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A Systematic Review of the Prevalence of Acne in Mainland China

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Abstract

Introduction Acne, a very common skin disease, can result in psychological distress and sustained impairment in quality of life. Data on the prevalence of acne and their difference in gender, region and age is sketchy. The aim of this review is to estimate the prevalence of acne in mainland China comprehensively and to quantify its association with gender, region and age.

Methods We searched electronic databases with predetermined search terms to identify relevant studies published between January 1, 1996 and September 30, 2016. We pointed out repeated results using Note Express software and evaluated the studies for inclusion. Two independent reviewers extracted data. Then statistical analyses were performed using Comprehensive Meta-Analysis version 2.0. A random-effects model was adopted to calculate the overall pooled prevalence and to merge categories, including gender, region and age for subgroup analyses. Logistic meta-regression analysis was used to clarify the associations between acne and the predictors age, gender, and region using odds ratios and their associated 95% confidence intervals.

Results 25 relevant studies were included in this meta-analysis. The overall pooled prevalence rates of acne were 39.2% (95% CI=0.310-0.479). The prevalence rates in different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95% CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95% CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the prevalence rates were 34.2% for northern China (95% CI=0.242-0.458) and 46.3% for southern China (95% CI=0.374-0.555). The associations between acne and the predictors age, gender, and region were statistically significant.

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4 **Conclusions** In mainland China, primary and secondary students exhibited higher
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6 prevalence rates than undergraduate students, males had higher prevalence rates of
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8 acne than females, and the prevalence rates of acne in southern China was higher than
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10 northern China.

11 12 13 **Strengths and limitations**

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15 To our knowledge, this was the first meta-analysis of its scope which will give us a
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17 detailed understanding of the prevalence of acne in mainland China and its
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19 associations with age, gender, and region and provide a sound basis for the future
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21 provision of health services.
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25 This systematic review, covering 12 different provinces, represents near-complete
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27 capture of the demographic for more than 80 thousand people over a 41-year period.

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29 Some limitations should be considered: the diagnostic criteria for acne differed among
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31 included studies; the age of the survey population could not be subdivided.
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34 35 **Introduction**

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37 Acne, a very common skin disease among adolescents, was the fourth most common
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39 reason for patients aged 11–21 years to visit a doctor in the USA¹. In addition, there is
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41 increasing epidemiological data suggesting that acne also affects a considerable
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43 number of adults^{2,3} and women are more frequently affected by adult acne than
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45 men⁴. Several studies have shown that the estimated prevalence rate of acne varies
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47 from 8.1% to 85.1% in China⁵⁻⁷, depending on the region, subjects' ages, and the
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49 nationality studied.
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52 The clinical features of acne include papules, pustules, cysts, comedos, and nodules.
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54 Acne occurs primarily on the face, neck, and upper trunk and can lead to scar
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56 formation if treated improperly. Thus, acne can result in psychological distress and
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3 have profound effects on patients' self-esteem, may leading to anxiety, depression,
4 diminished self-confidence, and communication difficulties^{8,9}.

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7 To date, many large population-based studies have been conducted to estimate the
8 prevalence rates of acne in regional populations. Because China comprises 34
9 province-level administrative regions, with 56 nations and a population of 1.3 billion
10 people, a country-wide, population-based study of the prevalence rates of acne in
11 China was needed.

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14 In this review, we examined the prevalence of acne in mainland China systematically
15 and to analyse the effects of gender, region and age on acne.

16 17 18 19 20 21 22 23 **Methods**

24 25 26 **Search strategy**

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28 Studies were aggregated from six databases between January 1, 1996 and September
29 30, 2016, including PubMed, EMBASE, the Web of Science, the China National
30 Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and
31 the Wan Fang Database for Chinese Periodicals. In addition, a manual search was
32 performed by checking the reference lists of the reports that were examined. The
33 following search terms were used to retrieve relevant studies, (acne), (prevalence or
34 incidence) AND (China or Chinese).

35 36 37 38 39 40 41 42 43 **Inclusion criteria**

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45 Studies that met all of the following criteria were included in the meta-analysis,

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47 (1) the study was a population-based survey;
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49 (2) the study evaluated the prevalence/incidence of acne;
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51 (3) the investigation involved random sampling or cluster sampling;
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53 (4) the sample size was >300;

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56 A flow chart illustrating the article search process is presented in Figure 1.

Data management

Any duplicate studies was removed by Note Express. Two reviewers(Qiang Chen and Danhui Li) independently evaluated the title and abstract of all studies identified through the search against the inclusion and exclusion criteria. The full text of all eligible studies will then be retrieved. Any disagreement will be resolved by a third reviewer. Excluded studies and the reasons for exclusion will be recorded.

Data extraction

Customised data information was extracted independently by two investigators. The following information was collected for each study: (1) the name of the first author; (2) the location of the investigation area; (3) the year in which the investigation occurred; (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6) the prevalence rates obtained for males, females, and overall; (7) the method used to sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.

Risk of bias (quality) assessment

Four key criteria^{10, 11} were used by two independent investigators (Qiang Chen and Danhui Li) to estimate study quality: (1) the sampling scheme (random or consecutive); (2) whether the study included an adequate description of the characteristics of the study population; (3) whether a clear definition of the prevalence rate was provided; and (4) whether the response rate exceeded 75%. The scoring rule used was the following, for each quality item, “clear or adequate” was scored as 1 point, whereas “no” was scored as 0 points. The study was considered to be of adequate quality if the quality score was greater than or equal to 3. The two reviewers carefully assessed the included studies independently and agree on the final grading. An additional reviewer was consulted should there be any uncertainty or disagreement.

Ethics and dissemination

Since primary data will not be collected, formal ethical approval will not be required.

The results will be disseminated through peer-reviewed publications, conference presentations and the media.

Statistical analysis

The statistical analyses were performed using Comprehensive Meta-Analysis version 2.0 (Biostat, Englewood Cliffs, NJ, USA; <http://www.meta-analysis.com>). We calculated the pooled prevalence estimates as proportions and 95% CIs for the subgroup categories weighted by the sample sizes of the individual studies and then pooled these data to derive an overall proportion and its associated 95% CI. The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic. Meanwhile, I^2 metrics were calculated to quantify heterogeneity. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into one of two groups (north versus south) according to the geographical regions in which the studies were conducted. Similarly, the studies were classified into three groups based upon the age of the participants in the samples, overall, undergraduate, and primary and secondary students ("p and s"). Subjects were also classified as male and female. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model. The associations between age, gender, region and risk of acne were expressed as ORs and 95% CIs. A value of $p < 0.05$ was considered statistically significant.

Analysis of the publication bias

To examine the authenticity of data, Egger test and Funnel plots were made by Comprehensive Meta-Analysis version 2.0. There is no publication bias if the studies

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3 arrange around the center line symmetrically and a value of $p>0.05$, otherwise there
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5 exists publication bias.
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7 8 **Results**

9 10 **Characteristics of the studies**

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12 Using the initial search strategy, 166 studies were identified, and 141 studies were
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14 subsequently excluded (Figure 1). A total of 25 studies^{5-7, 12-33} involving 83,008
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16 Chinese individuals were included in this meta-analysis. Detailed characteristics of
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18 each included study were presented in Table 1. The overall quality of all included
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20 studies was found to be adequate (Table 2).
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23 24 **The overall prevalence rates of acne in mainland China**

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26 A total of 25 studies involving 83,008 Chinese people were included in this
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28 meta-analysis. However, there was significant heterogeneity in this meta-analysis
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30 ($I^2=99.797\%$, $Q=11823.369$, $P<0.001$). Thus, a random-effects model was selected for
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32 the analysis. The overall pooled prevalence of acne was 39.2% (95% CI=0.310-0.479;
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34 Figure 2).
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37 38 **The prevalence rates of acne in mainland China by gender**

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40 A total of 24 studies involving 40,712 males and 41,907 females were included in this
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42 subgroup meta-analysis. However, there was significant heterogeneity among both the
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44 males ($I^2=99.582\%$, $Q=5508.959$, $P<0.001$) and females ($I^2=99.614\%$, $Q=5957.125$,
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46 $P<0.001$) in this meta-analysis. Thus, a random-effects model was selected for the
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48 analysis. Males (39.7%, 95% CI=0.317-0.482) exhibited a higher prevalence of acne
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50 than did females (35.7%, 95% CI=0.274-0.451, $Z=3.903$, $p<0.001$) in the subgroup
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52 analysis (Figure 3).
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55 56 **The prevalence rates of acne in mainland China by region**

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58 A total of 24 studies involving 65,663 Chinese were included in this subgroup
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3 meta-analysis. 10 of these studies were conducted in northern China (19,377 Chinese),
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5 and 14 studies were conducted in southern China (46,286 Chinese). However,
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7 significant heterogeneity was found both in the north ($I^2=99.573\%$, $Q=2109.204$,
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9 $P<0.001$) and in the south ($I^2=99.689\%$, $Q=4176.791$, $P<0.001$) in this meta-analysis.
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11 Thus, a random-effects model was selected for the analysis. The south (46.3%, 95%
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13 $CI=0.374-0.555$) had a higher prevalence of acne than did the north (34.2%, 95%
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15 $CI=0.242-0.458$, $Z=2.498$, $p=0.012$) in the subgroup analysis (Figure 4).

18 **The prevalence rates of acne in mainland China by age**

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21 A total of 25 studies, consisting of 4 studies that examined the overall population, 10
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23 p-and-s studies, and 11 undergraduate studies, were included in this subgroup
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25 meta-analysis. However, significant heterogeneity was found overall ($I^2=99.534\%$,
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27 $Q=643.149$, $P<0.001$), for the p and s subgroup ($I^2=98.860\%$, $Q=789.719$, $P<0.001$),
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29 and for the undergraduates ($I^2=99.130\%$, $Q=1149.658$, $P<0.001$) in this meta-analysis.
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31 Thus, a random-effects model was selected for the analysis. The prevalence of acne
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33 over all ages was 10.2% (95% $CI=0.059-0.171$). The primary and secondary students
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35 (50.2%, 95% $CI=0.451-0.554$) had a higher prevalence of acne than did the
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37 undergraduates (44.5%, 95% $CI=0.358-0.534$, $Z=2.411$, $p=0.016$) in the subgroup
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39 analysis (Figure 5).

42 **Logistic meta-regression analysis of the associations between age, gender, and** 44 **region and the prevalence of acne**

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47 The associations between acne and the predictors age, gender, and region were
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49 statistically significant (Table 3) as measured by the corresponding ORs and their
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51 associated 95% CIs. The OR of acne prevalence was 1.217 (95% $CI=0.109-14.681$,
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53 $p=0.024$) between male and female. Chinese male were 1.217 times more likely than
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55 female to have acne. The OR between north China and south China were 1.184
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(95%CI=0.002-3.833, $p=0.028$) for acne. South Chinese people were 1.184 times more likely than north Chinese people to have acne. The OR between primary and secondary school students and undergraduate were 3.127 (95%CI=0.001-3.838, $p=0.012$) for acne. Primary and secondary school students were 3.127 times more likely than undergraduate to have acne.

Analysis of the publication bias

There were no obvious asymmetries in the Funnel plots and the value of $p>0.05$ for the following groups: the overall pooled studies($t=0.031$, $p=0.976$, 95%CI=-0.215~0.222) (Supplementary file: Figure6), male subgroup($t=0.346$, $p=0.733$, 95% CI=-0.185~0.132) (Supplementary file: Figure7),female subgroup($t=0.143$, $p=0.887$, 95%CI=-0.164~0.188) (Supplementary file: Figure8), subgroup of overall-age -layer ($t=0.501$, $p=0.666$, 95%CI -0.831~0.658) (Supplementary file: Figure9), subgroup of primary and secondary school students ($t=0.580$, $p=0.578$, 95%CI=-0.246~0.147) (Supplementary file: Figure10), subgroup of undergraduates($t=1.061$, $p=0.316$, 95%CI=-0.121~0.335) (Supplementary file: Figure11) and Southern subgroup($t=0.441$, $p=0.667$, 95%CI=-0.194~0.293)(Supplementary file: Figure12). Except the studies of Northern China subgroup existed publication bia($t=3.369$, $p=0.01$, 95%CI=-0.520~-0.974).(Supplementary file: Figure 13).

Discussion

This meta-analysis, based on 83,008 subjects, derived from 25 studies, covering 12 provinces and municipalities in China, enable us to assess reliable prevalence of acne at the national level. Our results showed that the overall pooled prevalence of acne was 39.2%. Males (39.7%) exhibited a higher prevalence of acne than females (35.7% $Z=3.903$, $p<0.001$) in the subgroup analysis of gender. Meanwhile, the south (46.3%)

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3 had a higher prevalence of acne than north (34.2%, $Z=2.498$, $p=0.012$) in the regional
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5 subgroup analysis. Moreover, the primary and secondary students (50.2%) had a
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7 higher prevalence of acne than undergraduates (44.5%, $Z=2.411$, $p=0.016$) in the
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9 subgroup analysis of age. There was heterogeneity among the 25 included studies in
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11 this meta-analysis ($I^2=99.797\%$, $Q=11823.369$, $P<0.001$) and following reasons may
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13 explain the phenomenon. (1) Differences existed in the design of studies, such as
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15 non-unified age range, collection of data and research objects, prevalence of acne had
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17 deviation. (2) Evidence for seasonality was observed, with lower lipid production and
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19 reduced barrier function during the winter³⁴. And there was a correlation between the
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21 incidence of acne and skin surface lipid^{26,35}. The included articles may research in
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23 different seasons^{18, 21, 27, 32}, which resulted in different incidence of acne.
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28 Meanwhile, age-related subgroup prevalence rates were calculated in this study. The
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30 prevalence of primary and secondary students was 50.2%, which consistent with the
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32 results(51.3%) of B Wei³⁶. And primary and secondary students (50.2%) had a higher
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34 prevalence of acne than undergraduates (44.5%, $Z=2.411$, $p=0.016$), which was in
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36 agreement with the findings of Shen Y⁵. Moreover, by Logistic meta-regression
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38 analysis, we found the same results that primary and secondary school students were
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40 3.127 times more likely than undergraduate to have acne. Gustavo Nunes³⁷ and
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42 Yentzer BA³⁸ also reported that primary and secondary students (89.3%) had a higher
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44 prevalence of acne than did the undergraduates (61.9%) in the US population. CW
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46 Choi³⁹ reported that in the patients with late onset acne, the number of comedones, the
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48 total number of acne lesions and the proportions of comedones were significantly less
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50 than in the patients with early onset acne. The age of onset had a negative correlation
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52 with the number of comedones and the proportion of comedones in the T-zone and the
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54 entire face, namely, acne. And the clinical differences in acne based on age appeared
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3 to be mainly resulting from age of onset and not from the progression of the acne⁴⁰,
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In the present study, males (39.7%) had a 1.217 times higher prevalence rate of acne than did females (35.7%, $Z=3.903$, $p<0.001$). This result was in agreement with the findings of Schafer T⁴² that acne was more present in men (29.9%) than women (23.7%) in the city of Hamburg (Germany). This indicated that male had a higher risk of the occurrence and development of acne than females. (1) This difference might be related to lifestyle. It is well known to us all that males accounted for a larger proportion than female in drinking and smoking⁴³⁻⁴⁵. In several studies on acne, smoking appeared to be a strong disease-promoting factor⁴⁶⁻⁴⁸. (2) Besides this, males paid less attention to skin than females did in china. Nevertheless, inappropriate personal hygiene (use of abrasive soaps, harsh detergents, and excessive scrubbing) resulted in the pathological process of acne⁴⁹⁻⁵⁰. (3) Androgen levels. As we all know that increased androgen levels were a risk factors of acne⁵¹. Androgen levels were rise higher in male than female in adolescence. Adult women in different age categories have a lower prevalence of acne than adolescence. But recent researches have shown that acne is affecting an increasing number of adults, particularly females. Adult female acne should be considered as a specific acne subtype distinct from adolescent acne and to review topical and oral treatment options which may be particularly suitable for treating acne in adult females⁴. Therefore, several researches about adult female acne were expected in the future.

The prevalence rates of acne was also different in different regions. The prevalence of acne among individuals in southern China (46.3%) was higher than northern China (34.2%, $Z=2.498$, $p=0.012$). In consistent with Subramaniyan R⁵², he considered that the prevalence of acne was different in the east of the Indian mainland from its

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3 southern part. This difference may be due to several factors.(1) Climate. Enhanced
4 sebum excretion, colonization of the pilosebaceous duct with *Propionibacterium acnes*
5 and resultant inflammation were thought to play a critical role in the pathogenesis of
6 acne⁵³. The function of the sebaceous gland as an endocrine skin organ, which is
7 mainly composed of sebocytes, took an important role in the occurrence and
8 development of acne⁵⁴. Excessive sebum production and its abnormal lipid
9 ingredients from the sebaceous gland contributed to the formation of the primary acne
10 lesions⁵⁵. Sebocytes also produce inflammatory cytokines and they had a vital effect
11 on formation and aggravation of acne lesions⁵⁶. In China, southern China had longer
12 hours of sunshine than northern China. Solar radiation contained ultraviolet radiation,
13 which was an external environment factors causing many skin disease. And
14 ultraviolet radiation can show some effects on the glands through direct or indirect
15 pathways⁵⁷. Sebaceous gland hyperplasia and increased sebum secretion after
16 irradiation of ultraviolet (UV)-B has been widely accepted. The expression of
17 inflammatory cytokines, especially IL-1b, IL-6, IL-8 and TNF-a was significantly
18 increased in cultured sebocytes after treatment with UV-B⁵⁸. Meanwhile, correlational
19 research showed that time-distinct gene induction of TNF-a, IL-1b and matrilysin in
20 cultured HaCaT cells may be involved in UV-induced cellular responses⁵⁹. Although,
21 mRNA level does not always correspond to protein level in vivo, mRNA level of
22 inflammatory cytokines such as IL-1, IL-6 and TNF-a was also identified to be
23 increased through studies using whole mouse skin and human skin exposed to UV-B⁶⁰,
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61. What's more, it has been known that epithelial keratinocytes contain a functional
PPAR-c system and this system is a target for UV-B radiation⁶². The synthesis of free
fatty acids by PPAR-c stimulates the production of pro-inflammatory cytokines, such
as IL-1b and TNF-a, in sebaceous glands⁵⁸. (2)Humidity. The humidity in south of

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3 China was high than north of china was well known. Subramaniyan R et al⁵² reported
4 that the prevalence of dermatoses, including acne, much higher in humid regions than
5 arid regions. (3) Diet. Chili was a favorite food for the residents of southern compared
6 to the northern residents and southern residents ate more chili than northern. However,
7 spicy food was risk factors for the acne²⁵. In a word, environmental factors (climate
8 and humidity) and diet may lead to the difference of prevalence between northern and
9 southern China.
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19 **Conclusion**

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21 This systematic review will provide current evidence on the epidemiology of acne and
22 its association between acne and gender, region and age,. The evidence generated
23 from this paper may prove beneficial in terms of preventing skin lesion and improving
24 the quality of life.
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30 **Footnotes**

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33 **Contributors** Shengjie Li and Danhui Li conceived the study, participated in drafting
34 the final manuscript. Qiang Chen and Yi Liu analyzed the data and completed the
35 final draft of the manuscript. TingTing Liu and Wenhui Tang prepared all the figures.
36 All authors reviewed the manuscript.
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46 **Competing interests** None declared.
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48 **Provenance and peer review** Not commissioned; externally peer reviewed.
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51 **Data sharing statement** The data used to conduct this study are secondarily held
52 data available to the public in peer reviewed journals. As such we do not own the data
53 and have access to the data publicly. We therefore needed no special permissions to
54 use the data and wish to inform BMJ Open that all data used in this document are
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publicly held.

References

1. Ziv A, Boulet JR, Slap GB. Utilization of physician offices by adolescents in the United States. *Pediatrics* 1999;104:35-42.
2. Su P, Chen Wee AD, Lee SH, *et al.* Beliefs, perceptions and psychosocial impact of acne amongst Singaporean students in tertiary institutions. *J Dtsch Dermatol Ges* 2015; 13: 227–33.
3. Vergou T, Mantzou E, Tseke P, *et al.* Association of thyroid autoimmunity with acne in adult women. *J Eur Acad Dermatol Venereol* 2012; 26: 413–6.
4. B. Dreno. Treatment of adult female acne, a new challenge. *J Eur Acad Dermatol Venereol* 2015;29:14-9.
5. Shen Y, Wang T, Zhou C, *et al.* Prevalence of acne vulgaris in Chinese adolescents and adults, a community-based study of 17,345 subjects in six cities. *Acta Derm Venereol* 2012;92: 40-44.
6. Law MPM, Chuh AAT, Lee A, *et al.* Acne prevalence and beyond, acne disability and its predictive factors among Chinese late adolescents in Hong Kong. *Clin Exp Dermatol* 2010;35:16-21.
7. Wu T, Mei S, Zhang J, *et al.* Prevalence and risk factors of facial acne vulgaris among Chinese adolescents. *International journal of adolescent medicine and health* 2007;19:407-412.
8. Koo J. The psychosocial impact of acne, patients' perceptions. *J Am Acad Dermatol* 1995;32:S26-S30.
9. Mulder MM, Sigurdsson V, van Zuuren EJ, *et al.* Psychosocial impact of acne vulgaris. evaluation of the relation between a change in clinical acne severity and psychosocial state. *Dermatology* 2001;203:124-130 .

10. Cheng JW, Cheng SW, Ma XY, *et al.* The prevalence of primary glaucoma in mainland China, a systematic review and meta-analysis. *J Glaucoma* 2013;22:301-306.
11. Say L, Donner A, Gulmezoglu AM, *et al.* The prevalence of stillbirths, a systematic review. *Reprod Health* 2006;3:1.
12. Jian Zhang. Prevalence of acne in college students and the analysis of psychological condition of the patient. *Journal of Yichun College* 2011;33(4):89-90.
13. Ying C, Jing Wu, Liu Y, *et al.* The prevalence and related factors of acne in Guangzhou college Students. *Southern China Journal of Dermato-Venereology* 2009;16(2): 131-132 .
14. Li M, Candong L, Donghua C. Epidemiology investigation of acne in adolescents of different ages. *Journal of Gansu College of Traditional Chinese Medicine* 2008;25(1): 27-29.
15. Zhenxiu S. Investigation of the incidence of acne in College students. *China Journal of Leprosy and Skin Diseases* 2005;21(12): 994-995.
16. Jieying F, Ruiqiang F. Epidemiology of acne of 1561 middle school students in Guangzhou. *Southern China Journal of Dermato-Venereology* 2008;15(1):49-51 .
17. Luanduan C, Dinan Z, Yang L, *et al.* Epidemiological Investigations of 2015 Secondary Students of Acne. *China Modern Doctor* 2011;49(27):6-7.
18. Tieqiang Wu, Shuqing Mei, Jinxin Zhang, *et al.* Prevalence and Risk Factors of acne Vulgaris in Adolescents 10-18 Years old. *International Journal of Dermatology and Venereology* 2006;32(4): 201-204.
19. Feng Zhang, Jianbo Liu, Xuexiang Lin, *et al.* Analysis of Prevalence and Awareness of Acne of College Students in Dongguan city. *Medicine and Society*. 2014;27(5):68-70 .

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3 20. Zhaorui Liu, Yueqin Huang, Huaming Zhang, *et al.* Prevalence of the knowledge
4 and attitude behavior on acne of students grade 2 in senior high school in Beijing.
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6 *Chinese Journal of Dermatology* 2003;36(9):519-520.
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10 21. Rui F, Furen, Z. Epidemiological investigation of acne vulgaris in Jining area
11 junior high school students. *China Journal of Leprosy and Skin Diseases*
12 2014;30(4):214-215.
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15 22. Jianping C, Dapeng D, Yun S. Prevalence of Acne among primary and middle
16 school students in urban and rural area Of Xingtai city. *Chinese Journal of School*
17 *Health* 2008; 29(11):995-996 .
18
19
20
21
22 23. Bin D, Huiming Zeng, Yongjiang D, *et al.* Survey of acne vulgaris in college
23 students in Hainan Province and logistic analysis of risk factors. *China Tropical*
24 *Medicine*.2008;8(10):1867-1868.
25
26
27
28
29 24. AiLi Gao, Hong Zhang, Hanxiang Zeng, *et al.* The prevalence and risk factors
30 analysis of adolescent acne in Guangzhou city Tianhe district. *China Journal of*
31 *Leprosy and Skin Diseases* 2007; 23(12):1052-1053.
32
33
34
35 25. Bing L, Cangzhen H, Yanjie W. Investigation and analysis of risk factors for the
36 occurrence of acne among middle school students in Weinan City. *China Health Care*
37 *and Nutrition* 2012;22(8):2444-2445.
38
39
40
41
42 26. Shengjie L, Youcan Zhang, Gaomei Zheng, *et al.* Investigation and Analysis of
43 Sick Status and Influencing Factors on the Undergraduates Facial Acne Vulgaris in
44 Taian. *The Chinese Journal of Dermatovenereology* 2012;26(7):625-627.
45
46
47
48 27. Lijuan Liu, Shiheng Song, Li Cai, *et al.* Prevalence and awareness of risk factors
49 of acne among college students in Shijiazhuang City. *The Chinese Journal of*
50 *Dermatovenereology* 2014;28(2):171-172.
51
52
53
54
55 28. Qing Liu, Xin Gao, Xinhui Liu, *et al.* An epidemiological survey on acne in zibo
56
57
58
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- 1
2
3 district, Shandong Province. *Journal of Practical Dermatology* 2013;16(3):149-151.
- 4
5 29. Guangde Pei, Jinfeng Du, Ying Huang, *et al.* An epidemiological survey on acne
6
7 in Jiaozuo district of Henan Province. *The Chinese Journal of Dermatovenereology*
8
9 2010;24(12):1129-1131.
- 10
11 30. Aihua Z, Qingjuan G, Wanfa R, *et al.* Investigation on incidence rate of acne in
12
13 Youth. *Hebei Medicine* 1996;2(1):78-79.
- 14
15 31. Hong Z, Xiaobing, H, Lichun F. The situation and strategies of prevention about
16
17 acne of the Jiangmen middle-school students. *Journal of Practical Dermatology*
18
19 2009;2(1):14-16.
- 20
21 32. Zhiyong Z, Ziyin, L, Hui L, *et al.* Investigation of acne about related factors of
22
23 college students in Handan city. *Journal of Hainan Medical Universit*
24
25 2011;17(12):1718-1720.
- 26
27 33. Renli Wang, Ayi Ma, Xuehua Zhang, *et al.* A survey about the prevalence of acne
28
29 in Liangshan district of Sichuan Province. *Chinese Journal of Dermatology*
30
31 2010;43(12):875-877.
- 32
33 34. Karen Meyer BS, Apostolos Pappas PhD, Kelly Dunn BS, *et al.* Evaluation of
34
35 Seasonal Changes in Facial Skin With and Without Acne. *J Drugs Dermatol*
36
37 2015;14:593-601.
- 38
39 35. Ikaraoha CI, Taylor GO, Anetor JI, *et al.* Pattern of skin surface lipids in some
40
41 south-western Nigerians with acne vulgaris. *West Afr J Med.* 2004
42
43 Jan-Mar;23(1):65-8.
- 44
45 36. B Wei, Y Pang, H Zhu, *et al.* The epidemiology of adolescent acne in North East
46
47 China. *J Eur Acad Dermatol Venereol.* 2010;24:953-957.
- 48
49 37. Vilar GN, Santos LA, Sobral Filho JF. Quality of life, self-esteem and
50
51 psychosocial factors in adolescents with acne vulgaris. *An Bras Dermatol.*
- 52
53
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1
2
3 2015;90:622-629.

4
5 38. Yentzer BA, Hick J, Reese EL, *et al.* Acne vulgaris in the United States, a
6
7 descriptive epidemiology. *Cutis* 2010; 86:94-99.

8
9 39. CW Choi, DH Lee, HS Kim, *et al.* The clinical features of late onset acne
10
11 compared with early onset acne in women. *Journal of the European Academy of*
12
13 *Dermatology and Venereology* 2011;25:454-461.

14
15 40. Williams C, Layton AM. Persistent acne in women , implications for the patient
16
17 and for therapy. *Am J Clin Dermatol* 2006;7:281-290.

18
19 41. Marks R. Acne and its management beyond the age of 35 years. *Am J Clin*
20
21 *Dermatol* 2004; 5:459-462.

22
23 42. Schafer T, Nienhaus A, Vieluf D, *et al.* Epidemiology of acne in the general
24
25 population, the risk of smoking. *British Journal Of Dermatology* 2001;145:100-104.

26
27 43. Kegler MC, Hua X, Solomon M, *et al.* Factors associated with support for
28
29 smoke-free policies among government workers in Six Chinese cities, a
30
31 cross-sectional study. *Bmc Public Health* 2014;14: 1130.

32
33 44. Yang MJ. The Chinese drinking problem, a review of the literature and its implicat
34
35 ion in a cross-cultural study. *Kaohsiung J Med Sci* 2002;18:543-550.

36
37 45. Yang X, Lu X, Wang L, *et al.* Common variants at 12q24 are associated with
38
39 drinking behavior in Han Chinese. *Am J Clin Nutr* 2013;97:545-551.

40
41 46. Wolkenstein P, Misery L, Amici JM, *et al.* Smoking and Dietary Factors
42
43 Associated with Moderate-to-Severe Acne in French Adolescents and Young Adults,
44
45 Results of a Survey Using a Representative Sample. *Dermatology* 2015;230: 34-39.

46
47 47. Cesko E, Korber A, Dissemond J. Smoking and obesity are associated factors in
48
49 acne inversa, results of a retrospective investigation in 100 patients. *European Journal*
50
51 *Of Dermatology* 2009;19: 490-493.

- 1
2
3 48. Rehn LH, Meririnne E, Hook-Nikanne J, *et al.* Depressive symptoms, suicidal
4 ideation and acne, a study of male Finnish conscripts. *Journal Of the European*
5 *Academy Of Dermatology And Venereology* 2008;22:561-567.
6
7
8
9
10 49. Kilkenny M, Merlin K, Plunkett A, *et al.* The prevalence of common skin
11 conditions in Australian school children, III, Acne vulgaris. *Br J Dermatol*
12 1998;139:840-845.
13
14
15 50. Andrew FA, Lamb A. Concomitant therapy for acne in patients with skin of color,
16 a case-based approach. *Dermatol Nurs* 2009;21:1.
17
18
19
20 51. Henze C, Hinney B, Wuttke W. Incidence of increased androgen levels in patients
21 suffering from acne. *Dermatology.* 1998;196:53-4.
22
23
24 52. Subramaniyan R. Pattern of Dermatoses Among Nicobarese in a Community
25 Health Camp at Nancowry, Andaman and Nicobar Islands. *Indian J Dermatol.*
26 2016;61:187-9.
27
28
29
30 53. Cunliffe WJ. The sebaceous gland and acne-40 years on. *Dermatology* 1998;196:
31 9-15.
32
33
34 54. Gollnick H, Dreno B. Pathophysiology and management of acne PREFACE.
35 *Journal Of the European Academy Of Dermatology And Venereology* 2015;29:1-2.
36
37
38 55. Zouboulis CC. Acne and sebaceous gland function. *Clin Dermatol*
39 2004;22:360-366.
40
41
42 56. Zouboulis CC, Adjaye J, Akamatsu H, *et al.* Human skin stem cells and the ageing
43 process. *Exp Gerontol* 2008;43:986-997.
44
45
46 57. Roberts JE. Light and immunomodulation. *Ann NY Acad Sci* 2000;917:435-445.
47
48
49 58. Weon Ju LEE, Kyung Hea PARK, Mi Yeung SOHN, *et al.* Ultraviolet B irradiation
50 increases the expression of inflammatory cytokines in cultured sebocytes. *Journal of*
51 *Dermatology* 2013;40:993-997.
52
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3 59. Skiba B, Neill B, Piva TJ. Gene expression profiles of TNF-alpha, TACE, furin,
4
5 IL-1beta and matrilysin in UVA- and UVB-irradiated HaCat cells. *Photodermatol*
6
7 *Photoimmunol Photomed* 2005;21:173-182.
8
9
10 60. Murphy GM, Dowd PM, Hudspith BN, *et al.* Local increase in interleukin-1-like
11
12 activity following UVB irradiation of human skin in vivo. *Photodermatol*
13
14 1989;6:268-274.
15
16 61. Scordi IA, Vincek V. Timecourse study of UVB-induced cytokine induction in
17
18 whole mouse skin. *Photodermatol Photoimmunol Photomed* 2000;16:67-73.
19
20
21 62. Zhang Q, Southall MD, Mezsick SMQ, *et al.* Epidermal peroxisome
22
23 proliferator-activated receptor gamma as a target for ultraviolet B radiation. *J Biol*
24
25 *Chem* 2005;280:73-79.
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Figure Legends

Figure1. Flow-chart illustrating the article search process

Figure2. Forest plot of the overall prevalence rates of acne. CI=confidence interval.

Figure3. Forest plot of the prevalence rates of acne according to gender.
CI=confidence interval.

Figure4. Forest plot of the prevalence rates of acne according to region.
CI=confidence interval.

Figure5. Forest plot of the prevalence rates of acne according to age. CI=confidence interval. All=overall age. P and s=primary and secondary students.

Tables

Table 1. Characteristics of the populations examined in studies reporting the prevalence of acne in mainland China

Name	Region	Year	Age range	Sample size	Prevalence (%)		
					Male % (n)	Female % (n)	Total (%)
Zhang feng	Dong guan	2013	undergraduate	669	40.37 (379)	34.48 (290)	37.82
Liu lijuan	Shi jiazhuang	2013	undergraduate	742	42.11 (418)	36.11 (324)	39.49
Liu qing	Zi bo	2013	12-49	1455	9.4 (504)	11.5 (951)	8.32
Li shengjie	Tai an	2010	17-24	1416	39.85 (532)	46.61 (884)	44.07
Zhang zhiyong	Han dan	2010	undergraduate	1582	59.71 (834)	50.00 (748)	55.12
Cai xinduan	Guang dong	2010	9-18	2015	49.90 (986)	59.86 (1029)	54.99
Zhangjian	Yi chun	2011	18-26	448	45.16 (217)	32.03 (231)	38.39
Wang renli	Si chuan	2008-2009	all	10,503	19.3 (4319)	16.9 (6184)	18.1
Pei guangde	He nan	2008	all	1547	8.80 (742)	7.86 (805)	8.39
Chen ying	Guang zhou	2008	undergraduate	2252	34.7 (1253)	38.4 (999)	36.4
Zhang hong	Jiang men	2006-2008	17-18	12,450	55.9 (7134)	46.02 (5136)	51.83
Deng bin	Hai nan	2005	16-23	3500	34.8 (1990)	32.4 (1510)	33.8
Cui jianping	Xing tai	2007	10-18	2891	43.14 (1370)	35.44 (1521)	39.1
Min li	Fu jian	2007	15-23	1484	69.5 (836)	63.6 (648)	66.9
Feng jieying	Guang zhou	2004-2005	11-19	1561	51.95 (743)	60.76 (818)	56.57
Gao aili	Guang zhou	2004	12-20	2552	34.2 (1151)	31.6 (1305)	32.8
Wu tieqiang	Zhu hai	2004	10-18	3200	54.9 (1790)	51.6 (1410)	53.5
Sun zhenxiu	Nan jing	2005	16-23	2100	37.91 (1000)	22 (1100)	30.33
Liu zhaorui	Bei jing	2003	16-17	4933	67.1 (2364)	57.3 (2569)	62.0
Zhang aihua	Tai an, He ze	1996	14-23	1510	38.24 (829)	23.06 (581)	20.99
Fu rui	Ji ning	2012	11-17	2560	45.40 (1343)	47.80 (1177)	46.51
Li bing	Shan xi	2012	12-17	741	55.8 (335)	49.2 (406)	52.2
Yiwei Shen	China	2012	all	17,345	10.4 (7858)	6.1 (9487)	8.1
Law MP	Hong Kong	2010	undergraduate	389	N/A	N/A	85.1
Wu TQ	Guang dong	2007	10-18	3163	51.3 (1785)	58.6 (1378)	53.5

(n)= the number of participants, N/A= not available.

Table 2. Methodological quality of the studies reporting the prevalence of acne in mainland China

Name	Sampling scheme	Population characteristics	Prevalence definition	Diagnostic criteria	Response rate %	Score
Zhang feng	Random stratified sample	adequate	clear	clear	95	4
Liu lijuan	Random stratified sample	adequate	clear	clear	N/A	3
Liu qing	Cluster sampling	adequate	clear	clear	48.5	3
Li shengjie	Random stratified sample	adequate	clear	clear	100	4
Zhang zhiyong	Cluster sampling	adequate	clear	clear	97.75	4
Cai xinduan	Random stratified sample	adequate	clear	clear	98.05	4
Zhangjian	Random stratified sample	adequate	clear	clear	N/A	3
Wang renli	Random stratified sample	adequate	clear	clear	N/A	3
Pei guangde	Random stratified sample	adequate	clear	clear	53.4	3
Chenyong	Random stratified sample	adequate	clear	clear	90.8	4
Zhang hong	Cross-sectional	adequate	clear	clear	N/A	3
Deng bin	Random stratified sample	adequate	clear	clear	N/A	3
Cui jianping	Random stratified sample	adequate	clear	clear	98.1	4
Min li	Random stratified sample	adequate	clear	clear	N/A	3
Feng jieying	Random stratified sample	adequate	clear	clear	98.24	4
Gao aili	Cross-sectional	adequate	clear	clear	96.2	4
Wu tieqiang	Cross-sectional	adequate	clear	clear	98.84	4
Sun zhenxiu	Random stratified sample	adequate	clear	clear	N/A	3
Liu zhaorui	Random stratified sample	adequate	clear	clear	N/A	3
Zhang aihua	Random stratified sample	adequate	clear	clear	N/A	3
Fu rui	Cross-sectional	adequate	clear	clear	99.06	4
Li bing	Random stratified sample	adequate	clear	clear	95.2	4
Yiwei Shen	Community-based study	adequate	clear	clear	86.84	4
Law MP	Cross-sectional	adequate	no	clear	99.3	4
Wu TQ	Cross-sectional	adequate	clear	clear	98.8	4

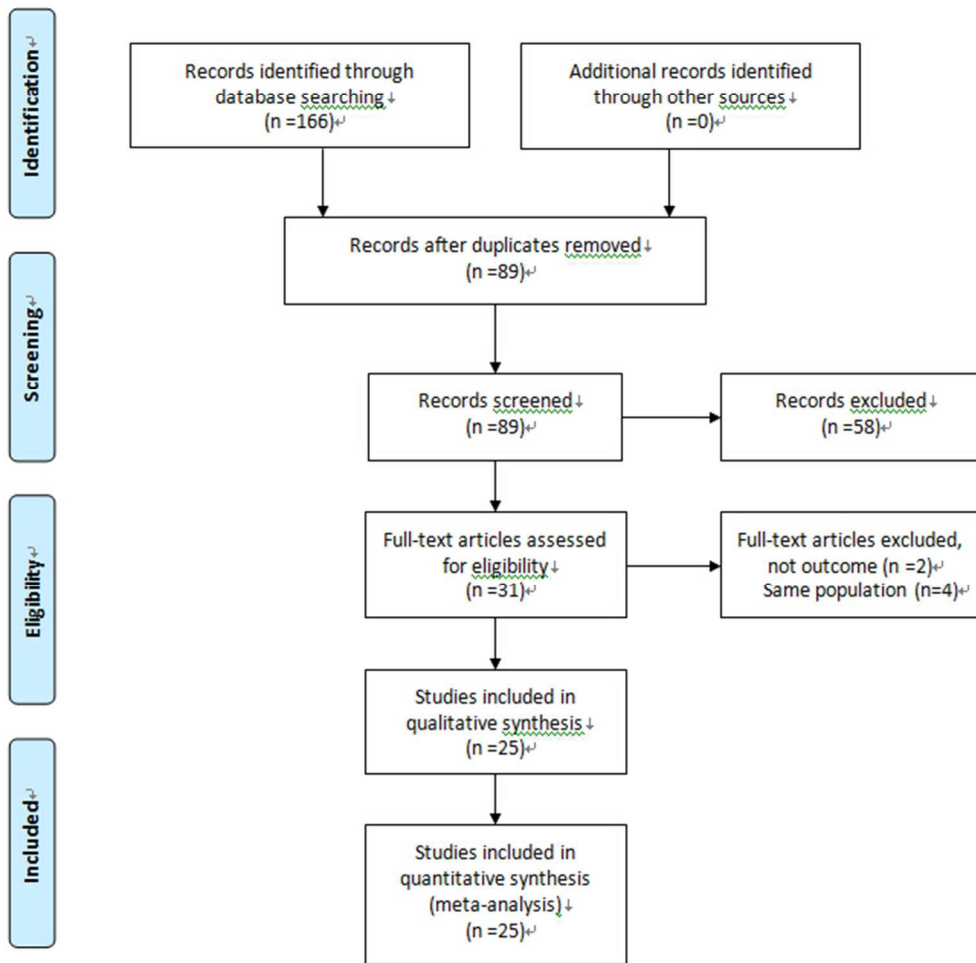
N/A= not available.

Table 3. Adjusted odds ratios for acne obtained by logistic meta-regression analysis

Factor	Number of studies	OR (95% CI)	P-value
Age of range			
undergraduate	11	1.00	
primary and secondary school students	10	3.127 (0.001-3.838)	0.012
Gender			
female	24	1.00	
male	24	1.217 (0.109-14.681)	0.024
Location			
north	10	1.00	
south	14	1.184 (0.002-3.833)	0.028

OR= odds ratio. CI=confidence interval

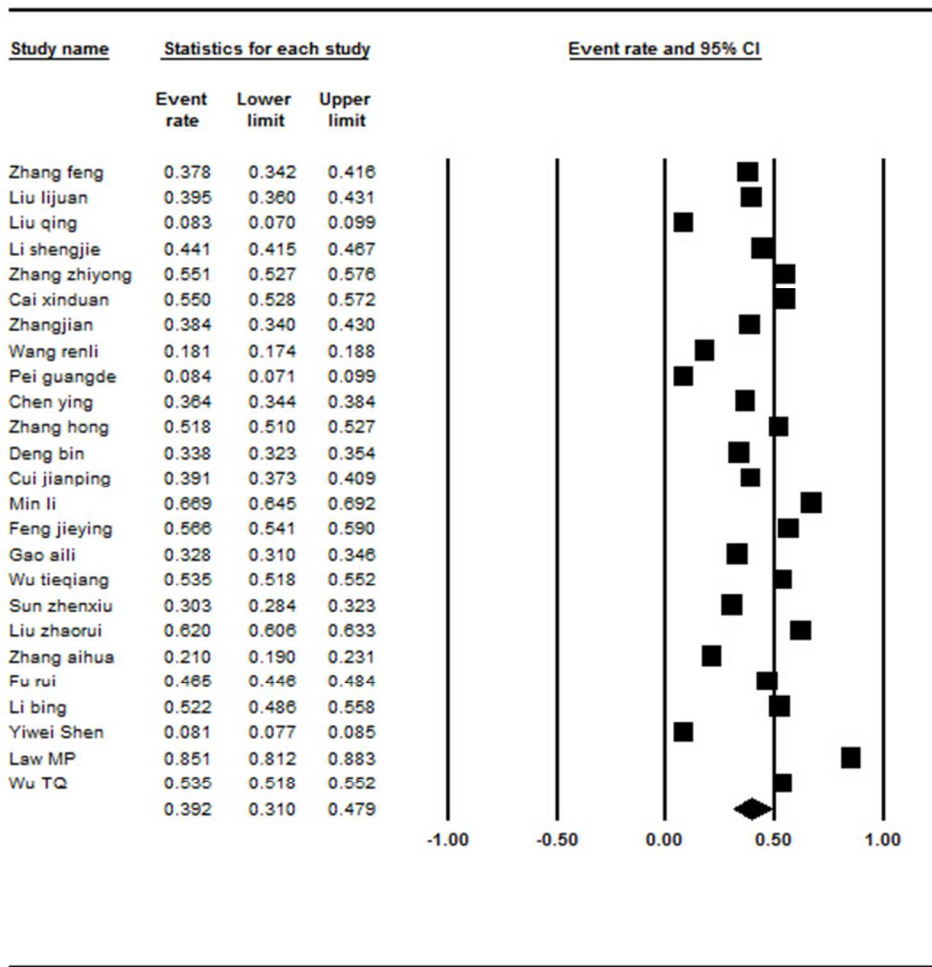
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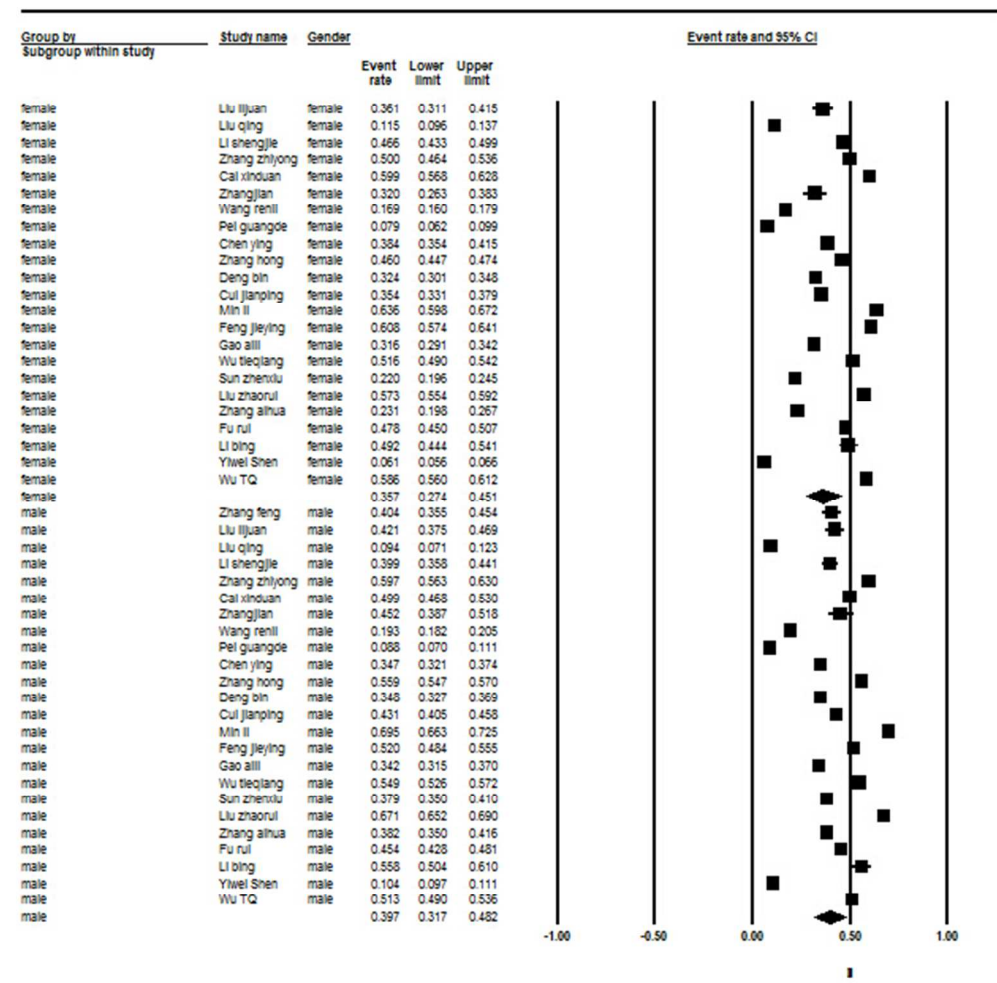
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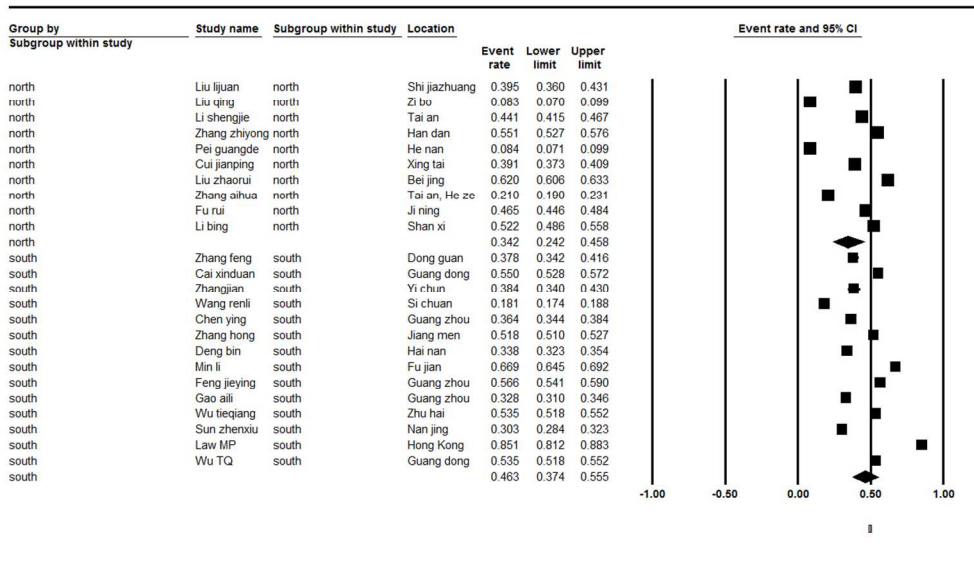
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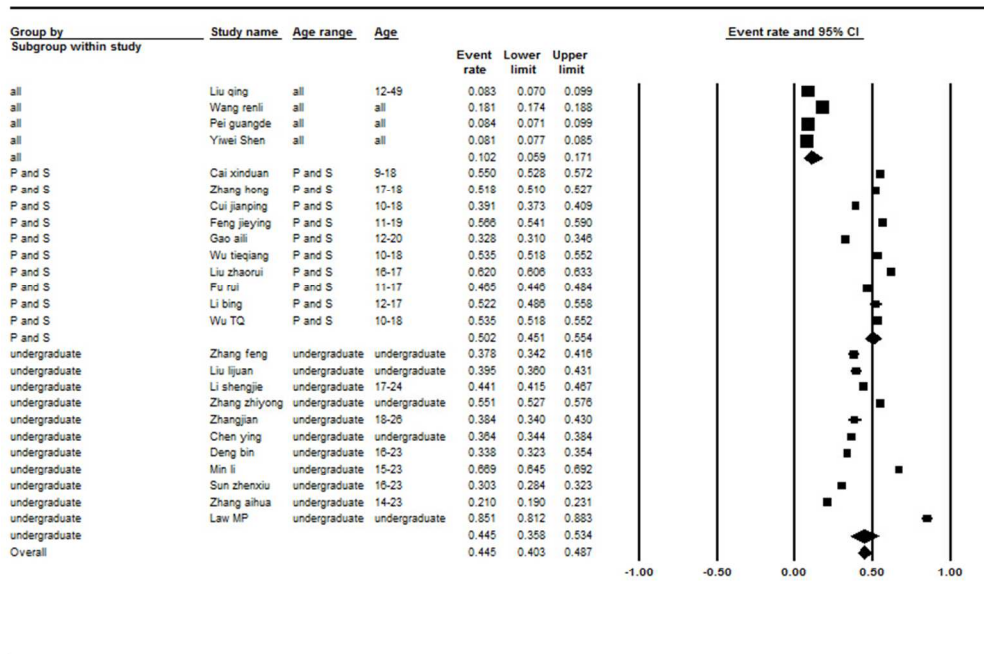
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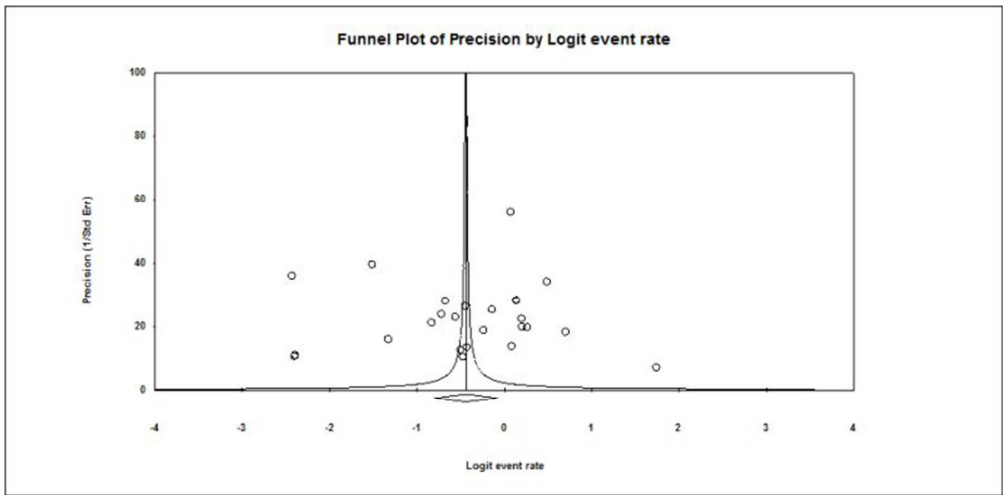
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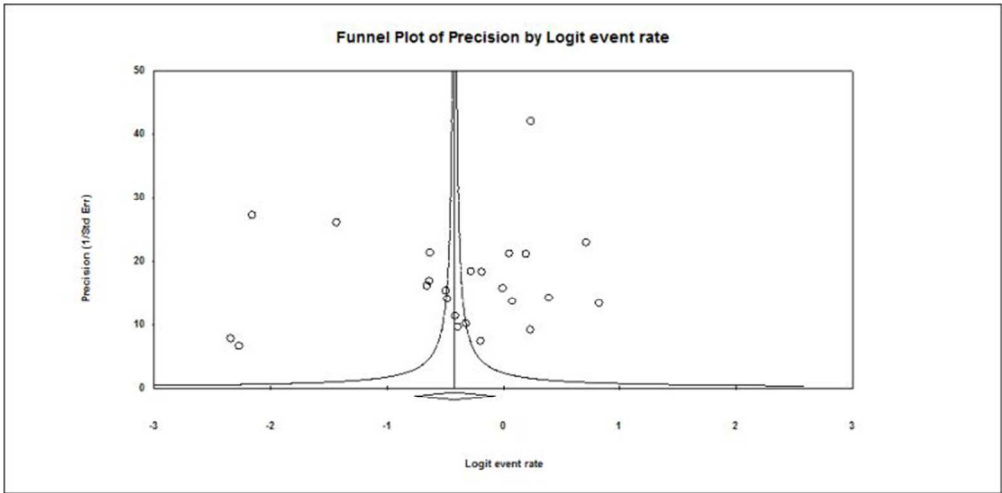
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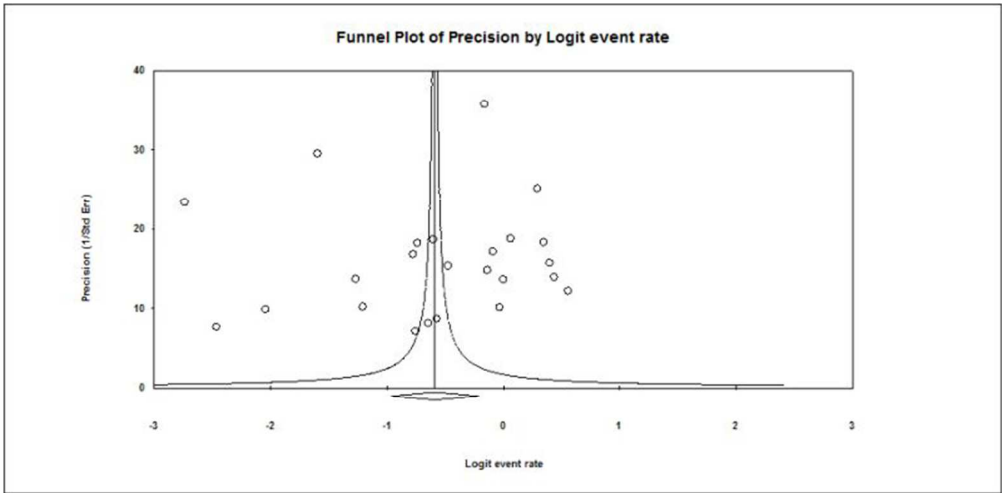
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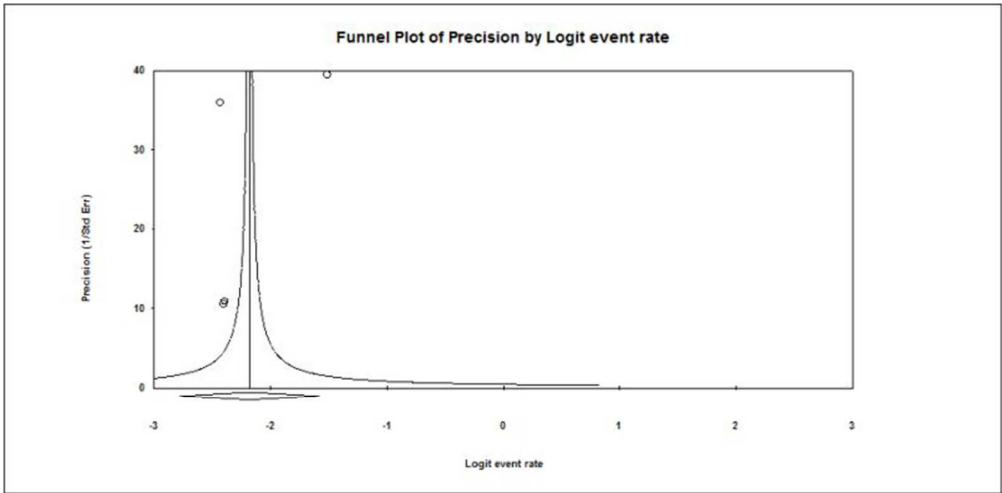
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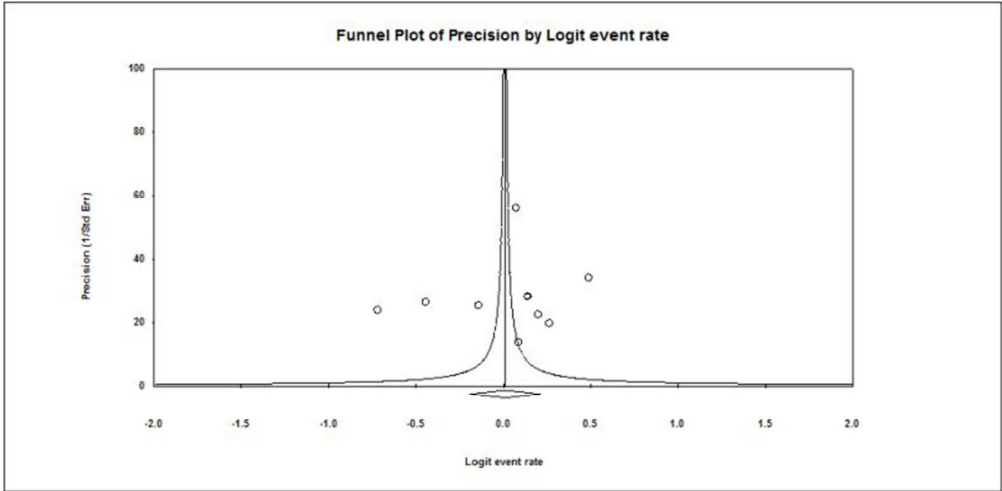
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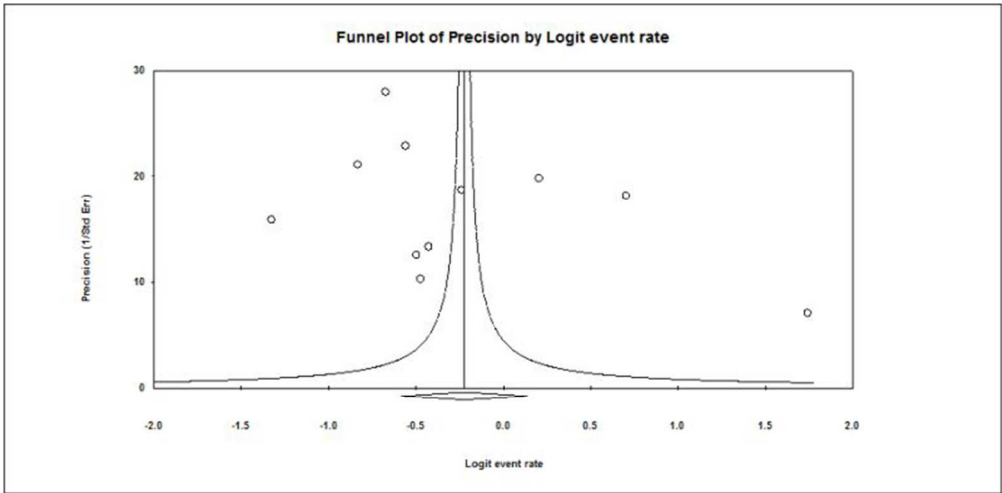
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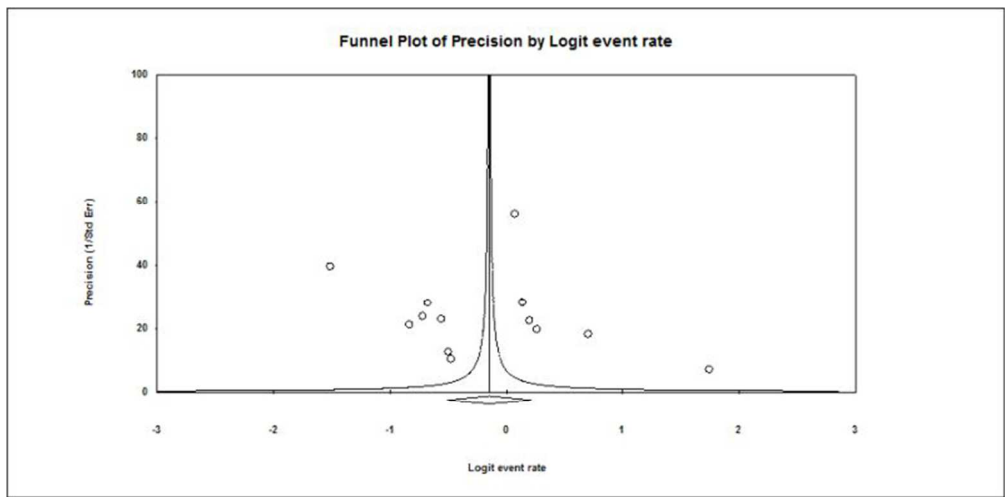
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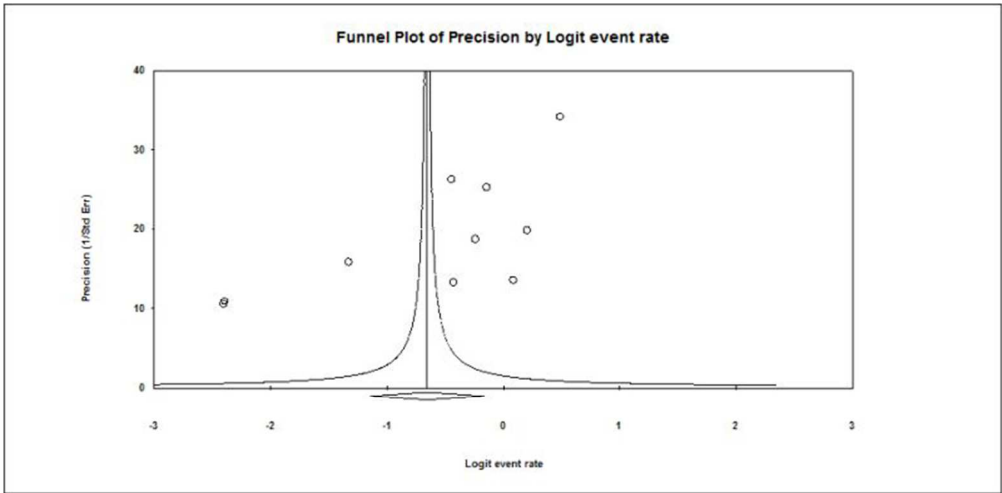
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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	A Systematic Review of the Prevalence of Acne in Mainland China	1
ABSTRACT			
Structured summary	2	<p>Background and Objectives: Acne, a very common skin disease, can result in psychological distress and sustained impairment in quality of life. Data on the prevalence of acne and their difference in gender, region and age is sketchy. The aim of this review is to estimate the prevalence of acne in mainland China comprehensively and to quantify its association with gender, region and age. Methods and analysis: We searched electronic databases with predetermined search terms to identify relevant studies published between January 1, 1996 and September 30, 2016. We pointed out repeated results using Note Express software and evaluated the studies for inclusion. Two independent reviewers extracted data. Then statistical analyses were performed using Comprehensive Meta-Analysis version 2.0. A random-effects model was adopted to calculate the overall pooled prevalence and to merge categories, including gender, region and age for subgroup analyses. Logistic meta-regression analysis was used to clarify the associations between acne and the predictors age, gender, and region using odds ratios and their associated 95% confidence intervals. Results: 25 relevant studies were included in this meta-analysis. The overall pooled prevalence rates of acne were 39.2% (95% CI=0.310-0.479). The prevalence rates in different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95% CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95% CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the prevalence rates were 34.2% for northern China (95% CI=0.242-0.458) and 46.3% for southern China (95% CI=0.374-0.555). The associations between acne and the predictors age, gender, and region were statistically significant. Conclusions: In mainland</p> <p>For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml</p>	2,3



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China, primary and secondary students exhibited higher prevalence rates than undergraduate students, males had higher prevalence rates of acne than females, and the prevalence rates of acne in southern China was higher than northern China. **Ethics and dissemination:** This systematic review does not require ethical approval. The results of this review will be submitted for peer-reviewed publication regardless of outcome and will be presented at relevant conferences. **Strengths and limitations:** (1)To our knowledge, this was the first and largest meta-analysis of its scope which will give us a detailed understanding of the prevalence of acne in mainland China and its associations with age, gender, and region and a sound basis for the future provision of health services.(2)This systematic review of acne in mainland China, covering 12 different provinces, represents near-complete capture of the demographic for more than 80 thousand people over a 41-year period.(3)Some limitations should be considered: First, the diagnostic criteria for acne differed among included studies. Second, the age of the survey population could not be subdivided, for example, the intervals 5-9, 10-14 and 15-19 years of age.

INTRODUCTION

Rationale

3 Acne, a very common skin disease among adolescents, was the fourth most common reason for patients aged 11–21 years to visit a doctor in the USA¹. The clinical features of acne include papules, pustules, cysts, comedos, and nodules. Several studies have shown that the estimated prevalence rate of acne varies from 8.1% to 85.1% in China²⁻⁴, depending on the region, subjects' ages, and the nationality studied.

Acne occurs primarily on the face, neck, and upper trunk and can lead to scar formation if treated improperly. Thus, acne can result in psychological distress, including anxiety, depression, diminished self-confidence, and communication difficulties, among other outcomes^{5, 6}. To date, many large population-based studies have been conducted to estimate the prevalence rates of acne in regional populations. Because China comprises 34 province-level administrative regions, with 56 nations and a population of 1.3 billion people, a country-wide,

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		population-based study of the prevalence rates of acne in China was needed.	
Objectives	4	In this review, we examined the prevalence of acne in mainland China and to analyse the effects of gender, region and age on it.	4
METHODS			
Protocol and registration	5	We have no original protocol and registration, so this item isn't applicable.	
Eligibility criteria	6	Studies that met all of the following criteria were included in the meta-analysis, (1) the study was a population-based survey; (2) the study evaluated the prevalence/incidence of acne; (3) the investigation involved random sampling or cluster sampling; (4) the sample size was >300; A flow chart illustrating the article search process is presented in Figure 1.	5,6
Information sources	7	Studies were aggregated from six databases between January 1, 1996 and September 30, 2016, including PubMed, EMBASE, the Web of Science, the China National Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and the Wan Fang Database for Chinese Periodicals.	4
Search	8	The following search terms were used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or Chinese).	4
Study selection	9	Figure1	Figure1
Data collection process	10	The data in this study were extracted independently and checked after independent extraction by two investigators.	5
Data items	11	The following information was collected for each study, (1) the name of the first author; (2) the location of the investigation area; (3) the year in which the investigation occurred; (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6) the prevalence rates obtained for males, females, and overall; (7) the method used to sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.	5
Risk of bias in individual studies	12	Quality assessment and analysis of the publication bias	5
Summary measures	13	odds ratios (ORs) and their associated 95% confidence intervals (CIs)	6
Synthesis of results	14	The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic. Meanwhile, I2 metrics were calculated to quantify heterogeneity. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into one of two groups (north versus south) according to the geographical regions in which the studies were conducted. Similarly, the studies were classified into	6



PRISMA 2009 Checklist

three groups based upon the age of the participants in the samples, overall, undergraduate, and primary and secondary students ("p and s"). Subjects were also classified as male and female. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model. The associations between age, gender, region and risk of acne were expressed as ORs and 95% CIs. A value of $p < 0.05$ was considered statistically significant.

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Four key criteria ^{7, 8} were used by two independent investigators (Qiang Chen and Danhui Li) to estimate study quality, (1) the sampling scheme (random or consecutive); (2) whether the study included an adequate description of the characteristics of the study population; (3) whether a clear definition of the prevalence rate was provided; and (4) whether the response rate exceeded 75%. The scoring rule used was the following, for each quality item, "clear or adequate" was scored as 1 point, whereas "no" was scored as 0 points. The study was considered to be of adequate quality if the quality score was greater than or equal to 3. We did not exclude studies on the basis of inadequate quality, but we accounted for inadequate quality in the statistical analysis. The two reviewers carefully assessed the included studies independently and agree on the final grading. Any disagreement will be resolved by a third reviewer.(Table2)	Table2
Additional analyses	16	All studies were classified into one of two groups (north versus south) according to the geographical regions in which the studies were conducted. Similarly, the studies were classified into three groups based upon the age of the participants in the samples, overall, undergraduate, and primary and secondary students ("p and s"). Subjects were also classified as male and female. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model. The associations between age, gender, region and risk of acne were expressed as ORs and 95% CIs. A value of $p < 0.05$ was considered statistically significant.	6
RESULTS			
Study selection	17	Using the initial search strategy, 166 studies were identified, and 141 studies were subsequently excluded (Figure 1). A total of 25 studies 2-4, 9-30 involving 83,008 Chinese individuals were included in this meta-analysis.	6,7
Study characteristics	18	Detailed characteristics of each included study were presented in Table 1.	Table 1
Risk of bias within studies	19	The overall quality of all included studies was found to be adequate (Table 2).	Table 2
Results of individual studies	20	Figure2-5	Figure2-5
Synthesis of results	21	Figure2-5	Figure2-5
Risk of bias across studies	22	Table 2	Table 2



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Additional analysis	23	logistic meta-regression model, subgroup analysis	8
DISCUSSION			
Summary of evidence	24	Our results showed that the overall pooled prevalence of acne was 39.2% for all ages. The prevalence rates in different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95% CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95% CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the prevalence rates were 34.2% northern China (95% CI=0.242-0.458) and 46.3% for southern China (95% CI=0.374-0.555).	9
Limitations	25	The diagnostic criteria for acne differed across studies and the age of the survey population could not be subdivided.	3
Conclusions	26	In conclusion, the overall pooled prevalence of acne was 39.2% in mainland China; acne occurred mainly among primary students, secondary students, and undergraduate students; the prevalence of acne in males was greater than that in females; and acne was more common in northern China than in southern China. This meta-analysis of the prevalence of acne may provide a sound basis for the future provision of health services.	9
FUNDING			
Funding	27	Issue of Tai'an Science and Technology Development Plan (201440774-05)	

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

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PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		
Identification	1a	a protocol of a systematic review
Update	1b	
Registration	2	We didn't have a registration number.
Authors:		
Contact	3a	1.Danhui Li. Key Laboratory of Environment and Genes Related to Diseases, Ministry of Education, Medical School, Xi'an Jiaotong University, Xi'an, Shaanxi, China. E-mail:danhui1002@sina.com 2.Qiang Chen. School of Public Health, Taishan Medical university, Tai'an, Shandong Province, China. E-mail:tychenqiang@126.com 3.Yi Liu. Department of Dermatology, Affiliated Hospital of Jining Medical University, Jining, Shandong province, China. E-mail: liuyx94@sohu.com 4.Ting-ting Liu. The school hospital of Taishan Medical university, Tai'an, Shandong Province, China. E-mail: tyliuting@yeah.net 5.Wenhui Tang Department of Biomedical Engineering, Maternal and Child Health Care of Laiwu City in Shandong Province, Laiwu, Shandong Province, China. E-mail: lwsfybjtwh@163.com 6.Sheng-jie Li. Department of Clinical Laboratory, Eye & ENT Hospital, Shanghai Medical College, Fudan University, China. * Corresponding author. Email: lishengjie6363020@163.com. Address: No.83 Fenyang Road, Shanghai, China, 200031
Contributions	3b	Shengjie Li and Danhui Li conceived the study, participated in drafting the final manuscript. Qiang Chen and Yi Liu analyzed the data and completed the final draft of the manuscript. TingTing Liu and Wenhui Tang prepared all the figures. All authors reviewed the manuscript.
Amendments	4	We searched electronic databases with predetermined search terms to identify relevant studies published between January 1, 1996 and September 30, 2016. We pointed out repeated results using Note Express software and evaluated the studies for inclusion. Two independent reviewers extracted data. Then statistical analyses were performed using Comprehensive Meta-Analysis version 2.0. A random-effects model was adopted to calculate the overall pooled prevalence and to merge categories, including gender, region and age for subgroup analyses. Logistic meta-regression analysis was used to clarify the associations between acne and the predictors age, gender, and region using odds ratios and their associated 95% confidence intervals.
Support:		

Sources	5a	This work was supported by Issue of Tai'an Science and Technology Development Plan grant number 201440774-05.
Sponsor	5b	Tai'an Municipal Science and Technology Bureau
Role of sponsor or funder	5c	

INTRODUCTION

Rationale	6	<p>Acne, a very common skin disease among adolescents, was the fourth most common reason for patients aged 11–21 years to visit a doctor in the USA¹. The clinical features of acne include papules, pustules, cysts, comedos, and nodules. Several studies have shown that the estimated prevalence rate of acne varies from 8.1% to 85.1% in China²⁻⁴, depending on the region, subjects' ages, and the nationality studied.</p> <p>Acne occurs primarily on the face, neck, and upper trunk and can lead to scar formation if treated improperly. Thus, acne can result in psychological distress, including anxiety, depression, diminished self-confidence, and communication difficulties, among other outcomes^{5, 6}. To date, many large population-based studies have been conducted to estimate the prevalence rates of acne in regional populations. Because China comprises 34 province-level administrative regions, with 56 nations and a population of 1.3 billion people, a country-wide, population-based study of the prevalence rates of acne in China was needed.</p>
Objectives	7	In this review, we examined the prevalence of acne in mainland China and to analyse the effects of gender, region and age on it.

METHODS

Eligibility criteria	8	<p>Studies that met all of the following criteria were included in the meta-analysis,</p> <ol style="list-style-type: none"> (1) the study was a population-based survey; (2) the study evaluated the prevalence/incidence of acne; (3) the investigation involved random sampling or cluster sampling; (4) the sample size was >300; <p>A flow chart illustrating the article search process is presented in Figure 1.</p>
Information sources	9	Studies were aggregated from six databases between January 1, 1996 and September 30, 2016, including PubMed, EMBASE, the Web of Science, the China National Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and the Wan Fang Database for Chinese Periodicals.
Search strategy	10	The following search terms were used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or Chinese).
Study records: Data management	11a	Any duplicate studies was removed by Note Express. Two reviewers(Qiang Chen and Danhui Li) independently evaluated the title and abstract of all studies identified through the search against the inclusion and exclusion criteria. The full text of all eligible studies will then be retrieved. Any disagreement will be resolved by a third reviewer. Excluded studies and the reasons for exclusion will be recorded.

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5	Selection process	11b	The data in this study were extracted independently and checked after independent extraction by two investigators.
6	Data collection process	11c	Customised data information was extracted independently by two investigators. The two pieces of final results were re-checked.
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8	Data items	12	The following information was collected for each study, (1) the name of the first author; (2) the location of the investigation area; (3) the year in which the investigation occurred; (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6) the prevalence rates obtained for males, females, and overall; (7) the method used to sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.
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13	Outcomes and prioritization	13	We calculated the pooled prevalence estimates as proportions and 95% CIs for the subgroup categories weighted by the sample sizes of the individual studies and then pooled these data to derive an overall proportion and its associated 95% CI. The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic. Meanwhile, I ² metrics were calculated to quantify heterogeneity. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into one of two groups (north versus south) according to the geographical regions in which the studies were conducted. Similarly, the studies were classified into three groups based upon the age of the participants in the samples, overall, undergraduate, and primary and secondary students ("p and s"). Subjects were also classified as male and female. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model. The associations between age, gender, region and risk of acne were expressed as ORs and 95% CIs. A value of $p < 0.05$ was considered statistically significant.
14			
15	Risk of bias in individual studies	14	Quality assessment and analysis of the publication bias
16			
17	Data synthesis	15a	The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic. Meanwhile, I ² metrics were calculated to quantify heterogeneity. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into one of two groups (north versus south) according to the geographical regions in which the studies were conducted. Similarly, the studies were classified into three groups based upon the age of the participants in the samples, overall, undergraduate, and primary and secondary students ("p and s"). Subjects were also classified as male and female. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model. The associations between age, gender, region and risk of acne were expressed as ORs and 95% CIs. A value of $p < 0.05$ was considered statistically significant.;
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32		15b	odds ratios (ORs) and their associated 95% confidence intervals (CIs)
33		15c	Logistic meta-regression analysis a
34		15d	
35	Meta-bias(es)	16	Analysis of the publication bias
36	Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)
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*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

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5 From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and
6 meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ*. 2015 Jan 2;349(jan02 1):g7647.
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BMJ Open

The Prevalence of Acne in Mainland China: a systematic review and meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-015354.R1
Article Type:	Research
Date Submitted by the Author:	17-Feb-2017
Complete List of Authors:	li, dan; Xi'an Jiaotong University, Key Laboratory of Environment and Genes Related to Diseases, Ministry of Education, Medical School Chen, Qiang; Taishan Medical University, School of Public Health Liu, Yi; Affiliated Hospital of Jining Medical University, Department of Dermatology Liu, Ting; Taishan Medical university, The school hospital of Taishan Medical university Tang, Wen; Maternal and Child Health Care of Laiwu City in Shandong Province, Department of Biomedical Engineering li, sheng; Eye & ENT Hospital, Shanghai Medical College, Fudan University, Department of Clinical Laboratory
Primary Subject Heading:	Dermatology
Secondary Subject Heading:	Epidemiology
Keywords:	Acne < DERMATOLOGY, Dermatological epidemiology < DERMATOLOGY, EPIDEMIOLOGY

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3 **The Prevalence of Acne in Mainland China: a systematic review**
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6 **and meta-analysis**
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8 Danhui Li^{1¶}, Qiang Chen^{2¶}, Yi Liu^{3¶}, Ting-ting Liu⁴, Wenhui Tang⁵, Shengjie Li^{6*}
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3 **Abstract**
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6 **Introduction** Acne, a very common skin disease, can result in psychological distress
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8 and sustained impairment in quality of life. Data on the prevalence of acne and their
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10 difference in gender, region and age is sketchy. The aim of this review is to estimate
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12 the prevalence of acne in mainland China comprehensively and to quantify its
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14 association with gender, region and age.
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17 **Methods** We searched electronic databases with predetermined search terms to
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19 identify relevant studies published between January 1, 1996 and September 30, 2016.
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21 We pointed out repeated results using Note Express software and evaluated the studies
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23 for inclusion. Two independent reviewers extracted data. Then statistical analyses
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25 were performed using Comprehensive Meta-Analysis version 2.0. A random-effects
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27 model was adopted to calculate the overall pooled prevalence and to merge categories,
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29 including gender (males and females), region (Northern China and Southern China)
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31 and age (primary and secondary students: 7-17 years old; undergraduates: 18-23 years
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33 old; overall: no limits of age) for subgroup analyses. Logistic meta-regression analysis
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35 was used to clarify the associations between acne and the predictors age, gender, and
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37 region using odds ratios and their associated 95% confidence intervals.
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43 **Results** 25 relevant studies were included in this meta-analysis. The overall pooled
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45 prevalence rates of acne were 39.2% (95% CI=0.310-0.479). The prevalence rates in
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47 different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary
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49 and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95%
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51 CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95%
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53 CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the
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55 prevalence rates were 34.2% for Northern China (95% CI=0.242-0.458) and 46.3%
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4 50 for Southern China (95% CI=0.374-0.555). The associations between acne and the
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6 51 predictors age, gender, and region were statistically significant.
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9 52 **Conclusions** In mainland China, primary and secondary students exhibited higher
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11 53 prevalence rates than undergraduate students; males had higher prevalence rates of
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13 54 acne than females; and the prevalence rates of acne in Southern China was higher than
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15 55 Northern China.
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17 56 **Strengths and limitations**

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21 57 To our knowledge, this was the first systemic review evaluating the overall acne
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23 58 prevalence in mainland China and analyzing its associations with age, gender, and
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25 59 region.
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28 60 This systematic review, covering 12 different provinces, was composed of 25 studies,
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30 61 80 thousand people over a 41-year period.
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32 62 Some limitations should be considered: the diagnostic criteria for acne differed among
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34 63 the included studies; the age of the survey population could not be subdivided.
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36 64 Moreover due to heterogeneity among papers, sample changed from variable to
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38 65 variable.
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40 66 **Introduction**

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44 67 Acne, a very common skin disease among adolescents, was the fourth most common
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46 68 reason for patients aged 11–21 years to visit a doctor in the USA¹. Acne is estimated
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48 69 to affect 9.4% of the world's population with the highest prevalence in adolescents².
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51 70 Acne vulgaris-associated disease burden exhibits global distribution and has
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53 71 continued to grow in prevalence over time within this population³. In addition, a
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55 72 group of increasing epidemiological data suggest that acne also affects a considerable
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57 73 number of adults⁴ and women are more frequently affected by adult acne than
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3 74 men⁵. The incidence of acne is different from various countries and ethnic groups. In
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5 75 Northern Tanzania, the prevalence of acne is reported to be 0.1%⁶. The prevalence of
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7 76 acne is 3.9% in the German population aged between 16 and 70 years⁷. The
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10 77 prevalence of acne is reported to be low in developing countries of Africa^{8,9}. Whereas
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12 78 a comprehensive systemic review of the prevalence of acne in the Chinese population
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14 79 is still lacking. Several studies have shown that the estimated prevalence rate of acne
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16 80 varies from 8.1% to 85.1% in China¹⁰⁻¹² depending on the region, subjects' ages, and
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18 81 the nationality studied.

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21 82 Acne is a chronic inflammatory disease of the pilosebaceous unit resulting from
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23 83 androgen-induced increased sebum production, altered keratinization, inflammation,
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25 84 and bacterial colonisation of hair follicles by propionibacterium acnes¹³. Acne vulgaris
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27 85 alters the normal skin physiology, impairing stratum corneum and transepidermal
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29 86 water loss¹⁴. The clinical features of acne include papules, pustules, cysts, comedos,
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31 87 and nodules. Acne occurs primarily on the face, neck, and upper trunk and can lead to
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33 88 scar formation if treated improperly. Acne scarring is a frequent complication of acne
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35 89 and patients are often lack of effective and safe methods of managing this condition¹⁵.
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37 90 Then resulting scars may negatively impact on an affected person's psychosocial and
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39 91 physical well-being. It is reported that acne can result in psychological distress and
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41 92 have profound effects on patients' self-esteem, which may lead to anxiety, depression,
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43 93 diminished self-confidence, and communication difficulties^{16,17}.

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47 94 Many large population-based studies have been conducted to estimate the prevalence
48
49 95 rates of acne in regional populations, but a comprehensive statistical analysis of the
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51 96 prevalence of Chinese acne has not emerged so far. China being a vast region,
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53 97 comprises of 34 province-level administrative regions, with 56 nations and a
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55 98 population of 1.3 billion people. Therefore a country-wide, population-based study of
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3 99 the prevalence rates of acne in China was needed. In this review, we examined the
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5 100 prevalence of acne in mainland China systematically and analysed the effects of
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7 101 gender, region and age on acne.
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102 **Methods**

103 **Search strategy**

104 Studies were aggregated from six databases between January 1, 1996 and September
15 30, 2016, including PubMed, EMBASE, the Web of Science, the China National
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17 105 Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and
18
19 106 the Wan Fang Database for Chinese Periodicals. The following search terms were
20
21 107 used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or
22
23 108 Chinese). The combination of acne, prevalence, incidence, China and Chinese were
24
25 109 used in varying combinations to identify relevant literature. Search strategies were
26
27 110 customised to suit each database. The search strategy is presented in supplementary
28
29 111 table 1. In addition, a manual search was performed by checking the reference lists of
30
31 112 eligible articles and relevant reviews.
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114 **Inclusion criteria**

115 Studies that met all of the following criteria were included in the meta-analysis,

- 116 (1) the study was a population-based survey;
117 (2) the study evaluated the prevalence/incidence of acne;
118 (3) the investigation involved random sampling or cluster sampling;
119 (4) the sample size was >300;

120 A flow chart illustrating the article search process is presented in Figure 1.

121 **Data management**

122 Any duplicate studies was removed by Note Express. Two reviewers (Qiang Chen and
123 Danhui Li) independently evaluated the title and abstract of all studies identified

1
2
3 124 through the search against the inclusion and exclusion criteria. The full text of all
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5 125 eligible studies were then retrieved. Any disagreement were resolved by a third
6
7 126 reviewer. Excluded studies and the reasons for exclusion were recorded.

9 10 127 **Data extraction**

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12 128 Customised data information was extracted independently by two investigators. The
13
14 129 following information was collected for each study: (1) the name of the first author; (2)
15
16 130 the location of the investigation area; (3) the year in which the investigation occurred;
17
18 131 (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6)
19
20 132 the prevalence rates obtained for males, females, and overall; (7) the method used to
21
22 133 sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.

23 24 134 **Risk of bias (quality) assessment**

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26
27 135 Four key criteria^{18, 19} were used by two independent investigators (Qiang Chen and
28
29 136 Danhui Li) to estimate study quality: (1) the sampling scheme (random or
30
31 137 consecutive); (2) whether the study included an adequate description of the
32
33 138 characteristics of the study population; (3) whether a clear definition of the prevalence
34
35 139 rate was provided; and (4) whether the response rate exceeded 75%. The scoring rule
36
37 140 used was the following, for each quality item, “clear or adequate” was scored as 1
38
39 141 point, whereas “no” was scored as 0 points. The study was considered to be of
40
41 142 adequate quality if the quality score was greater than or equal to 3. The two reviewers
42
43 143 carefully assessed the included studies independently and agree on the final grading.
44
45 144 An additional reviewer was consulted should there be any uncertainty or
46
47 145 disagreement.

48 49 146 **Ethics and dissemination**

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52 147 Since primary data was not collected, formal ethical approval was not required. The
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54 148 results will be disseminated through peer-reviewed publications, conference
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3 149 presentations and the media.
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5 150 **Statistical analysis**

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7 151 The statistical analyses were performed using Comprehensive Meta-Analysis version
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10 152 2.0 (Biostat, Englewood Cliffs, NJ, USA; <http://www.meta-analysis.com>). We
11
12 153 calculated the pooled prevalence estimates as proportions and 95% CIs for the
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14 154 subgroup categories weighted by the sample sizes of the individual studies and then
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16 155 pooled these data to derive an overall proportion and its associated 95% CI. The
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18 156 heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic.
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21 157 Meanwhile, I^2 metrics were calculated to quantify heterogeneity. A random-effects
22
23 158 model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects
24
25 159 model was applied. All studies were classified into one of two groups (north versus
26
27 160 south) according to the geographical regions in which the studies were conducted.
28
29 161 Similarly, the studies were classified into three groups based upon the age of the
30
31 162 participants in the samples, overall (no limits of age), undergraduate (18-23 years old),
32
33 163 and primary and secondary students ("p and s", 7-17 years old). Subjects were also
34
35 164 classified as male and female. The associations of age, gender, and region with the
36
37 165 prevalence of acne were evaluated using a logistic meta-regression model. The
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39 166 associations between age, gender, region and risk of acne were expressed as ORs and
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41 167 95% CIs. A value of $p < 0.05$ was considered statistically significant.
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45 168 **Analysis of the publication bias**

46
47 169 To examine the authenticity of data, Egger test and Funnel plots were made by
48
49 170 Comprehensive Meta-Analysis version 2.0. No publication bias exists if the studies
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51 171 arranged symmetrically around the central line with a p value of > 0.05 .
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54 172 **Results**

55 56 57 173 **Characteristics of the studies**

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3 174 Using the initial search strategy, 166 studies were identified, and 141 studies were
4
5 175 subsequently excluded (Figure 1). A total of 25 studies^{10-12,20-41} involving 83,008
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7 176 Chinese individuals were included in this meta-analysis. Detailed characteristics of
8
9
10 177 each included study were presented in Table 1. The overall quality of all included
11
12 178 studies was found to be adequate (Table 2).

14 179 **The overall prevalence rates of acne in mainland China**

15
16 180 A total of 25 studies involving 83,008 Chinese people were included in this
17
18 181 meta-analysis. However, there was significant heterogeneity in this meta-analysis
19
20 182 ($I^2=99.797\%$, $Q=11823.369$, $P<0.001$). Thus, a random-effects model was selected for
21
22 183 the analysis. The overall pooled prevalence of acne was 39.2% (95% CI=0.310-0.479;
23
24 184 Figure 2).

27 185 **The prevalence rates of acne in mainland China by gender**

28
29 186 A total of 24 studies involving 40,712 males and 41,907 females were included in this
30
31 187 subgroup meta-analysis. However, there was significant heterogeneity among both the
32
33 188 males ($I^2=99.582\%$, $Q=5508.959$, $P<0.001$) and females ($I^2=99.614\%$, $Q=5957.125$,
34
35 189 $P<0.001$) in this meta-analysis. Thus, a random-effects model was selected for the
36
37 190 analysis. Males (39.7%, 95% CI=0.317-0.482) exhibited a higher prevalence of acne
38
39 191 than females (35.7%, 95% CI=0.274-0.451, $Z=3.903$, $p<0.001$) in the subgroup
40
41 192 analysis (Figure 3).

45 193 **The prevalence rates of acne in mainland China by region**

46
47 194 A total of 24 studies involving 65,663 Chinese were included in this subgroup
48
49 195 meta-analysis. 10 of these studies were conducted in Northern China (19,377
50
51 196 Chinese), and 14 studies were conducted in Southern China (46,286 Chinese).
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53 197 However, significant heterogeneity was found both in the North ($I^2=99.573\%$,
54
55 198 $Q=2109.204$, $P<0.001$) and in the South ($I^2=99.689\%$, $Q=4176.791$, $P<0.001$) in this
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3 199 meta-analysis. Thus, a random-effects model was selected for the analysis. The South
4
5 200 (46.3%, 95% CI=0.374-0.555) had a higher prevalence of acne than did the North
6
7 201 (34.2%, 95% CI=0.242-0.458, $Z=2.498$, $p=0.012$) in the subgroup analysis (Figure 4).
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10 202 **The prevalence rates of acne in mainland China by age**

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12 203 A total of 25 studies, consisting of 4 studies that examined the overall population, 10
13
14 204 p-and-s studies, and 11 undergraduate studies, were included in this subgroup
15
16 205 meta-analysis. However, significant heterogeneity was found overall ($I^2=99.534\%$,
17
18 206 $Q=643.149$, $P<0.001$), for the p and s subgroup ($I^2=98.860\%$, $Q=789.719$, $P<0.001$),
19
20 207 and for the undergraduates ($I^2=99.130\%$, $Q=1149.658$, $P<0.001$) in this meta-analysis.
21
22 208 Thus, a random-effects model was selected for the analysis. The prevalence of acne
23
24 209 over all ages was 10.2% (95% CI=0.059-0.171). The primary and secondary students
25
26 210 (50.2%, 95% CI=0.451-0.554) had a higher prevalence of acne than did the
27
28 211 undergraduates (44.5%, 95% CI=0.358-0.534, $Z=2.411$, $p=0.016$) in the subgroup
29
30 212 analysis (Figure 5).
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34 213 **Logistic meta-regression analysis of the associations between age, gender, and** 35 36 214 **region and the prevalence of acne**

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38 215 The associations between acne and the predictors age, gender, and region were
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40 216 statistically significant (Table 3) as measured by the corresponding ORs and their
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42 217 associated 95% CIs. The OR of acne prevalence was 1.217 (95%CI=0.109-14.681,
43
44 218 $p=0.024$) between male and female. Chinese males might be more susceptible to acne
45
46 219 than females. The OR between Southern China and Northern China were 1.184
47
48 220 (95%CI=0.002-3.833, $p=0.028$) for acne. The geographical factors of Southern China
49
50 221 might be a risk factor for acne. The OR between primary and secondary school
51
52 222 students and undergraduate were 3.127 (95%CI=0.001-3.838, $p=0.012$) for acne. Age
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54 223 might play a vital role in the development of acne.
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224 Analysis of the publication bias

225 There were no obvious asymmetries in the Funnel plots and the value of $p > 0.05$ for
226 the following groups: the overall pooled studies ($t = 0.030$, $p = 0.976$, 95%
227 $CI = -0.215 \sim -0.222$) (Supplementary Figure 1), male subgroup ($t = 0.346$, $p = 0.733$, 95%
228 $CI = -0.185 \sim -0.132$) (Supplementary Figure 2), female subgroup ($t = 0.143$, $p = 0.887$,
229 95% $CI = -0.164 \sim -0.188$) (Supplementary Figure 3), subgroup of all age layers ($t = 0.501$,
230 $p = 0.666$, 95% $CI = -0.831 \sim -0.658$) (Supplementary Figure 4), subgroup of primary and
231 secondary school students ($t = 0.580$, $p = 0.578$, 95% $CI = -0.246 \sim -0.147$) (Supplementary
232 Figure 5), subgroup of undergraduates ($t = 1.061$, $p = 0.316$, 95% $CI = -0.121 \sim -0.335$)
233 (Supplementary Figure 6) and Southern China subgroup ($t = 0.441$, $p = 0.667$, 95%
234 $CI = -0.194 \sim -0.293$) (Supplementary Figure 7). Only the studies of the Northern China
235 subgroup had publication bias ($t = 3.369$, $p = 0.01$, 95% $CI = -0.520 \sim -0.974$)
236 (Supplementary Figure 8).

237 Discussion

238 This meta-analysis, based on 83,008 subjects, derived from 25 studies, covering 12
239 provinces and municipalities in China, enable us to assess reliable prevalence of acne
240 at the national level. Our results showed that the overall pooled prevalence of acne
241 was 39.2%. The acne prevalence was estimated to be 3.9% in the German population
242 aged between 16 and 70 years⁷ and 61.5% in the population aged from 20 to 60 years
243 old in Portugal⁴². The difference in age range, ethnic background and regions might
244 explain the difference in the incidence of acne. Males (39.7%) exhibited a higher
245 prevalence of acne than females (35.7%, $Z = 3.903$, $p < 0.001$) in the subgroup analysis
246 of gender. Meanwhile, the South (46.3%) had a higher prevalence of acne than North
247 (34.2%, $Z = 2.498$, $p = 0.012$) in the regional subgroup analysis. Moreover, the primary
248 and secondary students (50.2%) had a higher prevalence of acne than undergraduates

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3 249 (44.5%, $Z=2.411$, $p=0.016$) in the subgroup analysis of age. There was heterogeneity
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5 250 among the 25 included studies in this meta-analysis ($I^2=99.797\%$, $Q=11823.369$,
6
7 251 $P<0.001$) and the following reasons might explain the phenomenon. (1) Differences
8
9 252 existed in the design of studies, such as non-unified age range, collection of data and
10
11 253 research objects, explaining the deviation of the prevalence of acne. (2) Evidence for
12
13 254 seasonality was observed, with lower lipid production and reduced barrier function
14
15 255 during the winter⁴³. A correlation between the incidence of acne and skin surface
16
17 256 lipid^{34,44} has been observed before, thus the included articles may have been
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19 257 conducted in different seasons^{26,29,35,40}, which resulted in different incidences of acne.
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21 258 The age-related subgroup prevalence rates were also calculated in this study. The
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23 259 prevalence of primary and secondary students was 50.2%, which was consistent with
24
25 260 the results of B Wei *et al*⁴⁵ (51.3%). This result was similar to those reported by
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27 261 Karciauskiene J *et al*'s⁴⁶ results among schoolchildren aged 7-19 years, which was
28
29 262 55.4% in Lithuania. However, these results are lower than a study conducted in Brazil,
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31 263 where a prevalence rate of 96% was found in adolescents aged 10-17⁴⁷. This
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33 264 difference may also be attributed to the different age range, regions and ethnic
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35 265 backgrounds of the study subjects. Our results suggested that primary and secondary
36
37 266 students (50.2%) had a higher prevalence of acne than undergraduates (44.5%,
38
39 267 $Z=2.411$, $p=0.016$), which was in agreement with the findings of Shen *et al*¹⁰.
40
41 268 Moreover, using Logistic meta-regression analysis, we found that the OR between
42
43 269 primary and secondary school students and undergraduate were 3.127 (95%
44
45 270 $CI=0.001-3.838$, $p=0.012$) for acne. Gustavo Nunes *et al*⁴⁸ and Yentzer BA *et al*⁴⁹ also
46
47 271 reported that primary and secondary students (89.3%) had a higher prevalence of acne
48
49 272 than the undergraduate subjects (61.9%) in the US population. Choi CW *et al*⁵⁰
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51 273 reported that in patients with late onset acne, the number of comedones and total
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3 274 number of acne lesions and the proportions of comedones were significantly less than
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5 275 in patients with early onset acne. The age of onset had a negative correlation with the
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7 276 number of comedones and the proportion of comedones in the T-zone and the entire
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10 277 face, namely, acne. The clinical differences in acne based on age appeared to be
11
12 278 mainly a result of age of onset and not from the progression of the acne^{51,52}.

13
14 279 In the present study, males (39.7%) had a 1.112 times higher prevalence rate of acne
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16 280 than did females (35.7%, $Z=3.903$, $p<0.001$). This result was in agreement with the
17
18 281 findings of T Schafer⁵³ that acne was more present in men (29.9%) than women
19
20 282 (23.7%) in the city of Hamburg (Germany). Adityan B *et al*⁵⁴ showed that the male to
21
22 283 female ratio was 1.25:1 in South India. In Auckland, Lello J⁵⁵ reported that males
23
24 284 (91%) were more susceptible to acne compared with females (79%) and severe and
25
26 285 moderately severe acne was significantly more common in males (OR = 2.6, 95% CI:
27
28 286 1.73 < OR < 3.9) as well. What's more, moderate and severe acne (27.1% and 0.41%
29
30 287 of patients, respectively) were significantly ($P < 0.01$) were common in males (36.2%
31
32 288 and 0.9%, respectively) than females (21.2% and 0.2%, respectively) in Egypt⁵⁶. This
33
34 289 indicated that males had a higher risk of occurrence and development of acne than
35
36 290 females. (1) This difference might be related to lifestyle. It is well known to us that
37
38 291 males accounted for a larger proportion than females in drinking and smoking⁵⁷⁻⁵⁹. (2)
39
40 292 Males also tend to pay less attention to skin than females did in China. Inappropriate
41
42 293 personal hygiene (use of abrasive soaps, harsh detergents, and excessive scrubbing)
43
44 294 can contribute to the pathological process of acne^{60,61}. (3) Androgen levels elevation
45
46 295 are greater in males than females during adolescence and increased androgen levels
47
48 296 are a risk factors of acne⁶². The interplay of growth hormone (GH), insulin, and
49
50 297 insulin-like growth factor-1 (IGF-1) signaling during puberty may also have a causal
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52 298 role in the pathogenesis of acne by influencing adrenal and gonadal androgen
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3 299 metabolism⁶³. Adult women in different age categories have a lower prevalence of
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5 300 acne than adolescence. But recent researches have shown that acne is affecting an
6
7 301 increasing number of adults, particularly females. Adult female acne should be
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10 302 considered as a specific acne subtype distinct from adolescent acne and a review on
11
12 303 the topical and oral treatment options suitable for treating acne in adult females⁵ are
13
14 304 expected in the future.

15
16 305 The prevalence rates of acne was also different in different regions. The prevalence of
17
18 306 acne among individuals in Southern China (46.3%) was higher than Northern China
19
20 307 (34.2%, $Z=2.498$, $p=0.012$). This is consistent with Subramaniyan R⁶⁴, who
21
22 308 considered that the prevalence of acne was different between the east of the Indian
23
24 309 mainland and its Southern part. This difference may be due to several factors. (1)
25
26 310 Ultraviolet radiation. Enhanced sebum excretion, colonization of the pilosebaceous
27
28 311 duct with *Propionibacterium acnes* and resultant inflammation were thought to play a
29
30 312 critical role in the pathogenesis of acne⁶⁵. The function of the sebaceous gland as an
31
32 313 endocrine skin organ, which is mainly composed of sebocytes, has an important role
33
34 314 in the occurrence and development of acne⁶⁶. Excessive sebum production and its
35
36 315 abnormal lipid ingredients from the sebaceous gland contributed to the formation of
37
38 316 primary acne lesions⁶⁷. Sebocytes also produce inflammatory cytokines and they had
39
40 317 a vital effect on formation and aggravation of acne lesions⁶⁸. Southern China has
41
42 318 longer hours of sunshine than Northern China. Solar radiation contains ultraviolet
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44 319 radiation, which is an external environmental factor causing many skin disease.
45
46 320 Ultraviolet radiation can affect the glands through direct or indirect pathways⁶⁹. It is
47
48 321 widely accepted that sebaceous gland hyperplasia and increased sebum secretion
49
50 322 occur after irradiation of ultraviolet (UV)-B. The expression of inflammatory
51
52 323 cytokines, especially IL-1b, IL-6, IL-8 and TNF-a are significantly increased in
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3 324 cultured sebocytes after treatment with UV-B⁷⁰. Meanwhile, correlational research
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5 325 showed that time-distinct gene induction of TNF- α , IL-1 β and matrilysin in cultured
6
7 326 HaCaT cells may be involved in UV-induced cellular responses⁷¹. Although, mRNA
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9 327 levels do not always correspond to protein level *in vivo*, mRNA levels of
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11 328 inflammatory cytokines such as IL-1, IL-6 and TNF- α are also identified to be
12
13 329 increased through studies using whole mouse skin and human skin exposed to
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15 330 UV-B^{72,73}. What's more, it has been known that epithelial keratinocytes contain a
16
17 331 functional PPAR- γ system and this system is a target for UV-B radiation⁷⁴. The
18
19 332 synthesis of free fatty acids by PPAR- γ stimulates the production of pro-inflammatory
20
21 333 cytokines, such as IL-1 β and TNF- α , in sebaceous glands⁷⁰. (2) Humidity. There is
22
23 334 greater humidity in Southern parts of China than the Northern China. Subramaniyan
24
25 335 R⁶⁴ reported that the prevalence of dermatoses, including acne, are much higher in
26
27 336 humid regions than arid regions. (3) Diet. Chili is a popular food for Southern
28
29 337 residents compared to the Northern residents, and is consumed in greater quantities
30
31 338 than Northern residents, and spicy food has been identified as a risk factor for the
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33 339 development of acne³³. In simple terms, both environmental factors (climate and
34
35 340 humidity) and diet may lead to the different prevalence rates of acne between
36
37 341 Northern and Southern China.
38
39 342 This systematic review is likely limited by the different diagnostic criteria for acne
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41 343 among the included studies. Due to the enormous number of Chinese people, unitive
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43 344 diagnostic criteria was difficult to implement. In addition, the age of the survey
44
45 345 population could not be subdivided, which made further detailed analysis of age
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47 346 groups impossible. More research are needed on the national prevalence of acne in
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49 347 order to provide better baseline data and to monitor the effect of acne over time in
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51 348 China.
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3 349 **Conclusion**
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6 350 The overall pooled prevalence rate of acne was 39.2% in mainland China. Primary
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8 351 and secondary students exhibited higher prevalence rates than undergraduate students.
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10 352 Due to differences in lifestyle, skincare routines and androgen levels, males showed
11
12 353 higher prevalence rates of acne than females. A possible etiological factor for the
13
14 354 difference in prevalence rates of acne between Southern China and Northern China
15
16 355 may be due to the varying ultraviolet radiation, humidity and dietary habits between
17
18 356 these two regions. The evidence generated from this paper may prove beneficial in
19
20 357 terms of understanding the age and regional distribution and prevalence rates of acne
21
22 358 amongst the Chinese population, which may help in identifying target prevention and
23
24 359 treatment strategies for this cohort of patients.

25 360 **Footnotes**
26

27 361 **Contributors** Shengjie Li and Danhui Li conceived the study, participated in drafting
28
29 362 the final manuscript. Qiang Chen and Yi Liu analyzed the data and completed the
30
31 363 final draft of the manuscript. TingTing Liu and Wenhui Tang prepared all the figures.
32
33
34 364 All authors reviewed the manuscript.

35
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37
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41 367 **Competing interests** None declared.

42
43 368 **Provenance and peer review** Not commissioned; externally peer reviewed.

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45 369 **Data sharing statement** The data used to conduct this study are secondarily held
46
47 370 data available to the public in peer reviewed journals. As such we do not own the data
48
49 371 and have access to the data publicly. We therefore needed no special permissions to
50
51 372 use the data and wish to inform BMJ Open that all data used in this document are
52
53 373 publicly held.

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56 374 **References**
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- 375 1. Ziv A, Boulet JR, Slap GB. Utilization of physician offices by adolescents in the
376 United States. *Pediatrics* 1999;104:35-42.
- 377 2. Tan JKL, Bhate K. A global perspective on the epidemiology of acne. *Br J*
378 *Dermatol* 2015;172:3–12.
- 379 3. Lynn DD, Umari T, Dunnick CA, *et al.* The epidemiology of acne vulgaris in late
380 adolescence. *Adolesc Health Med Ther* 2016; 7:13-25.
- 381 4. Su P, Chen Wee AD, Lee SH, *et al.* Beliefs, perceptions and psychosocial impact
382 of acne amongst Singaporean students in tertiary institutions. *J Dtsch Dermatol*
383 *Ges* 2015; 13: 227–33.
- 384 5. B. Dreno. Treatment of adult female acne, a new challenge. *J Eur Acad Dermatol*
385 *Venereol* 2015;29:14-9.
- 386 6. Gibbs S. Skin disease and socioeconomic conditions in rural Africa: Tanzania. *Int J*
387 *Dermatol* 1996; 35: 633–639.
- 388 7. Augustin M, Herberger K, Hintzen S, *et al.* Prevalence of skin lesions and need for
389 treatment in a cohort of 90880 workers. *Br J Dermatol* 2011; 165: 865–873.
- 390 8. Hogewoning AA, Koelemiji I, Amoah AS, *et al.* Prevalence and risk factors of
391 inflammatory acne vulgaris in rural and urban Ghanaian school children. *Br J*
392 *Dermatol* 2009; 161: 470–492.
- 393 9. Cordain L, Lindeberg S, Hurtado M, *et al.* Acne vulgaris: a disease of Western
394 civilization. *Arch Dermatol* 2002; 138: 1584–1590.
- 395 10. Shen Y, Wang T, Zhou C, *et al.* Prevalence of acne vulgaris in Chinese adolescents
396 and adults, a community-based study of 17,345 subjects in six cities. *Acta Derm*
397 *Venereol* 2012;92: 40-44.
- 398 11. Law MPM, Chuh AAT, Lee A, *et al.* Acne prevalence and beyond, acne disability
399 and its predictive factors among Chinese late adolescents in Hong Kong.
400 *Clin Exp Dermatol* 2010;35:16-21.
- 401 12. Wu T, Mei S, Zhang J, *et al.* Prevalence and risk factors of facial acne vulgaris
402 among Chinese adolescents. *International journal of adolescent medicine and health*
403 2007;19:407-412.
- 404 13. Williams HC, Dellavalle RP, Garner S. Acne vulgaris. *Lancet* 2012; 379(9813):
405 361-72.
- 406 14. McCarty M. Evaluation and Management of Refractory Acne Vulgaris in
407 Adolescent and Adult Men. *Dermatol Clin* 2016;34(2):203-6.
- 408 15. Rania Abdel Hay, Khalid Shalaby, Hesham Zaher, *et al.* Interventions for acne

- 1
2
3 409 scars. *Cochrane Database Syst Rev* 2016;4:CD011946.
- 4 410 16. Lauermaann FT, Almeida HL Jr, Duquia RP, *et al.* Acne scars in 18-year-old male
5 411 adolescents: a population-based study of prevalence and associated factors. *An Bras*
6 412 *Dermatol* 2016; 91(3): 291-5.
- 7
8 413 17. Mulder MM, Sigurdsson V, van Zuuren EJ, *et al.* Psychosocial impact of acne
9 414 vulgaris. evaluation of the relation between a change in clinical acne severity and
10 415 psychosocial state. *Dermatology* 2001;203:124-130.
- 11
12 416 18. Cheng JW, Cheng SW, Ma XY, *et al.* The prevalence of primary glaucoma in
13 417 mainland China, a systematic review and meta-analysis. *J Glaucoma* 2013;22:
14 418 301-306.
- 15
16 419 19. Say L, Donner A, Gulmezoglu AM, *et al.* The prevalence of stillbirths, a
17 420 systematic review. *Reprod Health* 2006;3:1.
- 18
19 421 20. Jian Zhang. Prevalence of acne in college students and the analysis of
20 422 psychological condition of the patient. *Journal of Yichun College* 2011;33(4):89-90.
- 21
22 423 21. Ying C, Jing Wu, Liu Y, *et al.* The prevalence and related factors of acne in
23 424 Guangzhou college Students. *Southern China Journal of Dermato-Venereology*
24 425 2009;16(2):131-132 .
- 25
26 426 22. Li M, Candong L, Donghua C. Epidemiology investigation of acne in adolescents
27 427 of different ages. *Journal of Gansu College of Traditional Chinese Medicine*
28 428 2008;25(1): 27-29.
- 29
30 429 23. Zhenxiu S. Investigation of the incidence of acne in College students. *China*
31 430 *Journal of Leprosy and Skin Diseases* 2005;21(12): 994-995.
- 32
33 431 24. Jieying F, Ruiqiang F. Epidemiology of acne of 1561 middle school students in
34 432 Guangzhou. *Southern China Journal of Dermato-Venereology* 2008;15(1):49-51 .
- 35
36 433 25. Luanduan C, Dinan Z, Yang L, *et al.* Epidemiological Investigations of 2015
37 434 Secondary Students of Acne. *China Modern Doctor* 2011;49(27):6-7.
- 38
39 435 26. Tieqiang Wu, Shuqing Mei, Jinxin Zhang, *et al.* Prevalence and Risk Factors of
40 436 acne Vulgaris in Adolescents 10-18 Years old. *International Journal of Dermatology*
41 437 *and Venereology* 2006;32(4): 201-204.
- 42
43 438 27. Feng Zhang, Jianbo Liu, Xuexiang Lin, *et al.* Analysis of Prevalence and
44 439 Awareness of Acne of College Students in Dongguan city. *Medicine and Society*
45 440 2014;27(5):68-70 .
- 46
47 441 28. Zhaorui Liu, Yueqin Huang, Huaming Zhang, *et al.* Prevalence of the knowledge
48 442 and attitude behavior on acne of students grade 2 in senior high school in Beijing.

- 1
2
3 443 *Chinese Journal of Dermatology* 2003;36(9):519-520.
- 4 444 29. Rui F, Furen, Z. Epidemiological investigation of acne vulgaris in Jining area
5 445 junior high school students. *China Journal of Leprosy and Skin Diseases*
6 446 2014;30(4):214-215.
- 7
8 447 30. Jianping C, Dapeng D, Yun S. Prevalence of Acne among primary and middle
9 448 school students in urban and rural area Of Xingtai city. *Chinese Journal of School*
10 449 *Health* 2008;29(11):995-996 .
- 11
12 450 31. Bin D, Huiming Zeng, Yongjiang D, *et al.* Survey of acne vulgaris in college
13 451 students in Hainan Province and logistic analysis of risk factors. *China Tropical*
14 452 *Medicine* 2008;8(10):1867-1868.
- 15
16 453 32. AiLi Gao, Hong Zhang, Hanxiang Zeng, *et al.* The prevalence and risk factors
17 454 analysis of adolescent acne in Guangzhou city Tianhe district. *China Journal of*
18 455 *Leprosy and Skin Diseases* 2007;23(12):1052-1053.
- 19
20 456 33. Bing L, Cangzhen H, Yanjie W. Investigation and analysis of risk factors for the
21 457 occurrence of acne among middle school students in Weinan City. *China Health Care*
22 458 *and Nutrition* 2012;22(8):2444-2445.
- 23
24 459 34. Shengjie L, Youcan Zhang, Gaomei Zheng, *et al.* Investigation and Analysis of
25 460 Sick Status and Influencing Factors on the Undergraduates Facial Acne Vulgaris in
26 461 Taian. *The Chinese Journal of Dermatovenereology* 2012;26(7):625-627.
- 27
28 462 35. Lijuan Liu, Shiheng Song, Li Cai, *et al.* Prevalence and awareness of risk factors
29 463 of acne among college students in Shijiazhuang City. *The Chinese Journal of*
30 464 *Dermatovenereology* 2014;28(2):171-172.
- 31
32 465 36. Qing Liu, Xin Gao, Xinhui Liu, *et al.* An epidemiological survey on acne in zibo
33 466 district, Shandong Province. *Journal of Practical Dermatology* 2013;16(3):149-151.
- 34
35 467 37. Guangde Pei, Jinfeng Du, Ying Huang, *et al.* An epidemiological survey on acne
36 468 in Jiaozuo district of Henan Province. *The Chinese Journal of Dermatovenereology*
37 469 2010;24(12):1129-1131.
- 38
39 470 38. Aihua Z, Qingjuan G, Wanfa R, *et al.* Investigation on incidence rate of acne in
40 471 Youth. *Hebei Medicine* 1996;2(1):78-79.
- 41
42 472 39. Hong Z, Xiaobing, H, Lichun F. The situation and strategies of prevention about
43 473 acne of the Jiangmen middle-school students. *Journal of Practical Dermatology*
44 474 2009;2(1):14-16.
- 45
46 475 40. Zhiyong Z, Ziyin, L, Hui L, *et al.* Investigation of acne about related factors of
47 476 college students in Handan city. *Journal of Hainan Medical University*

- 1
2
3 477 2011;17(12):1718-1720.
4
5 478 41. Renli Wang, Ayi Ma, Xuehua Zhang, *et al.* A survey about the prevalence of acne
6
7 479 in Liangshan district of Sichuan Province. *Chinese Journal of Dermatology*
8
9 480 2010;43(12):875-877.
10
11 481 42. Semedo D, Ladeiro F, Ruivo M, *et al.* Adult Acne: Prevalence and Portrayal in
12
13 482 Primary Healthcare Patients, in the Greater Porto Area, Portugal. *Acta Med*
14
15 483 *Port* 2016;29(9):507-513.
16
17 484 43. Karen Meyer BS, Apostolos Pappas PhD, Kelly Dunn BS, *et al.* Evaluation of
18
19 485 Seasonal Changes in Facial Skin With and Without Acne. *J Drugs Dermatol*
20
21 486 2015;14:593-601.
22
23 487 44. Ikaraoha CI, Taylor GO, Anetor JI, *et al.* Pattern of skin surface lipids in some
24
25 488 south-western Nigerians with acne vulgaris. *West Afr J Med* 2004;23(1):65-8.
26
27 489 45. B Wei, Y Pang, H Zhu, *et al.* The epidemiology of adolescent acne in North East
28
29 490 China. *J Eur Acad Dermatol Venereol* 2010;24:953-957.
30
31 491 46. Karciauskiene J, Valiukeviciene S, Stang A, *et al.* Beliefs, perceptions, and
32
33 492 treatment modalities of acne among schoolchildren in Lithuania: a cross-sectional
34
35 493 study. *Int J Dermatol* 2015;54(3):e70-8.
36
37 494 47. Bagatin E, Timpano DL, Guadanhim LR, *et al.* Acne vulgaris: prevalence and
38
39 495 clinical forms in adolescents from Sao Paulo, Brazil. *An Bras*
40
41 496 *Dermatol* 2014;389(3):428-35.
42
43 497 48. Vilar GN, Santos LA, Sobral Filho JF. Quality of life, self-esteem and
44
45 498 psychosocial factors in adolescents with acne vulgaris. *An Bras Dermatol*
46
47 499 2015;90:622-629.
48
49 500 49. Yentzer BA, Hick J, Reese EL, *et al.* Acne vulgaris in the United States, a
50
51 501 descriptive epidemiology. *Cutis* 2010; 86:94-99.
52
53 502 50. CW Choi, DH Lee, HS Kim, *et al.* The clinical features of late onset acne
54
55 503 compared with early onset acne in women. *Journal of the European Academy of*
56
57 504 *Dermatology and Venereology* 2011;25:454-461.
58
59 505 51. Williams C, Layton AM. Persistent acne in women , implications for the patient
60
506 and for therapy. *Am J Clin Dermatol* 2006;7:281-290.
507
508 507 52. Marks R. Acne and its management beyond the age of 35 years. *Am J Clin*
509
508 *Dermatol* 2004; 5:459-462.
509
510 509 53. Schafer T, Nienhaus A, Vieluf D, *et al.* Epidemiology of acne in the general

- 1
2
3 510 population, the risk of smoking. *British Journal Of Dermatology* 2001;145:100-104.
4
5 511 54. Adityan B, Thappa DM. Profile of acne vulgaris--a hospital-based study from
6
7 512 South India. *Indian J Dermatol Venereol Leprol* 2009;75(3):272-8.
8
9 513 55. Lello J, Pearl A, Arroll B, *et al.* Prevalence of acne vulgaris in Auckland senior
10
11 514 high school students. *N Z Med J* 1995;108(1004):287-9.
12
13 515 56. E.A. El-Khateeb, N.H. Khafagy, K.M. Abd Elaziz, *et al.* Acne vulgaris:
14
15 516 prevalence, beliefs, patients' attitudes, severity and impact on quality of life in Egypt.
16
17 517 *Public Health* 2014;128(6):576-8.
18
19 518 57. Kegler MC, Hua X, Solomon M, *et al.* Factors associated with support for
20
21 519 smoke-free policies among government workers in Six Chinese cities, a
22
23 520 cross-sectional study. *Bmc Public Health* 2014;14: 1130.
24
25 521 58. Yang MJ. The Chinese drinking problem, a review of the literature and its implicat
26
27 522 ion in a cross-cultural study. *Kaohsiung J Med Sci* 2002;18:543-550.
28
29 523 59. Yang X, Lu X, Wang L, *et al.* Common variants at 12q24 are associated with
30
31 524 drinking behavior in Han Chinese. *Am J Clin Nutr* 2013;97:545-551.
32
33 525 60. Kilkenny M, Merlin K, Plunkett A, *et al.* The prevalence of common skin
34
35 526 conditions in Australian school children, III, Acne vulgaris. *Br J Dermatol*
36
37 527 1998;139:840-845.
38
39 528 61. Andrew FA, Lamb A. Concomitant therapy for acne in patients with skin of color,
40
41 529 a case-based approach. *Dermatol Nurs* 2009;21:1.
42
43 530 62. Henze C, Hinney B, Wuttke W. Incidence of increased androgen levels in patients
44
45 531 suffering from acne. *Dermatology* 1998;196:53-4.
46
47 532 63. Kumari R, Thappa DM. Role of insulin resistance and diet in acne. *Indian J*
48
49 533 *Dermatol Venereol Leprol* 2013;79(3):291-9.
50
51 534 64. Subramaniyan R. Pattern of Dermatoses Among Nicobarese in a Community
52
53 535 Health Camp at Nancowry, Andaman and Nicobar Islands. *Indian J Dermatol*
54
55 536 2016;61:187-9.
56
57 537 65. Cunliffe WJ. The sebaceous gland and acne-40 years on. *Dermatology* 1998;196:
58
59 538 9-15.
60
61 539 66. Gollnick H, Dreno B. Pathophysiology and management of acne. *Journal Of the*
62
63 540 *European Academy Of Dermatology And Venereology* 2015;29:1-2.
64
65 541 67. Zouboulis CC. Acne and sebaceous gland function. *Clin Dermatol*
66
67 542 2004;22:360-366.

- 1
2
3 543 68. Zouboulis CC, Adjaye J, Akamatsu H, *et al.* Human skin stem cells and the ageing
4 544 process. *Exp Gerontol* 2008;43:986-997.
- 5 545 69. Roberts JE. Light and immunomodulation. *Ann N Y Acad Sci* 2000;917:435-445.
6 546
7 547 70. Weon Ju LEE, Kyung Hea PARK, Mi Yeung SOHN, *et al.* Ultraviolet B
8 548 irradiation increases the expression of inflammatory cytokines in cultured sebocytes.
9 549 *Journal of Dermatology* 2013;40:993-997.
- 10 550 71. Skiba B, Neill B, Piva TJ. Gene expression profiles of TNF-alpha, TACE, furin,
11 551 IL-1beta and matrilysin in UVA- and UVB-irradiated HaCat cells. *Photodermatol*
12 552 *Photoimmunol Photomed* 2005;21:173-182.
- 13 553 72. Murphy GM, Dowd PM, Hudspith BN, *et al.* Local increase in interleukin-1-like
14 554 activity following UVB irradiation of human skin in vivo. *Photodermatol*
15 555 1989;6:268-274.
- 16 556 73. Scordi IA, Vincek V. Timecourse study of UVB-induced cytokine induction in
17 557 whole mouse skin. *Photodermatol Photoimmunol Photomed* 2000;16:67-73.
- 18 558 74. Zhang Q, Southall MD, Mezsick SMQ, *et al.* Epidermal peroxisome
19 559 proliferator-activated receptor gamma as a target for ultraviolet B radiation. *J Biol*
20 560 *Chem* 2005;280:73-79.
21 561
22 562
23 563
24 564
25 565
26 566
27 567
28 568
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30 570
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572 Figure legends

573 Figure 1 Flow-chart illustrating the article search process

574 First, we obtained 166 records identified through database searching. No additional
575 records identified through other sources. Second, 89 records left after duplicates
576 removed. Third, 58 studies were excluded after records screening. Then the
577 remainder 31 studies were full-text articles assessed for eligibility and 6 studies were
578 excluded. Finally 25 studies were included in quantitative synthesis (meta-analysis).
579

580 Figure 2 Forest plot of the overall prevalence rates of acne. CI=confidence 581 interval.

582 A total of 25 studies were included in this meta-analysis. Through analyzing in a
583 random-effects model, the overall pooled prevalence of acne was calculated as 39.2%
584 (95% CI=0.310-0.479) through analyzing in a random-effects model.
585

586 Figure 3 Forest plot of the prevalence rates of acne according to gender. 587 CI=confidence interval.

588 A total of 24 studies were included in this subgroup meta-analysis. Through analyzing
589 in a random-effects model, the prevalence rates of acne in males was 39.7% (95%
590 CI=0.317-0.482) and 35.7% (95% CI=0.274-0.451) in females. Males (39.7%)
591 exhibited a higher prevalence of acne than did females (35.7%) in the subgroup
592 analysis ($Z=3.903$, $p<0.001$).
593

594 Figure 4 Forest plot of the prevalence rates of acne according to region. 595 CI=confidence interval.

596 A total of 24 studies were included in this subgroup meta-analysis. 10 of these studies
597 were conducted in Northern China and 14 studies were conducted in Southern China.
598 Through analyzing in a random-effects model, the prevalence rates of acne in South
599 was 46.3% (95% CI=0.374-0.555) and 34.2% in North (95% CI=0.242-0.458). The
600 South (46.3%) had a higher prevalence of acne than did the North (34.2%) in the
601 subgroup analysis ($Z=2.498$, $p=0.012$).
602

603 Figure 5 Forest plot of the prevalence rates of acne according to age. 604 CI=confidence interval. All=overall age. P and s=primary and secondary 605 students.

606 A total of 25 studies, consisting of 4 studies that examined the overall population, 10
607 p-and-s studies, and 11 undergraduate studies, were included in this subgroup
608 meta-analysis. Through analyzing in a random-effects model, the prevalence of acne
609 over all ages was 10.2% (95% CI=0.059-0.171). The prevalence of acne in the
610 primary and secondary students was 50.2% (95% CI=0.451-0.554) and 44.5% (95%
611 CI=0.358-0.534) in the undergraduates. The primary and secondary students (50.2%)
612 had a higher prevalence of acne than did the undergraduates (44.5%) in the
613 subgroup analysis ($Z=2.411$, $p=0.016$).
614

615 Supplementary Figure 1 Funnel plots for the overall pooled studies

616 The total studies arrange around the center line symmetrically, so there is no
617 publication bias.
618

619 Supplementary Figure 2 Funnel plots for the male subgroup

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3 620 A total of 24 studies involving 40,712 males were included in the male subgroup
4 621 meta-analysis. The 24 studies arrange around the center line symmetrically, so there is
5 622 no publication bia.
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8 624 **Supplementary Figure 3 Funnel plots for the female subgroup**

9 625 A total of 24 studies involving 41,907 females were included in the female subgroup
10 626 meta-analysis. The 24 studies arrange around the center line symmetrically, so there is
11 627 no publication bia.
12 628

13 629 **Supplementary Figure 4 Funnel plots for the all-age-layer subgroup**

14 630 A total of 4 studies were included in the all-age-layer subgroup meta-analysis. The
15 631 studies arrange around the center line symmetrically, so there is no publication bia.
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17 633 **Supplementary Figure 5 Funnel plots for the subgroup of primary and**
18 634 **secondary school students**

19 635 A total of 10 studies were included in the subgroup meta-analysis of primary and
20 636 secondary school students. The studies arrange around the center line symmetrically,
21 637 so there is no publication bia.
22 638

23 639 **Supplementary Figure 6 Funnel plots for the subgroup of undergraduates**

24 640 A total of 11 studies were included in the subgroup meta-analysis of
25 641 undergraduates. The studies arrange around the center line symmetrically, so there is
26 642 no publication bia.
27 643

28 644
29 645 **Supplementary Figure 7 Funnel plots for the subgroup of Southern China**

30 646 A total of 14 studies were included in the Southern subgroup meta-analysis. The
31 647 studies arrange around the center line symmetrically, so there is no publication bia.
32 648

33 649 **Supplementary Figure 8 Funnel plots for the subgroup of Northern China**

34 650 A total of 10 studies were included in the Northern subgroup meta-analysis. The
35 651 studies arrange around the center line nonsymmetrically, so there existed publication
36 652 bia.
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659 **Tables**

660 Table 1. Characteristics of the populations examined in studies reporting the
 661 prevalence of acne in mainland China

Name	Region	Year	Age range	Sample size	Prevalence (%)		
					Male % (n)	Female % (n)	Total (%)
Zhang feng	Dong guan	2013	undergraduate	669	40.37 (379)	34.48 (290)	37.82
Liu lijuan	Shi jiazhuang	2013	undergraduate	742	42.11 (418)	36.11 (324)	39.49
Liu qing	Zi bo	2013	12-49	1455	9.4 (504)	11.5 (951)	8.32
Li shengjie	Tai an	2010	17-24	1416	39.85 (532)	46.61 (884)	44.07
Zhang zhiyong	Han dan	2010	undergraduate	1582	59.71 (834)	50.00 (748)	55.12
Cai xinduan	Guang dong	2010	9-18	2015	49.90 (986)	59.86 (1029)	54.99
Zhangjian	Yi chun	2011	18-26	448	45.16 (217)	32.03 (231)	38.39
Wang renli	Si chuan	2008-2009	all	10,503	19.3 (4319)	16.9 (6184)	18.1
Pei guangde	He nan	2008	all	1547	8.80 (742)	7.86 (805)	8.39
Chen ying	Guang zhou	2008	undergraduate	2252	34.7 (1253)	38.4 (999)	36.4
Zhang hong	Jiang men	2006-2008	17-18	12,450	55.9 (7134)	46.02 (5136)	51.83
Deng bin	Hai nan	2005	16-23	3500	34.8 (1990)	32.4 (1510)	33.8
Cui jianping	Xing tai	2007	10-18	2891	43.14 (1370)	35.44 (1521)	39.1
Min li	Fu jian	2007	15-23	1484	69.5 (836)	63.6 (648)	66.9
Feng jieying	Guang zhou	2004-2005	11-19	1561	51.95 (743)	60.76 (818)	56.57
Gao aili	Guang zhou	2004	12-20	2552	34.2 (1151)	31.6 (1305)	32.8
Wu tieqiang	Zhu hai	2004	10-18	3200	54.9 (1790)	51.6 (1410)	53.5
Sun zhenxiu	Nan jing	2005	16-23	2100	37.91 (1000)	22 (1100)	30.33
Liu zhaorui	Bei jing	2003	16-17	4933	67.1 (2364)	57.3 (2569)	62.0
Zhang aihua	Tai an, He ze	1996	14-23	1510	38.24 (829)	23.06 (581)	20.99
Fu rui	Ji ning	2012	11-17	2560	45.40 (1343)	47.80 (1177)	46.51
Li bing	Shan xi	2012	12-17	741	55.8 (335)	49.2 (406)	52.2
Yiwei Shen	China	2012	all	17,345	10.4 (7858)	6.1 (9487)	8.1
Law MP	Hong Kong	2010	undergraduate	389	N/A	N/A	85.1
Wu TQ	Guang dong	2007	10-18	3163	51.3 (1785)	58.6 (1378)	53.5

662 (n)= the number of participants, N/A= not available.

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667 Table 2. Methodological quality of the studies reporting the prevalence of acne in

668 mainland China

Name	Sampling scheme	Population characteristics	Prevalence definition	Diagnostic criteria	Response rate %	Score
Zhang feng	Random stratified sample	adequate	clear	clear	95	4
Liu lijuan	Random stratified sample	adequate	clear	clear	N/A	3
Liu qing	Cluster sampling	adequate	clear	clear	48.5	3
Li shengjie	Random stratified sample	adequate	clear	clear	100	4
Zhang zhiyong	Cluster sampling	adequate	clear	clear	97.75	4
Cai xinduan	Random stratified sample	adequate	clear	clear	98.05	4
Zhangjian	Random stratified sample	adequate	clear	clear	N/A	3
Wang renli	Random stratified sample	adequate	clear	clear	N/A	3
Pei guangde	Random stratified sample	adequate	clear	clear	53.4	3
Chenyong	Random stratified sample	adequate	clear	clear	90.8	4
Zhang hong	Cross-sectional	adequate	clear	clear	N/A	3
Deng bin	Random stratified sample	adequate	clear	clear	N/A	3
Cui jianping	Random stratified sample	adequate	clear	clear	98.1	4
Min li	Random stratified sample	adequate	clear	clear	N/A	3
Feng jieying	Random stratified sample	adequate	clear	clear	98.24	4
Gao aili	Cross-sectional	adequate	clear	clear	96.2	4
Wu tieqiang	Cross-sectional	adequate	clear	clear	98.84	4
Sun zhenxiu	Random stratified sample	adequate	clear	clear	N/A	3
Liu zhaorui	Random stratified sample	adequate	clear	clear	N/A	3
Zhang aihua	Random stratified sample	adequate	clear	clear	N/A	3
Fu rui	Cross-sectional	adequate	clear	clear	99.06	4
Li bing	Random stratified sample	adequate	clear	clear	95.2	4
Yiwei Shen	Community-based study	adequate	clear	clear	86.84	4
Law MP	Cross-sectional	adequate	no	clear	99.3	4
Wu TQ	Cross-sectional	adequate	clear	clear	98.8	4

669 N/A= not available.

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676 Table 3. Adjusted odds ratios for acne obtained by logistic meta-regression analysis

Factor	Number of studies	OR (95% CI)	P-value
Age of range			
undergraduate	11	1.00	
primary and secondary school students	10	3.127 (0.001-3.838)	0.012
Gender			
female	24	1.00	
male	24	1.217 (0.109-14.681)	0.024
Location			
north	10	1.00	
south	14	1.184 (0.002-3.833)	0.028

677 OR= odds ratio. CI=confidence interval

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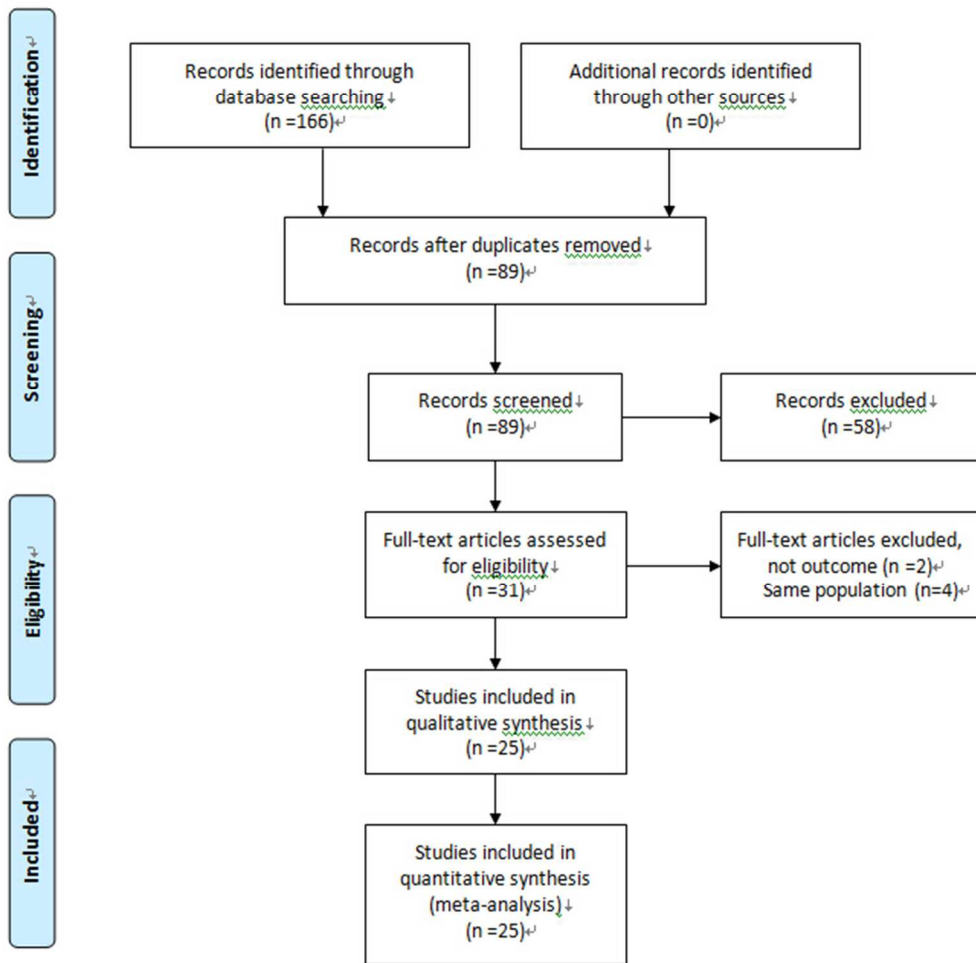
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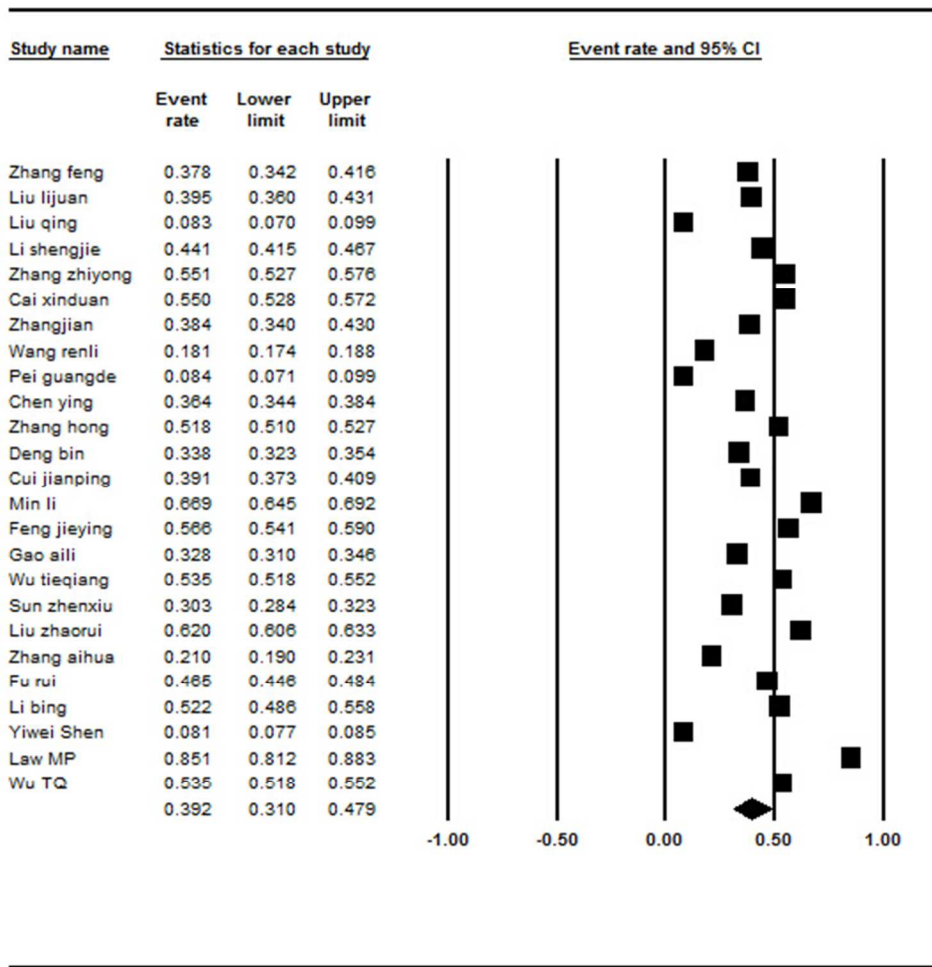
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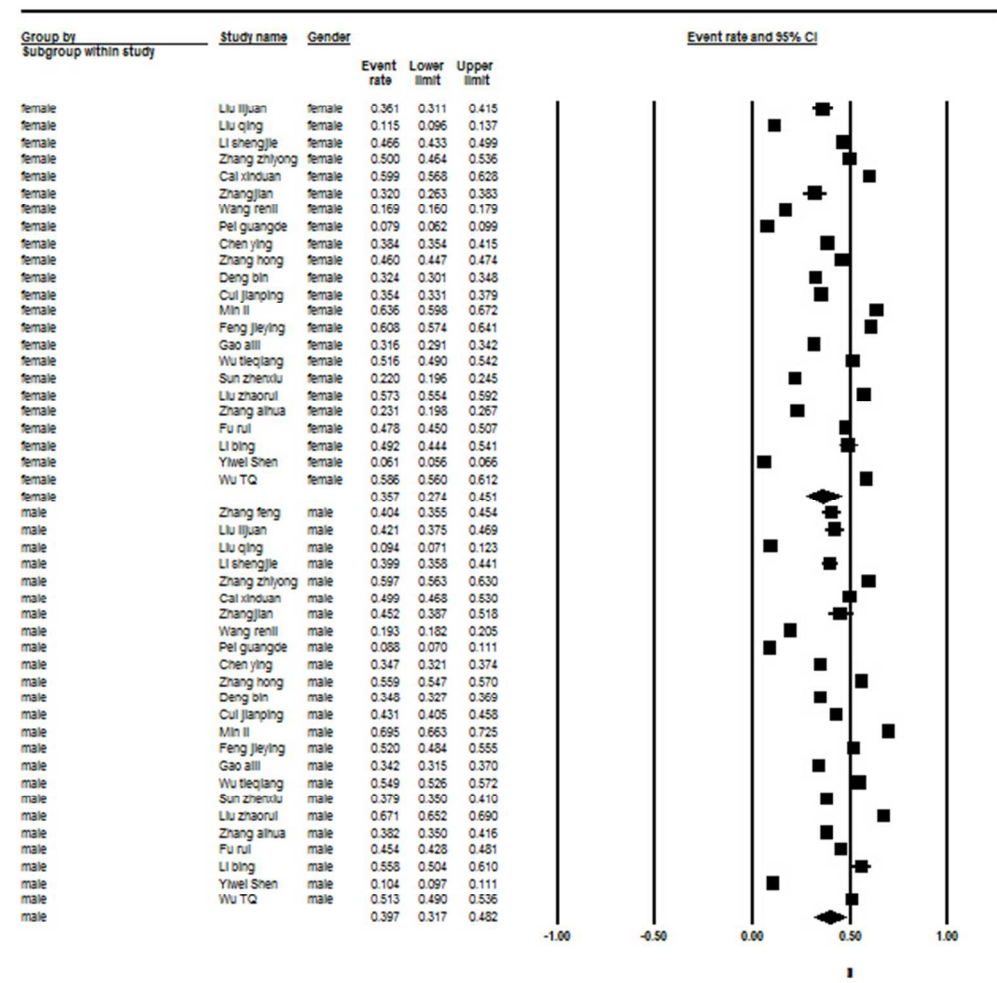
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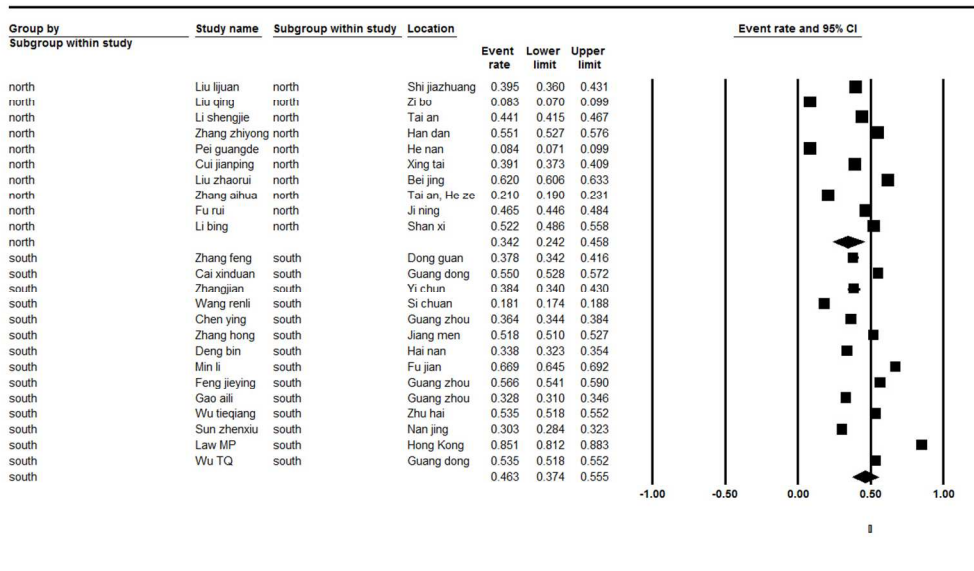
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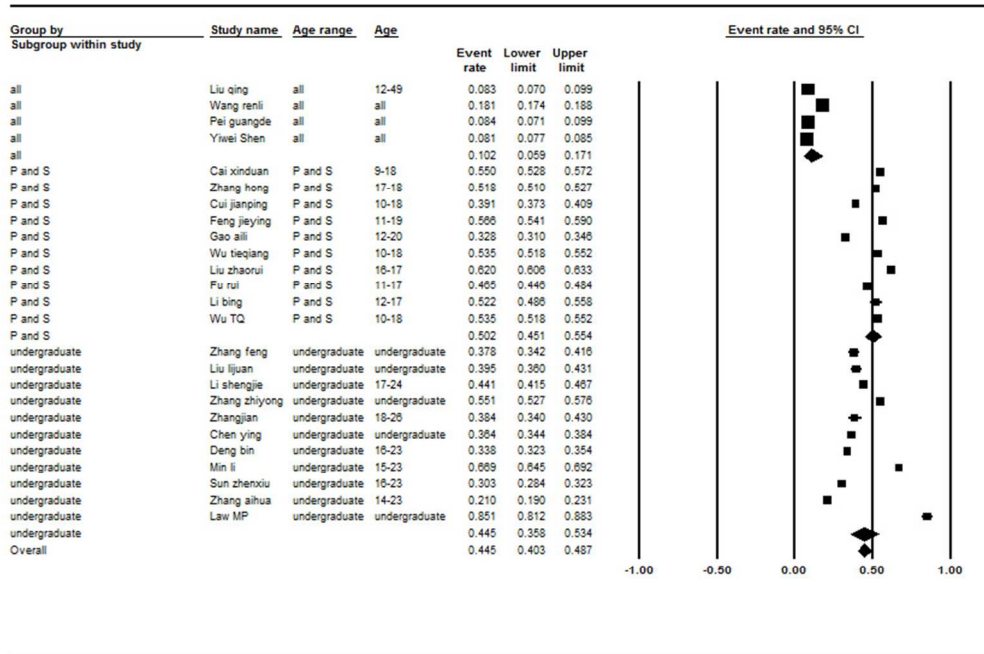
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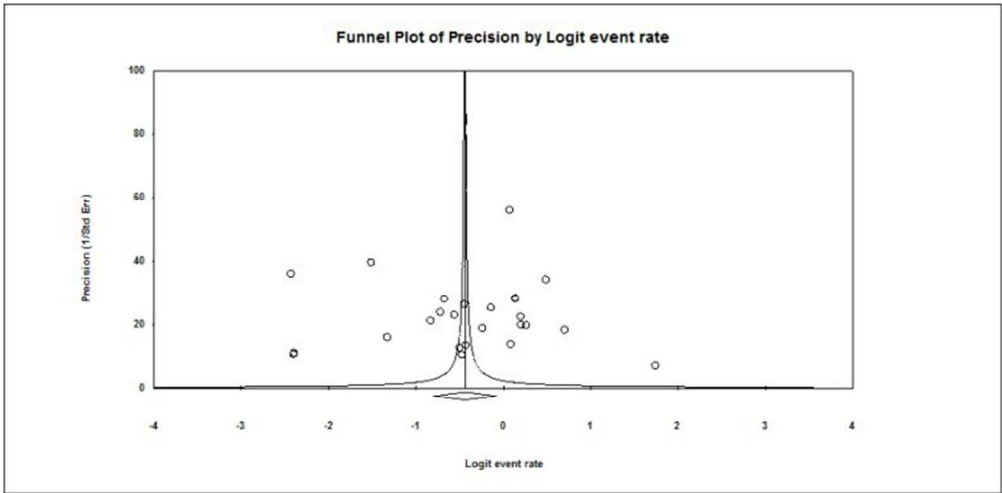
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Supplementary table 1. Details of electronic bibliographic database search strategies

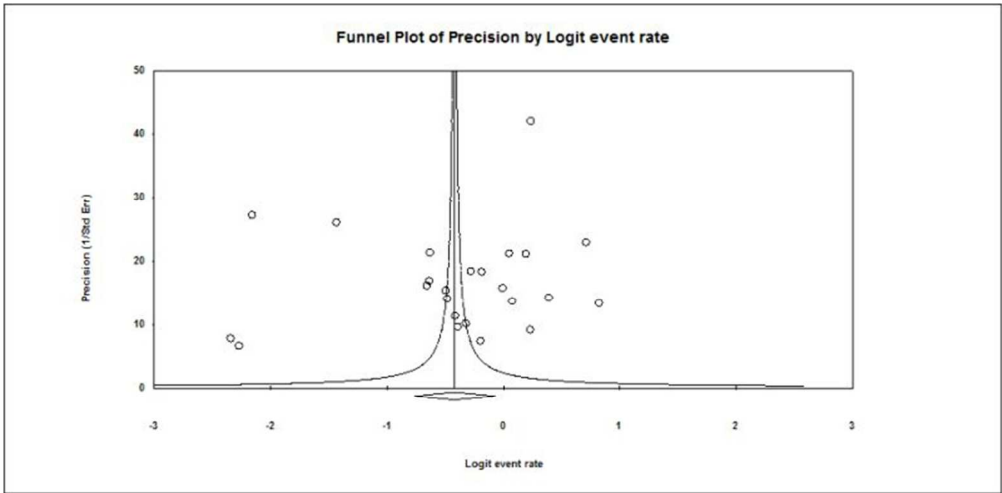
Database	Search strategies
Pubmed	((("acne vulgaris"[MeSH Terms] AND (("prevalence"[MeSH Terms]) OR "incidence"[MeSH Terms]))) AND ("China"[MeSH Terms]) OR "Chinese"[MeSH Terms])
Embase	Title or Abstract acne AND Title or Abstract (china or chinese) AND Title or Abstract (prevalence or incidence or epidemiology)
Web of science	Title or Abstract:(acne) AND Title or Abstract: (prevalence or incidence or epidemiology) AND Title or Abstract: (china or Chinese)
China National Knowledge Infrastructure Periodicals	Keywords: acne AND Keywords: prevalence or incidence or epidemiology
The VIP Database for Chinese Technical	(1) Title or Keywords: acne; Property: dim AND Title or Keywords: prevalence; Property: dim (2) Title or Keywords: acne; Property: dim AND Title or Keywords: incidence; Property: dim
The Wan Fang Database for Chinese Periodicals	(1) Title or Keywords: acne; Property: dim AND Title or Keywords: prevalence; Property: dim (2) Title or Keywords: acne; Property: dim AND Title or Keywords: incidence; Property: dim

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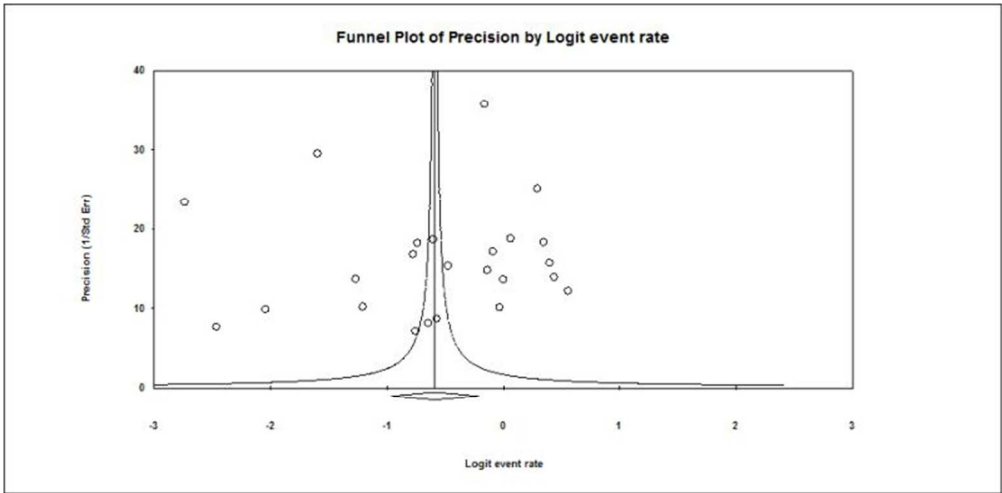
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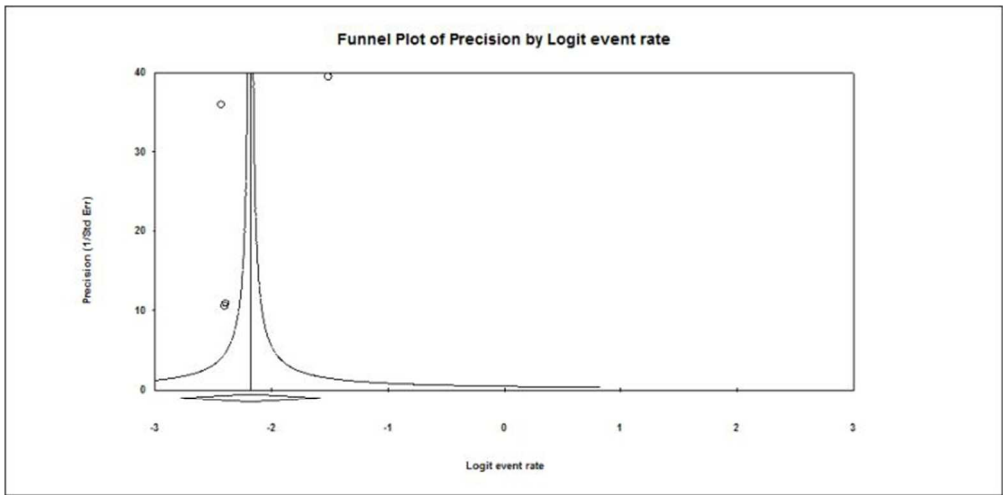
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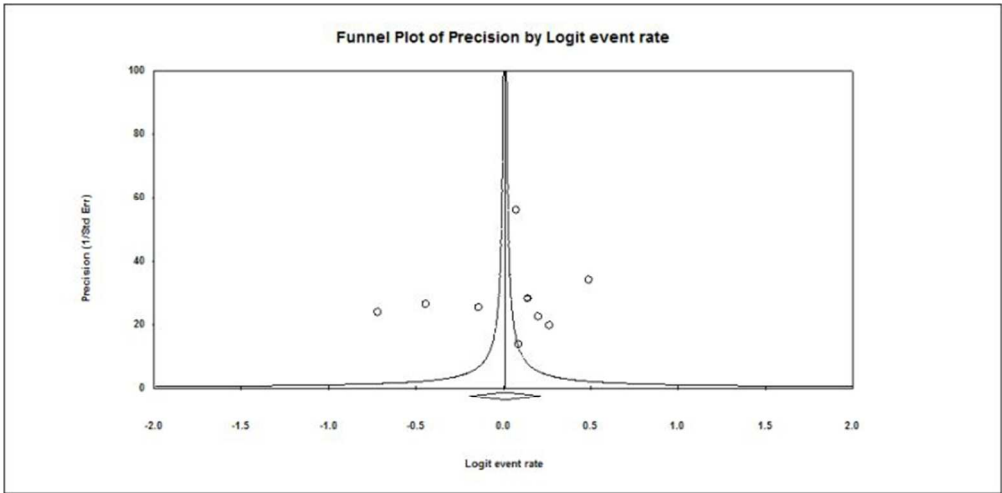
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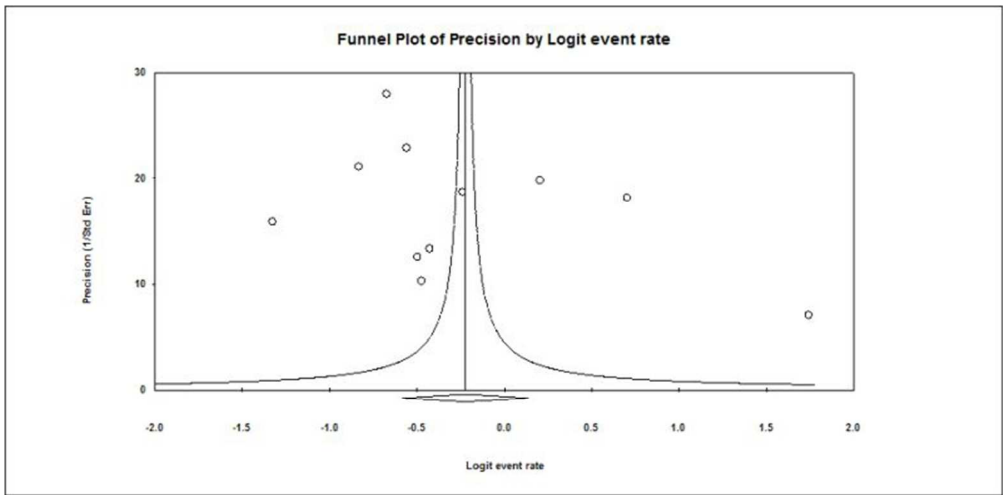
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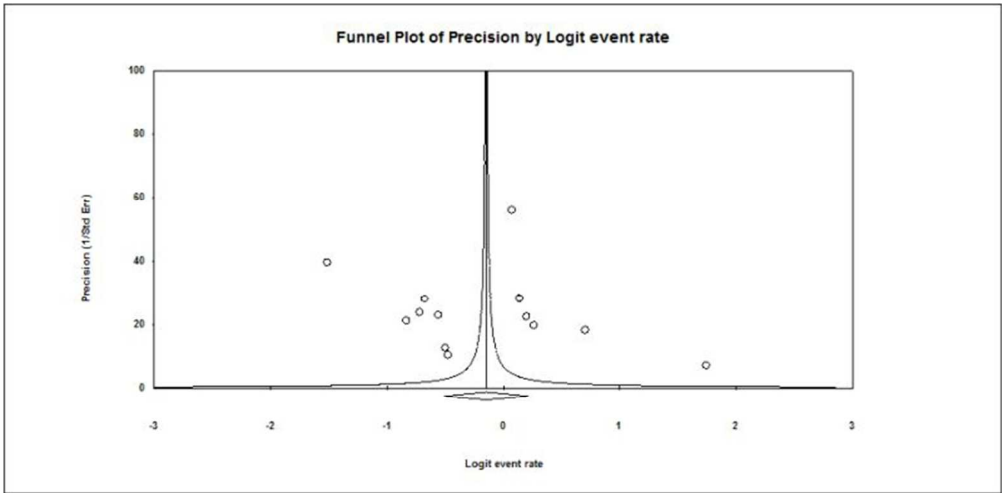
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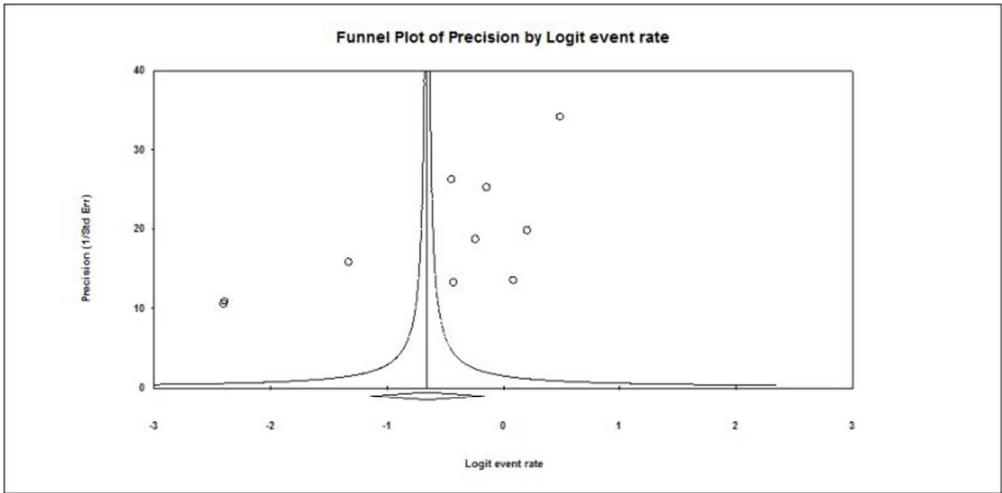


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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	The Prevalence of Acne in Mainland China: a systematic review and meta-analysis	1
ABSTRACT			
Structured summary	2	Objectives: The aim of this review is to estimate the prevalence of acne in mainland China comprehensively and to quantify its association with gender, region and age. Methods and analysis: We searched electronic databases with predetermined search terms to identify relevant studies published between January 1, 1996 and September 30, 2016. Note Express software, Comprehensive Meta-Analysis version 2.0, Logistic meta-regression analysis was used to dispose data and analyse. Results: The overall pooled prevalence rates of acne were 39.2%. In mainland China, primary and secondary students exhibited higher prevalence rates than undergraduate students; males had higher prevalence rates of acne than females; and the prevalence rates of acne in southern China was higher than northern China.	2,3
INTRODUCTION			
Rationale	3	Acne vulgaris burden exhibits global distribution and has continued to grow in prevalence over time within this population. Acne can result in psychological distress and have profound effects on patients' self-esteem. China comprises 34 province-level administrative regions, with 56 nations and a population of 1.3 billion people, a country-wide, population-based study of the prevalence rates of acne in China was needed.	3,4
Objectives	4	In this review, we examined the prevalence of acne in mainland China and to analyse the effects of gender, region and age on it.	4
METHODS			
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PRISMA 2009 Checklist

Protocol and registration	5	We have no original protocol and registration, so this item isn't applicable.	
Eligibility criteria	6	Studies that met all of the following criteria were included in the meta-analysis, (1) the study was a population-based survey; (2) the study evaluated the prevalence/incidence of acne; (3) the investigation involved random sampling or cluster sampling; (4) the sample size was >300; A flow chart illustrating the article search process is presented in Figure 1.	5,6
Information sources	7	Studies were aggregated from six databases between January 1, 1996 and September 30, 2016, including PubMed, EMBASE, the Web of Science, the China National Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and the Wan Fang Database for Chinese Periodicals.	4
Search	8	The following search terms were used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or Chinese).	4
Study selection	9	Figure1	Figure1
Data collection process	10	The data in this study were extracted independently and checked after independent extraction by two investigators.	5
Data items	11	(1) the name of the first author; (2) the location of the investigation area; (3) the year in which the investigation occurred; (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6) the prevalence rates obtained for males, females, and overall; (7) the method used to sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.	5
Risk of bias in individual studies	12	Quality assessment and analysis of the publication bias	5
Summary measures	13	odds ratios (ORs) and their associated 95% confidence intervals (CIs)	6
Synthesis of results	14	The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic and I^2 metrics. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into subgroups of regions, ages and gender. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model.	6

Section/topic	#	Checklist item	Reported
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Risk of bias across studies	15	Table 2	Table2
Additional analyses	16	Logistic meta-regression model, subgroup analysis	6
RESULTS			
Study selection	17	Using the initial search strategy, 166 studies were identified, and 141 studies were subsequently excluded (Figure 1). A total of 25 studies 2-4, 9-30 involving 83,008 Chinese individuals were included in this meta-analysis.	6,7
Study characteristics	18	Detailed characteristics of each included study were presented in Table 1.	Table 1
Risk of bias within studies	19	The overall quality of all included studies was found to be adequate (Table 2).	Table 2
Results of individual studies	20	Figure2-5	Figure2-5
Synthesis of results	21	Figure2-5	Figure2-5
Risk of bias across studies	22	Table 2	Table 2
Additional analysis	23	logistic meta-regression model, subgroup analysis	8
DISCUSSION			
Summary of evidence	24	Our results showed that the overall pooled prevalence of acne was 39.2% for all ages. The prevalence rates in different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95% CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95% CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the prevalence rates were 34.2% northern China (95% CI=0.242-0.458) and 46.3% for southern China (95% CI=0.374-0.555).	9
Limitations	25	The diagnostic criteria for acne differed across studies and the age of the survey population could not be subdivided.	3
Conclusions	26	The overall pooled prevalence of acne was 39.2% in mainland China; acne occurred highly in primary students and secondary students than undergraduate students; the prevalence of acne in males was greater than that in females; and acne was more common in northern China than in southern China. This meta-analysis of the prevalence of acne may provide a sound basis for the future provision of health services.	9
FUNDING			
Funding	27	Issue of Tai'an Science and Technology Development Plan (201440774-05)	



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From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Page 2 of 2

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BMJ Open

The Prevalence of Acne in Mainland China: a systematic review and meta-analysis

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-015354.R2
Article Type:	Research
Date Submitted by the Author:	13-Mar-2017
Complete List of Authors:	li, dan; Xi'an Jiaotong University, Key Laboratory of Environment and Genes Related to Diseases, Ministry of Education, Medical School Chen, Qiang; Taishan Medical University, School of Public Health Liu, Yi; Affiliated Hospital of Jining Medical University, Department of Dermatology Liu, Ting; Taishan Medical university, The school hospital of Taishan Medical university Tang, Wen; Maternal and Child Health Care of Laiwu City in Shandong Province, Department of Biomedical Engineering li, sheng; Eye & ENT Hospital, Shanghai Medical College, Fudan University, Department of Clinical Laboratory
Primary Subject Heading:	Dermatology
Secondary Subject Heading:	Epidemiology
Keywords:	Acne < DERMATOLOGY, Dermatological epidemiology < DERMATOLOGY, EPIDEMIOLOGY

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3 **1 The Prevalence of Acne in Mainland China: a systematic review**
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6 **2 and meta-analysis**
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8 Danhui Li^{1¶}, Qiang Chen^{2¶}, Yi Liu^{3¶}, Ting-ting Liu⁴, Wenhui Tang⁵, Shengjie Li^{6*}
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3 **Abstract**
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6 **Introduction** Acne, a very common skin disease, can result in psychological distress
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8 and sustain impairment in quality of life. Data on the prevalence of acne and the
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10 differences in gender, region and age is limited. The aim of this review is to estimate
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12 the prevalence of acne in mainland China comprehensively and to quantify its
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14 association with gender, region and age.
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17 **Methods** We searched electronic databases with predetermined search terms to
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19 identify relevant studies published between January 1st 1996 and September 30th 2016.
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21 We pointed out repeated results using Note Express software and evaluated the studies
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23 for inclusion. Two independent reviewers extracted the data, followed with statistical
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25 analyses using Comprehensive Meta-Analysis software version 2.0. A random-effects
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27 model was adopted to calculate the overall pooled prevalence and to merge categories,
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29 including gender (males and females), region (Northern China and Southern China)
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31 and age (primary and secondary students: 7-17 years old; undergraduates: 18-23 years
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33 old; overall: no limits of age) for subgroup analyses. Logistic meta-regression analysis
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35 was used to clarify the associations between acne and the predictors age, gender, and
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37 region using odds ratios and their associated 95% confidence intervals.
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43 **Results** 25 relevant studies were included in this meta-analysis. The overall pooled
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45 prevalence rates of acne were 39.2% (95% CI=0.310-0.479). The prevalence rates in
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47 different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary
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49 and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95%
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51 CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95%
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53 CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the
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55 prevalence rates were 34.2% for Northern China (95% CI=0.242-0.458) and 46.3%
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4 50 for Southern China (95% CI=0.374-0.555). The associations between acne and the
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6 51 predictors age, gender, and region were statistically significant.
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9 52 **Conclusions** In mainland China, primary and secondary students exhibited higher
10
11 53 prevalence rates than undergraduate students; males had higher prevalence rates of
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13 54 acne than females; and the prevalence rates of acne in Southern China was higher than
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15 55 Northern China.
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17 56 **Strengths and limitations**

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21 57 To our knowledge, this was the first systemic review evaluating the overall acne
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23 58 prevalence in mainland China and analyzing its associations with age, gender, and
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25 59 region.
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28 60 This systematic review, covering 12 different provinces, was composed of 25 studies,
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30 61 with 80 thousand people over a 41-year period.
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32 62 Some limitations should be considered: the diagnostic criteria for acne differed among
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34 63 the included studies; the age of the survey population could not be subdivided.
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36 64 Moreover due to heterogeneity among papers, the samples changed from variable to
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38 65 variable.
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40 66 **Introduction**

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44 67 Acne, a very common skin disease among adolescents, is the fourth most common
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46 68 reason for patients aged 11–21 years to visit a doctor in the USA¹. Acne is estimated
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48 69 to affect 9.4% of the world's population with the highest prevalence in adolescents².
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51 70 Acne vulgaris-associated disease burden exhibits global distribution and has
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53 71 continued to grow in prevalence over time within this population³. In addition, a
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55 72 group of increasing epidemiological data suggest that acne also affects a considerable
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57 73 number of adults⁴, and women are more frequently affected by adult acne than
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3 74 men⁵. The incidence of acne is different from various countries and ethnic groups. The
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5 75 prevalence of acne is reported to be low in developing countries of Africa^{6,7}. In
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7 76 Northern Tanzania, the prevalence of acne is reported to be 0.1%⁸, whereas the
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9 77 prevalence of acne is 3.9% in the German population aged between 16 and 70 years⁹.
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11 78 However, a comprehensive systemic review of the prevalence of acne in the Chinese
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13 79 population is still lacking. Several studies have shown that the estimated prevalence
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15 80 rate of acne varies from 8.1% to 85.1% in China¹⁰⁻¹² depending on the region,
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17 81 subjects' ages, and nationality studied.
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21 82 Acne is a chronic inflammatory disease of the pilosebaceous unit resulting from
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23 83 androgen-induced increased sebum production, altered keratinization, inflammation,
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25 84 and bacterial colonisation of hair follicles by *Propionibacterium acnes*¹³. Acne
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27 85 vulgaris alters the normal skin physiology, impairing stratum corneum and causing
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29 86 transepidermal water loss¹⁴. The clinical features of acne include papules, pustules,
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31 87 cysts, comedos, and nodules. Acne occurs primarily on the face, neck, and upper trunk
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33 88 and can lead to scar formation if treated improperly. Acne scarring is a frequent
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35 89 complication of acne and patients often lack effective and safe methods for managing
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37 90 this condition¹⁵. The resulting scars may negatively impact on an affected person's
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39 91 psychosocial and physical well-being. It has been reported that acne can result in
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41 92 psychological distress and have profound effects on the patients' self-esteem, which
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43 93 may lead to anxiety, depression, diminished self-confidence, and communication
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45 94 difficulties^{16,17}.
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50 95 Many large population-based studies have been conducted to estimate the prevalence
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52 96 rates of acne in regional populations, but a comprehensive statistical analysis of the
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54 97 prevalence of Chinese acne has not emerged so far. China, being a vast region,
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56 98 comprises of 34 province-level administrative regions, with 56 ethnic groups and a
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3 99 population of 1.3 billion people. Therefore a country-wide, population-based study of
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5 100 the prevalence rates of acne in China was needed. In this review, we examined the
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7 101 prevalence of acne in mainland China systematically and analysed the effects of
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10 102 gender, region and age on acne.

103 **Methods**

104 **Search strategy**

105 Studies were aggregated from six databases between January 1st 1996 and September
106 30th 2016, including PubMed, EMBASE, Web of Science, the China National
107 Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and
108 the Wan Fang Database for Chinese Periodicals. The following search terms were
109 used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or
110 Chinese). The combination of acne, prevalence, incidence, China and Chinese were
111 used in varying combinations to identify relevant literature. Search strategies were
112 customised to suit each database. The search strategy is presented in supplementary
113 table 1. In addition, a manual search was performed by checking the reference lists of
114 eligible articles and relevant reviews.

115 **Inclusion criteria**

116 Studies that met all of the following criteria were included in the meta-analysis,

- 117 (1) the study was a population-based survey;
118 (2) the study evaluated the prevalence/incidence of acne;
119 (3) the investigation involved random sampling or cluster sampling;
120 (4) the sample size was >300;

121 A flow chart illustrating the article search process is presented in Figure 1.

122 **Data management**

123 Any duplicate studies was removed by Note Express. Two reviewers (Qiang Chen and

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3 124 Danhui Li) independently evaluated the title and abstract of all studies identified
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5 125 through the search against the inclusion and exclusion criteria. The full text of all
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7 126 eligible studies were then retrieved. Any disagreement were resolved by a third
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10 127 reviewer. Excluded studies and the reasons for exclusion were recorded.

11 128 **Data extraction**

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14 129 Customised data information was extracted independently by two investigators. The
15
16 130 following information was collected for each study: (1) the name of the first author; (2)
17
18 131 the location of the investigation area; (3) the year in which the investigation occurred;
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20 132 (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6)
21
22 133 the prevalence rates obtained for males, females, and overall; (7) the method used to
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24 134 sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.

25 135 **Risk of bias (quality) assessment**

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29 136 Four key criteria^{18, 19} were used by two independent investigators (Yi Liu and Danhui
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31 137 Li) to estimate study quality: (1) the sampling scheme (random or consecutive); (2)
32
33 138 whether the study included an adequate description of the characteristics of the study
34
35 139 population; (3) whether a clear definition of the prevalence rate was provided; and (4)
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37 140 whether the response rate exceeded 75%. The scoring rule used was the following, for
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39 141 each quality item, “clear or adequate” was scored as 1 point, whereas “no” was scored
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41 142 as 0 points. The study was considered to be of adequate quality if the quality score
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43 143 was greater than or equal to 3. The two reviewers carefully assessed the included
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45 144 studies independently and agreed on the final grading. An additional reviewer was
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47 145 consulted should there be any uncertainty or disagreement.

48 146 **Ethics and dissemination**

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52 147 Since primary data was not collected, formal ethical approval was not required. The
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54 148 results will be disseminated through peer-reviewed publications, conference
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3 149 presentations and the media.
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5 150 **Statistical analysis**
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7 151 The statistical analyses were performed using Comprehensive Meta-Analysis software
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9 152 version 2.0 (Biostat, Englewood Cliffs, NJ, USA; <http://www.meta-analysis.com>). We
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11 153 calculated the pooled prevalence estimates as proportions and 95% CIs for the
12
13 154 subgroup categories weighted by the sample sizes of the individual studies and then
14
15 155 pooled these data to derive an overall proportion and its associated 95% CI. The
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17 156 heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic.
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19 157 Meanwhile, I^2 metrics were calculated to quantify heterogeneity. A random-effects
20
21 158 model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects
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23 159 model was applied. All studies were classified into one of two groups (North versus
24
25 160 South) according to the geographical regions in which the studies were conducted.
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27 161 Similarly, the studies were classified into three groups based upon the age of the
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29 162 participants in the samples, overall (no limits of age), undergraduate (18-23 years old),
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31 163 and primary and secondary students ("p and s", 7-17 years old). Subjects were also
32
33 164 classified as male and female. The associations of age, gender, and region with the
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35 165 prevalence of acne were evaluated using a logistic meta-regression model. The
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37 166 associations between age, gender, region and risk of acne were expressed as ORs and
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39 167 95% CIs. A value of $p < 0.05$ was considered statistically significant.
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45 168 **Analysis of the publication bias**
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47 169 To examine the authenticity of data, the Egger test and Funnel plots were produced
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49 170 using the Comprehensive Meta-Analysis software version 2.0. No publication bias
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51 171 exists if the studies arranged symmetrically around the central line with a p value of >
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53 172 0.05.
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56 173 **Results**
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174 **Characteristics of the studies**

175 Using the initial search strategy, 166 studies were identified. 141 studies were
176 subsequently excluded (Figure 1). A total of 25 studies^{10-12,20-41} involving 83,008
177 Chinese individuals were included in this meta-analysis. Detailed characteristics of
178 each included study are presented in Table 1. The overall quality of all included
179 studies was found to be adequate (Table 2).

180 **The overall prevalence rates of acne in mainland China**

181 A total of 25 studies involving 83,008 Chinese people were included in this
182 meta-analysis. However, there was significant heterogeneity in this meta-analysis
183 ($I^2=99.797\%$, $Q=11823.369$, $P<0.001$). Thus, a random-effects model was selected for
184 the analysis. The overall pooled prevalence of acne was 39.2% (95% CI=0.310-0.479;
185 Figure 2).

186 **The prevalence rates of acne in mainland China by gender**

187 A total of 24 studies involving 40,712 males and 41,907 females were included in this
188 subgroup meta-analysis. However, there was significant heterogeneity among both the
189 males ($I^2=99.582\%$, $Q=5508.959$, $P<0.001$) and females ($I^2=99.614\%$, $Q=5957.125$,
190 $P<0.001$) in this meta-analysis. Thus, a random-effects model was selected for the
191 analysis. Males (39.7%, 95% CI=0.317-0.482) exhibited a higher prevalence of acne
192 than females (35.7%, 95% CI=0.274-0.451, $Z=3.903$, $p<0.001$) in the subgroup
193 analysis (Figure 3).

194 **The prevalence rates of acne in mainland China by region**

195 A total of 24 studies involving 65,663 Chinese were included in this subgroup
196 meta-analysis. 10 of these studies were conducted in Northern China (19,377
197 Chinese), and 14 studies were conducted in Southern China (46,286 Chinese).
198 However, significant heterogeneity was found in both the North ($I^2=99.573\%$,

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3 199 $Q=2109.204$, $P<0.001$) and the South ($I^2=99.689\%$, $Q=4176.791$, $P<0.001$) subgroups
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5 200 in this meta-analysis. Thus, a random-effects model was selected for the analysis. The
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7 201 South (46.3%, 95% CI=0.374-0.555) had a higher prevalence of acne than the North
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10 202 (34.2%, 95% CI=0.242-0.458, $Z=2.498$, $p=0.012$) in the subgroup analysis (Figure 4).

203 **The prevalence rates of acne in mainland China by age**

14 204 A total of 25 studies, consisting of 4 studies that examined the overall population, 10
15
16 205 p and s studies, and 11 undergraduate studies, were included in this subgroup
17
18 206 meta-analysis. However, significant heterogeneity was found overall ($I^2=99.534\%$,
19
20 207 $Q=643.149$, $P<0.001$), for the p and s subgroup ($I^2=98.860\%$, $Q=789.719$, $P<0.001$),
21
22 208 and for the undergraduates ($I^2=99.130\%$, $Q=1149.658$, $P<0.001$) in this meta-analysis.
23
24 209 Thus, a random-effects model was selected for the analysis. The prevalence of acne
25
26 210 over all ages was 10.2% (95% CI=0.059-0.171). The p and s students (50.2%, 95%
27
28 211 CI=0.451-0.554) had a higher prevalence of acne than did the undergraduates (44.5%,
29
30 212 95% CI=0.358-0.534, $Z=2.411$, $p=0.016$) in the subgroup analysis (Figure 5).

34 213 **Logistic meta-regression analysis of the associations between age, gender, and** 35 36 214 **region and the prevalence of acne**

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38 215 The associations between acne and the predictors age, gender, and region were
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40 216 statistically significant (Table 3) as measured by the corresponding ORs and their
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42 217 associated 95% CIs. The OR of acne prevalence was 1.217 (95% CI=0.109-14.681,
43
44 218 $p=0.024$) between male and female subgroups. Suggesting that Chinese males might
45
46 219 be more susceptible to acne than females. The OR between Southern China and
47
48 220 Northern China were 1.184 (95% CI=0.002-3.833, $p=0.028$) for acne. The
49
50 221 geographical factors of Southern China might be a risk factor for acne. The OR
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52 222 between p and s students and undergraduate were 3.127 (95% CI=0.001-3.838,
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54 223 $p=0.012$) for acne, therefore age might have a vital role in the development of acne.
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224 Analysis of the publication bias

225 There were no obvious asymmetries in the Funnel plots and the p value exceeded 0.05
226 for the following groups: the overall pooled studies ($t=0.030$, $p=0.976$, 95%
227 $CI=-0.215\sim 0.222$) (Supplementary Figure 1), male subgroup ($t=0.346$, $p=0.733$, 95%
228 $CI=-0.185\sim 0.132$) (Supplementary Figure 2), female subgroup ($t=0.143$, $p=0.887$,
229 95% $CI=-0.164\sim 0.188$) (Supplementary Figure 3), subgroup of all age layers ($t=0.501$,
230 $p=0.666$, 95% $CI=-0.831\sim 0.658$) (Supplementary Figure 4), subgroup of p and s
231 students ($t=0.580$, $p=0.578$, 95% $CI=-0.246\sim 0.147$) (Supplementary Figure 5),
232 subgroup of undergraduates ($t=1.061$, $p=0.316$, 95% $CI=-0.121\sim 0.335$)
233 (Supplementary Figure 6) and Southern China subgroup ($t=0.441$, $p=0.667$, 95%
234 $CI=-0.194\sim 0.293$) (Supplementary Figure 7). Only the studies of the Northern China
235 subgroup had publication bias ($t=3.369$, $p=0.01$, 95% $CI=-0.520\sim -0.974$)
236 (Supplementary Figure 8).

237 Discussion

238 This meta-analysis, based on 83,008 subjects, derived from 25 studies, covering 12
239 provinces and municipalities in China, enables us to assess reliable prevalence rates of
240 acne at the national level. Our results showed that the overall pooled prevalence of
241 acne was 39.2%. Other studies have reported a range of acne prevalence from
242 different countries, such as 3.9% in the German population aged between 16 and 70
243 years⁹ and 61.5% in the Portugal population between the ages of 20 to 60 years old⁴².
244 The differences in age range, ethnic background, regions and pollution might explain
245 the difference in the incidence of acne. Skin is the outermost barrier and various air
246 pollutants such as oxides, particulate matter, ultraviolet radiation, polycyclic aromatic
247 hydrocarbons and the ozone can all affect the skin. Puri⁴³ reported that air pollutants
248 can cause damage to the skin by inducing oxidative stress, and prolonged or repetitive

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3 249 exposure to high levels of these pollutants may have profound negative effects on the
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5 250 skin. The various degrees of air pollution in different countries over the years has had
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7 251 different effects on the human skin. Males (39.7%) exhibited a higher prevalence of
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10 252 acne than females (35.7%, $Z=3.903$, $p<0.001$) in the subgroup analysis of gender.
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12 253 Meanwhile, the South (46.3%) had a higher prevalence of acne than the North (34.2%,
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14 254 $Z=2.498$, $p=0.012$) in the regional subgroup analysis. Moreover, the primary and
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16 255 secondary students (50.2%) had a higher prevalence of acne than undergraduates
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18 256 (44.5%, $Z=2.411$, $p=0.016$) in the subgroup analysis of age. There was heterogeneity
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20 257 among the 25 included studies in this meta-analysis ($I^2=99.797\%$, $Q=11823.369$,
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22 258 $P<0.001$) and the following reasons might explain the phenomenon. (1) Differences
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24 259 existed in the design of studies, such as non-unified age range, collection of data and
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26 260 research objects, explaining the deviation of the prevalence of acne. (2) Evidence for
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28 261 seasonality was observed, with lower lipid production and reduced barrier function
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30 262 during the winter⁴⁴. A correlation between the incidence of acne and skin surface
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32 263 lipid^{34,45} has been observed before, thus the included articles may have been
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34 264 conducted in different seasons^{26,29,35,40}, which resulted in different incidences of acne.
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36 265 The age-related subgroup prevalence rates were also calculated in this study. The
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38 266 prevalence of primary and secondary students was 50.2%, which was consistent with
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40 267 the results of Wei *et al*⁴⁶ (51.3%). This result was similar to those reported by
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42 268 Karciauskiene *et al*'s⁴⁷ results among schoolchildren aged 7-19 years, which was
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44 269 55.4% in Lithuania. However, these results are lower than a study conducted in Brazil,
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46 270 where a prevalence rate of 96% was found in adolescents aged 10-17⁴⁸. This
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48 271 difference may also be attributed to the different age range, regions and ethnic
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50 272 backgrounds of the study subjects. Our results suggest that primary and secondary
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52 273 students (50.2%) had a higher prevalence of acne than undergraduates (44.5%,
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3 274 $Z=2.411$, $p=0.016$), which is in agreement with the findings of Shen *et al*¹⁰. Moreover,
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5 275 using Logistic meta-regression analysis, we found that the OR between primary and
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7 276 secondary school students and undergraduate were 3.127 (95% CI=0.001-3.838,
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10 277 $p=0.012$) for acne. Vilar *et al*⁴⁹ and Yentzer *et al*⁵⁰ also reported that primary and
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12 278 secondary students (89.3%) had a higher prevalence of acne than the undergraduate
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14 279 subjects (61.9%) in the US population. Choi *et al*⁵¹ reported that in patients with late
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16 280 onset acne, the number of comedones and total number of acne lesions and the
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18 281 proportions of comedones were significantly less than in patients with early onset
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21 282 acne. The age of onset had a negative correlation with the number of comedones and
22
23 283 the proportion of comedones in the T-zone and the entire face, namely, acne. The
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25 284 clinical differences in acne based on age appeared to be mainly a result of age of onset
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27 285 and not from the progression of the acne^{52,53}.

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30 286 In the present study, males (39.7%) had a 1.112 times higher prevalence rate of acne
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32 287 than did females (35.7%, $Z=3.903$, $p<0.001$). This result is in agreement with the
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34 288 findings of Schafer *et al*⁵⁴ that acne was more present in men (29.9%) than women
35
36 289 (23.7%) in the city of Hamburg (Germany). Adityan and Thappa⁵⁵ showed that the
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38 290 male to female ratio was 1.25:1 in South India. In Auckland, Lello *et al*⁵⁶ reported that
39
40 291 males (91%) were more susceptible to acne compared with females (79%) and severe
41
42 292 and moderately severe acne was significantly more common in males (OR = 2.6, 95%
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44 293 CI: 1.73 < OR < 3.9) as well. Furthermore, moderate and severe acne (27.1% and
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46 294 0.41% of patients, respectively) were significantly ($P < 0.01$) were common in males
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48 295 (36.2% and 0.9%, respectively) than females (21.2% and 0.2%, respectively) in
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50 296 Egypt⁵⁷. This indicated that males had a higher risk of occurrence and development of
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52 297 acne than females. (1) This difference might be related to lifestyle. It is well known to
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54 298 us that males accounted for a larger proportion than females in drinking and
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3 299 smoking⁵⁸⁻⁶⁰. (2) Males also tend to pay less attention to skin health than females in
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5 300 China. Inappropriate personal hygiene (use of abrasive soaps, harsh detergents, and
6
7 301 excessive scrubbing) can contribute to the pathological process of acne^{61,62}. (3)
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9 302 Androgen levels elevation are greater in males than females during adolescence and
10
11 303 increased androgen levels are a risk factor of acne⁶³. The interplay of growth hormone
12
13 304 (GH), insulin, and insulin-like growth factor-1 (IGF-1) signaling during puberty may
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15 305 also have a causal role in the pathogenesis of acne by influencing adrenal and gonadal
16
17 306 androgen metabolism⁶⁴. Adult women in different age categories have a lower
18
19 307 prevalence of acne than adolescence. But recent research has shown that acne is
20
21 308 affecting an increasing number of adults, particularly females. Adult female acne
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23 309 should be considered as a specific acne subtype distinct from adolescent acne and a
24
25 310 review on the topical and oral treatment options suitable for treating acne in adult
26
27 311 females⁵ are expected in the future.
28
29 312 The prevalence rates of acne was also different in different regions. The prevalence of
30
31 313 acne among individuals in Southern China (46.3%) was higher than Northern China
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33 314 (34.2%, $Z=2.498$, $p=0.012$). This is consistent with Subramaniyan⁶⁵, who considered
34
35 315 that the prevalence of acne was different between the East of the Indian mainland and
36
37 316 its Southern part. This difference may be due to several factors. (1) Ultraviolet
38
39 317 radiation. Enhanced sebum excretion, colonization of the pilosebaceous duct with
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41 318 *Propionibacterium acnes* and resultant inflammation were thought to play a critical
42
43 319 role in the pathogenesis of acne⁶⁶. The function of the sebaceous gland as an
44
45 320 endocrine skin organ, which is mainly composed of sebocytes, has an important role
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47 321 in the occurrence and development of acne⁶⁷. Excessive sebum production and its
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49 322 abnormal lipid ingredients from the sebaceous gland contributed to the formation of
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51 323 primary acne lesions⁶⁸. Sebocytes also produce inflammatory cytokines and they have
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3 324 a vital effect on the formation and aggravation of acne lesions⁶⁹. Southern China has
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5 325 longer hours of sunshine than Northern China. Solar radiation contains ultraviolet
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7 326 radiation, which is an external environmental factor causing many skin diseases.
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9 327 Ultraviolet radiation can affect the glands through direct or indirect pathways⁷⁰. It is
10
11 328 widely accepted that sebaceous gland hyperplasia and increased sebum secretion
12
13 329 occur after irradiation of ultraviolet (UV)-B. The expression of inflammatory
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15 330 cytokines, especially IL-1b, IL-6, IL-8 and TNF-a are significantly increased in
16
17 331 cultured sebocytes after treatment with UV-B⁷¹. Meanwhile, correlational research
18
19 332 showed that time-distinct gene induction of TNF-a, IL-1b and matrilysin in cultured
20
21 333 HaCaT cells may be involved in UV-induced cellular responses⁷². Although, mRNA
22
23 334 levels do not always correspond to protein level *in vivo*, mRNA levels of
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25 335 inflammatory cytokines such as IL-1, IL-6 and TNF-a are also identified to be
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27 336 increased through studies using whole mouse skin and human skin exposed to
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29 337 UV-B^{73,74}. Furthermore, it has been known that epithelial keratinocytes contain a
30
31 338 functional PPAR-c system and this system is a target for UV-B radiation⁷⁵. The
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33 339 synthesis of free fatty acids by PPAR-c stimulates the production of pro-inflammatory
34
35 340 cytokines, such as IL-1b and TNF-a, in sebaceous glands⁷¹. (2) Humidity. There is
36
37 341 greater humidity in Southern parts of China than Northern China. Subramaniyan⁶⁵
38
39 342 reported that the prevalence of dermatoses, including acne, are much higher in humid
40
41 343 regions than arid regions. (3) Diet. Chili is a popular food for Southern residents
42
43 344 compared to the Northern residents, and is consumed in greater quantities than
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45 345 Northern residents. Spicy food has been identified as a risk factor for the development
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47 346 of acne³³. In simple terms, both environmental factors (climate and humidity) and diet
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49 347 may lead to the different prevalence rates of acne between Northern and Southern
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51 348 China.
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3 349 This systematic review is likely limited by the different diagnostic criteria for acne
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5 350 among the included studies. Due to the enormous number of Chinese people, it was
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7 351 difficult to implement an unitive diagnostic criteria. In addition, the age of the survey
8
9 352 population could not be subdivided, which made further detailed analysis of age
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11 353 groups impossible. More research are needed on the national prevalence of acne in
12
13 354 order to provide better baseline data and to monitor the effect of acne over time in
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15 355 China.

16 17 18 19 356 **Conclusion**

20
21 357 The overall pooled prevalence rate of acne was 39.2% in mainland China. Primary
22
23 358 and secondary students exhibited higher prevalence rates than undergraduate students.
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25 359 Due to differences in lifestyle, skincare routines and androgen levels, males showed
26
27 360 higher prevalence rates of acne than females. Possible etiological factors for the
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29 361 difference in prevalence rates of acne between Southern China and Northern China
30
31 362 may be due to the varying ultraviolet radiation, humidity and dietary habits between
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33 363 these two regions. The evidence generated from this paper may prove beneficial in
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35 364 terms of understanding the age and regional distribution and prevalence rates of acne
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37 365 amongst the Chinese population, which may help in identifying target prevention and
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39 366 treatment strategies for this cohort of patients.

40 367 **Footnotes**

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43 368 **Contributors** Shengjie Li and Danhui Li conceived the study, participated in drafting
44
45 369 the final manuscript. Qiang Chen and Yi Liu analyzed the data and completed the
46
47 370 final draft of the manuscript. TingTing Liu and Wenhui Tang prepared all the figures.

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49 371 All authors reviewed the manuscript.

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53
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56 374 **Competing interests** None declared.
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3 375 **Provenance and peer review** Not commissioned; externally peer reviewed.

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5 376 **Data sharing statement** No additional data are available.

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8 377 **References**

9
10 378 1. Ziv A, Boulet JR, Slap GB. Utilization of physician offices by adolescents in the
11 United States. *Pediatrics* 1999;104:35-42.

12
13 380 2. Tan JKL, Bhate K. A global perspective on the epidemiology of acne. *Br J*
14 *Dermatol* 2015;172:3–12.

15
16 381
17 382 3. Lynn DD, Umari T, Dunnick CA, *et al.* The epidemiology of acne vulgaris in late
18 adolescence. *Adolesc Health Med Ther* 2016; 7:13-25.

19
20 384 4. Su P, Chen Wee AD, Lee SH, *et al.* Beliefs, perceptions and psychosocial impact
21 of acne amongst Singaporean students in tertiary institutions. *J Dtsch Dermatol*
22 *Ges* 2015; 13: 227–33.

23
24 385
25 386
26 387 5. B. Dreno. Treatment of adult female acne, a new challenge. *J Eur Acad Dermatol*
27 *Venereol* 2015;29:14-9.

28
29 388
30 389 6. Hogewoning AA, Koelemiji I, Amoah AS, *et al.* Prevalence and risk factors of
31 inflammatory acne vulgaris in rural and urban Ghanaian school children. *Br J*
32 *Dermatol* 2009; 161: 470–92.

33
34 392 7. Cordain L, Lindeberg S, Hurtado M, *et al.* Acne vulgaris: a disease of Western
35 civilization. *Arch Dermatol* 2002; 138: 1584–90.

36
37 394 8. Gibbs S. Skin disease and socioeconomic conditions in rural Africa: Tanzania. *Int J*
38 *Dermatol* 1996; 35: 633–39.

39
40 396 9. Augustin M, Herberger K, Hintzen S, *et al.* Prevalence of skin lesions and need for
41 treatment in a cohort of 90880 workers. *Br J Dermatol* 2011; 165: 865–73.

42
43 398 10. Shen Y, Wang T, Zhou C, *et al.* Prevalence of acne vulgaris in Chinese adolescents
44 and adults, a community-based study of 17,345 subjects in six cities. *Acta Derm*
45 *Venereol* 2012;92: 40-4.

46
47 400
48 401 11. Law MPM, Chuh AAT, Lee A, *et al.* Acne prevalence and beyond, acne disability
49 and its predictive factors among Chinese late adolescents in Hong Kong.
50 *Clin Exp Dermatol* 2010;35:16-21.

51
52 403
53 404 12. Wu T, Mei S, Zhang J, *et al.* Prevalence and risk factors of facial acne vulgaris
54 among Chinese adolescents. *International journal of adolescent medicine and health*
55 405 2007;19:407-12.
56
57
58
59
60

- 1
2
3 407 13. Williams HC, Dellavalle RP, Garner S. Acne vulgaris. *Lancet* 2012;379(9813):
4 408 361-72.
5
6 409 14. McCarty M. Evaluation and Management of Refractory Acne Vulgaris in
7
8 410 Adolescent and Adult Men. *Dermatol Clin* 2016;34(2):203-6.
9
10 411 15. Rania Abdel Hay, Khalid Shalaby, Hesham Zaher, *et al.* Interventions for acne
11 412 scars. *Cochrane Database Syst Rev* 2016;4:CD011946.
12
13 413 16. Lauerma FT, Almeida HL Jr, Duquia RP, *et al.* Acne scars in 18-year-old male
14 414 adolescents: a population-based study of prevalence and associated factors. *An Bras*
15 415 *Dermatol* 2016; 91(3): 291-5.
16
17 416 17. Mulder MM, Sigurdsson V, van Zuuren EJ, *et al.* Psychosocial impact of acne
18 417 vulgaris. evaluation of the relation between a change in clinical acne severity and
19 418 psychosocial state. *Dermatology* 2001;203:124-30.
20
21 419 18. Cheng JW, Cheng SW, Ma XY, *et al.* The prevalence of primary glaucoma in
22 420 mainland China, a systematic review and meta-analysis. *J Glaucoma* 2013;22: 301-6.
23
24 421 19. Say L, Donner A, Gulmezoglu AM, *et al.* The prevalence of stillbirths, a
25 422 systematic review. *Reprod Health* 2006;3:1.
26
27 423 20. Jian Zhang. Prevalence of acne in college students and the analysis of
28 424 psychological condition of the patient. *Journal of Yichun College* 2011;33(4):89-90.
29
30 425 21. Ying C, Jing Wu, Liu Y, *et al.* The prevalence and related factors of acne in
31 426 Guangzhou college Students. *Southern China Journal of Dermato-Venereology*
32 427 2009;16(2):131-2 .
33
34 428 22. Li M, Candong L, Donghua C. Epidemiology investigation of acne in adolescents
35 429 of different ages. *Journal of Gansu College of Traditional Chinese Medicine*
36 430 2008;25(1): 27-9.
37
38 431 23. Zhenxiu S. Investigation of the incidence of acne in College students. *China*
39 432 *Journal of Leprosy and Skin Diseases* 2005;21(12): 994-5.
40
41 433 24. Jieying F, Ruiqiang F. Epidemiology of acne of 1561 middle school students in
42 434 Guangzhou. *Southern China Journal of Dermato-Venereology* 2008;15(1):49-51.
43
44 435 25. Luanduan C, Dinan Z, Yang L, *et al.* Epidemiological Investigations of 2015
45 436 Secondary Students of Acne. *China Modern Doctor* 2011;49(27):6-7.
46
47 437 26. Tieqiang Wu, Shuqing Mei, Jinxin Zhang, *et al.* Prevalence and Risk Factors of
48 438 acne Vulgaris in Adolescents 10-18 Years old. *International Journal of Dermatology*
49 439 *and Venereology* 2006;32(4): 201-4.
50
51 440 27. Feng Zhang, Jianbo Liu, Xuexiang Lin, *et al.* Analysis of Prevalence and
52
53
54
55
56
57
58
59
60

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2
3 441 Awareness of Acne of College Students in Dongguan city. *Medicine and Society*
4 442 2014;27(5):68-70.
- 5
6 443 28. Zhaorui Liu, Yueqin Huang, Huaming Zhang, *et al.* Prevalence of the knowledge
7 444 and attitude behavior on acne of students grade 2 in senior high school in Beijing.
8 445 *Chinese Journal of Dermatology* 2003;36(9):519-20.
- 9
10 446 29. Rui F, Furen Z. Epidemiological investigation of acne vulgaris in Jining area
11 447 junior high school students. *China Journal of Leprosy and Skin Diseases*
12 448 2014;30(4):214-5.
- 13
14 449 30. Jianping C, Dapeng D, Yun S. Prevalence of Acne among primary and middle
15 450 school students in urban and rural area Of Xingtai city. *Chinese Journal of School*
16 451 *Health* 2008;29(11):995-6.
- 17
18 452 31. Bin D, Huiming Zeng, Yongjiang D, *et al.* Survey of acne vulgaris in college
19 453 students in Hainan Province and logistic analysis of risk factors. *China Tropical*
20 454 *Medicine* 2008;8(10):1867-8.
- 21
22 455 32. AiLi Gao, Hong Zhang, Hanxiang Zeng, *et al.* The prevalence and risk factors
23 456 analysis of adolescent acne in Guangzhou city Tianhe district. *China Journal of*
24 457 *Leprosy and Skin Diseases* 2007;23(12):1052-3.
- 25
26 458 33. Bing L, Cangzhen H, Yanjie W. Investigation and analysis of risk factors for the
27 459 occurrence of acne among middle school students in Weinan City. *China Health Care*
28 460 *and Nutrition* 2012;22(8):2444-5.
- 29
30 461 34. Shengjie L, Youcan Zhang, Gaomei Zheng, *et al.* Investigation and Analysis of
31 462 Sick Status and Influencing Factors on the Undergraduates Facial Acne Vulgaris in
32 463 Taian. *The Chinese Journal of Dermatovenereology* 2012;26(7):625-7.
- 33
34 464 35. Lijuan Liu, Shiheng Song, Li Cai, *et al.* Prevalence and awareness of risk factors
35 465 of acne among college students in Shijiazhuang City. *The Chinese Journal of*
36 466 *Dermatovenereology* 2014;28(2):171-2.
- 37
38 467 36. Qing Liu, Xin Gao, Xinhui Liu, *et al.* An epidemiological survey on acne in Zibo
39 468 district, Shandong Province. *Journal of Practical Dermatology* 2013;16(3):149-51.
- 40
41 469 37. Guangde Pei, Jinfeng Du, Ying Huang, *et al.* An epidemiological survey on acne
42 470 in Jiaozuo district of Henan Province. *The Chinese Journal of Dermatovenereology*
43 471 2010;24(12):1129-31.
- 44
45 472 38. Aihua Z, Qingjuan G, Wanfa R, *et al.* Investigation on incidence rate of acne in
46 473 Youth. *Hebei Medicine* 1996;2(1):78-9.
- 47
48 474 39. Hong Z, Xiaobing H, Lichun F. The situation and strategies of prevention about

- 1
2
3 475 acne of the Jiangmen middle-school students. *Journal of Practical Dermatology*
4 476 2009;2(1):14-6.
5
6 477 40. Zhiyong Z, Ziyin, L, Hui L, *et al.* Investigation of acne about related factors of
7
8 478 college students in Handan city. *Journal of Hainan Medical University*
9
10 479 2011;17(12):1718-20.
11
12 480 41. Renli Wang, Ayi Ma, Xuehua Zhang, *et al.* A survey about the prevalence of acne
13 481 in Liangshan district of Sichuan Province. *Chinese Journal of Dermatology*
14 482 2010;43(12):875-77.
15
16 483 42. Semedo D, Ladeiro F, Ruivo M, *et al.* Adult Acne: Prevalence and Portrayal in
17 484 Primary Healthcare Patients, in the Greater Porto Area, Portugal. *Acta Med*
18 485 *Port* 2016;29(9):507-13.
19
20
21 486 43. Puri P, Nandar SK, Kathuria S, *et al.* Effects of air pollution on the skin: A review.
22
23 487 *Indian J Dermatol Venereol Leprol* 2017;7:1-9.
24
25 488 44. Karen Meyer BS, Apostolos Pappas PhD, Kelly Dunn BS, *et al.* Evaluation of
26 489 Seasonal Changes in Facial Skin With and Without Acne. *J Drugs Dermatol*
27 490 2015;14:593-601.
28
29
30 491 45. Ikaraoha CI, Taylor GO, Anetor JI, *et al.* Pattern of skin surface lipids in some
31 492 south-western Nigerians with acne vulgaris. *West Afr J Med* 2004;23(1):65-8.
32
33 493 46. B Wei, Y Pang, H Zhu, *et al.* The epidemiology of adolescent acne in North East
34 494 China. *J Eur Acad Dermatol Venereol* 2010;24:953-7.
35
36 495 47. Karciauskiene J, Valiukeviciene S, Stang A, *et al.* Beliefs, perceptions, and
37 496 treatment modalities of acne among schoolchildren in Lithuania: a cross-sectional
38 497 study. *Int J Dermatol* 2015;54(3):e70-8.
39
40 498 48. Bagatin E, Timpano DL, Guadanhim LR, *et al.* Acne vulgaris: prevalence and
41 499 clinical forms in adolescents from Sao Paulo, Brazil. *An Bras*
42 500 *Dermatol* 2014;389(3):428-35.
43
44 501 49. Vilar GN, Santos LA, Sobral Filho JF. Quality of life, self-esteem and
45 502 psychosocial factors in adolescents with acne vulgaris. *An Bras Dermatol*
46 503 2015;90:622-9.
47
48 504 50. Yentzer BA, Hick J, Reese EL, *et al.* Acne vulgaris in the United States, a
49 505 descriptive epidemiology. *Cutis* 2010; 86:94-9.
50
51 506 51. CW Choi, DH Lee, HS Kim, *et al.* The clinical features of late onset acne
52 507 compared with early onset acne in women. *Journal of the European Academy of*

- 1
2
3 508 *Dermatology and Venereology* 2011;25:454-61.
- 4 509 52. Williams C, Layton AM. Persistent acne in women, implications for the patient
5 and for therapy. *Am J Clin Dermatol* 2006;7:281-90.
- 6
7
8 511 53. Marks R. Acne and its management beyond the age of 35 years. *Am J Clin*
9
10 512 *Dermatol* 2004; 5:459-62.
- 11 513 54. Schafer T, Nienhaus A, Vieluf D, *et al.* Epidemiology of acne in the general
12 population, the risk of smoking. *British Journal Of Dermatology* 2001;145:100-4.
- 13 514
14 515 55. Adityan B, Thappa DM. Profile of acne vulgaris--a hospital-based study from
15 South India. *Indian J Dermatol Venereol Leprol* 2009;75(3):272-8.
- 16 516
17 517 56. Lello J, Pearl A, Arroll B, *et al.* Prevalence of acne vulgaris in Auckland senior
18 high school students. *N Z Med J* 1995;108(1004):287-9.
- 19 518
20
21 519 57. EA El-Khateeb, NH Khafagy, KM Abd Elaziz, *et al.* Acne vulgaris: prevalence,
22 beliefs, patients' attitudes, severity and impact on quality of life in Egypt. *Public*
23 520 *Health* 2014;128(6):576-8.
- 24 521
25 522 58. Kegler MC, Hua X, Solomon M, *et al.* Factors associated with support for
26 smoke-free policies among government workers in Six Chinese cities, a
27 cross-sectional study. *Bmc Public Health* 2014;14: 1130.
- 28 523
29 524
30 525 59. Yang MJ. The Chinese drinking problem, a review of the literature and its implicat
31 ion in a cross-cultural study. *Kaohsiung J Med Sci* 2002;18:543-50.
- 32 526
33 527 60. Yang X, Lu X, Wang L, *et al.* Common variants at 12q24 are associated with
34 drinking behavior in Han Chinese. *Am J Clin Nutr* 2013;97:545-51.
- 35 528
36 529 61. Kilkenny M, Merlin K, Plunkett A, *et al.* The prevalence of common skin
37 conditions in Australian school children, III, Acne vulgaris. *Br J Dermatol*
38 530 1998;139:840-5.
- 39 531
40 532 62. Andrew FA, Lamb A. Concomitant therapy for acne in patients with skin of color,
41 a case-based approach. *Dermatol Nurs* 2009;21:1.
- 42 533
43 534 63. Henze C, Hinney B, Wuttke W. Incidence of increased androgen levels in patients
44 suffering from acne. *Dermatology* 1998;196:53-4.
- 45 535
46 536 64. Kumari R, Thappa DM. Role of insulin resistance and diet in acne. *Indian J*
47 *Dermatol Venereol Leprol* 2013;79(3):291-9.
- 48 537
49 538 65. Subramaniyan R. Pattern of Dermatoses Among Nicobarese in a Community
50 Health Camp at Nancowry, Andaman and Nicobar Islands. *Indian J Dermatol*
51 539 2016;61:187-9.
- 52 540
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2
3 541 66. Cunliffe WJ. The sebaceous gland and acne-40 years on. *Dermatology* 1998;196:
4 542 9-15.
5
6 543 67. Gollnick H, Dreno B. Pathophysiology and management of acne. *Journal Of the*
7
8 544 *European Academy Of Dermatology And Venereology* 2015;29:1-2.
9
10 545 68.Zouboulis CC. Acne and sebaceous gland function. *Clin Dermatol* 2004;22:360-6.
11 546 69. Zouboulis CC, Adjaye J, Akamatsu H, *et al.* Human skin stem cells and the ageing
12 547 process. *Exp Gerontol* 2008;43:986-97.
13
14 548 70. Roberts JE. Light and immunomodulation. *Ann N Y Acad Sci* 2000;917:435-45.
15
16 549 71. Weon Ju LEE, Kyung Hea PARK, Mi Yeung SOHN, *et al.* Ultraviolet B irradiation
17 550 increases the expression of inflammatory cytokines in cultured sebocytes. *Journal of*
18 551 *Dermatology* 2013;40:993-7.
19
20 552 72. Skiba B, Neill B, Piva TJ. Gene expression profiles of TNF-alpha, TACE, furin,
21 553 IL-1beta and matrilysin in UVA- and UVB-irradiated HaCat cells. *Photodermatol*
22 554 *Photoimmunol Photomed* 2005;21:173-82.
23
24 555 73. Murphy GM, Dowd PM, Hudspith BN, *et al.* Local increase in interleukin-1-like
25 556 activity following UVB irradiation of human skin in vivo. *Photodermatol*
26 557 1989;6:268-74.
27
28 558 74. Scordi IA, Vincek V. Timecourse study of UVB-induced cytokine induction in
29 559 whole mouse skin. *Photodermatol Photoimmunol Photomed* 2000;16:67-73.
30
31 560 75. Zhang Q, Southall MD, Mezsick SMQ, *et al.* Epidermal peroxisome
32 561 proliferator-activated receptor gamma as a target for ultraviolet B radiation. *J Biol*
33 562 *Chem* 2005;280:73-9.
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571 Figure legends

572 Figure 1 Flow-chart illustrating the article search process

573 First, we obtained 166 records identified through database searching. No additional
574 records identified through other sources. Second, 89 records remained after
575 duplicates were removed. Third, 58 studies were excluded after records screening.
576 Then the remainder 31 studies were full-text articles assessed for eligibility and 6
577 studies were excluded. Finally 25 studies were included in the quantitative synthesis
578 (meta-analysis).

580 Figure 2 Forest plot of the overall prevalence rates of acne. CI=confidence 581 interval.

582 A total of 25 studies were included in this meta-analysis. Through analyzing in a
583 random-effects model, the overall pooled prevalence of acne was calculated as 39.2%
584 (95% CI=0.310-0.479) through analyzing in a random-effects model.

586 Figure 3 Forest plot of the prevalence rates of acne according to gender. 587 CI=confidence interval.

588 A total of 24 studies were included in this subgroup meta-analysis. Through analyzing
589 in a random-effects model, the prevalence rates of acne in males was 39.7% (95%
590 CI=0.317-0.482) and 35.7% (95% CI=0.274-0.451) in females. Males (39.7%)
591 exhibited a higher prevalence of acne than did females (35.7%) in the subgroup
592 analysis ($Z=3.903$, $p<0.001$).

594 Figure 4 Forest plot of the prevalence rates of acne according to region. 595 CI=confidence interval.

596 A total of 24 studies were included in this subgroup meta-analysis. 10 of these studies
597 were conducted in Northern China and 14 studies were conducted in Southern China.
598 Through analyzing in a random-effects model, the prevalence rates of acne in South
599 was 46.3% (95% CI=0.374-0.555) and 34.2% in North (95% CI=0.242-0.458). The
600 South (46.3%) had a higher prevalence of acne than the North (34.2%) in the
601 subgroup analysis ($Z=2.498$, $p=0.012$).

603 Figure 5 Forest plot of the prevalence rates of acne according to age. 604 CI=confidence interval. All=overall age. P and s=primary and secondary 605 students.

606 A total of 25 studies, consisting of 4 studies that examined the overall population, 10
607 p and s studies, and 11 undergraduate studies, were included in this subgroup
608 meta-analysis. Through analyzing in a random-effects model, the prevalence of acne
609 over all ages was 10.2% (95% CI=0.059-0.171). The prevalence of acne in the
610 primary and secondary students was 50.2% (95% CI=0.451-0.554) and 44.5% (95%
611 CI=0.358-0.534) in the undergraduates. The primary and secondary students (50.2%)
612 had a higher prevalence of acne than the undergraduates (44.5%) in the subgroup
613 analysis ($Z=2.411$, $p=0.016$).

615 Supplementary Figure 1 Funnel plots for the overall pooled studies

616 The studies arranged around the center line symmetrically, so there was no
617 publication bias.

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3 **Supplementary Figure 2 Funnel plots for the male subgroup**

4 A total of 24 studies involving 40,712 males were included in the male subgroup
5 meta-analysis. The 24 studies arrange around the center line symmetrically, so there
6 was no publication bia.
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9 **Supplementary Figure 3 Funnel plots for the female subgroup**

10 A total of 24 studies involving 41,907 females were included in the female subgroup
11 meta-analysis. The 24 studies arranged around the center line symmetrically, so there
12 was no publication bias.
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15 **Supplementary Figure 4 Funnel plots for the all-age-layer subgroup**

16 A total of 4 studies were included in the all-age-layer subgroup meta-analysis. The
17 studies arranged around the center line symmetrically, so there was no publication
18 bias.
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21 **Supplementary Figure 5 Funnel plots for the subgroup of primary and
22 secondary school students**

23 A total of 10 studies were included in the subgroup meta-analysis of primary and
24 secondary school students. The studies arranged around the center line symmetrically,
25 so there was no publication bias.
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28 **Supplementary Figure 6 Funnel plots for the subgroup of undergraduates**

29 A total of 11 studies were included in the subgroup meta-analysis of undergraduates.
30 The studies arranged around the center line symmetrically, so there was no
31 publication bias.
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34 **Supplementary Figure 7 Funnel plots for the subgroup of Southern China**

35 A total of 14 studies were included in the Southern subgroup meta-analysis. The
36 studies arranged around the center line symmetrically, so there was no publication
37 bias.
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40 **Supplementary Figure 8 Funnel plots for the subgroup of Northern China**

41 A total of 10 studies were included in the Northern subgroup meta-analysis. The
42 studies arranged around the center line nonsymmetrically, so there was publication
43 bias.
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659 **Tables**

660 Table1. Characteristics of the populations examined in studies reporting the
 661 prevalence of acne in mainland China

Name	Region	Year	Age range	Sample size	Prevalence (%)		
					Male % (n)	Female % (n)	Total (%)
Zhang feng	Dong guan	2013	undergraduate	669	40.37 (379)	34.48 (290)	37.82
Liu lijuan	Shi jiazhuang	2013	undergraduate	742	42.11 (418)	36.11 (324)	39.49
Liu qing	Zi bo	2013	12-49	1455	9.4 (504)	11.5 (951)	8.32
Li shengjie	Tai an	2010	17-24	1416	39.85 (532)	46.61 (884)	44.07
Zhang zhiyong	Han dan	2010	undergraduate	1582	59.71 (834)	50.00 (748)	55.12
Cai xinduan	Guang dong	2010	9-18	2015	49.90 (986)	59.86 (1029)	54.99
Zhangjian	Yi chun	2011	18-26	448	45.16 (217)	32.03 (231)	38.39
Wang renli	Si chuan	2008-2009	all	10,503	19.3 (4319)	16.9 (6184)	18.1
Pei guangde	He nan	2008	all	1547	8.80 (742)	7.86 (805)	8.39
Chen ying	Guang zhou	2008	undergraduate	2252	34.7 (1253)	38.4 (999)	36.4
Zhang hong	Jiang men	2006-2008	17-18	12,450	55.9 (7134)	46.02 (5136)	51.83
Deng bin	Hai nan	2005	16-23	3500	34.8 (1990)	32.4 (1510)	33.8
Cui jianping	Xing tai	2007	10-18	2891	43.14 (1370)	35.44 (1521)	39.1
Min li	Fu jian	2007	15-23	1484	69.5 (836)	63.6 (648)	66.9
Feng jieying	Guang zhou	2004-2005	11-19	1561	51.95 (743)	60.76 (818)	56.57
Gao aili	Guang zhou	2004	12-20	2552	34.2 (1151)	31.6 (1305)	32.8
Wu tieqiang	Zhu hai	2004	10-18	3200	54.9 (1790)	51.6 (1410)	53.5
Sun zhenxiu	Nan jing	2005	16-23	2100	37.91 (1000)	22 (1100)	30.33
Liu zhaorui	Bei jing	2003	16-17	4933	67.1 (2364)	57.3 (2569)	62.0
Zhang aihua	Tai an, He ze	1996	14-23	1510	38.24 (829)	23.06 (581)	20.99
Fu rui	Ji ning	2012	11-17	2560	45.40 (1343)	47.80 (1177)	46.51
Li bing	Shan xi	2012	12-17	741	55.8 (335)	49.2 (406)	52.2
Yiwei Shen	China	2012	all	17,345	10.4 (7858)	6.1 (9487)	8.1
Law MP	Hong Kong	2010	undergraduate	389	N/A	N/A	85.1
Wu TQ	Guang dong	2007	10-18	3163	51.3 (1785)	58.6 (1378)	53.5

662 (n)= the number of participants, N/A= not available.

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667 Table 2. Methodological quality of the studies reporting the prevalence of acne in
668 mainland China

Name	Sampling scheme	Population characteristics	Prevalence definition	Diagnostic criteria	Response rate %	Score
Zhang feng	Random stratified sample	adequate	clear	clear	95	4
Liu lijuan	Random stratified sample	adequate	clear	clear	N/A	3
Liu qing	Cluster sampling	adequate	clear	clear	48.5	3
Li shengjie	Random stratified sample	adequate	clear	clear	100	4
Zhang zhiyong	Cluster sampling	adequate	clear	clear	97.75	4
Cai xinduan	Random stratified sample	adequate	clear	clear	98.05	4
Zhangjian	Random stratified sample	adequate	clear	clear	N/A	3
Wang renli	Random stratified sample	adequate	clear	clear	N/A	3
Pei guangde	Random stratified sample	adequate	clear	clear	53.4	3
Chenyong	Random stratified sample	adequate	clear	clear	90.8	4
Zhang hong	Cross-sectional	adequate	clear	clear	N/A	3
Deng bin	Random stratified sample	adequate	clear	clear	N/A	3
Cui jianping	Random stratified sample	adequate	clear	clear	98.1	4
Min li	Random stratified sample	adequate	clear	clear	N/A	3
Feng jieying	Random stratified sample	adequate	clear	clear	98.24	4
Gao aili	Cross-sectional	adequate	clear	clear	96.2	4
Wu tieqiang	Cross-sectional	adequate	clear	clear	98.84	4
Sun zhenxiu	Random stratified sample	adequate	clear	clear	N/A	3
Liu zhaorui	Random stratified sample	adequate	clear	clear	N/A	3
Zhang aihua	Random stratified sample	adequate	clear	clear	N/A	3
Fu rui	Cross-sectional	adequate	clear	clear	99.06	4
Li bing	Random stratified sample	adequate	clear	clear	95.2	4
Yiwei Shen	Community-based study	adequate	clear	clear	86.84	4
Law MP	Cross-sectional	adequate	no	clear	99.3	4
Wu TQ	Cross-sectional	adequate	clear	clear	98.8	4

669 N/A= not available.

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676 Table 3. Adjusted odds ratios for acne obtained by logistic meta-regression analysis

Factor	Number of studies	OR (95% CI)	P-value
Age of range			
undergraduate	11	1.00	
primary and secondary school students	10	3.127 (0.001-3.838)	0.012
Gender			
female	24	1.00	
male	24	1.217 (0.109-14.681)	0.024
Location			
north	10	1.00	
south	14	1.184 (0.002-3.833)	0.028

677 OR= odds ratio. CI=confidence interval

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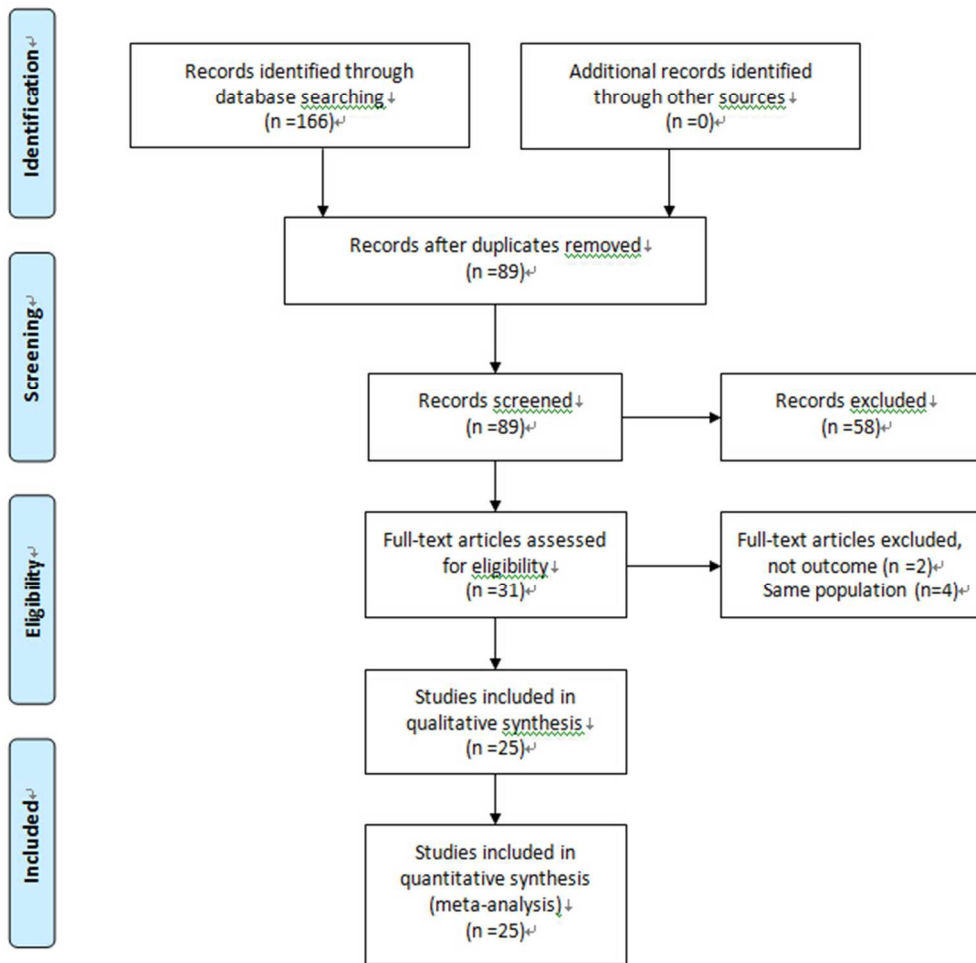
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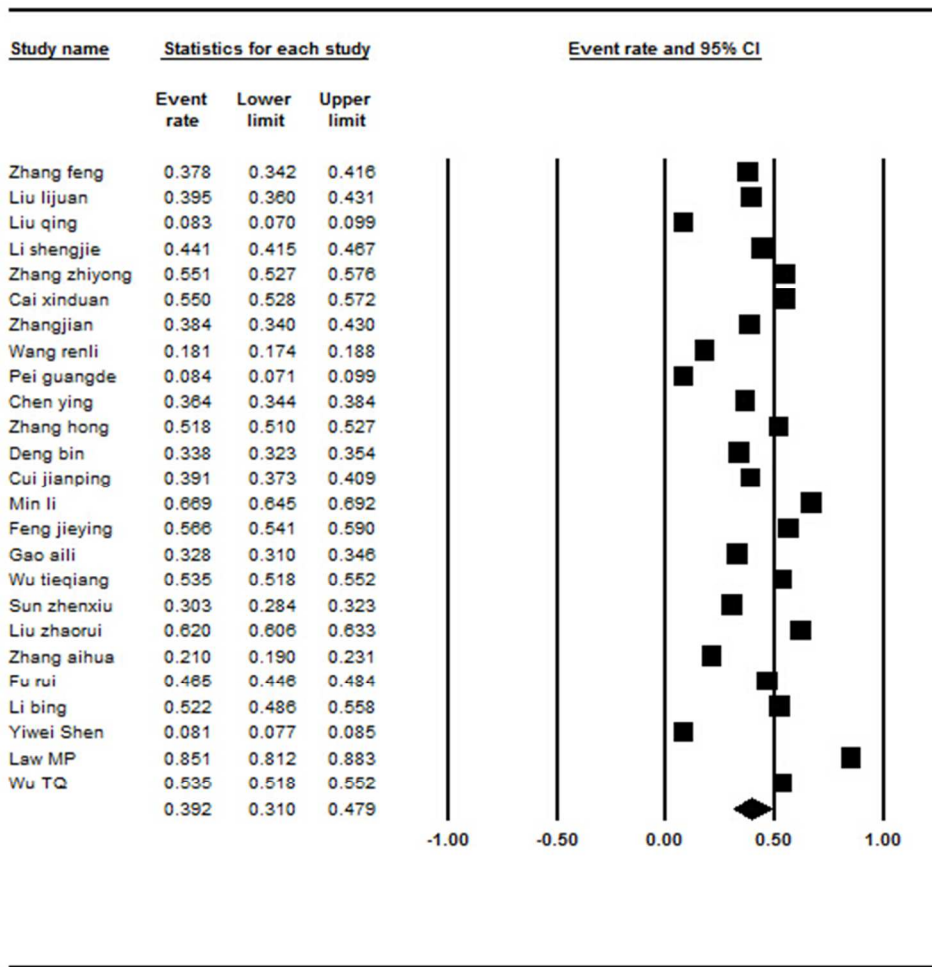
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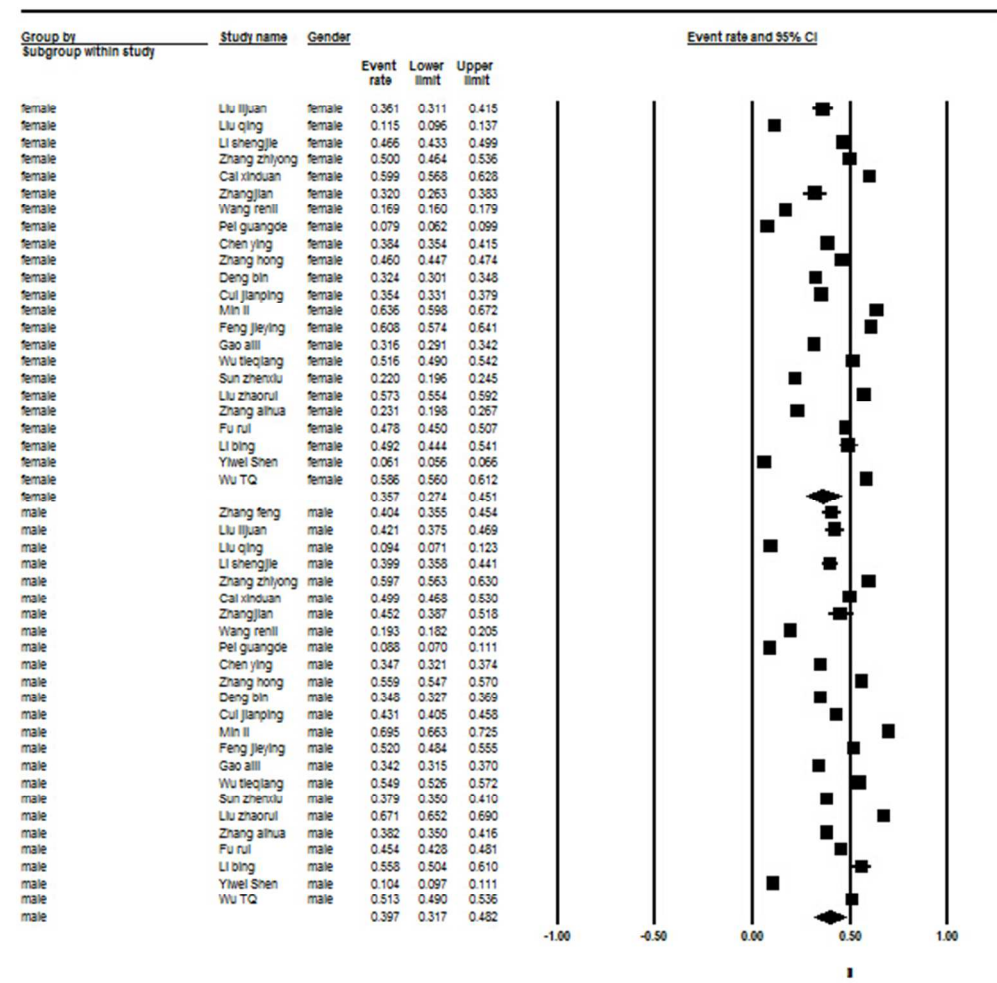
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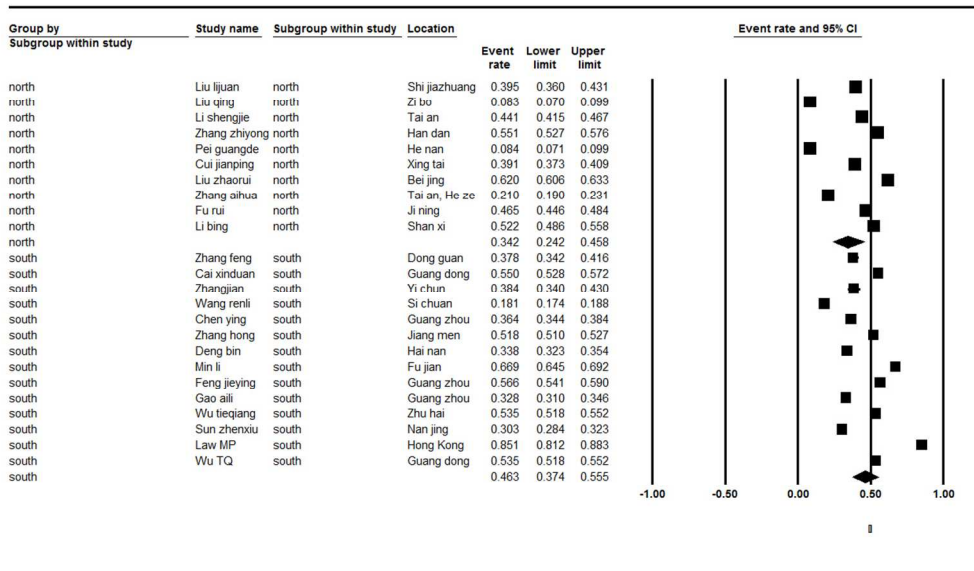
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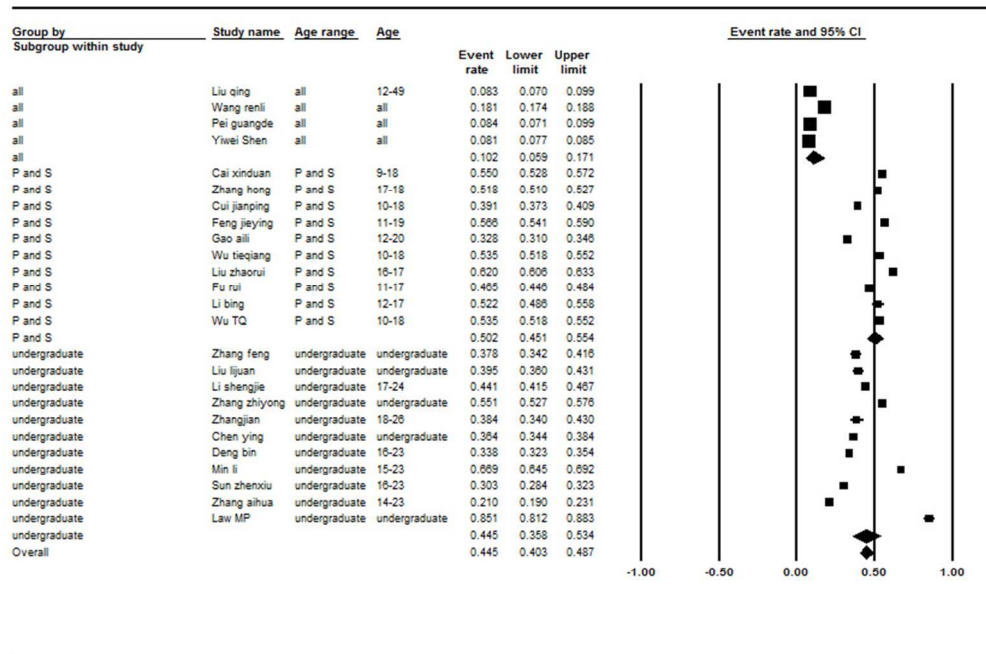
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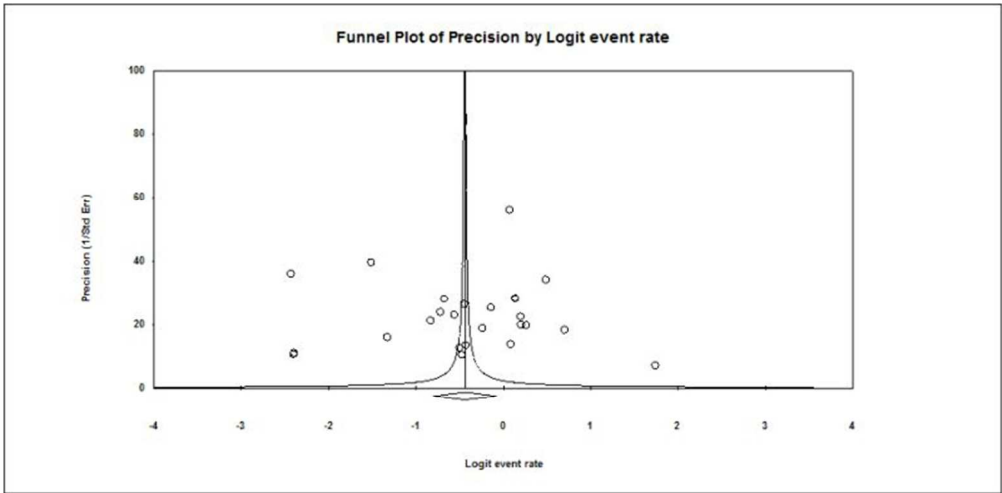
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Supplementary table 1. Details of electronic bibliographic database search strategies

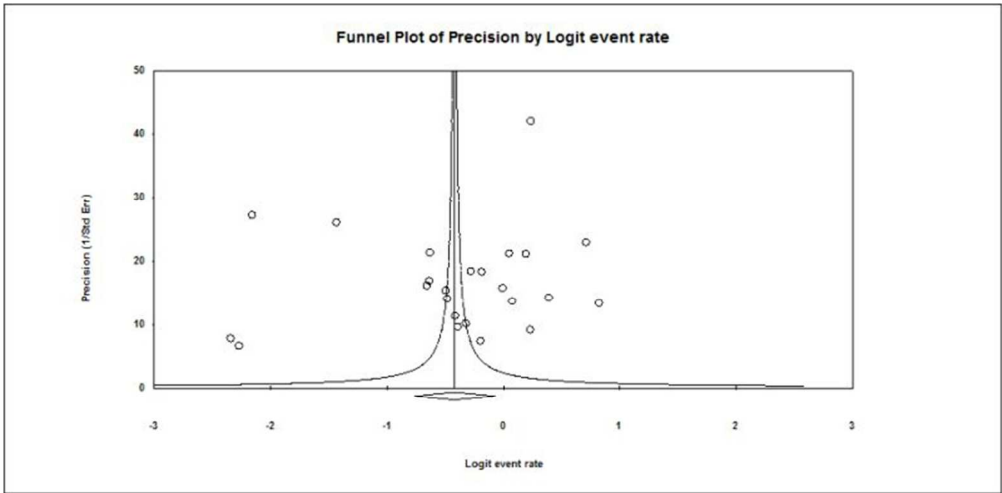
Database	Search strategies
Pubmed	((("acne vulgaris"[MeSH Terms] AND (("prevalence"[MeSH Terms]) OR "incidence"[MeSH Terms]))) AND ("China"[MeSH Terms]) OR "Chinese"[MeSH Terms])
Embase	Title or Abstract acne AND Title or Abstract (china or chinese) AND Title or Abstract (prevalence or incidence or epidemiology)
Web of science	Title or Abstract:(acne) AND Title or Abstract: (prevalence or incidence or epidemiology) AND Title or Abstract: (china or Chinese)
China National Knowledge Infrastructure Periodicals	Keywords: acne AND Keywords: prevalence or incidence or epidemiology
The VIP Database for Chinese Technical	(1) Title or Keywords: acne; Property: dim AND Title or Keywords: prevalence; Property: dim (2) Title or Keywords: acne; Property: dim AND Title or Keywords: incidence; Property: dim
The Wan Fang Database for Chinese Periodicals	(1) Title or Keywords: acne; Property: dim AND Title or Keywords: prevalence; Property: dim (2) Title or Keywords: acne; Property: dim AND Title or Keywords: incidence; Property: dim

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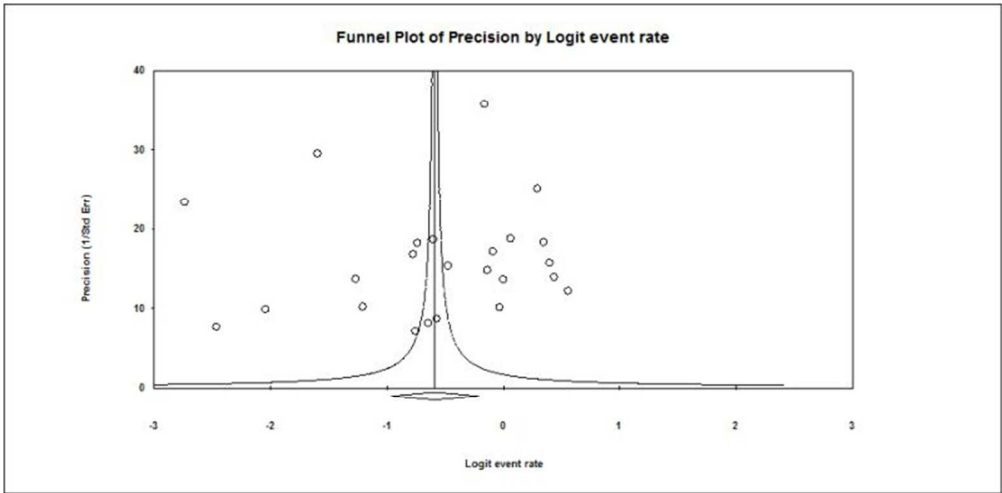
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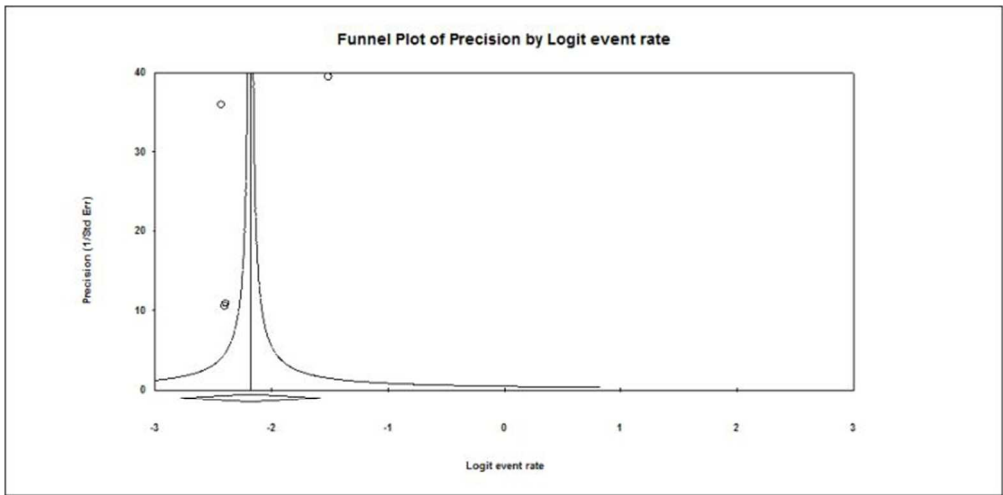
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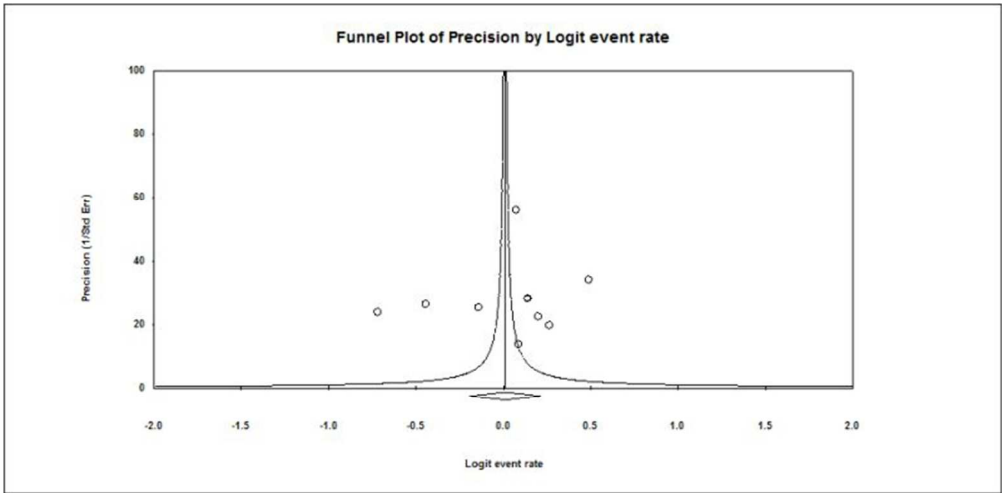
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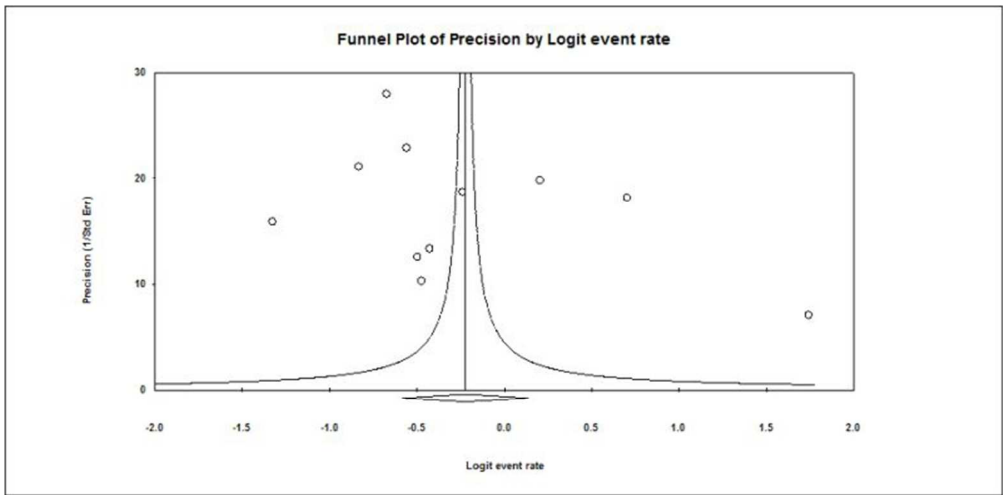
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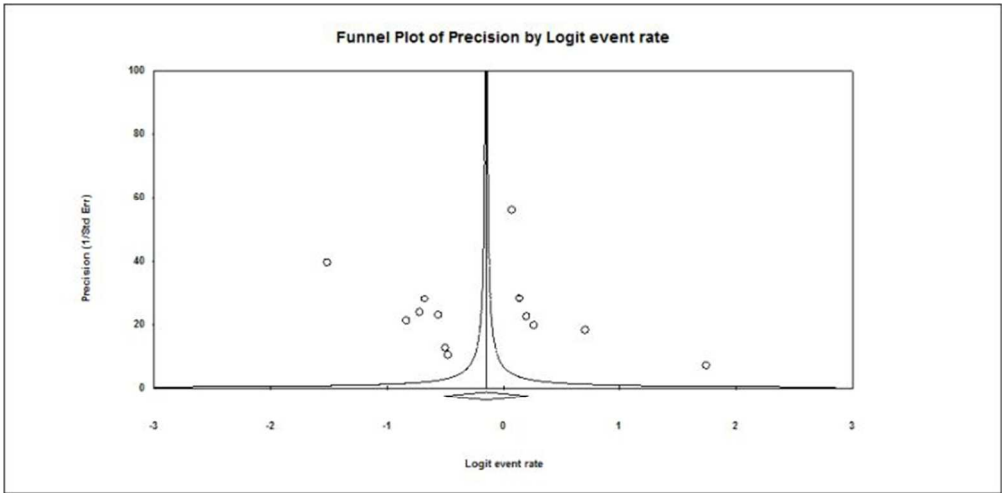
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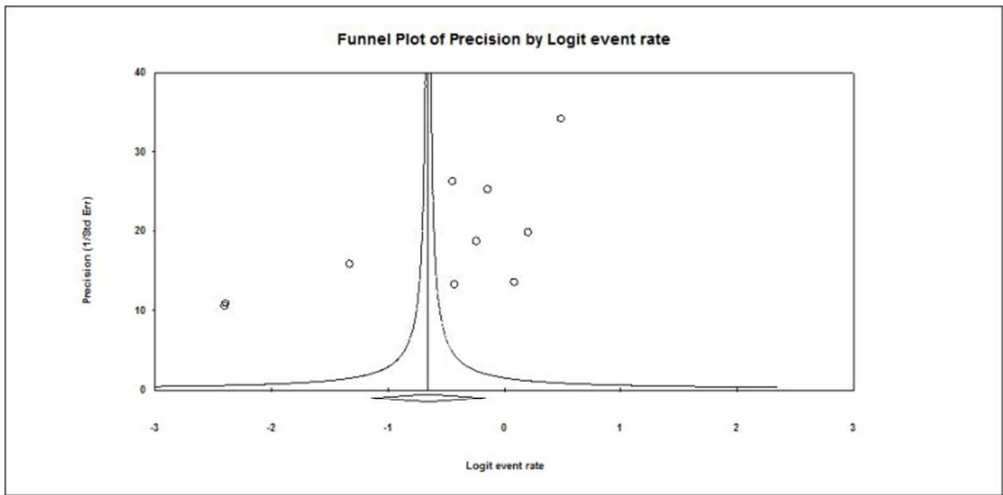
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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	The Prevalence of Acne in Mainland China: a systematic review and meta-analysis	1
ABSTRACT			
Structured summary	2	Objectives: The aim of this review is to estimate the prevalence of acne in mainland China comprehensively and to quantify its association with gender, region and age. Methods and analysis: We searched electronic databases with predetermined search terms to identify relevant studies published between January 1, 1996 and September 30, 2016. Note Express software, Comprehensive Meta-Analysis version 2.0, Logistic meta-regression analysis was used to dispose data and analyse. Results: The overall pooled prevalence rates of acne were 39.2%. In mainland China, primary and secondary students exhibited higher prevalence rates than undergraduate students; males had higher prevalence rates of acne than females; and the prevalence rates of acne in southern China was higher than northern China.	2,3
INTRODUCTION			
Rationale	3	Acne vulgaris burden exhibits global distribution and has continued to grow in prevalence over time within this population. Acne can result in psychological distress and have profound effects on patients' self-esteem. China comprises 34 province-level administrative regions, with 56 nations and a population of 1.3 billion people, a country-wide, population-based study of the prevalence rates of acne in China was needed.	3,4
Objectives	4	In this review, we examined the prevalence of acne in mainland China and to analyse the effects of gender, region and age on it.	4
METHODS			
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Protocol and registration	5	We have no original protocol and registration, so this item isn't applicable.	
Eligibility criteria	6	Studies that met all of the following criteria were included in the meta-analysis, (1) the study was a population-based survey; (2) the study evaluated the prevalence/incidence of acne; (3) the investigation involved random sampling or cluster sampling; (4) the sample size was >300; A flow chart illustrating the article search process is presented in Figure 1.	5,6
Information sources	7	Studies were aggregated from six databases between January 1, 1996 and September 30, 2016, including PubMed, EMBASE, the Web of Science, the China National Knowledge Infrastructure, the VIP Database for Chinese Technical Periodicals, and the Wan Fang Database for Chinese Periodicals.	4
Search	8	The following search terms were used to retrieve relevant studies, (acne), (prevalence or incidence) AND (China or Chinese).	4
Study selection	9	Figure1	Figure1
Data collection process	10	The data in this study were extracted independently and checked after independent extraction by two investigators.	5
Data items	11	(1) the name of the first author; (2) the location of the investigation area; (3) the year in which the investigation occurred; (4) the age range of the subjects; (5) the sample size (male, female, and overall); (6) the prevalence rates obtained for males, females, and overall; (7) the method used to sample subjects; (8) the criteria used to diagnose acne; and (9) the response rate.	5
Risk of bias in individual studies	12	Quality assessment and analysis of the publication bias	5
Summary measures	13	odds ratios (ORs) and their associated 95% confidence intervals (CIs)	6
Synthesis of results	14	The heterogeneity of the pooled prevalence was estimated using the χ^2 -based Q statistic and I^2 metrics. A random-effects model was used if heterogeneity was observed ($p < 0.05$); otherwise, a fixed-effects model was applied. All studies were classified into subgroups of regions, ages and gender. The associations of age, gender, and region with the prevalence of acne were evaluated using a logistic meta-regression model.	6

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Section/topic	#	Checklist item	Reported
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Risk of bias across studies	15	Table 2	Table2
Additional analyses	16	Logistic meta-regression model, subgroup analysis	6
RESULTS			
Study selection	17	Using the initial search strategy, 166 studies were identified, and 141 studies were subsequently excluded (Figure 1). A total of 25 studies 2-4, 9-30 involving 83,008 Chinese individuals were included in this meta-analysis.	6,7
Study characteristics	18	Detailed characteristics of each included study were presented in Table 1.	Table 1
Risk of bias within studies	19	The overall quality of all included studies was found to be adequate (Table 2).	Table 2
Results of individual studies	20	Figure2-5	Figure2-5
Synthesis of results	21	Figure2-5	Figure2-5
Risk of bias across studies	22	Table 2	Table 2
Additional analysis	23	logistic meta-regression model, subgroup analysis	8
DISCUSSION			
Summary of evidence	24	Our results showed that the overall pooled prevalence of acne was 39.2% for all ages. The prevalence rates in different age groups were 10.2% overall (95% CI=0.059-0.171), 50.2% for primary and secondary students (95% CI=0.451-0.554), and 44.5% for undergraduates (95% CI=0.358-0.534); by gender, the prevalence rates were 35.7% for females (95% CI=0.274-0.451) and 39.7% for males (95% CI=0.317-0.482); and by region, the prevalence rates were 34.2% northern China (95% CI=0.242-0.458) and 46.3% for southern China (95% CI=0.374-0.555).	9
Limitations	25	The diagnostic criteria for acne differed across studies and the age of the survey population could not be subdivided.	3
Conclusions	26	The overall pooled prevalence of acne was 39.2% in mainland China; acne occurred highly in primary students and secondary students than undergraduate students; the prevalence of acne in males was greater than that in females; and acne was more common in northern China than in southern China. This meta-analysis of the prevalence of acne may provide a sound basis for the future provision of health services.	9
FUNDING			
Funding	27	Issue of Tai'an Science and Technology Development Plan (201440774-05)	



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From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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