The prevalence and odds of anxiety and depression in children and adults with hidradenitis suppurativa: Systematic review and meta-analysis

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Background: Hidradenitis suppurativa (HS) is a chronic inflammatory skin disorder. Previous studies have yielded divergent results on the prevalence of depression and anxiety in patients with HS.

Objective: The aim of this meta-analysis was to provide a pooled estimate of the prevalence and odds of depression/anxiety in patients with HS.

Methods: Search for and extraction of relevant literature without restrictions from 5 databases (Cochrane Database, EMBASE, PubMed, PsycINFO, Science Direct) were performed. Pooled meta-analyses were made by using random-effects models.

Results: Meta-analyses of 28 studies of depression in HS and 12 of anxiety showed a prevalence of 21% (95% CI [17-25]) of depression and 12% (95% CI [6-17]) of anxiety in patients with HS, with very wide variations in both cases. Analysis of case-control studies showed an association between depression and HS (odds ratio, 1.99 95% CI [1.63-2.43]) and between anxiety and HS (odds ratio, 1.97 95% CI [1.65-2.35]).

Limitations: The results of this meta-analysis are conditioned by the limitations of the studies included and by differences in patient populations, methodologic approach, and data available.

Conclusion: Patients with HS have a high burden of depression and anxiety. Our results show that clinicians need to be vigilant for the presence of depression or anxiety and to refer patients when appropriate. (J Am Acad Dermatol 2020;83:542-53.)

Key words: anxiety; depression; hidradenitis suppurativa; meta-analysis; systematic review.

Hidradenitis suppurativa (HS) is a chronic follicular occlusive disease involving the folliculopilosebaceous unit. Clinically, patients have recurrent inflamed follicular lesions, nodules, and abscesses, leading to draining sinus tract formation and severe scars in the intertriginous areas.

The association between certain chronic inflammatory skin diseases and psychiatric disorders has been widely studied. Systematic reviews or meta-analyses of the prevalence of depression or anxiety in psoriasis, alopecia areata, and atopic dermatitis (AD) have been published.[1-4] A recent meta-analysis

showed a positive significant association between HS and the risk of suicide.[5] Previous observational and registry studies on the prevalence of depression and anxiety in patients with HS yielded divergent results.[6] A meta-analysis proposed prevalence rates of anxiety and depression based on 4 and 10 observational studies, respectively, in adult patients with HS.[7] First, the exact magnitude of the association between HS and anxiety is still unknown, since the 4 studies included failed to establish an odds ratio (OR). Second, the limited number of studies failed to test many factors that could affect prevalence. Third, numerous further studies have been published recently, and hence, a new meta-analysis would provide more accurate results. Therefore, we aimed to make a pooled estimate of the prevalence and odds of depression/anxiety in patients with HS and to study the relationship between variations in prevalence and study characteristics.

CAPSULE SUMMARY

- Divergent results on psychiatric prevalence in patients with hidradenitis suppurativa have been published.

- These meta-analyses show a positive significant association between hidradenitis suppurativa and depression/anxiety.

- Dermatologists should screen for depression/anxiety in patients with hidradenitis suppurativa and refer them for psychiatric evaluation and appropriate treatment when necessary.

MATERIALS AND METHODS
Literature search

The search for and extraction of relevant literature from 5 medical databases (Cochrane Database, EMBASE, PubMed, PsycINFO, Science Direct) were conducted by 2 authors (IJ and FR) from inception to May 2019 using the following search terms: *hidradenitis suppurativa* OR *acne inversa* AND *depression* OR *anxiety* OR *generalized anxiety disorder* OR *phobia* OR *panic disorder* OR *panic* OR *obsessive compulsive disorder* OR *OCD*. No limits were set on language, year of publication, age of study participants, or study size. All articles were screened according to title and abstract independently by 2 authors (IJ and FR). Additionally, studies were sought by screening reference lists of previous key or review articles. Recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) were followed.[8] In France, ethics approval is not required for this type of research.

Only articles with full text access were retained; those with access to only an abstract were excluded. The full-text articles were independently assessed for inclusion by 2 authors (LC and FR). If several articles analyzed data from the same cohort, we included the article with the most complete data. All disagreements between the reviewers were adjudicated by consensus between 3 authors (FR, LC, and IJ).

Data extraction

Two of the authors extracted and tabulated data and checked for accuracy (LC and FR). The data collected were sociodemographic (proportion of female patients included and mean age), medical (mean duration of HS, Hurley stage, proportion of smokers, and number of patients/control individuals with depression/anxiety), and methodologic (prospective or retrospective study, number of patients included, method of depression/anxiety assessment, and presence of control individuals).

Risk of bias

Three authors (FR, LC, and IJ) assessed the risk of bias for all studies with a specific instrument that has high interrater agreement in the assessment of risk of bias in studies measuring disease prevalence.[9] Disagreements between the reviewers were adjudicated by consensus between 3 of the authors. We included all studies irrespective of their risk of bias.

Statistical analysis

Statistical analysis was performed with Stata software, version 13 (StataCorp, College Station, TX). Study characteristics were summarized and reported as mean and standard deviation for continuous parameters and as percentage for categorical variables.

The meta-analysis took into account between- and within-study variability. To address the nonindependence of data caused by study effect, random-effects models[10] were preferred over the usual statistical tests to evaluate the prevalence of anxiety and depression. For stratified analyses according to the diagnostic tool used and for comparison between cases and controls, the same statistical approach was adapted. Results were expressed as prevalence and 95% confidence intervals (CIs). Heterogeneity in the study results was assessed by examining forest plots and using the I^2 statistic, which is the most common metric for measuring the magnitude of between-study

Abbreviations used:

CI: confidence interval
EC: estimated coefficient
HS: hidradenitis suppurativa
OR: odds ratio

heterogeneity and is easily interpretable. I^2 values range between 0% and 100% and are typically considered low for 25%, modest for 25% to 50%, and high for 50%.[11] Publication bias was assessed by funnel plots and confidence intervals. When possible (sufficient sample size), metaregressions were proposed to study the relationship between variations of prevalence and study characteristics such as assessment method, risk of bias, number and age of patients included, proportion of smokers and Hurley stage 3 patients included, and study design (prospective or retrospective). Results were expressed as regression coefficients (estimated coefficient [EC]) and 95% CI.

Finally, to verify the robustness of the results, sensitivity analyses were made excluding studies that were not evenly distributed around the base of the funnel. A sensitivity analysis was also performed to study the prevalence estimate only for those studies for which a case-control comparison was possible, to ensure the representativeness in terms of prevalence of this subsample.

RESULTS

A total of 356 and 120 articles on depression and anxiety, respectively, were identified. After screening of the titles and abstracts and removal of duplicates, 65 and 33 articles, respectively, remained and were submitted to full-text review. Of these articles, 37 on depression and 21 on anxiety were excluded. A total of 28 and 12 articles were included in the meta-analysis for depression and anxiety, respectively (Fig 1).

HS and depression

The 28 studies selected for the meta-analysis of the prevalence of depression are given in Table I.[12-39]

The meta-analysis showed a high prevalence of depression in patients with HS (21% 95% CI [17-25]) with very wide variations (I^2 = 99.7%). Prevalence varied according to the diagnostic tool used, from 10% (95% CI [5-15]) in studies based on medical records and the International Classification of Diseases/*Diagnostic and Statistical Manual of Mental Disorders* classification to 31% (95% CI [26-36]) in those involving self-administered

questionnaires (Fig 2). These results were confirmed by a metaregression analysis, which indicated that prevalence was significantly higher in surveys with self-administered questionnaires (EC, 0.21; 95% CI, 0.12-0.30; $P < .001$). Variations between the studies can also be explained by study design, with retrospective studies recording a lower prevalence than prospective ones (EC, −0.09; 95% CI, −0.19 to −0.01; $P = .035$), and by patient numbers, with studies including more than 500 patients recording a lower prevalence of depression (EC, −0.15; 95% CI −0.25 to −0.05; $P = .005$). In contrast, patient age, proportion of smokers, proportion of Hurley stage 3 patients, and bias risk had no effect on prevalence.

Analysis of the 10 case-control studies, comprising 78,129 patients and 14,086,989 control individuals, showed an association between depression and HS (OR, 2.03; 95% CI, 1.67-2.48, $P < .001$) (Supplemental Fig 1; available via Mendeley at DOI: http://dx.doi.org/10.17632/kwmh7vb9zh.1#file-5c6f68d5-9887-47f3-b098-474d3c925887). Even after exclusion of 1 study (using a self-administered questionnaire) for funnel plot publication bias (Supplemental Fig 2; available via Mendeley at DOI: http://dx.doi.org/10.17632/kwmh7vb9zh.1#file-5c6f68d5-9887-47f3-b098-474d3c925887), the association was still present (OR, 1.99; 95% CI, 1.63-2.43, $P < .001$) (Fig 3). Sensitivity analysis showed that the prevalence of depression in patients from the case-control studies was close to that observed in our meta-analysis (17% 95% CI [10-24] before exclusion of the biased article and 15% 95% CI [8-23] after exclusion).

HS and anxiety

The 12 studies selected for the meta-analysis of the prevalence of anxiety are listed in Table I.[20,21,26,27,29,32-36,39,40]

The meta-analysis showed anxiety to have a prevalence of 12% (95% CI [6-17]) in patients with HS with very wide variations (I^2 = 99.9%). Prevalence varied according to the diagnostic tool used, from 6% (95% CI [1-11]) in studies based on medical records and the International Classification of Diseases/*Diagnostic and Statistical Manual of Mental Disorders* classification to 25% (95% CI [13-36]) in those using self-administered questionnaires (Fig 4). These results were confirmed by a meta-regression analysis, which indicated that prevalence was significantly higher in surveys with self-administered questionnaires (EC, 0.19; 95% CI, 0.05-0.32; $P = .011$). Variations between the studies can also be explained by study design, with retrospective studies recording a lower prevalence than
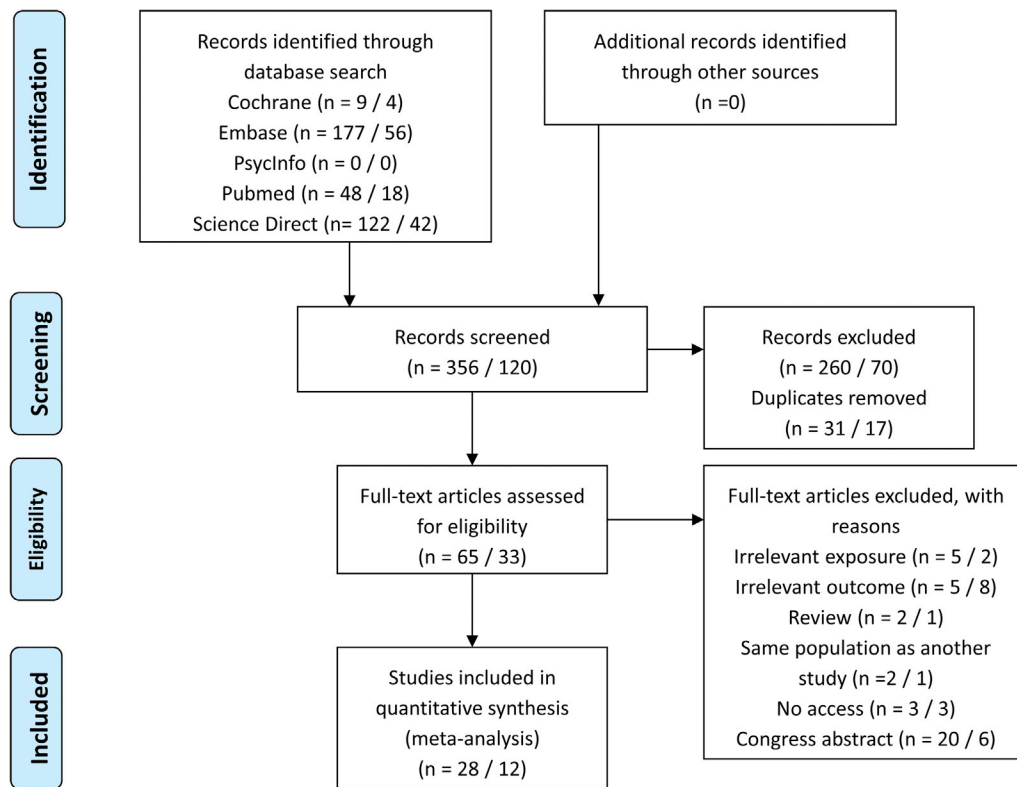
Fig 1. Flow diagram of article selection for the meta-analysis (Preferred Reporting Items for Systematic Reviews and Meta-analyses [PRISMA] 2009). The values represent the number of articles on depression/number of articles on anxiety.

prospective ones (EC, −0.16; 95% CI, −0.28 to −0.04; *P* = .012). Patient age, sample size, proportion of smokers included, and bias risk had no effect on prevalence.

Analysis of the 7 case-control studies (all retrospective), comprising 77,712 patients and 100,994,135 controls, showed an association between anxiety and HS (OR, 1.97; 95% CI, 1.65-2.35, *P* < .100) (Fig 5). The results were similar irrespective of the diagnostic tool used. Sensitivity analysis showed that the prevalence of anxiety in patients from the case-control studies was close to that observed in our meta-analysis (9% 95% CI [2-16]).

DISCUSSION
Main findings

This study showed a positive and significant association between HS and depression and anxiety. Additionally, it shows that the prevalence of both depression and anxiety varies according to the assessment method used (with prevalence being higher in studies using self-administered questionnaires) and study design (with prevalence being lower in retrospective studies).

Interpretation

Our meta-analysis was based on 28 studies of depression in 93,935 patients and 12 studies of anxiety in 78,326 patients. A previous article analyzed depression in 10 studies involving 40,307 patients (9 full-text articles and 1 abstract) and anxiety in 4 studies involving 15,533 patients (3 full-text articles and 1 abstract).[7] Of the 19 full-text additional articles of depression incorporated in the present meta-analysis, 7 included control individuals, 11 were retrospective and used medical records, and 8 were prospective and based on self-administered questionnaires. The number of patients per study ranged from 17 to 32,625. Of the 9 full-text additional articles of anxiety incorporated in the present article, 6 were retrospective and used medical records, and 3 were prospective and based on self-administered questionnaires. The number of patients per study ranged from 17 to 24,266. Among the additional studies analyzed, 7 on depression and 5 on anxiety comprised pediatric patients. The inclusion of these publications provided an accurate and reliable estimate of the prevalence rates of depression/anxiety and their association with HS and enabled us to assess various factors likely to

Table I. Description of selected studies

Study	Diagnosis	Assessment method	Design	Number of patients	Control individuals	Mean age, y	Age category	Female, %	Smokers, %	HS duration, y	Hurley 1, %*	Hurley 2, %*	Hurley 3, %*	Risk of bias
2010 Matusiak et al[12]	Depression	Self-questionnaire	Prospective	52	—	39.9	Adults	52	—	10.2	24	54	22	Moderate
2013 Kurek et al[13]	Depression	Self-questionnaire	Prospective	44	Healthy	34.3	Adults	55	—	10.0	—	—	—	Moderate
2013 Onderdijk[14]	Depression	Self-questionnaire ICD medical records	Prospective	211	Other†	43.0	Adults	—	—	16.8	30	56	13	Low
2013 Vazquez et al[15]	Depression	Medical records	Retrospective	268	—	—	Children and adults	71	57	—	60	38	2	Low
2014 Crowley et al[16]	Depression	Self-questionnaire	Prospective	154	—	36.3	Adults	71	55	11.9	16	55	29	Moderate
2014 Wormald et al[17]	Depression	Medical records	Prospective	27	—	34.7	Adults	70	41	—	—	—	100	High
2015 Khalsa et al[18]	Depression	ICD medical records	Retrospective	7901	Other†	36.2	Adults	75	—	—	—	—	—	Moderate
2015 Patel et al[19]	Depression	Medical records	Retrospective	112	Healthy	—	Adults	84	36	—	—	—	—	Moderate
2015 Shavit et al[20]	Anxiety and depression	Medical records	Retrospective	3207	Healthy	39.6	Children and adults	62	—	—	—	—	—	Low
2016 Humphries et al[21]	Anxiety and depression	Medical records	Retrospective	17	—	36.8	Adults	77	47	10.5	—	—	—	High
2016 Santos et al[22]	Depression	ICD medical records	Retrospective	1177	—	—	Children and adults	54	14	—	—	—	—	Low
2016 Vangipuram et al[23]	Depression	Medical records	Retrospective	283	—	—	Adults	81	50	—	46	36	19	Low
2017 Kirby et al[24]	Depression	Self-questionnaire	Prospective	154	—	40.9	Adults	84	—	—	—	—	—	Moderate
2017 Kluger et al[25]	Depression	Self-questionnaire	Prospective	26	—	44.2	Adults	62	77	18.4	50	42	8	High
2018 Garg et al[26]	Anxiety and depression	Medical records	Retrospective	32,625	Healthy	—	Adults	76	—	—	—	—	—	Low
2018 Huilaja et al[27]	Anxiety and depression	ICD medical records	Retrospective	4372	Healthy	39.6	Children and adults	59	—	—	—	—	—	Low
2018 Ingram et al[28]	Depression	Medical records	Retrospective	24,027	Healthy	—	Children and adults	—	—	—	—	—	—	Low
2018 Kimball et al[29]	Anxiety and depression	DSM 5 medical records	Retrospective	5357	Healthy	42.2	Adults	72	—	—	—	—	—	Low

Study	Disorder	Assessment	Design	N	Control	Age	Population							Quality
2018 Kjaersgaard Andersen et al[30]	Depression	Self-questionnaire	Prospective	503	—	41.0	Adults	79	53	21.0	—	—	—	Low
2018 Ramos Rodriguez et al[31]	Depression	ICD medical records	Retrospective	4369	Other[†]	—	Adults	62	—	—	—	—	—	Moderate
2018 Thorlacius et al[32]	Anxiety and depression	ICD medical records	Prospective	7732	Healthy	45.8	Adults	74	27	9.6	—	—	—	Low
2018 Tiri et al[33]	Anxiety and depression	ICD medical records	Retrospective	153	Healthy	15.6	Children	73	—	—	—	—	—	Low
2019 Butt et al[34]	Anxiety and depression	Self-questionnaire	Prospective	229	—	40.8	Adults	83	—	—	—	—	—	Moderate
2019 Nielsen et al[35]	Anxiety and depression	Self-questionnaire	Prospective	91	—	—	Adults	81	—	—	—	—	—	Moderate
2019 Patel et al[40]	Anxiety	Medical records	Retrospective	24,266	Healthy	41.3	Children and adults	60	—	—	—	—	—	Low
2019 Pavon Blanco et al[36]	Anxiety and depression	Self-questionnaire	Prospective	211	—	38.2	Adults	60	41	—	21	29	50	Low
2019 Senthilnathan et al[37]	Depression	Self-questionnaire	Prospective	67	—	39.3	Adults	90	—	—	—	—	—	Moderate
2019 Theut Riis et al[38]	Depression	—	Prospective	500	Healthy	36.6	Adults	50	18	—	—	—	—	Moderate
2019 Zimman et al[39]	Anxiety and depression	Medical records	Retrospective	66	—	37.0	Children and adults	65	59	—	42	36	21	High
Total anxiety	N = 12	9 medical records[‡] 3 self-questionnaires	4 Prospective 8 Retrospective	78,326	7[§]	37.7	1 Children 6 Adults 5 Mixed	70	41	—	—	—	—	8 Low 2 Moderate 2 High
Total depression	N = 28	18 medical records[‡] 9 self-questionnaires	13 Prospective 15 Retrospective	93,935	10[§]	38.1	1 Children 21 Adults 6 Mixed	70	43	14.8	35	41	20	13 Low 11 Moderate 4 High

DSM5, Diagnostic and Statistical Manual of Mental Disorders; ICD, International Classification of Diseases.

*Hidradenitis suppurativa severity was assessed according to the 3 Hurley stages.

[†]Other control individuals are patients of other dermatologic diseases in 2 studies and patients with inflammatory bowel disease in 1 study. Only studies with healthy control individuals were included in the case-control comparison.

[‡]The total medical records include medical records with ICD/DSM classification and unspecified medical records in the following ratios: 4/5 for anxiety and 9/9 for depression.

[§]These values represent the number of studies with healthy control individuals that were included in the case-control comparison.
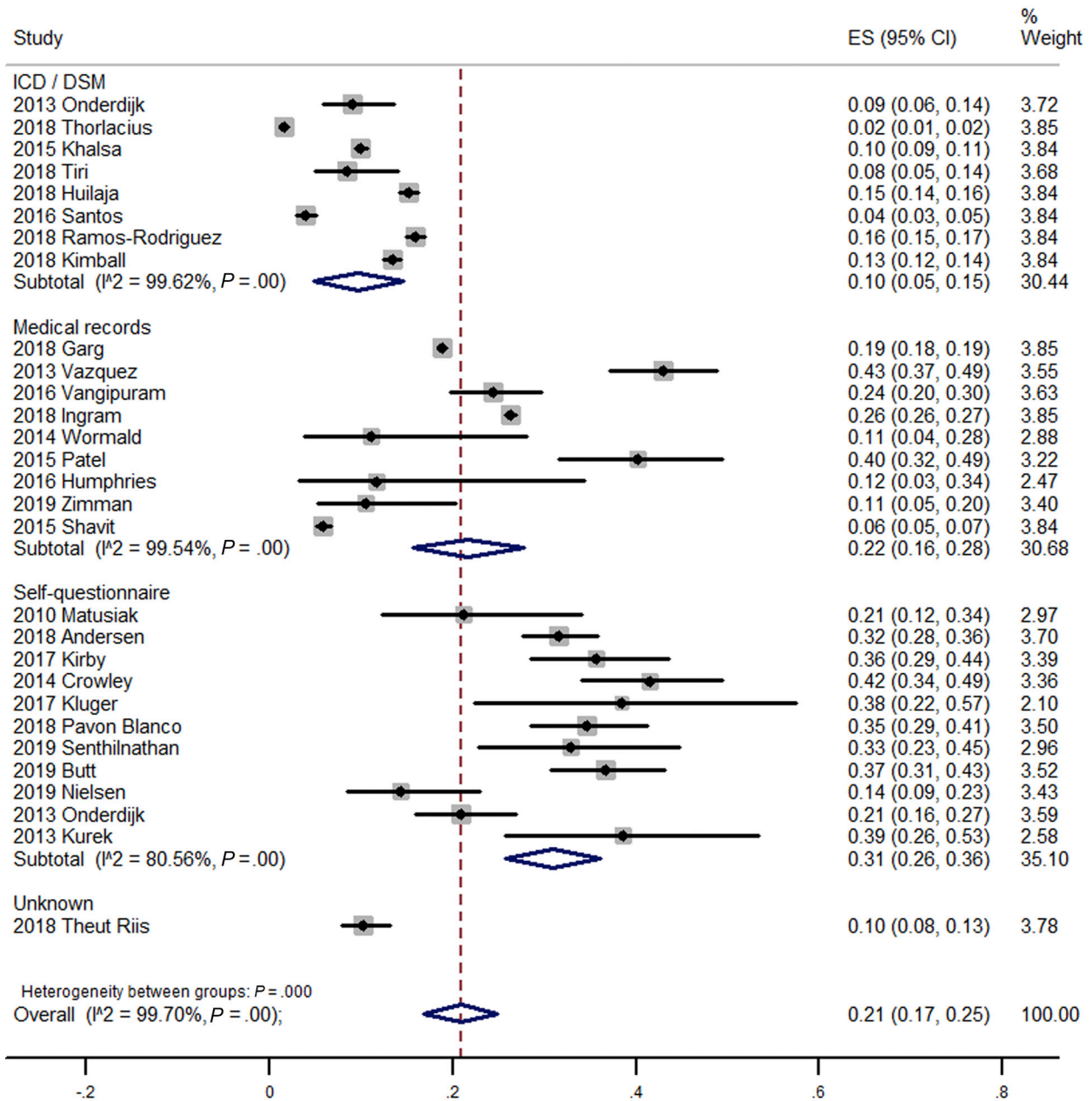
Fig 2. Meta-analysis of the prevalence of depression according to diagnostic tool. *CI*, Confidence interval; *DSM5*, *Diagnostic and Statistical Manual of Mental Disorders*; *ES*, effect-size (estimated prevalence); *ICD*, International Classification of Diseases.

affect prevalence such as sample size, study design, and patient age.

We observed a higher overall prevalence of depression (21%) among patients with HS than in the general population.[41,42] This overall prevalence of depression is slightly higher than that obtained in the article by Machado et al[7] (17%). We determined a pooled OR for depression (1.99) that is close to that obtained by Machado et al (1.84).

We observed a higher overall prevalence of anxiety (12%) among patients with HS than that obtained in a previous article (5%).[7] The 4 studies included by Machado et al[7] did not allow calculation of OR for anxiety. In our study, the OR determined was 1.97, showing a positive and significant association between HS and anxiety.

There are several possible explanations of the increased association between HS and depression or anxiety. Pain, malodorous sweating, and recurrent
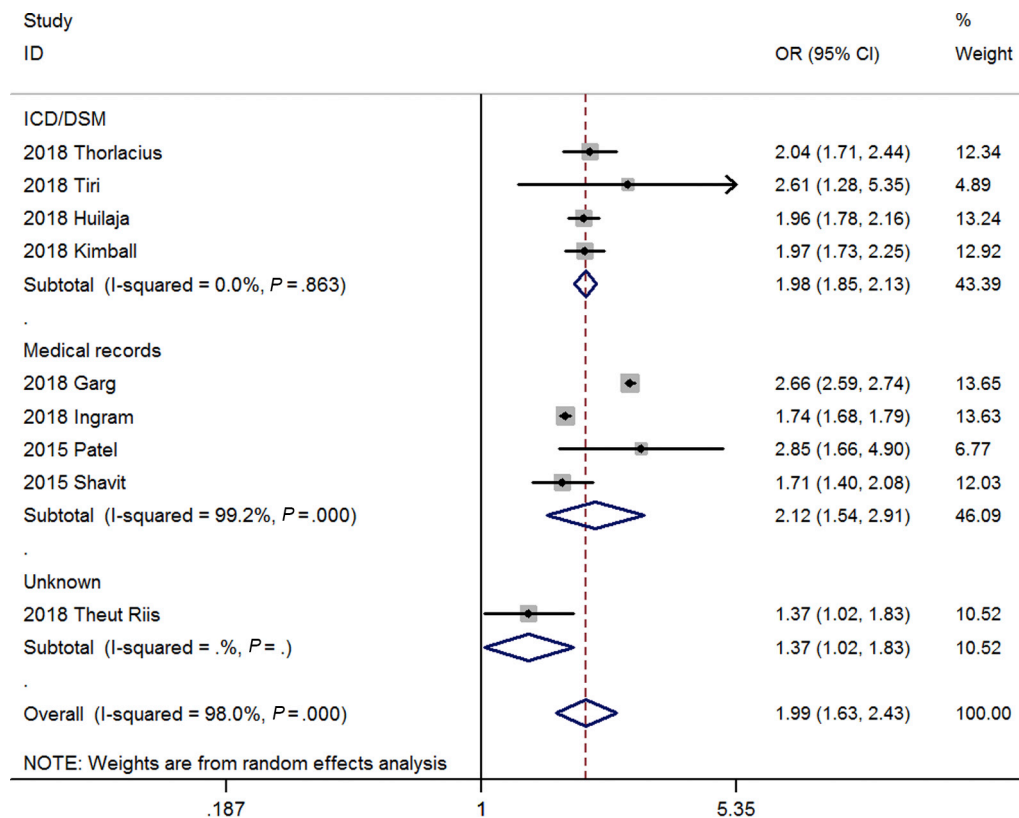
Fig 3. Odds ratio meta-analysis of the association between depression and hidradenitis suppurativa. *CI*, Confidence interval; *ID*, identification; *OR*, odds ratio.

fistula and scars impair social and professional activity and love and sexual life. HS significantly reduces quality of life,[6,43] particularly in terms of mental health.[44] This is why a specific quality of life scale currently in development, the HS-QoL-v2,[45] includes items on emotional consequences such as depression and anger. In addition, HS has been associated with cigarette smoking and comorbidities such as inflammatory bowel disease, cardiovascular disease, and obesity, which are themselves associated with depression and anxiety.[6,43] Finally, there is some evidence that inflammation could be a contributor to depression/anxiety comorbidity in inflammatory skin diseases.[46]

We observed a high heterogeneity across studies for which we suggest several explanations. A major reason for the variation in prevalence rates for both depression and anxiety is the manner in which depression/anxiety is evaluated. The highest prevalence rates were seen in studies using self-report instruments, which are likely to overestimate the prevalence of depression or anxiety. This tendency has been observed in the community,[41] in other chronic medical illnesses,[47,48] in psoriasis and in the article of Machado et al.[7] The appropriateness and different cutoff scores of the diagnostic tools to assess clinically significant symptoms could also have contributed to the very wide variations. More importantly, screening tools, compared with methods that use a formal diagnosis of depression/anxiety, can reveal only probable depression/anxiety. A structured clinical psychiatric interview represents the criterion standard.

Meta-regression analyses showed that variations can also be attributed to study design and the number of patients included in the studies, with lower prevalence being found in retrospective surveys and in studies involving 500 patients or more. These 2 factors are closely linked to the method of assessment because retrospective studies are based on medical records and allow inclusion of more patients. We know that the prevalence rates in studies based on medical records are lower than in those using self-report instruments. In addition, the risk of false negatives in these studies should not be underestimated: if there is not sufficient information about depression/anxiety or if the patient has not been assessed, the uncollected data will not be recorded.

Machado et al[7] showed no effect of risk of bias (with a scale often used for assessing risk of bias despite some limitations[49-51]) nor of patient age on
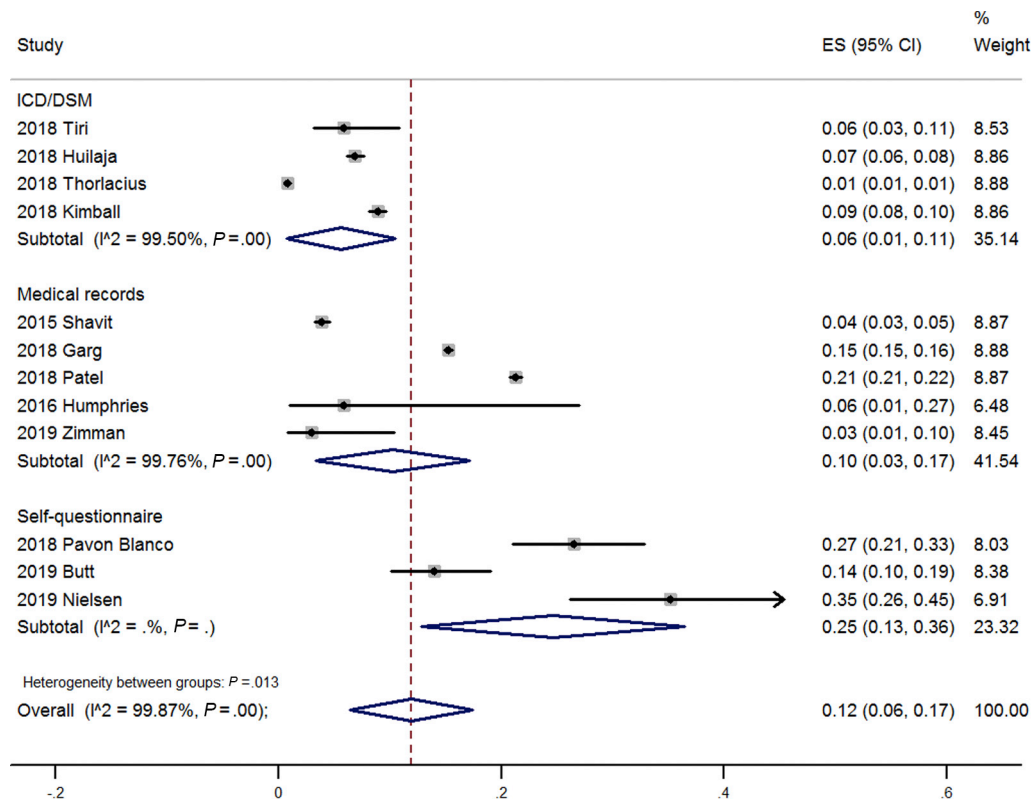
Fig 4. Meta-analysis of the prevalence of anxiety according to diagnostic tool. *CI*, Confidence interval; *DSM5*, *Diagnostic and Statistical Manual of Mental Disorders*; *ES*, effect-size (estimated prevalence); *ICD*, International Classification of Diseases.
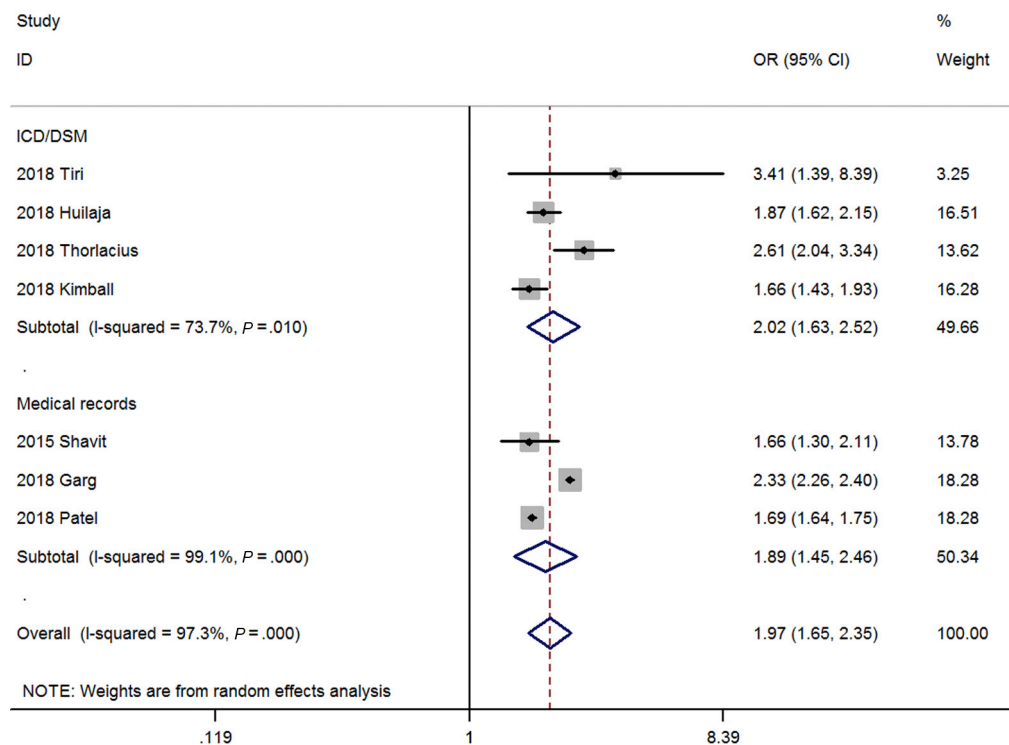
Fig 5. Odds ratio meta-analysis of the association between anxiety and hidradenitis suppurativa. *CI*, Confidence interval; *ID*, identification; *OR*, odds ratio.

the prevalence of depression (but the studies included had similar age groups: 34.3 to 45.8 years range of mean ages). However, the use of a specific tool[9] and the integration of studies including children had no effect on prevalence in our meta-analysis. Other meta-regression analyses failed to explain prevalence variations, but for some factors, the lack of data made it impossible to show any difference or to assess their effect on prevalence.

Prospective studies with large population-based samples based on a structured or semistructured clinical psychiatric interview with a record of patients' dermatologic data would make it possible to assess the specific prevalence of depression and anxiety disorders such as generalized anxiety, social anxiety, panic disorder, and agoraphobia stating the prevalence period studied.[52-56]

Limitations

Our meta-analysis was conditioned by the limitations of the studies included. Most of the studies did not provide sufficient details about the patients enrolled, such as the respective proportions of children and adults, the severity of HS (only 9 of the 28 studies on depression and 2 of the 12 on anxiety mentioned the Hurley stage), smoking, and somatic comorbidities, which in certain patients had known associations with depression or anxiety. In the retrospective studies, data were collected over widely varying periods. In studies of alopecia areata, it was observed in 50% of patients that psychiatric disorders pre-existed before skin disease onset.[57] In contrast, in the HS studies included in the present work, the time elapsed between the onset of depression or anxiety and that of HS was not given. Additionally, owing to lack of information in most of the studies included, we were unable to take into account psychological or pharmacologic treatments that can modify mood or anxiety. Finally, the variables retrieved from declarative data in some studies also represented a limitation.

CONCLUSION

This study shows that patients with HS have a high burden of depression and anxiety. Prospective studies with large population-based samples based on a structured or semistructured clinical psychiatric interview should now be performed to refine the analysis. For the immediate future, however, our results show that clinicians need to be vigilant to the presence of depression or anxiety and to assess whether patients with the conditions should be referred for psychiatric evaluation and appropriate treatment.

REFERENCES

1. Dowlatshahi EA, Wakkee M, Arends LR, Nijsten T. The prevalence and odds of depressive symptoms and clinical depression in psoriasis patients: a systematic review and meta-analysis. *J Invest Dermatol.* 2014;134(6):1542-1551.
2. Fleming P, Bai JW, Pratt M, Sibbald C, Lynde C, Gulliver WP. The prevalence of anxiety in patients with psoriasis: a systematic review of observational studies and clinical trials. *J Eur Acad Dermatol Venereol.* 2017;31(5):798-807.
3. Lee S, Lee H, Lee CH, Lee W-S. Comorbidities in alopecia areata: a systematic review and meta-analysis. *J Am Acad Dermatol.* 2019;80(2):466-477.e16.
4. Rønnstad ATM, Halling-Overgaard A-S, Hamann CR, Skov L, Egeberg A, Thyssen JP. Association of atopic dermatitis with depression, anxiety, and suicidal ideation in children and adults: a systematic review and meta-analysis. *J Am Acad Dermatol.* 2018;79(3):448-456.e30.
5. Phan K, Loya A, Ramachandran V, Smith SD. Hidradenitis suppurativa and risk of suicide—systematic review and meta-analysis [Epub ahead of print]. *J Dermatolog Treat.* 2019 May 7: 1-2.
6. Matusiak Ł. Profound consequences of hidradenitis suppurativa: a review [Epub ahead of print]. *Br J Dermatol.* 2018. https://doi.org/10.1111/bjd.16603. Published online May 9, 2018.
7. Machado MO, Stergiopoulos V, Maes M, et al. Depression and anxiety in adults with hidradenitis suppurativa: a systematic review and meta-analysis. *JAMA Dermatol.* 2019; 155:939-945.
8. 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.
9. Hoy D, Brooks P, Woolf A, et al. Assessing risk of bias in prevalence studies: modification of an existing tool and evidence of interrater agreement. *J Clin Epidemiol.* 2012; 65(9):934-939.
10. DerSimonian R, Laird N. Meta-analysis in clinical trials revisited. *Contemp Clin Trials.* 2015;45(Pt A):139-145.
11. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ.* 2003;327(7414):557-560.
12. Matusiak L, Bieniek A, Szepietowski JC. Psychophysical aspects of hidradenitis suppurativa. *Acta Derm Venereol.* 2010;90(3): 264-268.
13. Kurek A, Johanne Peters EM, Sabat R, Sterry W, Schneider-Burrus S. Depression is a frequent co-morbidity in patients with acne inversa. *J Dtsch Dermatol Ges.* 2013;11(8):743-750.
14. Onderdijk AJ, van der Zee HH, Esmann S, et al. Depression in patients with hidradenitis suppurativa. *J Eur Acad Dermatol Venereol.* 2013;27(4):473-478.
15. Vazquez BG, Alikhan A, Weaver AL, Wetter DA, Davis MD. Incidence of hidradenitis suppurativa and associated factors: a population-based study of Olmsted County, Minnesota. *J Invest Dermatol.* 2013;133(1):97-103.
16. Crowley JJ, Mekkes JR, Zouboulis CC, et al. Association of hidradenitis suppurativa disease severity with increased risk for systemic comorbidities. *Br J Dermatol.* 2014;171(6):1561-1565.
17. Wormald JCR, Balzano A, Clibbon JJ, Figus A. Surgical treatment of severe hidradenitis suppurativa of the axilla: thoracodorsal artery perforator (TDAP) flap versus split skin graft. *J Plast Reconstr Aesthet Surg.* 2014;67(8):1118-1124.

18. Khalsa A, Liu G, Kirby JS. Increased utilization of emergency department and inpatient care by patients with hidradenitis suppurativa. *J Am Acad Dermatol*. 2015;73(4):609-614.

19. Patel M, Cohen JM, Wright NA, Merola JF, Qureshi AA, Vleugels RA. Epidemiology of concomitant psoriasis and hidradenitis suppurativa (HS): experience of a tertiary medical center. *J Am Acad Dermatol*. 2015;73(4):701-702.

20. Shavit E, Dreiher J, Freud T, Halevy S, Vinker S, Cohen AD. Psychiatric comorbidities in 3207 patients with hidradenitis suppurativa. *J Eur Acad Dermatol Venereol*. 2015;29(2):371-376.

21. Humphries LS, Kueberuwa E, Beederman M, Gottlieb LJ. Wide excision and healing by secondary intent for the surgical treatment of hidradenitis suppurativa: a single-center experience. *J Plast Reconstr Aesthet Surg*. 2016;69(4):554-566.

22. Santos JV, Lisboa C, Lanna C, Costa-Pereira A, Freitas A. Hospitalisations with hidradenitis suppurativa: an increasing problem that deserves closer attention. *Dermatology (Basel)*. 2016;232(5):613-618.

23. Vangipuram R, Vaidya T, Jandarov R, Alikhan A. Factors contributing to depression and chronic pain in patients with hidradenitis suppurativa: results from a single-center retrospective review. *Dermatology*. 2016;232(6):692-695.

24. Kirby JS, Butt M, Esmann S, Jemec GBE. Association of resilience with depression and health-related quality of life for patients with hidradenitis suppurativa. *JAMA Dermatol*. 2017;153(12):1263-1269.

25. Kluger N, Ranta M, Serlachius M. The burden of hidradenitis suppurativa in a cohort of patients in southern Finland: a pilot study. *Skin Appendage Disord*. 2017;3(1):20-27.

26. Garg A, Papagermanos V, Midura M, Strunk A, Merson J. Opioid, alcohol, and cannabis misuse among patients with hidradenitis suppurativa: a population-based analysis in the United States. *J Am Acad Dermatol*. 2018;79(3):495-500.e1.

27. Huilaja L, Tiri H, Jokelainen J, Timonen M, Tasanen K. Patients with hidradenitis suppurativa have a high psychiatric disease burden: a Finnish Nationwide Registry study. *J Invest Dermatol*. 2018;138(1):46-51.

28. Ingram JR, Jenkins-Jones S, Knipe DW, Morgan CLI, Cannings-John R, Piguet V. Population-based Clinical Practice Research Datalink study using algorithm modelling to identify the true burden of hidradenitis suppurativa. *Br J Dermatol*. 2018;178(4): 917-924.

29. Kimball AB, Sundaram M, Gauthier G, et al. The comorbidity burden of hidradenitis suppurativa in the United States: a claims data analysis. *Dermatol Ther (Heidelb)*. 2018;8(4):557-569.

30. Kjaersgaard Andersen R, Theut Riis P, Jemec GBE. Factors predicting the self-evaluated health of hidradenitis suppurativa patients recruited from an outpatient clinic. *J Eur Acad Dermatol Venereol*. 2018;32(2):313-317.

31. Ramos-Rodriguez AJ, Timerman D, Khan A, Bonomo L, Hunjan MK, Lemor A. The in-hospital burden of hidradenitis suppurativa in patients with inflammatory bowel disease: a decade nationwide analysis from 2004 to 2014. *Int J Dermatol*. 2018;57(5):547-552.

32. Thorlacius L, Cohen AD, Gislason GH, Jemec GBE, Egeberg A. Increased suicide risk in patients with hidradenitis suppurativa. *J Invest Dermatol*. 2018;138(1):52-57.

33. Tiri H, Jokelainen J, Timonen M, Tasanen K, Huilaja L. Somatic and psychiatric comorbidities of hidradenitis suppurativa in children and adolescents. *J Am Acad Dermatol*. 2018;79(3):514-519.

34. Butt M, Sisic M, Silva C, et al. The associations of depression and coping methods on health-related quality of life for those with hidradenitis suppurativa. *J Am Acad Dermatol*. 2019;80(4): 1137-1139.

35. Nielsen RM, Lindsø Andersen P, Sigsgaard V, Theut Riis P, Jemec GB. Pain perception in patients with hidradenitis suppurativa. *Br J Dermatol*. 2020;182:166-174.

36. Pavon Blanco A, Turner MA, Petrof G, Weinman J. To what extent do disease severity and illness perceptions explain depression, anxiety and quality of life in hidradenitis suppurativa? *Br J Dermatol*. 2019;180(2):338-345.

37. Senthilnathan A, Kolli SS, Cardwell LA, Richardson IM, Feldman SR, Pichardo RO. Depression in hidradenitis suppurativa. *Br J Dermatol*. 2019;18:1087-1088.

38. Theut Riis P, Pedersen OB, Sigsgaard V, et al. Prevalence of patients with self-reported hidradenitis suppurativa in a cohort of Danish blood donors: a cross-sectional study. *Br J Dermatol*. 2019;180(4):774-781.

39. Zimman S, Comparatore MV, Vulcano AF, Absi ML, Mazzuoccolo LD. Hidradenitis suppurativa: estimated prevalence, clinical features, concomitant conditions, and diagnostic delay in a university teaching hospital in Buenos Aires, Argentina. *Actas Dermosifiliogr*. 2019;110(4):297-302.

40. Patel KR, Rastogi S, Singam V, Lee HH, Amin AZ, Silverberg JI. Association between hidradenitis suppurativa and hospitalization for psychiatric disorders: a cross-sectional analysis of the National Inpatient Sample. *Br J Dermatol*. 2019;181(2):275-281.

41. Lim GY, Tam WW, Lu Y, Ho CS, Zhang MW, Ho RC. Prevalence of depression in the community from 30 countries between 1994 and 2014. *Sci Rep*. 2018;8(1):2861.

42. American Psychiatrist Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM)*. 5th ed. Washington, D.C: American Psychiatrist Association; 2013.

43. Vinkel C, Thomsen SF. Hidradenitis suppurativa: causes, features, and current treatments. *J Clin Aesthet Dermatol*. 2018;11(10):17-23.

44. Alavi A, Anooshirvani N, Kim WB, Coutts P, Sibbald RG. Quality-of-life impairment in patients with hidradenitis suppurativa: a Canadian study. *Am J Clin Dermatol*. 2015;16(1):61-65.

45. Sisic M, Kirby JS, Boyal S, Plant L, McLellan C, Tan J. Development of a quality-of-life measure for hidradenitis suppurativa. *J Cutan Med Surg*. 2017;21(2):152-155.

46. Farzanfar D, Dowlati Y, French LE, Lowes MA, Alavi A. Inflammation: a contributor to depressive comorbidity in inflammatory skin disease. *Skin Pharmacol Physiol*. 2018; 31(5):246-251.

47. Krebber AMH, Buffart LM, Kleijn G, et al. Prevalence of depression in cancer patients: a meta-analysis of diagnostic interviews and self-report instruments. *Psychooncology*. 2014; 23(2):121-130.

48. Boeschoten RE, Braamse AMJ, Beekman ATF, et al. Prevalence of depression and anxiety in multiple sclerosis: a systematic review and meta-analysis. *J Neurol Sci*. 2017;372:331-341.

49. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. *Eur J Epidemiol*. 2010;25(9):603-605.

50. Hartling L, Milne A, Hamm MP, et al. Testing the Newcastle Ottawa Scale showed low reliability between individual reviewers. *J Clin Epidemiol*. 2013;66(9):982-993.

51. Luchini C, Stubbs B, Solmi M, Veronese N. Assessing the quality of studies in meta-analyses: advantages and limitations of the Newcastle Ottawa Scale. *World J Metaanal*. 2017;5(4):80.

52. Gündel H, Wolf A, Xidara V, et al. High psychiatric comorbidity in spasmodic torticollis: a controlled study. *J Nerv Ment Dis*. 2003;191(7):465-473.

53. Consoli SM, Rolhion S, Martin C, et al. Low levels of emotional awareness predict a better response to dermatological treatment in patients with psoriasis. *Dermatology*. 2006;212(2):128-136.
54. Uguz F, Engin B, Yilmaz E. Quality of life in patients with chronic idiopathic urticaria: the impact of axis I and axis II psychiatric disorders. *Gen Hosp Psychiatry*. 2008;30(5):453-457.
55. Jalenques I, Rondepierre F, Massoubre C, et al. High prevalence of psychiatric disorders in patients with skin-restricted lupus: a case-control study. *Br J Dermatol*. 2016;174(5):1051-1060.
56. Dhawan L, Singh SM, Avasthi A, Kumaran MS, Narang T. The prevalence of psychiatric comorbidity in patients with prurigo nodularis. *Indian Dermatol Online J*. 2018;9(5):318-321.
57. Chu S-Y, Chen Y-J, Tseng W-C, et al. Psychiatric comorbidities in patients with alopecia areata in Taiwan: a case-control study. *Br J Dermatol*. 2012;166(3):525-531.