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**Lakshmi S**
NTC Hospitals, Kizha Vaithiyanathapuram, Thathaneri Main Road, Madurai, Tamil Nadu, India

**Rajkumar K**
NTC Hospitals, Kizha Vaithiyanathapuram, Thathaneri Main Road, Madurai, Tamil Nadu, India

**Correspondence**
**Lakshmi S**
NTC Hospitals, Kizha Vaithiyanathapuram, Thathaneri Main Road, Madurai, Tamil Nadu, India

# Impact of body mass index and lifestyle factors on semen parameters

**Lakshmi S and Rajkumar K**

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**Abstract**
**Background:** Subfertility affects ~15% of couples who seek to obtain a pregnancy and male contribution is identified in 20–50% of the cases. One of the key factors attributed to subfertility and infertility is obesity. Adult obesity rate increases with age and its prevalence has been increasing over the recent decades. This study was carried out to evaluate the role of male obesity on the semen parameters.
**Methods:** This hospital based cross sectional study was conducted for a period of one year in 2017 in our tertiary care hospital. The study was carried out among 54 men who visited our clinic for evaluation of their fertility status during the study period. A single semen sample was collected from each participant. Height (m) and weight (kg) were recorded on the day of semen collection. Sperm concentration and percent motility was evaluated according to World Health Organization guidelines.
**Results:** Among 54 men analyzed 29 were less than 30 yrs. (53.7%). Majority of the participants were obese (53.7%). The lifestyle history showed that majority were non vegetarians (96.3%), non-alcoholics (68.5%) and non-smokers (81.5%). The mean semen volume was significantly decreased in patients with BMI > 25 as 1.96 ($p$<0.05).
**Conclusion:** Obesity is of growing concern among patients getting treated for infertility, both in males and females. Indirectly, diet and lifestyle factors also seem to have a detrimental effect on the semen parameters.

**Keywords:** Body mass index, lifestyle factors, semen parameters

## Introduction
The reproductive system of men and women are complex, yet sensitive to various extrinsic and intrinsic factors. A failure in the effective functioning of the reproductive system could be due to several intrinsic and extrinsic factors including religious, sociocultural factors, body mass index, hormonal levels and other metabolic disorders like diabetes mellitus, etc. Infertility is a global problem affecting 8-12% of the couples in their reproductive period. In India, the census of 1981 showed a prevalence of 4-6% while in 2007, the number of infertile couples were about 17.9 million [1]. Despite the fact that the social stigma associated with infertility almost always targets women, it is worth noting that the risk of infertility is equal for both the sexes (40%) [2].
Subfertility affects ~15% of couples who seek to obtain a pregnancy and male contribution is identified in 20–50% of the cases. [3]One of the key factors attributed to subfertility and infertility is obesity. Adult obesity rate increases with age and its prevalence has been increasing over the recent decades [4].Obesity has become a major disorder of concern worldwide, with respect to its increased risk of various systemic complications [5].This calls for greater clinical awareness regarding the effects of obesity on fertility and the need for improving our understanding of the underlying mechanisms in order to find appropriate interventions [6].
The excessive amount and distribution of body fat in female patients is related to fertility loss in women [7].Female patients presenting with high BMI (>25kg/m2) values are typically insulin resistant have polycystic ovarian syndrome and poor fertility prognosis [8, 10]. As much as obesity impacts women, it also affects the sperm quality in men. Among the individual factors which are considered to affect sperm quality in humans are environment, occupation, nutrition, stimulants, ejaculation frequency and lifestyle choices [11].Studies have demonstrated that male obesity causes alterations in sperm concentration, total sperm count, total motile sperm count, sperm morphology and DNA fragmentation [12].
The available evidence on the role of obesity and BMI on male infertility has been controversial or inconclusive to some extent.

It is therefore imperative to explore the aspect in order to devise preventive and curative strategies among sub fertile and infertile men.

**Objectives**

This study was carried out to determine the relationship between BMI and lifestyle factors on semen parameters among infertile couples.

**Methodology**

**Study setting and participants**

This hospital based cross sectional study was conducted for a period of one year in 2017 in our tertiary care hospital. The study was carried out among men who visited our clinic for evaluation of their fertility status during the study period. Men with apparent genital infection, uncontrolled hypertension history of previous vasectomy or varicocele removal and azoospermia were excluded from the study. A total of 54 men participated in the study.

**Ethical approval and informed consent**

Approval was obtained from the Institutional Ethics Committee prior to the commencement of the study. Each participant was explained in detail about the study and informed consent was obtained prior to the data collection.

**Data collection tools**

A structured interview schedule was used to obtain data pertaining to the demographic characteristics and medical history. Clinical examination was carried out to measure the height and weight of the participants. Height was recorded in meters using a non-elastic tape. Weight was recorded in kilograms using a standardized weigh scale. Body Mass Index (BMI) was calculated using the formula weight (kg)/height (metre$^2$). BMI was classified based on World Health Organization guidelines (Table 1) [13].

**Table 1:** Classification of Body Mass Index as per World Health Organization

| S. No | BMI (kg/m$^2$) | Classification |
|---|---|---|
| **1** | <18.5 | Underweight |
| **2** | 18.5 to 24.9 | Normal |
| **3** | 25.0 to 29.9 | Overweight |
| **4** | >30.0 | Obese |

Semen samples were collected according to the WHO guideline, by masturbation after avoidance of intercourse or ejaculation for 3 to 5 days. A single semen sample was collected from each man. Patient height (m) and weight (kg) were recorded on the day of semen collection. Semen specimens were permitted to liquefy for 60 minutes at 37 °C. Sperm concentration and percent motility was evaluated according to World Health Organization guidelines [14].

**Data analysis**

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done using

**Epidemiological Information Package 7:** Developed by Centre for Disease Control, Atlanta.

**Results**

Among 54 men analyzed 29 were less than 30 yrs. (53.7%) and 25 above 30yrs (46.3%). Majority of the participants were obese (53.7%). The lifestyle history showed that majority were non vegetarians (96.3%), non-alcoholics (68.5%) and non-smokers (81.5%). (Table 2)

**Table 2:** Background characteristics of the study participants

| S. No | Background Characteristic | Frequency N (54) | Percentage (%) |
|---|---|---|---|
| 1 | **Age distribution** | | |
| | <30yrs | 29 | 53.7 |
| | >30yrs | 25 | 46.3 |
| 2 | **BMI** | | |
| | <25 | 25 | 46.3 |
| | >25 | 29 | 53.7 |
| 3 | **Smoking** | | |
| | Smokers | 10 | 18.5 |
| | Non smokers | 44 | 81.5 |
| 4 | **Alcoholism** | | |
| | Alcoholic | 17 | 31.5 |
| | Non alcoholic | 37 | 68.5 |

The BMI was correlated with Volume, pH, Liquefaction, Counts and motility of the sperm. The mean volume of patients with BMI < 25 was 2.54 and it was significantly decreased in patients with BMI > 25 as 1.96 ($p < 0.05$). (Table 3)

**Table 3:** BMI and Semen Parameters

| Semen Analysis parameter | BMI | | | | 'p' |
|---|---|---|---|---|---|
| | Up to 25 kg/m$^2$ | | Above 25 kg/m$^2$ | | |
| | Mean | S.D. | Mean | S.D. | |
| Volume | 2.54 | 1.02 | 1.96 | 0.77 | 0.0464 Significant |
| P H | 7.3 | 0.64 | 7.26 | 0.71 | 0.9752 Not Significant |
| Liquefaction | 34.72 | 13.7 | 30.46 | 13.72 | 0.2069 Not Significant |
| Count | 43.5 | 29.54 | 49.4 | 31.95 | 0.6768 Not Significant |
| Motility | 49.08 | 17.99 | 41.34 | 21.63 | 0.095 Not Significant |
| Sluggish | 17.2 | 9.38 | 18.21 | 17.5 | 0.979 Not Significant |
| Non motile | 31.4 | 23.38 | 31.03 | 19.47 | 0.6634 Not Significant |

The semen parameters were correlated among vegetarians and Non vegetarians. The mean liquefaction time was 60 minutes among vegetarians and 31.39min among Non-vegetarians. The observed difference was statistically significant (p<0.05). (Table 4)

**Table 4:** Diet and semen parameters

| Semen Analysis parameter | Value for | | | | 'p' |
|---|---|---|---|---|---|
| | Vegetarians | | Non Vegetarians | | |
| | Mean | S.D. | Mean | S.D. | |
| Volume | 1.0 | - | 2.27 | 0.92 | 0.0542 Not Significant |
| P H | 7.5 | 0.71 | 7.27 | 0.68 | 0.6908 Not Significant |
| Liquefaction | 60.0 | 21.21 | 31.39 | 12.49 | 0.0358 Significant |
| Count | 23.5 | 30.4 | 27.56 | 30.67 | 0.1991 Not Significant |
| Motility | 20.5 | 27.58 | 45.8 | 19.67 | 0.1218 Not Significant |
| Sluggish | 15.0 | 21.21 | 17.85 | 10.88 | 0.8172 Not Significant |
| Non motile | 15.0 | 21.21 | 31.83 | 21.12 | 0.2699 Not Significant |

The impact of Alcoholism on different semen parameters was studied. The motility was affected in alcoholics. The mean count on sluggish motility 22.41 were more in alcoholics than in Non alcoholics.15.59 (p <0.05). (Table 5)

**Table 5:** Alcoholism and semen parameters

| Semen Analysis parameter | Value f/or | | | | 'p' |
|---|---|---|---|---|---|
| | Alcoholics | | Non alcoholics | | |
| | Mean | S.D. | Mean | S.D. | |
| Volume | 2.12 | 1.01 | 2.27 | 0.91 | 0.9848 Not Significant |
| P H | 7.06 | 0.44 | 7.38 | 0.74 | 0.0608 Not Significant |
| Liquefaction | 27.06 | 7.92 | 35.03 | 15.21 | 0.0585 Not Significant |
| Count | 44.21 | 17.86 | 47.79 | 35.26 | 0.948 Not Significant |
| Motility | 46.0 | 17.17 | 44.31 | 21.77 | 0.7376 Not Significant |
| Sluggish | 22.41 | 11.01 | 15.59 | 10.57 | 0.0443 Significant |
| Non motile | 26.06 | 15.38 | 33.57 | 23.16 | 0.1373 Not Significant |

## Discussion

Obesity is one of the major causes of infertility. In the last 5-10 years, several studies have demonstrated that maternal obesity is associated with changes in the oocyte that negatively impact embryo development thereby reducing the chances of conception, even after in vitro fertilization [15, 17]. It is only recently that the impact of male obesity on infertility risk has been considered.

Among 54 men analyzed in this study, BMI was correlated with various semen parameters like volume, pH, Liquefaction, count and motility. The mean volume of patients with BMI < 25 was 2.54 and it significantly deceased in patients with BMI > 25 upto 1.9 (p <0.05). Chavarro et.al in his study had observed that obesity and overweight men were associated with significantly decreased semen volume and also reported decreased sperm concentration [18]. Fejis et.al also demonstrated decrease in semen quality in men who were obese [19]. Both sperm concentration and motility were found to be associated with BMI several studies [20]. Stewert et.al linked obesity to reduced total sperm number in the ejaculate in his study [21].

The same semen parameters were correlated among vegetarians and Non vegetarians. The mean liquefaction time was 60 minutes among vegetarians and 31.39 minutes among non-vegetarians (p<0.05). There are very few studies done to explore this association. Further studies on large scale are needed for evaluation of the effect of dietary factors on semen quality. The mean sperm concentration was decreased among smokers (43.52) when compared to nonsmokers (60.5) but it was not statistically significant. There are controversial reports on effect of smoking on semen parameters [22]. In our present study we did not find any strong association between cigarette smoking and semen parameters.

The impact of alcoholism on different semen parameters was studied. The motility was significantly affected in alcoholics. The mean count on sluggish motility 22.41(11.01%) were more in alcoholics than among non-alcoholics 15.59(10.57%), (p<0.05). Dushyant Singh et.al also concluded that alcohol consumption was most commonly associated with Asthenozoospermia [23]. Alcohol has been shown to have a deleterious effect at all levels of male reproductive system. Alcohol interferes in the feedback of Hypothalamus pituitary-Gonadal axis (HPG) resulting in impairment of production and secretion of adequate quantity or potency of Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) leading to deterioration of Sertoli cells [24]. Alcohol affects the Leydig cells and reduces blood levels of testosterone and increases its metabolic clearance. Progressive damage to testis and reduction of sex hormones leads to loss of secondary sexual characters and development of impotence and infertility [25].

## Conclusion

In the present study we have found an association between obesity and semen quality. Obesity is of growing concern among patients getting treated for infertility, both in males and females. Indirectly, diet and lifestyle factors also seem to have a detrimental effect on the semen parameters. Our study has shown that alcohol consumption is associated with Asthenospermia. Hence it is essential to create awareness among the couples regarding the role of obesity and lifestyle factors in infertility.

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