RESEARCH ARTICLE

Effect of Body Mass Index on Semen Parameters in Subfertile Men

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Abstract

Aim: To determine the effect of body mass index (BMI) on semen parameters in men with subfertility.

Methodology: The present study was a cross-sectional study conducted from 1st January 2021 to 30th June 2021. All subfertile couples having male factor subfertility attending the subfertility clinic were asked to participate. The weight and height of all men were recorded, and they were asked to submit a semen sample to the reference lab. The results of the semen analysis conducted as part of an initial assessment were compared with the following World Health Organization (WHO) reference values.

Results: We included 347 males in the analysis. The mean age of the participant was 31.06 ± 4.89 years, and the mean duration of subfertility was 3.58 ± 1.62 years. Of these, 60.5% had primary subfertility. There were 44.4% of men with normal BMI and 9.8% were underweight. In our study population, 41.5% of men were overweight, and 4.3% were obese. When stratified according to BMI, only motility was significantly affected by BMI ($p = 0.044$).

Conclusion: A high BMI is associated with reduced motility of sperm in semen samples. Obese men are more likely to have abnormal total motile sperm count than men with normal BMI. Larger studies are needed to assess the relationship between semen quality and BMI.

Keywords: Body mass index, Semen, Subfertility.

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Introduction

Subfertility is a major clinical concern and affects 15% of reproductive-age couples. About 70 million couples experience subfertility worldwide. Among them, 40% of cases are due to male factors. Poor semen quality is a well-documented cause of male infertility.[1,2]

Obesity is becoming a health concern. Somatic diseases and reproductive health are affected by obesity. For the diagnosis of obesity, several simple techniques are used. BMI, though controversial, remains one of the most used techniques. Female fertility is significantly affected by BMI, but the effects of raised BMI on male fertility are less consistent. Some studies report decreased fertility with increased BMI of male partners, while others found no difference.[3,4]

It is uncertain that obesity affects a man's fertility. The data remain controversial. A linear link between obesity and decreased fertility has been proposed.[5] Sallmén et al.[6] concluded that this association needs further study. They concluded that if an association exists, programs to target obesity can save medical costs for infertility treatment. In a developing country with limited resources, the cost saving in this context may prove more significant.

Male subfertility is commonly overlooked in our society. The impact of this comes to light when the male partners seek to remarry to father children.[2] Obesity is now a pandemic; simply losing weight can lead to improved parameters. The health benefits of losing weight are not limited to just semen parameters and, in general, can have many positive effects on the lives of these individuals.

The causal relationship, though explored before, remains uncertain. Given the interplay between BMI and semen parameters, we conducted this study to determine the effect of BMI on semen parameters.

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Methodology

The present study was a cross-sectional study conducted from 1st January 2021 to 30th June 2021. All subfertile couples having male factor subfertility attending the subfertility clinic of the Department of Obstetrics and Gynecology, Ruth K. Pfau, Civil Hospital Karachi, were asked to participate. Couples who had been trying to conceive for 12 months, where the female partner had evidence of normal ovulation confirmed through normal mid-cycle serum progesterone level and her tubes were patent as assessed on hysterosalpingogram were included. Men with a history of fever (in the last 1 month), surgery to the groin spine or head, congenital anomalies of the phallus, and men with a history of stroke, renal impairment, thyroid disorders, and congestive cardiac failure were excluded. We also excluded couples where the female partners did not have a normal ultrasound of the pelvis, that is, any evidence of ovarian cyst or uterine fibroid. Men with a history of smoking, chewing tobacco, alcohol consumption, and recreational drug use were also excluded.

After informed consent, brief history was taken from each patient. In the outpatient department, the weight and height of all men were recorded. The patient was counseled and consent for semen analysis was taken. BMI categories used were as follows: underweight <18.5 kg/m^2, normal 18.5–24.99 kg/m^2, overweight 25.00–29.99 kg/m^2, and obese ≥30 kg/m^2.[7] The semen analysis results for sperm concentration, sperm motility (total motility), and sperm morphology were noted. The results of the semen analysis conducted as part of an initial assessment were compared with the following WHO reference values: sperm concentration: 15 million spermatozoa/mL or more, total motility (percentage of progressive motility and nonprogressive motility): 40% or more motile, and sperm morphology (percentage of normal forms): 4% or more. Sperm concentration, morphology, and motility were labeled as normal or low based on these values.[8]

All the patients were informed about coital abstinence for 3 days; the sample was collected at the laboratory through masturbation. The findings of the variables as mentioned above were entered in pro forma. The study was approved by the Ethical Review Board of the institute (IRB-1605/DUHS/Approval/2020). Written and informed consent for participation in the study was given by all participants.

Statistical Analysis

Sample Size

The sample size for this study was calculated to be $n = 218$ patients by taking 16% prevalence rate of obesity in Pakistani males with 80% power of the study, 5% type I error, and 5% of adjusted dropout rate.[9] This sample size was calculated using the WHO software. We used the estimating population proportion with the specified absolute precision test to calculate the sample size (Sample Size Determination in Health Studies, version 2.00, copyright (c) 1996–98, WHO).

Data were analyzed on Statistical Package for the Social Sciences (SPSS) version 23 (SPSS Inc., IBM Corp., Armonk, New York, USA). Mean and standard deviations were calculated for the quantitative variables like age and duration of subfertility. We classified BMI into four categories (underweight <18.5 kg/m^2, normal 18.5–24.99 kg/m^2, overweight 25.00–29.99 kg/m^2, and obese ≥30 kg/m^2), and sperm concentration, morphology, and motility were labeled as normal or low based on the reference values as ascertained by WHO manual values.[8,9]

Frequencies and percentages were then calculated for the qualitative variable, categories of BMI, sperm concentration, sperm morphology, and total sperm motility. Effect modifiers will be controlled through stratification of BMI to see the effect of these on the outcome variables. A bivariate analysis was conducted to test for a possible association between each dependent variable and the independent variables. The Pearson Chi-square test was used to assess associations between variables for an α error of 5%.

Results

During the study period, 356 couples satisfied the inclusion criteria and were asked to participate, three refused to participate, and six were lost to follow-up. We included 347 males in the analysis. The mean age of the participant was 31.06 ± 4.89 years, and the mean duration of subfertility was 3.58 ± 1.62 years. Of these, 60.5% had primary subfertility. There were 44.4% of men with normal BMI, and 9.8% were underweight. In our study population, 41.5% of men were overweight and 4.3% were obese. Table 1 also summarizes the semen parameters of the study population.

When stratified according to BMI, only motility was significantly affected by BMI ($p = 0.044$) (Table 2).

Discussion

Main Findings

Our study shows that BMI is significantly associated with low motility in semen analysis of males with subfertility. However, other parameters, that is, sperm concentration and morphology, are not significantly affected by the change in BMI.

Strengths and Limitations

The main strength of the study is the fact that we included a decent proportion of overweight men in the study, and we conducted this study on subfertile men so that the semen parameters across different categories of BMI remain comparable. Another strength of the study is the methodology in which all samples were analyzed at the same laboratory to minimize interlaboratory bias. The main limitation is its single-center design. Moreover, we did not assess the semen after weight loss.

Interpretation

Our study shows that high BMI can affect sperm parameters in subfertile men; however, the only parameter affected in our study was the motility of the sperm. Previous studies have

Table 1: Characteristics of the study population ($N = 347$)

	Mean ± standard deviation or (N%)
Age in years	31.06 ± 4.89
Type of infertility	
Primary	210 (60.5%)
Secondary	137 (39.5%)
Duration of infertility in years	3.58 ± 1.62
BMI in kg/m^2	
<18.5	34 (9.8%)
18.5–24.9	154 (44.4%)
25–29.9	144 (41.5%)
>30	15 (4.3%)
Morphology	
Low (>4% normal forms)	86 (24.8%)
Normal (4 or greater normal forms)	261 (75.2%)
Concentration	
Low (<15 million/mL)	74 (21.3%)
Normal (15 million/mL or more)	273 (78.7%)
Motility	
Low (<40 %)	218 (62.8%)
Normal (40% or greater)	129 (37.2%)

Table 2: Association of BMI with semen parameters

	BMI in kg/m²				
Semen parameters	*<18.5*	*18.5–24.9*	*25–29.9*	>30	*p-value*
Morphology					
Low (<4%)	5 (14.7%)	41 (26.6%)	38 (26.4%)	2 (13.3%)	0.336
Normal (4% or greater)	29 (85.3%)	113 (73.4%)	106 (73.6%)	13 (86.7%)	
Concentration					
Low (<15 million/mL)	4 (11.8%)	31 (20.1%)	38 (26.4%)	1 (6.7%)	0.107
Normal (15 million/mL or more)	30 (88.2%)	123 (79.9%)	106 (73.6%)	14 (93.3%)	
Motility					
Low (<40 %)	21 (61.8%)	98 (63.6%)	88 (61.1%)	11 (73.3%)	0.044*
Normal (40% or greater)	13 (38.2%)	56 (36.4%)	56 (38.9%)	4 (26.7%)	

*The Chi-square statistic is significant at the 0.05 level

shown that there is a direct association between high BMI and increased incidence of low semen volume (<1.5 mL), low total sperm count, low sperm concentration (<15 M/mL), and abnormal sperm morphology.[10,11] However, in our study, morphology and concentration were not significantly associated with BMI. The difference in our results could be explained by the large proportion of overweight individuals in our study. In our study population, 41.5% of men were overweight, and 4.3% were obese, so our results can be generalized to overweight individuals. However, there was a relatively smaller proportion of obese men in the population studied, so generalizing results to obese men may not be appropriate. Larger studies with obese men should be conducted to assess the effect of obesity on sperm parameters.

Another study showed an association of obesity with higher prevalence of oligospermia and asthenospermia. As compared to the nonobese, obese men were more prone to have oligospermia and asthenospermia.[12] However, a study conducted in Saudi Arabia showed sperm concentration was the only semen parameter which showed a significant reduction with higher BMI in infertile men.[13] The results from our study showed that motility was affected by BMI; as compared to males with normal BMI (63. 6%), obese men (73.3%) had a greater incidence of decreased motility. There was no significant impact on concentration or morphology.

Few studies show that abnormal BMI has no significant impact on total motility or progressive motility across BMI categories,[13] as well as other semen parameters among normal and elevated BMI.[14] Our findings are in contrast to these studies.

High BMI is associated with an increased level of leptin, which stops testosterone production and reduces sperm quality.[15] Few studies have also shown that insulin resistance, which results from obesity, leads to oxidative stress.[16,17] Oxidative stress has been shown to affect sperm motility and maturation.[18] A study showed that obesity causes oxidative stress that leads to a reduction in motile sperm in mice.[19] A recent study from China showed that BMI significantly affects semen.[20] This was not consistent with the findings of our study.

Although obesity is a major health concern and all men should try to maintain a healthy BMI, its association with suboptimal semen parameters remains ambiguous. The study in our population shows that only a decrease in semen motility was noted with raised BMI.

Further studies in multiple centers should be done to confirm these findings. Moreover, the effect of weight loss on semen parameters should also be established simultaneously so that men can be counseled about the benefit of weight loss in this condition.

Conclusion

A high BMI is associated with reduced motility of sperm in semen samples. Obese men are more likely to have abnormal total motile sperm count than men with normal BMI. Larger studies are needed to assess the relationship between semen quality and BMI.

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References

1. Ma J, Wu L, Zhou Y, et al. Association between BMI and semen quality: an observational study of 3966 sperm donors. Hum Reprod 2018;34(1):155–162. DOI: 10.1093/humrep/dey328
2. MacDonald AA, Herbison GP, Showell M, et al. The impact of BMI on semen parameters and reproductive hormones in human males: a systematic review with meta-analysis. Hum Reprod Update 2010;16(3):293–311. DOI: 10.1093/humupd/dmp047
3. Eisenberg ML, Kim S, Chen Z, et al. The relationship between male BMI and waist circumference on semen quality: data from the LIFE study. Hum Reprod 2014;29(2):193–200. DOI: 10.1093/humrep/det428
4. Aggerholm AS, Thulstrup AM, Toft G, et al. Is overweight a risk factor for reduced semen quality and altered serum sex hormone profile? Fertil Steril 2008;90(3):619–626. DOI: 10.1016/j.fertnstert.2007.07.1292
5. Håkonsen LB, Thulstrup AM, Aggerholm AS, et al. Does weight loss improve semen quality and reproductive hormones? Results from a cohort of severely obese men. Reprod Health 2011;8:24. DOI: 10.1186/1742-4755-8-24
6. Sallmén M, Sandler DP, Hoppin JA, et al. Reduced fertility among overweight and obese men. Epidemiology 2006;17(5):520–523. DOI: 10.1097/01.ede.0000229953.76862.e5
7. World Health Organization. Obesity and Overweight. Fact Sheet No. 311. [updated 2013 Mar].
8. WHO Laboratory Manual for the Examination of Human Semen and Sperm-cervical Mucus Interaction. 4th ed. Cambridge: Cambridge University Press; 1999.
9. Sherin A. Obesity: how to prevent Pakistani people from getting heavier? Khyber Med Univ J 2013;5(2):59–60.
10. Niederberger C. Re: the relationship between male BMI and waist circumference on semen quality: data from the LIFE study. J Urol 2014.
11. Tsao CW, Liu CY, Chou YC, et al. Exploration of the association between obesity and semen quality in a 7630 male population. PLoS One 2015;10(3):e0119458. DOI: 10.1371/journal.pone.0119458

12. Ramaraju GA, Teppala S, Prathigudupu K, et al. Association between obesity and sperm quality. Andrologia 2018;50(3):e12888. DOI: 10.1111/and.12888
13. Alshahrani S, Ahmed AF, Gabr AH, et al. The impact of BMI on semen parameters in infertile men. Andrologia 2016;48(10):1125–1129. DOI: 10.1111/and.12549
14. Rufus O, James O, Michael A. Male obesity and semen quality: any association? Int J Reprod Biomed 2018;16(4):285–290. DOI: 10.29252/ijrm.16.4.285
15. Hofny ER, Ali ME, Abdel-Hafez HZ, et al. Semen parameters and hormonal profile in obese fertile and infertile males. Fertil Steril 2010;94(2):581–584. DOI: 10.1016/j.fertnstert.2009.03.085
16. Dandona P, Aljada A, Chaudhuri A, et al. Metabolic syndrome: a comprehensive perspective based on interactions between obesity, diabetes, and inflammation. Circulation 2005;111(11):1448–1454. DOI: 10.1161/01.CIR.0000158483.13093.9D
17. Davi G, Falco A. Oxidant stress, inflammation and atherogenesis. Lupus 2005;14(9):760–764. DOI: 10.1191/0961203305lu2216oa
18. Ebisch IM, Thomas CM, Wetzels AM, et al. Review of the role of the plasminogen activator system and vascular endothelial growth factor in subfertility. Fertil Steril 2008;90(6):2340–2350. DOI: 10.1016/j.fertnstert.2007.10.026
19. Bakos HW, Mitchell M, Setchell BP, et al. The effect of paternal diet-induced obesity on sperm function and fertilization in a mouse model. Int J Androl 2011;34(5 Pt 1):402–1410. DOI: 10.1111/j.1365-2605.2010.01092.x
20. Wang EY, Huang Y, Du QY, et al. BMI effects sperm quality: a retrospective study in Northern China. Asian J Androl 2017;19(2):234–237. DOI: 10.4103/1008-682X.169996