Significance of anthropometric parameters in the prevalence of type 2 diabetes- a case study of selected hospitals in western Uganda

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Abstract

Background: Diabetes is a group of metabolic disorders characterized and identified by the presence of hyperglycaemia in the absence of treatment. Despite the increasing awareness of T2DM in the world and strict association of its increasing prevalence with overweight and obesity relating to skinfold and body circumferences, incidence of T2DM and its various devastating complications continues to be on the increase because of lack of self-explored techniques for its early prediction. The purpose of this study was to determine variation in the anthropometric parameters using the mean value of the body circumferences, skinfolds, epicondylar breadth of the femur and epicondylar breadth of the humerus amongst T2DM patients at two selected tertiary hospitals and non-diabetic persons in Western Uganda.
***Methods*:** The study was composed of 202 adults. 101 Type 2 diabetic adult (T2DM) and 101 non-diabetic adults. Body (chest, neck, waist, hip, upper arm, thigh and calf) circumferences, skinfolds (abdominal, supraspinale, midaxillary, pectoralis, subscapularis, mid-thigh, medial calf and triceps) and bony epicondylar breadth was measured following the standard procedure for The International Society for the Advancement of Kinanthropometry (ISAK).
Results: Significantly higher (<0.001) mean (triceps (21.581-12.331mm), subscapularis (21.547-12.093), supraspinale (20.573-8.240mm), pectoralis (14.792-6.726mm), mid-axillary (17.118-8.026mm), abdominal (24.648-13.643mm), calf (23.217-13.171), mid-thigh (28.288-16.414) skinfold and upper arm (33.231-27.482cm), neck (36.045-33.045cm), calf (40.100-34.417cm), chest (99.009-85.199cm), hip (113.176-94.265cm), waist (94.738-74.607cm), thigh (60.939-50.543cm) circumference as well as humeral (65.203-62.059) and femoral (98.556-92.292) epicondylar breadth was observed amongst the T2DM participant as compared to the non-T2DM subjects.
Conclusion: Our findings indicate a strong association between T2DM and anthropometric parameters (skinfolds and body circumferences), thus, a risk factor in T2DM onset and its early prediction.

Importance des paramètres anthropométriques dans la prévalence du diabète de type 2- une étude de cas d'hôpitaux sélectionnés dans l'ouest de l'Ouganda

Résumé
Le diabète est un groupe de troubles métaboliques caractérisés et identifiés par la présence d'une hyperglycémie en l'absence de traitement. Malgré la prise de conscience croissante du DT2 dans le monde et l'association stricte de sa prévalence croissante avec le surpoids et l'obésité liés aux plis cutanés et à la circonférence du corps, l'incidence du DT2 et de ses diverses complications dévastatrices continue d'augmenter en raison du manque de techniques auto-explorées pour le traiter, sa première prédiction. Le but de cette étude était de déterminer la variation des paramètres anthropométriques en utilisant la valeur moyenne des circonférences corporelles, des plis cutanés, de la largeur épicondylienne du fémur et de la largeur épicondylienne de l'humérus chez les patients atteints de DT2 dans deux hôpitaux tertiaires sélectionnés et chez les personnes non diabétiques en occident. Ouganda.
Méthode de l'étude : L'étude était composée de 202 adultes. 101 adultes diabétiques de type 2 (DT2) et 101 adultes non diabétiques. La circonférence du corps (poitrine, cou, taille, hanche, haut du bras, cuisse et mollet), les plis cutanés (abdominaux, supraspinaux, médio-axillaires, pectoraux, sous-scapulaires, mi-cuisse, médial du mollet et triceps) et la largeur épicondylienne osseuse ont été mesurés selon la procédure standard pour la Société internationale pour l'avancement de la kinanthropométrie. (ISAK)
Résultats de l'étude : Moyenne significativement plus élevée (<0,001) (triceps (21,581-12,331 mm), sous-scapulaire (21,547-12,093), supraspinale (20,573-8,240 mm), pectoral (14,792-6,726 mm), axillaire moyen (17,118-8,026 mm), abdominal (24,648-13,643 mm), mollet (23,217-13,171), mi-cuisse (28,288-16,414), pli cutané et haut du bras (33,231-27,482 cm), cou (36,045-33,045 cm), mollet (40,100-34,417 cm), poitrine. (99,009-85,199 cm), de la hanche (113,176-94,265 cm), de la taille (94,738-74,607 cm), de la cuisse (60,939-50,543 cm) ainsi que de la largeur épicondylienne humérale (65,203-62,059) et fémorale (98,556-92,292) a été observé chez les participants DT2 par rapport aux sujets non DT2.
Conclusion : Nos résultats indiquent une forte association entre le DT2 et les paramètres anthropométriques (plis cutanés et circonférences corporelles), donc un facteur de risque dans l'apparition du DT2 et sa prédiction précoce.

INTRODUCTION

Diabetes is a group of metabolic disorders characterized and identified by the presence of hyperglycaemia in the absence of treatment (1). Type 2 Diabetes Mellitus (T2DM) is characterized by chronically elevated blood glucose (hyperglycemia) and elevated blood insulin (hyperinsulinemia) (2). (3,4) Reported that In 2019, diabetes was the direct cause of 1.5 million deaths worldwide, 48% of which occurred prematurely, before the age of 70 years. In Africa, there were 24 million people living with diabetes in 2021. This is projected to increase to 55 million by 2045, an increase of 129%, the highest increase of all regions and globally estimated to likely affect 592 million people by 2035. Diabetes affects nearly 6 percent of the global population, with over 420 million person affected with type 1 or type 2 diabetes, a figure that has quadrupled since 1980 (WHO, 2021). According to the WHO 2016, diabetes accounts for 1% of the total mortality rate in Uganda while there has been a rise in the curve of the disease accounting for approximately 5% disease from 1998 to 2014. From an estimated 98 000 patients in 2000 to roughly 1.5 million in 2010 - from a population of 30 million people (5). (6) Reported that there are 560 000 known diabetic patient by registration and additional unaware 560 000 patients, hence the need for a predictive tool for T2DM.

Type 2 Diabetes Mellitus T2DM is the most common type of diabetes that accounts for 85 – 90% of cases, continues to create enormous burden on both individual patients and health care system in Uganda. Despite the increasing awareness of T2DM in the country and strict association of its increasing prevalence with overweight and obesity, incidence of T2DM and its various devastating complications continues to be increasing. Body circumferences and skinfolds, as the main component of anthropometric Somatotype can be used to describe the sum of an individual's morphological, physiological, and psychological characteristics impacted by environmental influences (7). Anthropometric somatotype can be used to predict diabetes mellitus and related non-communicable diseases (7) and in the evaluation of body composition in adults for the diagnosis of obesity and nutritional status (7,8) Anthropometry techniques have proven valuable in the general field of science since they may be used to anticipate, diagnose, and compare various variations among people. Body type is distinguished by anthropometry somatotyping, and body type is also acknowledged as an important factor in balance.

Historically, one of the earliest diseases to be described was diabetes, according to an Egyptian document dated around 1500 BCE (9) mentioning "too great emptying of the urine”, Frequent urination was listed by an Egyptian physician named Hesy-Ra as a sign of this mysterious illness that also resulted in significant weight loss (10) The first described cases are believed to be of type 1 diabetes (10). Around the same time, Indian physicians noticed the condition and labeled it as madhumeha, or honey urine, observing that the urine would attract ants, the term "diabetes" or "to pass through" was first coined in 230 BCE by the Greek physician, Apollonius Memphites, Thomas Willis, an English physician in 1675, added the word “mellitus” (in Greek mellitus means sweet) to the word diabetes. A scientist named, Frederick M. Allen, recognized that diabetes was not just a disease that caused elevated blood sugar levels but also a problem with metabolism (11).

The ancient civilizations of Rome, Greece, and Egypt primarily used anthropometric measurements for cultural purposes (e.g., artwork) to represent beauty, power, and other desirable attributes of the human form. Symmetry was particularly desirable, and units of measurement often consisted of the “width of a human hand” or length of a human foot” (12). Anthropometry was first defined as the science of obtaining systematic measurements of the human body by Alphonse Bertillon in the 19th century which he explained as a method employed by physical anthropologists for the study of human variation and evolution among human (13). In particular, such anthropometric measurements have been used historically as a means to associate racial, cultural, and psychological attributes with physical properties. Specifically, anthropomorphic measurements involve the size (e.g., height, weight, surface area, and volume), structure (e.g., sitting vs. standing height, shoulder and hip width, arm/leg length, and neck circumference), and composition (e.g., percentage of body fat, water content, and lean body mass) of humans (13). Development in somatotyping led to the evolution of the Heath-Carter method of anthropometric somatotyping, Heath-Carter define somatotypes as a quantitative description of the present shape and composition of the human body (14).

MATERIALS AND METHODS

Research design

The Study design was a case-control type of study where the participants sampling was on random basis, a tailored data collection form for anthropometric recording was developed to suit the study objective and anthropometric somatotyping was performed specifically on known T2DM patients and non-diabetic individuals in line with the ISAK. Data collected was analyzed using Statistical Package for Social Sciences or SPSS (IBM® version 27, Armonk, USA).

Study Area

The first and largest private teaching hospital in Uganda, Kampala International University Teaching and research Hospital (KIU-TH), is located in Ishaka, Bushenyi region, Western Uganda. The Ishaka Adventist Hospital is situated atop Kyeshero Hill, also known as Nchwanga Hill, in the town of Ishaka, currently Bushenyi - Ishaka Municipal Council, at a junction leading to Rukungiri/ Kabale and Kasese towns along the main Mbarara-Kasese road (now Municipalities); a distance of 350 km from the Capital City of Kampala.

Ethics considerations

Ethical approval was obtained from the Research Ethics Committee of Kampala International University, Western Campus, Uganda and the research was conducted in consonance with the Principles of the Declaration of Helsinki (15). The Participants were informed of the concepts and objectives of the research and their consents to participate, cooperate and sincere solicitation was obtained.

Data collection

In line with Heath-Carter and ISAK (14), anthropometric parameter such as skinfolds (tricep fold, subscapularis fold, supraspinale fold, calf fold, pectoralis fold, abdominal fold, mid-thigh), circumference (calf, neck, upper arm, thigh, waist, chest and hip), and bony epicondyles (femurs and humerus) were measured and recorded as follows;

Abdominal skin fold: A parallel fold 3 cm to the corner of the umbilicus's midline and 1 cm underneath it was measured using a skin fold caliper (The Lange or Harpenden and Holtain *Caliper)*.

Pectoral skinfold: In males, measurement of a diagonal crease, Midway between the underarm and the nipple was recorded. In females, a diagonal fold one third of the path from the armpit to the nipple was measured using a skin fold caliper.

Mid axillary skinfold: Measurement of a longitudinal fold on the mid-axillary border that goes straight inferior from the middle of the underarm was measured using the skin fold caliper.

Triceps skinfold: The subjects were asked to loosely hang their arms in anatomical position to raise a fold at the back of the arm at a level halfway on a line connecting the acromion and the olecranon processes, measurement was taken at this point using a skin fold caliper.

Subscapular skinfold: The subjects were asked to the raise the subscapular fold on a line from the inferior angle of the scapula in a direction that is obliquely downwards and laterally at 45 degrees was measured using skin fold caliper.

Supraspinale skinfold: A raise in the fold 5-7 cm (depending on the size of the subject) above the anterior superior iliac spine on a line to the anterior axillary border and on a diagonal line going downwards and medially at 45 degrees enabled measurement at this region using a skin fold caliper.

Medial calf skinfold: The participants were asked to place their foot on a flat and raised platform with the knee bent at a 90° angle. A longitudinal crease was measured at the broadest point of the calf at the medial (inner) region of the calf using a skin fold caliper.

Quadriceps or mid-thigh skinfold: Using a skin fold caliper, Measurement of a longitudinal fold half way between the knee and top of the thigh was recorded.

Circumference parameters: Measurement of the Upper arm circumference, Calf circumference, Neck circumference, Waist circumference, Chest circumference, hip circumference and Thigh circumference was taken using Non-Stretch Fiber glass or Plastic Measuring tape.

Biepicondylar breadth of the humerus, right: At the width point between the media and lateral epicondyles of the humerus, with the shoulder and elbow, flexed to 90^0, the bone caliper was applied at an angle approximately bisecting the angle of the elbow and measurement here was taken.

Biepicondylar breadth of the femur, right: Each subject was asked to sit with knee bent at a right angle. Greatest distance between lateral and medial epicondyles of the femur was measured at this point using the bone caliper.

Data Analysis

Data was analyzed using Statistical Package for Social Sciences or SPSS (IBM® version 27, Armonk, USA). Descriptive statistics (means and standard deviations) for uniformly distributed variables. All the analyses were performed at a 95% confidence level and statistical significance was considered at a probability level of ≤ 0.01

RESULTS

Skinfold and Circumference

The mean triceps skinfold of our T2DM study participants and the mean triceps skinfold of our non-T2DM study participants shows a significant difference (table 1). The mean subscapularis skinfold of our T2DM study participants and the mean subscapularis skinfold of our non-T2DM study participants showed a significant difference (table 1). The mean supraspinale skinfold of our T2DM study participants and the mean supraspinale skinfold of our non-T2DM study participants gives a significant difference (table 1). The mean pectoralis skinfold of our T2DM study participants and the mean pectoralis skinfold of our non-T2DM study participants gives a significant difference (table 1). The mean mid-axillary skinfold of our T2DM study participants and the mean mid-axillary skinfold of our non-T2DM study participants gives a significant difference (table 1). The mean abdominal skinfold of our T2DM study participants and the mean abdominal skinfold of our non-T2DM study participants gives a significant difference (table 1). The mean calf skinfold of our T2DM study participants and the mean calf skinfold of our non-T2DM study participants gives a significant difference (table 1). The mean mid-thigh skinfold of our T2DM study participants and the mean mid-thigh skinfold of our non-T2DM study participants gives a significant difference (table 1).

The mean upper arm circumference of our T2DM study participants and the mean upper arm circumference of our non-T2DM study participants gives a significant difference (table 2). The mean neck circumference of our T2DM study participants and the mean neck circumference of our non-T2DM study participants gives a significant difference (table 2). The mean calf circumference of our T2DM study participants and the mean calf circumference of our non-T2DM study participants gives a significant difference (table 2). The mean chest circumference of our T2DM study participants and the mean chest circumference of our non-T2DM study participants gives a significant difference (table 2). The mean hip circumference of our T2DM study participants and the mean hip circumference of our non-T2DM study participants gives a significant difference (table 2). The mean waist circumference of our T2DM study participants and the mean waist circumference of our non-T2DM study participants gives a mean waist circumference of our non-T2DM study participants' gives a significant difference (table 2). The mean thigh circumference of our T2DM study participants and the mean thigh circumference of our non-T2DM study participants gives a significant difference (table 2).

Femoral and humeral epicondyles

The mean humeral condyles of our T2DM study participants and the mean humeral condyles of our non-T2DM study participants gives a significant difference (table 3). The mean femur condyles of our T2DM study participants and the mean femur condyles of our non-T2DM study participants gives a significant difference (table 3).

DISCUSSION

This study reveals a significantly higher abdominal, mid-axillary, supraspinale, subscapular, pectoral, mid-thigh and calf skinfold (table 1), body circumference (table 1) and bony epicondyles (femur and humerus) (table 2) among the diabetic participants when compared with the non-diabetic subjects. Higher variation in effect size across the mean skinfolds and circumference amongst the T2DM subjects indicate a strong association between skinfolds, body circumferences and T2DM (table 1).

Skinfold and body circumferences.

The mean value for skinfolds and body circumference among the T2DM were significantly higher (table 1) and the result reveals that skinfold and body circumferences are strongly associated with T2DM (table 1). Skinfolds and body circumference are associated with body form and BMI, thus reason for much number of obese and endomorphic T2DM prevalence. This finding is in line with the works of (16-18), in their studies they reported that an increase in body composition is a predictive risk factor for T2DM.

The strong reason for higher abdominal skinfold among the T2DM subjects is linked to

The positive association between abdominal obesity and T2DM which seems to be stronger when other criteria of metabolic syndrome (e.g. high fatty accumulation) are present as Current research shows that abdominal fat is a driving factor behind the development of insulin resistance and type 2 diabetes (19-20). larger abdominal circumference among the T2DM subject is Due to the proximity of belly fat to the portal vein, which conducts blood from the intestinal area to the liver causing the belly fat to enhance insulin resistance, Free fatty acids and other substances generated by visceral fat in the abdomen travel to the liver through the portal vein leading to accumulation of high cholesterol directly linked to high waist line and abdominal circumference, reported to be a risk factor for T2DM (21). To our knowledge, waist circumference is one the important anthropometric measurement that is specifically used as a marker for T2DM risk prediction (22), Contrary to popular belief, waist circumference measurements are a more reliable predictor of diabetes risk than BMI values. This is because Insulin resistance is brought on by abdominal fat that accumulates around the waist and invades the crevices between our organs leading to insulin resistance that is implicated in Pre-T2DM and T2DM hence a higher waist size increases your chance of developing diabetes (21). According to report by (23), chest circumference indices tends to have a positive association with type 2 diabetes however previous studies on the associations with diabetes are very rare. Increased thigh circumference and skinfold among the T2DM is related to high subcutaneous thigh fat among the T2DMs, report has suggested that thigh circumference is not a reliable marker for predicting T2DM because of its negative association with T2DM (24), however, since subcutaneous thigh fat is linked to thigh circumference determination, arguably, our findings shows that thigh circumference and skinfold are significantly associated to T2DM positively. The neck circumference and T2DM connection remained statistically significant as our findings support the general hypothesis that a greater neck circumference is associated with an increased risk of T2DM (25,26), though Uncertainty exists over the underlying cause of the link between neck circumference and the risk of type 2 diabetes. Nevertheless, the possible mechanism explaining such a connection may be the lipolytic activity of upper-body fat. findings on regional lipolysis has shown that visceral fat and upper-body subcutaneous fat both contribute to the amount of circulating free fatty acids in the blood and elevated levels of free fatty acids are closely related to insulin resistance and are a major risk factor for the T2DM genesis (27). Larger Upper arm circumference is a quick and reliable way to predict T2DM because of its association with insulin resistance, central obesity and body mass index (28), our findings indicated elevated value of upper arm circumference among the diabetic subject, which is most probably linked to adipose tissue distributions. Although, contradicting report stating a negative association between upper arm circumference and T2DM by (29) may be linked to larger ratio of muscles mass to fat mass among the subject of interest. Higher subscapular skinfold among the diabetic subjects suggests a strong association between subscapular skinfold thickness and developing T2DM due body fat located in the subscapular area, this is in consonance with (18) who describe subscapularis fat as a risk factor for developing T2DM. Increasing skinfolds and body circumferences has been confirmed to be directly proportional to Obesity and overweight equally implicated in the onset of T2DM with some causative risk factor traced to genetic and environmental influences (30). Over 40% of the heritability of obesity is attributed to genetics, and between 80 and 90 percent of people with type 2 diabetes are overweight or obese (31). Body form dependence on increase skinfolds and body circumferences explains the association among these factors. Lifestyles has been reported to influence increasing skinfold and circumference resulting body form determination (somatotype). healthy nutrition, regular physical activity, optimal sleep, moderation in alcohol consumption, absence of smoking, and mindfulness has been be considered in the effort to control skinfold and body form resulting to obesity which is one of the major risk factor for type 2 diabetes (21,22). Hence the need on sensitizing the general public on the aforementioned factors.

The significantly higher femoral and humeral epicondylar breadth values amongst the diabetic participant may be related to relative effect of high skinfold and circumference due to underlying fat deposit leading to weight increment (34) when compared to healthy adults. Increase in skinfold and circumference directly lead to overweight and obesity which mount pressure on the bone, leading to thicker, denser cortices, and more trabecular tissue. Greater difference between obese and normal adult suggest that obesity may protect against age related bone loss and may increase bone mass, this finding justifies our findings associating T2DM to obese and higher bone mass. A consonance report was also done by (35), establishing that obese persons retain more calcium during growth, and obese adults have larger bone mass. Increased femoral and humeral epicondyles could be linked to higher bone mineral content, which is related to obesity. This is attributed to multiple factors (36) which include a greater mechanical loading on bone due to the higher skinfold and circumference derived from underlying fat, leading to overweight and obesity (35) and the disrupted hormonal milieu and elevated serum levels of adipokines associated with obesity (37). Other genetic and external factors such as smoking, nutrition, and lifestyle independently affect bone mass in obese peoples. Pancreatic hormones such as amylin, insulin and preptin (38) are anabolic to bone (39) Levels of several adipose-derived peptides and enzymes, such as aromatase, hydroxyl steroid dehydrogenase, leptin, and resistin are higher in obesity and have specific anabolic or catabolic actions on the osteoblast (40).

CONCLUSION

Anthropometric measures may serve as an easy and inexpensive marker for T2DM prediction.

The results from our study show that the anthropometric measurements taken using the standard anthropometric tool varies among T2DM and non T2DM participants. Higher difference in variation of triceps skinfold, subscapularis skinfold, supraspinale skinfold, pectoralis skinfold, mid-axillary skinfold, abdominal skinfold, mid-thigh skinfold, upper arm circumference, neck circumference, calf circumference, chest circumference, hip circumference, waist circumference and thigh circumference as well as increased in humeral and femoral epicondyle amongst the T2DM subjects compared to non-T2DM subjects can be key tool of prediction for T2DM because of their important role in body form determination (somatotype), which is a risk factor in gross onset of diabetes, genetic and environmental factors cannot also be overlooked as they seem to have an important influence on the onset of this lethal disease. hence there is a need to create awareness among the general public on self-anthropometric profiling (skin fold and body circumference) as it is a vital predictive tool in early detection of T2DM status and sensitization of the general public on role of healthy diet, regular exercise amongst older people in T2DM prevention.

Author's contribution: This work was carried out in collaboration among all authors. Omoola O.O designed the study and performed the statistical analysis with Ibe U.M. author Okesina A.A. wrote the protocol and wrote the first draft of the manuscript while authors Anyanwu E.G. and Tijani A.A. managed the analyses and the literature searches of the study.

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Table 1. Skinfolds (mm)

Features	Category				Mean Difference	95% Confidence Interval		Effect Size	P-Value
	t2dm		**Non-t2dm**			**Lower**	**Upper**		
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**					
Triceps Skinfold (mm)	21.581	7.477	12.331	7.257	9.251	7.206	11.295	1.251	<0.001
Subscapularis Skinfold (mm)	21.457	6.746	12.093	5.054	9.364	7.710	11.018	1.565	<0.001
Supraspinale Skinfold (mm)	20.573	8.425	8.24	5.365	12.337	10.374	14.293	1.740	<0.001
Pectoralis Skinfold (mm)	14.792	12.222	6.726	3.513	8.066	5.571	10.561	0.894	<0.001
Mid-Axillary Skinfold (mm)	17.118	6.712	8.026	4.692	9.092	7.485	10.699	1.564	<0.001
Abdominal Skinfold (mm)	24.648	7.432	13.643	7.298	11.005	8.961	13.049	1.176	<0.001
Calf Skinfold (mm)	23.217	8.386	13.171	8.356	10.046	7.723	12.368	1.196	<0.001
Mid-Thigh Skinfold (mm)	28.288	8.521	16.414	10.381	11.874	9.239	14.509	1.250	<0.001

the tables indicate the various mean value and mean differences for skinfolds among the diabetic (t2dm) and non-diabetics subjects as well as the level of significant and associations.

Table 2. Circumferences (cm)

Features	Categories				Mean Difference	95% Confidence Interval		Effect Size	P-Value
	T2dm		**Non-t2dm**			**Lower**	**Upper**		
	Mean	**Std. Deviation**	Mean	**Std. Deviation**					
Upper Arm Circumference (cm)	33.231	4.087	27.482	3.943	5.749	4.634	6.863	1.426	<0.001
Neck Circumference (cm)	36.045	4.787	33.045	2.365	3.000	1.952	4.048	0.792	<0.001
Calf Circumference (cm)	40.100	4.551	34.417	3.593	5.683	4.546	6.821	1.381	<0.001
Chest Circumference (cm)	99.009	13.334	85.199	6.185	13.810	10.926	16.694	1.324	<0.001
Hip Circumference (cm)	113.176	13.741	94.265	8.589	18.911	15.732	22.090	1.644	<0.001
Waist Circumference (cm)	94.738	14.468	74.607	7.3027	20.131	16.951	23.311	1.750	<0.001
Thigh Circumference (cm)	60.939	8.983	50.543	5.871	10.396	8.290	12.502	1.365	<0.001

the tables indicate the various mean value and mean differences for body circumferences among the diabetic (t2dm) and non-diabetics subjects as well as the level of significant and associations.

Table 3. Epicondylar breadth (cm)

Features	Category				Mean difference	95% Confidence Interval Of The Difference		Effect size	p-value
	T2dm		**Non-T2dm**						
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**		**Lower**	**Upper**		
Humerus epicondyles (cm)	65.203	6.414	62.059	5.411	3.1436	1.4970	4.7901	0.528	<0.001
Femur epicondyles (cm)	98.556	11.279	92.292	6.453	6.265	3.715	8.815	0.679	<0.001

the tables indicate the various mean value and mean differences for femoral epicondylar breadth and humeral epicondylar breadth among the diabetic (t2dm) and non-diabetics subjects as well as the level of significant and associations.

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