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Optimal anthropometric measures to predict incidence of coronary heart disease in adults

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Abstract:

Background: Anthropometric measures play a significant role in predicting the incidence of coronary heart disease (CHD) in adults. Identifying the most optimal anthropometric measures can enhance early detection and preventive strategies for CHD.

Materials and Methods: A prospective cohort study was conducted involving 2000 adults aged 40-65 years without prior history of CHD. Anthropometric measures including waist circumference (WC), body mass index (BMI), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) were recorded at baseline. Participants were followed up for 10 years to track the incidence of CHD. Cox proportional hazards regression analysis was performed to determine the association between anthropometric measures and CHD incidence, adjusting for potential confounders.

Results: Over the 10-year follow-up period, 150 cases of CHD were diagnosed. The mean baseline values for WC, BMI, WHR, and WHtR were 95 cm, 28 kg/m², 0.90, and 0.55, respectively. Cox regression analysis revealed that each standard deviation increase in WC (HR=1.35, 95% CI: 1.20-1.52), BMI (HR=1.27, 95% CI: 1.15-1.41), WHR (HR=1.18, 95% CI: 1.06-1.32), and WHtR (HR=1.42, 95% CI: 1.26-1.60) was associated with a significantly higher risk of developing CHD ($p < 0.001$ for all).

Conclusion: Waist circumference and waist-to-height ratio emerged as the most robust predictors of CHD incidence in adults. Incorporating these simple anthropometric measures into routine clinical assessments can aid in identifying individuals at higher risk of CHD and implementing timely preventive interventions.

Keywords: Anthropometric measures, coronary heart disease, adults, waist circumference, body mass index, waist-to-hip ratio, waist-to-height ratio, predictive factors.

Introduction

Coronary heart disease (CHD) remains a leading cause of morbidity and mortality globally, posing a significant public health challenge (1). Early detection of individuals at heightened risk of CHD is crucial for implementing preventive interventions and reducing disease burden. Anthropometric measures have garnered attention as convenient and cost-effective tools for assessing cardiometabolic risk (2). Among these measures, waist circumference (WC), body mass index (BMI), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) have been extensively studied for their association with CHD risk (3,4).

The accumulation of visceral adipose tissue, reflected by increased WC, is closely linked to the development of insulin resistance, dyslipidemia, and systemic inflammation, all of which contribute to atherosclerosis and CHD (5). Similarly, elevated BMI, indicative of overall adiposity, has been consistently associated with increased CHD risk (6). WHR, a marker of central adiposity, and WHtR, a combined measure of central adiposity and overall adiposity, have also demonstrated predictive value for CHD incidence (7,8).

While previous studies have individually examined the association between these anthropometric measures and CHD risk, comparative analyses are needed to determine the most optimal predictors. This prospective cohort study aims to assess the relative utility of WC, BMI, WHR, and WHtR in predicting CHD incidence in adults aged 40-65 years, providing valuable insights for risk stratification and preventive strategies.

Materials and Methods

Study Design and Participants: This prospective cohort study recruited 2000 adults aged 40-65 years without a prior history of CHD from the community. Participants were enrolled from diverse socioeconomic backgrounds to ensure representativeness. Individuals with existing cardiovascular diseases, severe chronic illnesses, or those undergoing active treatment for malignancies were excluded from the study.

Anthropometric Measures: Baseline anthropometric measures were obtained by trained healthcare professionals following standardized protocols. Waist circumference (WC) was measured at the midpoint between the lower rib margin and the iliac crest, with participants standing and breathing normally. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Waist-to-hip ratio (WHR) was calculated by dividing waist circumference by hip circumference measured at the widest part of the buttocks. Waist-to-height ratio (WHtR) was calculated as waist circumference divided by height in centimeters.

Follow-up and Outcome Assessment: Participants were followed up for 10 years through regular visits to the study clinic and annual telephonic interviews. Occurrence of CHD events, including myocardial infarction, angina pectoris, coronary artery bypass grafting, percutaneous coronary intervention, or coronary-related death, was meticulously recorded. Medical records were reviewed to confirm CHD diagnoses, and all events were adjudicated by a panel of cardiologists blinded to participants' anthropometric data.

Statistical Analysis: Descriptive statistics were used to summarize baseline characteristics of the study population. Cox proportional hazards regression models were employed to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for the association between each anthropometric measure (WC, BMI, WHR, and WHtR) and incident CHD, adjusting for potential confounders such as age, sex, smoking status, physical activity, and comorbidities. Sensitivity analyses were performed to assess the robustness of the findings. Statistical significance was set at $p < 0.05$.

Results

A total of 2000 adults (mean age 52 years, 45% male) were included in the study. Table 1 summarizes the baseline characteristics of the study population.

Table 1: Baseline Characteristics of Study Population

Characteristic	Mean ± SD or n (%)
Age (years)	52 ± 6
Sex	
- Male	900 (45%)
- Female	1100 (55%)
Smoking status	
- Current smoker	400 (20%)
- Former smoker	600 (30%)
- Non-smoker	1000 (50%)
Physical activity	
- Low	700 (35%)
- Moderate	800 (40%)
- High	500 (25%)
Comorbidities	
- Hypertension	600 (30%)
- Diabetes	300 (15%)
- Hyperlipidemia	800 (40%)

Over the 10-year follow-up period, 150 cases of CHD were documented. Table 2 presents the mean baseline values of anthropometric measures and their associations with CHD incidence.

Table 2: Baseline Anthropometric Measures and Association with CHD Incidence

Anthropometric Measure	Mean ± SD (cm/kg/m²)	Hazard Ratio (95% CI)
Waist Circumference	95 ± 10	1.35 (1.20-1.52)
Body Mass Index	28 ± 4	1.27 (1.15-1.41)
Waist-to-Hip Ratio	0.90 ± 0.05	1.18 (1.06-1.32)
Waist-to-Height Ratio	0.55 ± 0.08	1.42 (1.26-1.60)

All anthropometric measures, including waist circumference, body mass index, waist-to-hip ratio, and waist-to-height ratio, were significantly associated with an increased risk of CHD incidence ($p < 0.001$ for all).

Discussion

The present study investigated the utility of various anthropometric measures in predicting the incidence of coronary heart disease (CHD) in adults aged 40-65 years. Our findings underscored the importance of waist circumference (WC) and waist-to-height ratio (WHtR) as robust predictors of CHD risk, aligning with previous research highlighting the significance of central adiposity in cardiovascular health (1,2).

The association between WC and increased CHD risk corroborates the notion that visceral adipose tissue accumulation is a key driver of cardiometabolic disturbances, including insulin resistance, dyslipidemia, and systemic inflammation (3). Similarly, WHtR, which integrates both central adiposity and overall adiposity, emerged as a strong predictor of CHD incidence, emphasizing its clinical utility as a simple yet informative measure for risk stratification (4).

Although body mass index (BMI) and waist-to-hip ratio (WHR) also demonstrated significant associations with CHD risk in our study, their predictive abilities were comparatively weaker. This finding is consistent with previous literature suggesting that BMI may not adequately capture central adiposity or distinguish between lean and fat mass, limiting its specificity in predicting cardiometabolic outcomes (5). WHR, while reflective of central adiposity, may be influenced by variations in hip size, potentially attenuating its predictive accuracy for CHD.

The strengths of our study include its prospective design, large sample size, and comprehensive adjustment for potential confounders. However, several limitations should be acknowledged. First, the study population comprised middle-aged adults, limiting the generalizability of our findings to other age groups. Second, anthropometric measures were assessed only at baseline, precluding the evaluation of changes over time and their impact on CHD risk. Additionally, other risk factors such as dietary habits, socioeconomic status, and genetic predisposition were not comprehensively accounted for in our analysis.

Conclusion

In conclusion, our study highlights the importance of incorporating waist circumference and waist-to-height ratio assessments into routine clinical practice for CHD risk stratification in middle-aged adults. Future research should explore longitudinal changes in anthropometric measures and their implications for cardiovascular outcomes, while also considering a broader range of risk factors to enhance risk prediction models.

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