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Time-Restricted Eating and Sarcopenia Severity in Chinese Community-Dwelling Older Adults: A Cross-Sectional Study Stratified by Nutritional Status

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Abstract

Background

Time-restricted eating (TRE) is gaining attention for improving metabolic health, but its impact on muscle health in older adults remains unclear. Concerns include the risks of inadequate energy and protein intake within a shortened eating window and age-related anabolic resistance. Nutritional status, being closely tied to muscle health, may influence the association between TRE and sarcopenia, yet research in Chinese older adults is limited.

Aim

This study aimed to explore the association between TRE and sarcopenia severity in Chinese community-dwelling older adults and examine whether nutritional status modifies this relationship.

Methods

A cross-sectional study of 3,680 Chinese older adults (≥ 60 years) from Shanghai was conducted. TRE was defined as an eating window of ≤ 10 hours, determined via questionnaire. Sarcopenia severity was classified using the 2019 Asian Working Group for Sarcopenia criteria. Nutritional status was assessed using the Mini Nutritional Assessment and grouped as well-nourished or at risk of malnutrition. Multinomial logistic regression was used to evaluate relationships.

Results

Of the participants, 509 (13.8%) followed TRE. TRE was associated with higher odds of severe sarcopenia (OR = 1.75, 95% CI = 1.16–2.63, P = 0.008) but showed no significant associations with pre-sarcopenia or sarcopenia. Stratified analysis showed this association was significant in well-nourished individuals (OR = 1.92, 95% CI = 1.17–3.14, P = 0.010) but not in those at risk of malnutrition (OR = 1.83, 95% CI = 0.81–4.12, P = 0.145).

Conclusion

TRE within a 10-hour eating window was linked to higher odds of severe sarcopenia, particularly in well-nourished older adults. These findings highlight the need to consider nutritional status when evaluating TRE's implications for muscle health in aging populations.

Introduction

Sarcopenia is a progressive age-related skeletal muscle disorder characterized by the loss of muscle mass, muscle strength, and physical performance [1]. In older adults, sarcopenia is clinically important not only because of its high frequency, but also because it is associated with falls, disability, poor quality of life, and mortality [1]. With rapid population ageing, sarcopenia has become a major challenge for healthy ageing, particularly in Asian populations, where the Asian Working Group for Sarcopenia (AWGS) 2019 criteria are now widely used for diagnosis and severity classification [2]. Prevalence significantly increases with age, reaching up to 67.1% in those aged 80 years and above [3].Because sarcopenia develops through the interaction of ageing, chronic disease, physical inactivity, and inadequate nutrition, identifying modifiable lifestyle-related factors is an important research priority [4].

Time-restricted eating (TRE), a form of intermittent fasting, has recently gained attention as a potential dietary strategy for improving metabolic health. TRE typically involves restricting all daily caloric intake to a specific time window, usually ranging from an 8 to 12-hour period, abstaining from food during the remaining hours [5]. Accumulating evidence suggests that TRE may improve metabolic disorders, including obesity, and type 2 diabetes by enhancing circadian rhythms [6, 7] and regulating metabolic and inflammatory responses [8, 9]. However, whether these metabolic benefits translate into better muscle health in older adults remains unclear [10]. In ageing populations, muscle protein synthesis is already blunted by anabolic resistance, and shortening the eating window may reduce opportunities for adequate energy intake and optimal protein distribution across meals [11]. Animal studies have shown that 8-hour TRE may alleviate age-related sarcopenic obesity in HFD-induced mice by enhancing FGF21-FGFR1 signalling sensitivity and preserving muscle contractile function [12]. Notably, similar to time-restricted eating, other forms of fasting have also been shown to affect muscle-related indicators in older adults, such as Ramadan fasting, which can influence physical capacity and neuromuscular junction function in older men [13]. Current reviews emphasize that evidence supporting TRE for skeletal muscle function and metabolism in older adults is still limited, and that lean mass preservation should be considered when interpreting the potential benefits of TRE in this population [11, 14].

Nutritional status may be particularly relevant when evaluating the association between TRE and sarcopenia in older adults [15]. Poor nutritional status is closely linked to reduced muscle mass and function, and may influence how older individuals respond to a restricted eating window [15]. Therefore, nutritional status is not only a potential confounder, but also a plausible effect modifier of the association between TRE and sarcopenia [11]. Nevertheless, evidence on TRE and sarcopenia in community-dwelling older adults remains scarce, and data from Chinese populations are especially limited [11, 15]. In addition, few studies have examined whether the association between TRE and sarcopenia differs according to nutritional status [11]. Therefore, this study aimed to examine the association between TRE and sarcopenia severity in Chinese community-dwelling older adults, and to explore whether this association differed by nutritional status.

Methods

Study Participants

The study cohort comprised 3,899residents aged 60 years or olderfrom four districts in Shanghai,China, namely Jiangwan,Chongming, Pujiang, and Jiading. All participants were invited to participate in the national free health examination programme between 2020 and 2023. Inclusion criteria were as follows. They had to be aged 60 years orolder and resided in eitherJiangwan, Chongming, Pujiang, orJiading districts within Shanghai, China. All individuals were invited to the national free health examination programme from 2020 to 2023 and voluntarily took part in the study with signed informed consent. Participants were excluded under the following conditions. Those with an incomplete tripartite questionnaire were excluded. Individuals unable to complete grip strength and walking speed tests because of disability or other reasons, which would lead to missing data for sarcopenia diagnosis, were also excluded. In addition, participants with an incomplete Mini Nutritional Assessment (MNA) questionnaire were excluded. A total of 3,680 participants wereultimately included in the analysisas illustrated in Fig. 1. This research protocol was reviewed and approved bythe Ethics Committee. The studywas conducted in strictaccordance with relevant medicalresearch ethics guidelines. All participants were fully informed of the nature of the study and signed informed consent forms prior to participation. All data related to the study were kept strictly confidential and used solely for statistical analysis within this study.

Anthropometry

Following complimentary health examinations provided by the national programme, all participants were invited to attend face-to-face interviews to complete standardised questionnaires. These included questions regarding age, gender, educational level (illiterate or literate), smoking habits (smoker or nonsmoker), and drinking habits (drinker or nondrinker),

while also collecting information on living arrangements (living alone), marital status (widowed or not), and occupation type (farmer or non-farmer); The International Physical Activity Questionnaire Short Form (IPAQ) was used to assess participants' physical activity levels, and weekly metabolic equivalent minutes (Met-min/wk) were calculated [16]. Participants' height and weight were measured by trained personnel following standard operating procedures, and body mass index (BMI) was calculated using the formula BMI = weight (kg) / height² (m²). A questionnaire was used to collect participants' medical history and medication history [17], specifically identifying a history of conditions such as diabetes, hypertension, hyperlipidemia, stroke, as diagnosed by a physician.

Definition of TRE

By enquiring about participants' daily meal times (including breakfast, lunch, dinner, and snacks) during the month preceding the survey, this study calculated the time-of-day eating window as the time of the last meal minus the average start time of the first meal of the day [18, 19]. Participants were categorised into two group with a time-of-day eating window exceeding 10 hours (non-TRE) and those with a window within 10 hours (TRE) [20].

Definition of Pre-Sarcopenia (Low Muscle Strength Only), Sarcopenia, and Severe Sarcopenia. Muscle mass was measured using direct segmental multi-frequency bioelectrical impedance analysis (BIA; InBody S10, Biospace Co., Seoul, South Korea). Low muscle mass was defined as skeletal muscle index (SMI) < 7.0 kg/m² for males and < 5.7 kg/m² for females [21]. Muscle strength in the non-dominant hand was assessed using a dynamometer (GRIP-D, Takei Co., Ltd., Niigata, Japan). Low muscle strength was defined as a grip strength < 28 kg for males and < 18 kg for females [22]. Physical function was evaluated using normal walking speed; a walking speed < 1.0 m/s was classified as physical impairment, a criterion applicable to all male and female participants [21, 22]. All tests were conducted by the same physiotherapist at the same location. Pre-sarcopenia (low muscle strength only) was defined as reduced muscle strength with muscle mass within normal range. Sarcopenia was defined as low muscle mass index combined with either low muscle strength or physical disability [1, 23]. Sarcopenia patients exhibiting concurrent low muscle strength, low muscle mass, and physical disability could be diagnosed with severe sarcopenia (CPS) based on disease severity [24]. The diagnosis of sarcopenia is based on the new criteria established by the Asian Working Group for Sarcopenia (AWGS) in 2019 [25]. These criteria encompass reduced muscle mass and muscle strength and/or physical impairment.

Definition of nutritional status

The MNA, a well-validated scoring tool, was employed to assess nutritional status in older adults [26]. The MNA comprises 18 items, each weighted by assigning a score. Scores are determined based on predetermined responses, with higher scores indicating better nutritional status. Participants scoring above 23.5 were assigned to the well-nourished group, while those scoring ≤ 23.5 were assigned to the malnutrition risk group [27].

Statistical Analysis

IBM SPSS v26.0 software (SPSS Inc., Chicago, Illinois, USA) was employed for all statistical computations. The significance level was set at 0.05. This study analysed baseline cross-sectional data, encompassing sociodemographic and health-related characteristics of the cohort, and compared outcomes between two groups, namely the well-nourished group and the malnutrition-at-risk group. Categorical variables were expressed as incidence rates and percentages; intergroup differences were assessed using chi-square tests. Continuous normally distributed variables were presented as mean ± standard deviation; non-normally distributed continuous variables, such as IPAQ scores, were expressed as median and interquartile range; intergroup differences were tested using t-tests or Mann-Whitney U tests, respectively. We used multinomial logistic regression to estimate the association between TRE and sarcopenia severity, with non-sarcopenia as the reference category. Models were adjusted sequentially for demographic factors, lifestyle and social factors, and cardiometabolic comorbidities. To examine whether nutritional status modified this association, we

additionally tested a multiplicative interaction term between TRE and nutritional status in the overall sample, and then conducted stratified analyses by nutritional status. Results are presented as odds ratios (OR), 95% confidence intervals (CI), and corresponding p-values. All P-values represent two-tailed probabilities, with a significance level of α = 0.05. Differences were considered statistically significant when $P < 0.05$.

Results

Baseline characteristics

Of the 3,680 participants included in the final analysis, 13.8% (n = 509) demonstrated the TRE pattern, comprising 419 nutritionally adequate individuals and 90 at risk of malnutrition, while 19.1% of participants had sarcopenia. Results are presented in Tables 1 and 2. Background characteristics, stratified by nutritional status, are presented inrelation to the duration of the eating time window throughout the total sample. Participants following the TRE pattern exhibited reduced grip strength ($P = 0.049$), were less likely to be farmers ($P < 0.001$), engaged in less physical activity ($P < 0.001$), and were more likely to have diabetes ($P = 0.038$) and hyperlipidaemia ($P < 0.001$) compared to those without the TRE pattern (Table 1). Furthermore, among nutritionally adequate participants, those exhibiting the TRE pattern were less likely to be farmers ($P < 0.001$), engage in less physical activity ($P < 0.001$), and have a higher prevalence of hyperlipidaemia ($P < 0.001$) compared to non-TRE pattern participants. Additionally, those at risk of malnutrition within the TRE group displayedhigher BMI ($P = 0.005$) and lower IPAQ scores ($P = 0.002$). Moreover, data indicated a higher prevalence of sarcopenia among participantsadopting the TRE pattern, observable in both the total sample and the nutritionally adequate group stratified by nutritional status ($P = 0.029$, $P = 0.028$). Within the three groups stratified by sarcopenic status, this increased prevalence was more pronounced among participants with sarcopenia and severe sarcopenia ($P = 0.033$, $P = 0.029$) (Table 2).

Table 1
Baseline characteristics of the total sample of study participants (n = 3680)

Characteristics	Non-TRE (n = 3171)	TRE (n = 509)	P-value
Sociodemographic characteristics			
Age(y)	71.95 ± 5.79	71.80 ± 6.34	0.589
Female, n(%)	1809(57.0)	313(61.4)	0.067
Weight(kg)	61.98 ± 14.03	61.24 ± 10.30	0.685
BMI(kg/m^2)	23.82 ± 3.33	23.99 ± 3.32	0.309
IPAQ(Met-min/wk)	3399(1386,6825)	2772(1039,5418)	< 0.001
Living alone, n(%)	412(13.0)	69(13.6)	0.732
widowed, n(%)	519(16.4)	93(18.3)	0.291
Occupation(farmer), n(%)	1104(34.8)	125(24.6)	< 0.001
Educational level (Illiterate), n(%)	247(10.4)	136(10.5)	0.921
Smoking,n(%)	435(13.8)	69(13.6)	0.901
Alcohol drinking,n(%)	265(8.4)	34(6.7)	0.205
Handgrip strength(kg)	24.34 ± 8.82	23.52 ± 7.92	0.049
Gait speed(m/s)	1.12 ± 0.25	1.11 ± 0.26	0.503
Medical history			
Diabetes	682(21.6)	89(17.6)	0.038
Hypertension	2220(70.0)	364(71.4)	0.532
Hyperlipidemia	1432(45.5)	277(55.0)	< 0.001
Stroke	484(17.5)	85(18.8)	0.493
MNA	25.88 ± 2.25	25.72 ± 2.31	0.145
Nutritional status, n(%)			0.385
Risk of malnutrition	517(16.3)	91(17.8)	
Well-nourished	2654(83.7)	419(82.2)	
Sarcopenia	484(15.3)	97(19.1)	0.029
Sarcopenia staging,n(%)			0.033
Pre-sarcopenia	752(23.7)	112(22.0)	
Sarcopenia	293(9.2)	49(9.6)	
Severe sarcopenia	191(6.0)	48(9.4)	

Table 2
Baseline Characteristics of Study Participants, stratified by nutritional status

Characteristics	Well-nourished (n = 3073)			Risk of malnutrition (n = 607)		
	Non-TRE(n = 2654)	TRE(n = 419)	P-Value	Non-TRE(n = 517)	TRE(n = 90)	P-Value
Sociodemographic characteristics						
Age(y)	71.74 ± 5.67	71.59 ± 6.21	0.622	73.06 ± 6.28	72.78 ± 6.90	0.702
Female, n(%)	1470(55.4)	251(59.9)	0.083	339(65.6)	62(68.1)	0.634
Weight(kg)	62.45 ± 9.97	62.49 ± 9.79	0.934	53.39 ± 9.03	55.49 ± 10.68	0.435
BMI(kg/m^2)	24.38 ± 3.08	24.42 ± 3.13	0.769	20.94 ± 3.12	21.96 ± 3.41	0.005
IPAQ(Met-min/wk)	3612(1386,7035)	3066(1386,5586)	< 0.001	3066(924,6106)	1695(693,4127)	0.002
Living alone, n(%)	332(12.5)	49(11.7)	0.648	80(15.5)	20(22.0)	0.127
widowed, n(%)	415(15.6)	72(17.2)	0.410	104(20.3)	21(23.1)	0.543
Occupation(farmer), n(%)	900(33.9)	98(23.4)	< 0.001	204(39.6)	27(29.7)	0.072
Educational level (Illiterate), n(%)	251(9.5)	43(10.3)	0.594	73(14.2)	16(17.6)	0.397
Smoking,n(%)	377(14.2)	56(13.4)	0.645	58(11.3)	13(14.3)	0.412
Alcohol drinking,n(%)	246(9.3)	32(7.7)	0.286	19(3.7)	2 (2.2)	0.491
Handgrip strength	24.85 ± 8.85	24.09 ± 7.89	0.103	21.73 ± 8.15	20.85 ± 7.52	0.336
Gait speed(m/s)	1.13 ± 0.24	1.12 ± 0.26	0.907	1.05 ± 0.27	1.02 ± 0.27	0.302
Medical history						
Diabetes	563(21.4)	72(17.3)	0.061	119(23.1)	17(18.7)	0.355
Hypertension	1882(70.9)	303(72.3)	0.556	338(65.4)	61(67.0)	0.759
Hyperlipidemia	1198(45.5)	229(55.4)	< 0.001	234(45.3)	48(52.7)	0.192
Stroke	364(15.8)	62(16.7)	0.658	120(25.8)	23(28.4)	0.617
MNA	26.63 ± 1.47	26.54 ± 1.50	0.271	22.05 ± 1.56	21.96 ± 1.52	0.602
Sarcopenia	300(11.3)	63(15.0)	0.028	184(35.6)	34(37.8)	0.690
Sarcopenia staging,n(%)			0.029			0.694
Pre-sarcopenia	655(24.7)	93(22.2)		97(18.8)	19(21.1)	
Sarcopenia	197(7.4)	34(8.1)		96(18.6)	15(16.7)	
Severe sarcopenia	103(3.9)	29(6.9)		88(17.0)	19(21.1)	

Relationship between TRE and sarcopenic status

Utilizing a logistic regression model with sarcopenic status set as thedependent variable, this study examined the association between TRE and sarcopenia severity. The unadjusted model revealed a significant association between TRE and sarcopenic status (OR = 1.62; 95% CI = 1.16–2.28) (Table 3). In Model 3, TRE remained independently associated with increased odds of severe sarcopenia (OR = 1.75; 95% CI = 1.16–2.63). Further analyses stratified by nutritional status revealed, TRE was also associated with significantly increased sarcopenia severity in the well-nourished group (OR = 1.92; 95% CI = 1.17–3.14); notably, no significant association was observed between TRE and sarcopenic status in the malnourished group (OR = 1.83; 95% CI = 0.81–4.12) (Fig. 2).

Table 3
Association between time-restricted eating (TRE vs.non-TRE) and sarcopenia in total sample and by nutritional status

Variables	Crude Model[a]		Model 1[b]		Model 2[c]		Model 3[d]	
	OR (95%CI)	P-Value	OR (95%CI)	P-Value	OR (95%CI)	P-Value	OR (95%CI)	P-Value
Total (n = 3680)								
Non-sarcopenia	Ref		Ref		Ref		Ref	
Pre-sarcopenia	0.96(0.76–1.21)	0.735	0.96(0.76–1.22)	0.754	0.96(0.75–1.23)	0.750	0.99(0.76–1.28)	0.928
Sarcopenia	1.08(0.78–1.49)	0.649	1.23(0.87–1.74)	0.237	1.25(0.89–1.77)	0.204	1.33(0.93–1.92)	0.119
Severe sarcopenia	1.62(1.16–2.28)	0.005	1.92(1.32–2.80)	0.001	1.71(1.16–2.52)	0.007	1.75(1.16–2.63)	0.008
Well-nourished (n = 3073)								
Non-sarcopenia	Ref		Ref		Ref		Ref	
Pre-sarcopenia	0.92(0.71–1.18)	0.503	0.92(0.71–1.20)	0.541	0.94(0.72–1.22)	0.620	0.95(0.72–1.26)	0.717
Sarcopenia	1.12(0.76–1.64)	0.581	1.22(0.81–1.82)	0.345	1.23(0.82–1.85)	0.323	1.31(0.86–2.00)	0.212
Severe sarcopenia	1.82(1.18–2.80)	0.007	2.02(1.27–3.20)	0.003	1.75(1.08–2.82)	0.022	1.92(1.17–3.14)	0.010
Risk of malnutrition(n = 607)								
Non-sarcopenia	Ref		Ref		Ref		Ref	
Pre-sarcopenia	1.25(0.69–2.28)	0.468	1.12(0.59–2.11)	0.728	1.09(0.55–2.15)	0.803	1.13(0.56–2.29)	0.740
Sarcopenia	1.00(0.52–1.90)	0.992	1.29(0.65–2.56)	0.464	1.32(0.66–2.66)	0.437	1.42(0.68–2.98)	0.348
Severe sarcopenia	1.38(0.75–2.52)	0.300	1.92(0.94–3.92)	0.074	1.83(0.86–3.86)	0.115	1.83(0.81–4.12)	0.145

Abbreviations: TRE,time-restricted eating.

[a]Unadjusted

[b]Adjusted for age, sex, and BMI.

[c]Additionally adjusted for IPAQ,Living alone, widowed, farmer, illiteracy, smoking, and alcohol drinking.

[d]Additionally adjusted for IPAQ,Living alone, widowed, farmer, illiteracy, smoking, and alcohol drinking, diabetes, hypertension, hyperlipidemia, and stroke.

Discussion

This study assessed the association between 10-hour time-restricted eating (TRE) and the risk of sarcopenia, as well as its relationship with different nutritional statuses, among community-dwelling older adults aged 60 years and above in China. Results indicated that after adjusting for multiple confounding factors including age, sex, BMI, lifestyle, and chronic diseases, TRE was independently associated with higher odds for severe sarcopenia in Chinese community-dwelling older adults (OR = 1.75, 95% CI = 1.16–2.63, *P* = 0.008). This association was only significant in the well-nourished group (OR = 1.92, 95% CI = 1.17–3.14, *P* = 0.010), whereas no statistically significant association was observed in the malnutrition-risk group (OR = 1.83, 95% CI = 0.81–4.12, *P* = 0.145). These findings suggest that nutritional status might be a key moderatingfactor in the relationship between TRE and sarcopenia among older adults.

In this study, 13.8% (n = 509) of participants exhibited a TRE pattern within 10 hours. Compared to non-TRE pattern participants, the TRE group demonstrated significantly lower grip strength (23.52 ± 7.92 vs 24.34 ± 8.82 kg, *P* = 0.049) significantly lower physical activity levels (median IPAQ 2772 vs 3399 Met-min/wk, *P* < 0.001), higher prevalence of hyperlipidaemia (55.0% vs 45.5%, *P* < 0.001), and lower prevalence of diabetes (17.6% vs 21.6%, *P* = 0.038). These baseline characteristic differences both align with and diverge from some prior research findings. A Spanish study of individuals aged ≥ 64 years found that there was a certain association between the characteristics of those with longer fasting periods (≥ 12 hours) and the TRE group in this study [28, 29]. However, only 21.2% of participants in that study had a feeding period ≥ 12 hours, differing from the 13.8% TRE prevalence in this study. This discrepancy may be attributed to significant differences in dietary cultures between Eastern and Western populations —European populations tend to consume meals late at night, whereas Chinese elderly individuals predominantly maintain the traditional dietary habit of "three regular meals", with relatively concentrated eating windows. Consequently, the composition and manifestation of TRE patterns exhibit geographical variations [30, 43].

Regarding the association between TRE and sarcopenia, this study revealed that the effect of TRE on sarcopenia differed significantly according to disease severity. No significant association was observed between TRE and pre-sarcopenia or sarcopenia, whereas TRE was significantly associated with an increased risk of severe sarcopenia. This finding aligns with the conclusions of Alghadir et al. [12], which demonstrated that Ramadan-like fasting patterns elevated neuromuscular junction degradation markers and impaired muscle function in elderly men, suggesting potential adverse effects of time-restricted feeding on muscle metabolism in older populations [42, 47]. The underlying mechanism may relate to the unique characteristics of muscle anabolic metabolism in the elderly, whose muscle synthesis in this demographic is more sensitive to the timing and dosage of protein intake [15, 31]. TRE compresses the eating window to within 10 hours, potentially leading to concentrated protein intake and uneven distribution throughout the day, failing to sustainably provide substrates for muscle synthesis. This may be accompanied by implicitly insufficient total energy intake [44, 45], thereby activating muscle catabolic pathways such as the ubiquitin-proteasome pathway and reducing myoglobin synthesis rates [11, 32]. This adverse effect is more pronounced in individuals with severe sarcopenia, where muscle reserves are already significantly depleted, ultimately manifesting as a significant association between TRE and severe sarcopenia.

The modulating effect of nutritional status on the TRE-sarcopenia association constitutes the core finding of this study. Stratified analysis revealed that within the well-nourished group, the association between TRE and severe sarcopenia was markedly stronger (OR = 1.92, *P* = 0.010), whereas in the malnutrition-at-risk group, this association was non-significant (*P* = 0.145). This phenomenon may relate to differing metabolic adaptation mechanisms among older adults with varying nutritional statuses. Those in the well-nourished group typically possess relatively adequate muscle reserves and metabolic regulatory capacity. TRE-induced alterations in eating patterns may disrupt their existing muscle synthesis-catabolism equilibrium [46, 47], with suboptimal protein timing further exacerbating muscle loss [31]. Conversely, individuals at risk of malnutrition possess inherently lower muscle reserves and may endure prolonged energy or nutrient deficiency, leading to established metabolic adaptations [33, 34]. Consequently, the additional impact of TRE's feeding window restrictions on muscle metabolism is attenuated or masked more pronounced factors independently associated with

higher odds (such as overall inadequate nutrient intake) [35, 36]. This finding supports the hypothesis proposed in previous studies that "nutritional status modulates the effects of TRE on muscle metabolism" [35, 36], but clarifies its specific regulatory role in the association with severe sarcopenia risk using Chinese population data [48, 49, 50], thereby addressing the limitation of previous studies predominantly focusing on Western populations [37].

This study also observed differences between the TRE group and the non-TRE group in occupational composition (proportion of farmers 24.6% vs 34.8%, $P < 0.001$) and the distribution of chronic diseases, factors which may have potentially influenced the findings. For instance, the TRE group exhibited significantly lower levels of physical activity, whereas insufficient physical activity is strongly associated with sarcopenia [14, 37]; the TRE group exhibited a higher prevalence of hyperlipidaemia, and chronic inflammation (such as that associated with hyperlipidaemia) may also exacerbate muscle breakdown [14]. Although this study adjusted for confounding factors such as physical activity and chronic diseases in the multivariate regression model, residual confounding cannot be entirely ruled out. Furthermore, variations in TRE definitions across studies (e.g., duration of the eating window, specific time periods) may also contribute to inconsistent findings [38]. For instance, Smith et al. [10] observed in animal studies that an 8-hour TRE alleviated sarcopenic obesity in aged mice [39, 40], whereas our study found a 10-hour TRE associated with increased risk of severe sarcopenia in the elderly. This discrepancy may stem from multiple factors including species differences, TRE window duration [41], and dietary composition.

This study has several strengths. First, It included a relatively large sample of community-dwelling older adults examining the association between TRE within a 10-hour window and sarcopenia (including severity stratification). Second, standardised measurement methods were employed to assess muscle mass, muscle strength, and physical function. Diagnosis of sarcopenia and its severity strictly adhered to the 2019 Asian Working Group for Sarcopenia (AWGS) criteria. However, several limitations of this study warrant mention. Third, owing to the cross-sectional nature of the design, this study cannot establish a causal relationship between TRE and sarcopenia. Fourth, the definition of TRE relied on participants' self-reported eating time windows without accounting for specific timing or dietary composition, which may have affected the precision of the findings.

Conclusion

This cross-sectional study of 3,680 community-dwelling older adults individuals in Shanghai confirms that time-restricted eating (TRE) within a 10-hour window is significantly associated with higher odds of severe sarcopenia among Chinese community-dwelling older adults. Crucially, this association is observed only in nutritionally well-adapated elderly individuals and lacks statistical significance in those at risk of malnutrition. This finding suggests that the impact of TRE on sarcopenia in the elderlydemonstrates significant heterogeneity across populations, with nutritional status serving as a key moderating factor. Consequently, when developing TRE-based strategies for sarcopenia prevention or intervention in the elderly, individual nutritional status variations must be fully taken into account. For well-nourished elderly individuals, narrow-window TRE should be adopted cautiously; if implemented, concurrent optimisation of protein intake timing and dosage is recommended to prevent muscle loss. For participants at risk of malnutrition, TRE was not significantly associated with sarcopenia, and intervention strategies should prioritize improving overall nutritional status. Future prospective cohort studies and randomized controlled trials areneeded to confirm the causal relationship between TRE and sarcopenia, and to explore the effects of TRE on elderly muscle metabolism under different feeding window durations and dietary compositions. This will provide scientific evidence for developing more precise dietary intervention protocols for sarcopenia in the elderly.

Declarations

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (Ethics Committee) of Shanghai University of Medicine & Health Sciences (Clinical Trial Number: 2019-WJWXM-04-310108196508064467, approval date: 10 April 2019).

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Miao JJ: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft. Wu QH and Zhang JW: Investigation, Data curation, Writing – review & editing. Guo Q, Chen XY, Shen Y, Cai PP, He YC, Zhou JX, Chen JR, Chen YJ, Chen X and Gao P: Investigation, Data curation, Literature review. Han PP: Supervision, Funding acquisition, Project administration, Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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Figures

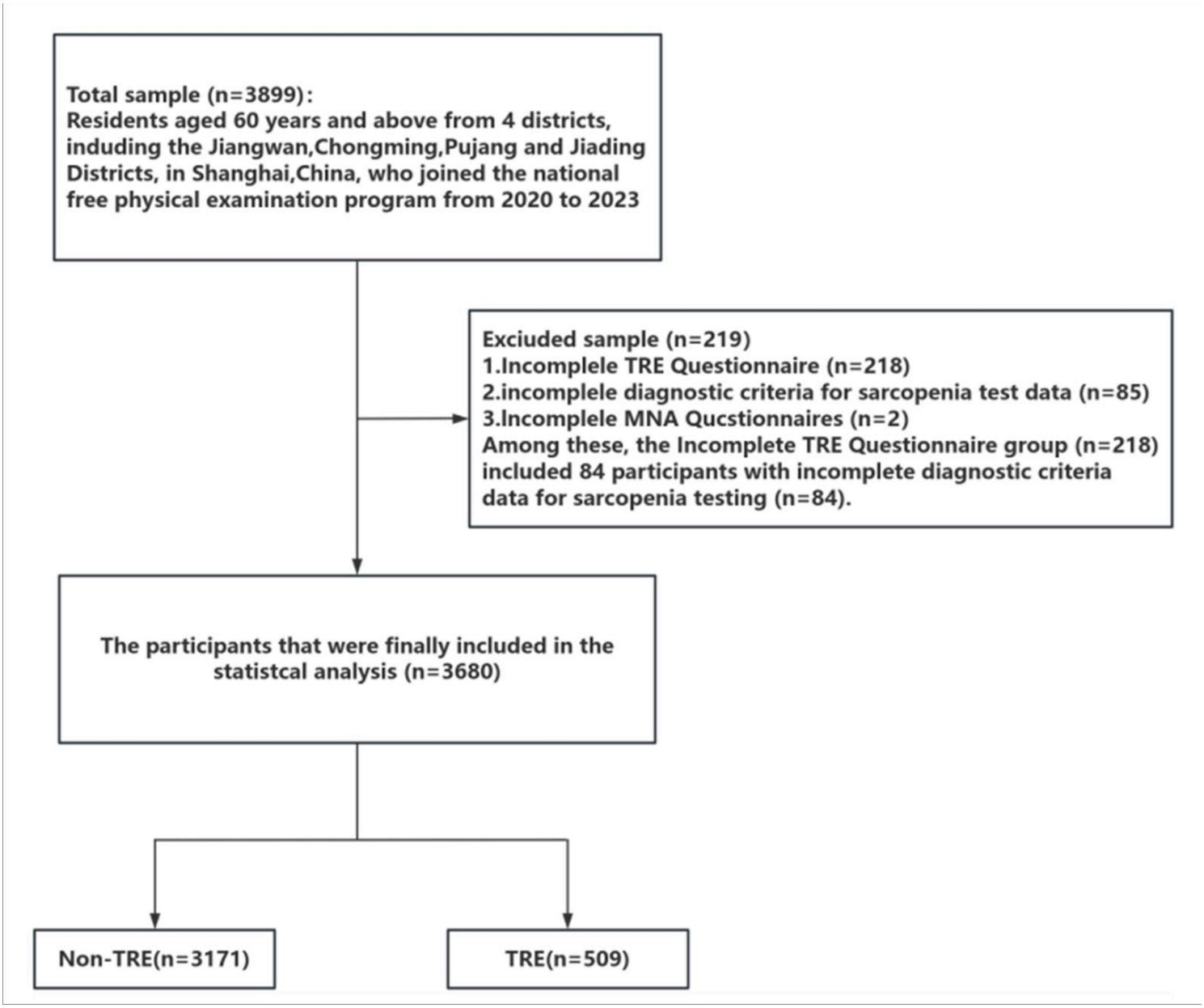


Figure 1

Participant selection flowchart

Variables	OR (95%CI)	P-Value
Total (n=3680)		
Non-sarcopenia	Ref	
Pre-sarcopenia	0.99(0.76-1.28)	0.928
Sarcopenia	1.33(0.93-1.92)	0.119
Severe sarcopenia	1.75(1.16-2.63)	0.008
Well-nourished (n = 3073)		
Non-sarcopenia	Ref	
Pre-sarcopenia	0.95(0.72-1.26)	0.717
Sarcopenia	1.31(0.86-2.00)	0.212
Severe sarcopenia	1.92(1.17-3.14)	0.010
Risk of malnutrition(n=607)		
Non-sarcopenia	Ref	
Pre-sarcopenia	1.13(0.56-2.29)	0.740
Sarcopenia	1.42(0.68-2.98)	0.348
Severe sarcopenia	1.83(0.81-4.12)	0.145

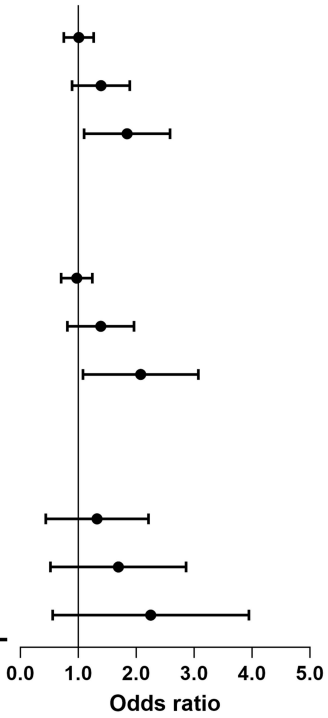


Figure 2

Association between time-restricted eating (TRE vs. non-TRE) and sarcopenia in total sample and by nutritional status. Model 3 was adjusted for age, sex, BMI, IPAQ, living alone, widowed, farmer, illiteracy, smoking, alcohol consumption, diabetes, hypertension, hyperlipidaemia, and stroke.