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Association of the triglyceride-glucose index with the risk of sarcopenia: a meta-analysis with clinical implications

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ADMINISTRATIVE INFORMATION

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INTRODUCTION

Review question / Objective Sarcopenia is associated with adverse clinical outcomes in older adults, yet simple and widely available biomarkers for early risk identification remain limited. This study aimed to determine the relationship between the triglyceride-glucose (TyG) index and the risk of sarcopenia.

Condition being studied Sarcopenia, characterized by the progressive loss of skeletal muscle mass and function, has become a major public health concern in aging societies. Recent epidemiological studies indicate that the prevalence of sarcopenia in community-dwelling older adults is approximately 10–20%, although it varies depending on the diagnostic criteria and study population [1]. Beyond being a marker of frailty, sarcopenia is independently associated with a wide range of adverse clinical outcomes, including falls, fractures, functional decline, postoperative complications, prolonged hospitalization, and increased mortality [2]. Established risk factors include advanced age, inadequate nutrition, physical inactivity, and chronic diseases such as diabetes and osteoporosis. Therefore, the identification of simple and accessible biomarkers for early detection and risk stratification of sarcopenia has become an important clinical priority [3]. Given the aging of populations and the increasing burden of chronic disease, identifying simple biomarkers or indices that help stratify the risk of sarcopenia in vulnerable groups is of considerable clinical importance.

The triglyceride–glucose (TyG) index, calculated from fasting triglyceride and plasma glucose levels, has emerged as a convenient and reliable surrogate marker of insulin resistance. Insulin resistance can impair muscle protein synthesis, reduce skeletal muscle glucose uptake, and promote chronic low-grade inflammation, all of which may contribute to muscle loss and functional decline, providing a biological rationale for investigating the relationship between the TyG index and sarcopenia. Compared with traditional methods such as the hyperinsulinemic–euglycemic clamp or the homeostasis model assessment of insulin resistance (HOMA-IR), the TyG index is inexpensive, reproducible, and easily obtained in routine clinical practice. Growing evidence has demonstrated that an elevated TyG index is associated with metabolic syndrome, type 2 diabetes, cardiovascular disease, and chronic kidney disease, highlighting its value as a systemic metabolic risk indicator [4, 5].

In recent years, an increasing number of observational studies have explored the relationship between the TyG index and sarcopenia; however, the findings have been inconsistent. Some cross-sectional analyses based on large population datasets such as the National Health and Nutrition Examination Survey (NHANES) reported that a higher TyG index was associated with an increased likelihood of sarcopenia, supporting the role of insulin resistance in muscle loss [6]. Conversely, other studies conducted in specific populations, including middle-aged and older women or individuals without diabetes, observed an inverse association, in which higher TyG levels appeared to be protective against sarcopenia, possibly reflecting differences in nutritional status, body composition, and metabolic reserve [7]. Furthermore, several investigations have suggested that composite indicators derived from the TyG index, such as TyG-BMI or TyG-waist circumference, may exhibit stronger associations with sarcopenia than the TyG index alone, indicating a complex interaction between metabolic dysfunction, adiposity, and skeletal muscle mass [8]. These heterogeneous findings, together with variations in study design, population characteristics, and diagnostic criteria for sarcopenia, make it difficult to draw definitive conclusions regarding the direction and magnitude of the association.

Despite the growing interest in the TyG index as a metabolic biomarker, no consensus has been reached regarding its relationship with sarcopenia, and the existing evidence has not been systematically synthesized. Therefore, this is the first meta-analysis to quantitatively evaluate the association between the TyG index and sarcopenia and to explore whether this relationship varies across different subgroups defined by sex, age, diabetes status, and TyG index classification methods.

METHODS

Search strategy The PubMed, Web of Science and CNKI databases were searched up to October 27, 2025, with the following terms: triglyceride glucose index, TyG index and sarcopenia. The specific search strategy for the PubMed database is shown in Supplementary file 1. Moreover, MeSH terms and free texts were used during the search process. References of included studies were also reviewed.

Participant or population Studies that met the following criteria were included: a. the TyG index was calculated according to the formula ln (triglyceride [mg/dL] × fasting glucose [mg/dL]/2) [10]; b. the association between the TyG index and the risk of sarcopenia was explored; c. odds ratios (ORs) with 95% confidence intervals (CIs) were reported; d. studies were published in English or Chinese; and e. full texts were available and in cases where the full text of an article was unavailable, attempts were made to contact the corresponding authors; if this failed, the study was excluded from the analysis.

Intervention Studies that met the following criteria were included: a. the TyG index was calculated according to the formula ln (triglyceride [mg/dL] × fasting glucose [mg/dL]/2) [10]; b. the association between the TyG index and the risk of sarcopenia was explored; c. odds ratios (ORs) with 95% confidence intervals (CIs) were reported; d. studies were published in English or Chinese; and e. full texts were available and in cases where the full text of an article was unavailable, attempts were made to contact the corresponding authors; if this failed, the study was excluded from the analysis.

Comparator Studies that met the following criteria were included: a. the TyG index was calculated according to the formula ln (triglyceride [mg/dL] × fasting glucose [mg/dL]/2) [10]; b. the association between the TyG index and the risk of sarcopenia was explored; c. odds ratios (ORs) with 95% confidence intervals (CIs) were reported; d. studies were published in English or Chinese; and e. full texts were available and in cases where the full text of an article was unavailable, attempts were made to contact the corresponding authors; if this failed, the study was excluded from the analysis.

Study designs to be included Cohort studies.

Eligibility criteria Studies that met the following criteria were included: a. the TyG index was calculated according to the formula ln (triglyceride [mg/dL] × fasting glucose [mg/dL]/2) [10]; b. the association between the TyG index and the risk of sarcopenia was explored; c. odds ratios (ORs) with 95% confidence intervals (CIs) were reported; d. studies were published in English or Chinese; and e. full texts were available and in cases where the full text of an article was unavailable, attempts

were made to contact the corresponding authors; if this failed, the study was excluded from the analysis.
Studies that met the following criteria were excluded: a. insufficient or severely duplicated (> 50%) data; and b. letters, editorials, reviews, case reports, animal studies or conference abstracts.

Information sources The following data were collected from the included studies: first author, patient source, year, sample size, number of sarcopenia cases, specific population characteristics, age, grouping method according to the TyG index, OR and 95% CI.

Main outcome(s) Incidence of sarcopenia.

Quality assessment / Risk of bias analysis Methodological quality was evaluated by the Newcastle–Ottawa Scale (NOS), and studies with NOS scores ≥6 were defined as high-quality studies [11, 12].

Strategy of data synthesis All analyses were conducted using STATA version 17.0 software. The primary outcome was the risk of sarcopenia associated with the TyG index. For studies reporting incidence or prevalence rates without directly reported odds ratios (ORs), we calculated ORs using standard formulas comparing the highest versus lowest TyG index categories or per unit increase, based on reported case numbers and total participants in each group. Heterogeneity between studies was assessed using the Q test and I^2 statistic. A random-effects model (DerSimonian and Laird method) was applied if significant heterogeneity was observed ($I^2 > 50\%$ or $P < 0.1$); otherwise, a fixed-effects model (Mantel-Haenszel method) was used [13]. This approach ensures that between-study variability is appropriately accounted for in the presence of heterogeneity.

Subgroup analysis Subgroup analyses were performed based on sex, age, diabetes status, and TyG index classification to explore potential sources of heterogeneity.

Sensitivity analysis Sensitivity analyses were conducted by sequentially omitting one study at a time to assess the robustness of the pooled results.

Country(ies) involved China - Department of Geriatric Medicine, The Second People's Hospital of Deyang.

Keywords Triglyceride–glucose index; sarcopenia; risk; meta-analysis.

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