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Association between anthropometric indices and serum adiponectin levels among young Indian adults: A cross-sectional study

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Abstract:

Adiponectin is an adipocyte-derived hormone having anti-inflammatory and insulin-sensitizing properties and plays a key role in the development of metabolic diseases. Therefore, it is of interest to evaluate the association between anthropometric indices and serum adiponectin levels in healthy young adults. BMI, WC, HC, WHR, WHtR and SAD were measured using standard techniques and serum adiponectin was estimated by ELISA. Serum adiponectin levels were significantly and inversely correlated with BMI ($r = -0.97$), WC ($r = -0.63$), WHR ($r = -0.46$), WHtR ($r = -0.64$) and SAD ($r = -0.51$) ($p < 0.001$ for all), with BMI being the only significant predictor in males and BMI along with WHtR in females on multivariate regression analysis. Thus, data shows that simple anthropometric indices such as BMI and WHtR may serve as useful tools for early identification of individuals at metabolic risk.

Keywords: Adiponectin, body mass index and obesity

Background:

Adiponectin is an adipocyte-specific protein hormone that plays a pivotal role in glucose regulation, fatty acid oxidation and insulin sensitivity [1, 2]. Reduced circulating adiponectin levels have been consistently associated with obesity, insulin resistance, type 2 diabetes mellitus and cardiovascular diseases [3, 4]. Anthropometric indices such as body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR) and waist-height ratio (WHtR) are widely used surrogate markers for assessing body fat distribution and obesity-related metabolic risk [5-7]. Central adiposity, in particular, has been shown to exert a stronger influence on adipokine dysregulation than peripheral fat accumulation [8]. Young adulthood represents a transitional phase characterized by dynamic changes in body composition influenced by lifestyle, dietary habits and genetic predisposition [9, 10]. Therefore, it is of interest to assess the relationship between various anthropometric indices and serum adiponectin levels in healthy young adults.

Materials and Methods:**Study design and participants:**

This cross-sectional study was conducted collaboratively by the Departments of Physiology and Biochemistry at King George's Medical University, Lucknow, India, after obtaining institutional ethical clearance (Approval No. 64 ECM II-B/P3). Written informed consent was obtained from all 100 participants. Apparently healthy individuals were recruited using a convenience sampling method.

Inclusion criteria:

Apparently healthy individuals, aged 18-25 years, native of North India, were recruited for the study irrespective of gender after obtaining informed written consent.

Exclusion criteria:

Subjects with any apparent metabolic disorder, chronic illness, cardiac illness, or congenital disorder were excluded from the study.

Anthropometric measurements:

All measurements were recorded by a single trained investigator using standardized protocols. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively and body mass index (BMI) was calculated (kg/m^2). Waist circumference (WC) was measured at the mid-axillary line over the iliac crest at end-expiration, hip circumference (HC) at across the largest circumference of the hips and sagittal abdominal diameter (SAD) in the supine position using an abdominal caliper at end-expiration. Waist-hip ratio (WHR) and waist-height ratio (WHtR) were calculated accordingly.

Biochemical analysis:

After overnight fasting, venous blood samples were collected. Serum adiponectin levels were estimated using a commercially available Adiponectin ELISA kit, following the manufacturer's instructions.

Statistical analysis:

Data were analyzed using SPSS software. Continuous variables are expressed as mean ± standard deviation. Pearson's correlation coefficient assessed associations and multiple linear regressions identified independent predictors. A p-value < 0.05 was considered statistically significant.

Results:

A total of 100 participants (55 males and 45 females) with a mean age of 21.35 ± 1.5 years were included. Baseline anthropometric and biochemical characteristics are summarized in **Table 1**. Serum adiponectin levels showed a significant inverse correlation with BMI, WC, WHR, WHtR and SAD (p < 0.001), while no significant association was observed with HC (**Table 2**). Multivariate regression analysis revealed BMI as the only significant predictor of serum adiponectin levels among males. Among females, both BMI and WHtR independently predicted adiponectin levels (**Table 3**).

Table 1: Baseline characteristics of study participants

Anthropometric parameters (n=100)	(Mean±SD)
Age	21.35 ± 1.5
Male: Female	55: 45
Height (cm)	163.08 ± 7.21
Weight (kg)	60.53 ± 8.74
BMI (kg/m²)	22.71 ± 2.72
HC (cm)	91.52 ± 6.87
WC (cm)	81.93 ± 7.87
WHR	0.89 ± 0.09
Waist-height ratio	0.50 ± 0.04
SAD (cm)	20.83 ± 3.10

Table 2: Correlation between anthropometric indices and serum adiponectin levels

Parameters	r	p
BMI (kg/m²)	-0.97	<0.001
HC (cm)	-0.11	0.23
WC (cm)	-0.63	<0.001
WHR	-0.46	<0.001
Waist height ratio	-0.64	<0.001
SAD (cm)	-0.51	<0.001

Table 3: Multiple linear regression analysis showing predictors of serum adiponectin levels

Anthropometric parameters	β- coefficient	p-value
Male		
BMI (kg/m²)	-387.81	<0.001
HC (cm)	-6.8	0.932
WC (cm)	44.67	0.600
WHR	-2820.64	0.674
Waist-height ratio	-2874.72	0.291
SAD (cm)	-26.62	0.22
Constant	15474.19	0.02
Female		
BMI (kg/m²)	-445.56	<0.001
HC (cm)	0.84	0.973
WC (cm)	-12.61	0.686
WHR	-304.04	0.914
Waist-height ratio	4096.08	0.011
SAD (cm)	-17.21	0.111
Constant	14600.81	0.0001

Discussion:

The present study shows a significant inverse association between serum adiponectin levels and multiple anthropometric indices reflecting both general and central adiposity in healthy

young adults. These findings are consistent with previous studies reporting reduced adiponectin concentrations with increasing adiposity and insulin resistance [11, 12]. BMI emerged as the most robust independent predictor of serum adiponectin levels in both sexes, highlighting its continued relevance as a simple and reliable marker for early metabolic risk assessment [13]. Additionally, waist-height ratio was independently associated with adiponectin levels in females, suggesting that indices reflecting central adiposity may better capture sex-specific metabolic risk [14]. The lack of association between hip circumference and adiponectin supports evidence that peripheral fat may exert neutral or protective metabolic effects compared to visceral fat [15]. Although SAD correlated negatively with adiponectin, it did not outperform simpler indices such as BMI and waist-height ratio.

Conclusion:

Serum adiponectin levels were significantly and inversely correlated with several anthropometric indices of adiposity in healthy young adults. BMI was the strongest independent predictor of adiponectin in both males and females, with WHtR providing extra predictive significance in females. Data shows that simple anthropometric indices, including BMI and WHtR, may serve as useful tools for the early identification of individuals at metabolic risk.

Limitations:

Longitudinal research is required to establish temporality, because the cross-sectional design precludes causal inference. Generalizability was restricted because the sample size was small and came from a particular geographic area. Significant confounders were not evaluated, including nutrition, exercise, hormone levels and socioeconomic status. Future research that takes these factors into account will yield more reliable findings.

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