Rwanda Medical Journal RMJ

ORIGINAL ARTICLE Open Access

Sonographic evaluation of the prevalence of Achilles tendon tear in patients with type-2 diabetes

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ABSTRACT

INTRODUCTION: The integrity of the Achilles tendon (AT) plays a significant role in foot biomechanical efficiency. Diabetes mellitus contributes to the development of AT tears which impairs movement and productivity. The objective of this study was to sonographically assess the prevalence and associated factors of Achilles tendon tears in Type-2 diabetes mellitus, with and without peripheral neuropathy (PN), and compare with a control population.

METHODS: A prospective cross-sectional study was conducted on 71 Type-2 diabetics subjects and 80 controls. AT tears and calcifications were detected in the subjects using high resolution B-mode ultrasound.

RESULTS: AT calcification was significantly associated with dominant and non-dominant foot AT tear, while HbA1c and PN were significantly associated with dominant foot AT tear ($P < 0.05$, respectively). There were significantly more AT calcifications and tears on the dominant foot AT of diabetics with PN ($P < 0.001$). The prevalence of AT tears in Type-2 diabetics was 7.75%. HbA1c ≥ 6.95% was shown to have a high sensitivity (75%), specificity (74.60%) and accuracy (75.35%) to correctly predict the development of a non-traumatic AT tear in diabetics with PN.

CONCLUSION: The prevalence of AT tear in Type-2 diabetics, based on sonographic diagnosis, is low. The likelihood of AT tears increases in the dominant foot when HbA1c level equals or exceeds 6.95% in diabetics with peripheral neuropathy. This preliminary study showcases the need to incorporate Achilles tendon sonographic evaluation to rule out tears in the management of diabetics.

Keywords: Achilles tendon, Type-2 diabetes mellitus, Tendon tear, Peripheral neuropathy, HbA1c, Ultrasonography

INTRODUCTION

Achilles tendon (AT) is the most powerful and biggest tendon in the human body [1]. It is strong enough to hold the weight of about 12 human bodies. [2]. The most frequent type of tendon tear

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Received: 26th July 2025; **Initial decision given:** 15th November 2025; **Revised manuscript received:** 19th November 2025; **Accepted:** 26th November 2025.
 Publisher: Rwanda Biomedical Centre (RBC)/Rwanda Health Communication Center, P. O. Box 4586, Kigali. ISSN: 2079-097X (print); 2410-8626 (online)

Citation for this article: Samuel Archibong Efanga; Affiong Ifop Ngaji; Akintunde Olusijibomi Akintomide et al. Sonographic evaluation of the prevalence of Achilles tendon tear in type-2 diabetes patients. Rwanda Medical Journal, Vol. 82, no. 4, p. 31-40, 2025. https://dx.doi.org/10.4314/rmj.v82i4.6

is AT tear and it has been reported to be on the rise. Its occurrence is common in males during recreational and competitive sport activities [1, 3, 4].

The incidence of AT tear is estimated to range from 11 to 37 per 100, 000 population. It has a bimodal distribution with the first peak occurring in individuals aged 25 to 40 years who are involved in high-energy sports while the second peak occurs in individuals above 60 years of age who are involved in low-energy sports. Histological evaluation of acutely torn AT revealed features of degenerative changes in spite of the absence of symptoms [5].

Achilles tendon disorders in Type-2 diabetes are associated with impaired tendon structure and function [6]. In this condition AT usually undergo alterations in its viscous and elastic properties, and gradually lose its parallel orientation to become friable [7,8]. The likelihood of developing AT tear increases by three-fold in individuals with diabetes mellitus (DM) [3,6]. Surprisingly, it has been observed that most asymptomatic AT tears in Type-2 diabetics were discovered during sonographic evaluation of the Achilles tendon for other purposes [9].

AT tears usually result from either the influence of a substantial force or the effect of physiological forces on a weak tendon. Majority of these tears occur at the water shed area which is approximately between 2 to 6 cm away from its insertion into the calcaneus, and this area is commonly structurally weak [2, 10]. Tears in the Achilles tendon result in a loss of plantar flexion strength, reduction in functional calf strength, development of a limp when walking, and inability to run and climb the stairs [10,11]. Neuropathy is the most common complication of DM and it results from vascular stenosis which compromises nerve perfusion. In terms of its manifestation, diabetic neuropathy can be peripheral, autonomic, proximal or focal. Peripheral neuropathy, which is characterized by pains, loss of sensation in the toes, feet, legs, hands and arms, is the most common type of diabetic neuropathy [12,13].

Imaging the Achilles tendon to detect tears using ultrasonography has proven to be a better option than MRI. This is based on the fact that ultrasonography permits dynamic assessment, offers better spatial resolution, provides a medium to assess tendinous neovascularization and is convenient for follow up than MRI [14].

There is a dearth of literature on the development of non-traumatic Achilles tendon tear in individuals with Type-2 DM. We sought to determine the structural changes that occur and the rate of occurrence of AT tears in Type-2 diabetics. Moreover, it is pertinent to encourage clinicians to inculcate periodic ultrasonographic assessment of AT in the course of monitoring diabetic patients. An early diagnosis of Achilles tendon tear has a high propensity to improve the patient's prognosis and ensure rapid healing [15].

This study aimed at sonographically evaluating the prevalence and associated factors of Achilles tendon tears in Type-2 diabetes mellitus, with and without peripheral neuropathy, and compare with healthy volunteers.

METHODS

Study design and setting

This prospective cross-sectional observational study was conducted from February to August 2024 at the Radiology department of a tertiary hospital. It is approximately a 1000-bed hospital with facilities for emergency, in-patient, out-patient and community health services, and conducts training of undergraduate medical students, post graduate medical students and para-medical students. The hospital's Institutional review board approved the study protocol (UCTH/HREC/33/116).

Study participants

The study population consisted of Type-2 diabetics who were recruited from the Diabetic clinic of the tertiary hospital and controls were individuals who work in the same hospital. The criteria for inclusion of the diabetic subjects were fasting blood glucose ≥ 7.00 mmol/l and glycated hemoglobin ≥ 6.5%, while a fasting blood glucose < 5.6 mmol/l and the absence of a history of diabetes mellitus and peripheral neuropathy were the criteria for inclusion of the control subjects [12,13,16]. Written informed consent was obtained from all the subjects of this study.

Exclusion criteria

History of Achilles tendon tear or repairs, a sportsperson, neuropathic arthropathy, nephropathy, pregnancy, gout, ankylosis spondylitis, rheumatoid arthritis, thyroid disorders, foot ulcers, parathyroid disorders, adrenal disorders, hereditary motor and sensory

neuropathy (diagnosed by a neurologist or a positive family history), Reiter's syndrome, familial amyloid polyneuropathy, pains around the ankle and Achilles tendon, foot deformity, injuries around the ankle, peripheral neuropathy from causes other than diabetes mellitus and tarsal tunnel syndrome
[12,13,16–20].

Sample size determination

A priori power analysis was done to determine the sample size for the two groups in the study. The statistical test selected for the analysis was difference between two independent groups. Significance level (P) was set at 0.05 while the desired power was 0.90. After the calculation the required sample size for each group in the study was shown to be 70. To enhance the statistical power of the results of this study the recruited subjects in each group were more in number than the calculated sample size. Following the employment of convenient sampling technique, seventy-one Type-2 diabetics were recruited while purposive sampling technique was used to recruit eighty control subjects.

Clinical evaluation

Clinical history was obtained from all the subjects to determine the duration of diabetes, suspicion of pregnancy, co-morbidities such as thyroid disease, and the presence of complications of DM. Physical examination was done on the subjects to assess for foot ulcers, gout, tenderness, injuries and deformity. The biodata, glycated hemoglobin (HbA1c) value and body mass index (BMI) of the subjects were assessed and documented. To determine the dominant foot, the subjects were requested to kick a stationary ball that was centrally placed in front of them, and the foot used in kicking the ball was noted as the dominant foot [17].

Diabetic peripheral neuropathy determination

The presence of peripheral neuropathy was determined using 10 gm Semmes-Weinstein monofilament by an Endocrinologist. The monofilament was gently pushed until it was bent for 1 second against the dorsum that lies between the 1st and 2nd toes of each foot, the plantar surfaces of the 1st, 3rd and 5th toes of each foot, the plantar surfaces of the 1st, 3rd and 5th metatarsal heads of each foot, the plantar surfaces of the medial and lateral aspects of the mid-foot and the heel in a random motion. At each region of examination, the subjects were requested to indicate if the press of the monofilament into their skin were felt or not. The presence of peripheral neuropathy was determined when the subject did not feel the press of the monofilament at more than 4 of the 10 sites examined [13,16,21,22].

Study tool and Achilles tendon evaluation

A Toshiba TUS-X100S (Xario 100) ultrasound machine (manufactured in 2015 by Toshiba Medical Systems corporation, in Japan) with a linear probe that operates at a frequency of 11 MHz was used for Achilles tendon ultrasonography. To evaluate the Achilles tendon, the subjects were requested to lie down on an examination couch in a prone position and the feet extended beyond the edge of the couch. All clothing around the ankles were rolled loosely to the knee level. With the ankles in a relaxed neutral position at approximately 900 and the toes pointing downwards, a generous amount of ultrasonographic coupling gel was applied over the area of the Achilles tendon. The Achilles tendon was scanned with the transducer in the longitudinal plane, from its point of insertion into the calcaneus bone below, to its musculotendinous junction at the calf muscles above, to evaluate for tendon tears and calcifications, and to lessen the effect of anisotropy, uniform perpendicular pressure was consistently applied to the tendon. The depths and gain settings were slightly altered to produce optimal images during the course of the evaluation. The ultrasonographic examination of the right and left Achilles tendons of the subjects was conducted by the first author who was blinded to their clinical status [13,16,17,22,23].

Achilles tendon tear

Partial thickness tears – Presents with discontinuity of some tendon fibrillar echotexture which appear as hypoechoic areas. There is usually a gap between the tendon fibers [13–15]. Full thickness tear presents with a clear retraction of majority of the tendon fibers from the site of laceration usually with a thin strand of tendon fiber connecting the frayed torn segments and this strand is bounded by hypoechoic areas. In acute cases hematoma with heterogenous echotexture may be seen which gradually reduces in echogenicity as it resolves [15, 24].

Achilles tendon calcification

Hyperechoic focus or foci within the Achilles tendon with or without posterior acoustic shadowing [25].

Statistical analysis

The study data were analyzed using the IBM SPSS Statistics for Windows version 23.0 (IBM Corp., Armonk, N.Y., USA). Descriptive and inferential analyses were applied as appropriate. One-way analysis of variance (ANOVA) was used to compare the mean values of continuous quantitative variables. Association was determined by using Chi-square analysis for the requisite data.

A receiver operating characteristic (ROC) curve was plotted to determine the HbA1c tear cut-off points and evaluate its diagnostic accuracy in predicting the likelihood of Achilles tendon tears in Type-2 Diabetics. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of HbA1c were determined. P-value <0.05 was considered statistically significant.

RESULTS

The study population comprised of 27 individuals with Type-2 diabetes mellitus complicated with peripheral neuropathy, 44 individuals with Type-2 diabetes mellitus without peripheral neuropathy and 80 non-diabetic controls. In the control, DM-PN and DM+PN groups the dominant foot was on the right in 62 subjects (77.50%), 31 subjects (70.46%) and 19 subjects (70.37%) respectively, while it was on the left in 18 subjects (22.50%), 13 subjects (29.54%) and 8 subjects (29.63%) respectively. There were significantly more males, females, married and single individuals, more individuals with primary and secondary education, and more employed and unemployed individuals in the control group (P < 0.05). There were generally more females and more married subjects in the three groups (Table 1).

The mean age of the subjects in the DM+PN, DM-PN and control groups were 47.52±11.77 years, 50.75±13.67 years and 46.04±11.22 years, respectively, but the difference was not significant (P > 0.05). The youngest (19 years) and oldest (76 years) subjects in this study were in the DM-PN group. The mean HbA1c (6.92±0.74%) in the DM+PN group was significantly the highest among the groups (P < 0.05), while the mean duration of DM (8.30±7.10 years) was significantly high in the DM-PN group (P < 0.05).

There was no significant difference between the mean BMI of the subjects among the groups (P > 0.05) (Table 2).

Table 1: Characteristics of study subjects

	CONTROL n (%)	DM-PN n (%)	DM+PN n (%)	P value
Gender				
Male	25 (60.98%)	8 (19.51%)	8 (19.51%)	0.000*
Female	55 (50%)	36 (32.73%)	19 (17.27%)	0.000*
Marital Status				
Married	56 (50%)	33 (29.46%)	23 (20.54%)	0.000*
Single	23 (67.65%)	7 (20.59%)	4 (11.76%)	0.001*
Divorced	1 (33.33%)	2 (66.67%)	0 (0%)	0.192
Widowed	0 (0%)	2 (100%)	0 (0%)	NPG
Educational Status				
Primary	9 (64.29%)	4 (28.57%)	1 (7.14%)	0.014*
Secondary	15 (48.39%)	10 (32.26%)	6 (19.35%)	0.004*
Tertiary	56 (52.83%)	30 (28.30%)	20 (18.87%)	0.228
Employment Status				
Employed	60 (58.25%)	25 (24.27%)	18 (17.48%)	0.000*
Unemployed	20 (41.67%)	19 (39.58%)	9 (18.75%)	0.004*

**P value less than 0.05 is significant; DM – PN: Diabetes mellitus without peripheral neuropathy; DM + PN: Diabetes mellitus with peripheral neuropathy; NPG: No P value generated.*

Table 2: The range, mean and difference of the descriptive characteristics of the study

	CONTROL n = 80			DM–PN n = 44			DM+PN n = 27			
	Min	**Max**	**Mean±SD**	**Min**	**Max**	**Mean±SD**	**Min**	**Max**	**Mean±SD**	**P-value**
Age (years)	25.00	73.00	46.04±11.22	19.00	76.00	50.75±13.67	25.00	64.00	47.52±11.77	0.271
BMI (kg/m²)	17.20	44.10	27.03±5.09	20.70	42.31	27.38±4.77	20.00	46.12	27.80±6.38	0.761
HbA1c (%)	4.20	6.30	5.14±0.51	5.60	8.60	6.52±0.73	5.80	8.60	6.92±0.74	0.000*
Duration of DM (years)	NA	NA	NA	1.00	33.00	8.30±7.10	1.00	30.00	7.48±6.12	0.000*

**P value less than 0.05 is significant; BMI: Body mass index; DM – PN: Diabetes mellitus without peripheral neuropathy; DM + PN: Diabetes mellitus with peripheral neuropathy; HBA1c: Glycated Haemoglobin; NA: Not applicable.*

Among the subjects with Type-2 diabetes, HbA1c, AT calcification and PN were all significantly associated with dominant foot AT tear (P < 0.05). PN and AT calcification both had significant association with non-dominant foot AT tear (P < 0.05).

Table 3: The association of Achilles tendon tear in the dominant and non-dominant ankles with other variables

	Dominant Foot AT Tear	**Non-dominant Foot AT Tear**
	P-value	P-value
Age (years)	0.646	0.495
BMI (kg/m²)	0.520	0.309
HbA1c	0.005*	0.059
Duration of DM (years)	0.639	0.462
AT Calcification	0.001*	0.001*
PN	0.007*	0.034*

**P value less than 0.05 is significant; AT: Achilles tendon thickness; BMI: Body mass index; DM–PN: Diabetes mellitus without peripheral neuropathy; DM+PN: Diabetes mellitus with peripheral neuropathy; HbA1c: Glycated Haemoglobin; PN: Peripheral neuropathy.*

The age of the subjects, their BMI and duration of DM had no significant association with dominant foot AT tear and non-dominant foot AT tear (P > 0.05) (Table 3).

There were significantly more tears and calcifications in the dominant foot AT of DM+PN subjects (P < 0.001). The prevalence of AT tears and AT calcification among Type-2 diabetics were 7.75 % and 6.34 %, respectively. In the DM+PN subjects 10 AT tears and 7 AT calcifications were observed with a prevalence of 37.04% and 25.93%, respectively, whereas in the DM-PN subjects 1 AT tear and 2 AT calcification were observed with a prevalence of 2.27% and 4.55%, respectively. No tear or calcification were seen in the dominant foot AT and non-dominant foot AT of the control subjects (Table 4).

Full thickness AT tear and partial thickness AT tears are shown in Figure 1a, b and c. Employing HbA1c as the gold standard, a ROC curve was plotted to determine the optimum cut-off points for predicting the likelihood of tears in the Achilles tendon (Figure 2). The sensitivity, specificity and accuracy of HbA1c for the diagnosis of AT tear

Table 4: Frequency distribution of AT tears and AT calcifications in the dominant and non-dominant feet of the control, DM-PN and DM+PN subjects

	CONTROL		DM-PN		DM+PN	
	Dominant Foot	Non-dominant Foot	Dominant Foot	Non-dominant Foot	Dominant Foot	Non-dominant Foot
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
AT Tear	0 (0%)	0 (0%)	1 (9.10%)	0 (0%)	8 (72.72%)	2 (18.18%)
AT Calcification	0 (0%)	0 (0%)	1 (11.11%)	1 (11.11%)	6 (66.67%)	1 (11.11%)

AT: Achilles tendon thickness

Figure 1: B-mode longitudinal sonogram of the Achilles tendon using a linear transducer.
It shows hypoechoic areas that extend from the posterior fibers through the intrasubstance fibers to the anterior fibers with retraction (two arrows) but separated by a thin strand of fiber in keeping with full thickness Achilles tendon tear (a). Hypoechoic areas are shown along the anterior fibers of the Achilles tendon (arrow) in keeping with partial thickness Achilles tendon tear (b). Hypoechoic region with a loss of continuity of the fibers at the Achilles tendon's insertion site (arrow) is shown in keeping with partial thickness Achilles tendon tear (c).

Table 5: Characteristics of HbA1C for predicting Achilles tendon tear in Type-2 diabetes patients

	HbA1c (%)
Area under curve	0.789
SE	0.06
P value	0.006*
95% Confidence Interval	0.665 – 0.913
Cut-off point (%)	≥ 6.95
Sensitivity (%)	75.00
Specificity (%)	74.60
Accuracy (%)	75.35
PPV (%)	15.00
NPV (%)	98.10

**P value less than 0.05 is significant; HBA1c: Glycated Haemoglobin; NPV: Negative predictive value; PPV: Positive predictive value; SE: Standard error.*

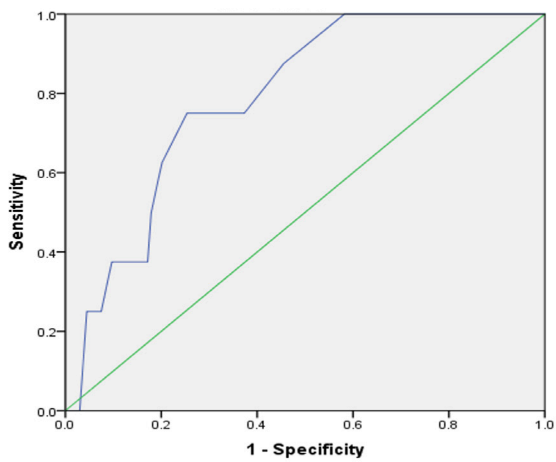

Figure 2: Receiver operating characteristics (ROC) curve to determine the sensitivity and specificity of HbA1c for the diagnosis of Achilles tendon tear in Type-2 diabetes patients.

was optimal at ≥ 6.95% (95% CI: 0.665 – 0.913), however, the positive predictive value (PPV) was shown to be low at this cut-off (15%) (Table 5).

DISCUSSION

Diabetes mellitus is commonly complicated with musculoskeletal disorders and one of these is Achilles tendon tear [3]. The biomechanical changes that occur in the soft tissues and tendons in diabetes favour the manifestation of tendon tears [15]. It is often misdiagnosed at initial presentation [5].

In the present study the occurrence of AT tears was significantly preponderant in diabetics with PN but low in diabetics without PN. Non-enzymatic glycosylation of collagen with advanced glycation end products (AGEs) induces intermolecular collagen cross-linking in the tendons of diabetics thus altering their physical and chemical properties. AGEs reduce the remodeling capacity of tendons when subjected to continuous stress [13, 26]. Vasculopathy further deprives the deformed inelastic tendon of adequate perfusion and when complicated with diabetic peripheral neuropathy the entire degeneration process becomes magnified resulting in the susceptibility to develop tears [13, 27–29].

In alliance with the findings of this study, Petrovic et al. [30], in the United Kingdom, demonstrated that AT fibers become significantly stiffer, more hysteretic and lose their elastic propensity as diabetic PN sets in. Same sequence of events was observed in the tendons of a canine model [28]. In a retrospective Taiwan-based study conducted by Kang et al. [31], that involved 80 diabetics and 339 non-diabetic controls, it was similarly noticed that tendon calcification and tears were more common in DM complicated with peripheral neuropathy.

Based on sonographic diagnosis, the prevalence of Achilles tendon tears in Type-2 DM was observed to be 7.75% in this study. However, there is a paucity of literatures that have investigated the prevalence of AT tears in diabetic patients. In a UK based study conducted by Chan et al. [14], it was reported that the prevalence of AT tears in the general population was 16.22%. Most of their participants were regularly involved in sporting activities either at a recreational level or professional level. They were also of the disposition that most AT tears were essentially extensions from areas of weakened degenerated fibers.

AT tears are seldom reported by diabetics due to the fact that most cases are asymptomatic and most clinicians, following physical examination, are rather inclined to diagnose cellulitis instead [32]. However, with time symptomatic pains appear at the site of AT tears with subsequent limitation of function [27, 33, 34]. Approximately 51% of diabetic patients complicated with peripheral neuropathy who had asymptomatic tendon tears suddenly develop pains and impaired ability to perform requisite daily activities about 2.8 years after the tear [35].

This study found that HbA1c was significantly associated with AT tears in Type-2 diabetics. HbA1c evaluation mirrors the level of circulating glucose in the blood stream within the past three months [36], and its elevation, even in the pre-diabetic phase, increases the odds of developing AT tear by three-folds, when compared to normal individuals [37, 38]. In tandem with our results, Kim et al. [39] noticed in a retrospectively conducted study in the Republic of Korea, that the group of subjects whose HbA1c level were kept within normal range significantly had lesser tendon re-tears within 3 to 6 months after surgical repairs of a previous tear (14.30% vs 51.10%, P < 0.001). Spoendlin et al. [4] in the United Kingdom, rather observed that poor glycemic control of hyperglycemia, with HbA1c in excess of 9%, significantly increased the odds of developing tendon tears in females (OR 2.03, 95% CI; 1.20 – 3.41) but not in males.

This study demonstrated that HbA1c had optimal diagnostic value to predict the likelihood of AT tears in Type-2 diabetics complicated with PN. Buttressing the findings of this study, Nichols et al. [9] in the United States of America inferred that elevated serum HbA1c has a major role in reflecting the extent of degenerative transformation in the AT of humans, and this precedes the appearance of tears. They further noted that HbA1c level above 7% is regarded as the exact point when degeneration and peripheral neuropathy commence in the AT [9, 40, 41]. In same vein, Yeom et al. [36] conducted a study in Seoul, Korea, whose subjects consisted of 35 Type-2 diabetics and 148 non-diabetics that underwent arthroscopic tendon tear repairs, and discovered that HbA1c level assessed 6 months after surgery had a sensitivity of 75.00%, specificity of 77.80% and accuracy of 77.10% to predict tendon re-tears. In China, an ensembled clinical machine learning-deep learning (CML-DL) model developed by Alike et al. [42] that enrolled 974 patients who were divided into three cohort groups, was demonstrated to have a high sensitivity (88.00%), specificity (81.20%), accuracy (83.60%), and area under curve (0.902), respectively to diagnose significant tendon tears. This model which was formulated to combine clinical and radiological findings was proven to have an excellent diagnostic performance [42].

Since HbA1c evaluation can also be useful to predict the development of Achilles tendon tear in Type-2 diabetics, in the absence of trauma [36], it is pertinent to ensure that its assessment and the evaluation for the development of peripheral neuropathy in diabetics be conducted three-monthly along with the sonographic assessment of AT. However, HbA1c may not be affordable for use by a large proportion of diabetic patients in economically developing countries. This makes it challenging to stick to it as a monitoring and predictive tool. Another downside is that HbA1c values can be altered by hemolytic conditions that result in anemic states [36, 41].

It was observed in this study that there were significantly more AT tears and AT calcifications on the dominant foot in individuals affected with Type-2 diabetes that is complicated with peripheral neuropathy. In an Egypt-based study, Eid [3] noticed the development of AT tears on the left foot in 8 participants out of 13 Type-2 diabetics while Afolabi et al. [34] in Nigeria, observed more AT calcifications on the left foot as well in both the Type-2 diabetics and control. They further opined that among the diabetic subjects, those with

peripheral neuropathy had more AT calcification and more AT fibre disorganization.
In an animal model, AGEs in diabetics were lucidly demonstrated to accelerate the aging of AT cells and enhance the development of ectopic calcification of AT fiber [6,27,33,34]. Minagawa et al. [43] in Japan, similarly observed a higher prevalence of tendon tears on the dominant side. The increased incidence of AT tears on the dominant foot in this study might be due to the strain which results from persistent application of mechanical forces on the tendon fibers brought about by the increased activities the dominant foot is subjected to, and the dominant foot of most diabetics in this study was the right foot [38, 44, 45].
This study was conducted at a health care center with constrained resources which lacked the availability of nerve conducting study apparatus to determine the presence of peripheral neuropathy in diabetics, which was a limitation. However, the utilization of Semmes Weinstein monofilament for the same purpose has been shown to have comparable efficacy and should consequently be regarded as a viable instrument to screen for Diabetic peripheral neuropathy [46]. Since diabetes promotes abnormal changes in the viscosity and elasticity of AT [7, 8] the use of elastography is appropriate for its evaluation, before and after tears. The acquisition of AT images with higher resolution requires the utilization of a linear probe that has a frequency greater than 12 MHz [24] which was not the case in this study. Further targeted studies with diverse population and a higher sample size are advocated for to confirm our findings.

CONCLUSION

The prevalence of AT tear in Type-2 diabetics, based on sonographic diagnosis, is low. The likelihood of AT tears increases in the dominant foot when HbA1c level equals or exceeds 6.95% in diabetics with peripheral neuropathy. This preliminary study showcases the need to incorporate Achilles tendon sonographic evaluation to rule out tears in the management of diabetics.

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