

The Relationship Between Age and Gender with Ferguson Angle in Low Back Pain Patients: A Retrospective Study

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ABSTRACT

Background: Low back pain (LBP) is defined as a global musculoskeletal problem, considered to have a high risk of disability years. LBP is more likely to affect older populations and women. Lumbar spine X-ray is the most widely used lower back examination as it produces clear images of the vertebral structure. One that has become the gold standard is measuring the Ferguson angle in lateral projection on lumbar spine X-rays. Measuring the angle in the lumbosacral is one of the determining parameters in evaluating the possible causes of LBP, one of which uses the Ferguson technique. **Objective:** To decide the relationship between age and gender with Ferguson angle in LBP patients at Dr. Soetomo General Hospital in January-December 2023. **Method:** This study is an observational analytical research conducted using a retrospective approach. **Results:** Overall a total of 164 samples met the inclusion and exclusion criteria. Most LBP sufferers were in the late adult age group (46-65 years), with a total of 74 patients (45.1%), and women predominating at 117 patients (71.3%). Spearman's analysis showed a very weak, insignificant correlation between age and Ferguson angle ($r = 0.042$, $p = 0.567$). Chi-square analysis found no significant relationship between gender and Ferguson angle ($p > 0.05$).

Keywords: relationship; age; gender; Ferguson angle; low back pain; Dr. Soetomo General Hospital.

INTRODUCTION

Low back pain (LBP) is one of the global musculoskeletal issues with a high risk of Years Lived with Disability (YLD) [1,2]. LBP is defined as pain or discomfort localized in the region beneath the ribs and above the lower gluteal fold, and it may or may not radiate to the legs [3]. There are several signs and symptoms in LBP, including pain that arises gradually over a certain period, is located somewhere along the lower back, with a feeling of tenderness in the muscles of the lower back, a limited range of motion on joints, and without any neurological disorders [4].

Previous studies have shown that around 80% of people globally have suffered from LBP [5]. With a total of 570 million cases worldwide and responsible

for 7.4% of global YLD, LBP is a major contributor to the burden of musculoskeletal conditions [6]. LBP is more prevalent among older individuals and women [7]. Based on the results of a research study conducted in 12 districts and cities in Indonesia on 9,482 residents with productive working age, LBP ranks highest, affecting approximately 16% of workers, indicating it is a common issue among the workforce [8].

LBP risk factors are generally categorized into two categories, individual and occupational risk factors. Individual risk factors for low back pain include age, sex, Body Mass Index (BMI), past medical history, and lifestyle. Whereas the occupational risk factors for low back pain are workload, work position

length of service, work duration, and repetition. LBP is a widespread health issue affecting people of all generations. In general, LBP can be experienced early, particularly in the 20–40 age range, and the risk increases significantly beyond the age of 30 [9]. Women experience LBP more frequently than men due to physiological differences in muscle capacity [10].

Radiological imaging plays a significant part in the evaluation of LBP. X-rays are the most widely utilized imaging modality. One of the clinically significant radiography angles is the lumbosacral angle (LSA), also known as the Ferguson angle, which is typically assessed to evaluate biomechanical aspects associated with low back pain (LBP). Plain X-rays of the lumbosacral spine in lateral projection can be used to measure the LSA using the Ferguson technique. Some previous studies have found that the usual range of LSA variations in asymptomatic patients varies from 32 and 40°. Age and gender are factors that influence LSA. An increase in LSA indicates the cause of early degenerative changes due to the strength of pressure on the intervertebral disc. Increased LSA causes the ligaments to stretch and the lower back muscles to contract in an attempt to maintain normal posture, which leads to the start of pain from sprains or strains in the back muscles, indicating LBP [11, 12, 13].

This study analyzed the relationship between age and gender with Ferguson angle in LBP patients. The authors hypothesize that the Ferguson angle, a critical component of LBP, is influenced by age and gender in patients. It is aspired that this research will enhance the accuracy of LBP diagnosis for aid in LBP case management in Indonesia and medical practitioners worldwide.

MATERIALS AND METHODS

This research is an analytical observational study with the purpose of determining the relationship between age and gender with Ferguson angle in low back pain (LBP) patients by using secondary data in the form of medical records. The population of this research is the medical records of LBP patients who underwent lateral projection lumbosacral x-ray examination in the Radiology Installation of Dr. Soetomo General Hospital from January to December 2023. The total sampling method is used in this research, by evaluating all the medical records then taken according to the inclusion and exclusion criteria during a specified period.

Inclusion and Exclusion Criteria

Patients with a confirmed diagnosis of LBP and complete lateral lumbosacral x-ray data were included. Patients with abnormal spinal structures (e.g., scoliosis, kyphosis), fractures, vertebral fusion, infections, malignancy, or incomplete medical records were excluded.

Ethics

The Dr. Soetomo General Hospital's Committee for Research Ethics has accepted this study (No. 1653/LOE/301.4.2/V/2024). To ensure confidentiality, the identities of the patients are not disclosed in this study. The authors will be the only ones to keep and utilize all of the collected data for the aim of this research.

RESULTS

The results of the secondary data analytical observation study in the form of medical records of low back pain (LBP) patients that undergo lateral projection lumbosacral x-ray examination in Dr. Soetomo General Hospital from January-December 2023 were reported quantitatively and data was obtained for 164 patients.

TABLE 1: Age Group Distribution.

Age Group (years)	n (n=164)	%
Adolescent: 12-25	20	12.2
Early adulthood: 26-45	57	34.8
Late adulthood: 46-65	74	45.1
Elderly: >65	13	7.9

Based on Table 1, regarding the age group distribution, it can be seen that it is dominated by patients in the age category of early adulthood, ranging from 46-65 years, with a total of 74 patients (45.1%), followed by patients in the early adulthood category with 57 patients accounting for 34.8%.

TABLE 2: Gender Distribution.

Gender	n (n=164)	%
Male	47	28.7
Female	117	71.3

With 117 patients or 71.3% of the total, females are more prevalent than males, who only contribute 47 patients, or 28.7%, according to Table 2 on gender distribution.

TABLE 3: Distribution of Ferguson Angle by Age Group.

Age Group (years)	Ferguson Angle (°)						Total	
	<32		32-40		>40		n	%
	n	%	n	%	n	%		
Adolescent: 12-25	7	35	9	45	4	20	20	100
Early adulthood: 26-45	16	28	22	39	19	33	57	100
Late adulthood: 46-65	16	22	38	51	20	27	74	100
Elderly: >65	2	15	9	70	2	15	13	100

Table 3 above shows the distribution of age groups based on Ferguson angle categories in three ranges, namely <math> <32^\circ </math>, $32-40^\circ$, and $>40^\circ$. It was found that there was a decrease in the percentage of Ferguson angles below 32° from the adolescent to the elderly age group with increasing age. In the adolescent age group, as many as 35% of individuals had a Ferguson angle below 32°.

In the early adult group, the percentage of individuals with a Ferguson angle below 32° decreased to 28%. In the late adult group, there was a further decrease, with only 22% of individuals having a Ferguson angle below 32°. In the elderly group, this decrease was even more significant, with only 15% of individuals having a Ferguson angle below 32°.

TABLE 4: Spearman Correlation Test Between Age Group and Ferguson Angle.

		Age Group	Ferguson Angle
Spearman's rho	Age Group	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	164
	Ferguson Angle	Correlation Coefficient	.045
		Sig. (2-tailed)	.567
		N	164

Based on Table 4, the correlation coefficient value between age and Ferguson angle is 0.042. This value indicates that the relationship between age and Ferguson angle is very weak. Therefore, a value of 0.042 indicates the Ferguson angle and age do not significantly relate.

The p-value obtained is 0.567. Given that the p-value is greater than 0.05, age and Ferguson angle do not appear to be statistically related. This high p-value also indicates that the age variable does not significantly affect the variation of the Ferguson angle in the sample studied.

TABLE 5: Distribution of Ferguson Angle by Gender.

Gender	Ferguson Angle ($^\circ$)						Total	
	<math> <32 </math>		$32-40$		>math> >40 </math>		n	%
	n	%	n	%	n	%		
Female	29	24,8	52	44,4	36	30,8	117	100
Male	12	25,5	26	55,3	9	19,1	47	100
Total	41	25	78	47,6	45	27,4	164	100

According to Table 5, the majority of people (44.4%) in the female group had a Ferguson angle between 32 and 40°. Conversely, 24.8% of women had an angle less than 32°, and 30.8% of women had an angle greater than 40°.

In the male group, the majority (55.3%) were also in the Ferguson angle range of 32–40°. However, there was a striking difference in the category of angles of more than 40°, where only 19.1% of men fell into this category, lower than women.

TABLE 6: Chi-Square Test Between Gender and Ferguson Angle.

	Value	Degrees of Freedom (df)	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.491 ^a	2	.288
Likelihood Ratio	2.589	2	.274
Linear-by-Linear Association	.973	1	.324
N of Valid Cases	164		

a. 0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 11.75.

According to the Chi-Square test results in Table 6, there was no significant relationship between gender and Ferguson angle examined using the Pearson Chi-Square, Likelihood Ratio, or Linear-by-Linear Association tests. Gender and Ferguson angle do not significantly relate given that the p-values from Pearson Chi-Square (0.288), Likelihood Ratio (0.274), and Linear-by-Linear Association (0.324) are all greater than 0.05.

DISCUSSION

Characteristics of Low Back Pain Patients at Dr. Soetomo General Hospital.

Age

The results of this study indicate that 74 people, or 45.1% of all patients, are in the late adult age group and that they represent the majority of patients with low back pain (LBP).

LBP is most common between the ages of 50 and 55, according to the World Health Organization (WHO), and its incidence rises with age until it reaches the age of 80. Furthermore, a study employing data samples from the Global Health Data Exchange (GHDx) revealed a steady rise in LBP cases, with the age group of 40–50 years old as the largest number of patients [14]. Another study analyzing disability-adjusted life years (DALYs) worldwide in LBP conditions found that most LBP sufferers were in the age range of 50-54 years [7].

The results found in both studies are consistent with the findings in this study. Compared to productive-age adults, the late-adult age group is more prone to certain LBP pathologies, including vertebral fractures due to osteoporosis, tumors and metastasis, spinal infections, and lumbar spinal stenosis. It is crucial to remember that aging is associated with a number of physical, psychological, and mental changes, involving spinal degeneration, comorbidities, lack of physical activity, and changes in the central pain mechanisms [15].

Gender

The results of the study show that there were 47 (28.7%) male and 117 (71.3%) female low back pain (LBP) sufferers. Thus, the majority of LBP patients are female. The findings in this study are in line with previous research. The World Health Organization (WHO) reports that females have a higher prevalence of LBP than males [16]. The overall burden of LBP cases is slightly higher in females than in males [14]. The global incidence of LBP was found to be lower in males than in females [7].

Possibly, due to a lower pain threshold, variety in physical changes, and hormonal fluctuations that occur during the menstrual cycle, this leads to a higher experience of LBP in females [17]. Additionally, complaints often occur in women during menopause with decreased estrogen hormone resulting in decreased bone density [10]. Furthermore, women may experience a chronic condition named endometriosis that can cause low back pain. This chronic condition happens as endometrial tissue grows outside the uterus, such as inside the pelvic cavity or other areas of the body, when they normally line the inside of the uterus. This abnormal growth may cause inflammation and scar tissue formation, inducing pain that is often felt in the area of lower back [18].

Another common cause of LBP is sacroiliac joint (SIJ) dysfunction. It is found that there is a difference in the shape of the SIJ in females and males, which results in variations in the biomechanical properties of the joint. The SIJ surface area in females is smaller than in males, contributing to the increase of stress on the joint. The higher risk of SIJ imbalance may be explained by the differences in SIJ anatomy based on gender. Pain is typically felt in the lower back, accompanied by radiating sharp pain to the thigh, and is often misdiagnosed as sciatica [19].

Relationship between Age and Ferguson Angle in Low Back Pain Patients at Dr. Soetomo General Hospital

Following the findings of this study, 164 patients were obtained with low back pain (LBP) at Dr. Soetomo Hospital in January-December 2023. Correlation analysis is used in testing the relationship between the ordinal data of the age group and the ordinal data of the Ferguson angle in this study sample. The test used to measure the correlation between the two ordinal variables is the Spearman test. The results of the Spearman correlation test obtained a correlation coefficient of 0.042, with a value below 0.2. It may be considered a very weak correlation, indicating no significant relationship between age and the Ferguson angle. The p-value obtained was 0.567, valued above 0.05, indicating that the age variable does not significantly affect the variation in the Ferguson angle in the sample studied.

The findings of this study are consistent with a prior study that found no significant relationship between the age factor and changes in the lumbosacral angle (LSA) [20]. Another study conducted at the Federal Medical Centre (FMC), Owerri, explained that the LSA tends to increase with age in all age groups, but decreases in the age group of 60 years and above [21]. The finding in this previous study is in line with the results of this research which found an increase in the Ferguson angle from the adolescent, early adult, to late adult age groups and a decrease in the elderly age group. There were 4 people with an LSA above 40 degrees in the adolescent age group (12-25 years), 19 people in the early adult age group (26-45 years), 20 people in the late adult age group (46-65 years), and 2 people in the elderly age group (>65 years). Previous studies that support the results of this study also obtained a p-value of 0.508 in comparing the relationship between the LSA in the non-geriatric age group and the geriatric age group. A p-value greater than 0.05 shows that there is no statistically significant difference in the LSA between the young and elderly adult groups, indicating that there is no direct relationship between age and the LSA [22].

In theory, age can affect the LSA and pelvic structure in patients with LBP. However, this influence is often associated with broader biomechanical changes due to the aging process that occurs with age. Age has a significant influence on intervertebral disc degeneration, which ultimately affects the LSA. With age, the intervertebral disc undergoes various degenerative changes, mainly due to cell aging and oxidative stress, which causes a loss of tissue matrix balance. This imbalance can indirectly affect the LSA due to structural changes in the intervertebral disc [5, 23].

Relationship between Gender and Ferguson Angle in Low Back Pain Patients at Dr. Soetomo General Hospital

In examining the relationship between gender on a nominal scale and the Ferguson angle on an ordinal scale in this study sample, the Chi-Square test will

be used. The results of the Chi-Square statistical test obtained a p-value greater than 0.05. Gender and the Ferguson angle do not significantly correlate, as indicated by a p-value greater than 0.05.

Previous studies that support the results of this study also obtained a p-value of 0.07, indicating no significant variation in the lumbosacral angle (LSA) based on gender [24]. It was found that there was not a significant difference in the LSA between males and females, according to another study that likewise found a p-value greater than 0.05 [22]. Other earlier studies showed that even though there are differences in the experience and management of LBP between males and females, structural angles such as the Ferguson angle do not necessarily exhibit consistent differences based on gender. This suggests that structural variants such as the LSA or Ferguson angle have little influence on those differences. Hormones, pain perception, and degenerative changes are more likely to cause differences in LBP prevalence between males and females. Additionally, it has been shown that pregnancy-related factors and hormonal fluctuations may cause females to suffer varying pain intensity when receiving management of LBP [19].

CONCLUSION

As the research has demonstrated, it was concluded that the majority of low back pain (LBP) patients were in the late adult age group, specifically those aged 46-65 years, with a total of 74 patients, accounting for 45.1% of all the patients. Additionally, females predominate LBP patients, with a total of 117 patients, accounting for 71.3% of all the patients. It was found that there was no significant relationship between age and the Ferguson angles, as age did not affect the variation of the Ferguson angle in the patients with LBP in this study. Since gender also had no apparent impact on the fluctuation of the Ferguson angle in LBP patients in this study, there was no substantial relationship between the two variables.

CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

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