

· 临床研究 ·

老年患者甘油三酯葡萄糖指数及其相关指数与肌少症的相关性研究

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【摘要】目的 探讨老年住院患者甘油三酯葡萄糖(TyG)指数、TyG-体质量指数(TyG-BMI)、TyG-腰围(TyG-WC)指数和TyG-腰高比(TyG-WHtR)指数与肌少症的相关性,并评价各指数对肌少症的诊断价值。**方法** 选取2022年1月至12月新疆维吾尔自治区人民医院综合保健内科收治的369例老年住院患者为研究对象。根据是否合并肌少症,将患者分为肌少症组($n=54$)和非肌少症组($n=315$)。收集患者人口学资料、血液检测指标及肌少症相关指标。采用SPSS 27.0统计软件进行数据分析。采用多因素logistic回归分析老年住院患者肌少症的影响因素。采用Pearson或Spearman相关性分析各指数与肌少症相关指标[四肢骨骼肌质量(ASM)、四肢骨骼肌质量指数(ASMI)、体质量指数(BMI)、握力及6 m步速]之间的相关性。采用受试者工作特征(ROC)曲线分析各指数对肌少症的诊断价值,并利用Delong检验评估不同模型曲线下面积(AUC)的差异。**结果** 多因素logistic回归分析显示,年龄为肌少症的危险因素($OR=1.113, 95\%CI 1.058\sim 1.170; P<0.001$),BMI则为保护因素($OR=0.657, 95\%CI 0.551\sim 0.783; P<0.001$)。相关性分析显示,TyG指数及其相关指数均与BMI呈正相关;TyG-BMI、TyG-WC及TyG-WHtR指数均与ASM、ASMI呈正相关;TyG-BMI及TyG-WC指数与握力呈正相关($P<0.05$)。但TyG指数与握力、ASM、ASMI无相关性。在调整了性别、年龄和血尿素氮后,TyG-BMI($OR=0.960, 95\%CI 0.947\sim 0.972$)、TyG-WC($OR=0.991, 95\%CI 0.988\sim 0.995$)及TyG-WHtR($OR=0.351, 95\%CI 0.207\sim 0.595$)指数均与肌少症患病风险呈独立负相关($P<0.001$)。ROC曲线分析显示,TyG指数预测肌少症的AUC为0.652($95\%CI 0.571\sim 0.732$),TyG-BMI指数AUC为0.835($95\%CI 0.779\sim 0.892$),TyG-WC指数AUC为0.725($95\%CI 0.653\sim 0.796$),TyG-WHtR指数AUC为0.655($95\%CI 0.574\sim 0.737$)。Delong检验表明,TyG-BMI指数和TyG-WC指数的诊断效能显著优于TyG指数($P<0.05$)。**结论** TyG指数及其相关指数均与肌少症呈负相关,TyG-BMI及TyG-WC指数较TyG指数有更好的肌少症诊断价值。

【关键词】 肌少症;甘油三酯葡萄糖指数;体质量指数;甘油三酯葡萄糖-体质量指数;甘油三酯葡萄糖-腰围指数**【中图分类号】** R592;R589.2**【文献标志码】** A**【DOI】** 10.11915/j.issn.1671-5403.2026.04.053**Correlation of triglyceride glucose index and its related indices with sarcopenia and their diagnostic value in elderly inpatients**Xu Lei^{1,2}, Wang Anyan², Tunike·Mulatibieke², Saiyare·Xuekelati², Wang Hongmei^{1,2*}(¹Xinjiang Medical University, Urumqi 830001, China; ²Department of General Healthcare Medicine, People's Hospital of Xinjiang Uygur Autonomous Region, Urumqi 830001, China)

【Abstract】 Objective To investigate the correlation of triglyceride glucose (TyG) index, TyG-body mass index (TyG-BMI), TyG-waist circumference (TyG-WC) index, TyG-waist-to-height ratio (TyG-WHtR) index with sarcopenia in elderly inpatients, and to evaluate the diagnostic value of above each index for sarcopenia. **Methods** A total of 369 elderly inpatients in our department between January and December 2022 were enrolled, and based on the presence of sarcopenia or not, they were assigned into a sarcopenia group ($n=54$) and a non-sarcopenia group ($n=315$). Demographic data, results of routine blood test, and sarcopenia-related indicators were collected. SPSS statistics 27.0 was used for statistical analysis. Multivariate logistic regression analysis was employed to identify factors influencing sarcopenia. Pearson or Spearman correlation analysis was performed to assess the correlations between TyG-related indices and sarcopenia-related indicators, including appendicular skeletal muscle mass (ASM), appendicular skeletal muscle mass index (ASMI), BMI, grip strength, and 6 m gait speed. Receiver operating characteristic (ROC) curves were plotted to evaluate the diagnostic value of TyG-related indices for sarcopenia, and Delong test was applied to compare the differences in the area under the curve (AUC) across models. **Results** Multivariate logistic regression analysis identified age as a risk factor ($OR=1.113, 95\%CI$

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1.058–1.170; $P < 0.001$), and BMI as a protective factor ($OR = 0.657$, 95%CI 0.551–0.783; $P < 0.001$) for sarcopenia. Correlation analysis indicated that all TyG index and its related indices were positively correlated with BMI, TyG-BMI, TyG-WC and TyG-WhtR indices were positively correlated with ASM and ASMI; TyG-BMI and TyG-WC indices were positively correlated with grip strength ($P < 0.05$). However, TyG index showed no correlation with grip strength, ASM or ASMI. After adjusting for gender, age and blood urea nitrogen, TyG-BMI ($OR = 0.960$, 95%CI 0.947–0.972), TyG-WC ($OR = 0.991$, 95%CI 0.988–0.995), and TyG-WhtR ($OR = 0.351$, 95%CI 0.207–0.595) indices were all independently and negatively correlated with sarcopenia risk ($P < 0.001$). ROC curve analysis revealed that the AUC values of TyG index, TyG-BMI, TyG-WC index and TyG-WhtR index in predicting sarcopenia were 0.652 (95%CI 0.571–0.732), 0.835 (95%CI 0.779–0.892), 0.725 (95%CI 0.653–0.796), and 0.655 (95%CI 0.574–0.737), respectively. Delong test suggested that both TyG-BMI and TyG-WC indices exhibited significantly superior diagnostic performance than TyG index ($P < 0.05$). **Conclusion** TyG index and its related indices are negatively correlated with sarcopenia, TyG-BMI and TyG-WC indices demonstrate better diagnostic value for sarcopenia than TyG index.

【Key words】 sarcopenia; triglyceride glucose index; body mass index; triglyceride glucose-body mass index; triglyceride glucose-waist circumference index

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肌少症是一种增龄相关的老年综合征,表现为肌肉质量减少、肌肉力量下降和(或)躯体功能减退^[1],在老年人中尤其常见,近年来患病率不断上升^[2]。肌少症与许多不良健康结局相关,如跌倒、功能障碍、生活质量差以及死亡^[3]。随着人口老龄化程度不断加深,肌少症已成为严重影响老年人群身体健康和生活质量的重要公共卫生问题。早期识别肌少症并给予相应干预可有效改善预后,提高老年人的生命质量。肌少症诊断复杂,涉及肌肉力量、肌肉质量和躯体功能。其中肌肉质量减少是临床确诊的核心指标,但其主要检测手段(磁共振成像、计算机断层扫描和双能X线吸收仪测量)存在费用高、便携性差且操作复杂等缺点。因此,开发一种简单、可靠、精确且经济的生物标志物,对于实现肌少症早期检测和高风险个体的预测具有重要意义。

有研究发现,肌少症是糖尿病的新型并发症^[4],糖尿病患者肌少症的患病率是非糖尿病患者的3倍^[5]。胰岛素抵抗(insulin resistance, IR)是糖尿病介导肌少症的关键环节。目前,甘油三酯葡萄糖(triglyceride glucose, TyG)指数被广泛用于IR的测量^[6],与IR的“金标准”葡萄糖钳夹实验相比, TyG指数易于获取且成本较低,适合大规模人群评估。在此基础上,整合了体质量指数(body mass index, BMI)、腰围(waist circumference, WC)及腰高比(waist-to-height ratio, WhtR)的衍生指数——TyG-BMI、TyG-WC及TyG-WhtR指数,被证实能更全面地反映机体IR水平^[7,8]。近年研究提示,上述指数与肌少症存在相关性,但现有结论尚不一致,且缺乏基于中国新疆地区人群的样本数据。因此,

本研究探讨新疆老年住院患者TyG指数及其相关指数与肌少症的相关性,并分析其对肌少症的诊断价值。

1 对象与方法

1.1 研究对象

本研究为横断面研究,选取2022年1月至12月新疆维吾尔自治区人民医院综合保健内科收治的369例老年住院患者为研究对象。本研究经新疆维吾尔自治区人民医院临床科研伦理委员会批准(伦理批号:KY2021031027)。本研究符合《赫尔辛基宣言》。

纳入标准:(1)年龄 ≥ 60 岁;(2)具备基本沟通能力;(3)自愿参加本研究,签署知情同意书。排除标准:(1)不具备自主行走能力;(2)具有认知功能障碍或精神障碍;(3)手骨存在严重关节炎,难以实施握力测试;(4)合并神经肌肉疾病;(5)病情危重。

1.2 方法

1.2.1 资料收集 收集患者包括性别、年龄、BMI、WhtR、婚姻状况、吸烟史、饮酒史等人口学资料。血液指标:由经过统一培训的医护人员按照标准化方案采集患者空腹静脉血样,送至中心实验室进行分析。收集空腹血糖、甘油三酯、血肌酐、尿酸、尿素氮、高密度脂蛋白胆固醇、低密度脂蛋白胆固醇、C反应蛋白及糖化血红蛋白。TyG指数= $\ln[\text{甘油三酯}(\text{mg/dl}) \times \text{葡萄糖}(\text{mg/dl}) / 2]$ 。TyG-BMI= $\text{TyG} \times \text{BMI}$, TyG-WC指数= $\text{TyG} \times \text{WC}$, TyG-WhtR指数= $\text{TyG} \times \text{WhtR}$ 。

1.2.2 肌少症诊断标准 (1)肌肉质量评估:采用InBody S10人体成分分析仪(韩国Biospace Co., Ltd

公司)测定四肢骨骼肌质量(appendicular skeletal muscle mass, ASM),计算四肢骨骼肌质量指数(appendicular skeletal muscle mass index, ASMI)。ASMI=ASM/Ht²,男性 ASMI<7.0 kg/m²,女性 ASMI<5.7 kg/m²,即认为存在肌肉质量减少;(2)肌肉力量评估:采用电子握力计(广东香山衡器集团,型号:CAMRYEH101)测量握力。受试者取舒适坐位,双足平放于地面,双肩内收中立位,肘关节屈曲90°,腕关节保持中立位。嘱受试者分别用左、右手以最大力量握持手柄,双手各测量两次,每次测量间隔1 min,取四次测量中的最大值作为最终握力值。男性握力<28 kg,女性握力<18 kg,则认为存在握力低下;(3)肌肉功能评估:采用6 m步行试验测定步速。在平坦、无障碍的地面标记6 m直线距离。嘱受试者以平日习惯的舒适步速从起点走至终点,允许使用日常辅助器具(如手杖)。计时器记录受试者足部启动至完全通过终点线所需的时间。共测试两次,取两次结果的平均值为最终步速。6 m步速<1.0 m/s认为存在步速低下。根据2019年亚洲肌少症诊断标准^[9],将骨骼肌质量减少伴有握力低下和(或)步速低下时可诊断为肌少症。根据是否合并肌少症,分为肌少症组($n=54$ 例)及非肌少症组($n=315$ 例)。

1.3 统计学处理

采用SPSS 27.0统计软件进行数据分析。计量资料呈正态分布者以均数±标准差($\bar{x}\pm s$)表示,组间比较采用独立样本 t 检验;呈偏态分布者以中位数(四分位数间距) $[M(Q_1, Q_3)]$ 表示,组间比较采用Mann-Whitney U 检验。计数资料以例数(百分率)表示,组间比较采用 χ^2 检验。采用单因素与多因素logistic回归分析肌少症的影响因素。采用Pearson或Spearman相关性分析TyG指数及其相关指数与肌少症相关指标间的相关性。采用受试者工作特征(receiver operating characteristic, ROC)曲线分析各指数对肌少症的诊断价值,并利用Delong检验评估不同模型曲线下面积(area under the curve, AUC)的差异。 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 老年住院患者的基线资料

肌少症患者年龄及血尿素氮水平显著高于非肌少症患者,BMI、甘油三酯水平、握力、6 m步速、腰围、ASM、ASMI、TyG指数、TyG-BMI、TyG-WC指数及TyG-WHtR指数均显著低于非肌少症患者,差异均

有统计学意义(均 $P<0.05$;表1)。

2.2 老年住院患者肌少症的多因素logistic回归分析

握力、6 m步速、ASM及ASMI为肌少症的诊断标准,为避免统计学循环论证,未将其纳入回归模型。以是否合并肌少症为因变量,以年龄、BMI、血尿素氮、腰围、甘油三酯为自变量,进行多因素logistic回归分析,发现年龄为肌少症的危险因素,BMI则为保护因素($P<0.05$;表2)。

2.3 TyG指数及其相关指数与肌少症相关指标的相关性

相关性分析显示,TyG指数及其相关指数均与BMI呈正相关;TyG-BMI、TyG-WC及TyG-WHtR指数均与ASM、ASMI呈正相关;TyG-BMI、TyG-WC指数与握力呈正相关($P<0.05$;图1)。但TyG指数与握力、ASM、ASMI无相关性。

2.4 TyG指数及其相关指数与肌少症的多因素logistic回归分析

调整性别、年龄和血尿素氮后发现,TyG指数每增加一个单位,肌少症患病率降低58.5%;每增加一个标准差,肌少症患病率降低37.9%。TyG-BMI指数每增加一个单位,肌少症患病率降低4.0%;每增加一个标准差,肌少症患病率降低76.6%。TyG-WC指数每增加一个单位,肌少症患病率降低0.9%;每增加一个标准差,肌少症患病率降低57.8%。TyG-WHtR指数每增加一个单位,肌少症患病率降低64.9%;每增加一个标准差,肌少症患病率降低44.2%。无论增加一个单位或增加一个标准差,TyG相关指标均与肌少症的呈负相关($P<0.05$;表3)。

2.5 TyG指数及其相关指数对肌少症的诊断价值

TyG指数预测肌少症的AUC为0.652(95%CI 0.571~0.732),最佳截断点为8.414,特异度为57.4%,灵敏度为70.2%。TyG-BMI预测肌少症的AUC为0.835(95%CI 0.779~0.892),最佳截断点为209.942,特异度为87.0%,灵敏度为67.0%。TyG-WC指数预测肌少症的AUC为0.725(95%CI 0.653~0.796),最佳截断点为803.239,特异度为77.8%,灵敏度为61.0%。TyG-WHtR指数预测肌少症的AUC为0.655(95%CI 0.574~0.737),最佳截断点为4.623,特异度为55.6%,灵敏度为73.0%。详见图2。Delong检验结果显示,TyG-BMI和TyG-WC指数的AUC值均显著高于TyG指数($P<0.05$),提示这两项指标的诊断效能优于TyG指数,其中TyG-BMI诊断效能最优。

表 1 两组患者基线资料比较

Table 1 Comparison of baseline data between two groups

Item	Non-sarcopenia (n = 315)	Sarcopenia (n = 54)	t/χ ² /Z	P value
Age (years, $\bar{x} \pm s$)	72.03 ± 8.08	80.72 ± 6.77	-6.90	<0.001
Gender [n (%)]			0.023	0.880
Male	161 (51.11)	27 (50.00)		
Female	154 (48.89)	27 (50.00)		
Marital status [n (%)]			3.28	0.194
Married	281 (89.21)	52 (96.30)		
Divorced/widowed	19 (6.03)	1 (1.85)		
Others	15 (4.76)	1 (1.85)		
BMI (kg/m ² , $\bar{x} \pm s$)	25.75 ± 3.16	21.63 ± 2.71	9.01	<0.001
Smoking [n (%)]	47 (14.92)	6 (11.11)	0.54	0.461
Drinking [n (%)]	43 (13.65)	3 (5.56)	2.77	0.096
Hypertension [n (%)]	159 (50.48)	34 (62.96)	2.88	0.090
Diabetes mellitus [n (%)]	60 (19.05)	12 (22.22)	0.30	0.587
CHD [n (%)]	67 (21.27)	13 (24.07)	0.21	0.644
COPD [n (%)]	20 (6.35)	2 (3.70)	0.58	0.448
CKD [n (%)]	55 (17.46)	11 (20.37)	0.27	0.606
SBP (mmHg, $\bar{x} \pm s$)	137.11 ± 21.12	132.63 ± 20.23	1.45	0.148
DBP (mmHg, $\bar{x} \pm s$)	75.06 ± 11.99	74.24 ± 11.46	0.47	0.641
SCr (μmol/L, $\bar{x} \pm s$)	65.12 ± 17.66	70.83 ± 34.90	-1.18	0.244
UA (μmol/L, $\bar{x} \pm s$)	335.51 ± 83.49	319.94 ± 86.83	1.26	0.209
BUN (mmol/L, $\bar{x} \pm s$)	5.44 ± 1.72	6.42 ± 2.96	-2.36	0.022
GLU (mmol/L, $\bar{x} \pm s$)	5.75 ± 1.89	5.68 ± 2.67	0.24	0.811
TG (mmol/L, $\bar{x} \pm s$)	1.46 ± 0.72	1.12 ± 0.45	4.63	<0.001
HDL-C (mmol/L, $\bar{x} \pm s$)	1.22 ± 0.30	1.28 ± 0.39	-1.41	0.159
LDL-C (mmol/L, $\bar{x} \pm s$)	2.54 ± 0.81	2.41 ± 0.66	1.16	0.248
CRP (mg/L, $\bar{x} \pm s$)	4.63 ± 12.89	5.64 ± 14.17	-0.47	0.642
HbA1c (% , $\bar{x} \pm s$)	6.39 ± 1.32	6.33 ± 1.35	0.46	0.649
GS (kg, $\bar{x} \pm s$)	27.42 ± 9.26	18.60 ± 7.18	7.96	<0.001
6 m gait speed (m/s, $\bar{x} \pm s$)	1.21 ± 0.96	0.80 ± 0.29	6.26	<0.001
WC (cm, $\bar{x} \pm s$)	96.25 ± 11.81	88.44 ± 9.67	4.16	<0.001
ASM (kg, $\bar{x} \pm s$)	20.14 ± 4.37	14.83 ± 3.73	9.42	<0.001
ASMI (kg/m ² , $\bar{x} \pm s$)	7.20 ± 1.01	5.67 ± 1.00	10.25	<0.001
TyG index ($\bar{x} \pm s$)	8.67 ± 0.53	8.40 ± 0.57	3.49	<0.001
TyG-BMI ($\bar{x} \pm s$)	223.57 ± 32.55	182.00 ± 28.00	8.84	<0.001
TyG-WC index [M(Q ₁ , Q ₃)]	827.75 (763.22, 903.12)	748.31 (676.11, 797.75)	-5.35	<0.001
TyG-WHtR index [M(Q ₁ , Q ₃)]	5.02 (4.59, 5.40)	4.58 (4.11, 5.12)	-3.72	<0.001

BMI: body mass index; CHD: coronary heart disease; COPD: chronic obstructive pulmonary disease; CKD: chronic kidney disease; SBP: systolic blood pressure; DBP: diastolic blood pressure; SCr: serum creatinine; UA: uric acid; BUN: blood urea nitrogen; GLU: glucose; TG: triglyceride; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; CRP: C-reactive protein; HbA1c: glycosylated hemoglobin Alc; GS: grip strength; WC: waist circumference; ASM: appendicular skeletal muscle mass; ASMI: appendicular skeletal muscle mass index; TyG: triglyceride glucose index; WHtR: waist-to-height ratio. 1 mmHg=0.133 kPa.

表 2 老年住院患者肌少症的多因素 logistic 回归分析

Table 2 Multivariate logistic regression analysis of sarcopenia in elderly inpatients

Factor	β	SE	Wald χ ²	P value	OR	95% CI
Age	0.107	0.026	17.479	<0.001	1.113	1.058-1.170
BMI	-0.421	0.090	21.848	<0.001	0.657	0.551-0.783
BUN	0.063	0.084	0.567	0.451	1.065	0.903-1.256
TG	-0.308	0.371	0.691	0.406	0.735	0.355-1.519
WC	-0.002	0.023	0.011	0.917	0.998	0.954-1.044

BMI: body mass index; BUN: blood urea nitrogen; TG: triglyceride; WC: waist circumference.

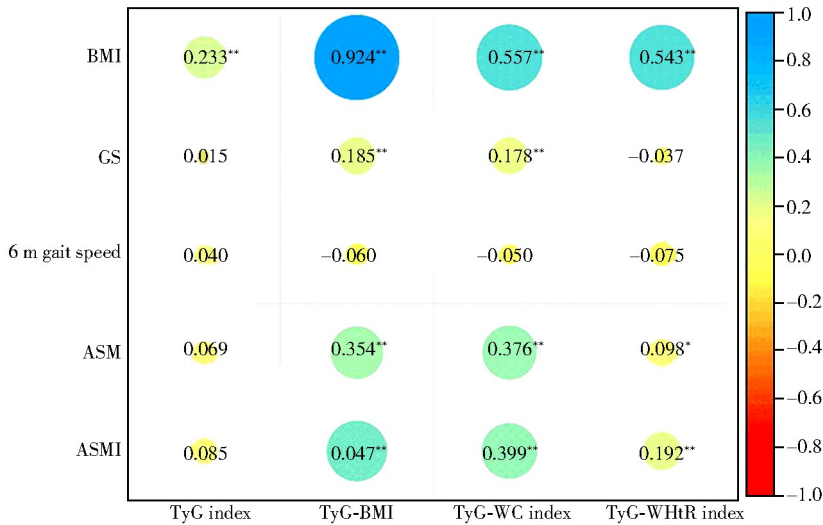


图1 TyG指数及其相关指数与肌少症相关指标的相关性分析

Figure 1 Correlation analysis between TyG index and its related indices and sarcopenia related indicators

BMI: body mass index; GS: grip strength; ASM: appendicular skeletal muscle mass; ASMI: appendicular skeletal muscle mass index; TyG: triglyceride glucose index; WC: waist circumference; WHtR: waist-to-height ratio. Blue indicates positive correlation, red indicates negative correlation. * $P < 0.05$; ** $P < 0.001$.

表3 TyG指数及其相关指数与肌少症的多因素 logistic 回归分析

Table 3 Multivariable logistic regression analysis of TyG index and its related indices with sarcopenia

Factor	Model 1			Model 2			Model 3		
	OR	95%CI	P value	OR	95%CI	P value	OR	95%CI	P value
TyG index									
Per 1-unit increase	0.356	0.196-0.645	<0.001	0.418	0.222-0.785	0.007	0.415	0.220-0.780	0.060
Per 1-SD increase	0.572	0.414-0.789	<0.001	0.623	0.443-0.877	<0.001	0.621	0.441-0.874	0.060
TyG-BMI									
Per 1-unit increase	0.955	0.943-0.967	<0.001	0.960	0.947-0.972	<0.001	0.960	0.947-0.972	<0.001
Per 1-SD increase	0.199	0.127-0.311	<0.001	0.236	0.149-0.374	<0.001	0.234	0.148-0.372	<0.001
TyG-WC index									
Per 1-unit increase	0.993	0.991-0.996	<0.001	0.993	0.990-0.997	<0.001	0.991	0.988-0.995	<0.001
Per 1-SD increase	0.433	0.301-0.622	<0.001	0.429	0.287-0.640	<0.001	0.422	0.281-0.633	<0.001
TyG-WHtR index									
Per 1-unit increase	0.494	0.323-0.756	<0.001	0.466	0.289-0.752	0.002	0.351	0.207-0.595	<0.001
Per 1-SD increase	0.589	0.428-0.811	<0.001	0.564	0.394-0.807	0.002	0.558	0.388-0.803	0.002

TyG: triglyceride glucose index; BMI: body mass index; WC: waist circumference; WHtR: waist-to-height ratio; BUN: blood urea nitrogen. Model 1 used the presence of sarcopenia as the dependent variable, with the TyG index, TyG-BMI, TyG-WC index, and TyG-WHtR index included as independent variables. Model 2 was adjusted for age and gender based on Model 1. Model 3 was further adjusted for BUN based on Model 2.

3 讨论

研究表明,胰岛素抵抗与肌少症呈正相关^[10-12],而TyG指数与肌少症的相关性尚存在争议。一项横断面研究发现,慢性炎症性气道疾病患者TyG指数与肌少症呈正相关,且TyG指数是预测肌少症风险的可靠指标^[13]。美国国家健康和营养检测调查数据提示,健康人群中调整协变量(性别、年龄、种族等)

后,TyG指数与肌少症呈正相关^[12]。一项来自美国的研究也证实,TyG指数与低肌肉质量、低肌肉力量和肌少症患病率呈正相关^[14]。但来自韩国国家健康和营养检测调查的两项研究发现,随着TyG指数增加,肌肉质量趋于减少^[15,16]。中国的两项队列研究也证实,随着TyG相关指数的增加,肌少症发生风险降低^[11,17]。本研究中,TyG、TyG-BMI、TyG-WC及TyG-WHtR指数均与肌少症患病风险呈显著负相关。

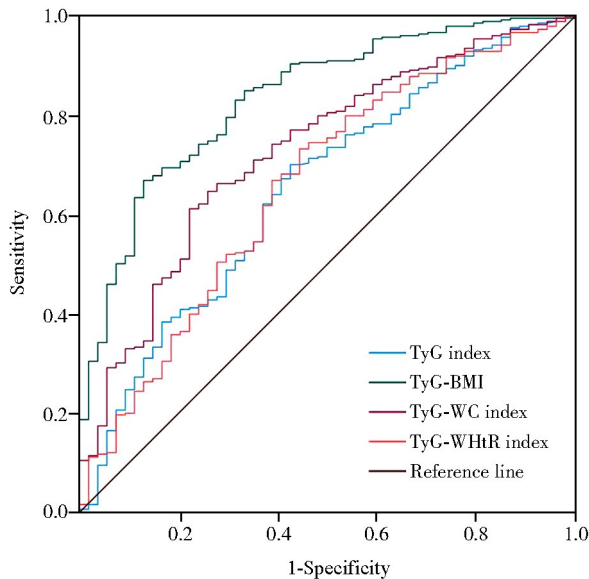


图2 TyG指数及其相关指数预测肌少症的ROC曲线
Figure 2 ROC curves of TyG index and its related indices for predicting sarcopenia

TyG: triglyceride glucose index; BMI: body mass index; WC: waist circumference; WHtR: waist-to-height ratio; ROC: receiver operating characteristic.

分析这种争议的原因:(1)未考虑BMI的影响。Chen等^[11]在调整BMI后,TyG指数与肌少症的负相关性不具有统计学意义;后对BMI进行中介分析,显示BMI在TyG指数与肌少症相关性中起重要中介作用(介导比例:88.7%)。(2)甘油三酯水平的地理分布差异。这种差异可能导致TyG指数在不同国家间存在较大差别^[18]。(3)研究对象的年龄构成不同。包括本研究在内,亚洲地区的相关研究多以中老年人作为对象^[11,16,17],而美国的研究则主要选取>20岁人群^[12-14]。(4)不同研究中采用的ASMI计算公式不一致。可以发现,TyG指数与肌少症呈负相关性的研究均采用AWGS2019的诊断标准^[9],而持正相关结论的研究多采用2014年美国国立卫生研究院的诊断标准^[19]。(5)TyG指数可反映胰岛素抵抗水平,较高水平的胰岛素抵抗会导致肌肉质量减少,但正常范围内的葡萄糖和脂质对肌肉合成具有营养支持作用。在中国老年人群中,这种营养支持的正向作用可能超过胰岛素抵抗的负向作用,进而导致研究结果出现差异。

本研究发现,ASM及ASMI与单一TyG指数之间并未表现出显著的相关性。这可能归因于老年住院患者常伴有不同程度的营养风险,较低的甘油三酯水平可能反映了营养消耗而非胰岛素敏感;此外,降脂或代谢调节药物的使用可能干扰了TyG指数

的计算底物,导致其在反映胰岛素抵抗时存在偏移,这也提示单一TyG指标在评估老年住院患者肌肉质量时存在局限性。本研究中,BMI为肌少症的独立保护因素,合并体格检测指标的TyG-BMI、TyG-WC和TyG-WHtR指数均与ASM及ASMI呈显著正相关,同样是肌少症的保护因素。尽管部分研究表明,肥胖人群中较高的BMI与WC引起的慢性炎症与胰岛素抵抗会导致骨骼肌流失与肌少症^[20,21],但在老年及慢性病患者中,“肥胖悖论”现象更为普遍,较高的BMI提高了能量储备和对抗消耗性疾病的能力,对肌少症具有保护作用^[22,23]。

本研究进一步证实,相较于单一的TyG指数,TyG-BMI指数和TyG-WC指数的对肌少症的诊断效能显著优于TyG指数,其中TyG-BMI诊断效能最优。与Zhang等^[17]的研究结果一致。提示引入BMI或WC能够显著提升对肌少症的识别能力。因此,TyG-BMI和TyG-WC指数有望作为简单、经济的初筛工具在临床推广应用。

综上,本研究证实TyG指数及其相关指数与肌少症呈负相关,TyG-BMI、TyG-WC指数比TyG指数具有更好的肌少症诊断价值。本研究分析了TyG相关指数对肌少症的诊断价值,为肌少症的诊断提供了新思路。此外,本研究首次分析了新疆地区老年住院患者TyG指数与肌少症的相关性,丰富了肌少症研究的地域和人群维度,为TyG指数在不同地区和人群中的应用提供了新的证据。但本研究仍存在局限性,作为横断面研究,无法确立因果关系;样本均来自单中心老年住院患者,代表性有限,影响结果的外推性。未来应开展大样本、前瞻性队列研究,以更深入地研究TyG相关指数与肌少症的相关性。

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