

Gender-Related Characterization of Acne in Chinese: A Multiple-Center Cross-Sectional Survey on 13085 Cases

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Background: Acne is a common inflammatory dermatosis. Although gender-related differences in prevalence and age of onset have been documented. Other gender-related characteristics of acne have not been well elucidated yet.

Objective: We compared characteristics of skin lesions, severity and risk factors of acne between males and females in Chinese.

Methods: Investigator-administered questionnaire was used to collect demographic data, clinical feature and risk factors of acne from May 2020 to August 2021. All participants were from outpatient clinics in seven cities, China.

Results: A total of 13085 participants, including 4746 males (36.27%) and 8339 females (63.73%), aged 8 to 35 years old, completed the questionnaire. The age of onset of acne was significantly younger in males than in females ($p < 0.001$). More females than males had comedones (83.76% vs 75.22%, $p < 0.001$). In contrast, more males than females had pustules, cyst/nodules, scars and severer lesions ($p < 0.001$). Moreover, the major risk factors for acne were constipation, cosmetics, dairy and sweet foods for females, while the major risk factors for males were computer usage/playing electronic games, staying up late at night, intake of hot or spicy foods. More females than males experienced good response to photodynamic treatment (79.52% vs 52.86%, $p < 0.05$).

Conclusion: Acne appears earlier in males than in females. Clinical features and risk factors for acne differ between males and females. More females than males experience good response to photodynamic therapy.

Limitation: This questionnaire survey was carried out in Chinese aged 8 to 35 years old. Gender-related characteristics in other ages and regions remain to be explored.

Keywords: acne, risk factors, gender, severity, treatment

Introduction

Gender differences in biology and pathogenesis of diseases have long been known. In general, females have longer life expectancy than males do.¹ Previous studies showed that excessive exposure to UV irradiation induces a higher transepidermal water loss rates in males than in females, while the rate of epidermal permeability barrier recovery is significant higher in females than in males following acute abrogation of barrier function with repeated tap-stripping.² The slower barrier recovery in males is in part attributable to sex hormone because estrogen (female hormone) accelerates while testosterone delays barrier development in fetal skin.³ Castration of male mice accelerates the recovery

of epidermal permeability barrier.⁴ The thickness of the skin is thicker in males than in females.⁵ Gender differences in skin disorders have also been demonstrated. For example, the prevalence of psoriasis and erythroderma in males is twice as high as that in females.⁶ Similarly, the incidence of non-melanoma skin cancers is higher in males than in females.⁷ In contrast, more females than males suffer from systemic lupus erythematosus.⁸ Likewise, prevalence of atopic dermatitis is higher in females than in males.⁹ Moreover, gender differences also reflect in disease severity. For instance, Psoriasis Area Severity Index is lower in females than in males.^{10,11} But the age of psoriasis onset is younger in females than in males.¹⁰ Taken together, this line of evidence indicates variation of cutaneous conditions with gender.

Acne is a common, chronic inflammatory skin disorder. The prevalence of acne varies greatly with age, gender and ethnicity. For example, prevalence of acne is over 40% in children aged 7–9 years old in Lithuania,¹² whereas no acne patients were observed in children under 9 years old in China.¹³ Prevalence of acne is higher in girls than in boys aged 7 to 12 years old, but lower in girls than in boys aged 16 to 18 years old.¹⁴ Similarly, prevalence of acne is higher in boys than in girls aged 15 to 29 years old in Chinese.¹³ However, the prevalence of acne is higher in girls than in boys aged 9 to 16 years old in Ghanaian.¹⁵ Moreover, the age of onset of acne is younger in females than in males.¹⁶ Furthermore, males with acne have more facial pores than females, while the number of facial pores is correlated positively with the severity of acne.¹⁷ Higher portion of males than females have severe acne (15% vs 3.9%).¹⁸ Males have higher risk for both severe acne (adjusted odds ratio=1.485, $p<0.05$) and acne scarring (adjusted odds ratio=2.460, $p=0.001$).¹⁹ Additionally, females with acne have higher Dermatology Life Quality Index score and Cardiff acne disability index than males do.²⁰ However, gender-related differences in acne severity and triggering/aggravating factors in Chinese are still limited. We assessed here the gender-related characteristics of disease severity and risk factors in Chinese with acne.

Participants and Methods

An investigator-administered questionnaire ([Supplementary material](#)) was used to collect demographic data, clinical features and risk factors of acne from May 2020 to August 2021. All participants were from outpatient clinics in 7 cities (Suzhou; Huzhou; Nanjing; Baoshan; Luzhou; Zhengzhou; Shanghai). This study was approved by institutional review board of the Fifth Affiliated Hospital of Dali University and carried out in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants and the legal guardian or the parent of individuals under age of 18 years prior to taking the questionnaire survey. Staying up late at night was defined as individuals went to bed after middle night ≥ 3 times per week. Playing electronics meant watching TV, playing electronic devices (phone, notebook and computer). Changes in living environment meant temporarily changing living place.

Acne was diagnosed by well-trained dermatologists at the time when questionnaire was administered. Only participants who had acne at the time when the questionnaire survey was taken were included in this analysis. Subjects without acne were excluded. According to the severity of disease, acne was classified into 4 categories, ie I, only comedones and a few papules; II, comedones, papules and a few pustules; III, larger inflammatory papules, pustules and a few cysts, involved the face and other body sites; IV, more severe with cysts becoming confluent.²¹ For risk factors, we did not attempt to quantify the extent of exposure to risk factors. For each item in the questionnaire, only yes-or-no question was provided. Therapeutic outcome of different treatments was based on the surveyees' response to the questionnaire.

Data Analysis

Data are analyzed with GraphPad Prism software 8.3.0. Descriptive data are expressed percentage while quantitative data are expressed as mean \pm sem. Either Chi-square test/Cochran-Mantel-Haenszel test or unpaired student *t* test was used to determine the significance between males and females.

Results

Demographic Characteristics

A total of 13085 participants, including 4746 males and 8339 females aged 8 to 35 years old, were included in this analysis ([Table 1](#)). The average age at onset was younger in males than in females (17.12 ± 0.05 vs 18.56 ± 0.05 , $p<0.001$).

Table 1 Demographic Characteristics

		Males (N=4746)	Females (N=8339)	P values
Age (yr)	<20	17.47 ± 2.01(47.75%)	17.81 ± 2.24(29.38%)	<0.001
	20–30	24.11 ± 2.54(47.81%)	24.54 ± 2.63(60.18%)	<0.001
	>30	34.55 ± 3.19(4.45%)	34.48 ± 3.12(10.44%)	0.782
	Overall	21.40 ± 0.07(100%)	23.6 ± 0.06(100%)	<0.001
Age at onset (yr)		17.12 ± 0.05	18.56 ± 0.05	<0.001
Disease duration (yr)		4.53 ± 0.05	5.40 ± 0.05	<0.001

Note: Data are expressed as Mean ± sem (% of total).

Characteristics of Skin Lesions

As shown in Table 2, proportion of subjects with comedones was greater in females than in males, while proportion of subjects with papules was comparable between males and females. In contrast, proportion of subjects with pustules, scar and cyst/nodules was higher in males than in females. Similarly, a greater portion of males had severe acne (grade IV) in comparison to that of females (30.66% vs 11.79%, $p<0.0001$). About 61% of females and 46% of males had grades I and II of acne (Figure 1). These results show that males tend to have severer acne than do females.

Risk Factors for Acne Differ Between Males and Females

We next analyzed the risk factors for acne in males and females. The major risk factors for acne were taking spicy foods and staying up late at night in both males and females (Table 3). Significantly higher portion of females aged ≤ 30 years old proclaimed that dairy diets, seafoods, sweet foods, changes in living environment, genetic factor and psychological stress are the triggering and/or aggravating factors for acne ($p<0.001$ for males vs females). Similarly, more females than males considered skin care products and constipation as the triggering and/or aggravating factors for acne ($p<0.001$). In contrast, more males than females aged 21–30 years old, but not in other age groups, experienced triggering and/or aggravating acne by changing season ($p<0.001$). Moreover, the influences of dairy diets and psychological stress on acne varied with age in both females ($p<0.0001$ for both) and males ($p=0.0021$ for dairy diets, $p=0.0014$ for psychological

Table 2 Clinical Features

	Age	Males	Females	P
Comedones	<20	1819/2266(80.27%)	2149/2450(87.71%)	<0.001
	20–30	1623/2269(71.53%)	4185/5018(83.4%)	<0.001
	>30	128/211(60.66%)	651/871(74.74%)	<0.001
Papules	<20	1870/2266(82.52%)	2005/2450(81.84%)	0.543
	20–30	1887/2269(83.16%)	4097/5018(81.65%)	0.121
	>30	168/211(79.62%)	665/871(76.35%)	0.318
Pustules	<20	1003/2266(44.26%)	791/2450(32.29%)	<0.001
	20–30	966/2269(42.57%)	1674/5018(33.36%)	<0.001
	>30	94/211(44.55%)	295/871(33.87%)	<0.001
Cyst/nodules	<20	634/2266(27.98%)	243/2450(9.92%)	<0.001
	20–30	756/2269(33.32%)	596/5018(11.88%)	<0.001
	>30	65/211(30.81%)	144/871(16.53%)	<0.001
Atrophic scar	<20	635/2266(28.02%)	307/2450(12.53%)	<0.001
	20–30	849/2269(37.42%)	889/5018(17.72%)	<0.001
	>30	67/211(31.75%)	129/871(14.81%)	<0.001
Hypertrophic scar	<20	182/2266(8.03%)	40/2450(1.63%)	<0.001
	20–30	277/2269(12.21%)	102/5018(2.03%)	<0.001
	>30	31/211(14.69%)	27/871(3.10%)	<0.001

Note: N/total (%).

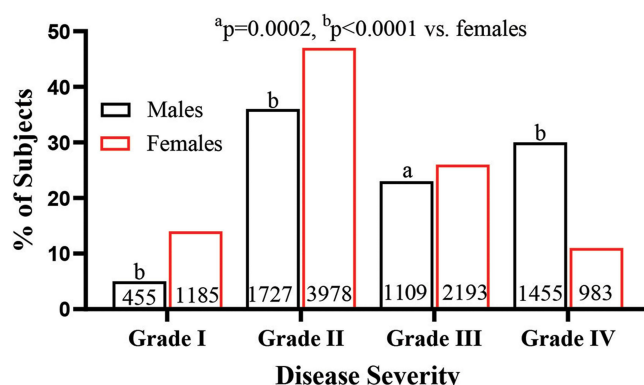


Figure 1 Comparison of disease Severity between males and females.

Notes: Disease severity was graded as described in the Materials and Methods section. Chi-square test was used to determine the significance between males and females. The number of subjects and significance are indicated in the figure ^a $p=0.002$ and ^b $p<0.0001$, males vs females.

stress). But the age-dependent effect of sweet foods on acne was only observed in females ($p<0.0001$), but not in males. These results demonstrate that the risk factors of acne vary with gender.

Males and Females Differentially Respond to the Treatments

Next, we compared the response to treatments between males and females. As shown in Table 4, males and females did not respond differently to most of the topical treatments except to topical benzoyl peroxide and clindamycin, which

Table 3 Triggering/Aggravating Factors

	Age	Males	Females	P
Dairy diets	<20	253(11.17%)	512(20.9%)	<0.001
	20–30	318(14.01%)	1245(24.81%)	<0.001
	>30	17(8.06%)	106(12.17%)	0.115
Spicy food	<20	1959(86.45%)	2135(87.14%)	0.491
	20–30	1880(82.86%)	4149(82.68%)	0.867
	>30	179(84.83%)	723(83.01%)	0.539
Sweet food	<20	670(29.57%)	1117(45.59%)	<0.001
	20–30	744(32.79%)	2667(53.15%)	<0.001
	>30	63(29.86%)	304(34.9%)	0.169
Seafood	<20	925(40.82%)	1108(45.22%)	0.002
	20–30	1007(44.38%)	2480(49.42%)	<0.001
	>30	76(36.02%)	420(48.22%)	0.002
Constipation	<20	1019(44.97%)	1517(61.92%)	<0.001
	20–30	1253(55.22%)	3563(71%)	<0.001
	>30	122(57.82%)	607(69.69%)	0.001
Genetics	<20	1100(48.54%)	1413(57.67%)	<0.001
	20–30	1206(53.15%)	2960(58.99%)	<0.001
	>30	117(55.45%)	456(52.35%)	0.419
Staying up late	<20	1797(79.3%)	2031(82.9%)	0.002
	20–30	1994(87.88%)	4371(87.11%)	0.358
	>30	174(82.46%)	702(80.6%)	0.535
Overtiredness	<20	1501(66.24%)	1788(72.98%)	<0.001
	20–30	1711(75.41%)	3836(76.44%)	0.342
	>30	160(75.83%)	630(72.33%)	0.342
Cosmetics	<20	893(39.41%)	1537(62.73%)	<0.001
	20–30	1042(45.92%)	3581(71.36%)	<0.001
	>30	85(40.28%)	553(63.49%)	<0.001

(Continued)

Table 3 (Continued).

	Age	Males	Females	P
Electronics	<20	1695(74.8%)	1828(74.61%)	0.893
	20–30	1739(76.64%)	3693(73.6%)	0.006
	>30	137(64.93%)	622(71.41%)	0.066
Changes in living environment	<20	1083(47.79%)	1474(60.16%)	<0.001
	20–30	1429(62.98%)	3514(70.03%)	<0.001
	>30	116(54.98%)	509(58.44%)	0.393
Changes in Season	<20	1587(70.04%)	1655(67.55%)	0.066
	20–30	1658(73.07%)	3367(67.1%)	<0.001
	>30	151(71.56%)	564(64.75%)	0.061
Psychological stress	<20	1160(51.19%)	1498(61.14%)	<0.001
	20–30	1244(54.83%)	3130(62.38%)	<0.001
	>30	92(43.6%)	431(49.48%)	0.125

Note: N (%).**Table 4** Response to Topical Treatments

Treatments	Severity	Males	Females	P
Tretinoin	I	71/97(73.2)	234/319(73.35)	0.975
	II	266/366(72.68)	893/1263(70.7)	0.463
	III	201/284(70.77)	554/757(73.18)	0.438
	IV	301/446(67.49)	300/408(73.53)	0.053
Benzoyl peroxide	I	20/22(90.91)	30/52(57.69)	0.005
	II	68/91(74.73)	185/273(67.77)	0.212
	III	42/65(64.62)	108/164(65.85)	0.859
	IV	45/105(42.86)	41/115(35.65)	0.274
Erythromycin	I	28/82(34.15)	66/206(32.04)	0.731
	II	105/296(35.47)	224/705(31.77)	0.255
	III	78/206(37.86)	146/421(34.68)	0.434
	IV	104/323(32.2)	81/242(33.47)	0.75
Clindamycin	I	15/46(32.61)	52/128(40.63)	0.338
	II	83/174(47.7)	178/426(41.78)	0.185
	III	48/134(35.82)	103/284(36.27)	0.929
	IV	66/209(31.58)	35/166(21.08)	0.023
Fusidic acid	I	28/38(73.68)	93/139(66.91)	0.426
	II	145/213(68.08)	517/720(71.81)	0.292
	III	73/146(50)	207/420(49.29)	0.882
	IV	93/283(32.86)	78/227(34.36)	0.722
Sulfur lotion	I	17/30(56.67)	12/34(35.29)	0.087
	II	77/105(73.33)	109/173(63.01)	0.076
	III	34/73(46.58)	41/105(39.05)	0.317
	IV	45/135(33.33)	30/70(42.86)	0.179
Glucocorticoids	I	3/11(27.27)	6/18(33.33)	0.732
	II	15/26(57.69)	26/42(61.9)	0.73
	III	10/16(62.5)	27/41(65.85)	0.812
	IV	18/34(52.94)	9/13(69.23)	0.312
Chemical peeling	I	40/53(75.47)	113/165(68.48)	0.333
	II	113/158(71.52)	364/533(68.29)	0.441
	III	64/100(64)	182/287(63.41)	0.917
	IV	61/145(42.07)	48/132(36.36)	0.332

Notes: Data are expressed as percentage of subjects who positively responded to topical treatments [N/total (%)]. Chi-square test is used to determine the significance between males and females. Italic bold indicates significant difference.

females displayed poor therapeutical response (for benzoyl peroxide, $p=0.005$ for grade I acne; for clindamycin, $p=0.023$ for grade IV acne). Likewise, the responses to either oral isotretinoin or antibiotics were comparable between males and females. Moreover, males and females displayed similar responses to the treatment with either laser or red blue light. However, more females with grades II and III acne exhibited better therapeutical response to photodynamic therapy ($p=0.031$ for grade II and $p=0.003$ for grade III). These results indicate gender-related differences in response to the treatments of acne. Notably, about 70% of subjects experienced good response to the treatment with tretinoin, while less than 40% of subjects declared good therapeutic response to erythromycin and clindamycin.

Discussion

Previous studies showed gender differences in prevalence and age of onset of acne.^{13–16} Correspondingly, we showed here that the age of onset was younger in boys than in girls. The earlier onset of acne in boys can be attributable to the higher testosterone levels. Previous studies demonstrated a link between high testosterone levels to the development of acne.^{22,23} First, serum testosterone levels are higher in individuals with acne than those without acne, and are passively correlated with the severity of acne.²⁴ Second, anti-androgenic therapy is effective for acne.^{25,26} Because testosterone levels are higher in boys than in girls at puberty age,^{27,28} the age of onset is younger in boys than in girls. The other gender-related difference is acne severity. Our results were consistent with prior study,²⁰ showing that males have more severe acne than females. This is not surprising. As mentioned above, boys have higher levels of serum testosterone, which is linked to acne. Also, females usually have greater cosmetic concern compared to males. Hence, females seek medical care in a timely manner when they find lesions on the skin. Appropriate early treatment can mitigate the progression of acne. Thus, proportion of severe acne are greater in males than in females.

Previous studies demonstrated that females have more comedones than males.²⁹ We show here that the prevalence of comedones was higher in females than in males (83.76% vs 75.22%, $p<0.001$). The underlying mechanisms accounting for such gender difference are unknown. Another remarkable gender-related difference was a higher prevalence of acne scars in males than in females (23.13% vs 12.69%, $p<0.0001$), consistent with previous observation.³⁰ Such gender-related difference is likely due to a higher sebum production in males than in females.^{17,31} Sebum can induce inflammation,^{32,33} resulting in severe acne, which is known to be linked to the development of acne scars.³⁴ Therefore, high prevalence of severe acne and acne scars in males is attributed to higher testosterone levels, resulting in increased sebum production and inflammation.

Although acne can occur as early as at age 6 in girls in the United States,³⁵ the present study showed the youngest Chinese with acne were 8 years old in girls. In comparison to Americans, Chinese children, especially those live in suburban areas, eat less protein and dairy products, while nutrition determines the onset of puberty.³⁶ The excessive nutrition is linked to the development of acne.³⁷ Thus, the age of onset is older in Chinese than in Americans. Previous study showed the age of onset of acne was ≥ 10 years in Chinese reported in 2011,¹³ a two-year older than that shown in the present study. Because the trend of pubertal age is decreasing,^{38,39} the difference in the age of onset between the present and previous studies could reflect the trend of decrease in pubertal age.

The risk factors for acne include diet, life style, psychological stress, etc. We show here that over 80% of the subjects claimed spicy food is triggering/aggravating factor, which is in contrast to previous study.⁴⁰ Thus, the pathogenic role of spicy food in acne remains to be explored. The present study also demonstrate that over 80% of subjects declared staying up late at night as a risk factor for acne, which can be attributed to the increased sebum production.⁴¹ Since acne is an inflammatory dermatosis, late bedtime-induced inflammation can also provoke and/or exacerbate acne.⁴² A striking difference between males and females is the risk factors, such as skin care products (relative risk=2.71) and psychological stress (relative risk=1.154), both of which prevalence were higher in females than in males. Females tend to frequently use more skin care products. Skin care products can worsen acne because some ingredients in skin care products can irritate the skin or cause acne.^{43–45} Thus, skin care products become a major risk factor for acne in females. In agreement with previous study,⁴⁶ psychological stress is one of the risk factors in females. Gender differences in response to psychological stress are due to psychological and biological differences as well as sex hormone.⁴⁷ Females usually experience a higher level of stress than males.^{48,49} Psychological stress increases the secretion of adrenal androgens, resulting in sebaceous hyperplasia,⁴⁶ consequently leading to the development and exacerbation of acne.

Regarding the sweet foods, females tend to eat more sweet foods than males.⁵⁰ Intake of excessive sugar can increase serum insulin, which lowers sex hormone-binding globulin concentration while elevating androgen concentration, resulting in the development and exacerbation of acne.⁵¹ Taken together, gender-related difference in risk factors for acne can be attributable to the differences in psychology, biology and life habits between males and females. Regarding the underlying mechanisms accounting for the gender differences in response to the treatments, it is unclear. Nevertheless, the results suggest that gender should be considered in the management of acne. Avoidance of sweet foods and proper management of constipation can possibly mitigate acne, especially in females. Benzoyl peroxide is more effective for mild acne in males than in females.

In conclusions, intake of spicy food, sweet food, playing electronics, constipation and late bedtime are the major risk factors for acne. Males and females with acne differ in age of onset, disease severity, some of risk factors and response to some treatments. In the management of acne, these gender differences should be considered.

Limitation

This questionnaire survey was carried out in Chinese aged 8 to 35 years old in southern China. Because sun-exposure can affect the severity of acne,^{52,53} gender-related characteristics of acne in other ages and regions such as northern China remain to be explored. Moreover, the disease duration and the number of subjects were not the same between males and females. And larger sample size can increase analysis power. It would be ideally to elucidate the gender-related differences between males and females with similar disease duration, age and sample size.

Data Sharing Statement

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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