Sensitivity and Specificity of Nepali Version of Quantitative Androgen Deficiency in Aging Males (qADAM) Questionnaire in Diabetic Patients

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ABSTRACT

Background

Diabetes mellitus (DM) is a chronic disorder with hyperglycemia that affects multiple systems with hypogonadism and erectile dysfunction some common issues affecting their quality sexual life. Quantitative androgen deficiency in aging males (qADAM) questionnaire is a trusted tool to assess hypogonadism and erectile dysfunction among diabetic patients and has been commonly used in Nepal too. However, the accuracy, sensitivity, and specificity of its Nepali version are yet to be tested.

Objective

To assess the accuracy, sensitivity, and specificity of the Nepali version of the quantitative androgen deficiency in aging males questionnaire among diabetic patients.

Method

A cross-sectional study was conducted among diabetic patients attending Dhulikhel Hospital, Kathmandu University Hospital. The Patients were asked to complete the valid Nepali translated version of quantitative Androgen Deficiency in Aging Males questionnaire. Participants' serum total and free testosterone, lipid profile, fasting blood glucose, HbA1c and Sex Hormone Binding Globulin (SHBG) were measured in clinical biochemistry laboratory and the accuracy, sensitivity and specificity of Nepali version of quantitative androgen deficiency in aging males were analyzed.

Result

The translated Nepali version of quantitative androgen deficiency in aging males questionnaire showed 61.9% sensitivity, 45.5% specificity, and 56.7% accuracy in diagnosing hypogonadism in reference to serum testosterone level.

Conclusion

This Nepali translated version of quantitative androgen deficiency in aging males questionnaire can be a noninvasive tool to assess hypogonadism and erectile dysfunction.

KEY WORDS

Diabetes, Hypogonadism, Nepali Translation, Quantitative androgen deficiency in aging males

INTRODUCTION

Diabetes Mellitus (DM) is considered one of the most serious public health issue affecting around 537 million adults globally in 2021 and 90 million of them were only in South East Asia and sexual dysfunction is emerging complication of DM.[1-3]

Erectile dysfunction (ED), a condition in which a male is unable to achieve and maintain an optimum erection to get satisfactory sexual intercourse, is the commonest sexual dysfunction among diabetic men and diabetes is considered as the potential risk factor for ED after old age in men.[4-6] Apparently, ED is one of the first symptoms of hypogonadism as testosterone reduces.[7] There is high prevalence of low testosterone among DM patients, nearly 40%, and more than 90% of them are experiencing some degree of ED.[8] People with DM are up to three to five times higher risk of ED than non-diabetic subjects.[5]

Measurement of serum testosterone level is the gold standard method to diagnose androgen deficiency in males. However, measuring testosterone is financially challenging in low and middle income countries, including Nepal.[9] One study has highlighted the association between DM and ED in Nepal by using the International Index of Erectile Function (IIEF-5) version 5 questionnaires tool.[10] But it was limited within the English version of IIEF-5 questionnaire focusing only on ED and lacked the evidence for status of biochemical hormones.

Statistical validation of sensitivity, specificity and accuracy of Nepali version of quantitative androgen deficiency in aging male (qADAM) is crucial to adopt the Nepali translated version of qADAM. The findings of this study will insights into new and different dimensions to positively influence decision-makers at local levels to diagnose the patients with hypogonadism by using local language (Nepali) validated questionnaires.

METHODS

This was an observational study conducted in Dhulikhel Hospital, Kathmandu University Hospital (DH-KUH), Nepal. Here the patients of diabetes mellitus, sexually active above 18 years old, visiting DH-KUH for their regular checkup were included. A total 97 participants between (2017-2019) were included and the sample size was calculated using www.satulator.com.[11] The calculated sample size was obtained with 95% confidence interval with 50% expected proportion and margin of error was 10%. An ethical approval was obtained from Kathmandu University School of Medical Sciences - Instructional Review Committee (KUSMS-IRC) before beginning the study.

The English and Nepali translated version of quantitative Androgen Deficiency in Aging Male (qADAM) questionnaire was used to assess hypogonadism.[12] The qADAM questionnaire contained the same 10 questions as in the original ADAM, but replaced the "yes" and "no," with a Likert scale of 1 to 5 with 1 denoting most symptomatic and 5 denoting least symptomatic.[13] A pilot study was conducted among 10% of total participants after ethical approval was obtained.

Known cases of DM patients visiting DH, KUH who agreed to participate voluntarily in this study by written consent were included in this study. All the male adults above 18 years of age, who were sexually active and had stable heterosexual relation for at least past two years, were included.

Participants with any other known conditions which could significantly affect penile erection except diabetes were excluded. Subject having genital anatomic deformities, spinal cord injuries, and having known or suspected chronic debilitating illnesses such as chronic heart failure, chronic liver disease, chronic renal failure, tuberculosis, chronic obstructive pulmonary diseases (COPD), and malignancy were also excluded. Subjects under medication with phosphodiesterase inhibitor therapy in the past one month were also excluded.

A structured questionnaire was introduced to obtain relevant socio-demographic, life style, medication and clinical information and 10 Nepali version questions of qADAM were introduced.[12]

The weight (in kilograms) of the participants was measured using a modern digital weighing scale without shoes and minimum clothing. Height and waist circumference (in centimeter) were measured using a measuring tape adopting standard guidelines. Blood pressure was measured in a sitting posture on the right arm over loose clothes using a standard digital blood pressure measuring (BP) machine.

Blood was collected from the median cubital vein of all the participants by experienced phlebotomist using aseptic technique in a sterile tube. Blood sample, about three ml was collected in a yellow capped gel activator tube for blood glucose, blood lipids (Total Cholesterol, HDL, LDL and Triacylglycerol), serum albumin, and total testosterone along with sex hormone binding globulin (SHBG).

Collected blood samples were transported immediately to the Department of Clinical Biochemistry Laboratory of DH-KUH. Blood in yellow capped, gel activator vacutainers was allowed to clot and then centrifuged at 4000 rpm for 7 minutes. Obtained serum was analyzed for biochemical parameters such as serum albumin, blood lipids and blood glucose in a fully automatic biochemistry analyzer (BA 400 Biosystems, Spain). In the lipid profile test, Total cholesterol, high-density lipoprotein (HDL) cholesterol, and low-density lipoprotein (LDL) cholesterol and Triacylglycerol were directly measured in serum. Serum sample was preserved and stored in minus 20°C freezer in the Department of Clinical Biochemistry Laboratory of DH, KUH for the analysis of SHBG, and total testosterone. These hormones were measured in Enzyme linked Immunosorbent Assay (ELISA).

The data obtained was coded and entered in Microsoft Excel spread sheet. The categorical data was expressed as rates, ratios and percentages and comparison was done using chi-square test. Continuous data was expressed as mean ± standard deviation. A 'p' value of ≤ 0.05 was considered as statistically significant. Sensitivity, specificity and accuracy of these translated questionnaires were assured in reference to male sex hormones level in blood.

The mean BMI of participants was 24.72±3.38 kg/m^2. And the mean systolic and diastolic blood pressure (BP) was 127.72±16.85 mmHg and 80.14±10.08 mmHg respectively. The participants were 39.2% non-smokers, 41.2% were past smokers and 19.6% were current smokers. Similarly, 24.7% of the above participants were currently alcohol drinkers, 39.2% had never drunk while 36.2% had quit alcohol drinking.

RESULTS

The participants were aged between 32 and 79 years with mean of 55.43±10.75 years. More than one third of the participants (36.1%) were in between 40 to 49 years followed by 60 to 69 years of age accounting one fourth of participants (24.7%) while lowest were in between 30-39 years (4.1% of the total participants). Out of all participants, 22.7% had no formal education, 16.5% had primary level education, 29.9% had completed secondary level education, and 11.3% had completed high school while 19.6% had university level education.

Table 1. **Baseline characteristics of the participants**

Number of Participants (97)				
	Minimum	Maximum	Mean	Standard Deviation
Age (year)	32	79	55.4	10.7
Height (cm)	148	182	163.7	7.2
Weight (kg)	42	104	66.4	10.9
BMI (kg/m^2)	18.5	38.6	24.7	3.3
Waist (cm)	71	122	94.7	9.9
Hip (cm)	71	118	95.15	6.8
Waist Hip Ratio	0.79	1.17	0.99	0.07
Systolic BP (mmHg)	90	190	127.7	16.8
Diastolic BP (mmHg)	50	110	80.1	10.0
Fasting Blood Glucose (mg/dl)	54	378	141.1	58.1
Total Testosterone (ng/dl)	39.0	639.0	294.1	122.4
Total Cholesterol (mg/dl)	97	325	184.8	49.7
HDL Cholesterol (mg/dl)	18	79	40.1	12.9
LDL Cholesterol (mg/dl)	26	230	115.4	44.8
Triacylglycerol (mg/dl)	47	575	176.7	96.6
qADAM Score	15	43	31.6	5.3

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Table 2. **Original and Nepali translated version of qADAM questionnaire**

Original Version (qADAM)	Nepali Translated Version
How would you rate your libido (sex drive)? 1(terrible) 2(poor) 3(average) 4(good) 5(excellent)	तपाई आफ्नो यौन "चाहना" लाई कसरी मापन गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How would you rate your energy level? 1(terrible) 2(poor) 3(average) 4(good) 5(excellent)	तपाई आफ्नो फुर्तिको मात्र कसरी मापन गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How would you rate your strength/endurance ? 1 (terrible) 2 (poor) 3 (average) 4 (good) 5 (excellent)	तपाई आफ्नो तागत र निरन्तर काम गर्न सक्ने क्षमता कसरी मापन गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (रामरो) ५ (अस्याधै राम्रो)
How would you rate your enjoyment of life ? 1(terrible) 2(poor) 3(average) 4(good) 5(excellent)	तपाई आफ्नो जीवनको रमाइलो लाई कसरी मापन गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How would you rate your happiness level ? 1 (terrible) 2 (poor) 3 (average) 4 (good) 5 (excellent)	तपाई आफ्नो खुसी लाई कसरी मापन गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How strong are your erections ? 1=extremely weak 5= extremely strong 1 2 3 4 5	तपाईको लिङ्ग कतितको कडा संग उत्तेजित हुन्छ ? १= अस्याधै लुलो ५= अस्याधै कडा १ २ ३ ४ ५
How would you rate your work performance over the past 4 weeks ? 1 (terrible) 2 (poor) 3 (average) 4 (good) 5 (excellent)	बिगत चार हप्तामा तपाई आफ्नो काम गराईको मापन कसरी गर्नुहुन्छ ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How often you fall asleep after dinner ? 1 (never) 2 (1-2/week) 3 (3-4/week) 4 (5-6/week) 5 (every night)	बेलुकी खाना पछिकतितको निदाउनु हुन्छ ? १ (कहिल्लै निदाउदीन) २ (हप्तामा १-२ पटक) ३ (हप्तामा ३-४ पटक) ४ (हप्तामा ५-६ पटक) ५ (सधै राति)
How would you rate your sports ability over the past 4 weeks ? 1(terrible) 2(poor) 3(average) 4(good) 5(excellent)	तपाई आफ्नो बिगत चार हप्ता यताको खेल्ने क्षमताको कसरी मापन गर्नुहुन्छ? १ (अस्याधै नराम्रो) २ (नराम्रो) ३ (ठिकै) ४ (राम्रो) ५ (अस्याधै राम्रो)
How much height you have lost ? 1 (2" or more) 2 (1.5-1.9") 3(1-1.4") 4 (0.5-0.9") 5 (none-0.4")	तपाईको उचाईमा कतिको कमि आएको छ ? १ (२" भन्दा धेरै) २ (१.५-१.९") ३ (१ - १.४") ४ (०.५-०.९") ५ (० - ०.४")

Statistically significant and strong negative correlation was observed between duration of diabetes and qADAM questionnaire score (Table 3). Similarly, there was negative correlation found between total Testosterone level and duration of diabetes diagnosed. However, this correlation was not statistically significant. Negative correlation was also found between level of HbA1c and total testosterone among diabetic patients. More than half of the participants (56.7%) were found having low level of serum total Testosterone while only 42.3% participants scored below 30 by qADAM questionnaire.

Table 3. Correlation between qADAM and Biochemical Parameters

	Test variable	Correlation	p-value
qADAM	Duration of DM	**-205**	**<.05**
	HbA1c	.098	.341
	Total Testosterone	.096	.348
	SHBG	-.051	.617
	Free Testosterone	.067	.516
	Albumin	-.032	.753
	Total Cholesterol	.231	<.023
	HDL	-.127	.215
	LDL	.181	.077
	TAG	.240	<.018

Sensitivity and specificity of qADAM Nepali translated version questionnaires were analyzed against serum total testosterone level by cross tabulation. This translated qADAM showed 61.9% sensitivity and 45.5% specificity to rule out hypogonadism in diabetic patients. This sensitivity and specificity was obtained by considering low level of total Testosterone as < 300 ng/dl and low score of qADAM questionnaire as ≤ 30. The accuracy of qADAM was found 56.7% on the basis of true positive, false positive and true negative, false negative.

Table 4. Sensitivity and Specificity of qADAM score in reference to Total Testosterone

			Normal	Hypogonadism	Total %
Obtained Results Based on qADAM score	Normal	Count	26	30	56
		% within Actual Outcome Based on Total Testosterone	61.9%	54.5%	57.7%
	Hypogonadism	Count	16	25	41
		% Within Actual Outcome Based on Total testosterone	38.1%	45.5%	42.3%
	Total Count		42	55	97

There was no noticeable difference obtained in sensitivity, when similar analysis was done with free testosterone and score of qADAM, that showed, 60.5% sensitivity however specificity is better, which was 52.4%.

DISCUSSION

Results demonstrated that the Nepali translation of the qADAM questionnaire has good face validity. This is a pioneer study focused on sexual dysfunction and hypogonadism among diabetic patients from Nepal. This study epitomizes prevalence of hypogonadism among diabetic patients attending DH, KUH, Nepal. This study also validated the translated Nepali version of qADAM questionnaire for sensitivity, specificity and accuracy.

Different studies has different cut off value for total testosterone in adults of different age groups. However, almost all the studies has similar acceptance for lower limit, which is < 300 ng/dL.[14] As the cut off value of total testosterone is < 300 ng/dl, 56.6% participants of this study had hypogonadism. The prevalence of hypogonadism in diabetic patients varies 30-80% globally.[15-17] This noticeable difference in prevalence of hypogonadism and erectile dysfunction has multiple factors such as age of participants, duration of diabetes, severity of diabetes, life style and associated comorbidities like hypertension, thyroid diseases etc.

Sexual behavior is a psychobiological reaction that needs the creation of a unique link between the two partners and goes much beyond the mechanical act of peno-vaginal intercourse.[18] There are well-known factors having significant impacts on how one perceives the quality of a sexual act. Cardiovascular diseases (CVD), nephropathy, retinopathy, neuropathy are some commonly diagnosed complications associated with diabetes, but some other health challenges such as cancer, functional disability, cognitive disability, affective disorders including sexual dysfunction (SD), infertility are also soaring.[4] In 1996 it was estimated that over 152 million men worldwide experienced ED and this data has been projected to reach around 322 million by 2025. The majority of this population is in the low and middle income countries.[19] However, erectile dysfunction is one of the most neglected public health complications associated with diabetes mellitus and considered as natural process of growing age or believed as emotional problem.[20]

A systematic review has shown the prevalence of ED as (mild 19.4%), mild to moderate (15.4%), moderate (10.4%) and severe (21.6%).[21] A potential meta-analysis of 145 studies showed that the overall prevalence of ED in diabetic patients is 52.5% (95% confidence interval [CI], 48.8-56.2), with prevalence rates of 37.5% in type 1 diabetes mellitus (T1DM) and 66.3% in type 2 diabetes mellitus (T2DM).[6]

There are several tools and scales to assess hypogonadism and erectile dysfunction but since the advent of ADAM questionnaires in 2000, by the Saint Louis University Androgen Deficiency in the Aging Male (ADAM) questionnaire has been widely utilized as a screening tool for identifying men at risk for androgen deficiency.[13] The sensitivity and specificity of ADAM questionnaires varies from 80-90% sensitive and 36-60% specific.[9,13]

However the exact sensitivity, specificity and accuracy of qADAM was not found but a study claimed that qADAM has positive and statistically significant positive correlation with serum testosterone.[13] In this study, it was considered that if a person scored ≤ 30 in qADAM questionnaires, in that situation its sensitivity is 61.9% and 45.5% specificity with 56.7% accuracy. However, further studies with large sample sizes are recommended to assure more reliable sensitivity, specificity and accuracy of qADAM questionnaires.

Although serums total testosterone and or free testosterone measurement is currently regarded as the gold standard for the diagnosis of hypogonadism in elderly men. However the financial burden for testing and limitation of availability of that test is a challenging for developing countries. There have been attempts to create straightforward, approachable, non-invasive technologies that could recognize andropausal men based on their clinical presentation.[22,23]

This study find qADAM questionnaire translated in Nepali version has low specificity, and other studies findings are also similar.[24] A syndromic diagnosis of male hypogonadism is made on the basis of recurrently low serum testosterone levels and consistent clinical symptoms and indications of androgen insufficiency.[25] According to a longitudinal research, 20% of men in their 60s and 50% of men in their 80s may have serum total testosterone (TT) levels that are significantly lower than those of healthy young men.[26] There are three types of hypogonadism: primary, secondary, and mixed. Disorders of the testes that cause inadequate testosterone production and poor fertility are the cause of primary hypogonadism.[27]

There is no specific level of testosterone below which a man can be categorically diagnosed as having hypogonadism. However, the lower limit of normal total testosterone is recommended to be 300 ng/dL by the different societies. The American Association of Clinical Endocrinology has recommended < 200 ng/dL as lower limit.[28] The recommended threshold for total testosterone by the International Society of Andrology, International Society for the Study of the Aging Male, European Association of Urology (EAU), European Academy of Andrology, and American Society of Andrology is 230 ng/dL.[29]

This study shows that males with type 2 diabetes mellitus (T2D) frequently experience symptomatic hypogonadism. Recent studies have conclusively shown that subnormal FT levels are associated with unreasonably low LH and FSH levels in at least 25% of the men with type 2 diabetes mellitus.[30,31] The underlying pathophysiological mechanism for T2DM-induced hypogonadotropic hypogonadism (HH) has not yet been identified, it is most likely complex and the major possible mechanisms are Insulin resistance, inflammation, and obesity.[32]

In spite of this high burden of hypogonadism and erectile dysfunction among diabetic patients, it is mostly being ignored in diabetic clinics by clinicians and patients are not so willing to talk about it openly. Use of only qADAM questionnaire to assess hypogonadism may have limitations, particularly in conditions where patients are shy to share the truth about their sexual and private life. However this is a significant, noninvasive and cost-effective tool to diagnose hypogonadism. But, still the measurement of biochemical hormones along with qADAM questionnaire will be more reliable.

The study may have recruited participants from a specific geographic region and hospital visiting patients, which could limit the generalization of the findings to the broader population of diabetic patients in Nepal. The sample may not be representative of all diabetic patients in terms of age, socioeconomic status, disease severity, or other relevant factors. The study may have a homogenous sample in terms of demographic characteristics, such as age, ethnicity, or comorbidities. This lack of diversity can limit the applicability of the findings to more diverse populations, affecting the external validity of the study.

CONCLUSION

The Nepali version of the qADAM questionnaire is valid and reliable with marked sensitivity and specificity. This study also showed reliable accuracy compare to serum testosterone level. This questionnaire solely may not sufficient always to identify hypogonadism, particularly in those who don't answer all questions honestly, so, measurement of serum testosterone is still essential. High prevalence of hypogonadism among diabetic patients is clear indication which can be ruled out by this validated qADAM questionnaire in diabetic patients of Nepal.

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REFERENCES

1. Abdul M, Khan B, Hashim MJ, King JK, Govender RD, Mustafa H, et al. Epidemiology of type 2 diabetes – Global burden of disease and forecasted trends. *J Epidemiol Glob Health*. 2020;10:107-11.
2. The IDF Diabetes Atlas. Resources | IDF Diabetes Atlas [Internet]. [cited 2023 Mar 25]. Available from: https://diabetesatlas.org/resources/?gclid=Cj0KCQjwt_qgBhDFARIsABcDjOdYFzL-qf28DLMOjuZ5Wz8ZTOyo3pZvVEaXonH5d6hwlUj_mCZ9lGQaAkgMEALw_wcB
3. Tomic D, Shaw JE, Magliano DJ. The burden and risks of emerging complications of diabetes mellitus. *Nat Rev Endocrinol*. 2022;18(9):525-39.
4. Johns Hopkins Medicine. Erectile Dysfunction | Johns Hopkins Medicine [Internet]. [cited 2023 Apr 1]. Available from: https://www.hopkinsmedicine.org/health/conditions-and-diseases/erectile-dysfunction
5. Defeudis G, Mazzilli R, Tenuta M, Rossini G, Zamponi V, Olana S, et al. Erectile dysfunction and diabetes: A melting pot of circumstances and treatments. *Diabetes Metab Res Rev.* 2022;38(2):1–25.
6. Kouidrat Y, Pizzol D, Cosco T, Thompson T, Carnaghi M, Bertoldo A, et al. High prevalence of erectile dysfunction in diabetes: a systematic review and meta-analysis of 145 studies. *Diabet Med*. 2017;34(9):1185–92.
7. Isidori AM, Buvat J, Corona G, Goldstein I, Jannini EA, Lenzi A, et al. A Critical Analysis of the Role of Testosterone in Erectile Function: From Pathophysiology to Treatment-A Systematic Review. *Eur Urol.* 2014 Jan 1;65(1):99–112.
8. El Saghier EOA, Shebl SE, Fawzy OA, Eltayeb IM, Bekhet LMA, Gharib A. Androgen deficiency and erectile dysfunction in patients with type 2 diabetes. *Clin Med Insights Endocrinol Diabetes.* 2015;8:55–62.
9. Naz S, Mandhan N, Shankar P, Raj K, Memon S. Sensitivity, Specificity and Accuracy of Androgen Deficiency in Ageing Male (ADAM) Questionnaire for the Clinical Detection of Androgen Deficiency in the Male Population in Pakistan. *Cureus.* 2020;12(11):10-3.
10. Tamrakar D, Bhatt DS, Sharma VK, Poudyal AK, Yadav BK. Association Between Erectile Dysfunction and Type 2 Diabetes Mellitus. *J Nepal Health Res Counc*. 2021 Sep 6;19(2):378-383. doi: 10.33314/jnhrc.v19i2.3394. PMID: 34601534.
11. www.statulator.com. Sample Size Calculator for Estimating a Proportion [Internet]. [cited 2023 Apr 5]. Available from: https://www.statulator.com/SampleSize/ss1P.html
12. Risal P, Maharjan A, Bhatt RD, Tamrakar D. Nepali translation and reliability analysis of quantitative androgen deficiency in the aging male questionnaire. *Kathmandu Univ Med J*. 2020;18(71):303–8.
13. Mohamed O, Freundlich RE, Dakik HK, Grober ED, Najari B, Lipshultz LI, et al. The quantitative ADAM questionnaire: A new tool in quantifying the severity of hypogonadism. *Int J Impot Res* [Internet]. 2010;22(1):20-4. Available from: http://dx.doi.org/10.1038/ijir.2009.35
14. Zhu A, Andino J, Daignault-Newton S, Chopra Z, Sarma A, Dupree JM. What Is a Normal Testosterone Level for Young Men? Rethinking the 300 ng/dL Cutoff for Testosterone Deficiency in Men 20-44 Years Old. *J Urol*. 2022;208(6):1295-301.
15. Serwaa D, Bello FA, Osungbade KO, Nkansah C, Osei-Boakye F, Appiah SK, et al. Prevalence and determinants of low testosterone levels in men with type 2 diabetes mellitus; a case-control study in a district hospital in Ghana. *PLOS Glob Public Heal* [Internet]. 2021;1(12):e0000052. Available from: http://dx.doi.org/10.1371/journal.pgph.0000052
16. Agarwal P, Singh P, Chowdhury S, Sharma S, Majumdar A, Shah P, et al. A study to evaluate the prevalence of hypogonadism in Indian males with Type-2 diabetes mellitus. *Indian J Endocrinol Metab.* 2017;21(1):64-70.
17. Ganesh HK, Sarathi HAV, George J, Shivane VK, Bandgar T, Menon PS, et al. Prevalence of hypogonadism in patients with type 2 diabetes mellitus in an Asian Indian study group. *Endocr Pract* [Internet]. 2009 Sep 1 [cited 2023 May 17];15(6):513-20. Available from: http://www.endocrinepractice.org/article/S1530891X20413655/fulltext
18. Grover S, Shouan A. Assessment Scales for Sexual Disorders—A Review. *J Psychosexual Heal*. 2020;2(2):121-38.
19. Aytaç IA, McKinlay JB, Krane RJ. The likely worldwide increase in erectile dysfunction between 1995 and 2025 and some possible policy consequences. *BJU Int* [Internet]. 1999 [cited 2023 Apr 1];84(1):50–6. Available from: https://pubmed.ncbi.nlm.nih.gov/10444124/
20. Chu NV, Edelman SV. Diabetes and Erectile Dysfunction. *Clin Diabetes* [Internet]. 2001 Jan 1 [cited 2023 Apr 4];19(1):45-7. Available from: https://diabetesjournals.org/clinical/article/19/1/45/217/Diabetes-and-Erectile-Dysfunction
21. Corona G, Giorda CB, Cucinotta D, Guida P, Nada E, Aglialoro A, et al. Sexual Dysfunction at the Onset of Type 2 Diabetes: The Interplay of Depression, Hormonal and Cardiovascular Factors. *J Sex Med* [Internet]. 2014 Aug 1 [cited 2023 Apr 1];11(8):2065–73. Available from: https://academic.oup.com/jsm/article/11/8/2065/6958184
22. Valenti G, Gontero P, Saccò M, Fontana F, Strollo F, Castellucci A, et al. Harmonized Italian version of the Aging Males' Symptoms scale. *Aging Male.* 2005;8(3-4):180-3.
23. Heinemann LA, Saad F, Zimmermann T, Novak A, Myon E, Badia X, et al. The Aging Males' Symptoms (AMS) scale: update and compilation of international versions. *Health Qual Life Outcomes.* 2003 May 1;1:15. doi: 10.1186/1477-7525-1-15. PMID: 12747807; PMCID: PMC155679.
24. Tancredi A, Reginster JY, Schleich F, Pire G, Maassen P, Luyckx F, et al. Interest of the Androgen Deficiency in Aging Males (ADAM) questionnaire for the identification of hypogonadism in elderly community-dwelling male volunteers. *Eur J Endocrinol.* 2004;151(3):355-60.
25. Bhasin S, Cunningham GR, Hayes FJ, Matsumoto AM, Snyder PJ, Swerdloff RS, et al. Testosterone therapy in men with androgen deficiency syndromes: An endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2010;95(6):2536-59.
26. Harman SM, Metter EJ, Tobin JD, Pearson J, Blackman MR. Longitudinal effects of aging on serum total and free testosterone levels in healthy men. *J Clin Endocrinol Metab*. 2001;86(2):724-31.
27. Surampudi PN, Wang C, Swerdloff R. Hypogonadism in the aging male diagnosis, potential benefits, and risks of testosterone replacement therapy. *Int J Endocrinol*. 2012;2012.
28. Hypogonadism A, Force T, Petak SM, Nankin HR, Spark RF, Swerdloff RS, et al. American association of clinical endocrinologists medical guidelines for clinical practice for the evaluation and treatment of hypogonagism in adult male patients - 2002 update. *Endocr Pract* [Internet]. 2002;8(6):439-56. Available from: https://doi.org/10.4158/EP.8.6.439
29. Kalra S, Jacob J, Unnikrishnan AG, Bantwal G, Sahoo A, Sahay R, et al. Expert Opinion on the Diagnosis and Management of Male Hypogonadism in India. *Int J Endocrinol*. 2023;2023.
30. Dhindsa S, Prabhakar S, Sethi M, Bandyopadhyay A, Chaudhuri A, Dandona P. Frequent occurrence of hypogonadotropic hypogonadism in type 2 diabetes. *J Clin Endocrinol Metab*. 2004;89(11):5462–8.
31. Dandona P, Dhindsa S. Update: Hypogonadotropic hypogonadism in type 2 diabetes and obesity. *J Clin Endocrinol Metab*. 2011;96(9):2643-51.
32. Russo V, Chen R, Armamento-Villareal R. Hypogonadism, Type-2 Diabetes Mellitus, and Bone Health: A Narrative Review. *Front Endocrinol* (Lausanne). 2021;11(January):1-17.