Psoriasis: Targets and Therapy

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REVIEW

The Effects of Cardiometabolic Comorbidities on Biologic Treatment for Psoriasis with Respect to PASI Scores: A Qualitative Systematic Review

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Objective: Cardiometabolic risk factors have been shown to decrease biologic efficacy in patients treated for inflammatory conditions. The purpose of this systematic review is to provide a qualitative evaluation of studies investigating biologic response among psoriasis patients with cardiometabolic comorbidities.

Methods: A comprehensive review was conducted according to the Preferred Reporting Guidelines for Systematic Reviews and Meta-Analysis guidelines to screen for studies including patients with cardiometabolic risk factors receiving biologic therapy for psoriasis. Studies not including a Psoriasis Area and Severity Index (PASI) score to evaluate treatment outcomes were not included. All studies underwent quality/bias analysis using the Methodological Index for Non-Randomized Studies (MINORS) scale.

Results: Obesity and Body Mass Index (BMI) were the most studied cardiometabolic risk factors. The majority of the studies reported a lower frequency of achieving PASI75 and PASI90 response with increasing BMI/obesity rates. Diabetes and hypertension showed similar findings but were not studied as frequently. Hyperlipidemia and other lipid disorders were less frequently studied.

Conclusion: Relationships between cardiometabolic risk factors and lower frequencies of achieving PASI75/90 exist in current literature. This qualitative systematic review reports evidence of lower PASI75 and PASI90 response rates in the presence of cardiometabolic risk factors.

Keywords: psoriasis, cardiometabolic, obesity, PASI, hypertension, biologic

Introduction

Psoriasis is a chronic, immune-mediated, inflammatory disease of the skin and joints. Psoriatic disease commonly involves systemic inflammation, dysmetabolism, and increased comorbid disease burden.[1–5] The management of moderate to severe psoriasis has undergone significant advancements with the availability of biologic therapies,[6] which include tumor necrosis factor-inhibitors (TNFi) [etanercept, infliximab, adalimumab, certolizumab], interleukin (IL) 12/23 inhibitors (IL-12/23i) [ustekinumab], IL-17 inhibitors (IL-17i) [secukinumab, ixekizumab, brodalumab], and IL-23 inhibitors (IL-23i) [guselkumab, tildrakizumab, risankizumab].[1] In Phase III clinical trials, approximately 65% of patients treated with IL-17i[7] have demonstrated 90% improvement in Psoriasis Area and Severity Index (PASI90) after 12 weeks of therapy, and approximately 74% of individuals treated with IL-23i achieved PASI90 after 16 weeks.[8] Despite the effectiveness of these therapies in clinical trials, response to biologics is not universal in a real-world setting.[9] Reasons for these variations in response to biologic therapies are not fully understood.

Treatment algorithms for managing moderate-to-severe psoriasis with biologics often are dependent on characteristics from specific patient populations (eg, pregnancy) and the presence or risk of exacerbation of comorbid diseases (eg psoriatic arthritis, chronic infections, inflammatory bowel disease, demyelinating disease, or heart failure).[10,11] Psoriasis is often accompanied by cardiometabolic-risk factor-type diseases that are similarly associated with chronic, systemic inflammation, such as type 2 diabetes mellitus, hypertension, hyperlipidemia, obesity.[12] Aside from contributing to poorer health, cardiometabolic risk factors have been shown to decrease biologic efficacy for various conditions.[13,14]

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Subanalyses of randomized controlled clinical trials indicate reduced efficacy of fixed-dose TNFi in the treatment of psoriasis among overweight and obese patients.[15–17] In contrast, randomized controlled clinical trials for IL-17i, IL-23i, and IL-12/23i have demonstrated equal effectiveness irrespective of body weight.[18–20] Although these trials offer valuable insights for clinicians, it is crucial to acknowledge that the observed favorable responses in the referenced studies may not be universal for everyone.

While biologic therapies may decrease incidence of myocardial infarctions[21] and onset of diabetes mellitus,[22] little research has been focused on how the presence of cardiometabolic comorbidities might be associated with response to biologic therapies. The purpose of this systematic review is to provide a qualitative evaluation of studies that have assessed PASI scores in patients with cardiometabolic comorbidities treated with biologic therapies.

Materials and Methods

This systematic review was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[23] A comprehensive literature search was performed for all studies evaluating psoriasis treatment with respect to cardiometabolic factors. All studies published from inception until January 2023 were identified in the PubMed, Medline (OVID), and Web of Science databases. The following search terms were used:

(psoriasis) OR (psoriatic) OR (psoriatic disease) OR (plaque psoriasis) OR (nail psoriasis) OR (scalp psoriasis)

AND

(comorbid) OR (comorbid disease) OR (cardiometabolic) OR (type 2 diabetes) OR (TIID) OR (metabolic syndrome) OR (diabetic) OR (diabetes) OR (obesity) OR (overweight) OR (nonalcoholic fatty liver disease) OR (metabolic disease) OR (comorbidities)

AND

(biologics) OR (biologic treatment) OR (certolizumab pegol) OR (Cimzia) OR (Cosentyx) OR (secukinumab) OR (enbrel) OR (etanercept) OR (humira) OR (adalimumab) OR (Ilumya) OR (tildrakizumab) OR (remicade) OR (infliximab) OR (Siliq) OR (brodalumab) OR (Skyrizi) OR (risankizumab) OR (Stelara) OR (ustekinumab) OR (Taltz) OR (ixekizumab) OR (tremfya) OR (guselkumab)

Article screening was completed by two independent investigators (A.O and A.T). Duplicate studies were removed, and the rest of the articles were screened by title and abstract. Peer-reviewed publications were included that were published in English, isolated psoriasis patients with cardiometabolic comorbidities, reported a PASI score, and reported any associations between patients with cardiometabolic comorbidities and disease progression when treated with biologics. Articles that did not isolate data for biologic treatments reported a PASI score, and did not isolate data on patients with cardiometabolic comorbidities were excluded. Similarly, articles that only evaluated the effects of biologics on cardiometabolic factors and not vice versa were excluded.

Included studies had the following categories of data collected: study design, patient demographics, study quality, study length, biologic drug used (if reported), cardiometabolic factor, effect on PASI score, type of psoriasis (if reported), and follow-up intervals (if reported).

Non-randomized studies were evaluated for study quality using the Methodological Index for Non-Randomized Studies (MINORS) score.[24] Categories were scored as 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate). Noncomparative studies featured 8 questions for the MINORS score with total scores ranging from 0 (poor study quality) to 16 (high study quality), while comparative studies featured 12 questions with total scores ranging from 0 to 24.

Due to heterogeneity of the data, only qualitative analysis was possible. Study demographics, biologic treatment, and PASI outcomes were reported separately for each study (Tables 1–3).

Results

Overall, 4756 articles were identified from databases. After removal of duplicates, 2305 articles were considered for inclusion. A total of 23 studies were included in the qualitative analysis (Figure 1). Eighteen of the 24 studies were not posthoc analyses for which the MINORS score was able to be calculated (Table 1). The average MINORS score for the included studies was 14.3 ± 3.1.

Table 1 Study Demographics and Study Quality of Included Studies

Author & Year	Study Type	Total Patients	% Male	Follow-Up Interval	MINORS Score
Enos (2022)[25]	Retrospective Cohort	2952	41.8%	6 months	16
Chiricozzi (2017)[26]	Retrospective Case Series	316	60.1%	Week 4, Week 12, Week 24, 1 year	17
Gkalpakiotis (2021)[27]	Retrospective Cohort	154	61.7%	Week 16, 28, and 52	11
Demirel Öğüt (2022)[28]	Prospective Case Series	82	57.3%	13 months (mean)	11
Karpinska-Mirecka (2021)[29]	Retrospective Case Series	20	40%	3 months	17
Narcisi (2023)[30]	Retrospective Cohort Study	237	59.9%	16 weeks	17
Notario (2019)[31]	Retrospective Case Series	136	71.3%	16 weeks	11
Petridis (2018)[32]	Prospective Observational Study	136	62.5%	14 ± 4; 30 ± 4, 54± 4 weeks	19
Pirro (2021)[33]	Retrospective Case Series	504	NR	Weeks 12 and 24	16
Bardazzi (2010)[34]	Retrospective Case Series	33	81.8%	4 months and 8 months	12
Rompoti (2020)[35]	Retrospective case series	85	75.3%	Weeks 4, 16, 52, and 78	11
Gargiulo (2022)[36]	Retrospective case series	131	70.2%	Weeks 16,28,40,52, and 104	11
Giunta (2016)[37]	Retrospective case series	66	57.6%	Weeks 12, 24. Years 1, 2, 3, and 4.	17
Hung (2021)[38]	Retrospective case series	135	77.8%	Weeks 0, 4, 12. 20. 28, and 36	17
Umezawa (2014)[39]	Retrospective case series	74	73.0%	16 weeks	11
Caldarola (2022)[40]	Retrospective cohort study	112	63.4%	4, 16, 28, and 52 weeks	17

Abbreviations: MINORS, Instrument for Assessing Methodological Quality of Non-Randomized Studies; NR, Not Reported.

Table 2 Findings of Included Studies

Author & Year	Cardiometabolic Comorbidity	Drug	Outcomes
Enos (2022)[9]	Obesity, Diabetes, Hypertension, Hyperlipidemia	TNFi, IL-17i, IL-23-I, or IL-12/23i	• Adjusted OR (95% CI) of achieving PASI90 ○ Obesity 0.70 (0.59, 0.81) ○ Diabetes 0.79 (0.63, 0.98) ○ Hypertension 0.84 (0.71, 1.01) ○ Hyperlipidemia 0.98 (0.82, 1.18) • Adjusted OR (95% CI) of achieving PASI75 ○ Obesity 0.75 (0.64, 0.88) ○ Diabetes 0.69 (0.56, 0.85) ○ Hypertension 0.81 (0.68,0.97) ○ Hyperlipidemia 1.02 (0.85, 1.22)
Chiricozzi (2017)[26]	Obesity/BMI	Adalimumab	• Psoriasis patient sub-cohort had a statistically significant higher number of PASI100 responders in the BMI <25kg/m^2 than the BMI >25kg/m^2 (P=0.021). • No significant differences found for PASI75 and PASI90.
Gkalpakiotis (2021)[27]	Obesity/BMI	Risankizumab	• Higher BMI was not statistically significant for achieving worse outcomes for achieving PASI90 or PASI100, however there was a correlation between the two.
Demirel Öğüt (2022)[28]	Obesity/BMI	Ixekizumab	• At week 4, PASI75 and PASI90 responses were lower in obese patients than non-obese patients (41.7% vs 78.3% and 33.3% vs 69.6%; p=0.028 and p=0.042, respectively). • The same result was seen for absolute PASI scores of <2, <3, and <5 at week 4 (p=0.001), p=0.035, and p=0.045 respectively.
Karpinska-Mirecka (2021)[29]	Hypertension, Diabetes, Lipid Disorders, BMI	Does not specify "biological agents"	• Hypertension, diabetes, lipid disorders, or BMI did not influence PASI scores after 3 months of biological agent treatment (p > 0.05)

(*Continued*)

Table 2 (Continued).

Author & Year	Cardiometabolic Comorbidity	Drug	Outcomes
Narcisi (2023)[30]	BMI	Tildrakizumab	• No BMI-related differences were observed in response to tildrakizumab therapy (p>0.05).
Notario (2019)[31]	Diabetes, Dyslipidemia, Hypertension	Secukinumab	• At week 16, the percentage of patients with a BMI greater than or equal to 30 who reached PASI75 and PASI90 response was significantly lower than those with a BMI of less than 30 (p < 0.01).
Petridis (2018)[32]	BMI	Infliximab	• BMI was not a risk factor for biologic response.
Pirro (2021)[33]	BMI	Secukinumab, Ustekinumab, Adalimumab, Etanercept, Ixekizumab	• After 12 and 24 weeks of therapy, PASI90 was achieved at a higher proportion in patients with a BMI of less than 30kg/m^2 (54.90% vs 43.45%; p = 0.014) and (66.84% vs 56.55%; p=0.021) respectively.
Bardazzi (2010)[34]	Obesity, Hypertension, Hyperlipidemia, Diabetes Mellitus	Adalimumab, Etanercept, Efalizumab, Infliximab	• Of the 26 patients with increased/unchanged weight, only 8 responded well to therapy (PASI75). • Of the 7 patients who lost weight, 6 achieved impressive results (PASI75).
Rompoti (2020)[35]	Obesity & "Metabolic Comorbidities"	Secukinumab	• Increased body weight and obesity (BMI greater than 30) negatively affected achievement of PASI100 at week 52. • Multivariate analysis demonstrated increased BMI and patients with more than 3 comorbidities to be at a risk of not achieving PASI at week 78 (P=0.024 and P=0.037 respectively).
Gargiulo (2022)[36]	BMI	Risankizumab	• An absolute PASI of less than or equal to 2 was reached by a significantly lower cohort of obese patients compared with overweight and normal weight patients at week 40 (75 vs 92.3 and 96%, respectively; p=0.041) • Same findings were found at week 52 (78.1 vs 96.2 and 96%, respectively; p = 0.038)
Giunta (2016)[37]	BMI	Etanercept	• PASI scores were significantly higher in obese patients than healthy weight or overweight patients (p<0.001).
Hung (2021)[38]	BMI	Guselkumab	• At week 4, patients with higher bodyweight were less likely to achieve PASI75 (p<0.006). • However, these results were no longer observed after week 4.
Umezawa (2014)[39]	Bodyweight and BMI	Ustekinumab	• Bodyweight greater than 80 kg and BMI greater than 25 showed fewer responders but was not statistically significant.
Caldarola (2022)[40]	Obesity	Risankizumab	• BMI had no impact on PASI75, PASI90, and PASI100

Abbreviations: BMI, Body Mass Index; PASI, Psoriasis Area & Severity Index; TNF, Tumor Necrosis Factor; IL, Interleukin; OR, Odds Ratio.

Table 3 Findings of Post-Hoc Analyses

Author & Year	Original Trial	Cardiometabolic Factors	Drug & Dosage	Outcomes
Pinter 2020[41]	FIXTURE, ERASURE, and CLEAR	• Body weight. • Waist Circumference • BMI • Metabolic Syndrome • Hypertension	• Secukinumab (300 mg) every week for 4 weeks and then every 4 weeks to Week 52. • Ustekinumab (45/90 mg) at Week 0 and 4 and then every 12 weeks. • Etanercept (50 mg)	• Mean body weight, waist circumference, and BMI were lower in the higher response groups of participants treated with secukinumab. • Metabolic Syndrome, hypertension, and diabetes was also associated with a poorer response in the secukinumab group. • Ustekinumab group had lower response in patients with diabetes, hypertension and metabolic syndrome. • Mean body weight, waist circumference, or BMI had no impact on the ustekinumab group. • Etanercept group showed diminished in response in patients with metabolic syndrome and those with a higher body weight.

(*Continued*)

Table 3 (Continued).

Author & Year	Original Trial	Cardiometabolic Factors	Drug & Dosage	Outcomes
Fernandez 2022[20]	reSURFACE 1 and reSURFACE 2	• Metabolic Syndrome	• Tildrakizumab (100 mg or 200 mg) at Weeks 0 and 4 and ever 12 weeks after.	• reSURFACE 1: At Week 28, 88.5%, 53.9%, and 26.9% of patients with metabolic syndrome receiving 100mg achieved a PASI 75/90/100 respectively compared to 86.7%, 60.2%, and 22.5% respectively without metabolic syndrome. • At week 244, 69.2%, 42.3%, and 15.4% of patients with metabolic syndrome achieved PASI 75/90/100 respectively compared to 82.7%, 54.1%, and 27.6% of the patients without metabolic syndrome respectively. • At Week 28, for the 200 mg group, 73.5%, 44.1%, and 23.5% of metabolic syndrome patients achieved PASI 75/90/100 respectively compared to 76.6%, 55.9%, and 31.5% without MetS respectively. • At Week 244, for the 200 mg group, 76.5%, 50.0%, and 23.5% of metabolic syndrome patients achieved PASI 75/90/100 respectively compared to 82.9%, 64.0%, and 33.3% without MetS respectively. • reSURFACE 2: At Week 28, 86.4%, 61.4%, and 34.1% of patients with metabolic syndrome receiving 100mg achieved a PASI 75/90/100 respectively compared to 92.8%, 72.5%, and 28.1% respectively without metabolic syndrome. • At week 244, 84.1%, 65.9%, and 31.8% of patients with metabolic syndrome achieved PASI 75/90/100 respectively compared to 91%, 69.5%, and 35.3% of the patients without metabolic syndrome respectively. • At Week 28, for the 200 mg group, 66.7%, 40.0%, and 20.0% of patients with metabolic syndrome patients achieved PASI 75/90/100 respectively compared to 64.6%, 51.5%, and 23.1% respectively without MetS. • At Week 244, for the 200 mg group, 76.7%, 43.3%, and 30.0% of metabolic syndrome patients achieved PASI 75/90/100 respectively compared to 86.9%, 59.2%, and 39.2% without MetS.
Hsu 2019[18]	AMAGINE 2 and AMAGINE 3	• Obesity	• Brodalumab (210 mg) every 2 weeks.	• Efficacy and safety of brodalumab did not differ between obese and non-obese patients.
Reich 2017[42]	UNCOVER-1 and UNCOVER-2 and UNCOVER 3	• Obesity	• Ixekizumab (80 mg) every 2 or 4 weeks.	• Greater body weight was generally associated with lower PASI scores across all participants.
Egeberg 2022[43]	UNCOVER-1 and UNCOVER 2 and UNCOVER 3	• Type 2 Diabetes (T2D) • Obesity	• Ixekizumab (80 mg) every 2 weeks until Week 12 and every 4 weeks after.	• Patients with T2D had a slower onset for achieving PASI100.

(*Continued*)

Table 3 (Continued).

Author & Year	Original Trial	Cardiometabolic Factors	Drug & Dosage	Outcomes
Lebwohl 2010[19]	PHOENIX 1 and PHOENIX 2	• Obesity	• Ustekinumab (45mg and 90 mg) every 12 weeks.	• Subpopulation of participants weighing >100 kg demonstrated higher PASI 75 response rates with 90 mg dose compared to 45 mg (P<0.001)

Abbreviations: MetS, Metabolic Syndrome; T2D, Type II Diabetes Mellitus; BMI, Body Mass Index; PASI, Psoriasis Area & Severity Index.

A total of 18 studies met inclusion criteria. Most studies (13/18) were published within the past five years (2018–2023). Plaque psoriasis was the primary analyzed form of psoriasis. Two studies included patients with psoriatic arthritis,[26,39] and one study included patients with psoriasis vulgaris and generalized pustular psoriasis.[39] A total of 7936 patients across all studies were evaluated for biologic efficacy and response. Follow-up time/intervals ranged from 3 months – 4 years to analyze long-term drug efficacy.

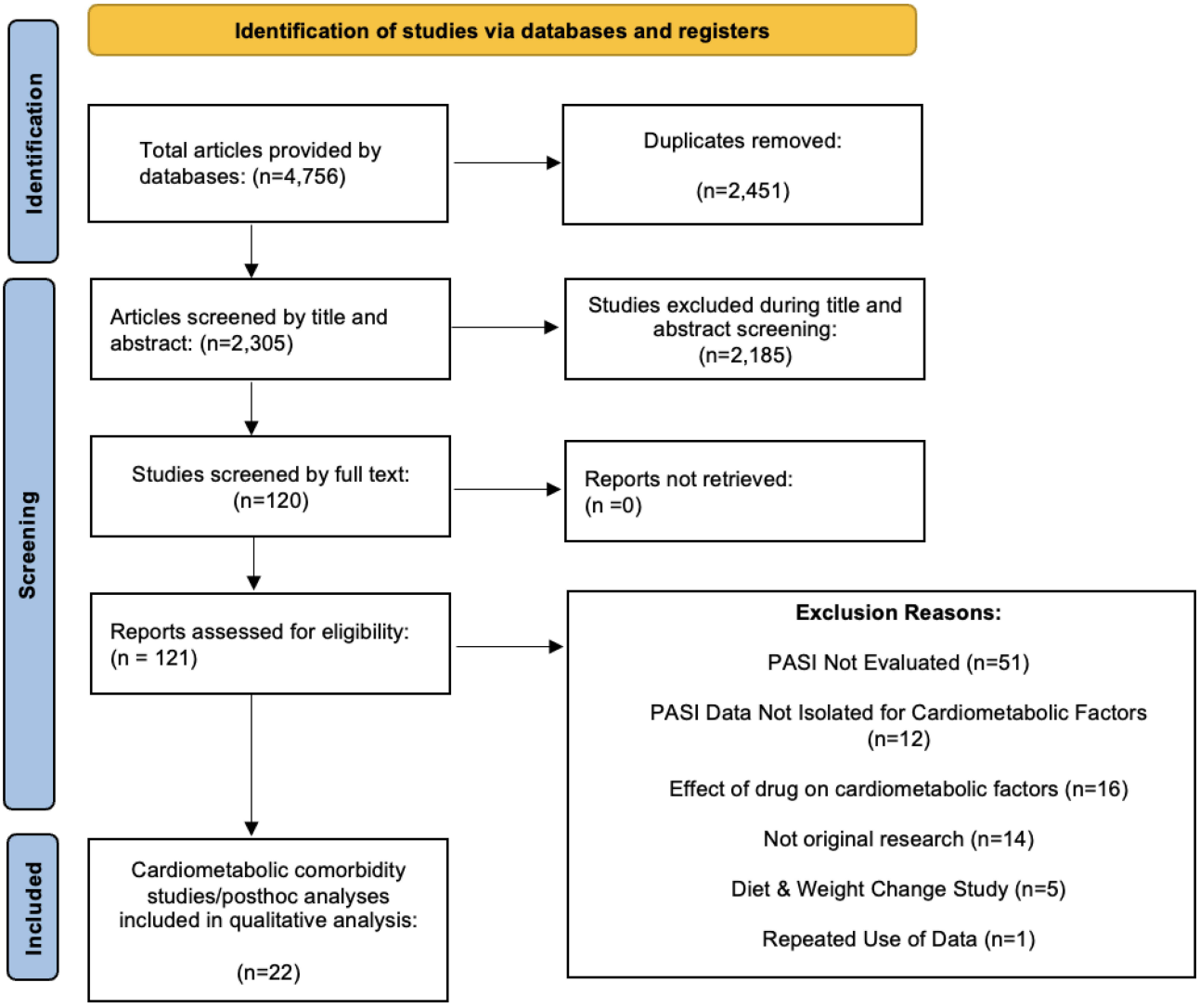

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Diagram of Included Studies.
Notes: PRISMA figure adapted from Liberati A, Altman DG, Tetzlaff J et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ*. 2009;339:b2700. Creative Commons.[23]

A total of 17 studies evaluated obesity/BMI as a cardiometabolic factor,[25–30,32–40,44] 4 studies evaluated diabetes,[25,29,31,34] 4 studies evaluated hypertension[25,29,31,34] and 4 studies evaluated lipid disorders.[25,29,31,34] Most of the studies tested drug efficacy for the IL-12/IL-23 inhibitors.[25,33,36,38–40,45] Seven papers also analyzed TNF inhibitors,[25,26,32–34,37,45] 5 analyzed IL-17 inhibitors[25,28,31,33,35] One study did not specify the class of the biologic and instead referred to treatment as biological agents.[29] Outcomes of each study are summarized in Table 2.

Several post-hoc analyses of randomized control trials were identified in the literature review. Posthoc analyses of the following randomized control trials were included: FIXTURE, ERASURE, CLEAR, reSURFACE 1, reSURFACE 2, AMAGINE 2, AMAGINE 3, and UNCOVER 1–3. Findings of each post-hoc analyses are shown in Table 3.

A total of 5 post-hoc analyses analyzed obesity/bodyweight/BMI.[18,19,41–43] Metabolic syndrome and T2D were the second most common cardiometabolic factor analyzed, with a total of 3 articles.[20,41,43] Finally, one posthoc analysis looked at hypertension in addition to metabolic syndrome and BMI.[41] Relevant outcomes of each posthoc analysis are summarized in Table 3.

Discussion

Here, in a qualitative systematic review of 23 manuscripts, we highlight response to biologics among patients with concurrent metabolic comorbidity. The average MINORS score of the non-randomized was a 14.2/24, indicating weaknesses in the methodology of some included studies.

Most of our included studies have assessed psoriasis treatment outcomes in patients with a high BMI/obesity,[25–30,32–40,44] which overwhelmingly highlight lower rates of achieving both PASI75 and PASI90. The majority of studies reported proportions of participants achieving PASI75, PASI90, and/or PASI100 based on BMI. Multiple studies also reported the effect of confounders on the odds of achieving PASI, with a focus on factors such as smoking, previous biologic treatment, alcohol consumption, and presence of a family history of psoriasis. One study calculated odds ratios of achieving PASI 75 and 90 based on associated comorbidities.[25] These results were found in almost all biologics used in the included studies, with some exceptions found during the use of Risankizumab,[27] infliximab,[32] brodalumab,[18] and in some cases adalimumab.[33] Pirro et al additionally found that patients with obesity had much higher rates of discontinuation of the drug, most likely due to the decreased levels of efficacy.[33] A posthoc analysis done by Lebwohl et al[19] demonstrated that patients weighing above 100kg benefited from the 90 mg dose of ustekinumab compared to the 45 mg dose. Aside from needing dosing adjustments, obese patients were also shown to have a slower response.[38] Hung et al found that although obese patients demonstrated a diminished response initially, this was no longer the case after four weeks of treatment with Guselkumab.[38] Further studies should be done that evaluate drug response in obese patients over a longer period, similarly to the reSURFACE clinical trial used to evaluate long-term impacts of metabolic syndrome.[20]

Type II Diabetes/Metabolic Syndrome were also commonly studied, with nearly every study finding lower frequencies of achieving PASI75 & PASI90 in patients with these comorbidities. In the post-hoc analysis conducted by Pinter et al, etanercept specifically showed a diminished response in patients with metabolic syndrome.[41] The same result was found for tildrakizumab in the post-hoc analysis conducted by Fernandez et al.[20] Enos et al found that patients with a history of diabetes showed decreased odds of PASI75 and PASI90 at 6 months following biologic initiation.[25]

Of the studies evaluating hypertension, two found an association between diminished drug responses and hypertension.[25,41] Using real-world data, Enos et al found that, overall, patients with hypertension had lower odds ratios of achieving PASI75.[25] Additionally, Pinter et al conducted a post-hoc analysis of multiple randomized control trials finding that patients in the lower response category to secukinumab had higher rates of ongoing hypertension.[41] Due to hypertension often being one of the many symptoms of metabolic syndrome, it is difficult to say how much hypertension specifically is related to poorer drug response. Future studies should isolate hypertensive patients when looking at odds of achieving a proper biologic response.

Only two of the studies included in this review analyzed hyperlipidemia as a cardiometabolic factor. Neither study found an association between hyperlipidemia and a biologic response. Similar to hypertension, hyperlipidemia is often one of the many symptoms of metabolic syndrome, making it difficult to assess how much of a direct effect it had in the studies evaluating metabolic syndrome.

Overall, psoriasis patients with cardiometabolic factors less frequently achieved PASI75 and PASI90 response when treated with biologics. An overwhelming number of studies focus on obesity/increased BMI. Future studies should explore other cardiometabolic factors such as diabetes mellitus, hypertension, and hyperlipidemia to assess for associations with treatment response to biologics. Such studies could aid in a more tailored care plan for patients on an individual level.

Limitations

Due to heterogeneity of the data, only a qualitative analysis of the data was possible. Additionally, all systematic reviews have an element of selection bias based on the keywords and journals selected by the primary and co-investigators. Additionally, the included studies had a low average MINORS score, indicating limitations in the methodology of the studies. Few studies factored in lifestyle factors, treatment adherence, or other confounding variables in their analysis of the results. Other limitations of this review are that few studies assess multiple agents, the population size varies for each study, and there is a difference in follow-up for each study included in this review.

Conclusion

Multiple published studies have demonstrated a poorer response to biologic treatment of psoriasis in the presence of cardiometabolic factors such as obesity, hypertension, type II diabetes, and other cardiometabolic disorders. With multiple studies pointing to a diminished rate of achieving PASI scores in the presence of cardiometabolic comorbidities, and the observed benefit of weight-based dosing for ustekinumab and infliximab in the presence of obesity,[19] future clinical investigations should focus on designing trials with biologic dose adjustments when comorbidities are present. Additional further research is also needed to understand the underlying mechanisms behind the associations of cardiometabolic risk factors and poorer response to biologic therapies. It is recommended that clinicians assess the comorbid disease status of psoriasis patients when developing a therapeutic care plan to optimize their care.

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