Original Article

Is erectile dysfunction genetically associated with psoriasis?

Boyu Xiang[1], Minghui Zhang[2], Dongjie Li[1,3,4,5]

[1]Department of Urology, Xiangya Hospital, Central South University, Changsha, China; [2]Department of Cardiology, Capital Medical University affiliated Beijing Anzhen Hospital, Beijing, China; [3]Institute of Clinical Pharmacology, Central South University, Hunan Key Laboratory of Pharmacogenetics, Changsha, China; [4]Department of Clinical Pharmacology, Xiangya Hospital, Central South University, Changsha, China; [5]National Clinical Research Center for Geriatric Disorders, Xiangya Hospital, Central South University, Changsha, China

Contributions: (I) Conception and design: D Li, B Xiang; (II) Administrative support: D Li; (III) Provision of study materials or patients: B Xiang, M Zhang; (IV) Collection and assembly of data: B Xiang, M Zhang; (V) Data analysis and interpretation: B Xiang, M Zhang; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Dongjie Li, MD, PhD. Department of Urology, Xiangya Hospital of Central South University, No. 87 Xiangya Road, Changsha 410008, China; Institute of Clinical Pharmacology, Central South University, Hunan Key Laboratory of Pharmacogenetics, Changsha, China; Department of Clinical Pharmacology, Xiangya Hospital, Central South University, Changsha, China; National Clinical Research Center for Geriatric Disorders, Xiangya Hospital, Central South University, Changsha, China. Email: dongjieli@csu.edu.cn.

Background: The association between psoriasis and erectile dysfunction (ED) is currently inconsistent in epidemiological and observational studies and the causal relationship between them has not been established. The aim of our study is to explore the potential genetic association between ED and psoriasis.

Methods: We explored the putative causality between psoriasis and ED by bidirectional Mendelian randomization (MR). The single nucleotide polymorphisms (SNPs) associated with psoriasis were retrieved from a large-scale public genome-wide association study (GWAS). The summary statistics of ED were obtained from individuals of European ancestry with 6,175 cases *vs.* 217,630 controls. Inverse-variant weighted (IVW), weighted median (WM), MR-Egger, MR-Steiger, and MR pleiotropy residual sum and outlier (MR-PRESSO) test were employed in MR analyses to investigate the bidirectional causal relationship between psoriasis and ED. Several sensitivity analyses were employed to confirm the findings of the MR analysis.

Results: Our MR analysis indicated that genetically predicted psoriasis showed no association with a higher risk of ED [odds ratio (OR) 2.878, 95% confidence interval (CI): 0.175–47.289, P=0.46]. As for the other direction, no causal association was disclosed between ED and psoriasis (OR 0.999, 95% CI: 0.997–1.002, P=0.62). These findings remained consistent in sensitivity analyses.

Conclusions: The study revealed a negative genetic association between psoriasis and ED. Certain acquired factors may contribute to a strong clinical connection between the two, highlighting the need for comprehensive management of these risk factors.

Keywords: Erectile dysfunction (ED); psoriasis; bidirectional Mendelian randomization (bidirectional MR); causality; genome-wide association study (GWAS)

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Introduction

Erectile dysfunction (ED) is defined as the inability to obtain and/or maintain a firm erection for satisfactory sexual intercourse (1). The epidemiology data shows that the incidence of ED in men 40 to 69 years old is 10–52%, and the annual incidence rate increased with each decade of age (2). It is estimated that by 2025, the number of ED patients worldwide will exceed 200 million. The diagnosis and accurate grading of impotence rely on the International

Index of Erectile Function (IIEF-5) (3), which is a self-report method. Hence, the real-life incidence may be higher than the estimated number. The incidence of ED continues to rise, placing a heavy medical, financial, and social burden. Therefore, it is of considerable relevance and urgency to prevent and take early intervention for risk factors for ED (4).

Psoriasis is a chronic inflammatory skin disease with an estimated prevalence of 1% to 2% in the population of Europe and North America (5). Even if treated promptly, it can lead to a variety of severity, and bring a significant burden on psychology, finance, and society (6). Since ED shares several risk factors with psoriasis, such as metabolic syndrome (MS), smoking, and obesity, some scientists (7) have attempted to address the association between them. However, the relationship between ED and psoriasis still remains unclear. Several observational clinical studies, including Egeberg's (8), Ji's (9), and Molina-Leyva's (10) cohorts, have explored the correlation between ED and psoriasis. It has been shown that psoriasis is a possible risk factor for ED, increasing the risk of ED by 1.15 to 3.85 times by causing chronic inflammation or causing psychological problems. Nevertheless, a study (7) has reported conflicting findings, suggesting that psoriasis is not per se a risk factor for ED. As traditional studies are vulnerable to reverse causality and confounding factors, there is a need for high-quality studies to further explore the association between psoriasis and ED (11).

Randomized controlled trials (RCTs) are the gold standard for studying causal inference. However, in fact, RCTs are often difficult to implement for the challenges of organization and cost, as well as the difficulty of passing ethical reviews. Mendelian randomization (MR) has the advantage of being less costly and easier to implement than RCTs. MR employs single nucleotide polymorphisms (SNPs), the genetic variants that are clearly associated with exposure, independent of confounding factors associated with exposure and outcome, and affect outcome only through exposure, to detect the genetic causality between exposure and outcome (12). It effectively avoids the reverse causality and confounding factors by mimicking random grouping in RCTs due to genotype randomization occurring after conception and is less likely to be influenced by environmental factors, which resolves the bias of observational studies, thus providing an alternative approach to exploring causality (13).

To our knowledge, prior research has not investigated bidirectional genetic associations between psoriasis and ED. In this study, we utilize a MR design on large-scale genome-wide association study (GWAS) to identify potential bidirectional associations between psoriasis and ED. We present this article in accordance with the STROBE-MR reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-24-10/rc).

Highlight box

Key findings

- The study found no genetic association between psoriasis and erectile dysfunction (ED) in bidirectional Mendelian randomization (MR) analysis. Acquired factors may play a significant role in the clinical connection between psoriasis and ED.

What is known and what is new?

- Some observational studies suggest a potential association between psoriasis and ED.
- This study adds new evidence by using bidirectional MR analysis to demonstrate no genetic association between psoriasis and ED.

What is the implication, and what should change now?

- Comprehensive management of risk factors is crucial for individuals affected by both psoriasis and ED.
- Further research is needed to explore the underlying mechanisms of the clinical connection between psoriasis and ED.

Methods

Study overview

The objective of MR analysis is to utilize genetic variants as instrumental variables in order to estimate the causal relationship between exposure and outcome. In this study, we use bidirectional MR analysis to detect the genetically causal susceptibility relationship between psoriasis and ED (*Figure 1*). The MR theory has three assumptions: (I) relevance assumption: instrumental variants (IVs) are forcefully associated with exposure; (II) exclusivity assumption: IVs are not associated with the outcome; and (III) independence assumption: IVs are not associated with confounders of the outcome (14).

Data source

Large-scale GWAS meta-analysis data of psoriasis were extracted from the Medical Research Council Integrative Epidemiology Unit at the University of Bristol (MRC IEU) consortium, with 462,933 participants (5,314 psoriasis cases and 457,619 control samples). ED GWAS statistics

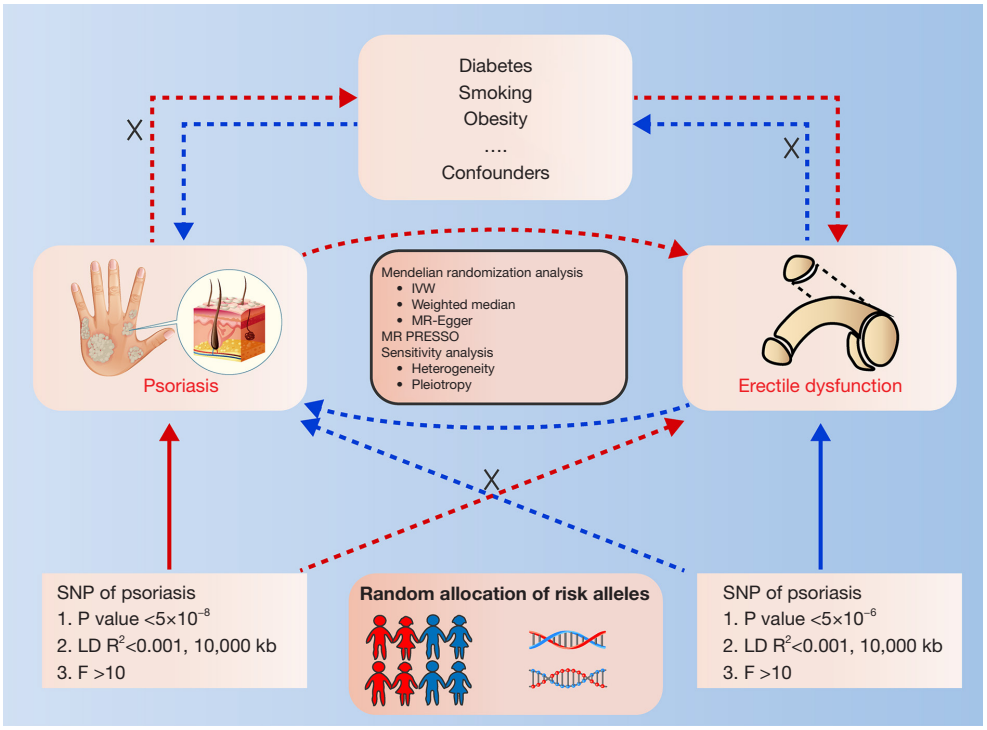

Figure 1 Schematic representation of the bidirectional Mendelian randomization analysis. IVW, inverse-variant weighted; F, F-statistic; LD, linkage disequilibrium; SNP, single nucleotide polymorphism.

were obtained from a recent GWAS meta-analysis of three cohorts (6,175 cases in 223,805 samples), including data from the UK Biobank, the Estonian Genome Centre of the University of Tartu, and the Partners HealthCare Biobank (15). All samples in the study were obtained from European populations. All of the above-mentioned data were used for MR analysis, which is publicly available on https://gwas.mrcieu.ac.uk/ (last accessed on December 7, 2023). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Genetic variants selection

Genetic IVs were selected based on specific criteria, including independent SNPs associated with psoriasis meeting the threshold of $P<5\times10^{-8}$, linkage disequilibrium (LD) $R^2<0.001$, and distance to index variants <10,000 kb. Conversely, with ED as exposure, a more lenient threshold was used to ensure an adequate number of SNPs ($P<5\times10^{-6}$) (16). We evaluated the strength of the IVs based on the F statistic according to $F = R^2 \times (N - 2)/(1 - R^2)$. An F-statistic >10 indicates a robust instrument that can avoid the effect of bias. R^2 reflects the proportion of variance in the exposure that can be interpreted by each SNPs. If the number of SNP <10, $R^2=2 \times EAF \times (1 - EAF) \times Beta^2$. If the number of SNP >10, it was calculated using the following formula: $R^2 = [2 \times Beta^2 \times (1 - EAF) \times EAF]/2 \times Beta^2 \times (1 - EAF) \times EAF + 2 \times SE^2 \times N \times (1 - EAF) \times EAF]$ (17). "N", "Beta", and "EAF" represent "sample size", "genetic effects of SNP on exposure data", and "effect-allele frequency", respectively.

Using the "harmonise_data" function in the TwoSampleMR package in R in order to: (I) coordinate the direction of exposure-SNP and consequence-SNP alleles; (II) according to the size of EAF, the palindromic SNPs that could not determine the direction were eliminated; (III) excluding incompatible SNP (A/G *vs.* A/C). To avert potential confounding, we found instrument SNPs in the PhenoScanner (18) after harmonizing the SNPs in the data source, then excluded SNPs associated with ED risk factors. Finally, the remaining SNPs were selected as IVs for the following MR test.

Statistical analysis

The MR aimed to establish causal links between psoriasis and ED. Causality was assessed using inverse variance weighting (IVW) (19), a meta-analysis approach that aggregates the effects of individual IVs to derive an overall weighted effect. The IVW approach produces consistent estimates when all SNPs are valid IVs, which is the main result of MR analysis. However, to ensure the stability of the results, complementary MR-Egger and weighted median (WM) regression methods were applied as sensitivity analyses (20). Additionally, the MR-Steiger method calculated the variance explained by the exposure and outcome, with insignificant results suggesting that the SNPs may have a greater impact on the outcome (ED) than the exposure (psoriasis).

Heterogeneity poses a significant challenge in MR analysis, potentially indicating the presence of pleiotropy. To address this issue, we conducted Cochran's Q test to detect horizontal pleiotropy and utilized funnel plot to evaluate heterogeneity (21). A P value >0.05 would be deemed as indicating insignificant heterogeneity. The WM model necessitates at least 50% of the weights to be derived from valid IVs and is advised for causal inference in the event of detecting horizontal heterogeneity in the IVW approach. This demonstrated superior estimation accuracy compared to MR-Egger and a more favorable finite sample type 1 error rate than did the IVW (22). The MR-Egger method, derived from Egger regression, was used to detect directional pleiotropy by incorporating an intercept term in the regression model. A convergence of the intercept term to 0 (<0.1) and a P value greater than 0.05 indicated the absence of evidence for directional pleiotropy in the analysis, thereby affirming the reliability of the MR analysis results. Additionally, the MR pleiotropy residual sum and outlier (MR-PRESSO) test was utilized to identify potential outliers (23). Subsequently, leave-one out analyses were conducted by excluding individual SNPs to identify highly influential SNPs, demonstrating the robustness of the casual estimation (24). (Analysis was conducted in R (R 4.3.1) and figures were produced using the package ggplot2 (Wickham, 2009).

Power analysis

The statistical power for MR was determined through power calculation using the online tool https://shiny.cnsgenomics.com/mRnd/. At a type I error rate of 0.05, the statistical power for the association between psoriasis and ED was found to be 100%. Additionally, the overlap and bias were assessed utilizing the online software available https://sb452.shinyapps.io/overlap/.

Results

Instrumental variable information

After excluding SNPs that did not meet the criteria of genome-wide significance ($P<5\times10^{-8}$), LD ($R^2<0.001$ and distance <10,000 kb), and F-statistics (F>10), and harmonizing the SNPs, 20 SNPs were selected as IVs for evaluating the effects of psoriasis on ED (*Table 1*). After searching the corresponding SNP in the PhenoScanner, one SNP (rs13191494) related to the risk factors of ED (diabetes mellitus and hyperthyroidism) was removed, and finally, 19 SNPs were retained. In the reverse direction, we identified four SNPs for assessing the effects of ED on psoriasis, using the criteria of $P<5\times10^{-6}$ and $R^2<0.001$ (*Table 2*).

Psoriasis to ED

The MR analysis demonstrated that the predisposition to psoriasis showed no effect on ED (IVW: OR 2.878, 95% CI: 0.175–47.289, P=0.46) (*Figure 2*). The scatter plot (*Figure 3*) disclosed that the SNP effect on ED increased insignificantly with the increase of the SNP effect on psoriasis. The effect of each SNP is displayed in *Figure 4A*. The WM analysis result was consistent with the IVW estimate (WM: OR 1.52, 95% CI: 0.074–31.291, P=0.79), but the MR-Egger estimate was in the opposite direction (MR-Egger: OR 0.741, 95% CI: 0.024–22.540, P=0.87).

To assess the robustness of the analysis, Cochren's Q test was performed, revealing no significant evidence of heterogeneity (IVW: P=0.35; MR-Egger: P=0.40) (*Table 3*). The leave-one-out analysis confirmed that no single SNP had a substantial impact on the causal relationship, thus ensuring the stability of our conclusion (*Figure 4B*). We also conducted the MR-PRESSO test to detect possible outliers, and no outlier was found (*Table 4*). Horizontal pleiotropy between SNPs and outcome was evaluated using MR-Egger regression (P=0.21). The results did not reveal any significant evidence of horizontal pleiotropy. Additionally, the funnel plot displayed a symmetric pattern for each SNP on ED and suggesting the absence of apparent horizontal pleiotropy (Figure S1). No SNP was detected by MR-Steiger filtering, which was likely

Table 1 Information on instrument SNP (psoriasis to ED)

SNP	Chromosome	Position	Effect allele	Other allele	Beta	Eaf	SE	Sample size	P value	R^2	F-statistic
rs11581607	1	67707690	A	G	–0.0026	0.0668	0.000443	462,933	5.20E–09	7.37E–05	34.11
rs4112787	1	152551325	T	C	0.0016	0.6585	0.000233	462,933	1.60E–12	1.08E–04	49.86
rs2111485	2	163110536	G	A	0.0014	0.6067	0.000226	462,933	1.00E–09	8.05E–05	37.27
rs842636	2	61091950	A	G	–0.0013	0.4354	0.000223	462,933	2.50E–09	7.68E–05	35.54
rs11135059	5	158771337	A	G	–0.0025	0.3291	0.000236	462,933	1.40E–26	2.46E–04	113.83
rs12188300	5	158829527	T	A	0.0051	0.0935	0.00038	462,933	1.60E–41	3.93E–04	182.16
rs848	5	131996500	C	A	0.0018	0.8162	0.000285	462,933	2.80E–10	8.60E–05	39.82
rs12189871	6	31251924	T	C	0.0214	0.0905	0.000384	462,933	1.00E–200	6.63E–03	3,089.48
rs2735003	6	29808634	G	T	–0.0026	0.208	0.000272	462,933	1.10E–21	1.98E–04	91.46
rs28367705	6	31284635	A	G	0.007	0.1109	0.000447	462,933	2.00E–55	5.31E–04	245.96
rs33980500	6	111913262	T	C	0.0028	0.0744	0.00042	462,933	2.30E–11	9.65E–05	44.67
rs582757	6	138197824	T	C	–0.0014	0.7262	0.000247	462,933	2.50E–08	6.70E–05	31.03
rs9277937	6	33184894	C	T	0.0029	0.0963	0.000376	462,933	3.20E–14	1.24E–04	57.62
rs11795343	9	32523737	C	T	–0.0014	0.4013	0.000226	462,933	1.80E–10	8.79E–05	40.71
rs7951925	11	128379964	G	A	–0.0013	0.3686	0.000229	462,933	2.40E–08	6.72E–05	31.13
rs8016947	14	35832666	G	T	0.0016	0.5618	0.000223	462,933	4.00E–13	1.14E–04	52.65
rs28998802	17	26124908	A	G	0.0019	0.1405	0.000322	462,933	6.60E–09	7.27E–05	33.65
rs11085725	19	10462513	T	C	–0.0017	0.2924	0.000244	462,933	7.70E–12	1.01E–04	46.85
rs632376	20	48520610	G	A	–0.0013	0.4199	0.000224	462,933	4.30E–09	7.45E–05	34.49

SNP, single nucleotide polymorphism; ED, erectile dysfunction; eaf, effect-allele frequency; SE, standard error.

Table 2 Information on instrument SNP (ED to psoriasis)

SNP	Chromosome	Position	Effect allele	Other allele	Beta	Eaf	SE	Sample size	P	R^2	F-statistic
rs10835054	11	26691664	T	C	0.1244	0.188	0.0253	223,805	8.54E–07	4.725E–03	1,062.45
rs113340062	8	98904160	C	T	0.193	0.0666	0.0386	223,805	5.88E–07	4.631E–03	1,041.28
rs57989773	6	100629078	C	T	0.1782	0.2322	0.0237	223,805	5.71E–14	1.132E–02	2,563.11
rs726857	2	145753424	A	T	–0.0925	0.3828	0.02	223,805	3.70E–06	4.043E–03	908.52

SNP, single nucleotide polymorphism; ED, erectile dysfunction; eaf, effect-allele frequency; SE, standard error.

to be primarily associated with ED rather than psoriasis.

ED to psoriasis

In the context of the reverse MR analysis, there was insufficient evidence to support a causal relationship between ED and psoriasis (IVW: OR 0.999, 95% CI: 0.997–1.002, P=0.62; WM: OR 1.000, 95% CI: 0.997–1.002, P=0.72; MR-Egger: OR 1.005, 95% CI: 0.998–1.012, P=0.28) (*Figure 2*). The effect of each SNP is displayed in *Figure 4C*.

Regarding the sensitivity of the analysis, the Cochren's Q test revealed no evidence of heterogeneity (IVW: P=0.21; MR-Egger: P=0.46) (*Table 3*). And the MR-PRESSO test

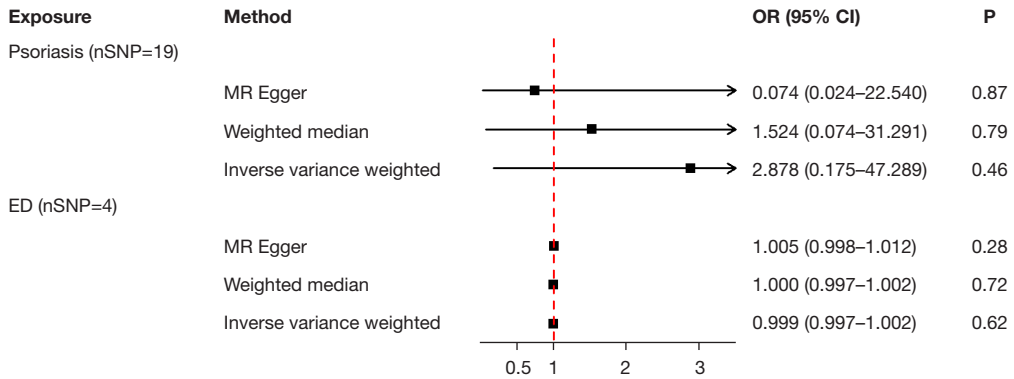

Figure 2 Forest plot for bidirectional MR results. OR, odd ratio; nSNP, number of single nucleotide polymorphism; MR, Mendelian randomization; ED, erectile dysfunction.

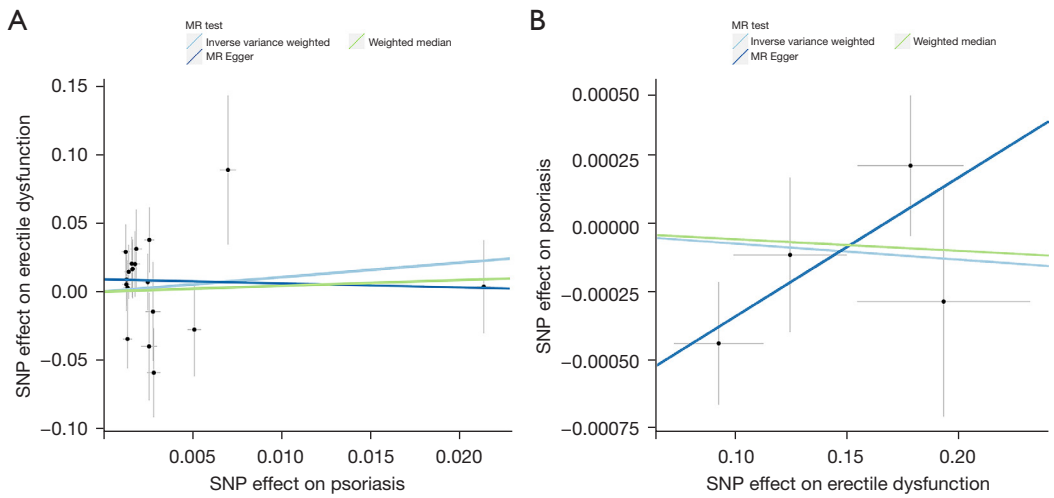

Figure 3 Scatter plots of MR estimates. (A) MR estimates of genetic risk of psoriasis on ED. (B) MR estimates of genetic risk of ED on psoriasis. ED, erectile dysfunction; SNP, single nucleotide polymorphism; MR, Mendelian randomization.

did not identify any outlier. Additionally, the results of the leave-one-out analysis validated that no potentially influential SNP skewed the causal relationship (*Figure 4D*). MR-Egger regression result (P=0.23) suggested that no evidence of horizontal pleiotropy was found.

Discussion

The overall results of MR analysis showed no potential genetic causal association either between psoriasis on ED or ED on psoriasis, which remained on consistent in sensitivity analyses. There are many observational studies demonstrating a higher risk of ED in patients with psoriasis. Some studies (25-27) have explored the impact of psoriasis on sexual function from psychological aspects (such as anxiety, depression, etc.), suggesting that patients with psoriasis may suffer from sexual dysfunction or ED due to psychological factors. However, Türel Ermertcan *et al.* (28) conducted a study and found that depression had no additional negative effect on sexual dysfunction in patients with psoriasis. Data separately collected by Chung *et al.* [2012] (29) and Egeberg *et al.* [2017] (8) further suggested that psoriasis may be an independent risk factor for ED by applying multivariate analysis to the epidemiological characteristics of selected patients. However, the study by Goulding (7) and Molina-Leyva (10) showed significant associations between ED and age, smoking, and anxiety/depression, independent of psoriasis

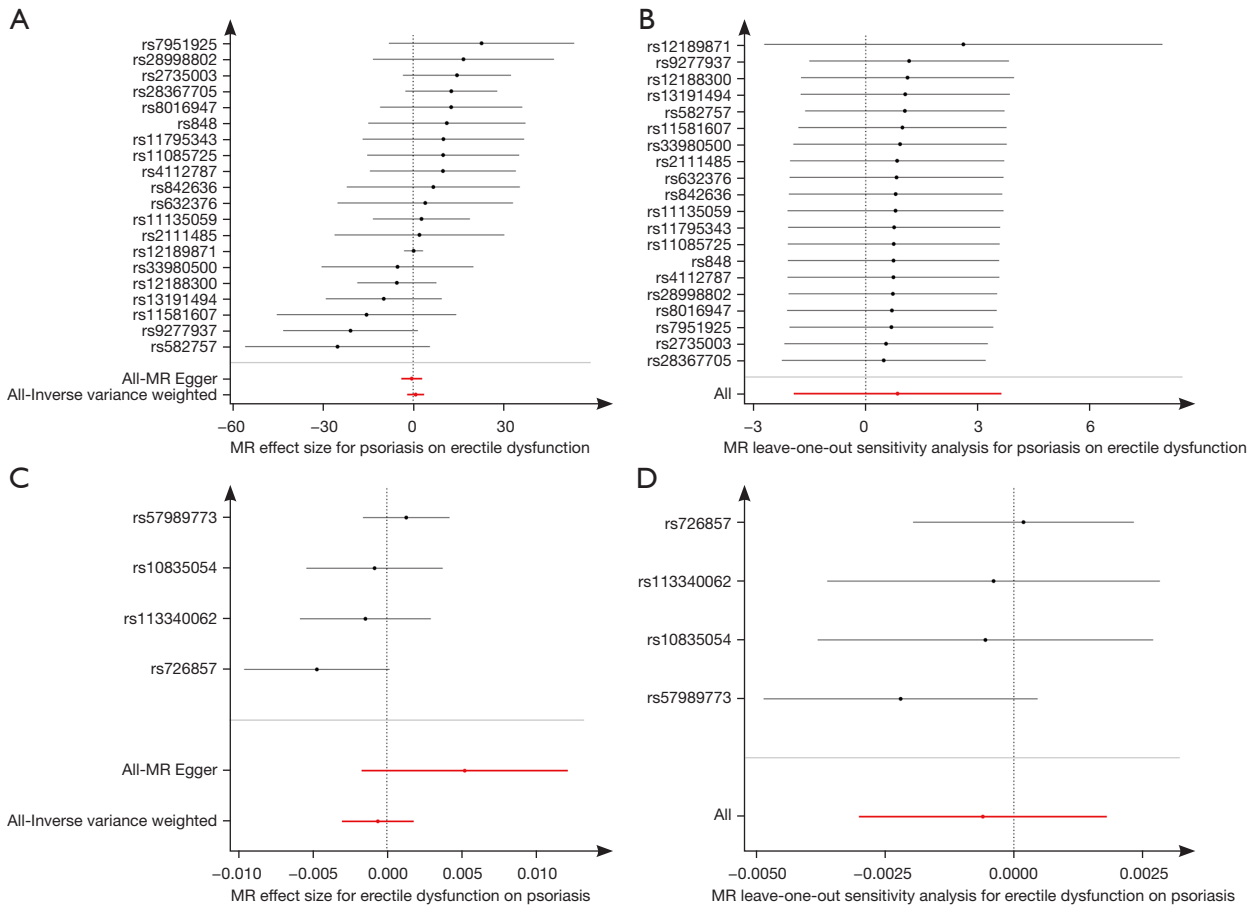

Figure 4 MR effect size and leave-one-out analysis. (A) Forest plots describe the effect size of each SNP of psoriasis on ED. (B) Leave-one-out analysis of the effect of psoriasis on ED. (C) Forest plots describe the effect size of each SNP of ED on psoriasis. (D) Leave-one-out analysis of the effect of ED on psoriasis. ED, erectile dysfunction; IVW, inverse-variant weighted; SNP, single nucleotide polymorphism; MR, Mendelian randomization.

Table 3 Pleiotropy tests and heterogeneity of MR

Exposure to outcome	Pleiotropy test			Heterogeneity test					
				MR Egger			IVW		
	Egger intercept	SE	P	Q	Q_degrees of freedom	Q_P	Q	Q_degrees of freedom	Q_P
ED to psoriasis	−0.0009	0.001	0.23	1.544	2	0.46	4.511	3	0.21
Psoriasis to ED	0.0091	0.007	0.21	17.884	17	0.40	19.688	18	0.35

MR, Mendelian randomization; IVW, inverse-variant weighted; SE, standard error; ED, erectile dysfunction.

itself, by multivariate analysis. A systematic review summarized the above studies and found that the risk of ED in patients with psoriasis was increased by 1.15- to 3.85-fold independent of organic or psychological risk factors (30).

Psoriasis is a chronic inflammatory skin disease mediated by T cells. It activates T cells to release a variety of inflammatory cytokines, such as IL-6, TNF-α, TGF-β, ET-1, leading to a large number of inflammatory mediators involved in the inflammatory response, and at the same time, the level of intracellular oxidative stress

Table 4 MR-Steiger and MR-PRESSO test

MR-Steiger	ID exposure	ID outcome	Exposure	Outcome	SNP r^2 exposure	SNP r^2 outcome	Correct causal direction	Steiger P value	MR-PRESSO	Main MR results						MR-PRESSO results, global test	
										Exposure	MR analysis	Causal estimate	SD	t	P	Observation of residual sum of squares	P value
1	ebi-a-GCST006956	ukb-b-10537	ebi-a-GCST006956	ukb-b-10537	0.001	1.05E−05	True	1.29E−15	1	Beta exposure	Raw	1.06	1.43	0.74	0.47	24.44	0.44
2	ukb-b-10537	ebi-a-GCST006956	ukb-b-10537	ebi-a-GCST006956	0.006	9.60E−05	True	4.89E−157	2	Beta exposure	Outlier-corrected	NA	NA	NA	NA	24.44	0.44
									3	Beta exposure	Raw	−0.000601	0.00123	−0.49	0.66	9.66	0.30
									4	Beta exposure	Outlier-corrected	NA	NA	NA	NA	9.66	0.30

MR, Mendelian randomization; PRESSO, pleiotropy residual sum and outlier; SNP, single-nucleotide polymorphism; NA, not available.

is increased (31). Together, they impair the function of vascular endothelial cells and induce atherosclerosis, and lead to the reduction of nitric oxide (NO) production (32). At the same time, reactive oxygen species (ROS) (33) and some inflammatory factors such as TGF-β1 and EF-1 can cause ED by affecting the contraction of cavernous smooth muscle (34,35). Platelet activation is also one of the pathogenic factors of psoriasis, which releases a large number of adhesion, pro-inflammatory factors, and ROS aggravates the inflammatory reaction, and forms vascular ED. Activated platelets can also cause the reduction of PGI2 synthesis and the increase of TXA2 synthesis, thereby destroying the balance of PGI2/TXA2 in the physiological state and shrinking the corpus cavernosum (36). However, no significant genetic association was identified in our study, patients with psoriasis may lead to ED for other non-genetic reasons such as psychological factors (anxiety and depression).

Although there are many observational studies demonstrating the association between psoriasis and ED, our study showed that psoriasis and ED were not causally related at the genetic level. Studies have shown that both psoriasis and ED are influenced by genetic factors. But the genetic characteristics of ED and psoriasis do not overlap much. Many of the leading SNPs associated with psoriasis were located in proximity to genes involved in specific adaptive and innate immune pathways. These included genes involved in antigen presentation (HLA-C, ERAP1), T17 cell activation (IL23R, IL23A, IL12B, TRAF3IP2), innate antiviral immunity/type I interferon signaling (RNF114, IFIH1) and skin barrier function (LCE3B/3D) (37). This supports a pathogenic interplay between immune activation and disruption of skin barrier function. Some of the SNPs associated with ED were located in ALCAM (rs9810233, rs1920201), SIM1 (rs17185536-T), and McHr2-sim1 (rs57989773-C) (38). And gene polymorphisms of eNOS insertion/deletion have been shown to be positively correlated with the risk of ED (39). We speculate that some acquired factors may lead to a close clinical correlation between psoriasis and ED. For example, psoriasis may increase the risk of ED through psychological (anxiety, depression) and behavior (diet, weight, alcohol, smoking, etc.) factors. Or maybe some common risk factors, such as MS, are associated with ED. It is suggested that we can prevent the occurrence of ED by improving psychological support for patients, helping patients correctly understand psoriasis, and advising patients to give up some bad habits. Future studies, on the one hand,

need to use multiple sources of GWAS data to explore the reliability of the results of MR. On the other hand, it is necessary to combine the results of observational studies with large samples and control the variables of non-genetic factors to explore the effect of each factor on psoriasis.

The strength of our study is our employment of MR analysis for providing high-level clinical evidence that minimizes residual confounding and reverse causality factors. In addition, we included large number of people with psoriasis and ED for bilateral MR Analysis, which were both from European populations, without sample overlap. Data bias stemming from population structure and sample overlap were rigorously managed. All of the above are difficult to achieve in RCTs. However, there are some limitations in this study. First, our data were derived from European populations, which means our findings cannot be automatically be extended to individuals of other ancestries. In the future, further validation is needed for other ethnic populations. Second, the psoriasis summary level data only provide binary variables, so how psoriasis severity is correlated with ED or how ED severity is correlated with psoriasis still remains unclear. Future studies should focus on investigating the relationship between different severity of psoriasis and ED. Third, the available psoriasis data had not been distinguished for the two sexes, potentially introducing bias into the results of MR. Incorporating sex-specific analyses in future research could yield deeper insights into genetic association.

Conclusions

Based on observational studies, there is an association between psoriasis and ED, and they each have genetic characteristics. However, there are no studies using bidirectional MR methods to investigate the genetic predisposition link between psoriasis and ED. In our study conducted on a population in Europe, we found no causal association between psoriasis and ED. The results of the reverse MR study also showed non-significant results. Some acquired factors (such as MS, behavioral, and psychological factors) may lead to a close clinical correlation between psoriasis and ED. The specific mechanisms still require further research.

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Footnote

Reporting Checklist: The authors have completed the STROBE-MR reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-24-10/rc

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-24-10/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-24-10/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

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