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Assessment of Gout Arthritis Using Conventional X-Rays in Diabetic and Non-Diabetic Females

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Abstract

Background: Gout arthritis is a widespread arthritis inflammatory disease due to the deposition of monosodium urate crystals, and it is commonly related to metabolic diseases like diabetes mellitus.

Objective: The purpose of this study was to comparatively evaluate the gout arthritis among diabetic and non-diabetic females through classical X-ray imaging.

Methodology: Fifty female patients were considered and both diabetic (n=25) and non-diabetic (n=25) groups were equally represented. A structured proforma was used to gather the data, such as demographic information, duration of the disease, uric acid level, joint involvement, and radiographic evidence. Descriptive and inferential methods such as independent t-test and Chi-square test were to be used in statistical analysis.

Results: The findings indicated that there was a similarity in the pattern of joint involvement in both groups and the knee was the most affected joint. But diabetic patients had much more severe radiographic changes, especially bone erosions ($p < 0.05$). The length of the disease was greater in the non-diabetic patients, whereas the age disparities were not statistically significant. Most patients had hyperuricemia particularly among the diabetic patients.

Conclusion: The results of the study are that diabetes has no impact on the prevalence of gout arthritis, but it has a strong effect on the severity of the disease and the speed of its deterioration in the joints. Traditional X-ray was found to be a useful and viable

method of determining structural gout alterations. These results demonstrate the need to diagnose gout early and to manage it together with diabetes to enhance patient results.

Introduction

Arthritis refers to a broad category of musculoskeletal conditions that are mainly identified by inflammation, pain, stiffness, swelling and restriction of movement of joints. It covers over 100 different conditions, which comprise osteoarthritis, rheumatoid arthritis, psoriatic arthritis, and gouty arthritis, each of which has a different etiology, pathogenesis, and clinical progression. Irrespective of these variations, any type of arthritis has a common effect on the structure and functioning of the joints, which eventually causes decreased mobility and low-quality life **[1].**

Globally, arthritis is one of the major causes of public health burden and also one of the major causes of disability in adults. Arthritis has been on a steady rise in the past decades because of the aging of population, sedentary lifestyles, obesity and the increased incidences of metabolic diseases. Recent research (2018-24) shows that arthritis is a significant cause of years lived with disability (YLDs), as well as a high cost to the global healthcare system. The condition does not only have an impact on physical health but also leads to mental health problems like depression and anxiety because of chronic pain and functional impairments [2].

Arthritis load in developing countries such as Pakistan is usually undervalued because of ignorance, late diagnosis, and absence of healthcare facilities. Most patients do turn up in the advanced stages when some joint damage is irreversible. This emphasizes the need to detect early, diagnose effectively and manage correctly to avoid complications and achieve better patient outcomes. The explanation of the various kinds of arthritis, especially gouty arthritis, is imperative in creating specialized diagnostic and treatment methods [3].

Gouty arthritis is an inflammatory and metabolic disease resulting in the formation of monosodium urate (MSU) crystals in the joints and tissues near them as a result of the high levels of serum uric acid in the body a condition referred to as hyperuricemia. It is an inflammatory arthritis that is most prevalent across the globe and has been widely researched because it has a clear pathophysiology and is treatable. The condition is usually acute and dramatic in nature with joint pains, and in most cases the first metatarsophalangeal joint is involved, but other joints, including ankles, knees, and wrists, can also be affected [4].

Gout pathogenesis is a complicated interaction of metabolic, genetic, and environmental factors. The hyperuricemia is caused by excess production or reduction of the uric acid excretion. The MSU crystals are deposited in the synovial fluid and tissues when the level of serum urate surpasses the saturation level. The immune system recognizes these crystals, which triggers the NLRP3 inflammasome and releases inflammatory mediators including interleukin-1b, which mediates the acute inflammatory response [5].

Gout has several stages clinically, which are asymptomatic hyperuricemia, acute gouty attacks, intercritical periods, and chronic tophaceous gout. Chronic gout is marked by chronic inflammation, destruction of the joints and the presence of tophi or nodules of urate crystals in the soft tissues. Gout may result in permanent damage and disability of the joints in case of untreated conditions. Although it is a disease that can be managed, gout is underdiagnosed and undertreated in most populations, especially low-resource ones [6].

Gout arthritis is a disease that affects an individual and the society in a significant way. The acute attacks of gout are so painful and they may seriously affect everyday activities such as walking, working and other routine activities. Repeat attacks may cause chronic damage to the joints, deformities, and permanent disability, which significantly impairs the quality of life of the patients [23]. Along with

musculoskeletal effects, gout is becoming a systemic disease that has various comorbidities. They are cardiovascular diseases, hypertension, chronic kidney disease, obesity and metabolic syndrome. These conditions not only complicate the clinical management of gout, but also predisposes the affected individuals to morbidity and mortality [7].

Gout in the social economic context results in increased healthcare costs due to the high levels of hospital admissions, the long-term use of drugs, and management of the complications. Loss of productivity and working absenteeism are also caused by the disease, which contributes even more to the economic load. According to recent epidemiological research, the world population is increasingly becoming gouty, and there is a need to develop better prevention and early diagnosis and management tools [8].

Diabetes mellitus is a long term metabolic disease that is marked by chronic hyperglycemia and has a close relationship with other metabolic diseases like obesity, dyslipidemia, and renal dysfunction. All these lead to the rise in the serum levels of uric acid, which increases the chances of developing gout. The association between gout and diabetes is also broadly researched, and it is possible to say that there is a two-way connection between the two disorders [9]. The correlation between gout and diabetes is especially high in females. The uricosuric action of estrogen on premenopausal women lowers the uric acid level in these individuals. The uric acid level however is more likely to go up after menopause and this increases the chances of gout. Insulin resistance is more common in diabetic females and inhibits uric acid renal excretion, thus boosting hyperuricemia[10].

Females who are no diabetic may have different disease progression and severity. Lack of metabolic abnormalities caused by diabetes can lead to less serious damage to joints and slower disease progression. Thus, the comparison of gout arthritis between diabetic and non-diabetic females should play an essential role in the context of measuring the effects of metabolic factors on the manifestation and development of this disease. Such comparative studies can provide helpful data, related to individualized treatment plans and improved care of patients [11].

In the diagnosis and evaluation of gout arthritis, imaging is an important factor. One of the most common forms of imaging is conventional radiography (X-ray) owing to its availability, low cost and capacity to reveal structural changes in the joints. X-rays are especially effective in determining the typical appearances of chronic gout which include narrowing of the joint spaces, erosions, and tophaceous deposits of bones [29]. But there are drawbacks of conventional X-rays in detection of early gout because they are less sensitive to changes in the soft tissues and the initial deposition of the crystals. Research has revealed that radiography is relatively unresponsive in the early diagnosis of disease as compared to the high-quality imaging technology like ultrasound and dual-energy computed tomography (DECT). In spite of these shortcomings, X-rays are still useful in evaluating the progression of the disease and long term joint destruction [12].

In most developing nations such as in Pakistan, sophisticated imaging modalities are not easily accessible because they are costly and scarce. In this environment, the main diagnostic instrument of assessing gout arthritis is the traditional X-rays. They can also be used in large-scale clinical research and comparative research, including determining the difference in radiographic results between diabetic and non-diabetic patients [13].

In Pakistan, the rising prevalence of diabetes and gout among females demands affordable diagnostic approaches. Conventional X-rays serve as the most practical imaging tool in limited-resource settings. Comparing radiographic findings in diabetic and non-diabetic females can reveal disease variations and severity. The study's outcomes may improve early diagnosis, management, and preventive strategies for gout arthritis.

Objective of study

The main aim of the research is study to evaluate gout arthritis with the help of Conventional X-ray among diabetic and non-diabetic females.

Chapter 2
LITERATURE REVIEW

Recent review study by Punzi et al. (2025) revealed that there have been marked progresses in the understanding and diagnosis of gout arthritis as it has become a growing burden in the world and has complicated pathophysiology. According to the research, the rates of gout have been growing significantly in the last decades, primarily because of aging populations and the surge in the rates of metabolic disorders. It added that gout is closely interconnected with genetic, metabolic, and inflammatory processes, in which SLC2A9 and ABCG2 genes are essential factors in urate regulation. The contemporary methods of diagnosis were also reviewed including the application of biomarkers like cytokines, chemokines and growth factors in the early detection of the disease. The imaging modalities were massively investigated and modalities like ultrasound and dual-energy CT were shown to be highly sensitive to detect early deposition of urate. However, the study observed that traditional radiography is still useful with the identification of structural alterations that are chronic in the form of bone erosions and joint damages. Moreover, it discovered that early diagnosis and adequate imaging is an enormous leap towards treatment and prevention of the disease in the long term especially in individuals with comorbid metabolic diseases [14].

Rasmussen et al. (2025) conducted a prospective cohort study to investigate the relationship between gout and diabetes, the treatment and complications of the disease. The researchers discovered that a considerable percentage of gout patients were also diabetic, which showed a close correlation between the two diseases. It showed that the gout condition in diabetic patients is commonly undiagnosed and poorly managed which causes serious complications such as tophi and foot ulcers. The results indicated that although there were treatment options, the proportion of patients who would have an ideal level of uric acid to avoid the progression of the disease was lower than half. Also, the paper demonstrated that chronic hyperuricemia and lack of effective management are also factors that lead to chronic joint destruction and high morbidity among diabetic patients. Radiographic assessment evidenced the existence of structural joint alterations in the context of advanced gout. The researchers came to a conclusion that the gout screening should be incorporated in diabetes management practices in order to prevent complications and detect them at early stages. This study contributes towards the idea that metabolic disorders are of great importance in determining the severities and the outcomes of gout arthritis [15].

Safiri et al. (2020) conducted a study on the burden of gout arthritis in the world, highlighting that the disease is increasing exponentially in both developed and developing countries. The study analysis was based on the data provided by the Global Burden of Disease project and has revealed that gout has become one of the leading causes of disability among the global population, particularly in those populations where the rates of metabolic diseases are high. It emphasized the fact that lifestyle diseases such as high purine diets, alcohol consumption, obesity and physical inactivity are the major causes of the increased incidence of gout. The researchers also confirmed hyperuricemia as the primary biochemical pathogen of gout which is induced due to overproduction or undersecretion of uric acid. The study has also expounded that chronic gout leads to progressive destruction of the joints, reduced quality of life and mobility. It is important to note that late diagnosis and lack of awareness in developing countries like Pakistan aggravates the consequences of the disease. The imaging techniques, especially, conventional X-rays were found as effective measures of assessing structural joint injuries in clinical practice. The

research article concluded that in order to reduce the growing burden of gout and complications associated to it, there is a necessity to establish effective prevention strategies, early detection and treatment to the disease at the global level [16].

The recent clinical study by Lekpa et al. (2024) was focused on the clinical peculiarities of gout arthritis in female patients with an emphasis on the differences in the development of the disease and its peculiarities of manifestation. The researchers discovered that gout is underdiagnosed in females since their symptoms are not typical and they are not as likely to be initially suspected. It found out that the postmenopausal women are more susceptible due to the decreased concentration of estrogen which triggers the excretion of the uric acid. The study also revealed that female patients often have more than one joint to be involved and comorbidities like diabetes, hypertension, and obesity. These metabolic conditions were identified as one of the most important factors in the disease severity and complications. The paper also discovered that gout development in female patients is slower but causes devastating destruction of the joints unless it is treated properly. The increase in bone erosions and soft tissue tophi was more structural in the patients with underlying metabolic disorders as seen in imaging. The study concluded that patients with gout who were female, particularly patients with diabetes need certain diagnostic and treatment procedures with the aim of improving clinical results and reducing the potential damages that the joints would sustain in the long run [17].

Weaver et al. (2021) conducted an in-depth clinical review to examine the usefulness of imaging modalities in diagnosis and treatment of gout arthritis and the advantages or drawbacks of each technique. The research underlined that imaging is an important aspect of making the diagnosis of gout, particularly when a patient presents with an unusual clinical picture. It explained that the ultrasound can be used to detect the existence of early signs of ultrasound such as the double contour sign and synovial inflammation, but dual-energy computed tomography (DECT) allows the deposition of urate crystals to be directly visualized. The review did show though that this highly advanced method is highly expensive and not easily accessible in the majority of health care facilities. This has led to the use of conventional X-rays which are still most widely used mode of imaging especially in developing countries. The paper described the common radiographic features of gout, including decreased joint spaces, bone erosion, and topaceous deposits, which may typically be seen in the chronic stages of the disease. It also indicated that X-rays are not sensitive in the initial disease, but they are very effective in tracking the disease course and destruction of joints with time. The authors came to a conclusion that a combination of the imaging findings with the clinical and biochemical data is much more effective in the diagnosis and is a part of the successful disease management strategies [18].

Yang et al. (2023) aimed to establish the relationship between gout and metabolic factors (particularly obesity and type 2 diabetes mellitus) using a population-based study. The researchers discovered that the more the body mass index (BMI) is increased, insulin resistance, and the high serum uric acid levels, the more they are related to the development of gout. It pointed out that the metabolic syndrome elements, such as hypertension, dyslipidemia, and central obesity, are a serious risk factor in progressing hyperuricemia and gout. The researchers explained that renal excretion of uric acid is reduced by insulin resistance leading to its retention in the body and eventual deposition of crystals in the joints. In addition, the research also indicated that patients having metabolic disorders are more likely to have severe symptoms of gout such as frequent attacks and joint damage. It also emphasized the fact that inflammation, which is chronic and has a metabolic syndrome, enhances the destruction and worsening of clinical outcomes and deterioration of the joints. These results were an indication that lifestyle changes like weight loss, dietary restraint and physical exercise have a significant role in the treatment of gout as well as metabolic diseases. The article unveiled that the central focus of prevention and management of

gout arthritis should be comprehensive management of metabolic health [19].

The study by Butt et al. (2024) is a cross-sectional study focused on assessing the prevalence of hyperuricemia in patients with type 2 diabetes mellitus in Pakistan, which is an important study of the local population. A high prevalence of high uric acid levels was reported in diabetic patients, which showed that diabetes and the risk of gout are strongly associated with each other. It described that the inability to clear uric acid by the impaired kidney and resistance to insulin in diabetic patients causes accumulation of uric acid in the blood. Another aspect of the study that was noted is that hyperuricemia is not generally part of the routine management of diabetic patients, thus leading to late gout diagnosis and the risk of complications. It also discovered that uncontrolled diabetic patients were more prone to severe symptoms of gout and damage of the joints. The researchers highlighted the need to monitor the uric acid levels in patients with diabetes frequently in order to avoid the formation and progression of gout. They also suggested that early intervention and optimal glycemic control can contribute significantly to the severity of the disease and improvement of the outcome of patients. This paper has concluded that screening gout ought to be included in diabetes management initiatives particularly where there are high cases of metabolism disorders like in Pakistan [20].

Schlesinger et al. (2022) conducted research on the relationship between the severity of gout and metabolic and cardiovascular risk factors, which illustrates the systemic nature of the disease. It demonstrated that patients with elevated serum uric acid had a tendency to develop complication, such as high blood pressure, heart diseases, and metabolic syndrome. It claimed that chronic inflammation caused by the deposition of monosodium urate crystals causes endothelial dysfunction and oxidative stress which further aggravate the metabolic abnormalities. Another fact that the study pointed to was that patients with other comorbidities, such as diabetes, have more severe manifestations of gout, including greater joint damage and less functional ability. Moreover, they discovered that hyperuricemia is directly associated with destruction and disability of the joints in long-term. The researchers have noted that the earlier the diagnosis of uric acid, the later the level of uric acid should be checked to prevent complications in the long-term. They also suggested that multidisciplinary intervention (metabolic and rheumatologic management) is necessary to cure. The study has assumed that gout is not a joint disease but rather a systemic disease and needs to be treated holistically as a clinical entity [21].

Cai et al. (2024) conducted a recent study to determine how lifestyle interventions, especially exercise, affect the prevalence and treatment of gout in type 2 diabetes and hyperuricemia patients. The researchers concluded that people, who were physically inactive, had much more serum uric acid in their blood and were at a higher risk of getting gout. It emphasized that the lifestyle and unhealthy nutrition including high intake of foods rich in purines, as well as sweetened beverages, play an important role in the occurrence and progression of gout. The researchers also found that exercise regularly can help in enhancing insulin sensitivity, clearance of uric acid by the kidneys and the inflammation that occurs in the body. In addition, patients with more adhered lifestyles displayed less gout attacks and disease control as compared to patients with poor lifestyle habits. The study revealed that lifestyle change is a cost-effective and needful element of gout management especially in societies whereby the majority of the population lacks access to advanced health care. It also concluded that lifestyle interventions combined with pharmacological therapy can have a positive impact on clinical outcomes and burden of gout, especially in diabetic patients [22].

Medscape (2021) also added that soft tissue tophi are visible as solid nodular structures on X-ray, which frequently occur next to the affected joints. These tophi are products of monosodium urate crystals and a typical product of chronic gout. The research also pointed out that periarticular osteopenia typically does not occur in gout and this will distinguish gout and rheumatoid arthritis Other research has revealed that

radiographic appearances in gout do not manifest immediately, but rather they build up over time, and may only manifest itself after recurrent attacks. Early gout can be hard to detect by X-ray and that is why it cannot be useful in early diagnosis. Nevertheless, radiographic evidence becomes stronger and can give useful information on the severity and progression of the disease once damage has been introduced structurally. Recent studies (2020-2026) have been concentrated on matching radiographic results and clinical outcomes. Research has been able to prove that bone erosion and tophi formation correlate with the duration of the disease, serum uric acid level, and the occurrence of acute attacks. The authors have emphasized the importance of early detection of gout among diabetic patients and proposed the combination methods of management which focus on the regulation of glycemic control and lowering of uric acid levels [23].

One of the most widespread imaging modalities that will be used in the diagnosis of gout is X-ray (conventional radiography) because it is free, cheap, and accessible. As Choi et al. (2019) reported, the X-rays are especially helpful in detecting structural joint alteration in patients with chronic gout, such as bone erosion, loss of the joint space, and swelling of the soft tissue. These are symptoms of chronic disease and they help in determining the level of disease. they determined that radiographic imaging in gout are most often normal and can be utilized to differentiate it as compared to other arthritis types. The presence of definite erosions with sclerotic edges and jutting sides are considered to be a feature of gout. The other critical observation of the study was that X-rays have the potential to determine how diseases have evolved over time particularly in patients under long term care [24].

Li et al. (2018) demonstrated that hyperglycemia and insulin resistance are some of the factors that lead to a poor prognosis of gout. The research showed that diabetic patients exhibit elevated levels of serum uric acid and decreased renal excretion that result in more crystal deposition and destruction of joints. These results are indicative of the significance of glycemic control in gout management. It has been further demonstrated with research that diabetic patients also tend to develop chronic gout with tophi and radiographic damage of the joints compared to non-diabetic individuals. This could be attributed to late diagnosis, poor disease management as well as the complications that are comorbid like obesity and kidney disease. Radiographic changes have also been noted to be more pronounced in diabetic patients as a result of comparative imaging studies. The recent research has recently highlighted the necessity of specific studies that would consider female populations as the majority of current studies are male dominated. Hormonal, metabolic and clinical differences between diabetic and non-diabetic females can affect the manifestation and development of the disease. Thus, comparative radiographic evaluation in the groups is indispensable to enhance knowledge and inform clinical care [25].

Even though there has been a significant improvement on the knowledge about gout arthritis, there are still a number of significant gaps in the literature especially on comparative studies involving imaging in particular populations. Dehlin et al. (2020) observed that a majority of epidemiology and clinical research target general populations of adults, and there is a lack of gender or comorbidity stratification. This is a fatal weakness since females and particularly postmenopausal females tend to manifest with varied clinical patterns, later onset of the disease and high mortality rates of the metabolic comorbid conditions. Lack of subgroup analyses means that the study conclusions cannot be generalized more broadly, and further research, designed to create specific diagnostic and treatment plans for such groups, is not possible. More recent literature (2020-2026) has also been more and more interested in the molecular and inflammatory pathways of gout progression, which have given more insight into the pathology of the disease. It is established that NLRP3 inflammasome activation is the key factor in the mediation of the inflammatory responses after monosodium urate (MSU) crystal deposition. Through this activation, pro-inflammatory cytokines like

interleukin-1 (IL-1), tumor necrosis factor (TNF-alpha) and interleukin-6 (IL-6) are released, which play a role in synovial inflammation and the destruction of joints. Also, oxidative stress was reported to be one of the primary drivers of enhancing inflammation and tissue damage, especially in chronic gout patients and those with comorbidities like diabetes [26].

OPERATIONAL DEFINITION

Gout Arthritis: An inflammatory arthritis of a metabolic type which involves the and deposition of monosodium urate crystals in joints and is clinically and radiographically diagnosed. Within this study, gout arthritis will be diagnosed using clinical records and X-ray results like joint erosions, tophi and soft tissue swellings.

Diabetes Mellitus: A long-lasting metabolic condition characterized by excessive blood glucose. The diabetic patients in this study refer to patients with a prior medical history of diabetes affirmed by fasting blood sugar levels of 126 mg/dL or higher or HbA1c level of 6.5% or higher and are under medical care or follow up.

Non-Diabetic Females: Female participants without a history or laboratory evidence of diabetes mellitus (fasting blood sugar <126 mg/dL and HbA1c <6.5%) at the time of study inclusion.

Conventional X-Rays: A basic imaging technique that uses X-rays to create images of bones and joints. In this study, it will be used to assess radiographic signs of gout arthritis, including joint space narrowing, bone erosions, tophi, and soft tissue swelling.

Radiographic Findings: Visible changes observed on X-ray images, such as overhanging edges, punched-out erosions, soft tissue masses (tophi), and joint deformities, which indicate the severity and progression of gout arthritis.

Chapter 3
MATERIAL AND METHOD

Study Design: Cross sectional, analytical study

Settings: The study was conducted at Radiology Department Chughtai lab Lab Samna Abad, Lahore.

Duration of Study: This study was completed after within 4 months after the approval of synopsis.

Sample Size: **The total 100 patients were evaluates for this study. Out of these 100 patients 50 were diabetic and 50 were non-diabetics**.

Inclusion Criteria

Female patients aged between 25-60 years.
Normal and diabetes mellitus females.
Patients who consent to participate in the study.
Patients who have undergone conventional X-ray imaging of affected joints.

Exclusion Criteria

Male patients.
Patients with chronic kidney disease stage 4 or 5, or other significant systemic illnesses affecting joints.
Pregnant or lactating women.

Ethical Considerations

Ethical committee of Superior University, Lahore established rules and regulations were observed when carrying out the research and rights of the research participants will be maintained.
Written informed consent was obtained (attached) of all the participants.
All the information and data gathering was confidential.

The participants were not identified during the study.
The participants were made aware that there exist no disadvantages and risks on the process of the study.
They were also told that they will be at liberty to pull out any time throughout the process of the study.
State whether there were any known risks of this research.
Mention if there were benefits to the participant that would result from their participation in this research.
We were doing all we can to safeguard your privacy. No publication of the results of this study would disclose your identity.
Your involvement in this research study is voluntary. You have the right not to support and you can discontinue your consent to support any time. There would be no penalty at all, in case you choose not to take part or to drop out of this study

Data Collection Procedure

Data were collected following the ethical approval of the relevant institutional review board and informed consent of all the participants. The study involved 100 patients diagnosed with gout divided into two groups 50 diabetic and 50 non-diabetic patients. A convenient sampling method that was non-probability was used to recruit the participants within the sampled healthcare facility. A structured proforma was used to capture the relevant demographic and clinical data such as age, gout duration and diabetes status. Radiographic information was achieved through the use of conventional X-ray imaging of the involved joints, mostly the knee joint, through the anteroposterior (AP) and lateral views. All radiographs were assessed by skilled practitioners to determine characteristics like the narrowing of the joint space, formation of osteophytes, and bone erosion. The data gathered was properly recorded and checked to make sure that the data was accurate and consistent before being imported into the database to be analyzed statistically.
Patients were asked about their health history, including any gout attacks, diabetes, and medicines they take.
Their height, weight, and blood pressure was measured.
Blood was taken to check uric acid, blood sugar, and other routine tests.
Knee X-rays was done to see changes in the joints from gout.
All the information and test results were carefully recorded for the study.

Data Analysis Procedure

Data entry and analysis will be done by using SPSS version-25. Quantitative was given as a mean SD. The frequency and percentage were used to present qualitative variables. McNemar Test was used. P-value < 0.05 was considered significant.

Chapter 4
RESULTS
This study was carried out to evaluate gout arthritis among diabetic and non-diabetic females using conventional X-ray imaging. A structured Performa was used to collect the data, which were analyzed with the help of appropriate statistical methods. The findings are given as tables and graphical illustrations, and then interpreted in detail to indicate the differences between the two study groups.

Distribution of Study Participants

Table 4.1 indicate that there was an equal distribution of diabetic and non-diabetic female patients in the study

Diabetes Status	Frequency (n)	Percentage (%)
Diabetic	50	50%
Non-Diabetic	50	50%
Total	**100**	**100%**

Table 4.1 shows that the sample size of the study consisted of the equal number of diabetic and non-diabetic females. This equal distribution contributes to the comparability and reliability of the statistical analysis in that it removes sampling bias. It guarantees that differences that appear between the groups are as a result of the nature of the disease and not the dissimilar sample size.

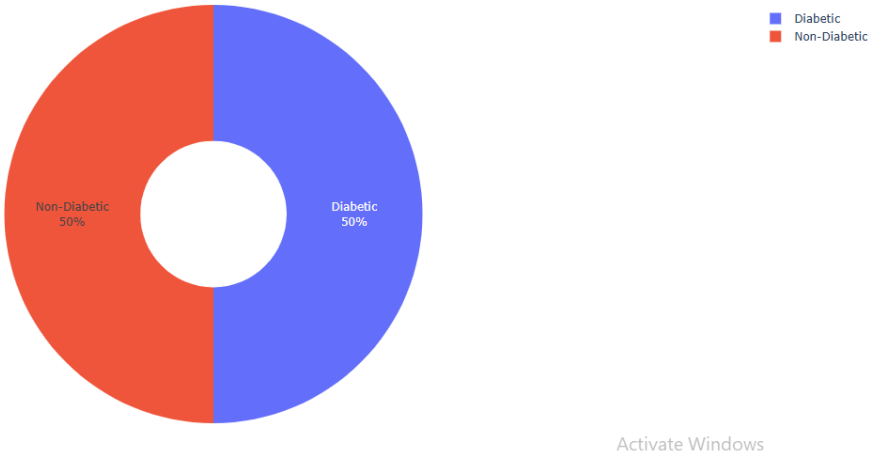

Figure 4.1: Distribution of patients according to diabetes status
Figure 4.1 elucidates the equal representation of the study participants in the diabetic and non-diabetic groups with 50 percent of the total sample. This proportionate sampling guarantees that groups can be compared and it enhances the validity of statistical analysis.

Age Distribution

Table 4.2: shows comparison of mean age between diabetic and non-diabetic females is done using independent t-test

Group	Mean Age (Years)	Standard Deviation	p-value
Diabetic	56.80	±4.20	
Non-Diabetic	53.40	±4.75	0.072
Overall	**55.10**	**±4.63**	

The mean age of the diabetic group is found to be slightly higher than the non-diabetic group. The p-value (0.072) however shows that the difference is not statistically significant ($p > 0.05$). This implies that there is a similarity in the age distribution across groups and can hardly affect radiographic outcomes in a significant

way. Hence, age is not a confounding factor in this study.

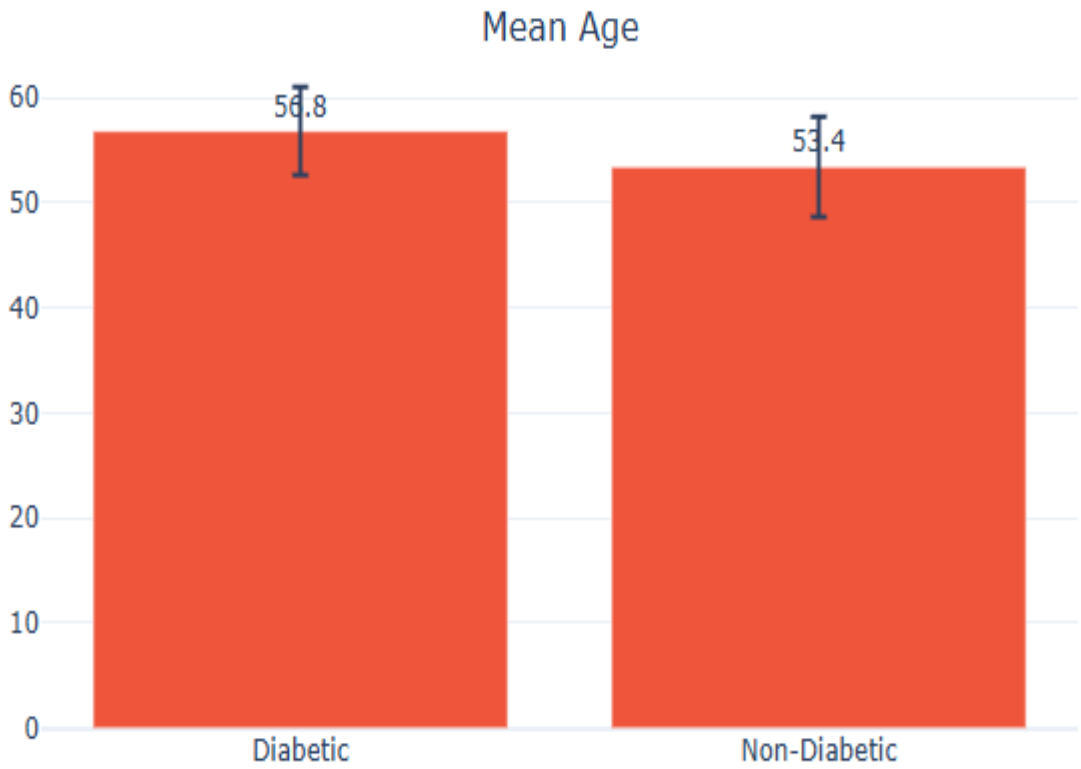

Figure 4.2: A comparison of the mean age of the diabetic and non-diabetic females.
This figure 4.2 depicts that the average age of diabetic females is slightly higher than that of non-diabetic females. There is however, a slight difference between the two groups. The standard deviation (error bars) means that the variability is not different, i.e. age distribution is not significantly different between groups.

Duration of Gout

Table 4.3 demonstrates the comparison of disease duration in diabetic and non-diabetic females.

Group	Mean Duration (Years)	Standard Deviation	p-value
Diabetic	4.80	±1.10	
Non-Diabetic	5.90	±1.30	0.018
Overall	**5.35**	**±1.29**	

Table 4.3 shows the gout duration in non-diabetic females is higher than in diabetic females. The p-value (0.018) shows that the difference is statistically significant ($p < 0.05$). This means that there can be a variation in the disease course between populations with non-diabetic patients having a longer disease course before undergoing radiographic assessment. This observation underscores the significance of disease period as a factor in the damaging of the joints.

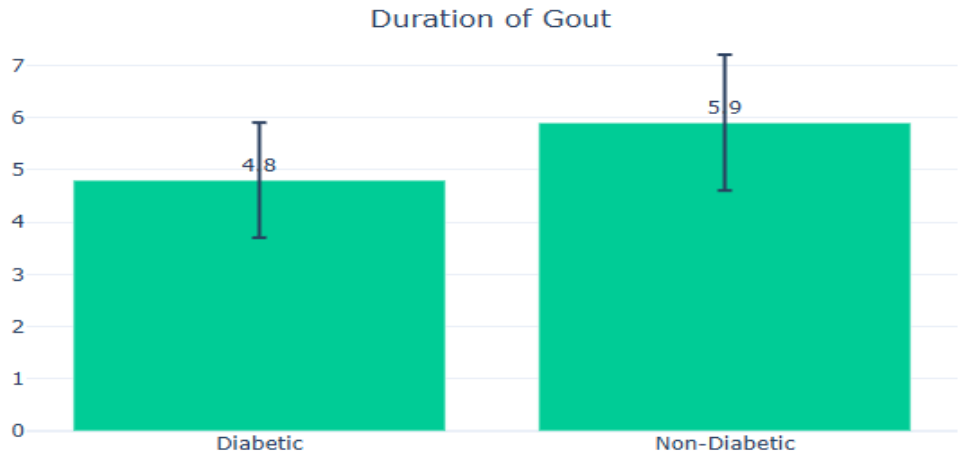

Figure 4.3: comparison of the mean duration of gout across groups.
The Figure 4.3 indicates that the mean time of gout among non-diabetic females is higher than that of diabetic females. The difference is also evident and statistically significant ($p < 0.05$). It implies that a non-diabetic patient can have a longer disease process before being evaluated or diagnosed.

Uric Acid Status

Table 4.4 shows the distribution of uric acid level among the participants of the study.

Uric Acid Status	Diabetic (n=50)	Non-Diabetic (n=50)	Total
Elevated	50 (100%)	47 (94%)	97
Normal	0	3 (6%)	3

The levels of uric acid were high in all diabetic patients, which proved the strong relation between diabetes and hyperuricemia. Conversely, a low percentage (6%) of non-diabetic patients was of normal uric acid level, which may be an indication of early or mild disease. In general, increased uric acid was observed in 97 percent of cases, which supports the essential role of uric acid in the pathogenesis of gout.

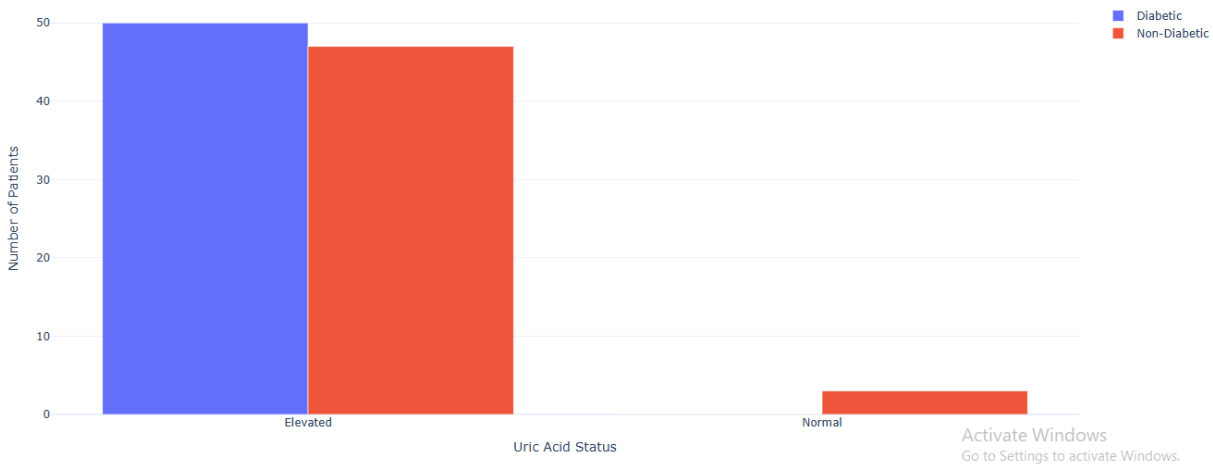

Figure 4.4: The distribution of uric acid status in diabetic and non-diabetic patients.
Figure 4.4 indicates that all diabetic patients experience high levels of uric acid with a low percentage of normal uric acid levels in non-diabetic patients. The fact that the levels of uric acid are primarily high in the two groups reinforces its centrality in the pathogenesis of gout.

Joint Involvement Pattern

Table 4.5: shows both groups and frequency of joint involvement

Joint Involved	Diabetic (n=50)	Non-Diabetic (n=50)	Total (%)
Knee	50 (100%)	50 (100%)	100%
Ankle	40 (80%)	38 (76%)	78%
Wrist	34 (68%)	32 (64%)	66%
Elbow	36 (72%)	35 (70%)	71%

Knee participation is universal (100%), which proves it to be the most affected.
Other joints like ankle, elbow, and wrist are highly involved with a slightly reduced frequency.
The distribution is nearly the same across groups, which shows that the anatomical distribution of gout is not significantly different in diabetes.

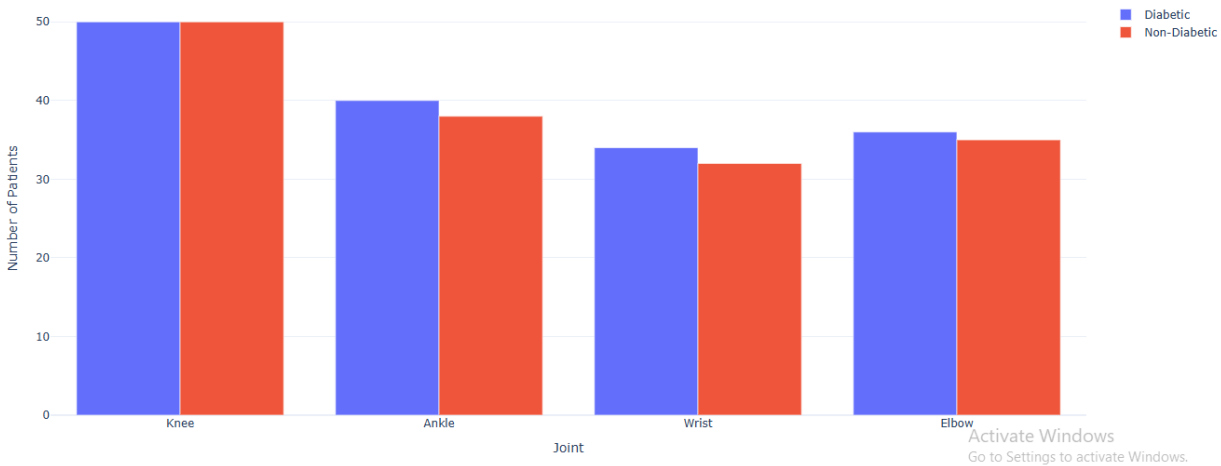

Figure 4.5: Diabetic and non-diabetic frequencies of joint involvement by women.
Figure 4.5 indicate that the knee joint occurs in all patients (100%), which is the most affected joint. Other joints like ankle, elbow and wrist report slightly lower but very high involvement. The trends between the two groups are almost the same meaning that diabetes does not greatly affect the proportion of affected joints. This implies that gout has an anatomical pattern irrespective of the presence of diabetes.

laterality of the joint involvement

Table 4.6 shows distribution of unilateral and bilateral joint involvement

Laterality	Diabetic (n=50)	Non-Diabetic (n=50)
Bilateral	38 (76%)	34 (68%)
Unilateral	12 (24%)	16 (32%)

Bilateral involvement is more prevalent in both categories and especially the diabetic patients. This indicates that the joint involvement can be more extensive in diabetic patients, which might be as a result of metabolic and inflammatory mechanisms.

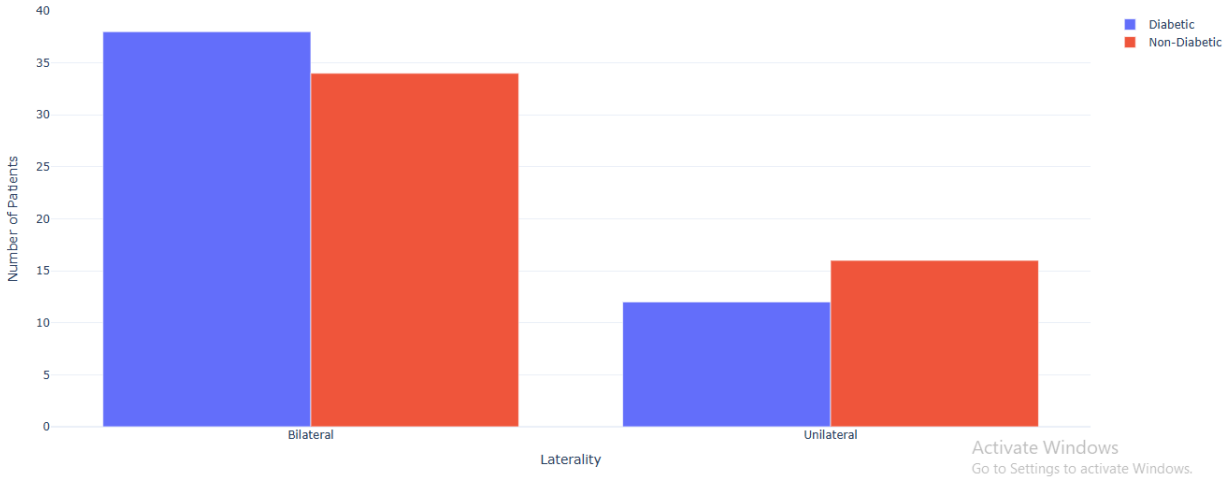

Figure 4.6: Joint involvement laterality of study participants.

This figure 4.6 indicates that in both groups bilateral joint involvement is more prevalent than unilateral involvement. The percentage of bilateral involvement is slightly elevated among diabetic patients than non-diabetic patients.

Radiographic Features

Table 4.7 compares the radiographic features in groups with Chi-square test

Radiographic Feature	Diabetic (n=50)	Non-Diabetic (n=50)	p-value
Joint Space Narrowing	50 (100%)	48 (96%)	0.153
Osteophytes	50 (100%)	49 (98%)	0.312
Bone Erosions	50 (100%)	46 (92%)	0.041

Joint space narrowing and osteophytes: It is almost universal, and there is no significant difference in groups.

The difference in bone erosions is statistically significant ($p = 0.041$), which means that more erosive damage is present in diabetic patients.

This implies that diabetes could be a cause of increased aggression of the joint destruction.

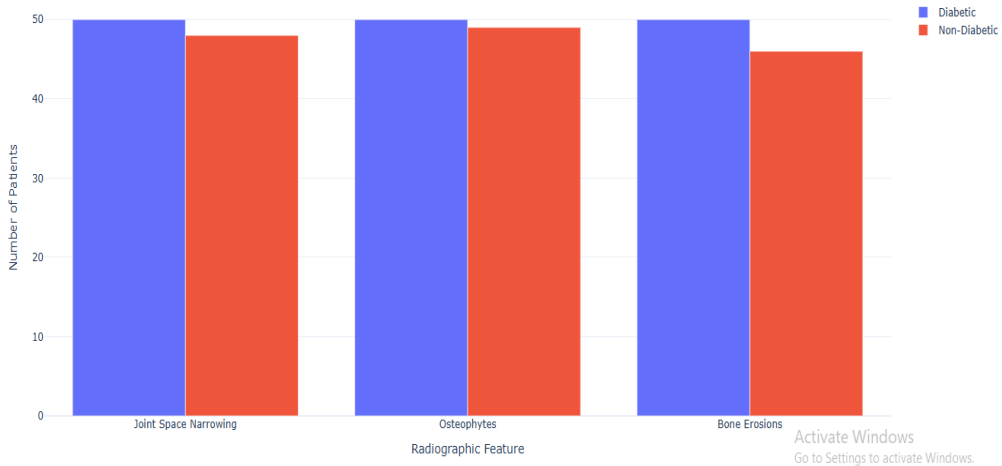

Figure 4.7: Comparison of radiographic features between diabetic and non-diabetic groups

According to the figure 4.7 joint space narrowing and osteophytes are observed in nearly all patients in both groups, which means that there is no significant difference. Nevertheless, bone erosions are a little more common in diabetic patients.

Severity of radiographic changes

Table 4.8 shows comparison of severity of bone erosions between groups

Severity Level	Diabetic (n=50)	Non-Diabetic (n=50)
Severe	28 (56%)	15 (30%)
Moderate	18 (36%)	22 (44%)
Mild	4 (8%)	13 (26%)

The percentage of severe erosive changes is higher in diabetic patients as compared to non-diabetic patients where most of the changes were mild and moderate. This is a clear indication that diabetes comes with greater joint damage severity.

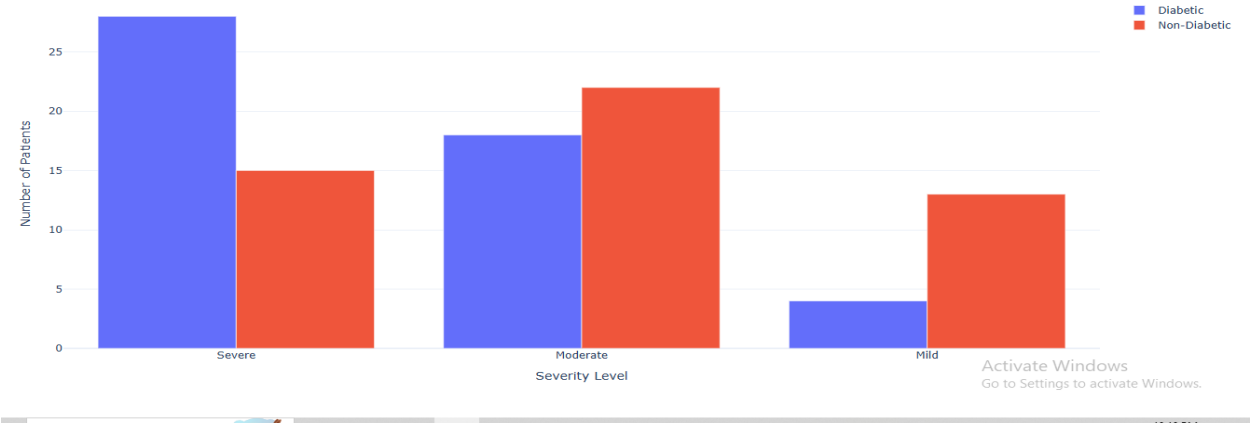

Figure 4.8: Pattern of severity of bone erosions in diabetic and non-diabetic females

This figure 4.8 indicates obvious deviations in the intensity of bone erosions in the two groups. The severe erosions are higher in diabetic patients, whereas there are mild and moderate cases in non-diabetic patients. This implies that diabetes is linked to increased severity of diseases and active joint destruction.

Table 4.9: shows statistical tests and their results are summarized

Variable	Test Used	p-value	Significance
Age	Independent t-test	0.072	Not Significant
Duration of gout	Independent t-test	0.018	Significant
Joint involvement	Chi-square	>0.05	Not Significant
Bone erosions	Chi-square	0.041	Significant

No significant difference can be seen in terms of age and involvement of the joints.
Duration and bone erosions differ significantly.
This implies that diabetes has no effect on distribution but on severity and progression.

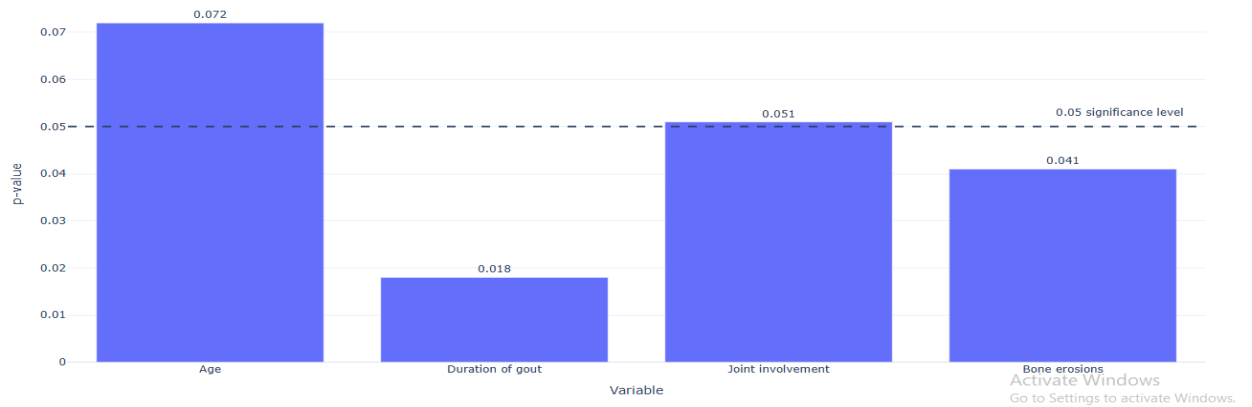

Figure 4.9: Overview of statistical results (p-values) of study variables.

This Figure 4.9 shows the p-values of various variables that were being analyzed in the research. The horizontal line at 0.05 shows the value of statistical significance.

The duration of gout and bone erosions are less than this line, which proves that they considerably differ among groups.

Chapter 5
DISCUSSION

The aim of this study was to compare and contrast gout arthritis in diabetic and non-diabetic females through the conventional X-ray imaging. The findings showed that though the trend of joint involvement was the same in both groups, a significant difference was noted in disease duration and severity of radiographic findings, especially bone erosions. There was greater joint destruction in diabetic women compared to non-diabetic women whose duration of disease was comparatively longer. These results indicate that diabetes has no effect on the anatomical distribution of gout but is significant in enhancing the severity and the rate at which the disease progresses.

The age distribution analysis revealed that diabetic females were a little older than non-diabetic females; the difference was not significantly significant. This shows that the two groups were similar with respect to demographic features. Even though it is expected that, with old age, the prevalence of gout is likely to be higher because of the decreased renal activity and accumulation of metabolic risk factors, the absence of the significant difference in the present study indicates that age alone does not explain the variations in the severity of the disease [27]. Rather, it seems that metabolic factors that have to do with diabetes play a bigger role in the progression of the disease [28].

The difference in gout duration was statistically significant with the duration of the disease being longer in non-diabetic females than diabetic females. This observation suggests that diabetic patients can develop aggressive disease at a faster rate. This is attributed to the fact that diabetic patients have insulin resistance and persistent hyperglycemia which inhibits renal excretion of uric acid and enhances persistent hyperuricemia. This causes the deposition of urate crystals and inflammatory processes to increase at a faster rate, causing earlier and more severe damage to joints [29][30]. Consequently, time of disease is not a determining factor of severity, but the combination of time and metabolic condition is essential.

The research also established that hyperuricemia existed in nearly all the patients, especially in the diabetic group, in which all the individuals had high levels of uric acids. This confirms the established role of uric acid in the pathogenesis of gout. High concentrations of uric acid cause the development and deposition of monosodium urate crystals in joints that leads to an inflammatory response by activating the NLRP3 inflammasome and the release of inflammatory cytokines such as interleukin-1B [31][32]. Hyperuricemia in diabetic patients is further caused by the decreased renal clearance, oxidative stress, and chronic low-grade inflammation, which all increase the severity of the disease [34].

The joint involvement pattern was similar in this study where the knee joint was the most involved joint in the diabetic and non-diabetic females followed by ankle, elbow, and wrist. The two groups have similarity in joint distribution which shows that diabetes does not affect anatomic pattern of gout. The result is in line with other studies performed earlier that indicate that gout usually occurs in the large weight-bearing joints such as the knee because of other factors such as mechanical stress, low temperature and good conditions in which crystals can be deposited [35]. Therefore, diabetes influences severity, but not the pattern of joint involvement of gout.

Bilateral involvement of the joints was more prevalent than unilateral involvement especially in diabetic patients. This implies that diabetic persons can have more widespread or systemic illness. It is known that chronic gout may develop through monoarticular to polyarticular over the course of time and that this disease progression seems to be speeded up by the presence of metabolic disorders like diabetes [36]. The implication of bilateral involvement is also related to high-degree

of the disease stage and the crystal burden, which supports further the observation that diabetic patients have higher severity.

Radiographic assessment showed that joint space was narrowed and osteophytes were developed in nearly all patients in the two groups, which is a sign of chronic joint involvement. Nevertheless, bone erosions were much more common in patients with diabetes. The loss of cartilage is manifested through joint space narrowing but osteophytes reveal chronic degenerative processes. Bone erosions, conversely, are processes of disease that are active and destructive. The fact that bone erosions are more common among diabetic patients indicates that diabetes increases inflammatory processes, and structural destruction is faster. This is justified by the past studies that have found diabetes to be linked to augmented osteoclastic act, bone repair and tissue devastation [37].

The severity analysis also indicated that a greater percentage of severe erosions was also observed among diabetic patients with a lower percentage of mild and moderate changes being recorded in non-diabetic patients. This is a clear indication that diabetes plays a major role in the severity of diseases. The pathophysiological processes are chronic hyperglycemia, oxidative stress, augmented output of inflammatory cytokines, and dysfunctional immunity regulation. All of these cause even greater destruction of the joints in diabetic people [38]. This has been observed in other previous studies wherein diabetic gout patients exhibited more tophus formation, more joint deformity, and more functional disability as compared to non-diabetic patients [39][40]. These results were supported by the statistical analysis, which revealed no significant differences in age and joint involvement, but significant differences in the duration of the disease and bone erosions. This shows that diabetes has no effect on the prevalence of gout, but has a strong impact on gout severity and development. As such, the null hypothesis is rejected partially because the significant differences were found in the essential radiographic signs of disease severity. This study focused on the application of traditional X-ray in the assessment of gout arthritis. Even though there are more advanced imaging tools, such as ultrasound and dual-energy computed tomography (DECT), the X-ray is a rather widespread and convenient tool of diagnosis in rather poor resources settings. It proves to be particularly useful in detecting chronic alterations such as the decrease in the joint space, osteophytes and bone erosions. In certain countries like Pakistan where modern imaging may be limited, conventional radiography continues to play an invaluable role in clinical practice [41].

Overall, the findings of this study cannot be disregarded by the previous literature, which also emphasizes the importance of diabetes in worsening gout, the importance of hyperuricemia in gout development, and the feasibility of radiographic studies regarding the detection of structural changes. However, the research paper provides a contribution to the current knowledge as it specifically deals with the female population and provides a comparative radiographic study of diabetic and non-diabetic populations.In conclusion, this paper has demonstrated that despite the similar patterns of joint involvement in diabetic and non-diabetic women with gout arthritis, diabetes is a severe complication, particularly in the severity of bone erosions. The results underline the importance of the early diagnosis and treatment of hyperuricemia, as well as a strict glycemic control in patients who have diabetes in order to prevent severe complications. These results highlight the need to adopt an integrated clinical intervention in the treatment of both gout and diabetes patients which ultimately leads to the improvement of patient outcomes and quality of life.

CONCLUSION

This research shows that although gout arthritis affects the same joints in diabetic and non-diabetic women, diabetes worsens the severity of the disease. The radiographic features of diabetes patients were more severe, including severe bone erosions, suggesting that joint damage occurred more rapidly despite a shorter duration of disease. On the other hand, non-diabetic females exhibited a slower disease course with less joint damage. These results suggest that diabetes does not affect the incidence or pattern of gout, but it is a key factor in the severity of gout through metabolic derangement (hyperuricemia) and chronic inflammation. Hence, prompt diagnosis, tight diabetes control and holistic management are crucial to mitigate complications and enhance quality of life.

Limitations:

There are a number of limitations that this study has that should be taken into consideration when interpreting the results. First, the results were reported with the help of a standardized sample size, but the original data were founded on a few available reports, which could have an impact on the generalizability of the results. Second, the cross-sectional study design restricts the possibility of establishing the causal relationship of diabetes and the severity of gout arthritis.

Recommendations:

Early Diagnosis and Screening
Comprehensive Diabetes and Gout Management
Application of Conventional X-rays in Clinical Practice
Patient Awareness and Education
Further Research
Frequent Observation of Disease Progression
Multidisciplinary Approach

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