World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(RESEARCH ARTICLE)

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A cross-sectional study to assess the risk of tarsal tunnel syndrome among type 2 diabetes patients

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World Journal of Biology Pharmacy and Health Sciences, 2025, 22(02), 192-211

Publication history: Received on 18 March 2025; revised on 29 April 2025; accepted on 01 May 2025

Article DOI: https://doi.org/10.30574/wjbphs.2025.22.2.0300

Abstract

Aim: To assess the risk of tarsal tunnel syndrome among chronic diabetic patients.

Objectives :1. Determine the risk of tarsel tunnel syndrome among chronic diabetic patients within the study population. 2. Investigate the relationship between diabetes – related variables (such as duration of diabetes, glycemic control) and the occurrence of tarsal tunnel syndrome.3. Associate the demographic variables with the risk of tarsal tunnel syndrome.

Results: The prevalence of TTS in diabetic patients has been reported to range between 10% to 20%.

Discussions: Tarsal tunnel syndrome (TTS) is an entrapment neuropathy affecting the tibial nerve, often underdiagnosed in diabetic patients. Diabetes-related peripheral neuropathy increases the risk of developing TTS due to nerve damage and metabolic changes. Several studies report a higher prevalence of TTS among individuals with long-standing diabetes and poor glycemic control. Early diagnosis and management are crucial to prevent chronic pain and improve quality of life in affected patients.

Conclusion: Male diabetic patients are more commonly affected by Tarsal Tunnel Syndrome (TTS), with prolonged diabetes (16–20 years) increasing the risk. Poor glycemic control (high HbA1c) and pre-diabetic states are strongly linked to TTS development. Thyroid dysfunction, especially hypothyroidism, further contributes to nerve compression risk in diabetics. Early diagnosis and personalized treatment improve outcomes and help prevent long-term complications.

Keywords: Tarsal Tunnel Syndrome; Diabetes Complication; Entrapment; Tinel Sign; Triple Compression Test

1. Introduction

Tarsal Tunnel Syndrome (TTS) is a condition that results from the compression or irritation of the tibial nerve, which runs through a narrow passage in the ankle called the tarsal tunnel. This tunnel is located on the inside of the ankle, just behind the bony prominence of the medial malleolus. The tibial nerve, along with several tendons, blood vessels, and ligaments, passes through this tunnel, and when the nerve is compressed or entrapped, it can lead to symptoms such as pain, tingling, numbness, and weakness in the foot and ankle. TTS is often caused by factors that put pressure on the tibial nerve, such as injury, overuse, and systemic conditions like diabetes, flat feet, or abnormal foot mechanics. The symptoms are typically worsened with activities that involve prolonged standing, walking, or other repetitive movements. Treatment options for TTS include conservative measures like rest, ice, anti-inflammatory medications, physical therapy, and orthotics to reduce pressure on the nerve. In severe cases, surgery may be needed to relieve the

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compression. Early diagnosis and intervention are important for managing the condition and preventing further nerve damage

2. Material and methods

2.1. Aim

To assess the risk of tarsal tunnel syndrome among chronic diabetic patients.

2.2. Objectives

- Determine the risk of tarsal tunnel syndrome among chronic diabetic patients within the study population.
- Investigate the relationship between diabetes – related variables (such as duration of diabetes, glycemic control) and the occurrence of tarsal tunnel syndrome.
- Associate the demographic variables with the risk of tarsal tunnel syndrome.

2.3. Study type

The cross-sectional study was conducted in the in- patient and out- patient department at A.C.S Medical College and Hospital.

2.4. Study population

- Inclusion criteria All male and female in-patients admitted in General medicine and General surgery department; diabetic patients were included; patients with age of 30 and above are included irrespective of their genders
- Exclusion criteria Any diabetic patients with diabetic foot ulcers

2.5. Sample size and population

569 participants were included in the study according to inclusion criteria and duration of the study was 6 months

3. Results and discussion

Table 1 Gender Distribution

Gender	Frequency	Percent
Male	296	52.0
Female	273	48.0
Total	569	100.0

Table 1 shows the gender distribution of tarsal tunnel syndrome among chronic diabetic patients, which shows among female male has more frequency and higher percentage of cause, with a graph representation.

Table 2 Duration Of Diabetes

Years	Duration	Frequency	Percent
1-5YRS	0	28	4.9
6-10YRS	1	250	43.9
11-15YRS	2	158	27.8
16-20YRS	3	74	13.0

Table 2 shows the duration of diabetes among diabetic patients in both male and female. Which shows 16-20 yrs. of duration has more frequency and higher percentage with graph representation

Table 3 HbA1C Levels

	HBA1C LEVEL	Frequency	Percent
Normal	0	4	0..7
Pre - Diabetic	1	101	17.8
Risk	2	463	81.4
	Total	568	100

Table 3 shows the HBA1C level among diabetic patients in both genders, with the graphRepresentation which Shows high of risk in pre- diabetic condition with frequency and Percentage.

Table 4 Recent Trauma (accident / injury/tendonitis) In the lower limb

RECENT TRAUMA	Frequency	Percent
Male	376	66.1
Female	193	33.9
Total	569	100.0

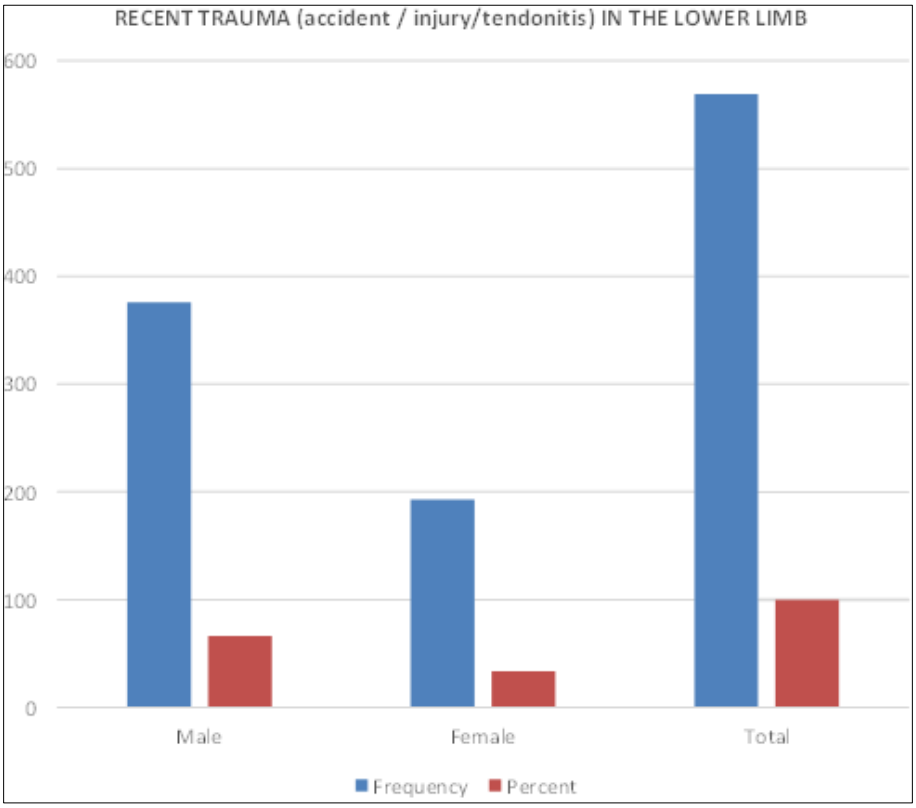

Figure 1 Recent trauma

Figure 1 shows the RECENT TRAUMA (accident / injury/tendonitis) IN THE LOWER LIMB in diabetic patients in both male and female, to see any defect or injury in lower limb, which shows with a graphical representation.

Table 5 Wearing tight shoes or sandals

	Frequency	Percent	Valid Percent
Male	568	99.8	99.8
Female	1	.2	.2
Total	569	100.0	100.0

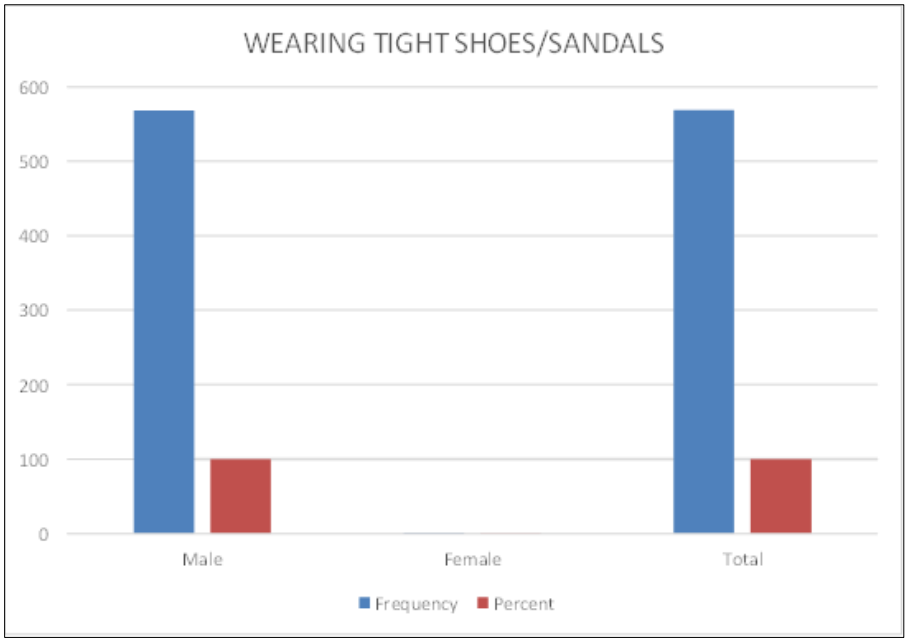

Figure 2 wearing tight shoes/ sandals to see any difficulty

Figure 2 shows the wearing tight shoes/ sandals to see any difficulty in diabetic patients to see if their tarsal tunnel syndrome symptoms with graph representation

Table 6 Atrophy of feet

ATROPHY IN FEET	Frequency	Percent
Male	342	60.1
Female	227	39.9
Total	569	100.0

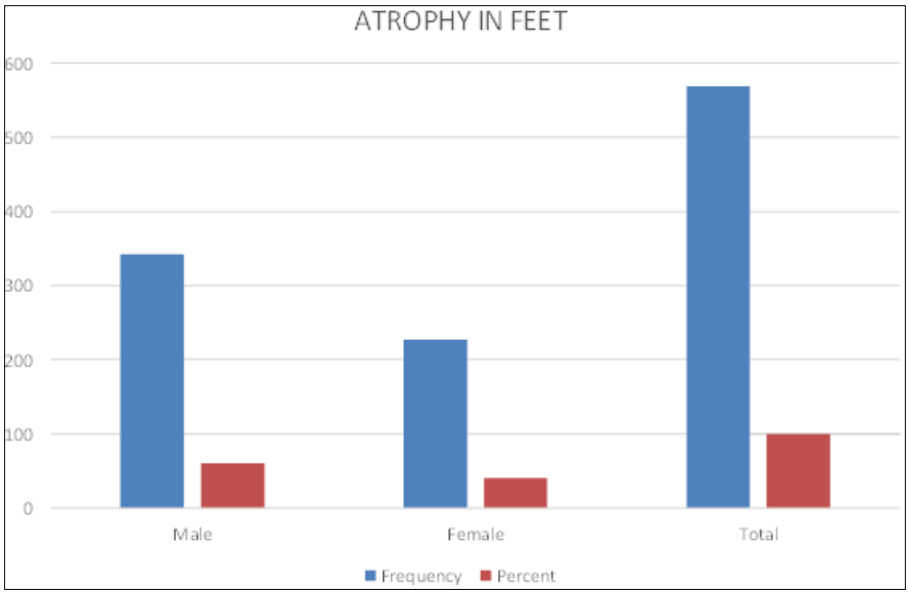

Figure 3 Atrophy in feet

Figure 3 Shows whether cause of atrophy in feet among diabetic patients, which Shows more Than females; males have high frequency and percentage with graph representation

Table 7 Edema in feet

	Frequency	**Percent**
Male	220	38.7
Female	349	61.3
Total	569	100.0

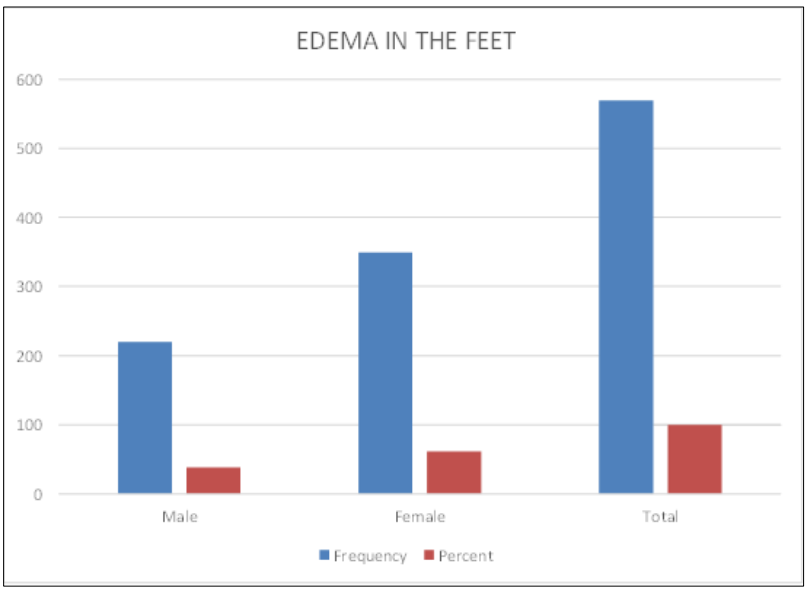

Figure 4 Edema in feet

Figure 4 Shows both tabular column and graph representation of Edema in feet among diabetic Patients in both genders, in which females have high percentage and frequency of cause of Edam more than males.

Table 8 Inversion

INVERSION	Frequency	Percent
Free	284	49.9
Difficult	285	50.1
Total	569	100.0

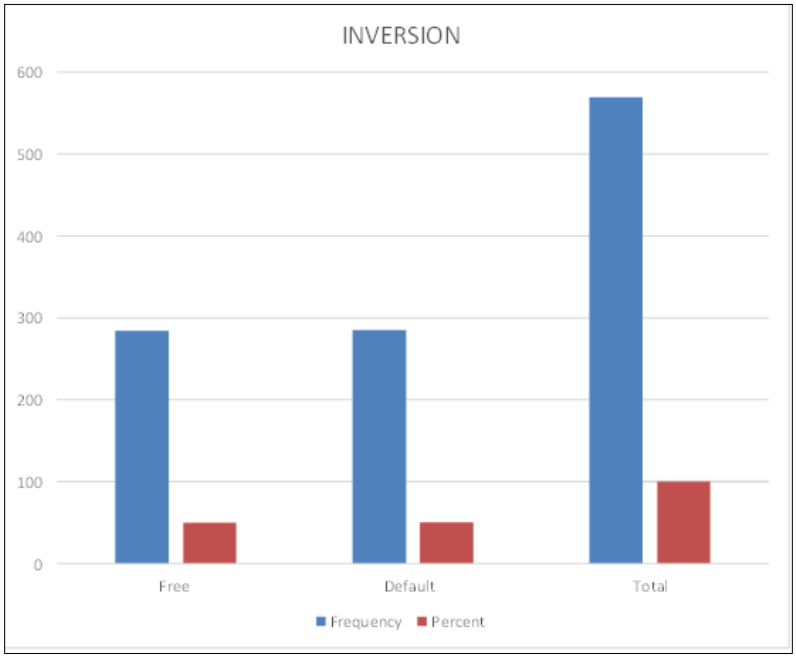

Figure 5 Inversion sign

Figure 5 Shows the Inversion sign in diabetic patients among both genders which Shows both Free and difficult movements in the leg with graph representation

Table 9 Eversion

EVERSION	Frequency	Percent
Free	337	59.2
Default	232	40.8
Total	569	100.0

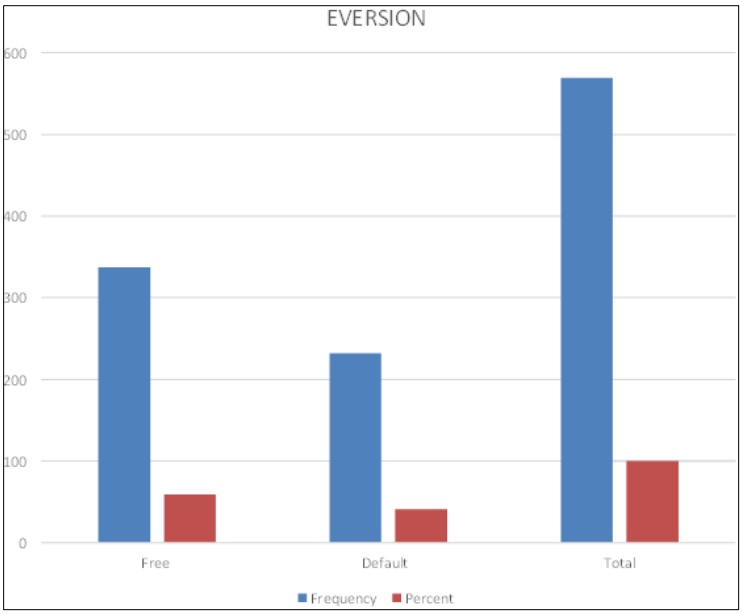

Figure 6 Eversion sign

Figure 6 Shows the Eversion sign in diabetic patients among both genders which Shows both Free and difficult movements in the leg with graph representation

Table 10 Dorsiflexion

DORSI FLEXION	Frequency	Percent
Free	199	35.0
Default	370	65.0
Total	569	100.0

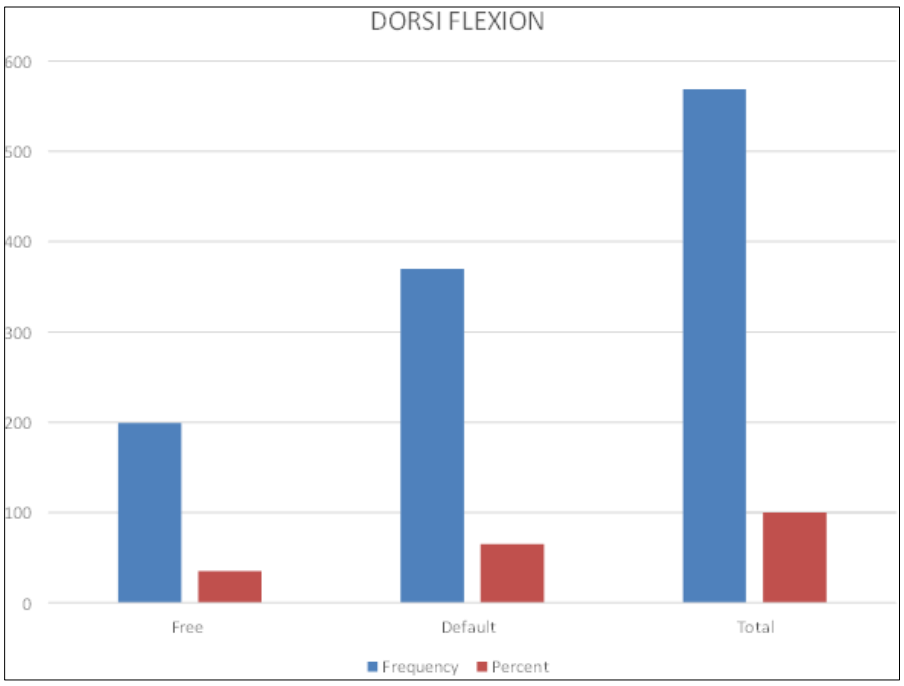

Figure 7 Dorsiflexion

FIGURE. 7 shows the dorsiflexion test which is a physical exam that helps diagnose tarsal tunnel Syndrome (TTS) by stretching and compressing the tibia nerve, with graph representation

Table 11 Plantar Flexion

Plantar Flexion	Frequency	Percent
Free	180	31.6
Default	389	68.4
Total	569	100.0

Figure 8 shows planter flexion movement which is a test used to diagnose tarsal tunnel Syndrome, and it's performed by Placing the foot into maximum plantar flexion and inversion Holding for 10–15 seconds Returning the foot to neutral. It is represented with graph and its Frequency with its percentage

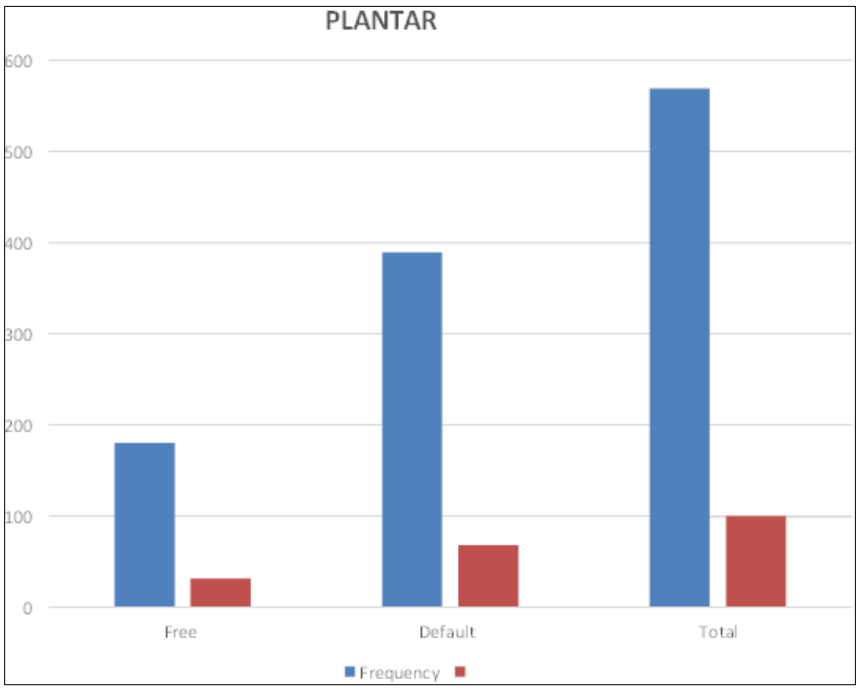

Figure 8 Plantar Flexion

Table 12 Numbness in the foot

Numbness in the foot	Frequency	Percent
Male	189	33.2
Female	380	66.8
Total	569``	100.0

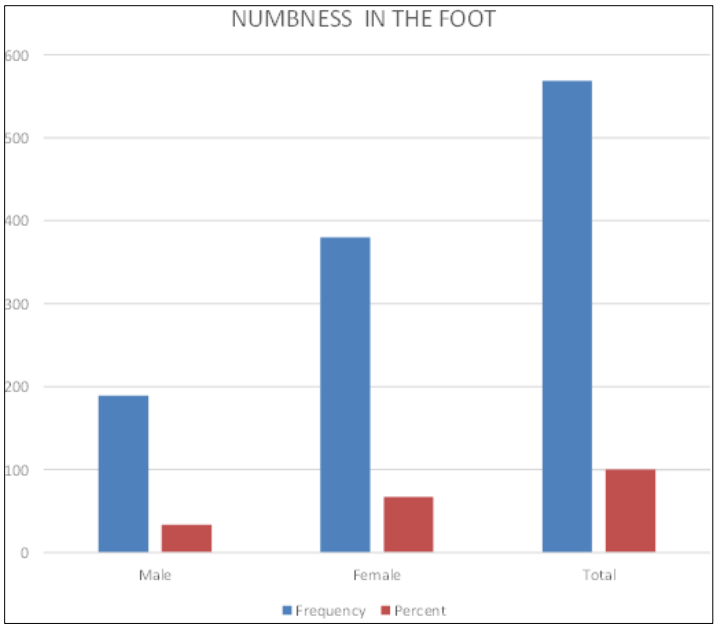

Figure 9 Numbness in the foot

Figure 9 shows the numbness in the foot among diabetic patients in both genders in the leg Which is one the signs and symptoms of tarsal tunnel syndrome. This shows us that females Have higher percentage and frequency than males with the graph representation

Table 13 Tingling in the foot

TINGLING IN THE FOOT	Frequency	Percent
Male	210	36.9
Female	359	63.1
Total	569	100.0

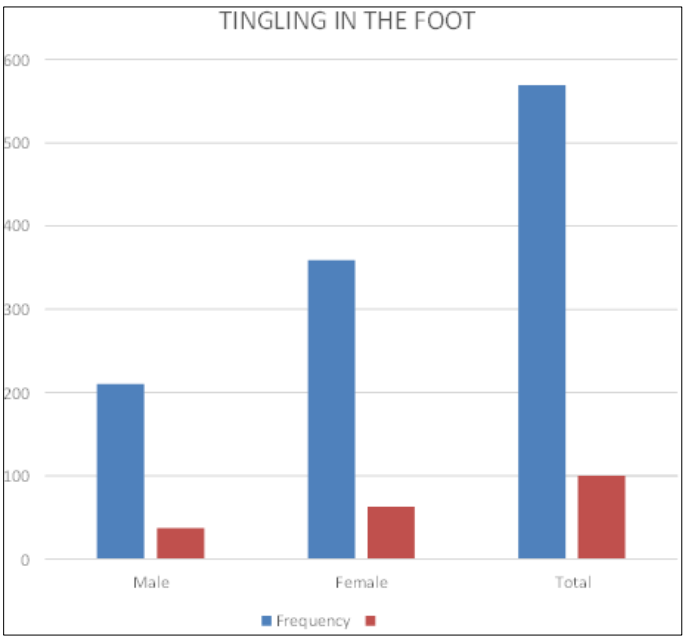

Figure 10 Tingling sign in the foot

Figure 10 shows about the tingling sign in the foot which is a symptom of tarsal tunnel syndrome (TTS), A condition that occurs when the tibia nerve in the ankle is compressed. It is more common in females More than males among diabetic patients is given in the above table and graphical representation

Table 14 burning sensation in the foot

BURNING SENSATION IN THE FOOT	Frequency	Percent
Male	199	35.0
Female	370	65.0
Total	569	100.0

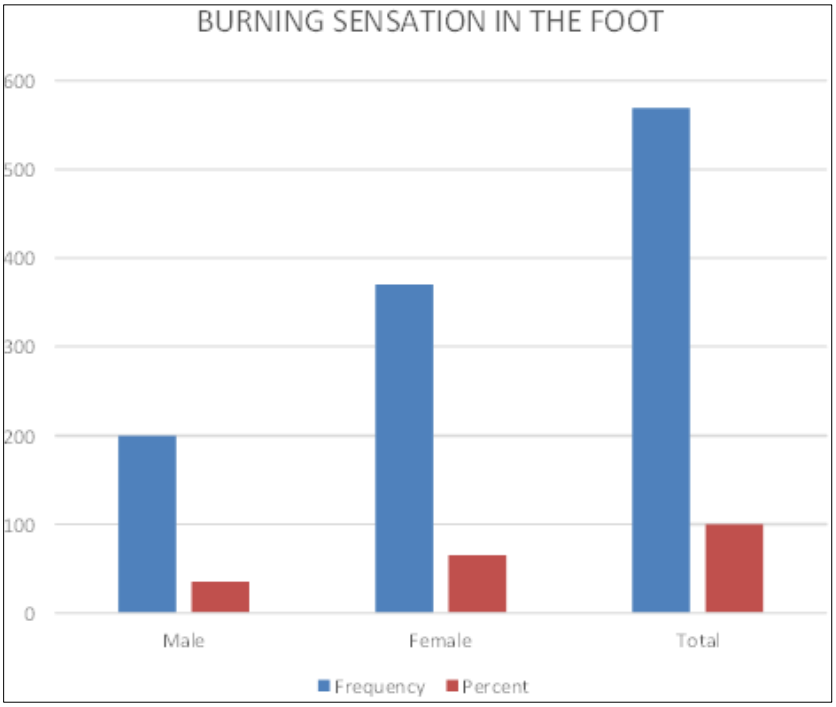

Figure 11 Burning sensation in the foot

Figure 11 shows the burning sensation in the foot which is a symptom of tarsal tunnel Syndrome (TTS) among diabetic patients in both the genders. Which shows more common in females Than males in the given table and graph representation

Table 15 Pain In The Foot

PAIN IN THE FOOT		Frequency	Percent
Mild	0	88	15.5
Moderate	1	162	28.5
Severe	2	216	38.0
Very Severe	3	103	18.1
	Total	569	100.0

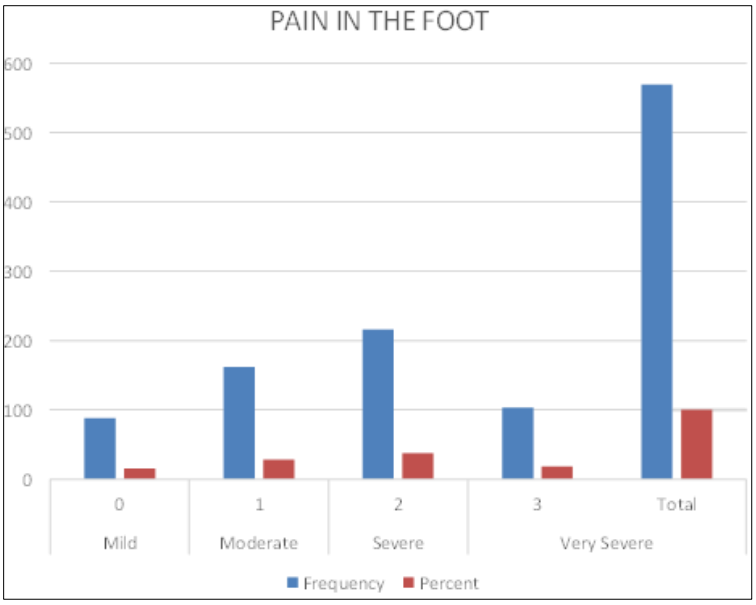

Figure 12 Foot Pain

Figure. 12 shows the foot pain among diabetic patients in both genders which is a symptom of Tarsal tunnel syndrome (TTS), a condition that occurs when the tibia nerve is Damaged in the ankle is represented with the table and graph

Table 16 Tinel Sign

TINEL SIGN	Frequency	Percent
Male	234	41.1
Female	335	58.9
Total	569	100.0

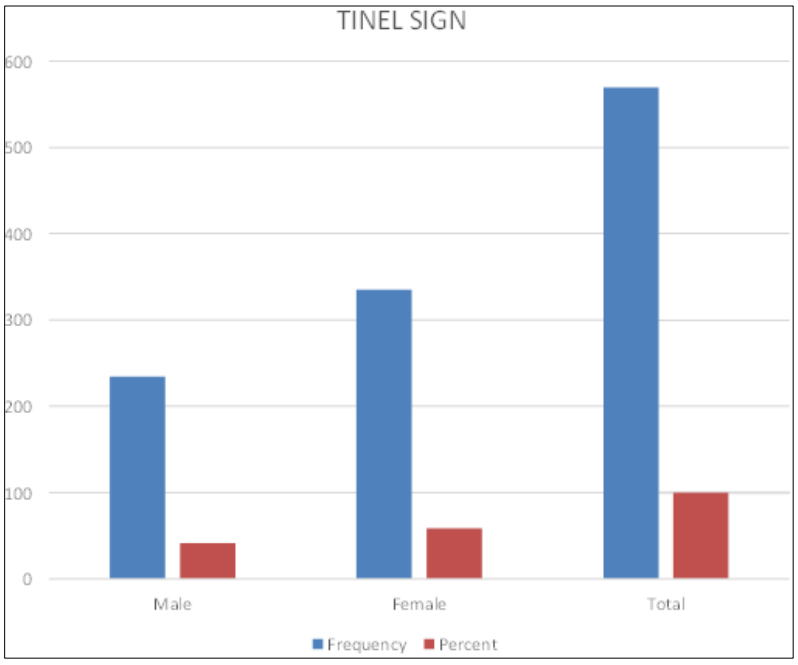

Figure 13 Tinsel sign

Figure 13 shows about tinsel sign in foot which is a tingling or "pins and needles" sensation felt in the foot after tapping the tarsal tunnel behind the ankle is represented with tabular column and graph.

Table 17 Triple Compression Test

Triple Compression Test	Frequency	Percent
Male	175	30.8
Female	394	69.2
Total	569	100.0

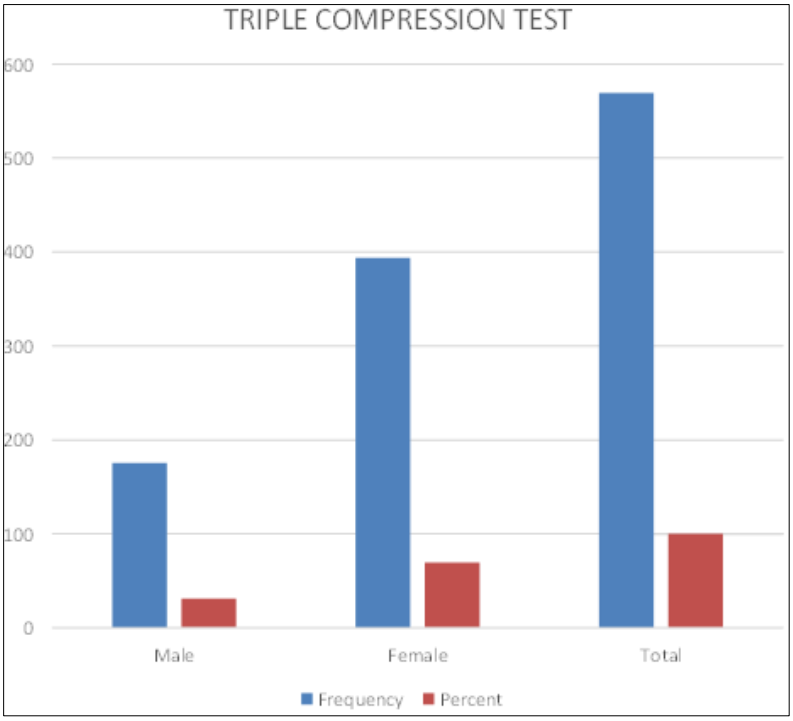

Figure 14 Triple compression test

Figure 14 shows about triple compression test or triple compression stress test which we Place Patient's foot in full plantarflexion and inversion with one hand, while simultaneously applying Digital pressure over the tarsal tunnel just posterior to the media malleolus for 30 seconds. It is A diagnostic procedure which is represented with table and graph.

Table 18 dorsiflexion eversion test

Dorsiflexion eversion test	Frequency	Percent
Male	206	36.2
Female	363	63.8
Total	569	100.0

Table 18 shows about dorsiflexion eversion test which is a physical exam that can help Diagnose tarsal tunnel syndrome. It involves: Passively everting and dorsiflexing the ankle Maximally dorsiflexing and holding the metatarsophalangeal (MTP) joints for 5–10 seconds.

Table 19 gender thyroid (WHETHER hypothyroidism or hyperthyroidism)

		THYROID (WHETHER hypothyroidismor hyperthyroidism)		Total
		Male	**Female**	
GENDER	Male	292	4	296
	Female	84	189	273
	Total	376	193	569

Table 19 The comparison between gender and thyroid among diabetic Patients with pie chart representation which shows males are more of than females

Table 20 Gender * Varicose Vein In Lower Limb

		Varicose Vein In Lower Limb		
		Male		Total
GENDER	Male	296	0	296
	Female	270	3	273
Total		566	3	569

Table 20 The comparison between gender and varicose vein in lower limb Among diabetic patients with pie chart representation which shows that males are More of than females.

Table 21 Gender * Recent Trauma (accident / injury/tendonitis) IN THE LOWER LIMB

		RECENT TRAUMA (accident / injury/tendonitis) IN THE LOWER LIMB		
		Male	**Female**	**Total**
GENDER	Male	214	82	296
	Female	162	111	273
Total		376	193	569

Table 21 The comparison between gender and recent trauma in the lower limb Among diabetic patients with pie chart representation which shows males are more of Than the females with high percentage.

Table 22 Gender * Wearing Tight Shoes/Sandals

		WEARING TIGHT SHOES/SANDALS		
		Male	**Female**	**Total**
GENDER	Male	296	0	296
	Female	272	1	273
	Total	568	1	569

Table 22 The comparison between gender and wearing tight shoes/ sandals Among diabetic patients which shows with the table and pie chart representation

Table 23 Gender * Edema In The Feet

		Edema In The Feet		
		Male	**Female**	**Total**
GENDER	Male	122	174	296
	Female	98	175	273
	Total	220	349	569

Table 23 Tthe comparison between gender and edema in the foot among Diabetic patients which show with a tabular column and a pie chart representation. This shows that females are more of than the males in this given comparison

Table 24 gender * numbness in the foot

		Male	**Female**	**Total**
GENDER	Male	111	185	296
	Female	78	195	273
	Total	189	380	569

Table 24 The comparison between gender and numbness in the foot among the diabetic patients which shows females are more of than males in this Comparison with the table and pie chart representation.

Table 25 Gender Vs Tingling In Foot

		Male	**Female**	**Total**
GENDER	Male	109	187	296
	Female	101	172	273
	Total	210	359	569

Table 25 The comparison between gender and tingling in the foot amongm Diabetic patients which shows females are more of than the males in this comparison with tabular column and pie chart representation.

Table 26 Gender * Burning Sensation In The Foot

		Male	**Female**	**Total**
GENDER	Male	103	193	296
	Female	96	177	273
	Total	199	370	569

Table 26 The comparison between the gender and burning sensation in the foot Among diabetic patients which shows that the females are more of than males in this Comparison with the table and pie chart representation.

Table 27 Cender * pain in the foot

		Mild	**Moderate**	**severe**	**Very Severe**	**Total**
GENDER	Male	54	79	108	55	296
	Female	34	83	108	48	273
	Total	88	162	216	103	569

Table 27 The comparison between the gender and pain in foot among diabetic Patients which shows each level of severity of pain according to the scales with pie chart and tabular column

Table 28 Gender * Tinel Sign

		Male	Female	Total
GENDER	Male	121	175	296
	Female	113	160	273
	Total	234	335	569

Table 28 The comparison between the gender and tinsel sign among diabetic patients Which is represented with tabular column and pie chart. This shows that the females are more of than the males in this comparison

Table 29 Gender * triple compression test

		TRIPLE COMPRESSION TEST		
		Male	Female	Total
GENDER	Male	95	201	296
	Female	80	193	273
	Total	175	394	569

Table 29 The comparison between the gender and triple compression test among Diabetic patients, where females are more of than the males in this comparison with the given Table and pie chart representation

Table 30 Gender * Dorsiflexion Eversion Test

		Male	Female	Total
GENDER	Male	108	188	296
	Female	98	175	273
	Total	206	363	569

Table 30 The comparison between the gender and dorsiflexion eversion test among Diabetic patients with the represented pie chart and tabular column show that the females are More of than the males in this given comparison

Table 31 Duration Of Diabetes: * Thyroid (Whether Hypothyroidism or hyperthyroidism)

		THYROID (WHETHER hypothyroidismor hyperthyroidism)		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	23	5	28
6-10YRS	1	151	99	250
11-15YRS	2	104	54	158
16-20YRS	3	54	20	74
	Total	332	178	510

Table 32 Duration of diabetes * varicose vein in lowerlimb

Years	DURATION	Male	Female	Total
1-5YRS	0	27	1	28
6-10YRS	1	249	1	250
11-15YRS	2	158	0	158
16-20YRS	3	74	0	74
	Total	508	2	510

Table 33 Duration Of Diabetes * Recent Trauma

		Recent Trauma (Accident / Injury/Tendonitis) In The Lower Limb		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	21	7	28
6-10YRS	1	155	95	250
11-15YRS	2	97	61	158
16-20YRS	3	55	19	74
	Total	328	182	510

Table 33 shows the comparison between duration of diabetes and recent trauma in the lower Limb among diabetic patients with the given tabular column and represented pie chart in both Genders.

Table 34 DURATION OF DIABETES * WEARING TIGHTSHOES/SANDALS

		WEARING TIGHT SHOES/SANDALS		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	28	0	28
6-10YRS	1	250	0	250
11-15YRS	2	158	0	158
16-20YRS	3	73	1	74
	Total	509	1	510

Table 34 shows the comparison between the duration of diabetes and wearing tight shoes / Sandals among diabetic patients with the given tabular column and represented pie chart in Both genders.

Table 35 Duration of diabetes * edema in the feet

		EDEMA IN THE FEET		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	18	10	28
6-10YRS	1	107	143	250
11-15YRS	2	33	125	158
16-20YRS	3	29	45	74
	Total	187	323	510

Table 35 shows the comparison between the duration of diabetes and edema in the feet among the diabetic patients in the both genders with the given tabular column and represented pic chart.

Table 36 DURATION OF DIABETES * - INVERSION

		INVERSION		**Total**
Years	**DURATION**	**Male**	**Female**	
1-5YRS	0	20	8	28
6-10YRS	1	148	102	250
11-15YRS	2	54	104	158
16-20YRS	3	30	44	74
	Total	252	258	510

Table 36 shows the comparison between the duration of diabetes and inversion among diabetic Patients with the given tabular column and represented pie chart in both genders.

Table 37 Duration Of Diabetes * Eversion

		EVERSION		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	24	4	28
6-10YRS	1	171	79	250
11-15YRS	2	73	85	158
16-20YRS	3	34	40	74
	Total	302	208	510

Table 37 shows the comparison between the duration of diabetes and eversion in foot among Diabetic patients with the given tabular column and represented pie chart in both genders.

Table 38 Duration Of Diabetes * Dorsi Flexion

		DORSI FLEXION		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	16	12	28
6-10YRS	1	87	163	250
11-15YRS	2	38	120	158
16-20YRS	3	30	44	74
	Total	171	339	510

Table 38 shows the comparison between the duration of diabetes and the dorsiflexion in the Foot among the diabetic patients in both genders which is shown with the given tabular Column and represented pie chart.

Table 39 Duration Of Diabetes * Plantar Flexion

		PLANTAR FLEXION		
Years	**DURATION**	**Male**	**Female**	**Total**
1-5YRS	0	18	10	28
6-10YRS	1	74	176	250
11-15YRS	2	30	128	158
16-20YRS	3	30	44	74
	Total	152	358	510

Table 39 shows the comparison between duration of diabetes and the plantar flexion of the foot Among diabetic patients in both genders with the given tabular column and represented pie chart.

Table 40 Durations of diabetes * numbness in the foot

Crosstab				
Count				
		NUMBNESS IN THE FOOT		**Total**
Years	**DURATION**	**Male**	**Female**	
1-5YRS	0	13	15	28
6-10YRS	1	87	163	250
11-15YRS	2	30	128	158
16-20YRS	3	31	43	74
	Total	161	349	510

Table 40 shows the comparison between the duration of diabetes and numbness in the foot Among diabetic patients in both the genders with the given tabular column and represented Pie chart.

Table 41 Duration of diabetes vs pain in the foot

Crosstab						
Count						
		P0IN IN THE FOOT				
Years	**DURATION**	**Mild**	**Moderate**	**Severe**	**Very Severe**	**Total**
1-5YRS	0	8	19	1	0	28
6-10YRS	1	18	114	108	10	250
11-15YRS	2	11	16	93	38	158
16-20YRS	3	29	2	11	32	74
	Total	66	151	213	80	510

Table 41 The comparison between the duration of diabetes and pain in the foot among Diabetic patients in both the genders with the given tabular column and represented pie chart.

4. Discussions

The gender distribution of Tarsal tunnel syndrome among chronic diabetic patients, which shows among female male has more frequency and higher percentage of cause, with a graph representation. The duration of diabetes among diabetic patients in both male and female. which shows 16-20 yrs. of duration has more frequency and higher percentage with graph representation. The HBA1C level among diabetic patients in both genders, with the graph representation which shows high of risk in pre- diabetic condition with frequency a percentage. shows the frequency and percentage of thyroid [whether hypo or hyperthyroidism among diabetic patients in both male and female, which shows male has more case of thyroid more than females with the graph representation The comparison between gender and thyroid among diabetic patients with pie chart representation. which shows males are more of than females. Research indicates that patients with diabetes have a higher risk of developing TTS compared to the general population. The prevalence of TTS in diabetic patients has been reported to range between 10% to 20%, though estimates may vary depending on the study population and diagnostic criteria used. A higher prevalence of TTS in diabetic patients can be attributed to several factors related to the pathophysiology of diabetes, particularly diabetic neuropathy and poor circulation.

5. Conclusion

Research indicates that male diabetic patients are more frequently affected by Tarsal Tunnel Syndrome (TTS) compared to females. Despite the higher occurrence in males, the gender distribution often shows a similar percentage of affected individuals once adjusted for total population numbers. This could be due to the greater overall risk factors in men, such as a higher likelihood of associated complications like diabetic neuropathy, obesity, and lifestyle factors.

The duration of diabetes plays a crucial role in the onset of TTS. Among chronic diabetic patients, those with a duration of 16-20 years tend to have the highest frequency and percentage of TTS cases, indicating that prolonged exposure to hyperglycemia and associated complications (like neuropathy and poor circulation) increases the risk of nerve compression in the tarsal tunnel.

The level of HbA1c (glycated hemoglobin) serves as a marker for long-term blood glucose control. Pre-diabetic conditions, reflected by higher HbA1c levels (typically between 5.7% and 6.4%), are associated with a significant increase in the risk of developing TTS. Diabetic patients with poor glycemic control (i.e., HbA1c > 7%) show a higher risk for neuropathy, which can exacerbate TTS symptoms.

Thyroid dysfunction, particularly hypothyroidism, is common in diabetic patients and can contribute to an increased risk of neuropathies such as TTS. Male diabetic patients tend to have a higher frequency of thyroid disorders compared to females. The reasons for this discrepancy are not entirely clear but may be related to hormonal differences or a higher prevalence of autoimmune thyroid disease in men with diabetes. Tarsal Tunnel Syndrome (TTS) is a neuropathic condition caused by the compression of the posterior tibial nerve, leading to symptoms like pain, tingling, numbness, and weakness in the foot. Early recognition and accurate diagnosis through clinical assessment, imaging, and electrodiagnostic tests are crucial for effective management. While conservative treatments such as rest, physical therapy, and orthotics can provide relief in many cases, more severe instances may require corticosteroid injections or surgery to decompress the nerve. The prognosis for TTS is generally favorable, especially when addressed early, though some patients may experience recurrent symptoms. Ultimately, a comprehensive, patient-specific approach to treatment is essential for restoring function and improving the quality of life for individuals affected by TTS.

Compliance with ethical standards

Disclosure of conflict of interest

There is no Conflicts of Interest

Statement of ethical approval

The study was approved by Institutional Ethics Committee ACS Medical College and hospital (No.972/2023/1EC/ACSMCH Dt. 17.11.2023)

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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