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Role of Obstructive Sleep Apnea and Body Mass Index on Semen Parameters of Infertile Men

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ABSTRACT

Background: Over the course of the last several years, sleep apnea and infertility have gained a significant amount of momentum. As a result of the vicious cycle that is formed when obesity, infertility, and obstructive sleep apnea interact with one another, their connections are under constant scrutiny. **Objective:** The objective of this study is to investigate the relationship between body mass index (BMI) and obstructive sleep apnea (OSA) in infertile men. **Study Design:** Cross-sectional study. **Settings:** Research was conducted at Department of Medicine and Endocrinology Fatima Memorial Hospital, Lahore Pakistan. **Duration:** From July 2021 to December 2021. **Methods:** Within this cross-sectional study, there were a total of seventy male participants who were infertile. The BMI was used to classify each person into one of many categories. The STOPBANG questionnaire was used to complete the screening for obstructive sleep apnea, and the score technique was used to accomplish the risk stratification. **Results:** In this study, out of seventy respondents 19 (27.1%) had a normal body mass index, whereas 30 (42.8%) were overweight and 21(30%) of the subjects were obese. According to the categorization of OSA, Low risk was found in 24 (34.2%) subjects, 20 (28.5%) were at intermediate risk and 26 (37.1%) of people had a high risk for OSA. In men with infertility, a high risk of OSA was shown to be significantly connected with sperm concentration ($p = 0.001$), but a high BMI was found to be strongly associated with sperm volume and sperm concentration ($p = 0.001$). **Conclusion:** It's possible that certain basic characteristics have a relationship with both the risk of OSA and an increased BMI. As a result, being checked for obstructive sleep apnea and maintaining a healthy weight may both boost reproductive potential.

Keywords: *Body Mass Index, Obstructive Sleep Apnea, Semen, Infertile Men, Endocrinology*

INTRODUCTION

Obesity is a serious public health issue that is plaguing developing nations as a result of its increasing prevalence as well as the harmful effects that are caused by a wide variety of lifestyle factors. Additionally, the incidence of noncommunicable diseases has grown dramatically among those who are fat or overweight.[1] In addition, a number of studies have shown that men who have a high body mass index (BMI) have low testosterone levels, poor sperm quality, and decreased fertility.[2]

There is a 10% increase in the risk of infertility for every 9 kg of weight gain that a woman experiences.[3] The impact of obesity on male reproductive ability may be modulated by a variety of pathways, such as oxidative stress, manipulation of the hypothalamic-pituitary-testicular axis, metabolic dysregulation, damage to the integrity of sperm DNA, and epigenetic alterations. In addition to this, obesity reduces the amount of kisspeptin mRNA that is produced, which results in hypothalamic hypogonadism.[4]

In those who had a high body fat percentage, the levels of hormones that play a role in the regulation of spermatogenesis and the activity of Sertoli cells were much lower. In addition to this, research has shown that obese men have an increased amount of white adipose tissue, which is the tissue that is accountable for aromatization and the release of leptin. It has been established that metabolic syndrome, a problem of energy storage and consumption, is connected with erectile dysfunction and hypogonadism.[3]

Hypogonadism is a condition in which the testicles become underdeveloped. Obesity is connected to aberrant spermatogenesis, which is linked with downstream abnormalities in important sperm parameters, defective sperm binding and capacitation, and adverse effects on the chromatin structure of sperm. Obesity also has a detrimental impact on the quality of sperm. Additionally, the stress that is caused by hyperlipidemia on the endoplasmic reticulum and the disruption of the homeostasis of Bcl-2 and Bax both contribute to the death of spermatogenic cells. In addition, recent studies have shown that obesity is linked to the production of biochemical changes in sperm. These changes, which include DNA methylation, protamination, and histone acetylation, all have a deleterious impact on the growth and development of children.[5]

Being overweight makes a person more likely to have upper airway obstruction while sleeping because it causes structural irregularities. This may lead to obstructive sleep apnea (OSA), which is the temporary or permanent cessation of breathing. The most common cause of obstructive sleep apnea is a mechanical stress that develops as a consequence of increased peri-pharyngeal fat buildup and increased pharyngeal collapsibility. In addition to this, Functional residual capacity (FRC) decreases, making the pharynx more susceptible to collapsing. and decreases the amount of tracheal traction that is placed on the pharynx.[6]

Snoring, extreme daytime sleepiness, and low oxygen levels during sleep are the key indicators of obstructive sleep apnea (OSA).[7] The incidence of OSA is much higher in men than in women. The prevalence of OSA is also influenced by a variety of factors, including environmental, social, and ethnic origins. People with a body mass index (BMI) of more than 28 kg/m2 have an increased risk of developing obstructive sleep apnea by 8 to 12 times. If obstructive sleep apnea is not treated, it may lead to a number of major health complications, including type II diabetes, hypertension, coronary artery disease, stroke, and infertility.[7,8]

Obstructive sleep apnea is a serious health concern. It is not well known that sleep disorders may contribute to hypogonadism, erectile dysfunction and infertility nevertheless, research is now being undertaken to support this theory. According to the evidence that is currently available, obesity and OSA appear to play opposing roles in the pathophysiology of male infertility.[9]

A recent case-control study that was conducted in Taiwan concluded that obstructive sleep apnea raises the risk of male infertility and that this risk is proportional to the duration of obstructive sleep apnea exposure. As a result, the objective of this study is to investigate the impact that obesity and OSA have on a variety of sperm parameters.[10]

The main objective of this study is to investigate the relationship between body mass index (BMI) and obstructive sleep apnea (OSA) in infertile men.

METHODS

This cross-sectional research was carried out at Department of Medicine and Endocrinology Fatima Memorial Hospital, Lahore Pakistan from July 2021 to December 2021 after obtaining approval from the Institutional Ethics Committee.

Men who had the history of infertility for at least a year despite regular, unprotected sexual activity between the ages of 25 and 40 years were included.

Men who had craniofacial abnormalities, had recent surgery on their upper airway, or had upper airway cancer or suffered from erectile dysfunction or infertility for causes relating to their testicles were not allowed to participate in the research.

Andrologists and gynecologists who specialize in infertility examined infertile couples as part of the evaluation process. In addition to that, they carried out any and all tests for infertility that were necessary such as a physical examination, assessment of the functioning of the endocrine system, genetic analysis, and so on. Only couples where the male partner had male factor infertility participated in the investigation (n=70). The case histories of the participants and their regular clinical examinations, including the analysis of their sperm, were documented in line with the standard operating procedures of the (place of the study)). The evaluation of seminal fluid was carried out in line with the standards established by WHO in 2010.[8] Men who decided to participate in the study and fulfilled the prerequisites for doing so were provided with a comprehensive description of the research in their native language. Participants were strongly encouraged to complete the STOPBANG obstructive sleep apnea screening questionnaire. This questionnaire is made up of eight different aspects including snoring, weariness, blood pressure, observed apneas, age, gender, neck circumference and body mass index (BMI). There is a yes or no option for each risk

component, which is used to categorize the risk. Responses that were positive for questions numbered 0–2, 3–4, and 5–8 indicated, in ascending order, low, moderate, and high-risk levels.

RESULTS

The correlation between body mass index (BMI) and sperm parameters, as well as OSA risk, was investigated. For the statistical analysis, SPSS version 20 was used. One way ANOVA is used for statistically significant if the p value was less than 0.05. The distribution of data on the basis of BMI categorization and OSA risk pattern are shown in table 1 and 2 respectively.

Participants were categorized as normal (18.5–22.9 kg/m2), overweight (23–24.9 kg/m2), or obese (>25 kg/m2) according to the world health organization (WHO). In this study, out of seventy respondents 19 (27.1%) had a normal body mass index, whereas 30 (42.8%) were overweight and 21(30%) of the subjects were obese. According to the categorization of OSA, Low risk was found in 24 (34.2%) subjects, 20 (28.5%) were at intermediate risk and 26 (37.1%) of people had a high risk for OSA. In men with infertility, a high risk of OSA was shown to be significantly connected with sperm concentration (p = 0.001), but a high BMI was found to be strongly associated with sperm volume and sperm concentration (p = 0.001).

Table 1: Semen analysis parameters based on Basal Metabolic Index (BMI) categories

Parameters	BMI categories	N	Mean ± SD	p value
BMI value (kg/m²)	Normal Weight	19	20.5 ± 2.3	0.001
	Overweight	30	22.6 ± 0.8	
	Obese	21	32.5 ± 1.4	
Age (years)	Normal Weight	19	31.9 ± 2.0	0.147
	Overweight	30	33 ± 1.9	
	Obese	21	32.6 ± 1.8	
Duration of Infertility (years)	Normal Weight	19	3.7 ± 0.7	0.002
	Overweight	30	4.6 ± 0.9	
	Obese	21	4.3 ± 0.7	
Volume (ml)	Normal Weight	19	2.6 ± 0.4	0.001
	Overweight	30	2.2 ± 0.1	
	Obese	21	1.8 ± 0.1	
Sperm concentration (10^6 ml)	Normal Weight	19	32.3 ± 7.1	0.001
	Overweight	30	33.8 ± 1.1	
	Obese	21	27.8 ± 0.8	
Motility (%)	Normal Weight	19	31.8 ± 0.7	0.001
	Overweight	30	28 ± 0.8	
	Obese	21	25.1 ± 0.8	
pH	Normal Weight	19	7.2 ± 0.1	0.001
	Overweight	30	7.1 ± 0.1	
	Obese	21	7.3 ± 0.1	

Table 2: Semen analysis parameters based on STOPBANG

Parameters	STOPBANG	N	Mean ± SD	p value
BMI (kg/m²)	Low Risk Score	24	23 ± 4.7	0.001
	Intermediate Risk Score	20	23.2 ± 3.4	
	High Risk Score	26	28.3 ± 2.3	
Age (years)	Low Risk Score	24	32.5 ± 1.7	0.989
	Intermediate Risk Score	20	32.5 ± 2.0	
	High Risk Score	26	32.62 ± 2.0	
Duration of Infertility (years)	Low Risk Score	24	4.4 ± 0.9	0.431
	Intermediate Risk Score	20	4.0 ± 0.9	
	High Risk Score	26	4.2 ± 0.76	
Volume (ml)	Low Risk Score	24	2.2 ± 0.3	0.027
	Intermediate Risk Score	20	2.3 ± 0.2	
	High Risk Score	26	2.0 ± 0.4	
Sperm concentration (10^6 ml)	Low Risk Score	24	32.9 ± 2.3	0.001
	Intermediate Risk Score	20	33.1 ± 2.2	
	High Risk Score	26	29.0 ± 6.1	
Motility (%)	Low Risk Score	24	28.9 ± 2.7	0.001
	Intermediate Risk Score	20	29 ± 2.4	
	High Risk Score	26	26.7 ± 2.1	
pH	Low Risk Score	24	7.1 ± 0.12	0.001
	Intermediate Risk Score	20	7.1 ± 0.08	
	High Risk Score	26	7.2 ± 0.08	

DISCUSSION

There are between 60 and 80 million couples throughout the world who are unable to have children due to infertility. Infertility is an important public health epidemic that affects the whole world. One in every four couples struggles with infertility in low-income countries, making the disorder one of the most common causes of childlessness in these regions. The incidence of obesity has grown over the last few decades, making it one of the key characteristics that are connected with infertility.

Over the last five to ten years, research has shown that having a body mass index (BMI) that is more than 25 kg/m2 has a negative impact on the quality of both oocytes and sperm. According to the findings of our inquiry, there was a connection between body mass index

(BMI) and a variety of sperm properties. These results were in line with those observed and discovered a significant decrease in sperm concentration among males with a higher BMI score.[11] The body mass index (BMI) was shown to have a direct and negative relationship with the quality of the sperm in another study that investigated the effect of losing weight on sperm characteristics.[12]

Despite this, a number of studies concluded that there is no connection between sperm properties and BMI. According to the findings of the quantity of sperm produced by infertile males of varying BMIs did not show any statistically significant differences.[13]

In our study a lower sperm concentration in the obese group with statistically significant difference detected between obese and normal-weight people in the comparison. The general population has been shown to have a median sperm concentration that ranges between 41-55 x 10^6 per milliliter in last 15 years, which is indicative of less-than-ideal sperm quality.[14]

In addition, research investigations have shown that there is a significant link between BMI and only sperm morphology and oligozoospermia, but not with other aspects of sperm.[15] Testosterone levels in men were shown to be lower in those with a higher BMI, whereas estradiol levels were found to be greater.[16] In addition, research has shown that the possibility of a decline in sperm quality is three times more likely in obese guys than it is in normal or overweight individuals.[17]

This is particularly concerning since obesity is a known risk factor for infertility. Our study also assessed the risk of OSA in the infertile community by using the STOPBANG questionnaire which shows the significant increase the risk in infertile obese subjects. The occurrence of OSA may be found all over the world; however, the United States has the highest frequency of occurrence at 16.5%. OSA prevalence varies not just with age but also with a person's gender and sexual orientation. It was demonstrated in a study that was done on the incidence of OSA showed the highest in individuals aged 50 to 59, and that men are affected to a greater degree (14.8%) than females (12.9%). Obesity is a significant risk factor for the onset and progression of obstructive sleep apnea (OSA). In point of fact, research has shown that obstructive sleep apnea (OSA) is twice as common in obese persons as it is in adults of normal weight.[18]

Obesity was a factor in 15 of the 18 individuals in our study who were at high risk for OSA. The present study findings were comparable to those observed that 47% of obese patients had moderate to severe OSA, and 27% had severe OSA showed that obese individuals were more likely to have OSA.[19]

However, nightly polysomnography was employed in the study to demonstrate the occurrence of obstructive sleep apnea. In addition, it has been suggested that the risk of developing moderate to severe OSA rises about sixfold for every 10% increase in BMI2. Researchers have conducted a number of studies to investigate the link between obstructive sleep apnea and male infertility.[2]

Based on their findings, it has been hypothesized that oxidative stress, systemic inflammation, insulin resistance, and abnormal reproductive hormone production could be the root causes. According to this study's findings, obstructive sleep apnea (OSA) risk is favorably connected with sperm concentration, however there is no meaningful relationship between OSA and other properties of sperm.[1]

Even though the results of our study showed that obstructive sleep apnea (OSA) and sperm concentration are related to one another, the presence of OSA still has to be confirmed using overnight polysomnography. Due to a lack of specific evidence, it is difficult to determine if OSA has a role in male infertility.[9]

CONCLUSION

Infertility, which has become a significant issue in recent years, is affected by obesity and obstructive sleep apnea (OSA). It is possible that the disruption of the hypothalamic-pituitary-testicular axis and other molecular abnormalities are caused by the impact of these two variables, namely its volume and concentration, on the quality of sperm. As a consequences of body weight at its obstructive sleep apnea (OSA) at an early stage in order to get treatment for it will enhance the quality of individual sperm and bring significant advancements in the treatment of infertility.

LIMITATIONS

The accuracy of the research may have been improved with a larger number of participants in the sample. It is necessary to conduct prospective study with the management of OSA as part of infertility treatment may improve the reproductive outcomes.

SUGGESTIONS / RECOMMENDATIONS

To better understand the connection between infertile men's BMI and OSA, a further prospective study with comprehensive data is required.

CONFLICT OF INTEREST / DISCLOSURE

None

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