The potency of common proinflammatory cytokines measurement for revealing the risk and severity of anxiety and depression in psoriasis patients

Nannan Tong | Yu Zhang | Anping Yang | Xiaoli Dai | Siyu Hao

1Department of Dermatology, The Second Affiliated Hospital of Harbin Medical University, Harbin, China
2Key Laboratory of Myocardial Ischemia, Chinese Ministry of Education, The Second Affiliated Hospital of Harbin Medical University, Harbin, China

Correspondence
Siyu Hao, Department of Dermatology, Key Laboratory of Myocardial Ischemia, Chinese Ministry of Education, The Second Affiliated Hospital of Harbin Medical University, No. 256 Xuefu Road, Harbin 150001, China.
Email: tusi871161@163.com

Funding information
Innovative Science Research Funding Project of Harbin Medical University.

Abstract
Objective: Proinflammatory cytokines mediate anxiety and depression in various ways, such as immunity, inflammation, and the hypothalamic–pituitary–adrenal axis. This study intended to further explore the linkage of common proinflammatory cytokine levels with anxiety and depression in psoriasis patients.

Methods: Totally, 150 psoriasis patients and 50 healthy controls (HCs) were included; the serum samples were collected, then common proinflammatory cytokines were measured by ELISA. Hospital Anxiety and Depression Scale (HADS) was assessed.

Results: HADS-anxiety (HADS-A) score, HADS-depression (HADS-D) score, TNF-α, IL-1β, IL-6, IL-12, IL-17A, and IL-23 were all increased in psoriasis patients compared to HCs (all p < 0.05). In psoriasis patients, TNF-α (p = 0.001), IL-12 (p = 0.035), and IL-17A (p < 0.001), but not IL-1β (p = 0.255), IL-6 (p = 0.248), and IL-23 (p = 0.216), were positively linked to HADS-A score. Meanwhile, TNF-α (p = 0.007) and IL-17A (p = 0.007) were enhanced in psoriasis patients with anxiety in contrast to those without anxiety; whereas IL-1β (p = 0.178), IL-6 (p = 0.360), IL-12 (p = 0.239), and IL-23 (p = 0.450) were not different. TNF-α (p < 0.001), IL-1β (p = 0.013), IL-17A (p < 0.001), and IL-23 (p = 0.023), but not IL-6 (p = 0.143) and IL-12 (p = 0.158), were positively linked to HADS-D score. Concurrently, TNF-α (p = 0.015), IL-17A (p < 0.001), and IL-23 (p = 0.017) were climbed in psoriasis patients with depression by comparison to those without depression; whereas IL-1β (p = 0.113), IL-6 (p = 0.237), IL-12 (p = 0.660) did not differ.

Conclusion: TNF-α, IL-17A, and IL-23 increments reflect anabatic anxiety and depression in psoriasis patients, uncovering the potency of proinflammatory cytokines measurement for monitoring or even preventing psoriasis patients’ anxiety and depression.

KEYWORDS
anxiety, depression, hospital anxiety and depression scale, proinflammatory cytokines, psoriasis
1 | INTRODUCTION

Psoriasis is an inflammatory skin disease mediated by immunity, which has a high incidence and prevalence worldwide. Although certain progress has been made in the treatment of psoriasis, this disease still cannot be completely cured and often leads to many complications, such as psoriatic arthritis, cardiovascular disease, metabolic syndrome, uveitis, etc. In addition to these complications, the body appearance of the psoriasis patient is also affected; all of these factors contribute to a huge psychological burden (such as anxiety and depression) on the psoriasis patients, which causes difficulties in rehabilitation and even leads to suicide. Therefore, it is necessary to explore potential factors that participate in the pathology of anxiety and depression, which might be helpful for attribution therapy and thereby improve the clinical outcomes of psoriasis patients.

Proinflammatory cytokines are reported to participate in the progression and pathogenesis of anxiety and depression. For example, tumor necrosis factor-α (TNF-α) activates the hypothalamic-pituitary-adrenal (HPA) axis and indoleamine 2,3-dioxygenase, which leads to the tryptophan depletion and thereby causes depression. Meanwhile, interleukin (IL)-1, IL-6, IL-8, etc., would activate the kynurenine pathway, which reduces the level of serotonin; thereby inducing anxiety and depression. Clinically, proinflammatory cytokines are linked with anxiety or depression in some autoimmune disease patients, such as multiple sclerosis and rheumatoid arthritis (RA) patients. For example, IL-2 is correlated with anxiety; while TNF-α and IL-1β are linked to depression in multiple sclerosis patients. Moreover, a study states that increased IL-17 and IL-6 are linked with depression in RA patients. Hence, it could be hypothesized that proinflammatory cytokines might be linked with these psychological issues in psoriasis patients. However, no study reports that.

Subsequently, this study intended to inspect the prevalence of mental problems (anxiety and depression) and expressions of proinflammatory cytokines, along with their inter-correlations in psoriasis patients.

2 | METHODS

2.1 | Participants

The study enrolled 150 patients with psoriasis who received treatment at our hospital between May 2020 and September 2021. The inclusion criteria for patients were: (1) diagnosed with psoriasis; (2) aged more than 18 years old. The exclusion criteria for patients were: (1) complicated with inflammatory skin diseases other than psoriasis; (2) accompanied with insufficiency of cardiovascular, kidney, and liver system; (3) had malignant tumors or hematological diseases; (4) history of documented mental disorders; (5) pregnant or lactating women. Besides, 50 healthy individuals who received physical examination during the same period were included as health controls (HCs). All HCs had a healthy status determined by physical examination and a record of personal medical history and aged more than 18 years old. The study ethics was approved by the Institutional Review Board. Both psoriasis patients and HCs provided written informed consent.

2.2 | Clinical data collection

After enrollment, we collected psoriasis patients’ demographics, disease features, and treatment information. The demographics included the followings: age; gender (female or male); body mass index (BMI). The disease features included the followings: disease duration; psoriatic body surface area (BSA); Psoriasis Area and Severity Index (PASI) score. The treatment information included the followings: current topical therapy (yes/no); current phototherapy (yes/no); current systemic nonbiologic treatment (yes/no); current biologics treatment (yes/no).

2.3 | Anxiety and depression evaluation

The anxiety and depression were assessed by Hospital Anxiety and Depression Scale (HADS) in psoriasis patients and HCs. The anxiety or depression was classified as no (scored from 0 to 7), mild (scored from 8 to 10), moderate (scored from 11 to 14), and severe (scored from 15 to 21).

2.4 | Enzyme-linked immunosorbent assay (ELISA)

The blood samples (10 ml) were collected into vacuum tubes from all study participants, then left at 37°C for half an hour and centrifuged (4000 revolutions per minute, 5 min) to separate the serum. After collection, the serum concentrations of TNF-α, IL-1β, IL-6, IL-12, IL-17A, and IL-23 were detected by commercial Human ELISA Kits (Thermo Fisher Scientific, China). All procedures were strictly performed according to the manufacturer’s protocols.

2.5 | Statistical analysis

SPSS V26.1 (IBM Corp.) was applied for statistical analysis, and GraphPad Prism V7.01 (GraphPad Software Inc.) was applied for graph plotting. The linkage between two non-normally distributed continuous variables was determined using Spearman’s rank correlation test. The comparison between two groups was assessed using Student’s t-test, the Mann-Whitney U-test, the chi-square test, and the Yates’-corrected chi-square test, as appropriate. The potential of variables to predict the risk of anxiety and depression in psoriasis patients was determined by the receiver operating characteristic (ROC) curve. A p-value <0.05 manifested statistical significance.
TABLE 1  Clinical features of patients with psoriasis

| Items                                           | Patients with psoriasis (N = 150) |
|-------------------------------------------------|-----------------------------------|
| Age (years), mean ± SD                          | 48.0 ± 13.6                       |
| Gender, n (%)                                   |                                   |
| Female                                          | 57 (38.0)                         |
| Male                                            | 93 (62.0)                         |
| BMI (kg/m²), mean ± SD                         | 24.3 ± 3.4                        |
| Disease duration (years), median (IQR)          | 9.0 (5.0–15.0)                    |
| Psoriatic BSA (%), mean ± SD                   | 20.3 ± 9.1                        |
| PASI score, mean ± SD                          | 10.5 ± 4.6                        |
| Current topical therapy, n (%)                  |                                   |
| No                                              | 13 (8.7)                          |
| Yes                                             | 137 (91.3)                        |
| Current phototherapy, n (%)                     |                                   |
| No                                              | 29 (19.3)                         |
| Yes                                             | 121 (80.7)                        |
| Current systemic nonbiologic treatment, n (%)   |                                   |
| No                                              | 50 (33.3)                         |
| Yes                                             | 100 (66.7)                        |
| Current biologics treatment, n (%)              |                                   |
| No                                              | 134 (89.3)                        |
| Yes                                             | 16 (10.7)                         |

Abbreviations: BMI, body mass index; BSA, body surface area; IQR, interquartile range; PASI score, psoriasis area and severity index score; SD, standard deviation.

3  | RESULTS

3.1  | Clinical features of psoriasis patients

The mean age of psoriasis patients was 48.0 ± 13.6 years; meanwhile, there were 57 (38.0%) females and 93 (62.0%) males. At the same time, the BMI of psoriasis patients was 24.3 ± 3.4 kg/m². The median (interquartile range [IQR]) value of disease duration was 9.0 (5.0–15.0) years. As for the mean values of psoriatic BSA and PASI scores, they were 20.3 ± 9.1 and 10.5 ± 4.6, correspondingly. Other clinical information on psoriasis patients is listed in Table 1.

3.2  | Comparisons of anxiety, depression, and inflammatory cytokine between psoriasis patients and HCs

The HADS-anxiety (HADS-A) score, anxiety rate, and severity were elevated in psoriasis patients compared with HCs (all p < 0.001). HADS-depression (HADS-D) score, depression rate, and severity were also enhanced in psoriasis patients in contrast with HCs (all p < 0.001). In terms of proinflammatory cytokines, they were climbed in psoriasis patients by contrast with HCs, including TNF-α (median [IQR]: 63.4 (50.2–79.4) vs. 55.0 (42.3–69.2) pg/ml, p = 0.008), IL-1β (median [IQR]: 4.1 (2.5–6.6) vs. 3.1 (1.8–5.0) pg/ml, p = 0.015), IL-6 (median [IQR]: 39.6 (28.9–51.0) vs. 24.2 (16.6–35.9) pg/ml, p < 0.001), IL-12 (median [IQR]: 78.0 (60.8–99.4) vs. 61.1 (50.1–83.1) pg/ml, p = 0.006), IL-17A (median [IQR]: 81.8 (61.2–105.6) vs. 60.5 (46.3–90.5) pg/ml, p = 0.001), and IL-23 (median [IQR]: 83.4 (62.6–119.2) vs. 75.1 (59.7–95.5) pg/ml, p = 0.018) (Table 2).

3.3  | Relation between proinflammatory cytokines and anxiety in psoriasis patients

TNF-α was positively correlated with the HADS-A score (p = 0.001, Figure 1A). While IL-1β (p = 0.255, Figure 1B) and IL-6 (p = 0.248, Figure 1C) were not linked with the HADS-A score. Additionally, IL-12 (p = 0.035, Figure 1D) and IL-17A (p < 0.001, Figure 1E), but not IL-23 (p = 0.216, Figure 1F) were positively linked to the HADS-A score in psoriasis patients.

Subsequently, the difference in proinflammatory cytokines between psoriasis patients with and without anxiety was compared. It was found that TNF-α was climbed in psoriasis patients with anxiety compared to those without anxiety (p = 0.007, Figure 2A). Whereas, IL-1β (p = 0.178, Figure 2B), IL-6 (p = 0.360, Figure 2C), and IL-12 (p = 0.239, Figure 2D) were not different between them. IL-17A (p = 0.007, Figure 2E), but not IL-23 (p = 0.450, Figure 2F) was elevated in psoriasis patients with anxiety compared to those without anxiety.

3.4  | Association between proinflammatory cytokines and depression in psoriasis patients

TNF-α (p < 0.001, Figure 3A) and IL-1β (p = 0.013, Figure 3B) were positively linked to the HADS-D score. However, IL-6 (p = 0.143, Figure 3C) and IL-12 (p = 0.158, Figure 3D) were not linked with the HADS-D score. Positive linkage was found in IL-17A (p < 0.001, Figure 3E) and IL-23 (p = 0.023, Figure 3F) with HADS-D scores in psoriasis patients.

Moreover, the comparison of proinflammatory cytokines between psoriasis patients with and without depression was evaluated. It was discovered that TNF-α was enhanced in psoriasis patients with depression in contrast to those without depression (p = 0.015, Figure 4A). IL-1β (p = 0.113, Figure 4B), IL-6 (p = 0.237, Figure 4C), and IL-12 (p = 0.660, Figure 4D) did not differ between them. Regarding IL-17A (p < 0.001, Figure 4E) and IL-23 (p = 0.017, Figure 4F), they were raised in psoriasis patients with depression in contrast to those without depression.

3.5  | ROC curves based on proinflammatory cytokines for estimating anxiety and depression

TNF-α (area under the curve [AUC] (95% confidence interval [CI]): 0.634 (0.542–0.727), Figure 5A) and IL-17A (AUC (95% CI): 0.635 (0.540–0.730), Figure 5B), but not IL-23 (AUC (95% CI): 0.538 (0.443–0.633), Figure 5C) had a certain ability to discriminate psoriasis patients with anxiety from those without anxiety. While the
combination of TNF-\(\alpha\), IL-17A, and IL-23 improved this discriminating ability to some extent (AUC (95% CI): 0.670 (0.580–0.760), Figure 5D). Meanwhile, TNF-\(\alpha\) (AUC (95% CI): 0.616 (0.526–0.706), Figure 5E), IL-17A (AUC (95% CI): 0.674 (0.587–0.760), Figure 5F), and IL-23 (AUC (95% CI): 0.614 (0.524–0.704), Figure 5G) also showed a certain capacity to distinguish psoriasis patients with depression from those without depression. Additionally, the combination of TNF-\(\alpha\), IL-17A, and IL-23 also enhanced the distinguishing capacity to some extent (AUC (95% CI): 0.701 (0.618–0.784), Figure 5H).

3.6 | Linkage of proinflammatory cytokines with treatments in psoriasis patients

Increased IL-12 (\(p = 0.045\)) and IL-23 (\(p = 0.026\)) were linked to current topical therapy. Nevertheless, no relation was found between proinflammatory cytokines and current phototherapy (all \(p > 0.05\)). Decreased TNF-\(\alpha\) (\(p = 0.002\)) and IL-12 (\(p = 0.018\)) were related to current systemic nonbiologic treatment. Declined IL-12 (\(p = 0.048\)) and IL-17A (\(p = 0.002\)) were linked to current biologics treatment (Table S1).

4 | DISCUSSION

Autoimmune disease patients often suffer from psychological problems, such as anxiety and depression.\textsuperscript{17-19} For instance, ankylosing spondylitis patients have higher anxiety rates compared to healthy individuals.\textsuperscript{20} Meanwhile, in contrast with healthy populations, RA patients exhibit higher anxiety and depression levels.\textsuperscript{20} Additionally, a study claims that anxiety and depression are prevalent in inflammatory bowel disease (IBD) patients.\textsuperscript{21} Conclusively, these

### Table 2: Comparisons of anxiety, depression and inflammatory cytokines between patients with psoriasis and HCs

| Items                        | HCs (N = 50) | Patients with psoriasis (N = 150) | Statistics (t, \(\chi^2\), Z) | p-Value |
|------------------------------|-------------|----------------------------------|-------------------------------|---------|
| Anxiety                      |             |                                  |                               |         |
| HASD-A score, mean ± SD      | 3.6 ± 2.0   | 7.6 ± 3.1                        | -8.320                        | <0.001  |
| Anxiety, n (%)               |             |                                  |                               |         |
| No                           | 46 (92.0)   | 98 (65.3)                        | 13.228                        | <0.001  |
| Yes                          | 4 (8.0)     | 52 (34.7)                        |                               |         |
| Anxiety severity, n (%)      |             |                                  |                               |         |
| No                           | 46 (92.0)   | 98 (65.3)                        | -3.749                        | <0.001  |
| Mild                         | 4 (8.0)     | 28 (18.7)                        |                               |         |
| Moderate                     | 0 (0.0)     | 16 (10.7)                        |                               |         |
| Severe                       | 0 (0.0)     | 8 (5.3)                          |                               |         |
| Depression                   |             |                                  |                               |         |
| HASD-D score, mean ± SD      | 3.5 ± 2.2   | 8.3 ± 3.4                        | -9.307                        | <0.001  |
| Depression, n (%)            |             |                                  |                               |         |
| No                           | 47 (94.0)   | 83 (55.3)                        | 24.645                        | <0.001  |
| Yes                          | 3 (6.0)     | 67 (44.7)                        |                               |         |
| Depression severity, n (%)   |             |                                  |                               |         |
| No                           | 47 (94.0)   | 83 (55.3)                        | -5.011                        | <0.001  |
| Mild                         | 3 (6.0)     | 30 (20.0)                        |                               |         |
| Moderate                     | 0 (0.0)     | 26 (17.3)                        |                               |         |
| Severe                       | 0 (0.0)     | 11 (7.3)                         |                               |         |
| Inflammatory cytokines       |             |                                  |                               |         |
| TNF-\(\alpha\) (pg/ml), median (IQR) | 55.0 (42.3–69.2) | 63.4 (50.2–79.4) | -2.648 | 0.008 |
| IL-1\(\beta\) (pg/ml), median (IQR) | 3.1 (1.8–5.0) | 4.1 (2.5–6.6) | -2.421 | 0.015 |
| IL-6 (pg/ml), median (IQR)   | 24.2 (16.6–35.9) | 39.6 (28.9–51.0) | -5.764 | <0.001 |
| IL-12 (pg/ml), median (IQR)  | 61.1 (50.1–83.1) | 78.0 (60.8–99.4) | -2.773 | 0.006 |
| IL-17A (pg/ml), median (IQR) | 60.5 (46.3–90.5) | 81.8 (61.2–105.6) | -3.297 | 0.001 |
| IL-23 (pg/ml), median (IQR)  | 75.1 (59.7–95.5) | 83.4 (62.6–119.2) | -2.360 | 0.018 |

Abbreviations: HADS-A, hospital anxiety and depression scale for anxiety; HADS-D, hospital anxiety and depression scale for depression; HCs, health controls; IL-12, interleukin-12; IL-17A, interleukin-17A; IL-23, interleukin-23; IL-1\(\beta\), interleukin-1-beta; IL-6, interleukin-6; IQR, interquartile range; SD, standard deviation; TNF-\(\alpha\), tumor necrosis factor-alpha.
proinflammatory cytokines are related to anxiety or depression in these autoimmune disease patients; however, it remains unknown in psoriasis patients. The present study discovered that anxiety and depression were enhanced in psoriasis patients compared to HCs. It could be argued that compared with healthy individuals, psoriasis patients were more likely to suffer comorbidities and the body appearance damaged, which decreased the quality of life and social activities of psoriasis patients, thus the prevalence of anxiety and depression was increased in psoriasis patients by contrast with HCs. Additionally, the inflammation status was generally higher in psoriasis patients; meanwhile, inflammation outbreaks were linked with the prevalence of anxiety and depression; therefore, anxiety

**FIGURE 1** TNF-α, IL-12, and IL-17A were positively linked to HADS-A scores in psoriasis patients. Association of TNF-α (A), IL-1β (B), IL-6 (C), IL-12 (D), IL-17A (E), and IL-23 (F) with HADS-A score in psoriasis patients

**FIGURE 2** TNF-α and IL-17A were climbed in psoriasis patients with anxiety in contrast to those without anxiety. Comparison of TNF-α (A), IL-1β (B), IL-6 (C), IL-12 (D), IL-17A (E), and IL-23 (F) between psoriasis patients with and without anxiety
and depression were aggravated in psoriasis patients. In addition, this study also discovered that 34.7% of psoriasis patients had anxiety and 44.7% of psoriasis patients had depression. According to a previous study, the prevalence of anxiety and depression is 36.0% and 19%, respectively. Our finding suggested that anxiety prevalence was similar (34.7% vs. 36%) to previous data, however, the depression prevalence was increased (44.7% vs. 19%) in psoriasis patients. These indicated that anxiety and depression were serious issues in psoriasis patients.

Besides, the expressions of proinflammatory cytokines in psoriasis patients and HCs were further measured. In accordance with previous studies, this study found that common proinflammatory cytokines,
Tong et al. containing TNF-α, IL-1β, IL-6, IL-12, IL-17A, and IL-23, were enhanced in psoriasis patients compared to HCs.1,24,25 The possible explanation would be that: proinflammatory cytokines participated in the progression and pathogenesis of psoriasis; for example, IL-1 mediated inflammation of psoriasis by activating macrophages to secrete IL-3626; meanwhile, IL-23 contributed to dermatitis pathogenesis of psoriasis through activating the signal transducer and activator of transcription 3-retinoid-related orphan receptor-γ T pathway to induce the release of IL-17A in macrophages27; therefore, TNF-α, IL-1β, IL-6, IL-12, IL-17A, and IL-23 were elevated in psoriasis patients compared to HCs.

Anxiety or depression may be linked to the release of proinflammatory cytokines in autoimmune disease patients.15,28,29 For instance, depression symptom is discovered in RA patients with elevated serum IL-6 and IL-1717; at the same time, IL-6 and IL-17 not only cause arthritis but also induce depression in RA patients.15 This study exhibited that IL-17A and TNF-α were positively linked to anxiety, while TNF-α, IL-17A, along with IL-23 were positively linked to depression in psoriasis patients. The possible reason might be that: proinflammatory cytokines might trigger anxiety and depression in various ways, for example, enhanced proinflammatory cytokines might activate the kynurenine pathway, leading to tryptophan depletion and reduced serotonin levels, which further causes depressive symptoms13,31; meanwhile, proinflammatory cytokines might also activate the HPA axis or affect the neurotransmitter metabolism, thereby causing anxiety or depression.32 Therefore, TNF-α, IL-17A, and IL-23 increments were linked with aggravated depression and anxiety in psoriasis patients.

Several limitations existed in this study: (1) the HADS score for estimating anxiety and depression was a self-assessed questionnaire, which might exist an assessment bias; (2) although the linkage of proinflammatory cytokines with anxiety and depression was revealed, the detailed mechanism of these proinflammatory cytokines underlying anxiety and depression in psoriasis patients remained unclear; (3) using psoriatic tissues as samples might be more representative; subsequent studies could make improvements based on this consideration; (4) the pathogenesis of proinflammatory cytokines for regulating anxiety and depression might be different from other autoimmune diseases, further studies could take this into account and investigate the specific mechanisms; (5) some intermediate products, such as indoleamine 2,3-dioxygenase and serotonin were interacted with proinflammatory cytokines to regulate anxiety and depression; therefore, it was meaningful to detect these intermediate products as well; this could be the direction of further studies; (6) this study only assessed anxiety and depression after enrollment; further studies could explore the longitudinal changes in anxiety and depression by multiple points evaluation in psoriasis patients; (7) the linkage of proinflammatory cytokines with anxiety and depression in patients with other autoimmune diseases needed to be further explored; (8) this study revealed the linkage between proinflammatory cytokines and treatment modalities; however, whether the proinflammatory cytokines caused by treatments would further lead to anxiety and depression remained unclear; further studies could explore the linkage based on this consideration; (9) the treatments would directly modulate the levels of proinflammatory cytokines; therefore, this study evaluated the linkage between proinflammatory cytokines and treatment modalities; however, whether this regulation would further regulate anxiety and depression needed to be further explored.

In summary, TNF-α, IL-17A, and IL-23 increments might reflect anabatic anxiety and depression in psoriasis patients. This finding indicates the potential value of proinflammatory cytokines

![Figure 5](image_url)
measurement for monitoring or even preventing anxiety and depression in psoriasis patients.

**FUNDING INFORMATION**
This study was supported by Innovative Science Research Funding Project of Harbin Medical University.

**CONFLICT OF INTEREST**
None.

**DATA AVAILABILITY STATEMENT**
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**INFORMED CONSENT**
Both psoriasis patients and HCs provided written informed consent.

**ORCID**
Siyu Hao  https://orcid.org/0000-0001-8646-0275

**REFERENCES**

1. Griffiths CEM, Armstrong AW, Gudjonsson JE, Barker J. Psoriasis. Lancet. 2021;397(10281):1301-1315.
2. Parisi R, Iskandar IYK, Kontopantelis E, et al. National, regional, and worldwide epidemiology of psoriasis: systematic analysis and modelling study. BMJ. 2020;369:m1590.
3. Masson W, Lobo M, Molinero G. Psoriasis and cardiovascular risk: a comprehensive review. Adv Ther. 2020;37(5):2017-2033.
4. FitzGerald O, Ogdie A, Chandran V, et al. Psoriatic arthritis. Nat Rev Dis Primers. 2021;7(1):59.
5. Hao Y, Zhu YJ, Zou S, et al. Metabolic syndrome and psoriasis: mechanisms and future directions. Front Immunol. 2021;12:711060.
6. Lam M, Steen J, Lu JD, Vender R. The incidence and prevalence of uveitis in psoriasis: a systematic review and meta-analysis. J Cutan Med Surg. 2020;24(6):601-607.
7. Rzeszutek M, Podkowa K, Pietra M, Pankowski D, Cyran-Stemplewska S. Comparative study of life satisfaction among patients with psoriasis versus healthy comparison group: the explanatory role of body image and resource profiles. J Neurol. 2021;30(1):S195-S200.
8. Rosinska M, Rzepa T, Szramka-Pawlak B, Zaba R. Body image and depressive symptoms in persons suffering from psoriasis. Psychiatr Pol. 2017;51(6):1145-1152.
9. Ding J, Xiao H, Shen M, et al. Association of psoriasis with anxiety and depression: a case-control study in Chinese patients. Front Med (Lausanne). 2021;8:771645.
10. Bakar RS, Jaapar SZS, Azmi AF, Aun YC. Depression and anxiety among patients with psoriasis: a correlation with quality of life and associated factors. J Taibah Univ Med Sci. 2021;16(4):491-496.
11. Pompili M, Bonanni L, Gualtieri F, Trovini G, Persechino S, Baldessarini RJ. Suicidal risks with psoriasis and atopic dermatitis: systematic review and meta-analysis. J Psychosom Res. 2021;141:110347.
12. Postal M, Appenzeller S. The importance of cytokines and autoantibodies in depilatory. Autoimmun Rev. 2015;14(1):30-35.
13. Zador F, Joca S, Nagy-Grocz G, et al. Pro-inflammatory cytokines: potential links between the endocannabinoid system and the kynurenine pathway in depression. Int J Mol Sci. 2021;22(11):5903.
14. Rossi S, Studer V, Motta C, et al. Neuroinflammation drives anxiety and depression in relapsing-remitting multiple sclerosis. Neurology. 2017;89(13):1338-1347.
15. Li YC, Chou YC, Chen HC, Lu CC, Chang DM. Interleukin-6 and interleukin-17 are related to depression in patients with rheumatoid arthritis. Int J Rheum Dis. 2019;22(6):980-985.
16. Zigmond AS, Snith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-370.
17. Mustac F, Pasic H, Medic F, et al. Anxiety and depression as comorbidities of multiple sclerosis. Psychiatr Danub. 2021;33(Suppl 4):480-485.
18. Figus FA, Piga M, Azzolin I, McConnell R, Iagnocco A. Rheumatoid arthritis: extra-articular manifestations and comorbidities. Autoimmun Rev. 2021;20(4):102776.
19. Kussainova A, Kassym L, Akhmetova A, et al. Vitiligo and anxiety: a systematic review and meta-analysis. PLoS One. 2020;15(11):e0241445.
20. Khan A, Pooja V, Chaudhury S, Bhattacharya A, Saldanha A. Evaluation of depression, anxiety, stress, and quality of life in rheumatoid arthritis patients and comparison with healthy individuals. Ind Psychiatry J. 2021;30(Suppl 1):S195-S200.
21. Gao X, Tang Y, Lei N, et al. Symptoms of anxiety/depression is associated with more aggressive inflammatory bowel disease. Sci Rep. 2021;11(1):1440.
22. Bulat V, Situm M, Delas Azdajaic M, Lovric I, Dediol I. Study on the impact of psoriasis on quality of life: psychological, social, and financial impacts. Psychiatr Danub. 2020;32(Suppl 4):553-561.
23. Polio CF, Miot HA, Matos TDS, et al. Prevalence and factors associated with depression and anxiety in patients with psoriasis. J Clin Nurs. 2021;30(3-4):572-580.
24. Armstrong AW, Read C. Pathophysiology, clinical presentation, and treatment of psoriasis: a review. JAMA. 2020;323(19):1945-1960.
25. Lauffer F, Eyerich K, Boehncke WH, et al. Cytokines of the IL-17 family in psoriasis. J Dtsch Dermatol Ges. 2020;18(7):675-681.
26. Conti F, Pregliasco FE, Bellomo RG, et al. Mast cell cytokines IL-1, IL-33, and IL-36 mediate skin inflammation in psoriasis: a novel therapeutic approach with the anti-inflammatory cytokines IL-37, IL-38, and IL-1Ra. Int J Mol Sci. 2021;22(15):8076.
27. Hou Y, Zhu L, Tian H, et al. IL-23-induced macrophage polarization and its pathological roles in mice with iniquimod-induced psoriasis. Protein Cell. 2018;9(9):1027-1038.
28. Fakra E, Marotte H. Rheumatoid arthritis and depression. Joint Bone Spine. 2021;88(5):105200.
29. Ferreira AM, Leal B, Ferreira I, et al. Depression and anxiety in multiple sclerosis patients: the role of genetic variability of interleukin 1beta. Mult Scler Relat Disord. 2021;89(13):1338-1347.
30. Troubat R, Barone P, Leman S, et al. Depression and anxiety in patients with psoriasis versus healthy comparison group: the explanatory role of body image and resource profiles. J Neurol. 2021;30(1):181-191.
31. Zador F, Joca S, Nagy-Grocz G, et al. Pro-inflammatory cytokines: potential links between the endocannabinoid system and the kynurenine pathway in depression. Int J Mol Sci. 2021;22(11):5903.
32. Ting EY, Yang AC, Tsai SJ. Role of Interleukin-6 in depressive disorder. Int J Mol Sci. 2020;21(6):2194.

**SUPPORTING INFORMATION**
Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Tong N, Zhang Y, Yang A, Dai X, Hao S. The potency of common proinflammatory cytokines measurement for revealing the risk and severity of anxiety and depression in psoriasis patients. J Clin Lab Anal. 2022;36:e24643. doi: 10.1002/jcla.24643