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The association between the severity score of the disease and arterial stiffness in patients with axial spondylitis

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ABSTRACT

Background and objectives. Axial spondyloarthritis (axSpA) is a chronic inflammatory disease affecting the spine and sacral joints, causing back pain and stiffness. Patients with axSpA have double the cardiovascular risk due to ongoing inflammation, leading to higher morbidity and mortality. Early identification of cardiovascular risks is crucial. This study is aimed to depict the link between disease severity and arterial stiffness in axSpA patients.

Materials and methods. This cross-sectional study was conducted from January to March 2023, involving axial spondyloarthritis on patients aged 16–60 years who visited the Rheumatology Outpatient Unit at Dr. Soetomo Hospital and met ASAS criteria.

Results. Thirty SpA patients participated, consisting of 7 males (23.3%) and 23 females (76.7%). Ages ranged from 18 to 58, with an average of 43.33 ± 13.32. The age distribution included 2 patients aged 26–35 (6.7%), 7 aged 36–45 (23.3%), 9 aged 46–55 (30.0%), and 6 aged 56–65 (20.0%). Treatment duration revealed that 18 patients (60.0%) had been treated for 1–5 years, while 12 patients (40.0%) had been treated for over 5 years.

Conclusions. The study found a predominance of female patients aged 46–55, with no significant differences in mSASSS scores by gender or age. In axSpA patients, a strong correlation was observed between mSASSS scores and arterial stiffness, highlighting the relationship between disease severity and cardiovascular risk.

Keywords: axial spondyloarthritis, rheumatology outpatient unit

INTRODUCTION

Axial spondyloarthritis (axSpA) is a chronic inflammatory disease that primarily affects the axial skeleton (sacral joints and spine) [1]. In general, individuals with axSpA will experience chronic rigidity and back discomfort that affects the lower pelvis, back, or other spinal structures [2].

Globally, the prevalence of axSpA is known to affect 0.5%–2% of the population. The prevalence of axSpA in each continent varies, such as in Southeast Asia by 0.20%, in the Arctic by 1.61%, in the Americas by 1.35%, in Europe by 0.54%, and in South Asia by 0.22% of the population [3,4]. This number is notably significant due to the fact that individuals with axSpA have a cardiovascular risk associated with atherosclerosis that is twice as high as that of non-axSpA. The economic burden for individuals with axSpA will increase, as well as morbidity and mortality associated with cardiovascular disease [5–8].

The identification of cardiovascular risks associated with axSpA at an early stage can actually prevent or reduce the economic burden or increased morbidity and mortality experienced by axSpA patients. Moreover, it has been established that the elevated

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risk of cardiovascular disease in individuals with axSpA is associated with chronic inflammatory processes, crucial in the development of cardiovascular disease. However, the cytokine profile of axSpA is still mainly unknown [3,4]. The disease severity scores will be evaluated in this investigation using mSASSS scoring as a measuring tool. The mSASSS score has been shown to have advantages over other scores, including the Bath-Ankylosing Radiology Index (BASRI) and the Radiology AS Spinal Score (RASSS), in the context of SpA patients whose disease duration is unidentified. This is due to the fact that the longer the disease has been present, the more restricted spinal mobility becomes. This information is supported by numerous previous studies and additional structural injuries to the vertebrae [9].

Arterial stiffness, wave reflection intensity, and endothelial function are independent predictors of cardiovascular risk in a variety of patient populations and are directly known to accelerate the atherosclerotic process. Furthermore, numerous pathological conditions, including diabetes, atherosclerosis, dyslipidemia, and chronic kidney disease are associated with elevated arterial rigidity. Increased arterial rigidity is a predictor of an elevated risk of cardiovascular and all-cause mortality, and appears to contribute to the intricate etiology of cardiovascular disease. The examination of arterial stiffness is also relatively straightforward and does not cause any damage to the patient [10,11]. Therefore, the aim of this study was to determine the relationship between disease severity scores and arterial stiffness in axial spondyloarthritis patients.

METHODS

A cross-sectional study was performed from January to March 2023 at Dr. Soetomo General Academic Hospital. The study protocol was approved by the Medical Ethics Committee of Dr. Soetomo General Academic Hospital (Ethical Number: 0646/KEPK/IV/2023).

Sampling was carried out using a consecutive sampling technique, namely all SpA patients who visited the Rheumatology Outpatient Unit at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia and met the inclusion criteria and did not meet the exclusion criteria were included in this study until "n" was reached from the calculation of the sample size or SpA population visiting the Rheumatology Outpatient Unit within a period of 3 months.

Inclusion criteria were: patients aged 16-60 years, axial spondyloarthritis patients diagnosed with ASAS criteria who seek treatment at the Rheumatology Outpatient Unit at Dr. RSUD. Soetomo Surabaya. Meanwhile, **the exclusion criteria** were: not smoking or having no history of smoking, being diagnosed with hypertension through two measurements before clinical manifestations of axSpA appeared. If the diagnosis of hypertension was established after the symptoms of axSpA appeared or after the diagnosis of axSpA, the subject was included in the study. Other drop out reasons were: a history of diabetes mellitus, coronary heart disease, heart failure, stroke, chronic kidney failure, malignancy, chronic infectious diseases (such as TB and hepatitis), and patients with other autoimmune diseases (such as SLE and RA), taking, ARBs, ACE inhibitors, and CCBs. The sample was calculated using the sample size formula for cross-sectional research with correlative analysis:

$$n=\left[\frac{(z\alpha+z\beta)}{0.5\ ln\ \frac{(1+r)}{(1-r)}}\right]^2+3$$

$$n=\left[\frac{(1.96+0.84)}{0.5\ ln\ \frac{(1.62)}{(0.38)}}\right]^2+3$$

$$n=\left[\frac{(2.8)}{0.5\ ln\ \frac{(1.62)}{(0.38)}}\right]^2+3$$

$$n=\left[\frac{(2.8)}{0.5\ ln\ \frac{(1.62)}{(0.38)}}\right]^2+3$$

n = 17.91 ≈ 18

Description:

n: Sample size
α: Level of significance (set by researchers at 0.05)
Zα: The standard value of Z for a 0.05 two-tailed hypothesis is 1.96
β: Power of the test (set by researchers at 0.80)
Zβ: The standard value of Z for b 0.80 is 0.84
R: Correlation coefficient that is considered significant (r: 0.62)

RESULTS

A total of 30 samples were included in this study, which consisted of all SpA patients who visited the Rheumatology Outpatient Unit at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. Of the 30 samples, 7 were male, accounting for 23.3% of the total. The female gender represented 23 sam-

ples, with a percentage of 76.7%. To describe the age characteristics of the 30 samples, the age range was 18 to 58 years, with an average age of 43.33 ± 13.32. The age range of 6 years (20.0%) was used to categorize the samples. The sample consisted of 2 individuals aged 26–35 years (6.7%), 7 individuals aged 36–45 years (23.3%), 9 individuals aged 46–55 years, (30.0%), and 6 individuals aged 56–65 years (20.0%). According to the descriptive characteristics of the length of treatment from 30 samples, 18 samples had a duration of 1–5 years, representing a percentage of 60.0%. For 12 samples, the treatment duration was longer than 5 years, with a percentage of 40.0% (Table 1).

TABLE 1. Descriptive demographic characteristics

Demographic characteristics	n=30
Gender	
Male	7 (23.3%)
Female	23 (76.7%)
Age	
Range (Mean ± SD)	18-58 (43.33 ± 13.32)
16-25 years	6 (20.0%)
26-35 years	2 (6.7%)
36-45 years	7 (23.3%)
46-55 years	9 (30.0%)
56-65 years	6 (20.0%)
Long Treatment	
1-5 Th	18 (60.0%)
> 5 Th	12 (40.0%)

Based on the results of descriptive Table 2 and the aggregate test of 2 assessors in assessing the mSASSS score, it was found that for assessor 1 the average score from 30 samples was 18.63 ± 4.013 and for assessor 2 the average score from 30 samples was 18.57 ± 4.006, based on the results of the Cohen-test. Kappa obtained a p-value of 0.000, where the value <0.05 means that the mSASSS score assessment between assessor 1 and assessor 2 was agreement or similarity. Cohen-Kappa test coefficient value of 0.777 means that the level of agreement or the similarity between assessors 1 and 2 in assessing the mSASSS scores was 77.7%, positioning it in the strong category. The results of the aggregate and similarity tests revealed that the mSASSS scores used in this study were the mSASSS scores from the average of rater 1 and rater 2.

TABLE 2. Descriptive and mSASSS Kappa test

Parameter	Assessment 1 (Mean ± SD)	Rater 2 (Mean ± SD)	p-value	Kappa coefficient
mSASSS Score	18.63 ± 4.013	18.57 ± 4.006	0,000	0.777

According to the results of Table 3 for descriptive mSASSS scores, the range was 11.5 to 28.5 with an average mSASSS score of 18.60 ± 4.00. Based on the results of the normality test using the Shapiro Wilk test, the p-value for the score was 0.561, where a value >0.05 allows the mSASSS scores data to be considered normally distributed.

TABLE 3. Descriptive and normality test of mSASSS and PWV

Variable	Range (Mean ± SD)	p-value	Information normality
mSASSS	11.5 - 28.5 (18.60 ± 4.00)	0.561	Normal
PWV-R	10.60 - 23.80 (15.00 ± 3.50)	0.000	Abnormal
PWV-L	11.10 - 25.00 (14.92 ± 3.56)	0.000	Abnormal

The results of Table 3 for 30 samples' descriptive PWV-R indicated that the score range was 10.60 to 23.80 with an average PWV-R score of 15.00 ± 3.50. Based on the results of the normality test using Shapiro Wilk test, the p-value was 0.000, where the value <0.05 means that PWV-R score data were abnormally distributed. For descriptive PWV-L, the scores range was 11.10 to 25.00 with an average PWV-L score of 14.92 ± 3.56. Based on the results of the normality test using Shapiro Wilk test, the p-value was 0.000 where the value <0.05 means the PWV-L score data was abnormally distributed.

TABLE 4. mSASSS score test with demographics

Demographic characteristics	mSASSS Range (Mean ± SD)	p-value
Gender		
Man	11.5 - 22.0 (16.93 ± 4.15)	0.213
Woman	12.0 - 28.5 (19.11 ± 3.91)	
Age		
16-25 Years	14.0 - 20.0 (16.83 ± 2.14)	0.466
26-35 Years	14.0 - 20.0 (17.00 ± 4.24)	
36-45 Years	12.0 - 22.5 (17.93 ± 3.63)	
46-55 Years	11.5 - 23.5 (19.17 ± 3.77)	
56-65 Years	12.0 - 28.5 (20.83 ± 5.85)	
Long Treatment		
1-5 Years	12.0 - 22.5 (17.86 ± 2.98)	0.222
> 5 Years	11.5 - 28.5 (19.71 ± 5.13)	

The mSASSS score test results presented in Table 4, with demographics for gender from 30 samples, revealed that the male gender's mSASSS score was in the range of 11.5 to 22.0 with a mean score of 16.93 ± 4.15, while for female gender's mSASSS score was in the range of 12.0 to 28.5 with a mean score of 19.11 ± 3.91. Based on the mean value, it was found that women's mSASSS scores tended to be higher than men's and based on comparisons using the T test, a p-value of 0.213 was obtained, where the value >0.05 means that the difference in mSASSS scores based on gender was not significant.

According to the results of Table 4, it was found that mSASSS scores for patients aged 16-25 years were in the range of 14.0 to 20.0 with a mean score of 16.83 ± 2.14, for those aged 26-35 years old, the mSASSS scores were in the range 14.0 to 20.0 with a mean score of 17.00 ± 4.24, and for those aged 36-45 years mSASSS scores were in the range 12.0 to 22.5 with a mean score of 17.93 ± 3.63. The mSASSS scores for patients aged 46-55 years were in the range 11.5

to 23.5 with a mean score of 19.17 ± 3.77, while for those aged 56-65 years the scores were in the range 12.0 to 28.5 with a mean score of 20.83 ± 5.85. Based on the mean value, it was found that the older the age, the higher the mSASSS score, and based on comparisons using ANOVA test, the p-value was 0.466, where the value >0.05 means that the difference in mSASSS scores based on age range was not significant or not significantly different.

Based on the same results of Table 4, it was also found that the mSASSS scores were in the range of 12.0 to 22.5 with a mean score of 17.86 ± 2.98 for the length of treatment between 1 and 5 years, while they were in the range of 11.5 to 28.5 with a mean score of 19.71 ± 5.13 for length of treatment >5 years. Based on the mean value, it was found that the mSASSS scores for treatment duration >5 years tended to be higher than for the treatment duration of 1-5 years. Based on a comparison using the T test, the p-value was found to be 0.222, where the value >0.05 means the difference in mSASSS scores based on treatment duration was not significant.

TABLE 5. Test of the relationship between mSASSS scores and PWV-R and PWV-L scores

	N	r	p-value	information
mSASSS score with PWV-R	30	0.726	0.000	Relate
mSASSS score with PWV-L	30	0.695	0.000	Relate

Table 5 revealed the results for the relationship between mSASSS and PWV-R using the Spearman test with a p-value of 0.000, where the value <0.05 means that there is a significant or meaningful relationship between mSASSS and PWV-R. It was also found that the correlation coefficient or r value was 0.726 or 72.6%, meaning that the relationship between those two variables is strong, and the strength is significant. Figure 1 shows that the intersection line between mSASSS and PWV-R has an ascending tendency, similar to the relationship between mSASSS and PWV-R proving a direct proportionality between the mSASSS score and the PWV-R score.

Based on the results of Table 5 for the relationship between mSASSS and PWV-L using the Spearman test , a p-value of 0.000 was obtained, where the value <0.05 means that there is a significant relationship between mSASSS and PWV-L. Also, the correlation coefficient or r value was 0.695 or 69.5% meaning that the relationship between the two variables is strong and the strength is significant according to statistical tests. Figure 1 shows that the intersection line between mSASSS and PWV-L has an upward tendency, which means that the relationship between mSASSS and PWV-L follows the same direction, proving a direct proportionality between the mSASSS score and the PWV-L score.

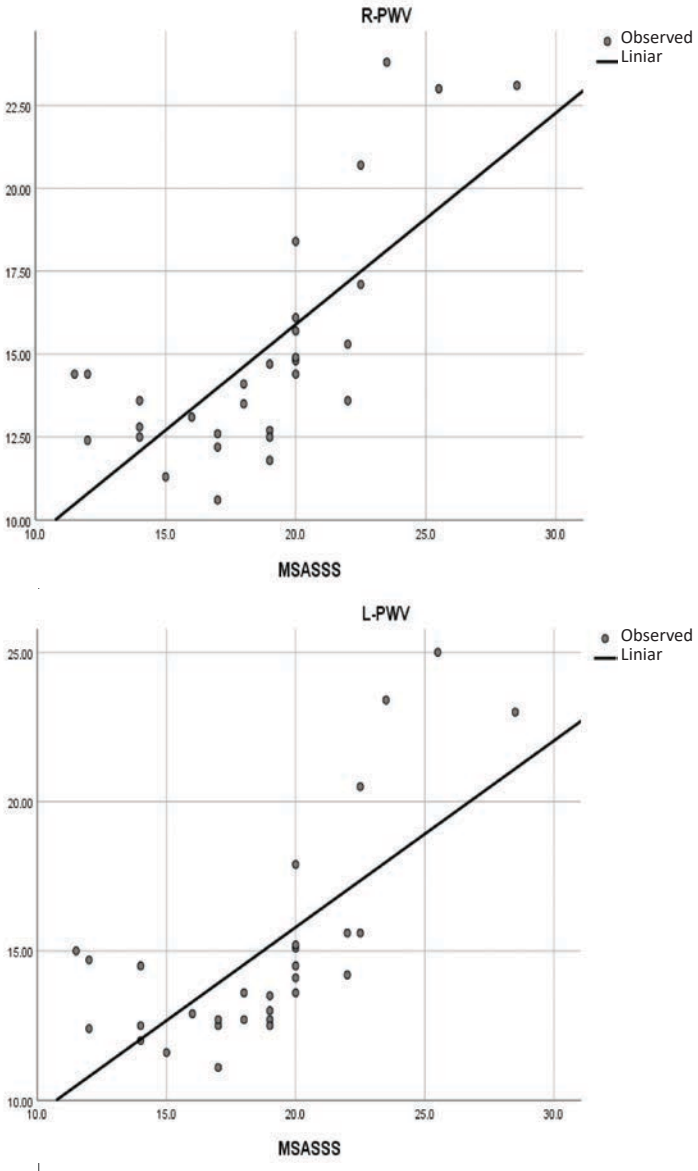

FIGURE 1. Scater graph of the relationship between mSASSS and PWV

DISCUSSION

Spondyloarthritis (SpA) is a disease characterized by chronic inflammation of the axial skeleton being more predominant in men than women.

Our study proved the opposite with 23.3% of SpA patients being males and 76.7% females. These data were in contrast to the previous research which revealed that SpA occurs more often in men than women with a ratio of male: female patients of 2-3: 1 [2]. In researches conducted by Liew (2021) [11] and Giollo (2017) [7], it was found that there were more males than females patients. Research by Avram (2016) [5] on ankylosing spondylitis patients also showed that the prevalence was higher in males than in females.

In Sieper et al. research [2], the mean age of SpA patients was 43.33 ± 13.32 years. Those aged 46-55 years were the largest percentage (30%), while those aged 36-45 years were the smallest (23.3%). According to the same study, this disease generally begins in the 3rd decade of life, patients with positive HLA-B27 can experience SpA 5 years earlier than HLA-B27 negative patients [2]. Research by Avram (2016) on ankylosing spondylitis patients in Romania showed a mean age similar to this study, namely 45.8 ± 11.7 years. Research by Liew in the United States and Giollo in Italy showed a greater mean age of SpA patients, namely 53.39 ± 10.0 years and 54 ± 11 years [7,11].

SpA patients often have other comorbidities such as hypertension and coronary heart disease. This is thought to occur due to the patient's risk factors and complications due to systemic inflammation [12]. The theory underlying the occurrence of inflammation in SpA may or may not be related to HLA-B27. In the mechanism related to HLA-B27, there is an increase in the activation of CD4+ cell expression, which in turn causes an increase in IL-23, IL-17, IL-6, which ultimately causes an increase in TNF-a. In mechanisms that are not related to HLA-B27, inflammation occurs due to interactions between genes and the environment in joint tissue and the gastrointestinal tract which will activate CD4+Th17 cells and increase the formation of IL-17 and TNF-a. This process causes clinical manifestations in the form of joint erosion, enthesitis, and syndesmophytes which are observed with the mSASSS score [2,9].

mSASSS is a modified SASSS score and has a better specificity and sensitivity. This score is calculated based on vertebral X-ray radiology examination and is used to measure structural damage to the spine in SpA. mSASSS can assess erosion, sclerosis, squaring, syndesmophytes and bridges at the anterior vertebral corners (VC) of both the cervical and lumbar spine. In mSASSS there are 24 VCs assessed from the lateral view of the vertebral X-ray. Point 1 is given if erosion and/or sclerosis and/or squaring is found, point 2 is given if syndesmophytes are found, and point 3 is given if there is bridging syndesmophyte. The total score obtained ranges from 0 to 72 [9].

In this study, the mSASSS score in female patients was higher than in male patients. The mean mSASSS score in female patients was 19.11 ± 3.91 while in male patients it was 16.93 ± 4.15, but comparison using the T test showed that this difference was not significant. Previous research by Li (2019) showed that gender was related to mSASSS scores, where male gender was related to higher mSASSS scores. Male gender has a worse prognosis and more severe radiographic changes, but changes in mSASSS mainly depend on the formation of new syndesmophytes and ankylosis and have low sensitivity Li (2019). However, our study had different results. Hallström (2023) research also shows that mSASSS scores in male patients are higher than female patients with a significant difference. Disease progression was found to be worse in male patients compared to female patients. What is found in female patients but not found in male patients is that in female patients there are slightly more syndesmophytes in the cervical vertebrae than in the lumbar vertebrae. According to Ensslin (2023), the presence of degenerative osteophytes can influence the assessment of syndesmophytes in SpA patients, especially in men who have jobs with heavy physical activity. The difference between the results of our study and the previous researches is thought to be due to differences in the demographics of the research sample.

In our study, we found that the older the age, the higher the mSASSS score. Comparison using the ANOVA test showed that the differences in mSASSS scores based on age range were not significant. Previous research of Li et al. (2019) showed a significant difference where patients aged more than 40 years had greater mSASSS scores compared to patients aged less than 40 years. This means that as age increases, structural damage becomes greater.

Arterial stiffness is a reduced ability of the arteries to expand and contract in response to changes in pressure. Parameters that describe arterial stiffness include compliance and distensibility. Compliance (C) is a measure of the change in volume (ΔV) in response to changes in blood pressure (ΔP; $C = \Delta V/\Delta P$). In stiff blood vessels, volume changes and compliance decreases with certain pressure changes. Distensibility (D) is the compliance relative to the initial volume ($D = \Delta V/\Delta P \times V$) and is therefore more closely related to the stiffness of the arterial wall. The consequence of reduced compliance/distensibility is an increase in the velocity of pressure propagation along the artery, called pulse wave velocity (PWV). Commonly used points are the carotid and femoral arteries because they are shallow and easy to access [12].

Arterial stiffness can be measured using the non-invasive method of measuring pulse wave velocity (PWV). The pressure generated by ventricular ejection will be distributed along the artery, its speed determined by the elasticity of the artery wall. Aortic PWV measurement is the gold standard for measuring arterial stiffness [13].

In this study, it was found that the PWV-R and PWV-L scores in women tended to be greater than those in men, but this difference was not statistically significant. Previous research states that increased arterial stiffness occurs in both men and women [14].

PWV-R and PWV-L scores are related to age, where the greater the age, the greater the PWV-R and PWV-L scores. The difference in PWV-R scores based on age range was not significant, while for PWV-L the difference was statistically significant. Arterial stiffness is known to be associated with age. In the first decade of life, arterial stiffness decreases until it is lowest at the age of 10 years, after which arterial stiffness increases in both men and women. The increase in aortic stiffness with age is slow and continuous. The increase in aortic PWV is 0.1 m/second per year or around 1%. A real increase occurs especially after the age of 55 years, this is in accordance with the epidemiology of hypertension where the prevalence increases after the age of 55 years. Systolic hypertension is the main clinical manifestation of large arterial stiffness [14].

The mechanism of increased arterial stiffness due to age is not yet known with certainty. Fracture and fragmentation of elastic fibers after repeated stress cycles is thought to be one of the causes. Apart from that, there is an increase in collagen and calcium deposits [12].

Central arterial stiffness increases progressively with age. As the aorta becomes stiffer, systolic pressure increases and results in hypertrophy and fibrosis of the left ventricle. Increased aortic stiffness and reduced reservoir capacity lead to a decrease in diastolic pressure. Lower diastolic blood pressure reduces coronary artery perfusion and increases subendocardial ischemia which is exacerbated by left ventricular hypertrophy [13]. On the other hand, the increase in peripheral arterial stiffness with increasing age is not as severe as that of central arteries. Previous studies have shown that changes in carotid-radial PWV or femoral-tibial PWV are two to three times less common than PWV changes in the central aorta. Arterial stiffness in the carotid arteries was found to be associated with increasing age while in the femoral arteries it was not associated [14].

In SpA patients there is inflammation, deposits of collagen, cholesterol, fat, proliferation of myocytes, macrophages, leukocytes, cellular waste products, and calcium deposits which also play a role in arterial stiffness. There are changes in the extracellular matrix and smooth muscle tone in the medial arterial walls, decreased availability of nitric oxide (NO), increased angiotensin II, increased proinflammatory cytokines. The stiffness of the arterial walls causes an increase in pulse pressure, an increase in blood pressure, cyclic shear stress and tensile stress, re-triggering the stress process in the endothelium, increasing ROS and causing inflammation which ultimately forms an endless cycle. A decrease in diastolic blood pressure and reduced blood flow due to a reduced diameter of the arterial lumen which is preceded by arterial stiffness can trigger ischemia. Ischemia is associated with increased angiotensin II activity, which in turn increases NADPH oxidase activity, reduces NO bioavailability and increases ROS production. Angiotensin II activates Matrix Metallo Proteinases (MMP) and causes arterial fibrosis. Activation of cytokines such as MCP, TNF, IL-1, IL17, and IL-6 due to angiotensin II signals exacerbates Sp.A activity [13].

In this research, it was found that the PWV-R and PWV-L scores were related to the length of treatment. In patients who have been on treatment for > 5 years, the PWV score tends to be greater. Previous research stated that the duration of the disease in SpA patients was related to the formation of arterial stiffness. PWV has a positive correlation with SpA disease progression [5].

In this study, it was found that the mSASSS score had a strong relationship with PWV-R and PWV-L, where the higher the mSASSS score, the greater the PWV-R and PWV-L scores and vice versa.

Hypertension and arterial stiffness have a causal relationship where arterial stiffness plays a role in the pathogenesis of hypertension and hypertension can cause arterial stiffness. In hypertensive patients, hypertrophy occurs in the medial layer of blood vessels which causes the formation of extracellular matrix in the media layer and adventitia. This is associated with reduced compliance and distensibility of blood vessels and is found in central arteries but not in peripheral arteries. In peripheral arteries such as the radial artery, the arterial diameter does not change even though there is an increase in blood pressure, whereas in central arteries there is an increase in arterial diameter which corresponds to an increase in blood pressure [14]. It is known that 19% of SpA sufferers have comorbidities in the form of hypertension [15].

SpA sufferers have higher serum levels of immune-inflammatory markers than patients who do not suffer from SpA. These immune-inflammatory markers include IL1-b, IL-6, and TNF-a. Immuno-inflammatory activation in SpA is thought to be related to arterial stiffness and atherosclerosis. Inflammation has a direct role in arterial stiffness. Apart from inflammation, there are several other factors that contribute to arterial stiffness in patients with inflammatory arthritis, namely metabolic variables (blood sugar, cholesterol levels, triglyceride levels) or endothelial damage variables such as ROS and NO. ROS have adverse effects on the vasculature, oxidative stress is known to favor the occurrence of vascular disease. Previous research results show that reducing oxidative stress can reduce aortic stiffness [4].

PWV measurements in this study were carried out on peripheral arteries only, namely the brachial and tibial arteries, PWV measurements on central

arteries, namely the aorta, were not carried out in this study. The strength of this research is that other comorbidities influence it the occurrence of arterial stiffness such as diabetes mellitus, coronary heart disease, heart failure, stroke, chronic kidney failure, malignancy, chronic infectious diseases (such as TB and hepatitis), and patients with other autoimmune diseases (such as SLE and RA) have been excluded thereby reducing the possibility of their occurrence bias in research results due to these comorbidities.

CONCLUSION

The predominant gender of SpA patients in our study was feminine and the predominant age range was 46-55 years. There was no significant differences in mSASSS scores based on gender or age revealed by our results. Neither PWV-R nor PWV-L scores had significant differences based on gender. The difference in PWV-R scores based on age was not significant, while the difference in PWV-L scores based on age was significant. There was noticed a strong relationship between mSASSS scores and PWV-R and PWV-L scores. The higher the mSASSS score, the higher the PWV-R and PWV-L scores. A relationship between disease severity scores and arterial stiffness in patients with axial spondyloarthritis was also identified.

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REFERENCES

1. Poddubnyy D. Axial spondyloarthritis: is there a treatment of choice? *Ther Adv Musculoskelet Dis*. 2013 Feb;5(1):45–54. doi: 10.1177/1759720X12468658.
2. Sieper J, Poddubnyy D. Axial spondyloarthritis. *Lancet* (London, England). 2017 Jul;390(10089):73–84. doi: 10.1016/S0140-6736(16)31591-4.
3. Perhimpunan Reumatologi Indonesia. *Diagnosis dan Pengelolaan Spondiloartritis.* 2021;1:i–48. https://reumatologi.or.id/wp-content/uploads/2021/05/Spondiloartritis-2021.pdf.
4. Tuttolomondo A, Pecoraro R, Buttà C, Di Raimondo D, Ferrante A, Della Corte V, et al. Arterial stiffness indexes and serum cytokine levels in seronegative spondyloarthritis: relationships between stiffness markers and metabolic and immunoinflammatory variables. *Scand J Rheumatol.* 2015;44(6):474–9. doi: 10.3109/03009742.2016.1151073.
5. Avram C, Dragoi RG, Popoviciu H, Dragoi M, Avram A, Amaricai E. Association between arterial stiffness, disease activity and functional impairment in ankylosing spondylitis patients: a cross-sectional study. *Clin Rheumatol.* 2016;35(8):2017–22. doi: 10.1007/s10067-016-3297-7.
6. Prati C, Demougeot C, Guillot X, Sondag M, Verhoeven F, Wendling D. Vascular involvement in axial spondyloarthropathies. *J Bone Spine.* 2019;86(2):159–63. doi: 10.1016/j.jbspin.2018.05.003.
7. Giollo A, Dalbeni A, Cioffi G, Ognibeni F, Gatti D, Idolazzi L, et al. Factors associated with accelerated subclinical atherosclerosis in patients with spondyloarthritis without overt cardiovascular disease. *Clin Rheumatol.* 2017 Nov;36(11):2487–95. doi: 10.1007/s10067-017-3786-3.
8. Gensler LS. Axial spondyloarthritis: the heart of the matter. *Clin Rheumatol.* 2015 Jun;34(6):995–8. doi: 10.1007/s10067-015-2959-1.
9. Ramiro S, van Tubergen A, Stolwijk C, Landewé R, van de Bosch F, Dougados M, et al. Scoring radiographic progression in ankylosing spondylitis: should we use the modified Stoke Ankylosing Spondylitis Spine Score (mSASSS) or the Radiographic Ankylosing Spondylitis Spinal Score (RASSS)? *Arthritis Res Ther.* 2013 Jan;15(1):R14. doi: 10.1186/ar4144.
10. Ladehesa-Pineda ML, Arias de la Rosa I, López Medina C, Castro-Villegas MDC, Ábalos-Aguilera MDC, Ortega-Castro R, et al. Assessment of the relationship between estimated cardiovascular risk and structural damage in patients with axial spondyloarthritis. *Ther Adv Musculoskelet Dis.* 2020;12:1759720X20982837. doi: 10.1177/1759720X20982837.
11. Liew JW, Reveille JD, Castillo M, Sawhney H, Naovarat BS, Heckbert SR, et al. Cardiovascular Risk Scores in Axial Spondyloarthritis Versus the General Population: A Cross-sectional Study. *J Rheumatol.* 2021 Mar;48(3):361–6. doi: 10.3899/jrheum.200188.
12. Cecelja M, Chowienczyk P. Role of arterial stiffness in cardiovascular disease. JRSM Cardiovasc Dis. 2012 Jul;1(4). doi: 10.1258/cvd.2012.012016.
13. Birbari AE, Mallat SG, Lakiss A. Arterial stiffness. *J Med Liban.* 2002;50(1–2):39–44.
14. Benetos A, Waeber B, Izzo J, Mitchell G, Resnick L, Asmar R, et al. Influence of age, risk factors, and cardiovascular and renal disease on arterial stiffness: clinical applications. *Am J Hypertens.* 2002 Dec;15(12):1101–8. doi: 10.1016/s0895-7061(02)03029-7.
15. Zhao SS, Radner H, Siebert S, Duffield SJ, Thong D, Hughes DM, et al. Comorbidity burden in axial spondyloarthritis: a cluster analysis. *Rheumatology* (Oxford). 2019 Oct;58(10):1746–54. doi: 10.1093/rheumatology/kez119.