, nasal polyps, diabetic ketoacidosis and medications.[1,6] Certain medications may reduce salivary flow, such as antidepressants, antipsychotics, narcotics, decongestants, antihistamines, and antihypertensive drugs, thereby contributing towards extra-oral sources of OM.[13,14,15]

Transitory sources include dietary garlic, onions, and peppers, smoking, alcohol as well as morning bad breath.[1,6]

A lack of information exists regarding the self-perception of OM among dental students in the Eastern region of Saudi Arabia. It was therefore the purpose of this study to evaluate the self-perception of OM, and to correlate this with various practices of oral hygiene, among Saudi dental students at the College of Dentistry at the Imam Abdulrahman Bin Faisal University (IAU), in the Eastern Province of Saudi Arabia.

MATERIALS AND METHODS

A self-administered questionnaire was distributed among students including those from the second to the fifth year of study. The questionnaire was developed by reviewing the literature and making some modifications according to local culture. It was tested in a pilot study and adjusted accordingly. The identity of the students was not disclosed and the confidentiality of their identity was assured. A sufficient amount of time (15 minutes) was provided to answer the questionnaire.

The questionnaire incorporated both Arabic and English languages, and was constructed in three parts. The first part comprised socio-demographic factors including gender, age and educational level, while the second part related to the subject's perception of OM and its previous history and social effects thereof. Subjects were asked about the degree of OM (through a scale from 0-10), the timing thereof (after waking up, when hungry or thirsty, while talking with other people, morning, afternoon or all day), the use of self-medication, or whether treated by a dentist or a physician. The third part covered the dental history, oral hygiene practices and smoking status. This included oral health problems such as bleeding gums, tooth decay, xerostomia and coated tongue. Oral hygiene practices were self-assessed and included the frequency of tooth brushing, dental floss usage, tongue cleaning, mouth rinsing, and the usage of miswak and toothpicks.

Data analysis was performed by using SPSS-20.0 (IBM product, Chicago-USA). The numeric response variables regarding age and self-assessment scores, were presented as Mean ± Standard deviations (±SD). Self-assessment OM scoring variables were stratified into three categories (mild, moderate & severe), based on the severity of OM. Student's attitudes towards bad breath, their practice of oral hygiene and the impact thereof on their bad breath and general oral health conditions, were compared with OM categories in order to determine any associations. This was done by utilizing the Pearson's Chi-square test. Multiple logistic regression analysis was performed to evaluate the effect of various factors on the severity of OM specific to gender. A P-value of ≤ 0.05 was considered statistically significant.

RESULTS

From a total of 372 students, 244 responded to the questionnaire, giving a response rate of 66%. Of these, 225 questionnaires were successfully completed and were thus included in the data analysis. 109 (48.5%) were males and 116 (51.5%) were females. The ages of the students were stratified into two categories i.e. ≤ 20 years and >20 years. The mean age of the participants was 21.01 ± 1.33 years (range 19 to 25 years).

The self-assessment OM score was stratified into four categories i.e. 0 as none, 1-3 as mild, 4-6 as moderate and 7-10 as severe OM. 11 (4.89%) students indicated no OM, 92 (40.89%) a mild score (1-3), 110 (48.89%) a moderate score (4-6), and 12 (5.33%) a severe score (*Figure 1*). The mean self-assessment OM score was calculated to be 3.66 ± 1.87.

Most of the students indicating severe OM were found in the category of >20 years of age. Male students had a preponderance for moderate and severe OM, i.e. 66.7% for males and 33.3% for females. However, the distribution of the self-assessment score for OM was not statistically significant according to age and gender (p=0.361 and p=0.201 respectively) (*Figure 2*).

Regarding the presence, examination and any treatment of bad breath, the only significant association with the severity of OM was the treatment of bad breath by means of traditional medicine (p=0.001). A marginal statistical significance was seen in relation to severe OM associated with bad breath in relatives of the students, and examination for bad breath by dentists (p=0.06). However, no other factors related to bad breath including examination for bad breath by physicians, those receiving treatment by dentists or by

TABLE 1: RELATIONSHIP OF STUDENT'S ATTITUDE TOWARDS BAD BREATH WITH SEVERITY OF OM:

Factors	Total (%)	Self-assessment score of oral malodor			P-value
		Mild (1-3)	Moderate (4-6)	Severe (7-10)	
	n = 214	n = 92	n = 110	n = 12	
Any relative has bad breath	102 (47.7)	37 (40.2)	57 (51.8)	8 (66.7)	0.060
Examination for bad breath by Dentist.	20 (9.3)	5 (5.4)	12 (10.9)	3 (25.0)	0.066
Examination for bad breath by Physician.	3 (1.4)	0 (0)	3(2.7)	0 (0)	0.249
Received treatment by Dentist	21 (9.8)	8 (8.7)	10 (9.1)	3 (25.0)	0.205
Received treatment by Physician	2 (0.9)	0 (0)	2 (1.8)	0 (0)	0.399
Self-treatment for bad breath by self-medication	70 (32.7)	30 (32.6)	36 (32.6)	4 (33.3)	0.619
Self-treatment for bad breath by traditional medicine	41 (19.2)	11 (12.0)	23 (20.9)	7 (58.3)*	0.001

*Significantly higher proportion at 5% level of significance.

TABLE 2: RELATIONSHIP OF PARTICULAR PATTERN OF BAD BREATH WITH SEVERITY OF OM:

Factors	Total (%)	Self-assessment score of oral malodor			P-value
		Mild (1-3)	Moderate (4-6)	Severe (7-10)	
	n = 214	n = 92	n = 110	n = 12	
Worst after waking up	151 (70.6)	59 (64.1)	82 (74.5)	10 (83.3)*	0.002
Worst when hungry	52 (24.3)	22 (23.9)	27 (24.5)	3 (25.0)	0.993
Worst when thirsty	26 (12.1)	11 (12.0)	14 (12.7)	1 (8.3)	0.904
Worst while talking with other people	7 (3.3)	0 (0)	5 (4.5)	2 (16.7)*	0.005
Worst in morning	17 (7.9)	7 (7.6)	9 (8.2)	1 (8.3)	0.988
Worst in afternoon	2 (0.9)	0 (0)	2 (1.8)	0 (0)	0.385
Worst during all day	1 (0.5)	0 (0)	0 (0)	1 (8.3)*	0.001
Is it normal to have bad breath?	55 (25.7)	18 (19.6)	35 (31.8)	2 (16.7)	0.076
Bad breath interferes with social life	23 (10.7)	4 (4.3)	14 (12.7)	5 (41.7)*	0.001
Bad breath bothers you	146 (68.2)	60 (65.2)	78 (70.9)	8 (66.7)	0.213

*Significantly higher proportion at 5% level of significance.

physicians, as well as self-treatment for bad breath, were found to be statistically significant in relation to the severity of self-assessed OM (See *Table 1).*

When evaluating particular patterns of bad breath, factors which were significantly associated with the severity of OM were after waking up, talking with other people, having bad breath all day, and bad breath interfering with social life ($p<0.01$). (See *Table 2* and *Figure 3*).

Except for the regular usage of toothpicks ($p=0.026$), particular practices of oral hygiene including usage of mouthwash, brushing and the periodic change of toothbrushes, the usage of miswak with the periodic change thereof, and the daily usage of floss, were not found to be associated with the severity of OM at a 5% level of significance (See *Table 3*).

No relationship was found between general oral health conditions, including tooth decay (dental caries), removable or fixed prosthesis, bleeding gums, dryness of mouth, as well as cigarette smoking, drinking tea with mint, the tongue coated with white or yellowish deposits, and the cleaning of the tongue with a brush or tongue scraper, with the severity of OM at a 5% level

TABLE 3: RELATIONSHIP OF PRACTICE OF ORAL HYGIENE WITH SEVERITY OF OM:

Factors	Total (%)	Self-assessment score of oral malodor			P-value
		Mild (1-3)	Moderate (4-7)	Severe (8-10)	
	n = 214	n = 92	n = 110	n = 12	
Brush your teeth	203 (94.9)	88 (95.7)	104 (94.5)	11 (91.7)	0.275
How often brushing:					
Regularly	181 (84.6)	80 (87.0)	92 (83.6)	9 (75.0)	0.648
Sometimes	19 (8.9)	7 (7.6)	10 (9.1)	2 (16.7)	
Rarely	1(0.5)	1 (1)	0 (0)	0 (0)	
Frequency of changing toothbrush					
1 month	6 (2.8)	4 (4.3)	2 (1.8)	0 (0)	0.514
3 months	104 (48.6)	48 (52.2)	49 (44.5)	7 (58.3)	
6 months	71 (33.2)	28 (30.4)	41 (37.3)	2 (16.7)	
12 months	15 (7.0)	8 (8.7)	7 (6.4)	0 (0)	
Floss every day	67 (31.3)	34 (37.0)	31 (28.2)	2 (16.7)	0.411
Use miswak every day	6 (2.8)	4 (4.3)	2 (1.8)	0 (0)	0.646
Frequency of changing miswak					
1 month	21 (9.8)	11 (12.0)	10 (9.1)	0 (0)	0.280
3 months	5 (2.3)	1 (1.1)	3 (2.7)	1 (8.3)	
6 months	6 (2.8)	3 (3.3)	3 (2.7)	0 (0)	
12 months	6 (2.8)	1 (1.1)	4 (3.6)	1 (8.3)	
Use mouthwash regularly	60 (28.0)	25 (27.2)	31 (28.2)	4 (33.3)	0.907
Use toothpick regularly	42 (19.6)	18 (19.6)	18 (16.4)	6 (50.0)*	0.026

*Significantly higher proportion at 5% level of significance.

TABLE 4: RELATIONSHIP OF GENERAL ORAL HEALTH CONDITIONS WITH SEVERITY OF OM:

Factors	Total (%)	Self-assessment score of oral malodor			P-value
		Mild (1-3)	Moderate (4-7)	Severe (8-10)	
Tooth decay (dental caries)	100 (46.7)	37 (40.2)	58 (52.7)	5 (41.7)	0.169
Removable or fixed prosthesis	33 (15.4)	13 (14.1)	19 (17.3)	1 (8.3)	0.615
Bleeding gums	28 (13.1)	8 (8.7)	17 (15.5)	3 (25.0)	0.158
Dryness of month	29 (13.6)	10 (10.9)	16 (14.5)	3 (25.0)	0.370
Cigarette smoking	16 (7.5)	4 (4.3)	11 (10.0)	1 (8.3)	0.291
Take tea with mint regularly	54 (25.2)	23 (25.0)	27 (24.5)	4 (33.3)	0.765
Tongue coated with white or yellowish deposits	39 (18.2)	17 (18.5)	19 (17.3)	3 (25.0)	0.689
Cleaning of tongue by brush or tongue scraper					
Regularly	67 (31.3)	30 (32.6)	31 (28.2)	6 (50.0)	0.304
Sometimes	82 (38.3)	37 (40.2)	43 (39.1)	2 (16.7)	
Rarely	37 (17.3)	14 (15.2)	22 (20.0)	1 (8.3)	

TABLE 5: LOGISTIC REGRESSION ANALYSIS.

Factors	Self-assessment score of oral malodor						Odd ratio	P-value
	Mild (1-3)		Moderate (4-7)		Severe (8-10)			
	Male (n=40)	Female (n=52)	Male (n=58)	Female (n=52)	Male (n=8)	Female (n=4)		
Use of floss	13 (32.5)	21 (40.4)	17 (29.3)	14 (26.9)	1 (12.5)	1 (25.0)	0.843[a] 0.556[b]	0.742
Use of miswak	4 (10.0)	0 (0)	1 (1.7)	1 (1.9)	0 (0)	0 (0)	0.390[a] 0.008[b]	0.378
Regular use of toothpick	13 (32.5)	5 (9.6)	14 (24.1)	4 (7.7)	5 (62.5)	1 (25.0)	0.558[a] 1.583[b]	0.035
Cigarette smoking	4 (10.0)	0 (0)	10 (17.2)	1 (1.9)	0 (0)	1 (25.0)	2.046[a] 2.273[b]	0.136
Cleaning tongue coating regularly/ sometimes	28 (70.0)	39 (75.0)	38 (65.5)	36 (69.2)	7 (87.5)	1 (25.0)	0.715[a] 3.444[b]	0.113

a Shows odd ratio of moderate (4-7) oral malodor in comparison of mild (1-3) score.
b Shows odd ratio of moderate (4-7) oral malodor in comparison of mild (1-3) score.
Values given in parenthesis are gender-specific percentages calculated column-wise.

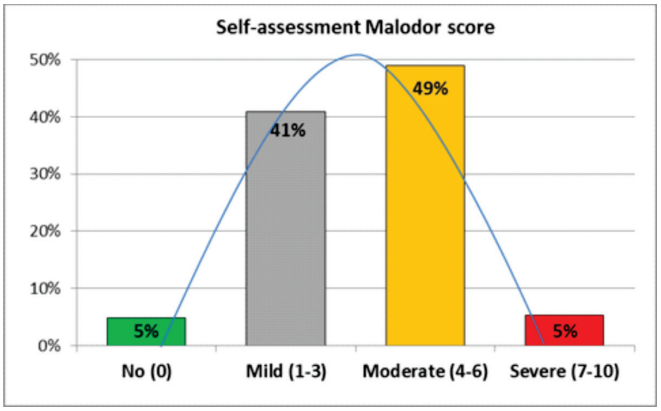

Fig 1: Distribution of self-assessment malodor score.

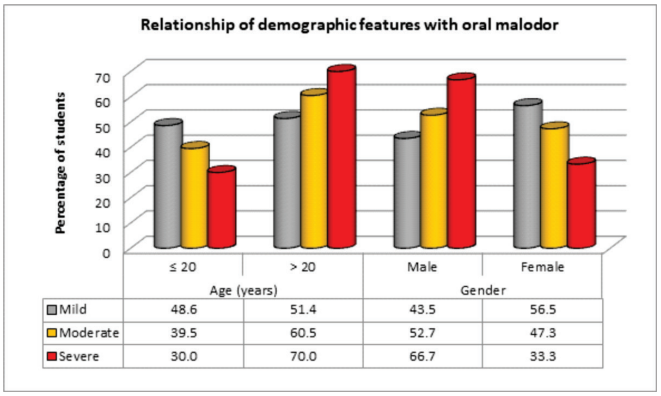

Fig 2: Relationship of demographic features with oral malodor.

of significance (See *Table 4*).

Logistic regression analysis was performed specific to males and females to identify associations between their self-assessment of OM and other factors (*Table 5*). Only the regular use of toothpick was significantly associated with severity of OM (p=0.035), identified more in females than males (OR=0.558). Use of floss was associated with severity of OM, found more in females than males (OR=0.843). Use of miswak was associated with a mild OM score, found more in males than females (OR=0.390). A self-assessment of moderate severity of OM was found more in males than females associated with cigarette smoking (OR=2.046). Severity of OM, associated with cleaning of tongue coating regularly or sometimes, was equally found in males and females (OR=0.715).

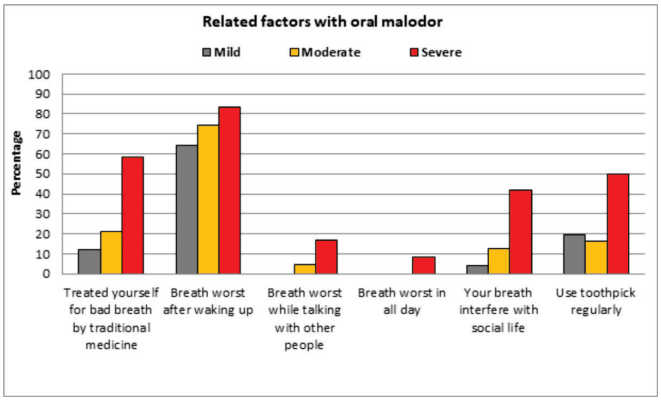

Fig 3: Related factors with severity of oral malodor.

DISCUSSION

Oral malodor is considered one of the causes of personal discomfort and social embarrassment. Almost $1 billion a year is spent in the United States on deodorant-type mouth rinses, mints, and products to manage bad breath.[16] Various studies among dental students on their self-perception of OM have been performed in

different parts of the world,[1,6-8,17-19,21,22,24,26] including central Saudi Arabia.[18] In this study the self-perception of OM was studied among dental students in the Eastern province of Saudi Arabia, which was also correlated with their oral hygiene practices.

The percentage prevalence of students reporting self-perception of OM has been shown to differ between male and female dental students in various studies. A higher percentage of males has been reported in some studies[1,6,18], while other studies have shown a higher percentage in females.[7,8,17]. In this study male students reported a higher percentage, especially regarding severe OM (*Figure 2*).

Factors in this study associated with students' general oral health which are perceived as influencing their self-perception of OM, such as caries, was found to be the highest as compared to gingival bleeding and dryness of mouth. Dental caries had a slightly higher prevalence in females than in males, but the opposite was found regarding gingival bleeding, whereby the prevalence among males was almost three times as high as compared to females. Caries was self-reported in 48% of males and in 49% of females. Almost 15% of males and 11% of females reported dry mouths. Reduced salivary flow during sleep can result in "morning breath," being a transitory condition which disappears after a meal.[6] In this study, 70.6% reported having bad breath after waking up in the morning. Previous studies have shown similar results whereby "morning breath" was ascribed to decreased salivary flow during sleeping.[1,17,19]

Various aspects of oral hygiene practice were assessed in this study. Females showed a higher percentage frequency of toothbrushing. This was also reflected in their lower percentage of bleeding gums and a lower associated self-perception of OM (*Tables 3* and *4*). However, the effect of toothbrushing was not significantly associated with the self-perception of OM. Other studies have also shown no significant relationship between the frequency of brushing and OM.[6,18]

Flossing was performed on a daily basis by 29% of male students and by 33% of female students. Similar results are seen in a Turkish study indicating a significant difference in the prevalence of floss usage between males (25.4%) and females (37.4%) (P=0.038).[20] Other studies have also found a higher percentage of floss usage in female students as compared to males.[20-23] Interdental flossing has been shown to significantly reduce the concentration of volatile sulphur compounds.[24] This may explain the higher self-perceived OM in males in this study who reported a lower percentage of daily flossing. This finding was however not statistically significant (*Table 5*).

In this study, only 32% of males and 40% of females cleaned their tongues regularly, thereby also possibly contributing to OM in our study population. Tongue coating has been shown to increase organoleptic scores and VSC values,[25,26] as well as gingival inflammation.[27] The present study reiterates the general consensus that tongue coating could be the reason for OM in our study population. However, in this study, cleaning the tongue by a brush or a tongue scraper and its effects on OM was found to be not statistically significant (P=0.3) (*Table 4*).

Although students self-reported a high percentage of OM, a small percentage of students used miswak with the purpose of decreasing their self-perception of OM (*Table 3*). This finding is similar to a study in Kuwait whereby self-perceived OM was significantly associated with the non-usage of miswak.[28]

Smoking among dental students was also found to be prevalent. In this study 2% of females and 14% of males reported smoking, whereby the effect of smoking was found to be significantly associated with the self-perception of OM. Other studies in Saudi Arabia have reported a prevalence of 27.8% among males and 2.4% among females,[29] as well as a prevalence of 65% among males and 23.1% among females.[30] The differences in these prevalences of tobacco usage have been ascribed to cultural issues.[30] Furthermore, sulphur components in cigarette smoke can cause OM[31], and together with dry mouth and periodontal disease, this may further contribute to the severity of OM.[32]

A significant association was found between the severity of OM and the effects thereof on student's social life (p=0.001) (*Table 2*). People with OM tend to avoid social interaction, as described also in other studies.[6,19]

Within the limitations of this study, the self-perceptions of OM among dental students was studied. However, large discrepancies may exist between the actual overall prevalence of OM and self-perceptions of OM, as shown in other studies.[19.33] Furthermore, differences in assessment methods, the criteria used for measurement as well as lifestyle and culture can lead to various differences in self-perception of OM.[6,34] It is thus proposed that the students in this study undergo further clinical (organoleptic assessment) and laboratory evaluation so as to establish the overall prevalence of OM. By this means comparisons can be drawn between the overall prevalence and the self-perceptions of OM.

CONCLUSIONS

This study identified a high prevalence of OM among dental students. The regular use of dental floss and removal of tongue coating can significantly reduce OM. Dental students, as oral health care providers, should also be effective role models for their patients. This can only be achieved when they themselves practice and maintain good oral hygiene habits. Their self-care behavior should be routinely assessed and professional guidance should be provided, so as to improve their quality of life, as well as that of their patients.

Future studies should be conducted to correlate self-perceived OM with objective clinical examination and laboratory methods, so as to manage OM among

the studied student population.

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