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ORIGINAL

VISCERAL ADIPOSITY INDICATORS AND ANTHROPOMETRIC INDICES AS SCREENING TOOLS OF METABOLIC SYNDROME AMONG CHINESE ATHLETIC PATIENTS

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ABSTRACT

Aim: More alarming is the increase in the metabolic syndrome (MetS) prevalence in athletic patients suffering adult growth hormone deficiency (AGHD). Chinese visceral adipose index (CVAI) serves for measuring visceral adiposity as well as predicting Chinese people's MetS, while studies have not confirmed its predictive ability for AGHD athletic patients. The study aims at proving such predictive ability by directly comparing the screening abilities exhibited by CVAI, VAI, LAP, WHR, WHtR and WC for identifying MetS of AGHD athletic patients in China. **Materials and methods:** The study involved 113 AGHD athletic patients together with 113 healthy controls, calculating the CVAI, LAP, VAI, BMI, WHtR, WHR, and HOMA-IR. The definition of MetS followed the Joint Interim Statement criteria. The ROC assisted in comparing the AUC regarding each index, obtaining their cut-off points for the prediction of MetS. **Results:** The WC, WHR, WHtR, VAI, LAP and CVAI were in a higher level in AGHD patients. AGHD patients had a MetS prevalence of 41.3 %. AGHD athletic patients suffering MetS exhibited remarkably larger WC, WHR, WHtR, VAI, LAP, CVAI but lower IGF-1, relative to those without MetS. The CVAI was taken into account to divide AGHD patients to four quartiles. With the increase in CVAI, HDL-C, IGF-1 declined, while other related indicators were on the rise. Pearson analysis revealed the obvious association between CVAI, VAI and LAP with MetS, regardless of gender and age. According to the ROC curve of VAI and the anthropometric indicators (ATI) diagnosing

metabolic syndrome, CVAI presented the maximum AUC value (85.80 and 84.45 for males and females, respectively) for AGHD patients. **Conclusions:** CVAI is able to effectively, reliably and screen MetS of Chinese AGHD athletic patients, and exhibits a better performance relative to the other adiposity measures for the evaluation of MetS in Chinese AGHD patients.

KEYWORD: Chinese visceral adipose index (CVAI), adult growth hormone deficiency (AGHD), metabolic syndrome (MetS), visceral adiposity indicators (VAI); athletic patients

1. INTRODUCTION

In the era of modern sports medicine and healthcare, the pursuit of optimal athletic performance goes hand in hand with the importance of maintaining overall health. Among the many health concerns that athletes, both professional and recreational, face, metabolic syndrome stands out as a multifaceted condition with significant implications. It is characterized by a cluster of risk factors, including abdominal obesity, hyperglycemia, hypertension, and dyslipidemia, which collectively increase the risk of cardiovascular disease and type 2 diabetes. In the Chinese athletic patient population, where the pursuit of excellence in sport is a common aspiration, understanding and addressing metabolic syndrome are of paramount importance (ESMAEILI & VALAVI, 2016; Kishida, Funahashi, Matsuzawa, & Shimomura, 2012). Visceral adiposity indicators and anthropometric indices have emerged as valuable screening tools for assessing the risk of metabolic syndrome. These measures provide valuable insights into the distribution of body fat and its potential impact on metabolic health. As athletes strive to optimize their physical performance, it becomes imperative to strike a delicate balance between lean muscle mass and body fat, particularly within the abdominal region (Costa et al., 2019; Xia et al., 2016).(Chiang & Koo, 2012; Qing, Wei, Chan, Xiaoya, & Xin, 2017).

This research endeavor delves into the nuanced relationship between visceral adiposity indicators, anthropometric indices, and the prevalence of metabolic syndrome among Chinese athletic patients(Momiyama et al., 2010) (Abs et al., 2006) (Gazzaruso, Gola, Karamouzis, Giubbini, & Giustina, 2014). By scrutinizing these parameters, we aim to provide athletes, coaches, and healthcare professionals with effective screening tools that can aid in the early detection and management of metabolic syndrome, ultimately promoting both athletic excellence and long-term health. (Alberti et al., 2009; Isomaa et al., 2001; Lakka et al., 2002; Uzunova et al., 2015; Verhelst et al., 2011). (Després et al., 2008). As we embark on this journey, we acknowledge the dual significance of our research – enhancing the performance and well-being of Chinese athletes. The findings from this study hold the potential to revolutionize the way we approach health assessments in the realm of sports

medicine, fostering a holistic perspective on athleticism that encompasses not only physical prowess but also metabolic health(Murray, Adams, & Shalet, 2004), (Yamamoto & Sugimoto, 2014) (Wüster et al., 2001), (Crespo, Santos, & Webb, 2015).

2. MATERIALS AND METHODS

The study has obtained the approval of ethics committee of First Affiliated Hospital of Chongqing Medical University, and obtained participants' informed consent before the study began. It covered 113 AGHD patients who were treated at above hospital during February 2009 and March 2017 as well as 113 healthy controls who possessed alike characteristics (with gender and age matched) and received treatment at the same hospital. Before GH replacement started, we defined GHD according to the GH peak < 5.0 μg/L in ITT (Biller et al., 2002; Molitch et al., 2006). All patients underwent replacement treatment using sufficient, stable and regular hormone (oestrogen, glucocorticoids, thyroid hormones, rogen, etc.) in the preset hormone levels, while GH remained in the regular reference interval. No patients have undergone GH therapy. Evaluation of 113 healthy controls was performed via ITT for excluding AGHD patients.

The exclusion criteria: heat disease, mental disorder, kidney and liver functional disorders, being currently treated by antidiabetic, antihypertensive, as well as lipid-regulating drugs, with a malignant tumor history. Definition of metabolic syndrome followed the new Harmonized definition (JIS criteria), that takes the previously set WC cut-off value (COV) for Chinese. Participants were required to conform at least 3 of the 5 criteria: 1) WC ≥ 85 cm and ≥ 80 cm for men and women, respectively 2) receiving antihypertensive therapy or the BP ≥130/85 mmHg, 3) receiving antidiabetic therapy or the fasting blood glucose ≥ 5.6 mmol/L, 4) TG ≥ 1.7 mmol/L 5) HDL cholesterol less than 1.03 mmol/L and 1.29 mmol/L specific to males and females (Joshi et al., 2016).

All participants had finished a questionnaire that included the medical history of hypertension, diabetes, drug use, and alcohol consumption, smoking, as well as normal physical exercise. Anthropometric measurements involved weight, height, WC, HC, SBP and DBP. Measurement accuracy of body weight was ± 0.2 kg and that of height, WC and HC was 0.1 cm at minimum record unit. The glucose oxidase method served for measuring fasting serum glucose (FPG). Biochemical autoanalyzer assisted in detecting the lipid metabolism spectrums. Chemiluminescent immunometric assay examined the fasting insulin (FINS), and detected the GH and IGF-1concentration. We obtained all the blood samples after no less than 12 h of fasting. Related calculation formula are:

HOMA-IR: FINS (mIU/L) × FPG (mmol/L)/22.5.

BMI: weight (kg)/ heigh (m)^2.
WHtR: WC/ height.
WHR: WC/HC.
LAP: Males: [WC (cm) − 65] × TG concentration (mmol/L)
Females: [WC ±(cm) − 58] × TG concentration (mmol/L).
CVAI: Males: CVAI = − 267.93 + 0.68 * age + 0.03 * BMI + 4.00 * WC + 22.00 * Log10TG − 16.32 * HDL-C;
Females: CVAI = − 187.32 + 1.71 * age + 4.23 * BMI + 1.12 * WC + 39.76 * Log10TG − 11.66 * HDL-C.
VAI: Males: VAI = WC/[39.68 +(1.88 × BMI)] × TG/1.03 × 1.31/HDL;
Females: VAI = WC/[36.58 +(1.89 × BMI)]× TG/0.81 × 1.52/HDL.

2.1 Statistical analysis

SPSS22.0 statistical software served for analyzing all of the acquired data. We expressed continuous variables in the form of mean±SD. Independent-samples t-tests assisted in analyzing these variables in 2 groups. ANOVA assisted in the analysis in multiple groups. We expressed skewed variables in the form of the intermediate value with the interquartile range (25–75%), adopting the Mann-Whitney U-test and the Kruskal—Wallis test for the analysis in two groups and multiple groups, respectively. Categorical variables were expressed in the form of frequency and the analysis was conducted with the Chi-square test. Pearson correlation tests served for conducting correlation analysis between the analyzed ATMPs and MTPs and MetS components. Analysis on the ROC curve was carried out, together with the calculation on AUC of the ROC with 95% CIs. All statistical tests in the study were two-sided tests. p-values < 0.05 reported statistical significance.

3. RESULT

For the 113 AGHD patients, 46 developed MetS, 40.71 % met the JIS criteria regarding MetS, with a higher proportion relative to the controls (15.04%). AGHD subjects exhibited larger WC, WHR, WHtR, DBP, TG, VAI, LAP and CVAI while smaller HDL-C (P<0.05) (Table 1). Indicators of BMI, SBP, HC, FPG, TC, LDL-C, age, weight, height, cigarette smoker, alcohol drinker, and normal physical exercise were not different for patients. Relative to AGHD patients who did not develop MetS, those who developed MetS possessed obviously higher levels in terms of weight, BMI, WC, HC, WHR, WHtR, SBP, DBP, FBG, PINS, HOMA-IR, TG, VAI, LAP and CVAI, and smaller HDL-C and IGF-1 (Table 2). Table 3 lists the clinical features. Based on the quartiles of CVAI, CVAI increase was coupled with increased age, height, weight, BMI, WC, HC, WHR, FPG, FINS, HOMA-IR, TG, LAP, VAI but decreased HDL-C, IGF-1. Chinese AGHD patients with higher CVAI had a higher MetS level (P<0.001). For AGHD men, VAI related to TG and HDL-C, LAP related to TG, HDL-C, WC and HOMA-IR while CVAI exhibited an obvious relation to all MetS

components besides BP (Table 4). For AGHD females, VAI related to TG, HDL-C, and DBP, LAP related to TG, HDL-C, WC and HOMA-IR, while CVAI exhibited a clear relation to all of MetS components besides DBP, and such relation remained even after age adjustment. According to the ROC curve regarding VAI and ATI for metabolic syndrome diagnosis, for male AGHD patients, CVAI possessed the largest AUC value (0.966), and then LAP (0.930), VAI (0.879), WHR (0.879), WC (0.910) and WHtR (0.b92) (Table 5)(Fig 1) and for female AGHD patients, CVAI possessed the largest AUC value (0.964), then LAP (0.934), VAI (0.872), WHR (0.815), WHtR (0.812) and WC (0.703) (Table 5)(Fig 2). Hence, CVAI exhibited the highest AUC values for both male and female AGHD patients. CVAI also presented the largest Youden's index, and the most appropriate COV was 82.42 and 85.80 for man and woman, respectively.

4. DISCUSSION

CVAI can reliably and applicably predict the MetS facing Chinese people, who is the biggest ethnic group in China [16]. Nevertheless, how CVAI influences AGHD patients' MetS has not be deeply investigated. The study revealed the higher CVAI in AGHD group. Also, relative to AGHD patients who did not develop MetS, those who developed MetS exhibited larger CVAI. For AGHD patients, those in the 4 quartiles of CVAI developed a larger MetS. CVAI was also remarkably related to MetS in both male and female AGHD patients, and such relation remained even after the age adjustment. The AUC of CVAI were 0.952 and 0.964 for male and female, respectively. Hence, CVAI exhibits a close relation to MetS and can significantly discriminate MetS among Chinese AGHD patients.

Based on the JIS criteria, 40.71% of AGHD patients suffered MetS, that met the findings of previous study. Obviously, visceral obesity acted as the essential factor amid the other four components constituting MetS and remarkably affected MetS. According to previous study findings, VAI and LAP could more better assess the MetS of AGHD patients, relative to WC, BMI, WHR as well as WHtR, while comparison between LAP and VAI was not conducted directly . Clearly, the study is the first one performing direct comparison between LAP, CVAI and VAI for predicting MetS of Chinese AGHD patients.

Relative to VAI (VAI, LAP, and CVAI), WHR, WHtR and WC exhibit weak diagnostic performance for predicting MetS in male and female AGHD patients (Fig. 1 and Fig. 2). Despite their close relation to central obesity and being in the diagnosis criteria regarding MetS [24], they are incapable of well distinguishing VAT from SAT . Many studies found the significant role played by VAT instead of SAT in MetS[14,15]. Also, tall and short individuals saw diminishing performance exhibited by WHtR for the central obesity diagnosis

VAI consisted of ATMPs (BMI and WC) as well as MTPs (TG and HDL-C), as well as LAP consisted of WC and TG, reliably marker the central lipid accumulation. LAP and VAI were confirmed to be two useful markers for predicting the risk regarding MetS, cardiovascular diseases, type 2 diabetes, as well as IR. Despite this, the study determined the better performance exhibited by LAP than VAI in MetS prediction in AGHD patients, that met the findings of previous study. For adults in rural area of Xinjiang with low income, LAP exhibited larger AUC specific to the MetS screening relative to VAI for males and females. For females suffering polycystic ovary syndrome, LAP could better discriminate MetS relative to VAI. Nevertheless, LAP and VAI could more poorly diagnose MetS relative to CVAI in Chinese AGHD patients. Relative to other indices, CVAI exhibited the largest AUC value (85.80 and 84.45 for man and woman, respectively) in AGHD patients (Table 4). All these confirmed the optimal screening ability of CVAI for discriminating Chinese AGHD patients who suffered or did not suffer MetS. That may be because different ethnic groups have obviously different adipose tissue distribution. Relative to western populations, Asians are more likely to develop visceral adipose accumulation. CVAI, VAI and LAP targeted Chinese population, Caucasian populations and non-Hispanic blacks, the white, and Mexican Americans, respectively. Besides, differences between different ethnic groups also come from their specific lifestyles, dietary habits as well as genetic factors. CVAI, VAI, and LAP all can indicate visceral adiposity, but only CVAI considers the factor of age. A study was conducted involving Gujarati Asian Indians, finding the most appropriate COV for LAP and VAI specific to the young and the old at (75.42,87.4) and (35.88,34.7). It proved age as an useful risk factor of cardiovascular diseases and an influencing factor of the COV exhibited by metabolic risk markers. The study faces three limitations. 1) it had a relatively small sample size, which shall be enlarged in further studies. 2) despite the consideration of how GH affected metabolic parameters in the study, how the rhGH replacement therapy affected AGHD patients was not evaluated, which shall be concerned in future studies. 3) the study was limited to Chinese population, which is the biggest ethnic group in Asia, hence, other ethnic groups shall be considered.

5. Conclusion

In conclusion, our investigation has revealed that visceral adiposity indicators and anthropometric indices are effective screening tools for identifying the risk of metabolic syndrome among Chinese athletic patients. These measures offer a nuanced understanding of body fat distribution and its association with metabolic health, enabling early detection and intervention. Striking a balance between athletic performance and metabolic well-being is crucial for athletes, and implementing these screening tools can facilitate proactive steps to mitigate the risk of metabolic syndrome, leading to improved health outcomes and a more comprehensive approach to athlete care. This

research underscores the evolving nature of sports medicine, emphasizing that optimal athletic performance should be complemented by a commitment to metabolic health, ensuring that athletes pursue their goals with a heightened awareness of their overall well-being.

Table 1. Basic characteristics exhibited by the study population

VARIABLES	AGHD GROUP	CONTROL GROUP	*P* -VALUE
Age (year)	47.11±13.37	45.44±14.01	0.362
Alcohol drinkers (n%)	31.5%	22.8%	0.246
Cigarette smokers (n%)	16.3%	8.7%	0.18
Regular physical exercise (n%)	41.3%	50%	0.236
MetS (n%)	40.71%	15.04%	0.000
Height (cm)	162.57 ± 7.83	161.89± 9.20	0.555
Weight (kg)	62.60(53.95,71.75)	57.30(52.55,67.60)	0.112
BMI (kg/m^2)	23.59± 3.50	22.90 ± 2.89	0.107
WC (cm)	86.32± 9.98	79.01± 7.95	0.000
HC (cm)	95.81± 6.78	94.29±4.94	0.057
WHR	0.90±0.06	0.84±0.06	0.000
WHtR	0.53±0.05	0.49±0.05	0.000
SBP (mmHg)	123.5±17.28	123.7 ±16.09	0918
DBP (mmHg)	76.69±13.62	74.69±10.21	0.002
FPG (mmol/L)	5.30(4.90,5.90)	5.30(5.00,5.80)	0.563
FINS (Mu/L)	8.00(5.31,10.45)	6.03(3.88,7.84)	0.000
HOMA-IR	2.04(1.21,2.67)	1.41(0.98,1.88)	0.000
TC (mmol/L)	4.94±1.57	4.69±0.92	0.142
TG (mmol/L)	1.73(0.87,2.59)	1.02(0.82,1.61)	0.003
LDL-C (mmol/L)	2.98±1.15	2.83±0.87	0.291
HDL-C (mmol/L)	1.10(0.93,1.71)	1.50(1.22,1.71)	0.000
LAP	34.20(21.19,75.96)	19.24(10.77,33.73)	0.000
VAI	2.31(0.93,4.28)	1.06(0.75,1.79)	0.000
CVAI	77.19±40.97	50.57±35.62	0.000

MetS, metabolic syndrome; BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; WHtR waist-to-height ratio; BP: blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; ITT: insulin tolerance test; FSG, fasting serum glucose; FPG, fasting plasma glucose; FINS, fasting serum insulin; HOMA-IR, homeostasis model assessment index for insulin resistance; IR: insulin resistance; TC, total cholesterol; TG, triglyceride; LDL-C, low density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; LAP, lipid accumulation product; VAI: visceral adiposity index; CVAI, Chinese Visceral adiposity Index; ATMPs: anthropometric parameters; MTPs: metabolic parameters; VAT: visceral adipose tissue; SAT: subcutaneous adipose tissue.

Table 2 Basic characteristics exhibited by AGHD patients who had or did not have MetS.

VARIABLES	METS GROUP（N=46）	NO-METS GROUP(N=67)	*P*-VALUE
Age (year)	54.07 ± 11.00	42.33± 12.79	0.000
Alcohol drinkers n%	48.8%	33.3%	0.125
Cigarette smokers n%	30.2%	16.7%	0.133
Regular physical exercise (n%)	41.8%	41.7%	0.844
MetS (n%)	162.39 ± 8.03	162.69 ± 7.76	0.845
Height (cm)	66.53 ± 13.64	59.95 ± 9.18	0.003
Weight (kg)	25.02 ± 3.91	22.61 ± 2.82	0.000
BMI (kg/m^2)	92.42 ± 10.30	82.13 ± 7.26	0.000
WC (cm)	97.87 ± 7.59	94.39 ± 5.82	0.007
HC (cm)	0.94 ± 0.005	0.87 ± 0.01	0.000
WHR	48.8%	33.3%	0.000
WHtR	30.2%	16.7%	0.001
SBP (mmHg)	0.57 ± 0.05	0.50±0.04	0.021
DBP (mmHg)	129.74 ± 21.49	119.25 ± 12.10	0.001
FPG (mmol/L)	89.00（67.25,98.00）	76.00（70.00,80.00）	0.000
FINS(Mu/L)	5.80(5.00,6.10)	5.20(4.80,9.30)	0.000
HOMA-IR	13.38 ± 8.46	6.63 ±2.84	0.499
TC (mmol/L)	3..42 ± 2.07	1.54 ±0.67	0.000
TG (mmol/L)	5.06 ± 1.81	4.86 ±1.39	0.906
LDL-C (mmol/L)	2.35(1.89,3.69)	0.92(0.79,1.47)	0.000
HDL-C (mmol/L)	2.56(2.05,3.59)	2.81（2,3.63）	0.104
GH (nmol/L)	0.27(0.08,1.68)	0.16(0.04,0.59)	0.000
IGF1 (nmol/L)	48.15 ± 20.27	96.07±40.50	0.000
LAP	76.14(65.68,94.12)	22.36（12.00,29.70）	0.000
VAI	4.13(2.81,5.88)	1.01(0.62,2.28)	0.000
CVAI	113.56 ± 25.30	5.22±29.29	0.000

Table3(a). Baseline Characteristics exhibited by AGHD patients based on CVAI quartiles

VARIABLES	CVAI				P-VALUE
	Q 1	Q2	Q3	Q4	
Age (year)	40.29 ±13.91	40.68 ±13.20	50.57 ±10.75	56.55 ±7.52	0.000
Mets (n)	0/28	2/28	19/28	25/29	0.000
Alcohol drinkers n%	34.8%	34.8%	34.8%	34.8%	0.335
Cigarette smokers n%	26.1%	8.7%	21.7%	56.5%	0.201
Regular physical exercise(n%)	30.4%	43.5%	52.2%	39.1%	0.507
Height (cm)	159.96±6.68	159.39±6.51	163.71±9.39	167.03±6.15	0.000

Table3(b). Baseline Characteristics exhibited by AGHD patients based on CVAI quartiles

VARIABLES	CVAI				P-VALUE
	Q 1	Q2	Q3	Q4	
Weight (kg)	54.58±6.68	59.02±11.46	61.01±8.50	75.43±7.10	0.000
BMI (kg/m^2)	21.29±1.97	22.80±2.90	23.03±3.00	27.11±3.05	0.000
WC (cm)	78.02±5.37	84.57±7.94	85.04±7.90	97.26±7.19	0.000
HC (cm)	91.77±5.70	94.91±5.08	94.39±5.47	101.93±6.41	0.000
WHR	0.85±0.04	0.89±0.07	0.90±0.05	0.95±0.05	0.000
WHtR	0.49±0.03	0.52±0.04	0.53±0.04	0.58±0.05	0.025
SBP (mmHg)	118.04±14.01	121.21±12.32	123.27±23.27	131.28±15.45	0.001
DBP (mmHg)	74.00(68.50,92.00)	79.50(72.00,80.00)	80.00(61.00,87.00)	89.00(79.50,98.00)	0.001
FPG (mmol/L)	5.00(4.83,5.30)	5.25(4.60,5.80)	5.40(5.00,6.05)	5.90(5.30,6.08)	0.000
FINS (Mu/L)	4.25(2.77,5.91)	7.59(6.96,9.68)	9.35(7.39,10.00)	14.72(10.23,16.50)	0.000
HOMA-IR	1.03±0.52	1.84±0.50	2.22±0.52	4.07±2.35	0.000
TC (mmol/L)	4.87(4.71,6.84)	4.53(3.68,5.51)	4.46(3.48,6.03)	4.70(3.70,4.95)	0.203
TG (mmol/L)	0.80(0.49,0.96)	0.96(0.89,1.75)	2.28(1.44,3.81)	2.18(1.91,3.69)	0.000
LDL-C (mmol/L)	3.00(2.72,4.34)	2.97(2.18,3.61)	2.50(1.98,4.45)	2.11(1.81,3.20)	0.117
HDL-C (mmol/L)	1.94(1.30,2.20)	1.18(1.05,1.67)	1.07(0.09,1.32)	0.88(0.85,1.08)	0.000
GH (nmol/L)	0.12(0.04,0.71)	0.14(0.03,0.38)	0.40(0.17,1.58)	0.21(0.06,1.30)	0.434
IGF1 (nmol/L)	119.26±45.70	92.99±17.92	58.62±14.93	36.79±13.13	0.000
LAP	11.93(9.37,24.09)	23.14(21.58,33.77)	61.14(38.38,81.30)	84.00(72.89,101.47)	0.000
VAI	0.55(0.42,1.01)	1.08(0.94,2.48)	3.34(2.32,5.70)	4.41(2.54,5.70)	0.000
CVAI	26.21(21.32,34.30)	67.00(55.17,70.47)	88.49(83.87,98.74)	125.05(114.02,135.42)	0.000

Table 4 Correlation of MetS components with VAI and ATI

	TG	HDL-C	FPG	HOMA-IR	SBP	DBP	WC
Man							
CVAI	0.449**	-0.554**	0.360**	0.638**	0.252	0.174	0.830**
CVAI(age adjusted)	0.438**	-0.640**	0.361**	0.614**	0.110	0.027	0.823**
VAI	0.985**	-0.551**	0.113	0.174	0.237	0.146	0.042
VAI(age adjusted)	0.985**	-0.570**	0.118	0.160	0.257	0.244	0.025
LAP	0.947**	-0.589**	0.002	0.426**	0.006	0.118	0.404**
LAP(age adjusted)	0.950**	-0.637**	0.010	0.398**	0.114	0.057	0.376**
Woman							
CVAI	0.559**	-0.482**	0.410*	0.697**	0.339**	0.097	0.626**
CVAI(age adjusted)	0.463**	-0.580**	0.309*	0.658**	0.331**	0.016	0.784**
VAI	0.863**	-0.667**	0.245	0.299	0.178	0.325*	0.005
VAI(age adjusted)	0.866**	-0.671**	0.202	0.252	0.234	0.361**	0.010
LAP	0.866**	-0.591**	0.306	0.442**	0.101	0.179	0.395**
LAP(age adjusted)	0.848**	-0.610**	0.233	0.370**	0.025	0.239	0.409**

Table 5. ROC curves for MetS diagnosis in AGHD.

VARIABLES	CUT-OFF	AREA	P-VALUE
Man			
CVAI	85.80	0.952	0.000
VAI	2.97	0.895	0.000
LAP	57.82	0.927	0.000
WHR	0.94	0.856	0.000
WHtR	0.52	0.845	0.000
WC	91.50	0.854	0.000
Woman			
CVAI	84.45	0.964	0.000
VAI	1.95	0.872	0.000
LAP	39.23	0.934	0.000
WHR	0.88	0.815	0.000
WHtR	0.49	0.812	0.000
WC	82.50	0.703	0.010

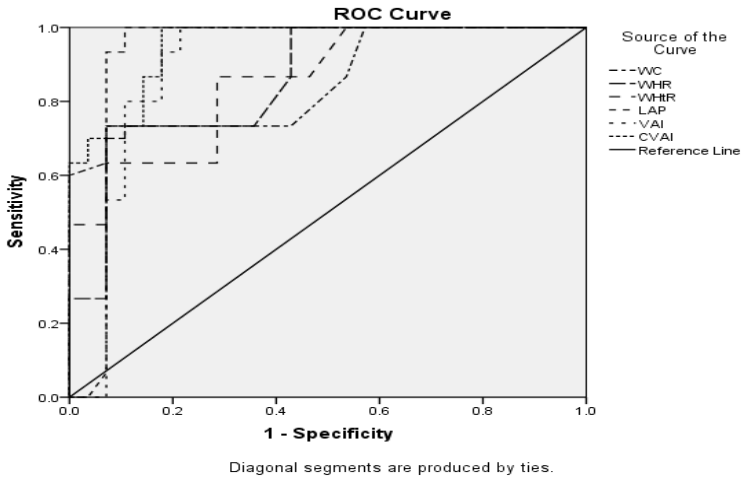

Figure. 1 ROC curves analyses on related indexes to screen MetS in male patients suffering AGHD.

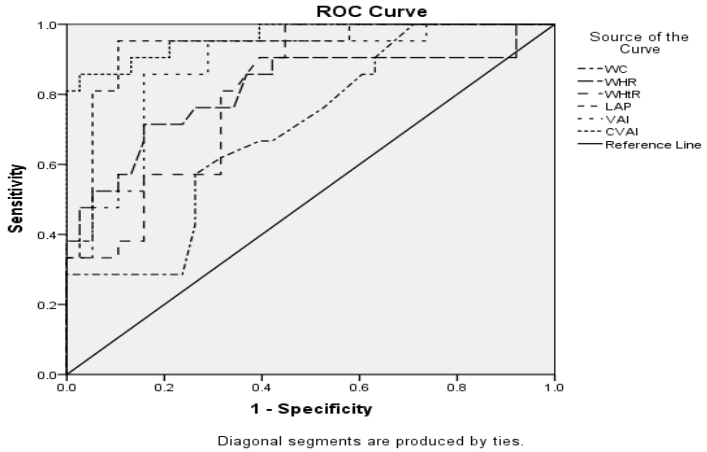

Figure. 2 ROC curves analyses on related indexes to screen MetS in female patients suffering AGHD

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Conflict of interest

The authors declared no conflicts of interest.

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