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Anthropometric Indicators of Central Obesity in the Identification of General and Cancer Related Risk Mortality: Findings from the EPIC Italian Cohort

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INTRODUCTION

Obesity is a growing risk factor among adults, and its accurate identification remains a public health priority. While body mass index (BMI) is widely used, it does not account for fat distribution [1]. Combining BMI with central obesity indicators – such as waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WtHR) – has been shown to improve mortality risk prediction [2,3]. Nevertheless, these indicators have limitations, such as the absence of standardized measurement procedures [4]. Accordingly, the potential predictive role of non-traditional anthropometric indicators – such as the weight-adjusted waist index (WWI), the conicity index (C-index), and relative fat mass (RFM) – has been highlighted [5-7]. However, their clinical interpretation may be limited by the complexity of the required calculations.

AIMS

To develop a novel, clinically applicable and easily interpretable anthropometric method for the classification of central obesity, and to assess its predictive value for all-cause and cancer mortality in comparison with both traditional (BMI, WC, WHR, WtHR) and non-traditional (WWI, C-index, RFM) anthropometric indicators.

METHODS

This study included 45698 adult men and women from the Italian EPIC cohort (1993–1998). Demographic, lifestyle, and medical history data were collected enrollment using standardized questionnaires. Anthropometric measurements (height, weight, waist and hip circumferences) were used to calculate indicators. To calculate Delta Waist (ΔW) a linear regression was performed on WC as a function of height, weight, sex, age, sex/height and sex/age interaction. The model was weighted based on health risk categories defined by NICE [8]: participants with no increased risk were assigned a weighting factor of 1, those with increased risk a weighting factor of 0.5, and those with high or very high risk a weighting factor of 0. Predicted waist circumference was derived from this model by standardizing age to 35 years and reclassifying high/very high risk individuals into the nearest increased risk group stratified by waist circumference, assigning them the highest value of BMI. On this basis, weighting factor was recalculated. ΔW was calculated as the difference between observed and predicted WC. Pearson correlation coefficients were calculated between ΔW, the other non-traditional and traditional indicators. Cox proportional hazards models, with age as the primary time variable, were used to assess the association between ΔW, or other anthropometric variables, and the risk of all-cause and cancer mortality. All models were stratified by study center and adjusted for years of education, smoking status, physical activity level, diabetes, hypertension, and menopausal status for women (model 1).

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All models were also adjusted for BMI (model 2). All analyses were performed separately for men and women. Hazard ratios (HRs) and 95% confidence intervals were estimated. Model performance was assessed using the Bayesian Information Criterion (BIC), with lower values indicating better fit. Statistical significance was set at $p < 0.05$.

RESULTS

During a median follow-up of 15 years, all-cause and cancer deaths were 1002 and 548 in men and 1473 and 888 in women, respectively. ΔW showed a lower correlation with BMI (men: r=0.64; women: r=0.71) than WC (men: r=0.87; women: r=0.91), WtHR (men: r=0.84; women: r=0.90) and WHR (men: r=0.69; women: r=0.75). A strong positive correlation was observed between RFM and BMI (men: r=0.84; women: r=0.85), while correlations between WWI, C-index and BMI were lower than r=0.5 in both sexes. WWI, C-index and RFM were positively correlated with WC, WtHR, WHR in both sexes. After adjustment for covariates, the estimated HRs of all-cause and cancer mortality according to BMI, WC, WtHR, WHR, ΔW, WWI, C-index and RFM are shown in Table 1. In both sexes ΔW was associated with an increased risk of both all-cause mortality (men: HR 1.02 (95% CI 1.01-1.03); women: HR 1.02 (95% CI 1.01-1.02)) and cancer mortality (men: HR 1.02 (95% CI 1.01-1.03); women: HR 1.01 (95% CI 1.003-1.02)) (model 1). Adjustment for BMI did not affect the association between ΔW and all-cause mortality in both sexes and cancer mortality in men, but modified the association between ΔW and cancer mortality in women (model 2). The other indicators were associated with an increased risk of all-cause mortality in men and women and with cancer mortality in men, while in women the association with cancer mortality was observed for all indicators except WHR, WWI and C-index (model 1). After adjusting for BMI no association was found between RFM and all-cause mortality in both sexes, nor between WHR and all-cause mortality in women. Furthermore, in women after adjusting for BMI, WC, WtHR, and RFM were no longer associated with cancer mortality (model 2). In the BIC analysis, the model with ΔW showed the lowest value in both men and women for all-cause mortality (men: BIC=14650; women: BIC=24329). Lower BIC values for cancer mortality were found for C-index in men (BIC=8096) and for WHR in women (BIC=15009).

CONCLUSIONS

ΔW represents a new anthropometric indicator of central obesity, easy to use and understand. In the Italian EPIC cohort it was associated with all-cause mortality risk in both sexes, with better results than other anthropometric indicators already validated and standardized.

BIBLIOGRAPHY

1. Nowak M.M., Niemczyk M., Gołębiewski S. et al., Impact of Body Mass Index on All-Cause Mortality in Adults: A Systematic Review and Meta-Analysis. J Clin Med, 2024; 13(8):2305
2. Jayedi A., Soltani S., Zargar M.S. et al., Central fatness and risk of all cause mortality: systematic review and dose-response meta-analysis of 72 prospective cohort studies. BMJ, 2020; 370:m3324
3. Shi X., Chai L., Zhang D. et al., Association between complementary anthropometric measures and all-cause mortality risk in adults: NHANES 2011-2016. Eur J Clin Nutr, 2025; 79(1):71-78
4. Verweij L.M., Terwee C.B., Proper K.I. et al., Measurement error of waist circumference: gaps in knowledge. Public Health Nutr, 2013; 16(2):281-288
5. Ding C., Shi Y., Li J. et al., Association of weight-adjusted-waist index with all-cause and cardiovascular mortality in China: A prospective cohort study. Nutr Metab Cardiovasc Dis, 2022; 32(5):1210-1217
6. Zhang A., Li Y., Ma S. et al., Conicity-index predicts all-cause mortality in Chinese older people: a 10-year community follow-up. BMC Geriatr, 2022; 22(1):971
7. Suthahar N., Zwartkruis V., Geelhoed B. et al., Associations of relative fat mass and BMI with all-cause mortality: Confounding effect of muscle mass. Obesity (Silver Spring), 2024; 32(3):603-611
8. National Institute for Health and Care Excellence (NICE), Obesity: identification, assessment, and management. NICE guideline, 2014; CG189.

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Table 1. Estimated HRs of all-cause and cancer mortality according to BMI, WC, WtHR, WHR, ΔW, C-index, WWI and RFM.

			Men				Women			
			HR	95% CI	p	BIC	HR	95% CI	p	BIC
All-cause Mortality	Model 1	BMI	1.05	1.03-1.07	<0.001	15511.65	1.02	1.01-1.04	<0.001	24638.91
		WC	1.02	1.01-1.03	<0.001	14655.46	1.01	1.01-1.02	<0.001	24337.93
		WtHR*10	1.36	1.21-1.53	<0.001	14661.52	1.2	1.11-1.30	<0.001	24342.63
		WHR	7.85	2.70-22.81	<0.001	14674.01	3.29	1.56-6.96	0.002	24337.03
		ΔW	1.02	1.01-1.03	<0.001	14650.1	1.02	1.01-1.02	<0.001	24328.64
		WWI	1.29	1.15-1.45	<0.001	14669.3	1.16	1.07-1.25	<0.001	24347.84
		C-index	12.65	4.60-34.73	<0.001	14663.43	4.55	2.30-8.97	<0.001	24343.46
		RFM	1.04	1.02-1.06	<0.001	14666.8	1.02	1.01-1.03	<0.001	24350.00
	Model 2	BMI	0.98	0.95-1.02	0.4	14661.61	0.99	0.97-1.01	0.42	24344.56
		WC	1.02	1.01-1.04	<0.001		1.02	1.01-1.03	<0.001	
		BMI	0.99	0.96-1.04	0.85	14668.35	1.00	0.97-1.02	0.87	24349.88
		WtHR*10	1.39	1.09-1.78	0.007		1.21	1.03-1.38	0.02	
		BMI	1.03	1.01-1.05	0.002	14671.84	1.02	1.01-1.03	0.003	24335.77
		WHR	3.36	0.98-11.54	0.05		2.21	0.98-5.00	0.06	
		BMI	1,002	0.98-1.03	0.91	14656.95	0.99	0.98-1.01	0.55	24335.55
		ΔW	1.02	1.01-1.03	<0.001		1.02	1.01-1.03	<0.001	
		BMI	1.03	1.01-1.05	0.004	14668.01	1.02	1.002-1.03	0.02	24349.54
		WWI	1.19	1.05-1.36	0.006		1.11	1.02-1.21	0.01	
		BMI	1.03	1.01-1.05	0.009	14663.59	1.01	1.00-1.02	0.03	24346.05
		C-index	6.97	2.30-21.08	<0.001		3.23	1.53-6.82	0.002	
		BMI	1.02	0.98-1.05	0.34	14672.76	1.02	0.99-1.04	1.13	24354.99
		RFM	1.03	0.99-1.07	0.10		1.01	0.98-1.03	0.53	
Cancer Mortality	Model 1	BMI	1.03	1.00-1.05	0.03	8508.83	1.02	1.01-1.04	0.005	15144.87
		WC	1.02	1.01-1.02	0.001	8096.65	1.01	1.003-1.01	0.006	15025.73
		WtHR	8.85	1.78-43.93	0.007	8100.19	3.64	1.28-10.25	0.01	15020.63
		WHR	1.35	1.73-31.22	0.007	8100.13	1.57	0.57-4.32	0.38	15009.79
		ΔW	1.02	1.01-1.03	0.001	8097.52	1.01	1.003-1.02	0.006	15026.04
		WWI	1.24	1.06-1.45	0.006	8099.71	1.07	0.97-1.18	0.16	15031.22
		C-index	10.32	2.64-40.28	<0.001	8095.84	2.19	0.90-5.34	0.08	15030.2
		RFM	1.03	1.01-1.06	0.01	8100.59	1.01	1.00-1.03	0.04	15029.01
	Model 2	BMI	0.96	0.91-1.004	0.07	8102.58	1.01	0.98-1.04	0.52	15032.11
		WC	1.03	1.01-1.05	0.001		1.00	0.99-1.02	0.37	
		BMI	0.96	0.91-1.004	0.07	8105.33	1.02	0.98-1.05	0.25	15032.88
		WtHR	1.03	1.01-1.05	0.001		1.25	0.15-10.39	0.83	
		BMI	1.01	0.98-1.04	0.54	8206.32	1.02	1.01-1.04	0.01	15016.96
		WHR	5.81	1.12-30.12	0.03		0.95	0.31-2.88	0.93	
		BMI	0.99	0.96-1.03	0.65	8103.59	1.01	0.99-1.04	0.27	15024.88
		ΔW	1.02	1.004-1.03	<0.01		1.01	0.99-1.02	0.26	
		BMI	1.01	0.98-1.04	0.47	8105.47	1.02	1.003-1.04	0.02	15032.84
		WWI	1.21	1.02-1.44	0.03		1.02	0.90-1.13	0.77	
		BMI	1.01	0.97-1.03	0.66	8101.91	1.02	1.00-1.04	0.03	15032.45
		C-index	9.01	2.02-40.11	0.004		1.40	0.53-3.76	0.49	
		BMI	0.98	0.93-1.03	0.46	8106.31	1.03	0.99-1.06	0.08	15026.05
		RFM	1.05	1.00-1.10	0.05		0.99	0.97-1.02	0.72	

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