

Waist circumference and waist-to-height ratio in relation to semen quality and serum reproductive hormones levels among Estonian Fertile Men

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Introduction

Deviations from normal body weight disturb the reproductive system. It has been suggested that body mass index (BMI), especially above 30, is associated with subfertility in men. A problem with this method is that individuals with a normal BMI may also suffer from metabolic complications commonly found in obese or individuals with a high BMI may be mesomorphic. Therefore, BMI may not be the most accurate marker to assess body fatness. In our study we employed more accurate surrogate measures of adiposity, such as waist circumference (WC) and waist-to-height ratio (WHtR), to evaluate whether adiposity is related to changes in semen quality and serum sex-hormones concentrations.

Material & Methods

During 2010 – 2011 male partners of pregnant women were invited to participate in this study. A total of 260 men were divided into 3 groups according to their WC: (I) <94 cm (low risk), (II) 94-101.9 cm (increased risk), (III) ≥102 cm (high risk) (Alberti et al., 2009). Men were also categorized into 2 groups according to their WHtR: (I) < 0.5; (II) ≥ 0.5 (Browning L et al., 2010). Semen was collected by masturbation and sperm parameters were analyzed according to WHO criteria. Patient height, weight, WC and testicular volume were recorded. Body composition was determined using TANITA Corporation (TBF-300MA). Blood samples were collected for sex hormones and biochemical markers (between 8 AM and 10 AM). Statistical analysis was done using SPSS 20.0 statistical software. Statistical significance was defined as $p < 0.05$.

Results

The mean age of the 260 men was 32 years. Clinical findings are shown in Table 1. WC and WHtR were inversely related to testosterone and sex hormone binding globulin (SHBG) levels. Men with WC ≥102 cm and with WHtR ≥ 0.5 had lower total sperm count than did men with a WC < 94 cm and with WHtR <0.5 (shown in Table 2 and 3). WC and WHtR were related neither to estradiol, FSH and LH levels nor to sperm volume, -concentration, -motility or -morphology.

Table 1. Clinical findings of the fertile Estonian men

Parameters	Mean ± SD	Median
Age in year	32.3 (6.7)	31.0
Height (cm)	180.5 (6.2)	180.0
Weight (kg)	83.8 (13.0)	82.0
Weight 5 years ago (kg)	80.6 (12.4)	79.0
Waist circumference (cm)	91.0 (9.7)	90.0
Body fat percentage (%)	19.8 (5.8)	19.6
Body mass index (BMI)	25.7 (3.8)	25.1
Testicular volume (ml) ^a	23.8 (4.7)	23.5
Abstinent time (day)	3.9 (1.6)	3.0
Genital and chronic diseases, n (%)		
Varicocele, n (%)	65 (25.0)	
Chlamydia trachomatis, n (%)	4 (1.5)	
Ureaplasma urealyticum, n (%)	7 (2.7)	
HIV, n (%) ^b	1 (0.4)	
Diabetes, n (%)	1 (0.4)	
Hypertension, n (%)	16 (6.2)	
Hypothyreosis, n (%)	1 (0.4)	

^a Mean of left and right testis, measured by use of Prader's orchidometer

^b Patient is on the antiviral treatment

Conclusion

Our preliminary results suggest that visceral adiposity (as assessed by increased WC above 94 cm and WHtR ≥ 0.5) is specifically associated with lower testosterone and SHBG levels. Men with WC ≥102 cm and with WHtR ≥ 0.5 are also increased risk of lower total sperm count.

References

Alberti, K et al., (2009). Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International. Circulation, 120(16), 1640–5.

Browning, L. M et al., (2010). A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. Nutrition Research Reviews, 23(2), 247–69

Results

Table 2. Distribution of semen quality and hormone concentrations according to WC

	WC			P value
	< 94cm (n=165)	94-101.9cm n=(57)	≥ 102cm n=(38)	
Semen volume (mL)				
Mean (95% CI)	3.9(3.7;4.2)	3.8(3.3; 4.3)	3.6(3.1; 4.1)	.566
Median (25th, 75th)	3.9(3.0; 5.2)	3.7(2.9; 5.3)	3.3(2.7; 4.8)	
Sperm concentration (×10⁶ per mL)				
Mean (95% CI)	79.5(70.7; 89.6)	66.2(52.4; 83.6)	59.9(45.4; 79.0)	.085
Median (25th, 75th)	85.0(52.0;140.0)	66.0(41.0; 121.0)	63.5(27.2; 122.2)	
Total sperm count (× 10⁶)				
Mean (95% CI)	310.4(275.6;349.7)	248.6(190.2; 324.7)	215.9(162.4; 287.4)	.029
Median (25th, 75th)	334.4(193.6; 543.7)	282.0(109.9; 486.5)	219.1(129.8; 425.0)	
Motile spermatozoa (%)				
Mean (95% CI)	50.6(48.8; 52.3)	51.9(48.4; 55.5)	54.6(50.9; 58.4)	.157
Median (25th, 75th)	51.0(43.5; 58.0)	54.0(45.0; 59.5)	55.0(45.5; 63.0)	
Normal morphology (%)				
Mean (95% CI)	10.8(10.0;11.7)	10.8(9.2; 12.5)	10.2(8.8; 11.6)	.808
Median (25th, 75th)	11.0(6.0;14.0)	10.0(6.5; 15.5)	10.0(7.0; 13.0)	
Testosterone concentration (nmol/L)				
Mean (95% CI)	18.4(17.4; 19.3)	14.7(13.5; 15.9)	12.3(11.1; 13.5)	<.001
Median (25th, 75th)	17.6(14.2; 21.5)	13.8(11.9; 18.1)	12.1(9.0; 15.2)	
E₂ concentration (pmol/L)				
Mean (95% CI)	127.8 (119.5; 136.0)	114.6(103.3; 125.8)	126.8(110.6; 143.0)	.227
Median (25th, 75th)	119.9(87.0; 157.3)	107.0(80.5; 155.5)	114.9(96.3; 147.5)	
Serum SHBG (nmol/L)				
Mean (95% CI)	37.8(35.2; 40.5)	28.7(25.1; 32.3)	22.7(20.4; 25.1)	<.001
Median (25th, 75th)	34.7(26.4; 46.1)	24.6(18.7; 36.0)	22.8(16.7; 27.8)	
Serum LH (IU/L)				
Mean (95% CI)	3.9(3.6; 4.2)	3.4(3.0; 3.7)	3.8(3.2; 4.4)	.202
Median (25th, 75th)	3.7(2.4; 4.9)	3.2(2.4; 4.2)	3.3(2.3; 5.2)	
Serum FSH (IU/L)				
Mean(95% CI)	3.9(3.6; 4.2)	4.0(3.4; 4.6)	4.2(3.5; 5.0)	.687
Median (25th, 75th)	3.5(2.5; 5.0)	3.9(2.7; 4.7)	3.6(2.7; 5.6)	

Table3. Distribution of semen quality and hormone concentrations according to WHtR

Parameter	WHtR		P value
	< 0.5 (n=131)	≥ 0.5 (n=129)	
Semen volume (mL)			
Mean (95% CI)	3.9(3.7;4.2)	3.7(3.4; 4.0)	.355
Median (25th, 75th)	3.9(3.0; 5.2)	3.7(2.8; 5.0)	
Sperm concentration (×10⁶ per mL)			
Mean (95% CI)	79.6(69.3; 91.4)	67.4(58.5; 77.7)	.100
Median (25th, 75th)	90.0(52.0;150.1)	67.5(43.0; 119.9)	
Total sperm count (× 10⁶)			
Mean (95% CI)	312.0(273.1; 356.7)	251.4(214.4 295.0)	.041
Median (25th, 75th)	340.0(199.7; 524.8)	275.3(154.3; 482.0)	
Motile spermatozoa (%)			
Mean (95% CI)	50.4(48.5; 52.4)	52.5 (50.0; 54.7)	.163
Median (25th, 75th)	51.0(44.0; 57.0)	53.0(44.0; 61.0)	
Normal morphology (%)			
Mean (95% CI)	10.8(9.8;11.8)	10.7(9.7; 11.6)	.812
Median (25th, 75th)	11.0(6.0;14.0)	10.0(7.0; 14.0)	
Testosterone concentration (nmol/L)			
Mean (95% CI)	18.5(17.4; 19.7)	14.8(13.9; 15.6)	<.001
Median (25th, 75th)	17.7(14.5; 21.6)	13.8(11.9; 17.9)	
E₂ concentration (pmol/L)			
Mean (95% CI)	128.3(118.9; 137.6)	121.1(112.9; 129.2)	.253
Median (25th, 75th)	118.0(88.0; 155.0)	114.9(83.6; 155.8)	
Serum SHBG (nmol/L)			
Mean (95% CI)	38.8(35.6; 41.9)	28.4(26.2; 30.6)	<.001
Median (25th, 75th)	36.0(27.0; 47.9)	25.3(19.3; 34.0)	
Serum LH (IU/L)			
Mean (95% CI)	3.9(3.6; 4.2)	3.6(3.3; 3.9)	.202
Median (25th, 75th)	3.7(2.4; 4.8)	3.4(2.3; 4.5)	
Serum FSH (IU/L)			
Mean(95% CI)	4.0(3.6; 4.3)	4.0(3.6; 4.3)	.981
Median (25th, 75th)	3.6(2.5; 5.1)	3.5(2.6; 4.7)	