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ORIGINAL RESEARCH

Correlation of BMI and waist circumference with semen parameters among male partners of infertile couples

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INTRODUCTION

Infertility is defined by the World Health Organization as the failure to conceive following 12 months of unprotected intercourse (1,2). In couples seeking treatment, the male factor contributes approximately 30% (3). Male infertility continues to be neglected issue. Gynecologists mostly concentrate on female partners whereas surgeons look for presence of varicocele or hydrocele. Little attention has been given to male infertility.

Obesity is associated with significant disturbances in the hormonal milieu that can affect the reproductive system(4,5), Increased weight may coincide with conditions like diabetes, hypertension and altered sex-hormonal status, which is well documented with respect to female studies (6).

It is hypothesized that obesity associated with increased insulin resistance may disturb the hormonal and metabolic regulation of spermatogenesis resulting in subnormal semen parameters. Obesity per se may also be responsible for increased oxidative stress in the local testicular environment resulting in damage to the developing spermatozoa. There have been some studies in recent years pointing to an increased risk of abnormal semen parameters among overweight men, and a higher likelihood of sub-fertility among couples in whom the husband is obese.

As obesity is defined in terms of body mass index (BMI) and central obesity is measured by waist circumference (WC), the purpose of this study was to investigate the relationship between body mass index (BMI) and waist circumference with semen parameters among male partners of infertile couples

AIM OF STUDY

The aim of this study was to find the correlation of BMI and waist circumference(WC) with semen parameters in male partners of infertile couples.

METHODS

This crosssectional observational study was conducted in the Department of Obstetrics and Gynaecology at S.M.S. Medical College Jaipur from December 2018 to March 2021.

INCLUSION CRITERIA

- Male partners of infertile women between the age groups 20 to 45 years after at least one year of having regular unprotected intercourse.

EXCLUSION CRITERIA

- Those who are taking drugs affecting semen parameters or sexual hormone level like SSRI,antipsychotics drugs.
- Absent /undescended testies.
- Heavy smoker (WHO≥ 20 pieces /day)
- Moderate or excessive use of alcohol (Moderate use is defined by the dietary guidelines for Americans as no more than two alcoholic beverages a day).

A thorough history and complete general physical examination including weight, height, BMI, and systemic examination (including breast & thyroid) was done. Local examination of male partners was done in Surgery out patients department. Semen analysis was done twice at an interval of one weekfollowing 3-5 days of abstinence. After a 30 minute liquefaction period, the semen characteristics were quantified (semen volume, counts, motility and morphology by using a Makler semen counting chamber. Sperm morphology was determined using the strict criteria described by Kruuger and colleague (36gorg) and expressed as percent normal sperm. Total sperm count was calculated as the product between sperm concentration and ejaculate volume. The semen analysis was performed in one single centre and one laboratory to exclude the inter-laboratory variation.

CALCULATION OF BODY MASS INDEX

Height & Weight were measured as per standard WHO techniques. Height was measured with participants standing without shoes using a wall mounted anthropometric rod with least count measure of 1cm. Weight was measured with electronic machine with least count of 500 gms with light clothing worn without shoes.

BMI:- Weight in Kilogram/ (Height in meters)

CALCULATION OF CENTRAL OBESITY

It was calculated by measuring waist circumference (WC) which was measured at the narrowest point between the lower border of the rib cage and iliac crest. WC is used as index for central obesity. In the western countries cut off for WC is 102 cm but due to variation in body proportion, BMI and WC do not correspond to same body fat in 20 different population. The cut off value for Indian adults is taken as 86 cm for male and 80 cm for female.

SAMPLE SIZE

Association between BMI and waist circumference (WC) with semen parameters (semen volume, sperm count, motility and morphology) were assessed using Spearman correlation and analysis of variance, and a multiple linear regression analysis was performed . Assuming a correlation coefficient of 0.30 between BMI and sperm count, taking alpha error as 0.05 and beta error as 90 %, a sample size of 113 had been calculated (Hulley, Stephen B.; Cummings, Steven R .; Browner, Warren S,; Grady, Deborah; Hearts, Norman (2013). *Designing Clinical Research*. Lippincott Williams and Wilkins. Page 218 -ISBN 1608318044.). Assuming a loss to follow up of 20%, 150 patients were enrolled in this study

STATISTICAL ANALYSIS

- **A**ll statistical analysis were performed using SPSS for Window version 17 and two tailed P value < 0.05 was considered statisticallysignificant.
- Correlation BMI and WC with semen parameters was determined by Pearson's correlation.
- Association of BMI with semen parameters was calculated by ANOVA and Kruskal Wallis tests
- Intergroup variations were compared by Bonferroni test correction.

- parametric data was compared using Fisher's exact test.

RESULTS

Age of the patients in the present study ranged from 20 – 45 years and the mean age was 31.22±4.68 years (Table 1). For the purpose of analysis, the participants were divided in three groups. Group 1 – (BMI <25Kg/m2) Group2 – (BMI ≥25 to <27Kg/m2) Group 3 – (BMI ≥27Kg/m2) Overweight is defined as a BMI ≥25 Kg/m2 and obesity as a BMI ≥30Kg/m2 (WHO 2000). There were only 16 patients with BMI ≥30 Kg/m2 so the overweight group was sub-divided into ≥25 to <27 BMI and >27BMI groups. Mean BMI of study population was 25.40±3.7 Kg/m^2 (Table 2). Correlation of BMI and WC with semen parameters was calculated by Pearson's correlation coefficient (Table 3 & 4). Comparison of semen parameters in three BMI groups was stastically different (Table 5)

Table 1: Age profile of study population

	Cases	
Age interval (in years)	**N**	**%**
20-30	53	35.33
30-40	88	58.67
≥ 40	9	6.00
TOTAL	150	100
Mean age	31.22	
±SD	4.68	

Figure 1: Age profile of study population

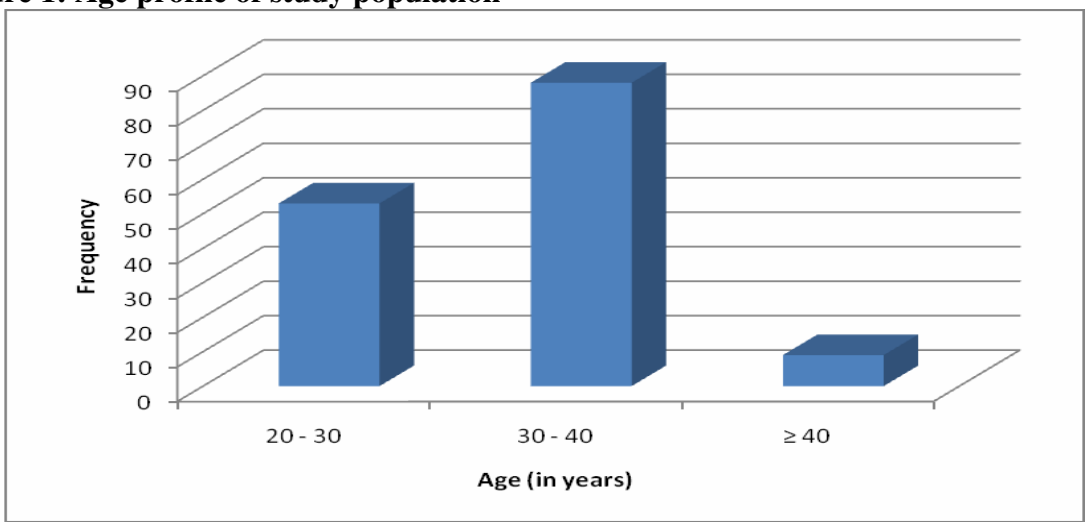


Table 2: BMI distribution of study population

BMI (Kg/m2)	N	%
< 25	67	44.67
≥25 - <27	44	29.33
≥27	39	26.00
TOTAL	150	100
Mean	25.40	
±SD	3.70	

Figure 2: BMI distribution of study population

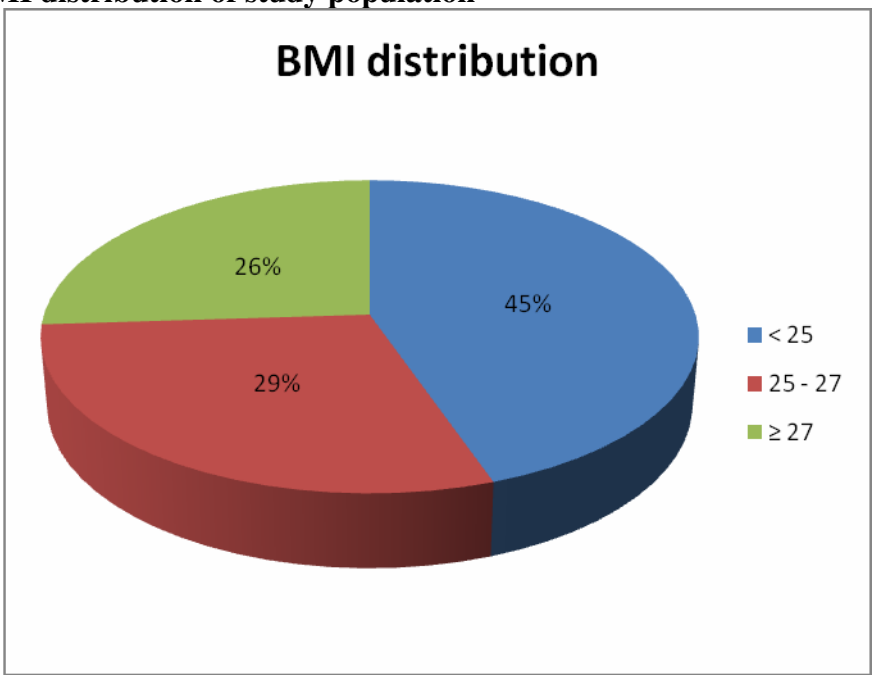


Table 3: Correlation of BMI with semen parameters

BMI Vs.	Pearson's Correlation	p-value
Volume (ml)	-0.212	0.009
Counts (M/ml)	-0.270	0.00
Total Sperm count (Million)	-0.371	0.000
Motility (%)	-0.306	0.000
Morphology (%)	-0.219	0.007
Vitality (%)	-0.133	0.104
pus cells/Hpf	0.047	0.570

Table 4: Correlation of WC with semen parameters

WC Vs.	Pearson's Correlation	p-value
Volume(ml)	0.006	0.941
Counts(Million/ml)	-0.101	0.221
Total Sperm count (Million)	-0.054	0.514
Motility (%)	-0.080	0.329
Morphology (%)	0.029	0.729
Vitality (%)	0.069	0.401
Pus cells/ HPF	0.102	0.212

Table 5: Comparison of semen parameters among BMI study groups

BMI →	**< 25 (Gr. 1)**		**≥25 to < 27 (Gr.2)**		**≥27 (Gr.3)**		**P-value**	**p-value**		
Semen Parameters ↓	**Mean**	**±SD**	**Mean**	**±SD**	**Mean**	**±SD**		**1 vs. 2**	**1 vs.3**	**2 vs. 3**
Volume(ml)	2.11	1.36	2.10	0.62	1.46	0.86	0.006	0.970	0.009	0.000
Counts (M/ml)	33.21	29.96	32.72	25.70	13.11	10.14	0.000	0.930	0.000	0.000

Total Sperm count (Million)	60.00	37.20	61.87	36.62	21.76	23.80	0.000	0.794	0.000	0.000
Motility (%)	47.39	19.17	48.43	22.79	33.26	17.95	0.001	0.795	0.000	0.001
Morphology (%)	55.94	26.35	47.40	21.78	42.28	25.29	0.019	0.077	0.010	0.325
Vitality (%)	53.13	17.15	54.23	13.16	49.21	19.19	0.354	0.720	0.279	0.164
pus cells/Hpf	2.74	2.40	2.32	1.55	3.09	4.28	0.466	0.306	0.594	0.270
Semen-positive	8	11.94%	4	9.09%	2	5.13%	0.508	0.636	0.247	0.487

Figure 3: Mean of volume in BMI groups

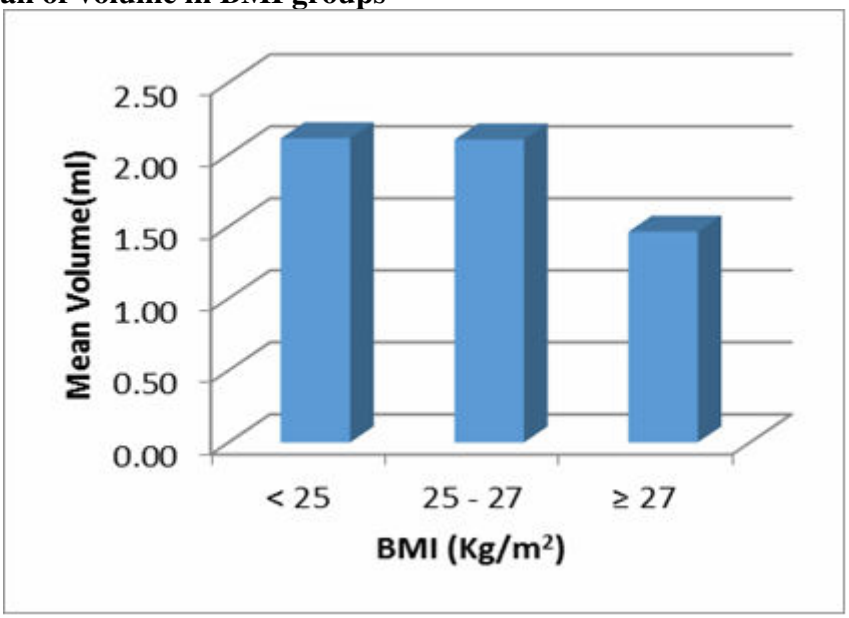
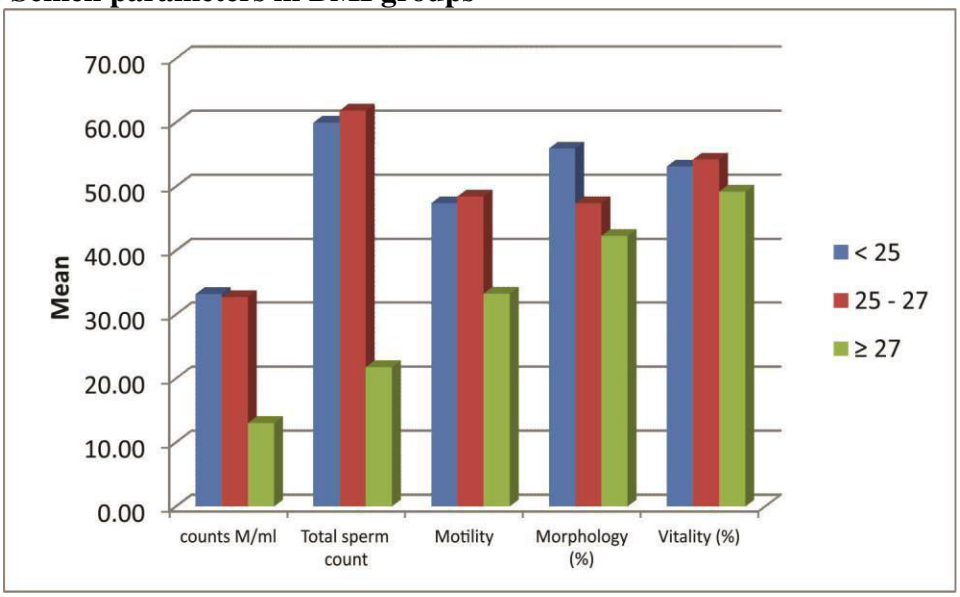


Figure 4: Semen parameters in BMI groups



DISCUSSION

Overweight and obesity have become a major public health concern worldwide(7). In the developing world the prevalence of overweight or obesity is increasing at alarming rate (8-12). There are major health implications of this epidemic. Increased body weight has been associated with a higher frequency of an ever increasing number of adverse health consequences including hypertension, cardiovascular disease, type-2 diabetes and other metabolic disorders(13); osteoarthritis(14); gall bladder stone disease(15); asthma and other chronic respiratory conditions (16-18) as well as multiple malignancies(19).

Reproductive consequences of overweight and obesity in women have received substantial attention. Excessive body weight has been associated with an increased rate of polycystic ovary syndrome, menstrual cycle disturbances, infertility, miscarriage, infertility treatment failure and multiple complications of pregnancy including gestational diabetes, preeclampsia,macrosomic foetus, and cesareandelivery(20-23). However, the reproductive consequences of excess body weight in men have been studied to a lesser extent.

As the incidence of overweight and obesity in men of reproductive age is rising, therefore, this study investigated the correlation between BMI and WC with semen parameters in the male partner of infertile couples.Waist circumference is a marker of central obesity. Mean WC of present study was 86.57±7.59cm.

The cut off value for WC in Indian adults is taken as 86 cm in males. According to this criteria 32.66% (49 /150) men were having WC ≥86cm.

Reference value of semen volume is taken as 1.5 ml (According to WHO criteria 2010). Mean semen volume in this study was 1.94±1.10 ml. Semen volume was negatively ($p<0.006$) and significantly correlated with BMI ($r=0.212$, $p<0.009$). Overweight and obese (≥25Kg /m2) category men had significantly lower volume than men with normal weight men (BMI<25 kg/m2).

Mean concentration was 27.85±26.28 million/ml in this study. Correlation of BMIwith sperm concentration was negative and significant($r= -.270$, $p <0.00$). Sperm concentration reduced significantly from 33.21±29.96 (BMI <25Kg/m^2) to 13.11±10.14million/ml(BMI ≥27 Kg/m^2)with increase in BMI. Total sperm count was also negatively correlated ($r=0.371$,$p<0.00$) with BMI. Mean total sperm count was 50.25±38.16 million. Mean total sperm count decreased from 60.00±37.20 to 21.76±23.80 million/ml from lower to higher BMI groups.

In this study,correlation of BMI and total sperm motility was negative and significant ($r=-0.306$, $p<0.00$). Sperm motility was decreased significantly from 47.39±19.17(BMI<25Kg/m^2) to 33.26±17.95%(BMI≥27Kg/m^2)with increase in BMI ($P<0.00$). Mean motility was 44.02±20.88%.

There was a negative but significant correlation between BMI and sperm morphology ($r=0.219$, $p<0.007$). Normal sperm morphology varied from 55.94±26.35 to 42.28±25.29% when BMI increased from <25 Kg/m^2 to ≥27 Kg/m^2.

There was negative correlation between BMI and vitality but this was nonsignificant. Sperm vitality was found to be comparable in the different BMI groups.

Thus, we found as BMI increased, abnormal number of sperm cells also increased.In correlation of BMI with semen parameters, volume ($r= -0.212$, $p <0.009$), sperm concentration ($r= -.270$, $p <0.00$), total sperm count ($r= -371$, $p <0.000$), motility ($r= -0.36$, $p <0.001$) and morphology ($r= -0.219$, $p <0.007$) were inversely and significantly correlatedbutno correlation was found for vitality and pus cells.

In correlation of Waist circumference (WC) with semen parameters sperm concentration, total sperm count ($r= -0.054$) and motility were inversely correlated but difference was not significant. Correlation was not found for vitality and pus cells.

On comparing, semen parameters in three BMI groups, volume ($p < 0.006$), sperm concentration ($p < 0.00$), total sperm count ($p < 0.00$), motility ($p < 0.00$) and morphology ($p < 0.019$) were significantly lower in the ≥27 BMI group as compared to the lower BMI groups.

CONCLUSION

Obesity as evidenced by high BMI, had a significant inverse relationship with semen volume, sperm concentration,total sperm counts, motility and morphology. No significant correlation was observed between waist circumference and semen parameters.

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