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·会议摘要·

身体圆度指数、内脏脂肪指数及内脏脂肪代谢评分在预测新发房颤中的作用：一项基于英国生物银行队列的研究

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［摘要］ **目的** 探讨身体圆度指数（body roundness index，BRI）、内脏脂肪指数（visceral adiposity index，VAI）和内脏脂肪代谢评分（metabolic score for visceral fat，METS-VF）与新发房颤（atrial fibrillation，AF）风险之间的纵向关联。**方法** 本研究纳入英国生物银行队列中基线时无 AF 或妊娠，且完成了 BRI、VAI 和 METS-VF 第 1 次和第 2 次评估的参与者。采用 K 均值聚类分析对 BRI、VAI 和 METS-VF 的变化进行分类，并计算累积肥胖指数。主要结局为新发 AF。采用 3 个 Cox 回归模型来研究 BRI、VAI 和 METS-VF 变化与新发 AF 发生风险之间的纵向关联。结果以风险比（hazard ratio，HR）及其相应的 95% 置信区间（confidence interval，CI）表示。采用限制性立方样条分析，以评价基线/累积肥胖指数与新发 AF 之间的潜在非线性关联。使用 C 指数分析，以评估 BRI、VAI 和 METS-VF 对新发 AF 的预测价值。根据年龄、性别、种族、吸烟状态、饮酒情况和身体活动进行亚组分析。采用多基因风险评分评估遗传易感性，分析肥胖指数与遗传风险之间的潜在相互作用。采用单变量线性回归分析，评估累积肥胖指数与磁共振成像和双能 X 射线吸收测量参数之间的关系，包括内脏脂肪组织（visceral adipose tissue，VAT）体积、VAT 质量、躯干脂肪体积和躯干脂肪质量。进一步应用极端梯度提升（XGBoost）算法测量特征重要性，以评估每个肥胖指数对成像参数的预测价值。进行孟德尔随机化分析，调查躯干脂肪质量与 AF 之间的潜在因果关系。**结果** 共纳入 12 776 例参与者，平均随访 9.60 年，记录 761 例（5.96%）新发 AF 事件。根据肥胖指数的变化，将参与者分为 4 类。在完全调整模型中，与 BRI 第 1 类参与者相比，第 3 类（HR＝1.30，95%CI 1.04～1.63，P＝0.023）和第 4 类（HR＝2.17，95%CI 1.61～2.93，P＜0.001）参与者新发 AF 的风险显著增加。与 METS-VF 第 1 类参与者相比，第 4 类参与者新发 AF 的风险显著增加（HR＝1.66，95%CI 1.15～2.39，P＝0.007）。未观察到不同 VAI 类别与新发 AF 风险的关联。对于累积 BRI、VAI 和 METS-VF，每增加 1 个标准差，新发 AF 的完全调整 HR 分别为 1.23（95%CI 1.13～1.35）、1.02（95%CI 0.94～1.10）和 1.23（95%CI 1.12～1.35）。将累积肥胖指数（BRI、VAI 和 METS-VF）以四分位数分类（以第一四分位数为参考），BRI（HR＝1.40，95%CI 1.10～1.79，P＝0.007）和 METS-VF（HR＝1.44，95%CI 1.13～1.83，P＝0.003）最高四分位数参与者新发 AF 风险均显著增加；而在 VAI 中未观察到显著关联（HR＝1.00，95%CI 0.81～1.23，P＝0.988）。限制立方样条分析显示，累积 BRI、基线/累积 VAI 以及基线/累积 METS-VF 与新发 AF 风险存在非线性关系（$P_{总体}$＜0.05，$P_{非线性}$＜0.05）。在 C 指数分析中，BRI 对新发 AF 的预测性能最高，其次是 METS-VF 和 VAI。亚组分析表明，在 60 岁以下参与者中，METS-VF 与新发 AF 风险的关联更强（$P_{交互}$＝0.008）。按遗传风险分层的多基因风险评分分析显示，BRI 与遗传风险对新发 AF 存在协同效应，随着 BRI 和遗传风险增加，新发 AF 的总体风险增加。线性回归分析显示，累积 BRI 与 VAT 体积、VAT 质量、躯干脂肪体积和躯干脂肪质量正相关。基于 XGBoost 算法的特征重要性图表明，累积 BRI 对 VAT 体积、VAT 质量、躯干脂肪体积和躯干脂肪质量的预测价值最大。孟德尔随机化分析证实了躯干脂肪质量与 AF 之间存在显著的因果关系。**结论** BRI、METS-VF 和 VAI 与新发 AF 之间存在显著的非线性关联。较高的 BRI 和 METS-VF 与新发 AF 风险增加显著相关，而 VAI 与新发 AF 风险无显著关联。BRI 与 VAT 和躯干脂肪正相关，且在预测新发 AF 方面，其性能优于 VAI 和 METS-VF。监测和管理 BRI 可能对 AF 的早期检测和干预具有重要意义。

［关键词］ 身体圆度指数；内脏脂肪指数；内脏脂肪代谢评分；房颤
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Body roundness index, visceral adiposity index, and metabolic score for visceral fat in predicting new-onset atrial fibrillation: a UK Biobank cohort study

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［**Abstract**］ **Objective** To explore the longitudinal associations of body roundness index (BRI), visceral adiposity index (VAI), and metabolic score for visceral fat (METS-VF) with the risk of new-onset atrial fibrillation (AF). **Methods** This study included participants from the UK Biobank who were free of AF or pregnancy at baseline and completed the first and second assessments of BRI, VAI, and METS-VF. The changes in BRI, VAI, and METS-VF were classified using K-means clustering analyses, and the cumulative adiposity indices were also calculated. The primary outcome was new-onset AF. Three Cox regression models were employed to investigate the longitudinal associations of the BRI, VAI, and METS-VF changes with the risk of incident new-onset AF. The results were presented as hazard ratios (HRs) and the corresponding 95% confidence intervals (CIs). Restricted cubic spline analyses were performed to explore potential non-linear associations between baseline or cumulative adiposity indices and the risk of new-onset AF. C-index analyses were conducted to evaluate the predictive value of BRI, VAI, and METS-VF for new-onset AF. Subgroup analyses were performed according to age, gender, race, smoking status, alcohol consumption, and physical activity. Polygenic risk scores were applied to account for genetic susceptibility and investigate potential interactions between adiposity indices and genetic risk. Univariate linear regression analyses were performed to evaluate the relationships of cumulative adiposity indices and magnetic resonance imaging and dual X-ray absorptiometry parameters, including visceral adipose tissue (VAT) volume, VAT mass, trunk fat volume, and trunk fat mass. We further applied the eXtreme Gradient Boosting (XGBoost) algorithm, with the feature importance being measured to evaluate the predictive value of each adiposity index for imaging parameters. Mendelian randomization analysis was further conducted to investigate the potential causal relationship between trunk fat mass and AF. **Results** A total of 12 776 participants were included. Over a median follow-up of 9.60 years, 761 (5.96%) new-onset AF events were recorded. Participants were divided into four classes based on the changes in adiposity indices. In the fully adjusted model, compared to participants in Class 1 of BRI, those in Class 3 (HR＝1.30, 95%CI 1.04-1.63, P＝0.023) and Class 4 (HR＝2.17, 95%CI 1.61-2.93, P＜0.001) were associated with significantly higher risks of new-onset AF. Regarding METS-VF, participants in Class 4 of METS-VF also demonstrated a significantly higher risk of new-onset AF compared to those in Class 1 (HR＝1.66, 95%CI 1.15-2.39, P＝0.007). However, no significant association was observed between different classes of VAI and the risk of new-onset AF. For every 1 standard deviation increase in cumulative BRI, VAI, and METS-VF, the fully adjusted HRs of new-onset AF were 1.23 (95%CI 1.13-1.35), 1.02 (95%CI 0.94-1.10), and 1.23 (95%CI 1.12-1.35), respectively. Cumulative adiposity indices (BRI, VAI, and METS-VF) were divided into quartiles. Using the first quartile as reference, participants in the highest quartiles of BRI (HR＝1.40, 95%CI 1.10-1.79, P＝0.007) and METS-VF (HR＝1.44, 95%CI 1.13-1.83, P＝0.003) both exerted a significantly higher risk of new-onset AF. Regarding VAI, no significant association was observed (HR＝1.00, 95%CI 0.81-1.23, P＝0.988). Restricted cubic spline analyses revealed non-linear relationships between cumulative BRI, baseline/cumulative VAI, and baseline/cumulative METS-VF with new-onset AF risk (all $P_{overall}$＜0.05, $P_{non\text{-}linear}$＜0.05). In the C-index analysis, BRI demonstrated the highest predictive performance for new-onset AF, followed by METS-VF and VAI. Subgroup analysis indicated a stronger association between METS-VF and the risk of new-onset AF amongst participants younger than 60 years ($P_{interaction}$＝0.008). Polygenic risk score analysis stratified by genetic risk demonstrated a synergistic effect between BRI and genetic risk with new-onset AF, with the overall risk of new-onset AF increasing as both BRI and genetic risk increased. Linear regression analysis revealed a positive correlation between cumulative BRI with VAT volume, VAT mass, trunk fat volume, and trunk fat mass. The feature importance plot derived from the XGBoost algorithm indicated that cumulative BRI had the greatest predictive value on VAT volume, VAT mass, trunk fat volume, and trunk fat mass. Mendelian randomization analysis confirmed a significant causal relationship between trunk fat mass and AF. **Conclusions** There are significant non-linear associations between BRI, METS-VF, and VAI with new-onset AF. Higher BRI and METS-VF are significantly associated with a higher risk of new-onset AF, whereas no significant association is observed for the VAI. BRI exhibits a positive correlation with VAT and trunk fat, and

demonstrates superior performance in predicting new-onset AF compared to VAI and METS-VF. Monitoring and managing BRI may be important in the early detection and intervention of AF.

［**Key Words**］ body roundness index; visceral adiposity index; metabolic score for visceral fat; atrial fibrillation

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