# Prevalence of thyroid disorders among the diabetic population in Arar, Saudi Arabia

*Haider O. Elmisbah,* MRCS, MD, *Riyad Y. Laham,* MD, *Hafiz O. Almisbah,* MD, *Hadeel T. Alanazi,* Medical student, *Taif A. Alanazi,* Medical student, *Raghad M. Alanzi,* Medical student, *Wejdan A. Aldahmashi,* Medical student, *Anshoo Agarwal,* MD, *Rashad Q. Othman,* MD, PhD.

## ABSTRACT

**الأهداف**: دراسة مدى انتشار اضطرابات الغدة الدرقية (TDs) بين السكان المصابين بالسكري في عرعر، المملكة العربية السعودية.

**المنهجية**: أجريت دراسة تصميم مقطعية في عرعر، المنطقة الشمالية من المملكة العربية السعودية، خلال الفترة من أكتوبر 2023 إلى يناير 2024. قمنا باستخدام استبيان منظم لجمع البيانات. من السكان المصابين بالسكري الذين تزيد أعمارهم عن 18 عامًا.

**النتائج**: اشتملت الدراسة على 501 مشاركاً. معظمهم يقع ضمن الفئة العمرية 20-35، ويشكلون 36.5% من العينة. يبدو أن نقص فيتامين د هو الحالة المرضية الأكثر شيوعًا. يليه عن كثب نقص فيتامين B12؛ يُظهر ارتفاع ضغط الدم وارتفاع نسبة الدهون في الدم أيضًا معدلات انتشار ملحوظة، حيث يؤثر على 10.5-22.1% من السكان. وفيما يتعلق بمرض السكري، أجري تشخيص إصابة 42.8% من السكان بهذه الحالة. ومن بين مرضى السكري، أجري تشخيص الغالبية (67.6%) بالنوع الثاني، في حين أن 32.4% مصابون بالنوع الأول. هناك علاقة بين مرض السكري و TDs، حيث أبلغ 51.3% من المشاركين عن ذلك.

**الخلاصة**: تشير النتائج إلى أن البالغين في عرعر، المملكة العربية السعودية، يفتقرون إلى بعض المعرفة حول أمراض الغدة الدرقية وعلاقتها بمرض السكري.

**Objectives:** To study the prevalence of thyroid disorders (TDs) among the diabetic population in Arar, Saudi Arabia.

**Methods:** A cross-sectional design study carried out in Arar, northern province of Saudi Arabia, from October 2023 to January 2024. A structured questionnaire was used to collect the data. From the diabetic population aged over 18 years old.

**Results:** A total of 501 participants were enrolled. Most fall within the 20-35 age range, comprising 36.5% of the sample. Vitamin D deficiency appears to be the most prevalent comorbid condition. Following closely behind is vitamin B12 deficiency; hypertension and high blood lipids also show notable prevalence rates, affecting 10.5-22.1% of the population. In terms of diabetes, 42.8% of the population has been diagnosed with the condition. Among those with diabetes, the majority (67.6%) have been diagnosed with the second type, while 32.4% have the first type. There is an association between diabetes and TDs, with 51.3% of participants reporting this.

**Conclusion:** The findings indicate that the adults in Arar, Saudi Arabia, lack some knowledge of TDs and their relationship to diabetes.

**Keywords:** goitre, hyperthyroidism, hypothyroidism, diabetes mellitus, hyperglycaemia

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*From the Department of General Surgery(Elmisbah, Laham); from the Department of Internal Medicine(Almisbah); from the Department of Pathology (Agarwal, Othman), Faculty of Medicine; and from the College of Medicine (T. Alanazi, A. Alanazi, Alanzi, Aldahmashi), Northern Border University, Arar, Kingdom of Saudi Arabia.*

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*Address correspondence and reprint request to: Dr. Haider O. Elmisbah, General Surgery Department, Faculty of Medicine, Northern Border University, Arar, Kingdom of Saudi Arabia. E-mail: hayder.uthman@nbu.edu.sa*
*ORCID ID: https://orcid.org/0000-0002-2232-2540*

Thyroid disorders (TDs) and diabetes mellitus (DM) were the most observed endocrine diseases in the practice. In recent decades, there has been a significant rise in the occurrence of TDs globally, with a specific emphasis on the variables that contribute to their development.[1] Undiagnosed or untreated TDs can lead to severe consequences and have a significant impact on various aspects of health, such as cardiovascular and metabolic disorders, mental health, and bone health.[2,3] Primary TDs commonly stem from causes like autoimmune destruction, radiation-induced thyroiditis, postsurgical hypothyroidism, and anti-thyroid drugs.[4,5] Symptoms and signs of hypothyroidism include fatigue, depression, cold intolerance, hoarseness, dry skin, constipation, bradycardia, and hyporeflexia.[6,7]

It is crucial to establish awareness and educational campaigns to enhance understanding of these disorders, facilitating the prompt detection of undiagnosed cases to prevent further complications. Diabetes mellitus is a prevalent disease that can affect individuals of any age.[8] TDs, particularly autoimmune TDs, are the most common endocrine illness in diabetics.[9] Both TDs and DM are prevalent across various populations and age groups and there exists an interplay between the 2 conditions, potentially influencing each other.[10,11]

Numerous studies have been carried out to determine the prevalence of TDs among diabetic patients. Recent research has identified an association between autoimmune hypothyroidism and DM.[12] For instance, a study involving 233 Brazilian children and adolescents with DM revealed that 23% of them had TDs, predominantly females.[13] In Saudi Arabia, several studies have been undertaken to assess the prevalence of TDs among individuals with type 2 DM.[14,15] A study carried out on 200 individuals (100 with type 1 and 100 with type 2 DM) at the Diabetes Centre in Saudi Arabia indicated that 31% of participants had TDs.[16]

Recent studies have highlighted a significantly increased risk of thyroid cancer in patients with DM.[17] Research has specifically indicated a significantly elevated incidence of thyroid cancer among Chinese women diagnosed with type 2 DM.[18] As the studies carried out in Saudi Arabia on the prevalence of TDs among patients with DM are scarce, this study aimed to study the prevalence of TDs among the diabetic population in Arar, Saudi Arabia. We also aimed to analyse other disease conditions associated with TDs and to create awareness regarding screening for TDs in the diabetic population.

**Methods.** This study adopted a cross-sectional research design to investigate the prevalence of TDs among the diabetic population residing in Arar, Northern Saudi Arabia. The use of a cross-sectional approach enabled the collection of data at a specific point in time, providing a snapshot of prevalence and awareness levels.

The sampling strategy for this study employed a purposive sampling technique. Factors such as age, gender, education, and employment status were considered to ensure a diverse and representative sample of the diabetic adult population in Arar.

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We will estimate a sample size using the Raosoft® calculator, with a 5% level of significance, a 5% margin of error, 95% confidence, and an expected response distribution of 50%. So, the calculated sample is 384 participants, and by adding 10% to compensate for the missing and incomplete questionnaires, we need a minimum sample of 403 participants.

Inclusion criteria encompass individuals aged 18 years and older who are residents of Arar during the data collection period.

We exclude those who have cognitive problems or are unable to respond to the questionnaire and those who refuse to participate in the study. We also excluded diabetic people who had undergone bariatric surgery, diabetic people who had undergone thyroid surgery.

The data collection instrument for this study was a previously validated online questionnaire, as employed in studies by Karla et al[19] and Misfer et al.[20] This questionnaire, crafted in Arabic, encompasses 3 primary sections: socio-demographic data, questions regarding TDs, and their knowledge and awareness on them.

The data collection process was facilitated through the publication of the questionnaire on Google Documents, offering a user-friendly and accessible platform for participants. Electronic distribution of the questionnaire was carried out via popular social media applications to ensure a wide reach within the diabetic adult population of Arar. This approach aligns with contemporary trends in survey administration and enhances the efficiency of data collection.

***Statistical analysis.*** Quantitative data obtained from the questionnaire underwent the Statistical Package for the Social Sciences statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were employed to summarise socio-demographic characteristics and the prevalence of TDs. Inferential statistics, such as Chi-square tests or logistic regression, may be utilised to explore potential associations between socio-demographic variables and awareness levels.

**Results.** As shown in Table 1, the majority fall within the 20-35 age range, comprising 36.5% of the sample. The next largest age group is 35-40, accounting for 14.1% of the respondents. Notably, individuals aged 60 and above represent 8.8% of the total sample. In terms of nationality, the overwhelming majority of participants (97.8%) identify as Saudi, while a smaller proportion (2.2%) are non-Saudi. Moreover, 6.1% of respondents did not specify their nationality. The educational level of the participants varies, with the most prevalent category being individuals holding a bachelor's degree, constituting 55% of the sample.

This is followed by those with a secondary education level at 18.7%, and uneducated individuals at 9.2%. The data also indicates a diverse range of occupations among the participants, with employees representing the largest group at 40.6%, followed by those not currently working at 32.4%. Moving on to marital status, the majority of participants (62.8%) are married, while 29.2% are single. Divorced individuals represent 4.1% of the sample and widowed individuals represent 3.9%. The duration of TD among participants varies, with 66.4% reporting that they do not have a thyroid disease. Of those who do, 13.6% have been affected for less than a year, while 10.2% have had the condition for 1-5 years, and 9.7% for more than 5 years. Regarding weight-related parameters, 45.7% of participants are categorised as overweight or obese, while 54.3% are not. The distribution of body mass index (BMI) reveals that 33.8% of participants have a normal BMI, while 32.8% are classified as obese, and 31.6% as overweight. Additionally, 1.7% are underweight. Finally, the data provides insight into participants' waist circumference, with 26.8% falling within the 70-100 cm range, 29.0% within 100-140 cm, and 27.3% within 140-180 cm. Notably, 15.3% of participants indicated that they did not know their waist circumference.

**Table 1 -** Sociodemographic characteristics of the participants (N=411).

| Parameters | n (%) |
|---|---|
| *Age* | |
| 18-20 | 26 (6.3) |
| 20-35 | 150 (36.5) |
| 35-40 | 58 (14.1) |
| 40-45 | 83 (20.2) |
| 50-55 | 58 (14.1) |
| 60> | 36 (8.8) |
| *Nationality* | |
| Saudi | 402 (97.8) |
| Non-Saudi | 9 (2.2) |
| No | 25 (6.1) |
| *Education level* | |
| Uneducated | 38 (9.2) |
| Basic | 5 (1.2) |
| Primary | 17 (4.1) |
| Middle | 24 (5.8) |
| Secondary | 77 (18.7) |
| Bachelor's degree | 226 (55.0) |
| Above university | 16 (3.9) |
| Others | 8 (1.9) |
| *Occupation* | |
| Businessman | 19 (4.6) |
| Factor | 17 (4.1) |
| Military | 2 (0.5) |
| Employee | 167 (40.6) |
| Student | 25 (6.1) |
| retired | 6 (1.5) |
| Housewife | 22 (5.4) |
| not working | 133 (32.4) |
| Other | 20 (4.9) |
| *Marital status* | |
| Married | 258 (62.8) |
| Single | 120 (29.2) |
| Divorced | 17 (4.1) |
| Widowed | 16 (3.9) |
| *Duration of thyroid disorder* | |
| Less than one year | 56 (13.6) |
| 1-5 years | 42 (10.2) |
| more than 5 years | 40 (9.7) |
| Do not have thyroid disease | 273 (66.4) |
| *Overweight or obese* | |
| Yes | 188 (45.7) |
| No | 223 (54.3) |
| *BMI* | |
| Underweight | 7 (1.7) |
| Normal | 139 (33.8) |
| Obese | 135 (32.8) |
| Overweight | 130 (31.6) |
| *Waist circumference (cm)* | |
| less than 70 | 7 (1.7) |
| 70-100 | 110 (26.8) |
| 100-140 | 119 (29.0) |
| 140-180 | 112 (27.3) |
| Do not know | 63 (15.3) |

Values are presented as numbers and percentages (%). BMI: body mass index

As illustrated in Table 2, vitamin D deficiency appears to be the most prevalent comorbid condition, affecting 174 individuals, which accounts for 42.3% of the population under study. Following closely behind is vitamin B12 deficiency, impacting 108 individuals (26.3%). Hypertension (22.1%), high blood lipids (10.5%), and iron deficiency anaemia (14.6%) also show notable prevalence rates. It is noteworthy that 5.6% of the population did not exhibit any of the listed comorbid diseases. In terms of DM, 42.8% of the population has been diagnosed with the condition, while the remaining 57.2% do not have DM. Among those with DM, the majority (67.6%) have been diagnosed with the second type, while 32.4% have the first type.

In Table 3, 54.5% of respondents acknowledged the influence of hypothyroidism on cholesterol levels.

**Table 2 -** Comorbid diseases among the study participants (N=411).

| Parameters | n (%) |
|---|---|
| *Comorbid diseases (bias risk)* | |
| Vitamin D deficiency | 174 (42.3) |
| Vitamin B12 deficiency | 108 (26.3) |
| Hypertension | 91 (22.1) |
| High blood lipids | 43 (10.5) |
| Iron deficiency anemia | 60 (14.6) |
| Diabetes | 5 (1.2) |
| Nothing | 23 (5.6) |
| *Have diabetes* | |
| Yes | 176 (42.8) |
| No | 235 (57.2) |
| *Type of diabetes (n= 176)* | |
| The first type | 57 (32.4) |
| The second type | 119 (67.6) |

Values are presented as numbers and percentages (%).

Furthermore, the survey indicates that 50.9% of participants recognise the connection between a weak thyroid gland and heart disease. The relationship between DM and TDs is also a point of interest, with 51.3% of respondents acknowledging this association. In addition, the hereditary aspect of hypothyroidism is recognized by 43.6% of respondents, shedding light on the genetic predisposition to TDs. Moreover, the data draws attention to the potential consequences of untreated TDs on maternal and foetal health, with 65.2% of respondents acknowledging this serious outcome. The link between TDs and iodine deficiency is recognized by 55.2% of respondents, emphasizing the significance of adequate iodine intake for thyroid health. Furthermore, the survey indicates that certain medications and surgical procedures can contribute to the development of TDs, with 51.3% of respondents acknowledging this association. Moving on to the relationship between DM and TDs, the data reflects a recognition of the biochemical, genetic, and hormonal malfunctions contributing to this association by 47.4% of respondents. Additionally, the survey highlights the similarity in signs and symptoms between diabetes and TDs, with 61.1% of respondents acknowledging this overlap. Moreover, the survey indicates that the combination of diabetes and TDs can mask early diabetes complications, a point recognised by 47.4% of respondents. The potential impact of diabetes treatment on worsening TDs is acknowledged by 36.0% of respondents. Finally, the survey draws attention to the

**Table 3 -** Participants' knowledge regarding thyroid disorders in diabetes mellitus patients (N=411).

| Manifestations of thyroid disorders | Yes | No | Neutral |
|---|---|---|---|
| Hypothyroidism affects the level of cholesterol in the blood | 224 (54.5) | 79 (19.2) | 108 (26.3) |
| A weak thyroid gland leads to heart disease | 209 (50.9) | 90 (21.9) | 112 (27.3) |
| Is there a relationship between diabetes and thyroid disorders? | 211 (51.3) | 96 (23.4) | 104 (25.3) |
| Is hypothyroidism hereditary? | 179 (43.6) | 143 (34.8) | 89 (21.7) |
| Fatigue and drowsiness are symptoms of thyroid disorders | 305 (74.2) | 47 (11.4) | 59 (14.4) |
| Sudden weight gain is a symptom of thyroid disorders | 308 (74.9) | 47 (11.4) | 56 (13.6) |
| Dry skin and hair are symptoms of thyroid disorders | 267 (65.0) | 64 (15.6) | 80 (19.5) |
| Did you know that thyroid disorders are associated with serious outcomes for the mother and fetus, when left untreated? | 268 (65.2) | 78 (19.0) | 65 (15.8) |
| Did you know that thyroid disorder is linked to iodine deficiency? | 227 (55.2) | 97 (23.6) | 87 (21.2) |
| Did you know that thyroid disorders can occur when taking certain medications or after undergoing surgery? | 211 (51.3) | 110 (26.8) | 90 (21.9) |
| The association between diabetes mellitus and thyroid disorders results from several biochemical, genetic, and hormonal malfunctions. | 195 (47.4) | 82 (20.0) | 134 (32.6) |
| Diabetes and thyroid disorders have similar signs and symptoms, such as edema, fatigue, paleness, and weight gain. | 251 (61.1) | 69 (16.8) | 91 (22.1) |
| The combination of diabetes and thyroid disorders can mask early diabetes complications | 195 (47.4) | 85 (20.7) | 131 (31.9) |
| Diabetes treatment can worsen thyroid disorder | 148 (36.0) | 115 (28.0) | 148 (36.0) |
| Antithyroid medications can worsen blood sugar control | 174 (42.3) | 84 (20.4) | 153 (37.2) |
| Diabetes affects thyroid function by altering the level of thyroid hormone and impairing the conversion of thyroid hormone to triiodothyronine in peripheral tissues. | 190 (46.2) | 63 (15.3) | 158 (38.4) |
| The effectiveness of thyroid hormone therapy may be affected in hypothyroid patients with coexisting diabetes | 175 (42.6) | 77 (18.7) | 159 (38.7) |
| There may be an increased incidence of differentiated thyroid cancer among women with diabetes | 171 (41.6) | 84 (20.4) | 156 (38.0) |
| Medications taken for diabetes, thyroid disorder, and other comorbidities can alter thyroid function or blood sugar control in people who live with diabetes and thyroid disorder. | 184 (44.8) | 70 (17.0) | 157 (38.2) |
| An unrecognized thyroid disorder can worsen blood sugar control and increase cardiovascular risks in diabetes. | 188 (45.7) | 72 (17.5) | 151 (36.7) |
| The effect of thyroid hormone in the digestive tract is to increase glucose absorption | 181 (44.0) | 77 (18.7) | 153 (37.2) |
| The effect of thyroid hormone on the liver: increased gluconeogenesis in the liver | 176 (42.8) | 75 (18.2) | 160 (38.9) |
| The effect of thyroid hormone on adipose tissue is to increase lipolysis, increase fatty acids in plasma. | 179 (43.6) | 71 (17.3) | 161 (39.2) |
| The effect of thyroid hormone on muscles is to increase glucose uptake | 181 (44.0) | 70 (17.0) | 160 (38.9) |
| The effect of thyroid hormone on pancreatic beta cells is to increase insulin secretion | 187 (45.5) | 71 (17.3) | 153 (37.2) |

Values are presented as numbers and percentages (%).

potential impact of anti-thyroid medications on blood sugar control, with 42.3% of respondents recognising this association.

In Table 4, for individuals with a waist circumference less than 70 cm, the distribution of thyroid presence across different durations is as follows: less than one year (0%), 1-5 years (0.5%), more than 5 years (0%), and no thyroid presence (1.2%). Moving to the 70-100 cm waist circumference category, the distribution of thyroid presence is as follows: less than one year (4.1%), 1-5 years (2.2%), more than 5 years (1.9%), and no thyroid presence (18.5%). Similar distributions are observed for the 100-140 cm and 140-180 cm waist circumference categories, with varying percentages of thyroid presence across different duration groups. The proportions of individuals with and without DM are presented across the various durations of thyroid presence.

In terms of statistical analysis, the *p*-values are included to indicate the significance of the observed associations. It is worth noting that the *p*-values for waist circumference in relation to thyroid presence duration is 0.670 and the presence of DM in relation to thyroid presence duration is 0.205. These values are crucial for determining the statistical significance of the observed relationships and can provide valuable insights into the potential associations between these variables.

**Discussion.** Thyroid disorders are becoming more common in Saudi Arabia, especially among women.[21] The prevalence of TDs in the country has been the focus of various investigations. A study carried out by Alqahtani et al[22] revealed a prevalence rate of 49.8%, with subclinical hypothyroidism accounting for 39.3% of the cases. The prevalence of primary hypothyroidism was 5.3%, subclinical hyperthyroidism was 2.7%, and primary hyperthyroidism was 2.5%. A study carried out with 411 individuals from various age groups found that the prevalence of thyroid diseases was reported to be 44.6%. The duration of sickness varied, ranging from months to years. The study found that 13.6% of the participants had experienced the effects for less than a year, 10.2% for a duration of 1-5 years, and 9.7% for more than 5 years. The results of this study closely correspond to research carried out by Rana et al,[23] which emphasised the significant occurrence of thyroid problems in adult Saudi women. The most prevalent type of TD found was subclinical hypothyroidism. Palma et al[24] carried out a study that found that subclinical hypothyroidism was the most prevalent condition among diabetic patients. It accounted for 11.8% of instances of TDs and had a prevalence rate of 14.7%. Within our research, 42.8% of the individuals involved exhibited DM, with the majority of cases being attributed to type 2 diabetes (67.6%), while the remaining cases were classified as type 1 diabetes (32.4%). The study also investigated the duration of thyroid problems and DM, and the results revealed a statistically insignificant connection. Previous studies have emphasised the significance of maintaining a heightened level of suspicion for TDs in individuals with diabetes in order to promote early identification and effective treatment.[25] Furthermore, case-control studies have demonstrated a significantly higher prevalence of TDs in individuals with type 2 diabetes mellitus (T2DM) compared to those without the condition. The prevailing TDs were subclinical hypothyroidism, followed by overt hypothyroidism and hyperthyroidism.[26] Previous studies have identified variations in the prevalence rates of TDs among patients with T2DM.[27-29] The results of our research are consistent with previous studies that have found a high occurrence of TDs in patients with T2DM, such as the study carried out by Zhu et al.[30] However, our findings differ with those of Khassawneh et al,[31] who showed

**Table 4 -** Association between the presence and duration of thyroid disease and the presence of diabetes mellitus and waist circumference (N=411).

| Variables | Thyroid presence and duration | | | | Total (N=411) | *P*-values |
|---|---|---|---|---|---|---|
| | Less than one year | From 1-5 years | More than 5 years | No | | |
| *Waist circumference (cm)* | | | | | | |
| less than 70 | 0 (0.0) | 2 (0.5) | 0 (0.0) | 5 (1.2) | 7 (1.7) | |
| 70-100 | 17 (4.1) | 9 (2.2) | 8 (1.9) | 76 (18.5) | 110 (26.8) | |
| 100-140 | 14 (3.4) | 12 (2.9) | 12 (2.9) | 81 (19.7) | 119 (29.0) | 0.670 |
| 140-180 | 17 (4.1) | 15 (3.6) | 12 (2.9) | 68 (16.5) | 112 (27.3) | |
| I do not know | 8 (1.9) | 4 (1.0) | 8 (1.9) | 43 (10.5) | 63 (15.3) | |
| *Have DM?* | | | | | | |
| Yes | 29 (7.1) | 22 (5.4) | 15 (3.6) | 110 (26.8) | 176 (42.8) | 0.205 |
| No | 27 (6.6) | 20 (4.9) | 25 (6.1) | 163 (39.7) | 235 (57.2) | |

Values are presented as numbers and percentages (%). T-test used to calculate the *p*-values.

lower rates of prevalence. The high incidence of TDs in our study highlights the significance of carrying out screenings for thyroid abnormalities in this particular group. Furthermore, the participants' level of awareness regarding TDs in DM was determined to be below the desired level, as more than 50% of participants provided wrong responses to questions testing their awareness. Nevertheless, there was a pretty high level of awareness regarding the typical symptoms of TDs, as almost 75% of individuals correctly recognised weight disturbance, weariness, drowsiness, and dry hair or skin as indicative of TDs. Prior research has emphasised different degrees of knowledge regarding the symptoms of TDs, underscoring the importance of educating the public and raising awareness regarding the early signs of the disease, as well as its risk factors and connection to other chronic ailments, namely, DM.[31-33]

***Study limitations.*** The study was carried out in a specific city in Saudi Arabia (Arar), which may limit the generalizability of the findings to other regions or populations with different demographic characteristics or healthcare systems. The study relied on a sample size of 420 participants, which may not be representative of the entire diabetic population in Arar. There could be potential selection bias if certain groups of diabetic individuals were more likely to participate in the study than others. Data collection was based on self-reported information from participants through a structured questionnaire. This method may introduce recall bias or inaccuracies in reporting, particularly when it comes to medical history, or symptoms related to TDs.

In conclusion, although there was no significant association between TDs and diabetes, a considerable prevalence of TDs was reported in patients with diabetes, especially those with T2DM. Thus, it was determined that regular screening for TDs should be carried out in diabetes patients. This intervention will enhance their overall well-being and reduce their incidence of illness and disease. Research indicates that people in Arar have a limited understanding of the correlation between TDs and diabetes.

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