

Effect of Increasing BMI on Routine Semen Parameters in Young Adult Males

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Abstract

Background: Effect of increasing weight in females upon their reproductive health has been widely studied. There is very sparse data regarding similar effect of increasing weight in males upon reproductive health. Recently, even obesity has been considered to be a male factor in infertility. However, there are conflicting reports regarding the effect of increasing body weight upon semen parameters in males. Hence, the present study was undertaken to study the effect of increasing BMI upon routine semen parameters. **Methods:** The ninety subjects participating in this study were grouped in three groups of subjects that were formed based upon BMI as normal weight group (BMI 18.0 – 22.9), overweight group (BMI 23.0 – 24.9) and obese group (BMI 25.0 and above). Routine semen analysis was done as per the guidelines of WHO and appropriate statistical test were applied. **Results:** It was observed that there is a statistically significant decline in the routine seminal parameters like sperm count per ml, total sperm count, motile sperm count per ml and total motile sperm count from the normal weight group to the overweight and the obese group. There was no statistically significant difference in semen volume in the three groups. **Conclusion:** There is an direct inverse relationship between increasing body weight and routine semen parameters in young adult healthy males. There are several factors that may be responsible for such observation as disturbed hormonal milieu, decreased levels of Inhibin B, increased insulin resistance and adipocytokine mediated free radical damage. As the subjects are mostly young and in their reproductive age, it is important that BMI should be considered as an important factor in infertility checkup.

Key words: BMI, semen analysis, sperm count, sperm motility

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Introduction

There has been a rapid rise in the incidence of obesity, in both males and females worldwide.¹ The increase in obesity has been associated with increase in incidence of chronic diseases, mostly related to cardiovascular, respiratory and musculoskeletal health. Some researchers have also reported that obesity may also cause increased risk of reproductive health.² The effect of obesity on female reproductive health has been widely explored. It has been reported that women with excess body weight are more likely

to have fertility problems.^{3,4} Recently, studies have indicated that obesity also affects male reproductive health.^{5,6} Obesity is associated with significant disturbance in the hormonal milieu that can affect the reproductive health.^{7,8} Jensen et al has reported that there is a negative correlation between obesity and various sperm parameters in the general population.⁹ Obesity is being regarded as a male factor of infertility and data so far reported favor a possible correlation between increased body weight and sperm parameter abnormalities. However, there are some conflicting reports too that suggest that

there is no adverse effect of increasing body weight on semen parameters.^{10,11} Zorn et al did not find any correlation between the elevated leptin levels in obese men and sperm parameters.¹² There are sparse population based data on the effect of men's body mass on a couple's fertility.¹³ However, newer data from population studies, have suggested a relationship between increasing BMI and male infertility.^{13,14} Still, there are opinions that this could be related to confounding factors like male age, smoking and alcohol use & female partner obesity. However, once these factors have been excluded it was shown that for every 3-point increase in a man's BMI, couples were 10% more likely to be infertile. In view of these conflicting reports regarding the effects of increasing body weight in the form of increasing BMI upon male reproductive health and scarcity of Indian data in this regard, the present study was undertaken. The aim of the present study was to find out the effect upon several sperm parameters in men belonging to different BMI groups.

Materials and Methods

The study was conducted at the Post graduate research laboratory in department of physiology at Peoples College of medical sciences & research centre, Bhopal. Ninety healthy adult males in the age range of 21 – 40 were recruited from various constituent colleges of Peoples University. Subjects were divided into three groups depending on the new BMI cutoff point for Indian population given by Government of India.¹⁵ According to this, Group I comprised of those with BMI in the range 18.0 to 22.9 and were considered normal weight group. Group II comprised those with BMI in the range of 23.0 to 24.9 and were considered as overweight. Group III comprised those with BMI of 25.0 or more and were considered as obese. The study protocol and the procedure were explained in detail to all the subjects and assured that they have understood it completely. A written informed consent was taken from each subject. Ethical clearance was obtained from institutional ethics committee. A detailed history was taken prior to recruitment and particularly history of substance abuse was obtained. Subjects with history of smoking

tobacco and those with history of any disease that can affect sperm parameters like mumps infection, history of any testicular pathology, hydrocoele, varicocele, diabetes, leprosy or any surgical procedure of the genitals were excluded from the study. Anthropological parameters like weight and height were determined and BMI was estimated by the formula: weight (kg) / square of height (mt).

All participants were given appointment for semen analysis with instruction to follow sexual abstinence of 4 days prior to semen analysis. Routine semen analysis was performed according to guidelines by WHO.¹⁶ Semen parameters that were estimated were semen volume, sperm count per ml, total sperm count, motile sperm count per ml, total motile sperm count, percentage of motile sperms, grade of motility and sperms with normal morphology.

Results

The present study was conducted in three groups of subjects that were formed based upon BMI as normal weight group (BMI 18.0 – 22.9), overweight group (BMI 23.0 – 24.9) and obese group (BMI 25.0 and above). Their mean age in these groups was 26.03, 26.13 and 26.97 respectively indicating that the subjects were young adult males. Table 1 shows the anthropometric parameters like weight, height and BMI of the three groups. There were no significant differences statistically in age and height among the three groups.

Table- 2: shows the mean values of routine semen parameters in the three groups. Statistical test ANOVA was used for looking into the association between the mean values. It was found that there was no statistically significant difference in semen volume among the three groups. However, the sperm count per ml, total sperm count, motile sperm count per ml and total motile sperm count were found to be declining from normal weight group to obese group. It was seen that this decline from normal weight to overweight and to obese group was statistically significant from their F value (table 2).

Table- 1: showing age and anthropometric parameters of subjects in three groups

Parameter		Normal weight (n=30)	Overweight (n=30)	Obese (n=30)
Age (years)	Mean	26.03	26.13	26.97
	SD	1.43	1.89	2.54
Weight (kg)	Mean	55.03	63.57	69.5
	SD	2.14	3.04	2.24
Height (mt)	Mean	1.6	1.64	1.59
	SD	0.13	0.06	0.05
BMI	Mean	21.78	23.56	27.67
	SD	3.45	1.09	1.73

Table- 2: Showing routine semen parameters in the three groups based upon BMI viz., Normal weight (BMI 18.0 – 22.9), Overweight (BMI 23.0 – 24.9) and Obese (BMI 25.0 and above)

Semen parameter	Normal weight (n=30)	Overweight (n=30)	Obese (n=30)	F – value
Semen volume (ml)	2.613 ± 0.859	2.567 ± 0.897	2.433 ± 0.817	0.356
Sperm count (million/ml)	46.70 ± 12.38	29.80 ± 18.77	26.13 ± 12.83	16.144*
Total sperm count (millions)	119.5 ± 48.19	77.33 ± 57.17	61.36 ± 35.74	11.830*
Motile sperm count (millions/ml)	25.86 ± 8.56	14.93 ± 10.38	9.68 ± 6.12	28.044*
Total motile count (millions)	66.27 ± 28.78	39.83 ± 30.25	28.73 ± 25.64	13.936*

(*p value < 0.0001 means very highly significant)

Discussion

The present study was conducted on 90 volunteers divided into 3 groups based upon BMI. Since the study was conducted upon Indian subjects the revised classification of BMI was followed that was given by government of India.¹⁵ According to this classification, BMI 18 – 22.9 are considered normal weight, BMI of 23 – 24.9 as overweight and BMI of 25 or more are obese. All the subjects were in the age range of 20-40 years. Upon routine semen analysis, the parameters assessed were sperm count, motile sperm count, percentage of motile sperms and percentage of morphologically normal sperms.

In the present study we found that as the BMI increased, there was a corresponding decrease in the sperm count and motile sperm count. There are studies that have reported that men with higher BMI have exhibited altered quantity & quality of semen.^{9,11,17,18} A WHO surveillance study also reported that obese men have significantly lower total sperm count than non

obese men.¹⁹ The results of our study are in accordance with these findings. In another study on military recruits in which men with normal BMIs were compared with those with BMIs over 25.0, it was found that total sperm count per ejaculate was reduced by 24% in men with BMI > 25.0 kg/m². They also reported an associated decrease in testosterone, FSH, Inhibin B and SHBG in overweight group.⁹ While the effects of body weight upon conventional sperm parameters have been extensively studied, there are very few studies upon non-conventional sperm parameters. It was reported by recent study that overweight & obese men have lower progressively motile spermatozoa and morphologically normal forms compared to healthy normoweight men.²⁰ The findings of our study are in accordance with these findings. In the same study, they also assessed non conventional sperm parameters and concluded that overweight & obese men had increased percentage of spermatozoa with low mitochondrial membrane potential (MMP) & PS (phosphatidyl serine) externalization, which is

an early sign of apoptosis. In our study, we found that as the BMI increased, there was a decline in not only motile sperm count but also the grade of motility.

The hypogonadism resulting due to obesity can be attributed to several factors. There is excessive aromatization of testicular and adrenal androgen in the adipose tissue thus increasing the circulating levels of estrogens. This increased estrogen is responsible for inappropriate suppression of hypothalamo-pituitary-adrenal axis resulting in decreased synthesis of testosterone.²¹ It is still not clear whether this decrease in testosterone levels is resulting in suppression of spermatogenesis. Some studies have found that the decrease in semen parameters is related to the disturbed testosterone to estrogen ratio in overweight & obese people. Inhibin is considered to be an important marker of spermatogenesis and secreted from sertoli cells. Inhibin has a direct action upon pituitary gland in suppressing the FSH production. It has been found that there are reduced levels of inhibin B in several obese males.

With increase in body weight there is increase in the adipocytes in tissues. This leads to increased formation of adipocytokines which results in inflammatory changes and free radical damage, ultimately leading to decrease in sperm count and motility. The adipocytes also secrete leptin and the levels of leptin are directly related to fat in the body. The leptin has an inhibitory effect upon neutral alpha glucosidase enzyme. This enzyme is required for the maturation of spermatozoa in epididymis which renders the sperm its motility.

Obesity is also seen to be associated insulin resistance. The insulin resistance has been shown to be having a negative relationship with testosterone levels. Studies have shown that type 2 diabetes males have lower testosterone levels than the control.

There is an increased incidence of sleep apnea among obese men in which there is decrease in the nocturnal rise of testosterone. Testicular hyperthermia is also hypothesized to be one of the mechanisms for deterioration of semen parameters. It is known that an increase in testicular temperature by a few degrees results in decrease in sperm count and motility.

Thus, a disturbed hormonal milieu can be considered as the cause for decline in sperm count and motility among the males with increasing body weight. Since, the subjects participating in the present study belonged to the reproductive age group, the result bears deep implication.

Conclusion

We infer that increasing body weight and obesity should be considered as an integral part of infertility checkup in male partners of infertile couples. Further, studies can be considered to explore if the changes in sperm parameters be reversed after losing weight so that weight losing programme can be considered as part of infertility treatment.

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