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Research Article

SYSTEMIC IMMUNE INFLAMMATION INDEX AND PAN-IMMUNE INFLAMMATION VALUE IN PREDICTING HUMAN LEUKOCYTE ANTIGEN-B27 POSITIVITY: A STUDY ON ANKYLOSING SPONDYLITIS PATIENTS

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ABSTRACT

Objective: Ankylosing spondylitis (AS) is defined as both an auto-immune and autoinflammatory illness. Human leukocyte antigen B27 (HLA-B27), which is extensively employed in the diagnosis of chronic inflammatory diseases, is the basic laboratory parameter of axial spondylarthritis including AS. Systemic immune-inflammation index (SII) and pan-immune-inflammation value (PIV), obtained by formulating complete blood count parameters, are promising biomarkers that reflect systemic inflammation and local immune response and predict prognosis in diseases. The aim of this study was to investigate the sensitivity and specificity of SII and PIV biomarkers in predicting HLA-B27 positivity in AS patients.

Materials and Methods: The research included 68 individuals with HLA-B27 tests (+) (AS group) and 102 patients with HLA-B27 tests (-) (control group).

Results: In the AS group, lymphocyte and mean platelet volume values were determined to be lower than in the control group, while other complete blood count parameters, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were found to be higher. While the SII and PIV values of the AS group determined a positive relation with CRP and ESR levels, they did not show a correlation in the control group. While the sensitivity for PIV in predicting HLA-B27 positivity was found to be 83.80% and the specificity was found to be 84.30%, for SII the sensitivity was found to be 83.80% and the specificity was found to be 86.30%.

Conclusion: Easily and rapidly accessible biomarkers SII and PIV can potentially be used to predict HLA-B27 positivity in AS patients.

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Keywords: PIV, Ankylosing Spondylitis, SII, Human leukocyte antigen-b27

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INTRODUCTION

Ankylosing Spondylitis (AS) is a chronic inflammation autoimmune illness of unknown pathophysiology that principally influences the spine, peripheral joints, and sacroiliac joints. The etiology of AS is thought to be influenced by several factors including immunity, environment, infection and genetics (1). On the one hand, immune pathways such as inflammasome activation, autophagy and ubiquitination play a role in both adaptive and innate immunity in AS, while on the other hand, the presence of an autoimmune response in AS and the accompanying production of specific autoantibodies is an increasingly common concept. Thus, both autoimmune and autoinflammatory factors are involved in the pathogenesis of AS on a continuum (2). Knowing the molecular and cellular processes that underlie the pathophysiology of AS, an inflammation arthritis that influences the spine and is related with both skeletal and immune system disorders, will provide a foundation for investigating potential new treatments for AS (3).

Human leukocyte antigen B27 (HLA-B27), which is related with prolonged inflammation illness, is largely used for diagnosis reasons in these illnesses (4). HLA-B27 prevalence, which is also the basic laboratory parameter of axial spondylarthritis, an inflammatory and immune-mediated disease, varies by geographic region and ethnicity and generally reflects the prevalence of axial spondylarthritis. HLA-B27, which has a significant impact in the pathophysiology of axial spondylarthritis and many referral strategies, is associated with a spondylarthritis phenotype with consistent positive associations with family histories, earlier illness onset, hip involvement, acute anterior uveitis, and shorter diagnosis delay (5). HLA-B27 is a genetic biomarker strongly related with all axial spondylarthritis, from non-radiographic axial spondylarthritis to AS, also known as radiographic axial spondylarthritis, and its absence causes diagnostic delay. The pathophysiology of the condition is poorly understood in HLA-B27 (-) patients, and signs and symptoms are frequently overlooked or misdiagnosed, delaying diagnosis and treatment (6).

The pan-immune-inflammation value (PIV), obtained by formulating complete blood count data, is a promising biomarker for predicting course of illness in pediatric diseases related with immune anomalies and various types of tumors. It also serves as a valuable biomarker to differentiate patients from healthy individuals and to distinguish between remission and active periods in rheumatoid arthritis, a persistent auto-immune illness that causes systemic inflammation (7). Furthermore, a study analyzing 20 years of data reported that PIV is a value to evaluate inflammation and immunity, that inflammation and immunity affect the prognosis of hypertensive people, and that high PIV is corelated with cardiovascular mortality and increased all-cause mortality in hypertensive people (8). On the other hand, the systemic immune-inflammation index (SII), based on platelet, lymphocyte and neutrophil counts, is considered a good value reflecting the systemic inflammation and local immune response (9). Furthermore, a study examining data from a cohort of 40,937 individuals reported that SII is one of the newer measures used to quantify an

individual's systemic inflammatory activity and that there is a significant relation between SII, and the prevalence and mortality of chronic kidney disease linked by immunity and inflammation (10).

The aim of this research was to appraise whether PIV and SII index could predict HLA-B27 positivity in AS people, especially in case of HLA-B27 positivity. Also, to investigate the sensitivity, specificity and cut-off point of these two immune-inflammatory markers in HLA-B27 positivity in AS people.

MATERIALS AND METHODS

Study design

The ethics committee decision for the research was taken at the Samsun University Non-Interventional Clinical Ethics Committee meeting held on February 28, 2024. (Protocol code: GOKAEK 2024/5/5). The principles outlined in the Helsinki Declaration, revised in 2013, were followed throughout the study. Patients who applied to Samsun University Faculty of Medicine Samsun Research and Training Hospital Medical Genetics Polyclinic for HLA-B27 testing between January 01, 2023, and December 31, 2023, and were pre-diagnosed with AS were scanned from the hospital information management system (HIMS). Patients with comorbidities such as cancer, diabetes, chronic kidney diseases and other autoimmune diseases were excluded from the research. In addition to the HLA-B27 test, those who underwent complete blood count, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) analysis were included in the research. Complete blood count data (lymphocyte, neutrophil, monocyte, platelet, WBC (white blood cell), MCV (mean corpuscular volume), RDW (red blood cell distribution width) and MPV (mean platelet volume)), ESR and CRP results of the individuals included in the research were obtained from HIMS. Additionally, the PLR (platelet/lymphocyte ratio), MLR (monocyte/lymphocyte ratio) and NLR (neutrophil/lymphocyte ratio) values of these individuals were calculated and included in the research. Additionally, the SII indexes of the individuals were calculated using the formula neutrophil count×platelet count/lymphocyte count (11). PIV indices of the patients were calculated using the formula monocyte count×platelet count×neutrophil count/lymphocyte count (12).

Laboratory analyses

Whole blood parameters were studied using Sysmex XN 1000 (Sysmex Turkey Diagnostic Systems Limited Company, Sarıyer, Istanbul, Turkey), CRP analysis was performed using Beckman Coulter AU5800 Biochemistry autoanalyzer (Beckman Coulter Life Sciences, Indiana, USA) and ESR analysis was performed using ALS-100 PLUS (Alaris Medical and Laboratory Products Industry and Trade Limited Company, Bornova, Izmir, Turkey). HLA B27 test was performed using HLA B27 REAL TIME PCR KIT WITH DNA ISOLATION (SNP Biotechnology, Çankaya, Ankara, Turkey) (Catalog No: 501R-10-02) on a Bio-Rad CFX96 device (Bio Rad Laboratories, Dubai, United Arab Emirates).

Statistical analyses

IBM SPSS Statistics 22.0 program was used for statistical data analyses. The normal distribution properties of age and laboratory findings were evaluated using the Shapiro-Wilk test and skewness and kurtosis statistics. Since the findings did not show a normal distribution, they were shown as median and interquartile range (25th and 75th percentiles). In addition, comparisons between groups and subgroups were compared using a nonparametric test (Mann Whitney U test). P values less than 0.05 were found to be statistically important. Spearman correlation analysis was performed between SII and PIV parameters and CRP and ESR parameters. In addition, Receiver Operating Characteristics (ROC) analysis was performed to see the specificity and sensitivity of SII and PIV parameters in HLA-B27 positivity.

RESULTS

HLA-B27 testing was performed on 588 patients between 01/01/2023 and 12/31/2023. Of these patients whose HLA-B27 test was analyzed, 68 (11.56%) were found to have positive HLA-B27 test results. Patients with positive HLA-B27 tests were defined as the AS group. To ensure that the study was not influenced by age and gender factors, the selection criteria for the control group included an average age and gender ratio similar to the AS group. Considering the average age and gender ratio of the AS group, a group of 102 patients randomly selected from among patients with negative HLA-B27 test and preliminary diagnosis of AS was defined as the control group.

Table 1. Laboratory findings of ankylosing spondylitis and control groups

Parameter	Control n=102	AS n=68	p
WBC (*10⁹/L)	7.16 (5.14-8.03)	8.52 (7.06-10.08	<0.001
Neutrophil (*10⁹/L)	3.78 (3.01-4.41)	7.42 (5.71-9.04)	<0.001
Lymphocyte (*10⁹/L)	2.20 (1.76-2.61)	1.32 (1.06-1.77)	<0.001
Monocyte (*10⁹/L)	0.50 (0.36-0.56)	0.77 (0.54-0.99)	<0.001
Platelet (*10⁹/L)	248.00 (228.75-294.00)	320.00 (252.50-355.00)	<0.001
NLR	1.66 (1.46-2.02)	5.72 (3.24-8.53)	<0.001
MLR	0.22 (0.18-0.27)	0.58 (0.31-0.93)	<0.001
PLR	124.67 (89.09-165.65)	243.39 (143.06-334.91)	<0.001
MCV	85.20 (81.40-89.10)	86.10 (79.93-89.58)	>0.05
MPV	10.30 (9.60-10.90)	9.69 (8.62-10.50)	<0.001
RDV	12.50 (12.00-13.50)	13.60 (13.03-15.10)	<0.001
ESR (mm/h)	9.00 (6.00-11.00)	31.50 (26.25-38.75)	<0.001
CRP (mg/L)	2.56 (1.25-3.40)	15.10 (10.78-22.25)	<0.001
SII	467.95 (347.17-529.68)	1834.33 (816.93-3025.88)	<0.001
PIV	215.81 (144.47-267.87)	1412.44 (443.22-2980.56)	<0.001

Abbreviations: WBC: White blood cell, NLR: neutrophil/lymphocyte ratio, MLR: monocyte/lymphocyte ratio, PLR: Platelet/lymphocyte ratio, MCV: Mean corpuscular volüme, MPV: Mean platelet volume, RDW: Red cell distribution width, CRP: C-reactive protein, ESR: Erythrocyte sedimentation ratio, SII: Systemic Immune Inflammation Index, PIV: Pan-immune-inflammation value

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The median age of the individuals in the AS group was 31.00 (26.00-37.25) years, while the median age of the individuals in the control group was 32.50 (27.00-39.75) years. Of the individuals in the AS group, 31 (45.59%) were female and 37 (54.41%) were male. Of the individuals in the control group, 46 (45.09%) were female and 56 (54.90%) were male. There was no important difference in median age and gender ratio between the two groups. The laboratory results of the two groups are presented in Table 1.

In the AS group, WBC, neutrophil, monocyte, platelet, NLR, MLR, PLR, RDV, ESR, CRP, SII and PIV values were determined to be higher than in the control group. Lymphocyte and MPV values were determined to be lower in the AS group than in the control group (Table 1). Correlation analysis was carried out to see the relation between SII and PIV parameters and CRP and ESR parameters. SII values of AS group showed positive correlation with CRP (Correlation coefficient (Cc): 0.990 p<0.001) and ESR (Cc: 0.790, p<0.001) levels, while they did not show correlation in the control group.

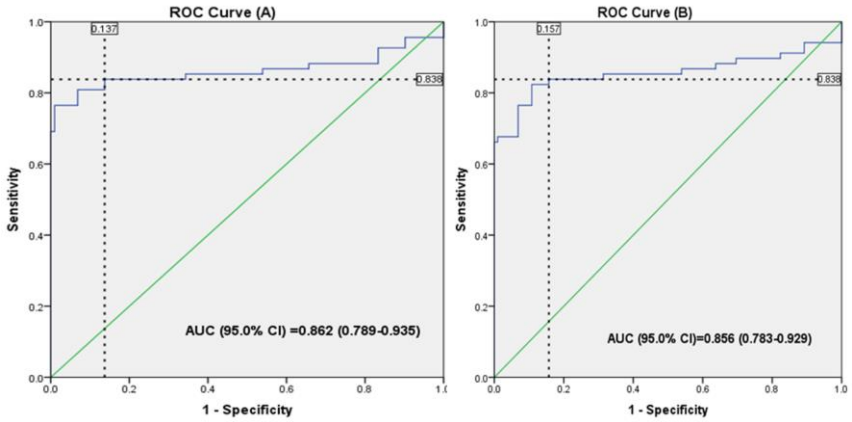

Figure 1. ROC curve graph of SII and PIV

Similarly, PIV values of AS group showed positive correlation with CRP (Cc: 0.990, p<0.001) and ESR (Cc: 0.791, p<0.001) levels, while they did not show correlation in the control group. ROC analysis was performed to see the specificity and sensitivity of PIV and SII values in HLA-B27 positivity. The results of the analysis are shown in Table 2 and Figure 1. For the prediction of HLA-B27 positivity/negativity, sensitivity for PIV was 83.80% and specificity was 84.30%, while sensitivity for SII was 83.80% and specificity was 86.30% (Table 2 and Figure 1).

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Table 2. Results of ROC curve analysis of PIV and SII index in predicting active period of ankylosing spondylitis and HLA-B27 positivity

	Index	AUC (95.0% CI)	p	Cutoff
HLA-B27 positivity	PIV	0.856 (0.783-0.929)	<0.001	282.98
	SII	0.862 (0.789-0.935)	<0.001	561.78

HLA-B27: Human Leukocyte Antigen-B27, AUC: Area under the curve, CI: Confidence interval, SII: Systemic Immune Inflammation Index, PIV: Pan-immune-inflammation value

DISCUSSION

The association between HLA-B27 positivity, which is seen in approximately 8% of the Central European population, and AS was discovered 50 years ago. Approximately 60-90% of individuals with axial spondylarthritis, including AS, worldwide are HLA B27 (+) individuals. The illness prevalence is related to the HLA-B27 frequency in the public. HLA-B27 is also a significant player in the diagnosis, classification and severity of axial spondylarthritis. In an effort to understand the pathophysiology of AS, the arthritogenic peptide hypothesis postulates a strong relationship between HLA-B27 positive and AS etiology (13). The generally accepted function of HLA-B27 is to initiate adaptive immunological responses by presenting antigenic peptides to CD8 cells. According to this theory, HLA-B27 exposes CD8 cells to peptides originating from exogenous sources, such bacteria. These lymphocytes subsequently react with antigens at the site of disease inflammation, resulting in inflammation (14). In a recent research conducted in southeastern of Turkey, the HLA-B27 prevalence was determined to be 20.16% and it was reported that this high prevalence may be related to consanguineous marriage and that HLA-B27 has a predictive role in the diagnosis and prognosis of AS (15).

In this study conducted in the north of Turkey, the HLA-B27 prevalence was determined as 11.56%. It was also found that the immune-inflammatory markers of HLA-B27 (+) individuals were higher than the values of HLA-B27 (-) individuals. In a recent study of 446 AS patients, it was reported that CRP and ESR levels were detected at high levels. It was also reported that ankylosing spondylitis illness activity score was positively correlated with CRP and ESR levels (16). Another recent study reported that those with an AS disease activity score above 4 had higher ESR and CRP levels than those below 4 (17). A study conducted with AS individuals with long-term illness reported that radiographic progression during cure was importantly related with higher time-averaged CRP values (18). Similarly, ESR levels of AS patients were found to be strongly associated with AS Quality of Life, Bath AS Illness Activity Index (BASDAI), AS Illness Activity Score (ASDAS) and Bath AS Functional Index, night pain, morning stiffness, total pain intensity and fatigue (19).

In this study, both CRP and ESR were higher in HLA-B27 (+) individuals than in HLA-B27 (-) individuals. In addition, ESR and CRP levels were associated with PIV and SII values in HLA-B27 (+) individuals, but no association was found in HLA-B27 (-) individuals.

In the recent Spondylo Arthritis International Society (ASAS)-EULAR study, which includes recommendations for AS patients, the ASDAS emerged as the most appropriate tool to assess disease activity and has been recommended for the follow-up of AS patients. Calculated preferably using CRP, ASDAS is a well-balanced score in contrast to the historically more widely used BASDAI. In addition to including CRP as a quantitative indicator of inflammation, it has been validated with the rapid quantitative CRP test, further increasing its applicability for routine clinical work. Specific cut-off values for ASDAS have been validated to define illness activity states and criteria for enhancement and deterioration (20). The cut-off values currently used by rheumatologists to escalate treatment are ASDAS $\geqslant$2.1 compared to BASDAI $\geqslant$4 for axial spondylarthritis (21). In this study, HLA-B27 positivity was determined as 282.98 for PIV value and 561.78 for SII index.

Since this study is a retrospective study, the fact that it does not include clinical findings of the patients other than CRP and ESR can be considered as a limitation of the study. On the other hand, this study is a reference for future studies in which clinical findings and organ involvements will be evaluated by establishing one-to-one communication with the patients. In addition, although it is known that HLA-B27 is an important laboratory parameter in AS patients, it is not applicable in every health institution and clinic and it has practical difficulties such as obtaining results late compared to other tests. On the other hand, providing easy and fast access to SII and PIV parameters obtained from routine tests such as complete blood count is an important factor that increases the value of this study in clinical practice. Evaluating the ability of parameters such as SII and PIV to predict HLA-B27 positivity may improve early decision-making processes in AS patients.

CONCLUSION

The values of immune-inflammatory parameters such as SII and PIV were higher in HLA-B27 (+) individuals compared to HLA-B27 (-) individuals. SII and PIV levels were related with ESR and CRP levels in HLA-B27 (+) individuals, but not in HLA-B27 (-) individuals. The cut-off value for SII in HLA-B27 positivity was 561.78 and for PIV was 282.98. In conclusion, immune-inflammatory markers such as SII and PIV can be evaluated in the prediction of HLA-B27 positivity in AS.

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Authorship contributions

AK, TK, RA and FS formed the study concept and design, TK, RA, SS and ÖS contributed to the acquisition of the data, AK, ÖS and SS performed analysis and interpretation of the data, AK, FS, RA and SS contributed to the drafting of the manuscript, critical revision of the manuscript for important intellectual content, AK and FS provided statistical expertise.

Data availibity statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of competing interest

All authors declare that they have no conflict of interest.

Ethics

The ethics committee decision for the research was taken at the Samsun University Non-Interventional Clinical Ethics Committee meeting held on February 28, 2024. (Protocol code: GOKAEK 2024/5/5).

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REFERENCES

1. Yang H, Chen Y, Xu W, Shao M, Deng J, Xu S, et al. Epigenetics of ankylosing spondylitis: Recent developments. Int J Rheum Dis. 2021 Apr;24(4):487-493.

2. Mauro D, Thomas R, Guggino G, Lories R, Brown MA, Ciccia F. Ankylosing spondylitis: an autoimmune or autoinflammatory disease? Nat Rev Rheumatol. 2021 Jul;17(7):387-404.

3. Liu L, Yuan Y, Zhang S, Xu J, Zou J. Osteoimmunological insights into the pathogenesis of ankylosing spondylitis. J Cell Physiol. 2021 Sep;236(9):6090-6100.

4. Waeckel L, Kennel A, Berger AE, Lambert C. Human leukocyte antigen-B27 typing by flow cytometry: Comparison of three CE-IVD methods. Cytometry B Clin Cytom. 2023 Nov;104(6):460-467.

5. Fahed H, Mauro D, Ciccia F, Ziade NR. What Does Human Leukocyte Antigen B27 Have to Do with Spondyloarthritis? Rheum Dis Clin North Am. 2020 May;46(2):225-239.

6. Deodhar A, Gill T, Magrey M. Human Leukocyte Antigen B27-Negative Axial Spondyloarthritis: What Do We Know? ACR Open Rheumatol. 2023 Jul;5(7):333-344.

7. Tutan D, Doğan AG. Pan-Immune-Inflammation Index as a Biomarker for Rheumatoid Arthritis Progression and Diagnosis. Cureus. 2023 Oct 6;15(10):e46609.

8. Wu B, Zhang C, Lin S, Zhang Y, Ding S, Song W. The relationship between the pan-immune-inflammation value and long-term prognoses in patients with hypertension: National Health and Nutrition Examination Study, 1999-2018. Front Cardiovasc Med. 2023 Mar 2;10:1099427.

9. Huang H, Liu Q, Zhu L, Zhang Y, Lu X, Wu Y, Liu L. Prognostic Value of Preoperative Systemic Immune-Inflammation Index in Patients with Cervical Cancer. Sci Rep. 2019 Mar 1;9(1):3284.

10. Huang P, Mai Y, Zhao J, Yi Y, Wen Y. Association of systemic immune-inflammation index and systemic inflammation response index with chronic kidney disease: observational study of 40,937 adults. Inflamm Res. 2024 Apr;73(4):655-667.

11. Li G, Yu J, Jiang S, Wu K, Xu Y, Lu X, et al. Systemic Immune-Inflammation Index Was Significantly Associated with All-Cause and Cardiovascular-Specific Mortalities in Patients Receiving Peritoneal Dialysis. J Inflamm Res. 2023 Aug 31;16:3871-3878.

12. Lin F, Zhang LP, Xie SY, Huang HY, Chen XY, Jiang TC, Guo L, Lin HX. Pan-Immune-Inflammation Value: A New Prognostic Index in Operative Breast Cancer. Front Oncol. 2022 Apr 13;12:830138.

13. Braun J, Sieper J. Fifty years after the discovery of the association of HLA B27 with ankylosing spondylitis. RMD Open. 2023 Aug;9(3):e003102.

14. Garrido-Mesa J, Brown MA. T cell Repertoire Profiling and the Mechanism by which HLA-B27 Causes Ankylosing Spondylitis. Curr Rheumatol Rep. 2022 Dec;24(12):398-410.

15. Oral D, Erdal GG, Tekeş S, Yücel I, Em S. Prevalence of HLA B27 in Patients Diagnosed with Ankylosing Spondylitis (AS) in Diyarbakır, Southeastern Region of Turkey. Niger J Clin Pract. 2024 Jan 1;27(1):29-34. doi: 10.4103/njcp.njcp_258_23. Epub 2024 Feb 5. PMID: 38317032.

16. Cui R, Wang YL, Tao YL, Tong Q, Chen Z, Dai SM. Platelet to albumin ratio is an independent indicator for disease activity in ankylosing spondylitis. Clin Rheumatol. 2023 Feb;42(2):407-413.

17. Uzeli Şen U, Başaran PO. Pan-immune inflammation value as a biomarker in ankylosing spondilitis and associated with disease activity. Anatolian Curr Med J. 2024;6(1):48-54

18. Konsta M, Sakellariou GT, Rusman T, Sfikakis PP, Iliopoulos A, van der Horst-Bruinsma IE. Long-term effect of TNF inhibitors on radiographic progression in ankylosing spondylitis is associated with time-averaged CRP levels. Joint Bone Spine. 2021 May;88(3):105111.

19. Yılmaz O, Tutoğlu A, Garip Y, Ozcan E, Bodur H. Health-related quality of life in Turkish patients with ankylosing spondylitis: impact of peripheral involvement on quality of life in terms of disease activity, functional status, severity of pain, and social and emotional functioning. Rheumatol Int. 2013 May;33(5):1159-63.

20. Ramiro S, Nikiphorou E, Sepriano A, Ortolan A, Webers C, Baraliakos X, et al. ASAS-EULAR recommendations for the management of axial spondyloarthritis: 2022 update. Ann Rheum Dis. 2023 Jan;82(1):19-34.

21. Chen YH, Huang WN, Chen YM, Lai KL, Hsieh TY, Hung WT, Lin CT, Tseng CW, Tang KT, Chou YY, Wu YD, Huang CY, Hsieh CW, Chen YJ, Liao YW, Chen HH. The BASDAI Cut-Off for Disease Activity Corresponding to the ASDAS Scores in a Taiwanese Cohort of Ankylosing Spondylitis. Front Med (Lausanne). 2022 May 16;9:856654.