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SYSTEMATIC REVIEW

Association Between Psoriasis and Vitiligo: A Systematic Review and Meta-Analysis

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Abstract

Background The relationship between psoriasis and vitiligo has not been previously confirmed, and we therefore aimed to investigate this association.

Methods We conducted a search of the MEDLINE and EMBASE electronic databases on 22 January 2018 for case–control, cross-sectional, and cohort studies examining the association between psoriasis and vitiligo. A customized Newcastle–Ottawa Scale was used to assess the risk of bias of the included studies. We performed a random effects meta-analysis to calculate pooled odds ratios (ORs) with 95% confidence intervals (CIs) for case–control and cross-sectional studies.

Results Of 2453 citations identified from the literature search, 10 case–control/cross-sectional studies with a total of 120,866 psoriasis cases and 79,907 vitiligo cases were included in our study. Four of these studies were rated as high risk of bias. We found a significantly increased odds for vitiligo in psoriasis patients (summary OR 2.29, 95% CI 1.56–3.37, studies = 7), as well as a significantly elevated odds for psoriasis in vitiligo patients (summary OR 3.43, 95% CI 1.86–6.33, studies = 4).

Conclusions Our meta-analysis showed that psoriasis and vitiligo are associated with each other. Several studies had a high risk of bias, and further investigation is needed to confirm this association and amplify treatment options.

Key Points

This meta-analysis found a statistically positive association between psoriasis and vitiligo; psoriatic patients had a twofold odds of vitiligo while vitiligo patients had a threefold odds of psoriasis.

A shared genetic basis and common cellular immune pathway may explain this association, implying a potential for overlap in disease management.

1 Introduction

Psoriasis is a chronic systemic inflammatory disease that typically presents on the skin as erythematous plaques with silver scales. It is a relatively common disease with an estimated prevalence ranging from 0.51 to 11.43% in adults [1]. Current evidence supports an immune-related cytokine and chemokine dysfunction as the main pathogenesis for psoriasis [2], with stem cell abnormalities potentially contributing to the immune imbalance [3].

Vitiligo is a pigmentary dermatosis where destruction of epidermal melanocytes causes macular or patchy depigmentation of the skin. A systematic review reported a prevalence of vitiligo that ranges from 0.06 to 2.28% in the general population [4]. Many causes, including autoimmunity, have been implicated in the etiology of vitiligo [5].

Currently, there are limited observational studies evaluating the association between psoriasis and vitiligo, and results are inconsistent [6–15]. While the association between the two diseases could simply be coincidental, it has been proposed that patients with one immune-mediated inflammatory disorder are more likely than controls to have another immune-mediated inflammatory disorder, raising the possibility of a shared etiology [16]. Psoriasis patients were

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reported to have a higher frequency of concomitant autoimmune diseases than the general population, including rheumatoid arthritis, inflammatory bowel diseases, and multiple sclerosis [17]. Similarly, vitiligo has been associated with other autoimmune diseases, such as thyroid diseases, pernicious anemia, diabetes mellitus, and alopecia areata [5]. Shared cell-mediated immune pathogenesis, including T-helper (Th) 1 and Th17 pathways, may contribute to similar patterns of overactive cellular response in both diseases [17]. The objective of this study was to systematically evaluate the evidence and quantify the association between psoriasis and vitiligo.

2 Materials and Methods

We conducted a systematic review and meta-analysis of observational studies on the association between psoriasis and vitiligo. The reporting of this study was in accordance with the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines [18]. The two authors (HY and CC) independently conducted study selection, data extraction, and risk of bias assessment, and disagreement was resolved by discussion.

2.1 Inclusion and Exclusion Criteria

Observational case–control, cross-sectional, or cohort studies written in English that examined the association between psoriasis and vitiligo were included in our study. Studies must have provided odds ratios (ORs) or sufficient raw data to calculate ORs. The exclusion criteria included abstract-only articles, conference proceedings, and articles that were not peer-reviewed.

2.2 Literature Search and Study Selection

We conducted a search of the MEDLINE and EMBASE electronic databases on 22 January 2018 for relevant observational studies (a detailed search strategy is presented in electronic supplementary Table S1). Titles and abstracts were first screened from the initial literature search result. After screening the titles and abstracts, we obtained the full text of potential articles and examined them for relevance. Finally, the bibliographies of all included articles were reviewed to screen for potential relevant studies.

2.3 Data Extraction

After identifying relevant studies, the following information was extracted: author, publication year, country of study, study design, number in the case and control groups, method of defining cases and controls, method for selection of controls, how exposure was ascertained for cases and controls, demographic characteristics of cases and controls, nonresponse rates, risk estimates on the association between psoriasis and vitiligo, and whether any additional confounders were adjusted or matched for in the analysis.

2.4 Risk of Bias Evaluation

The risk of bias of included observational studies was assessed by using a customized Newcastle–Ottawa Scale (NOS) for case–control studies [19]. A green, yellow, and red light scoring system was designed by the two authors to interpret the NOS results (see details in electronic supplementary Table S2). A study with one or more red lights indicated a lower-quality study, while a study with no red lights suggested a higher-quality study. Specifically, a study was considered low risk of bias for comparability if it controlled for additional confounding factors in the analysis in addition to age and sex, such as healthcare consumption or comorbid diseases.

2.5 Statistical Analysis

Two meta-analyses were performed separately to examine the association between psoriasis and vitiligo. The first meta-analysis assessed the OR of vitiligo in psoriasis patients, while the second meta-analysis assessed the OR of psoriasis in vitiligo patients. The most fully adjusted OR was used whenever provided. If OR estimates were not presented in the study, then crude ORs were calculated by using the reported raw data. Taking into account potential between-study variability, the DerSimonian and Laird random-effects model was used to obtain summary ORs and 95% confidence intervals (CIs) [20]. The chi-square test was used to assess heterogeneity, and was quantified using the I^2 statistic [21]. An I^2 of $< 25\%$ was considered lower heterogeneity, while more than 75% considered higher heterogeneity [22].

Assessment for heterogeneity was explored by subgroup analysis on adjustment for other potential confounding variables and study quality. Funnel plots were used to examine potential publication bias [23]. All statistical analyses were performed using Review Manager version 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). All statistical tests were two-sided, and a p value < 0.05 was considered statistically significant.

3 Results

3.1 Study Characteristics

Our systematic literature search identified 2453 articles, and a total of 10 studies were ultimately included in our study.

Seven studies investigated the association of vitiligo in psoriasis patients [6–12], including three case–control studies and four cross-sectional studies. Four studies looked at the association of psoriasis in vitiligo patients, including three case–control studies and one cross-sectional study [11, 13–15]. One overlapping case–control study looked at both associations [11]. We found no relevant cohort studies. The selection process and reasons for exclusion are summarized in Fig. 1. A total of 120,866 psoriasis cases and 79,907 vitiligo cases were included in the statistical analyses.

The main characteristics of the included studies are summarized in Table 1. Risk of bias assessment revealed four studies of lower quality [8, 10, 14, 15] and six studies of higher quality (electronic supplementary Fig. S1) [6, 7, 9, 11–13].

3.2 Meta-Analysis of the Association between Psoriasis and Vitiligo

A meta-analysis of seven studies [6–12] that provided the odds of vitiligo in psoriasis patients revealed a twofold increase of vitiligo in psoriasis patients (summary OR 2.29, 95% CI 1.56–3.37) (Fig. 2). There was high statistical heterogeneity across the included studies ($p < 0.00001$, $I^2 = 84\%$).

Conversely, a meta-analysis of four studies that provided the odds of psoriasis in vitiligo patients [11, 13–15] found a threefold increase of psoriasis in vitiligo patients (summary OR 3.43, 95% CI 1.86–6.33) [Fig. 3]. There was also high statistical heterogeneity across the four studies ($p < 0.00001$, $I^2 = 97\%$).

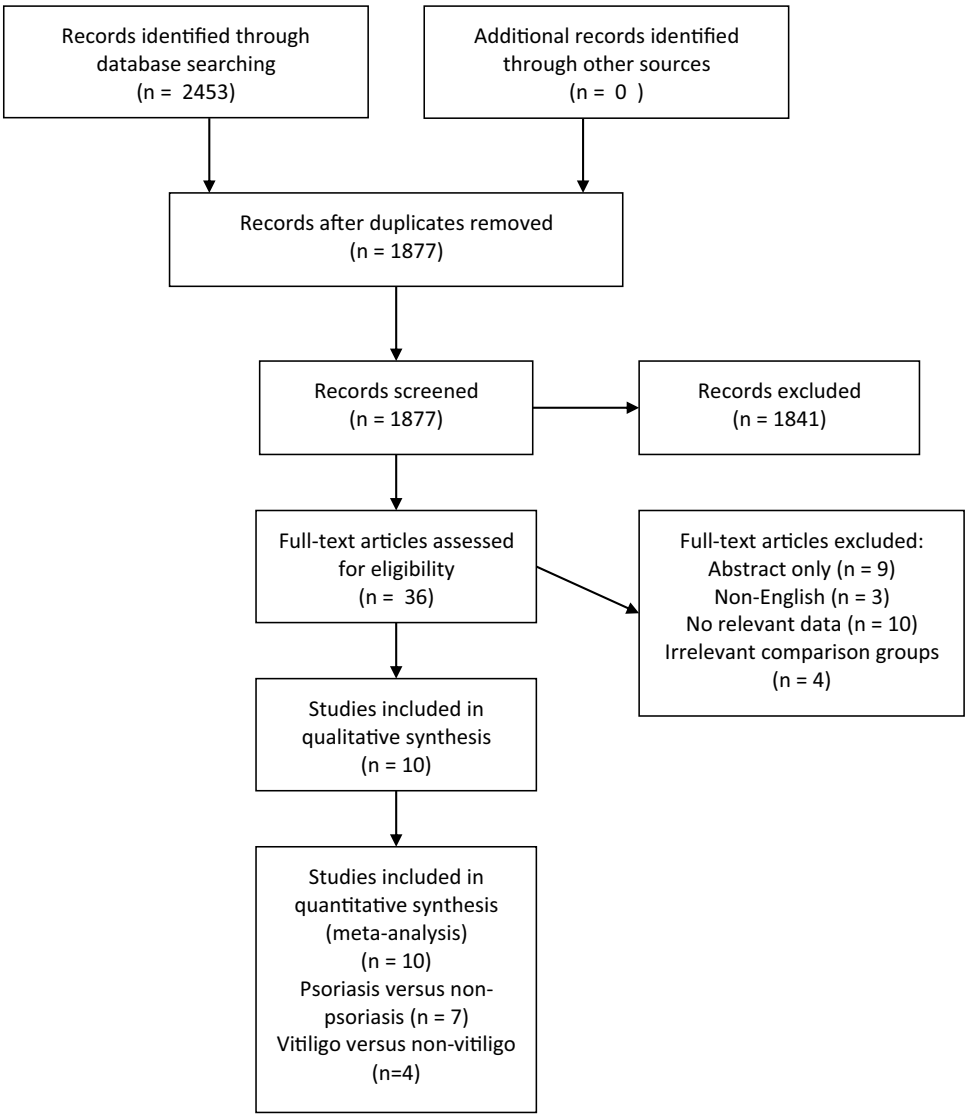

Fig. 1 The systematic search flow diagram

Table 1 Characteristics of included studies

First author, year, country	Study design	Cases (% female and mean age)	Controls (% female and mean age)	Case definition and sampling population/outcome definition	Results	
					Crude OR (95% CI)	Adjusted OR (95% CI)
Studies investigating the odds of vitiligo in psoriasis patients						
Tsai et al. 2011, Taiwan [6]	Case–control (1:4 ratio, matched by age, sex, and urbanization level of residential areas)	51,800 psoriasis cases (38%, 46.4 years)	207,200 controls (38%, 46.3 years)	ICD-9-CM psoriasis code from national health insurance database in 2006, validation carried out more than once/ICD-9-CM code for vitiligo, diagnosis confirmed by specialist at least two consecutive times	4.77 (3.16–7.18)	NA
Wu et al. 2012, USA [7]	Case–control (1:5 ratio, matched by age, sex, and length of enrollment)	25,341 psoriasis cases (52%, 48.7 years)	126,705 controls (52%, 48.9 years)	ICD-9 psoriasis code from Kaiser Permanente, Southern California, database from 1 January 2004 to 28 February 2011/ ICD-9 vitiligo code, validation carried out more than once	1.75 (1.45–2.12)	NA
Augustin et al. 2015, Germany [8]	Cross-sectional	1313 childhood psoriasis cases (52%, NA)	291,868 children without psoriasis (49%, NA)	ICD-10 psoriasis code from German health insurance company database in 2009/ICD-10 vitiligo code	2.08 (0.67–6.49)	NA
Blegvad et al. 2017, Denmark [9]	Cross-sectional	1925 children and adolescents with psoriasis (55%, 13.8 years)	1,194,712 children and adolescents without psoriasis (49%, 9.2 years)	ICD-10 psoriasis code from Danish registries on 31 December 2012/ICD-10 vitiligo code	18.77 (8.32–42.33)	4.76 (1.71–13.20) adjusting for age, sex, and number of dermatology visits
Radtke et al. 2017, Germany [10]	Cross-sectional	37,456 adults with psoriasis (NA)	1,305,215 adults without psoriasis (NA)	ICD-10 psoriasis code from German health insurance company database in 2009/ICD-10 vitiligo code	2.44 (2.07–2.87)	NA
Sharquie et al. 2017, Iraq [11]	Case–control (1:2 ratio, hospital controls were visiting for other reasons and matched by age and sex)	250 psoriasis cases between 14 and 68 years of age (64%, 26.6 years)	500 controls (58%, 28.0 years)	Diagnosis from documented dermatology clinic visit with physical examination at a single hospital/clinical diagnosis on documented visit	3.38 (0.80–14.26)	NA

Table 1 (continued)

First author, year, country	Study design	Cases (% female and mean age)	Controls (% female and mean age)	Case definition and sampling population/outcome definition	Results	
					Crude OR (95% CI)	Adjusted OR (95% CI)
Zander et al. 2017, Germany [12]	Cross-sectional	2781 psoriasis cases between 16 and 70 years of age (38%, 46.2 years)	136,137 participants without psoriasis (44%, 43.1 years)	Diagnosis by board-certified dermatologist who conducted physical examination and standardized interviews for employees undergoing occupational skin cancer screening from 2001 to 2014/clinical diagnosis on documented visit	0.87 (0.52–1.45)	0.82 (0.49–1.38) adjusting for age and sex
Studies investigating the odds of psoriasis in vitiligo patients						
Chen et al. 2015, Taiwan [13]	Case–control (1:4 ratio, matched by age and sex)	14,883 adult vitiligo cases (57%, 44 years)	59,532 adult controls (57%, 44 years)	ICD-9-CM vitiligo code from national health insurance database from 1 January 1997 to 31 December 2011, diagnosis confirmed by dermatologist at least three consecutive times/ICD-9-CM psoriasis code	4.16 (3.62–4.78)	3.15 (2.72–3.64), adjusting for age, sex, other comorbid diseases, visit times, annual income, and area
Lee et al. 2015, South Korea [14]	Cross-sectional	63,467 average vitiligo cases over 3 years (NA)	General population: average 50,131,632 over 3 years (57%, NA)	ICD-10 vitiligo code from nationwide health insurance database from 2009 to 2011/ICD-10 psoriasis code	5.83 (5.50–6.19)	NA
Teulings et al. 2015, The Netherlands [15]	Case–control (cases were asked to invite a genetically non-related person of the same age group without vitiligo to fill in the questionnaire)	1307 non-segmental vitiligo cases aged ≥ 50 years (63%, 61 years)	788 controls (44%, 60 years)	Clinical diagnoses made during a visit to the Netherlands Institute of Pigment Disorders from January 1996 to September 2010/diagnoses by written self-report via postal survey	1.10 (0.71–1.70)	NA
Sharquie et al. 2017, Iraq [11]	Case–control (1:2 ratio, hospital controls were visiting for other reasons and were matched by age and sex)	250 vitiligo cases between 14 and 68 years of age (63%, 27.1 years)	500 controls (58%, 28.0 years)	Diagnosis from documented dermatology clinic visit with physical examination at a single hospital/clinical diagnosis on documented visit	15.89 (3.61–70.06)	NA

CI confidence interval, *ICD-9* International Classification of Diseases, Ninth Revision, *ICD-9-CM* International Classification of Diseases, Ninth Revision, Clinical Modification, *ICD-10* International Classification of Diseases, Tenth Revision, *NA* not available, *OR* odds ratio

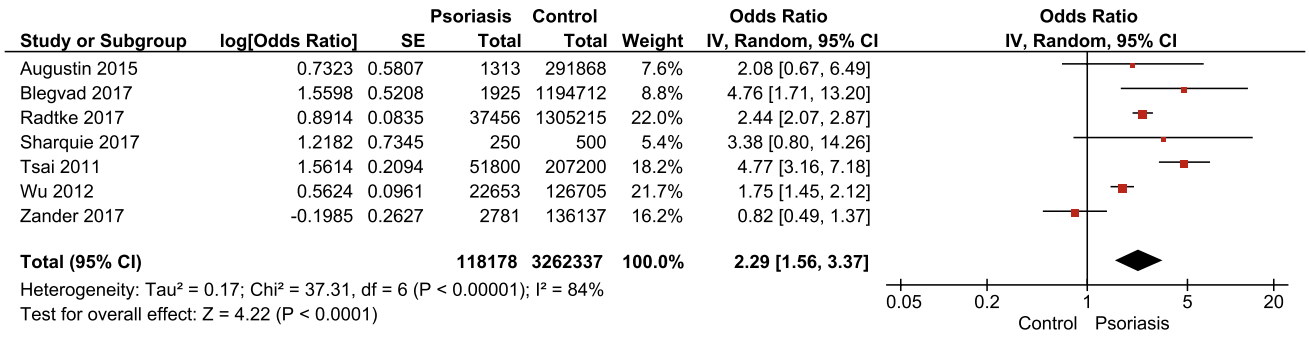

Fig. 2 The odds of vitiligo in psoriasis patients. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

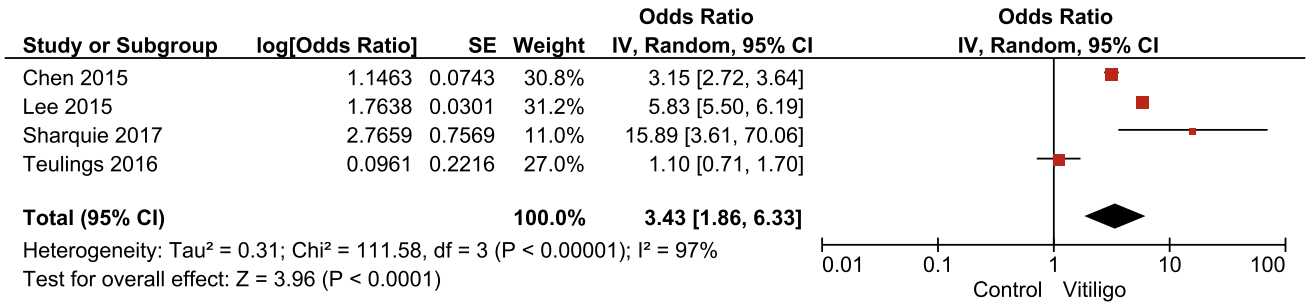

Fig. 3 The odds of psoriasis in vitiligo patients. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

3.3 Exploration of Heterogeneity and Publication Bias

Stratified analysis was carried out to assess heterogeneity, and no significant between-subgroup heterogeneity by adjustment for potential confounding variables or study quality was identified ($p > 0.47$ for all subgroup differences). There remained a largely positive association and high heterogeneity for both adjusted and unadjusted subgroups in the two meta-analyses, although the summary estimate was not statistically significant for adjusted odds of vitiligo in psoriasis patients (Figs. 4 and 5). With regard to study quality, stratified estimates remained similar for studies on psoriasis patients; lower-quality studies had minimal heterogeneity, while higher-quality studies had high heterogeneity (Fig. 6). For studies on vitiligo patients, there was positive association for psoriasis that was statistically significant only in higher-quality studies, and heterogeneity remained high regardless of study quality (Fig. 7). Finally, no obvious publication bias was detected on funnel plots for both meta-analyses, but interpretation was difficult due to the low number of studies.

4 Discussion

Although there have been reports of patients who had concomitant psoriasis and vitiligo, including cases where the psoriatic plaques were confined to vitiligo patches [24], it has been argued that this may be due to chance alone [25]. However, our meta-analyses found significant associations between psoriasis and vitiligo that were consistent in both directions: compared with controls, psoriasis patients were 2.29-fold more likely to have vitiligo, while vitiligo patients were 3.43-fold more likely to be diagnosed with psoriasis.

The most common reason for studies to have a higher risk of bias was lack of adjustment for additional variables in addition to sex and age, limiting the comparability between cases and controls. However, the similar effect estimates regardless of study quality suggest that the positive association between the two diseases is consistent even after adjusting for potential confounders, such as comorbid diseases and healthcare consumption. However, stratified results should be interpreted with caution as some of the CIs were very wide, resulting in imprecise effect estimates.

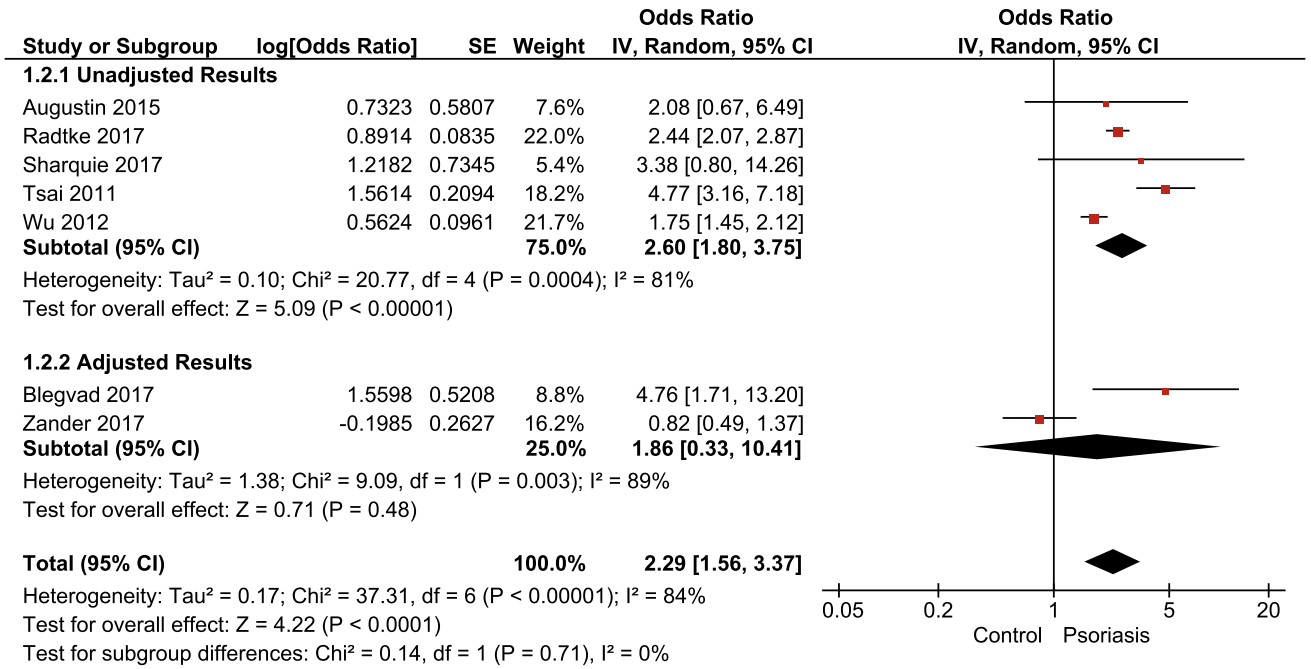

Fig. 4 The odds of vitiligo in psoriasis patients, stratified by adjustment. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

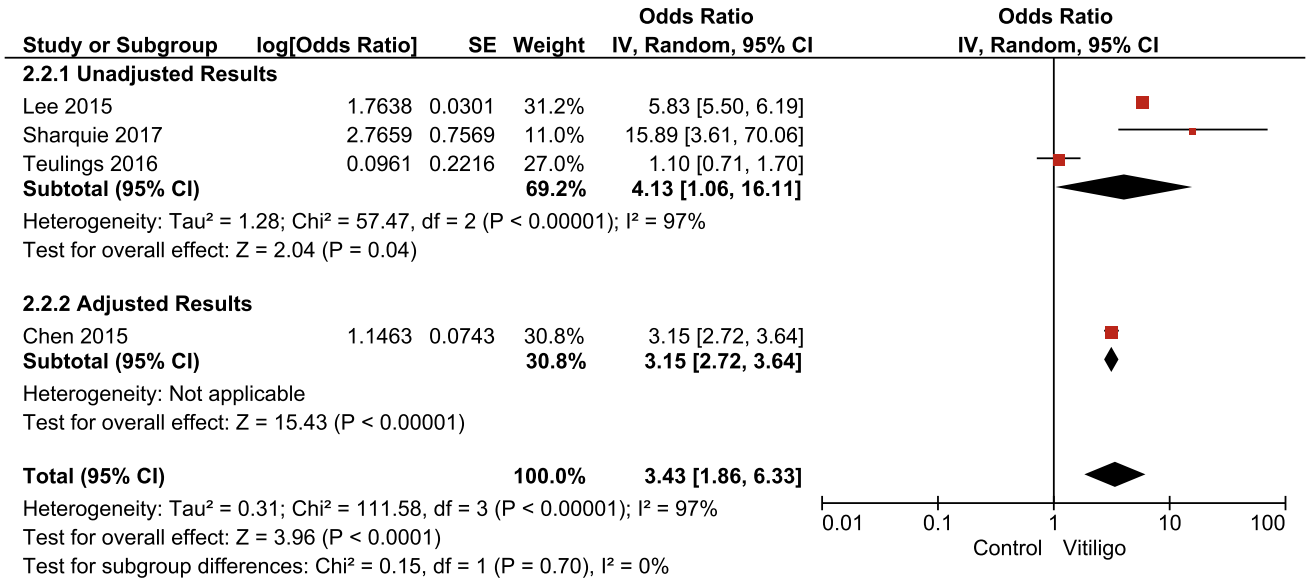

Fig. 5 The odds of psoriasis in vitiligo patients, stratified by adjustment. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

One explanation for the association between psoriasis and vitiligo is the common genetic basis for increased autoimmunity and inflammation. Genome-wide association studies have found increasing evidence of genetic predisposition to multiple autoimmune diseases [26]. Inflammasomes, multiprotein complexes in the cytoplasm that activate pro-inflammatory cytokines, may play an important role [27, 28]. Inflammasome-related genetic sequence variants have been found to be associated with psoriasis in generalized vitiligo patients and play a role in psoriasis susceptibility [29, 30]. Inflammasome markers in the skin have been identified in both vitiligo and psoriasis [31–33]. Both diseases

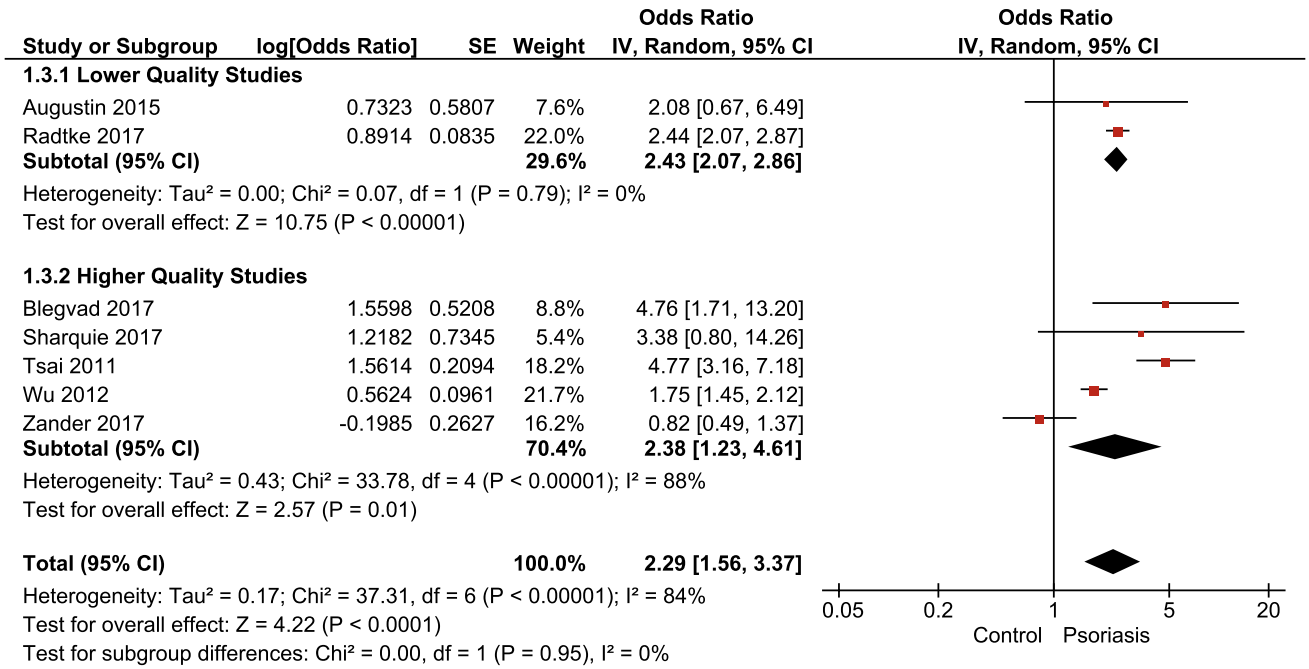

Fig. 6 The odds of vitiligo in psoriasis patients, stratified by study quality. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

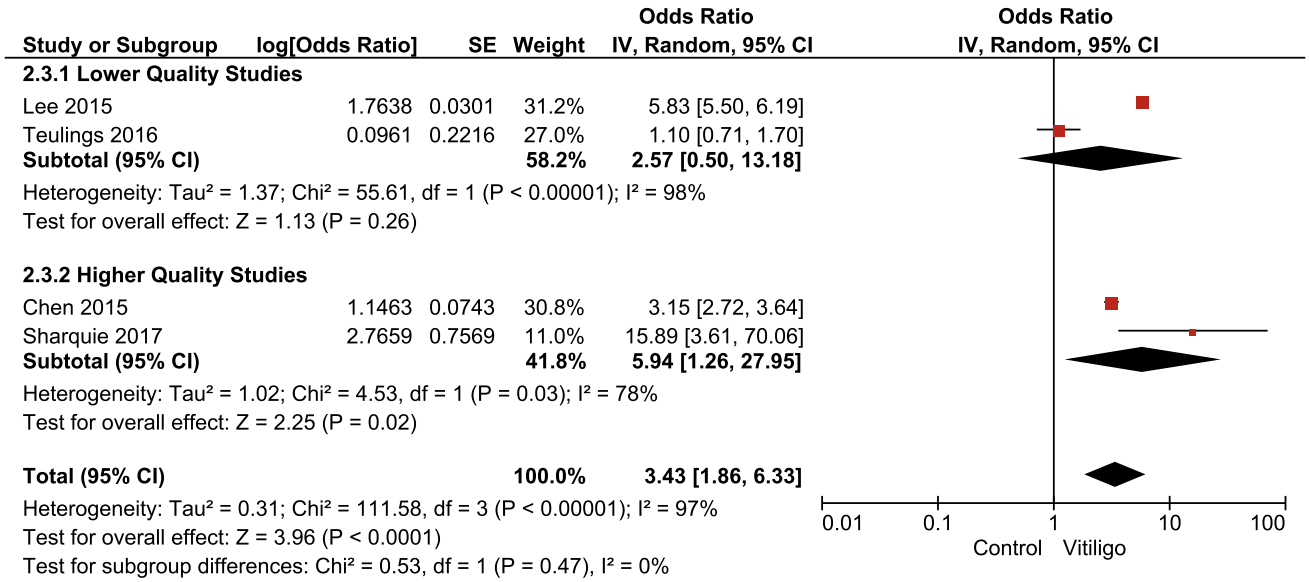

Fig. 7 The odds of psoriasis in vitiligo patients, stratified by study quality. *CI* confidence interval, *df* degrees of freedom, *IV* inverse variance, *SE* standard error

also share a common genetic locus in major histocompatibility complex [34].

A second explanation is a shared importance of cellular immune pathways, including Th1 and Th17 [35–40]. Additionally, interferon (IFN)-α has been recognized to potentially induce both psoriasis and vitiligo when used to treat hepatitis C infection [41–44]. One patient treated with IFNα for hepatitis B infection developed vitiligo and psoriasis lesions concurrently [45]. IFNα produced by plasmacytoid dendritic cells may play a role in the pathogenesis of both diseases via Th1- and Th17-mediated autoimmune inflammation of the skin [43, 46, 47].

Interestingly, the Janus kinase (JAK) inhibitor tofacitinib has been used to treat both psoriasis and vitiligo [48, 49]. In psoriasis patients, tofacitinib inhibits JAK/signal transducers and activators of transcription (JAK/STAT)-dependent cytokines, blocking stimulation of Th17 cells and reducing the production of IL-17. For vitiligo, tofacitinib reduces the targeted destruction of melanocytes by T cells, which is mediated by IFNγ and the JAK-STAT pathway. While evidence is still limited, there have been promising initial results for the effect of tofacitinib in both diseases. Furthermore, narrow-band ultraviolet B phototherapy treatment has been shown to simultaneously improve psoriasis and vitiligo in the same patient [50]. The potential effectiveness of tofacitinib and narrow-band ultraviolet B phototherapy at managing both diseases lends support to the argument of a shared cellular immune pathway.

This study has several limitations. First, all the included studies were either cross-sectional or case–control studies, with potential for recall bias. However, most of the included studies used data from claims databases and would thus mitigate such bias. Second, there is a risk of language bias as the search was limited to English-language studies only. This bias may be minimized as studies from Taiwan, Germany, Denmark, Iraq, and South Korea were also included. Additionally, few studies presented ORs after adjustment for potential confounders. Finally, we were unable to further explore heterogeneity due to the small number of included studies. The strengths of this study include the use of two meta-analyses to establish a significant and consistent association between psoriasis and vitiligo, as well as the relatively large number of cases for both psoriasis and vitiligo.

5 Conclusion

This study found that psoriasis patients have a significantly higher odds of vitiligo, and vice versa. These results remained consistent for both low- and high-quality studies. While an understanding of this association may have future therapeutic implications for both diseases, more investigation is necessary to test this hypothesis.

Compliance with Ethical Standards

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Conflict of interest Hsi Yen and Ching-Chi Chi have no conflicts of interest directly relevant to the content of this article.

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