A Systematic Review of the Relationship between Risk of Varicoceles and Obesity

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objectives: The systematic review was conducted to assess the relationship between varicoceles, risk of varicoceles or body mass index and obesity.

Review Methods: The present systematic review scrutinized all the research articles published in
English from 1971 to 12 July 2021 pertaining to the relationship between varicoceles, risk of varicoceles or body mass index and obesity. The systematic review was piloted under the PRISMA directives.

**Data Sources:** Research articles were retrieved from the National Strength and Conditioning Association, Google Scholar, Web of Science, MEDLINE, Journal of Strength and Conditioning, and PubMed database using the vital search terms: risk of varicoceles or varicoceles in combination with obesity, body mass index.

**Results:** There was a total of 370 studies found, with 29 publications included in this systematic review. There were 16 (55.1%) studies on the risk of varicoceles or varicoceles in combination with body mass index, 7 (24.1%) on the risk of varicoceles or varicoceles in combination with obesity, and 6 (20.7%) on the risk of varicoceles or varicoceles.

**Conclusions:** Most cases in our systematic review included body mass index and risk of varicoceles or varicoceles, a few involved obesity and risk of varicoceles or varicoceles, while some included varicoceles relevant cases.

**Keywords:** Body mass index; Obesity; Varicoceles.

1. INTRODUCTION

Varicocele is the tortuosity or dilatation of the pampiniform plexus veins. Although they are more common on the left side clinically, the reported incidence of bilateral varicoceles varies greatly, ranging from 30% to 80%. A single right-sided varicocele is very rare, and it increases the possibility of a retroperitoneal tumour [1]. Varicoceles that are perceptible on physical examination are known as clinical varicoceles, and only these varicoceles have been linked to infertility. Despite the availability of many radiologic modalities, imaging investigations are not advised to identify subclinical varicoceles in individuals who do not have a palpable abnormality [2]. In the adult male urological population, varicoceles are a common finding. They may be palpated in about 15% to 20% of men in clinical settings [1]. Varicoceles are important since they influence male fertility because they occur in 70% of secondary infertile men and 35% of primarily infertile men [3]. Varicoceles have been linked to reduced Leydig cell activity, sperm quality, and testicular volume in several WHO investigations [4].

Celsus reported varicoceles in the first century C.E. The precise pathogenic processes have not been documented to our knowledge. To correctly diagnose a varicocele, a thorough physical examination is required. A warm environment, a relaxed and willing patient, and a competent therapist are all ideal circumstances. The scrotum should be relaxed and warm to enable inspection of the scrotal contents. A chilly atmosphere or an unhappy patient may cause the scrotum to shrink or stiffen, making it much harder to palpate a varicocele. Some doctors have even suggested using a heating pad to guarantee the physical evaluation is accurate. In the recumbent and upright postures, the individual should be evaluated [5]. Obese individuals, both fertile and infertile, had a lower varicoceles frequency. Also proposed as etiologies were the nutcracking effect decreasing sperm constriction of the left vein because of enhanced adipose tissue between the aorta and the superior mesenteric artery and difficult palpation owing to adipose tissue in the inguinal scrotal areas [6].

The overall reported higher prevalence of infertility in obese individuals confounds the reduced frequency of varicoceles in obese patients. The Norwegian Mother and Child Cohort and the Danish National Birth Cohort Study found that couples with an obese male spouse had a lower conception rate [7]. Jensen et al. (2004) found that obese and overweight males had lesser sperm concentrations (39 vs 46 million/ml) and a greater incidence of oligospermia (21% vs 24.4%) [8].

2. METHODS

**2.1 Literature Search**

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to evaluate articles that included "varicoceles in combination with obesity, body mass index", as shown in Fig. 1. The search engine "Web of Science, Google Scholar, MEDLINE, PubMed, Journal of Strength and Conditioning, and National Strength and Conditioning Association" systematically searched for the articles published from 1971 to
12 July 2021. All the articles with the keywords "risk of varicoceles or varicoceles combined with obesity, body mass index" were searched.

2.2 Inclusion and Exclusion Criteria
All articles with the keywords "risk of varicoceles or varicoceles combined with obesity, body mass index" was initially included, with systematic reviews, literature reviews, reports, books, and chapters being excluded later. Obesity will be reported in a broad sense that includes body mass index.

2.3 Data Extraction
Different investigators chose the papers separately established on the inclusion and exclusion criteria mentioned above. If the investigators chose different numbers of articles, they came to an agreement after some discussion. Following that, each investigator looked over the entire contents of the publications and extracted the relevant data into excel sheets. Finally, the findings were evaluated by a third investigator.

3. RESULTS
The initial search identified 370 studies using the National Strength and Conditioning Association, Google Scholar, Web of Science, MEDLINE, Journal of Strength and Conditioning, and PubMed search engine. The preliminary search technique was thorough and had strict parameters in order for all articles to be included. Twenty-nine published research articles reported the relation between varicoceles and obesity or body mass index of the 29 published studies showing the risk of varicoceles or varicoceles association with obesity, or body mass index incorporated in our systematic review, 24.1% (n=7) used varicoceles and obesity; 55.1% (n=16) used varicoceles and body mass index, and 20.7% (n=6) used varicoceles. The normative figures from published research papers for varicoceles combined with obesity or body mass index are described in this section. A comprehensive overview of selected studies is described in Table 1.

**Fig. 1. PRISMA flow diagram**
The researchers wanted to investigate whether there was a relationship between BMI and the occurrence and varicocele severity in a south-eastern Iranian male's sample. One hundred sixty-seven males were sent to the University associated Urology Clinics in Zahedan, Iran, for cross-sectional research in 2010 and 2011. Expert urologists looked at the patients to see whether they had varicocele and graded it from I to III. The patients' age, varicocele side, and varicocele grade and height and weight were assessed and documented. The individuals were divided into groups based on their age. The patients were 27.9 ± 7.6 years old on average, with a BMI of 23.5 ± 4.7 kg/m2. In individuals between the ages of 20 and 30, varicocele was most frequent. There was no significant difference in age in patients with grade II varicocele (P=0.11) in most individuals. Right varicocele patients were given the same medium BMI as left varicocele patients. BMI was the same for individuals with right or left varicocele for those with bilateral varicocele. In 17.9%, 56.5% and 25.6% of patients, respectively, were discovered varicocele grades I, II and III [20].

In a retrospective data analysis, 193 Caucasian adolescents and children aged 9 to 19 years with II to III grade left varicocele were evaluated. The BMI, height and weight of the patients were compared to the standard age standards in Germany. Significant concomitant illnesses and a family predisposition to varicocele were also observed. In the group of patients under study, the height and weight mean percentages were considerably higher, whereas, for the general population (p=0.019, 0.005 and 0.002), the mean BMI percentiles (42nd) were significantly lower than the age-related 50th percentiles. 12.2% of the patient's brothers had acquired varicoceles in our case study. The research has shown that the physical characteristic of the varicocele is linked to the development of infancy or adolescence. Varicocele patients were shown to be larger and taller than a control group of older people, although having a lower BMI [24].

Table 1. Characteristics of selected studies

| References | Study design                  | Country      | Men with varicoceles | Men without varicoceles |
|------------|-------------------------------|--------------|----------------------|-------------------------|
| [6]        | Case study                    | NA           | 1093                 | 2120                    |
| [9]        | Case study                    | NA           | 490                  | 560                     |
| [10]       | Case study                    | NA           | 20                   | 20                      |
| [11]       | Case study                    | NA           | 98                   | NA                      |
| [12]       | Case study                    | NA           | 330                  | 767                     |
| [13]       | Case study                    | NA           | 40                   | 40                      |
| [14]       | Prospective study             | South Korea  | 320                  | 1618                    |
| [15]       | Cross-sectional study         | Bulgaria     | 255                  | 5945                    |
| [16]       | Retrospective study           | Austria      | 1111                 | NA                      |
| [17]       | Case study                    | NA           | 77                   | NA                      |
| [18]       | Case study                    | NA           | 35                   | NA                      |
| [19]       | Retrospective study           | South Korea  | 211                  | 102                     |
| [20]       | Cross-sectional study         | Iran         | 167                  | NA                      |
| [21]       | Retrospective-comparative study | NA            | 587                 | 1255                    |
| [22]       | Retrospective cohort study    | NA           | 147                  | NA                      |
| [23]       | Case-control study            | NA           | 153                  | 250                     |
| [24]       | Retrospective study           | NA           | 193                  | NA                      |
| [25]       | NA                            | NA           | 102                  | 95                      |
| [26]       | Case study                    | NA           | 200                  | 200                     |
| [27]       | Retrospective study           | Turkey       | 85                   | 1424                    |
| [28]       | Case study                    | NA           | 298                  | 577                     |
| [29]       | Retrospective study           | USA          | 114                  | NA                      |
| [30]       | Cross-sectional study         | China        | 1911                 | 37648                   |
| [31]       | Prospective study             | NA           | 138                  | 117                     |
| [32]       | Retrospective study           | NA           | 398                  | 1708                    |
| [33]       | Retrospective study           | NA           | 143                  | 50                      |
| [34]       | Retrospective study           | Turkey       | 498                  | 2061                    |
| [35]       | Retrospective study           | Israel       | 47398                | 1,275,663               |
From 2004 to 2014, 153 individuals with mild and severe varicocele were examined in a case-control study. The height and BMI of the 153 varicocele patients were compared to the height and BMI of 250 men who did not have varicocele as a control group. Obese men had a reduced varicocele risk than overweight and normal men when sociodemographic variables were taken into account (OR= 0.38, 95% CI= 0.17, 0.85). Taller males had a higher adjusted OR for varicocele than men of moderate height and average height. According to the findings of this research, non-obese men and tall men are at a greater varicocele risk; thus, counselling and assessment of men at greater varicocele risk may help decrease infertility [36].

Another research looked at the relationship between weight and height and varicocele grade in people aged 18 to 30. Four hundred people between the ages of 18 and 30 were enrolled and sent to the Medical Commission or Tabriz Medical Sciences University's specialized clinics from September 2004 until March 2005. Varicocele patients were given one of three classes depending on the severity of their illness, after splitting the volunteers into two groups - the Varicocele Group and the Non-varicocele Group: moderate (Grade II) and mild (Grade II) or serious (Grade III). Finally, we examined the connection between height, weight and BMI. The varicocele's height and severity on the left were significantly linked to, i.e., disease severity with height increased (p=0.004). The greater incidence of varicocele was likewise associated with height. Instead, the BMI and low weight improved varicocele frequency but did not affect the severity of the illness. In the end, the incidence and severity of left varicocele were directed towards patients' height, perhaps owing to their left internal spermatic venous lengths and greater hydrostatic pressure in taller individuals. BMI and weight and also have a bearing on varicocele occurrence. Evaluating puberty overall appears to benefit small and large individuals [37].

In separate research, conventional ultrasonography criteria were employed to identify varicoceles. Patients were categorized as normal if their BMI was fewer than 25 kg/m2, overweight if it was 25 to 30, or obese if it was higher than 30 using National Institutes of Health standards. An ultrasound-detected varicocele was found in 330 (30.8%) of the 1,079 individuals. Body mass index was 26.7 ± 3.8 kg/m2 in individuals with a varicocele and 26.0 3.7 kg/m2 in those without varicocele. A varicocele was found in 171 individuals (16.0%) on physical examination. On physical examination, individuals with a varicocele had a BMI of 26.6 ± 3.7 kg/m2 than those without a varicocele with a BMI of 26.4 ± 3.9 kg/m2. A varicocele was found in 129 (34.5%) of the 374 normal-weight individuals, whereas 43 (25.6%) and 163 (30.6%) of the obese and overweight patients, respectively, had a varicocele. There was a statistically significant difference between obese and non-obese individuals. The incidence of varicoceles identified by ultrasonography is lower in obese individuals. The decreased frequency is not related to a physical examination but rather to another reason [12].

Male infertility hits around 6% of males in their reproductive years. Although the impact of male BMI on fertility is unknown, it has been suggested that overweight or obese men take longer to conceive. BMI is thought to be negatively linked to fertility, as shown by lower sperm concentration and varicocele. The study comprised 98 males with a mean age of 32.74 ± 6.96 years, self-reported BMI, and semen analysis. Age, BMI, pubertal timing, varicocele development, testosterone, luteinizing hormone, and follicle-stimulating hormone (n = 18) were examined. The average age of the participants in the research was 32.74 ± 6.96 years. The prevalence of normospermia, oligozoospermia, azoospermia, and varicocele development did not differ by BMI. The frequency of development of varicocele and the sperm concentration is not linked in men who are obese [11].

Physical exams were carried out in middle school boys from six areas of South Korea in prospective research to evaluate the existence and severity of varicoceles. All of the boys' weight, height, and testicular volume was measured. Varicoceles were counted to see how often they were. The existence and severity of varicoceles were investigated concerning testicular volume, BMI, age, and the prevalence and intensity of varicoceles. A total of 1938 men were examined, with an average age of 14.1 years and 14.1 years. A varicocele was found on the left side of 295 males and the right side of 8 boys. In 17 people (0.9%), bilateral varicoceles were discovered. A grade 1, 2, or 3 varicocele was found in 151 (51.2%), 80 (27.1%), and 64 (25.1%) of the boys with a left varicocele, respectively. Varicoceles did not become more common as people become older. With the extent of the varicocele, the percentage of males
with testicular size disparities rose. After age was taken into account, BMI was shown to associate with the occurrence of varicoceles negatively. Varicoceles are seen in 16.5% of South Korean middle school males. Varicoceles seem to have a detrimental impact on testicular development. The incidence of varicoceles shows a significant negative association with BMI [14].

4. DISCUSSION

Obesity is linked to a significant disruption in the hormonal environment, which may impact the reproductive system. When women are at the two extremes of weight or obesity reduction, this impact is seen in women with various reproductive problems. This connection is poorly defined in males. Several studies have linked the build-up of adipose tissue in males to a reduction in total and free T serum levels and an upsurge in E22 serum levels. Low sperm count may result from this hormonal change. Obesity and different sperm characteristics were shown to have a negative association in the general population. There is a connection between increasing BMI and male infertility, according to recent data from population research. Because of the recent and fast rise in obesity in the industrialized world, the relationship between fertility and obesity has gotten much attention. The goal of this systematic review is to look at the link between varicocele and obesity and BMI [38].

The expansion of the scrotal plexus and the internal venous sperm system is known as varicocele. Around 15% of men are affected with scrotal varicocele, and 2% to 10% of those who have it feel pain. The dilated venous complex compressing neighbouring neural fibres, hormonal imbalances, oxidative stress, hypoxia, increased venous pressure, greater testicular temperature, and the reflux of toxic metabolites from the adrenal or renal systems are all potential causes of pain. Throbbing pain, aching, or dullness in the groyne, scrotum, or testicle are common symptoms of varicocele-related testicular discomfort; it may also be acute, sharp, or stabbing. The therapy of testicular pain caused by varicocele starts with a careful, nonsurgical approach and observation period. Inappropriately selected patients with clinically palpable varicocele, varicocelectomy eliminates about 80% of all testicular pain. Due to low complication rates and good outcomes, microsurgical varicocelectomy techniques have gained prominence. Varicocelectomy success is determined by the varicocele severity, the kind and length of the pain, BMI, prior conservative therapy, and the surgical method. Grade varicocele is only detectable during the Valsalva technique; grade α is felt but not visible, and grade β is visible. Although a grade 0 (subclinical) varicocele is not perceptible, Doppler ultrasonography may identify it [39].

Obesity is negatively linked to the occurrence and severity of varicoceles, suggesting that obesity may result in a reduced nutcracker impact [40]. According to Handel et al., the incidence of varicocele decreases as BMI rises since more significant adipose tissue reduces the left renal vein's constriction and avoids identification due to adipose tissue in the spermatic cord [6]. In research, varicocele patients had a lower BMI than normal age-matched controls, but varicocele grade 3 does not have a substantially lower BMI than varicocele grade 3 patients. The difference in aetiology between our research and Tsao et al. may be because the prior study's patients were young men serving in the armed forces, which was not the case with our patients, but the aetiology still has to be investigated further [41].

Gorur et al., [32] suggests that varicocele presence and BMI score have a significant reverse connection. The findings of this study also indicate that varicocele recurrences have risen markedly with decreasing BMI values, particularly in individuals who had less than 25 kg m² of BMI. A low BMI scoring seems predisposed for recurrence of varicocele and may be an objective indication of subinguinal microsurgical varicocelectomy. For better clarification of potential processes, more comparative investigations, haemodynamic (Doppler ultrasound), radiological and genetic are essential [32].

The connection between BMI and varicoceles has been studied extensively, with conflicting results. Based on a study of 840 patients with varicoceles and age-matched controls without varicoceles, Smith first indicated in 1957 that patients with varicoceles were heavier and taller [42]. Delaney et al. found in 2004 that individuals with varicoceles were significantly heavier and taller than those without varicoceles, although there were no significant changes in BMI [43]. The varicoceles group substantially decreased BMI in teenagers, according to logistic regression analysis; however, the difference was not significant in adults [44]. Contrary to these studies' findings, much additional research found
an inverse relationship between BMI and varicoceles in both adults and adolescents [44,45,46,25,47]. Nielsen et al. found that the incidence of varicoceles reduced as BMI increased in 2106 males aged 18–85 years admitted to the hospital for erectile dysfunction or infertility in 2006 [32]. In a study of 1055 young military males published in 2009, Tsao et al. discovered that BMI was inversely linked to the occurrence and severity of varicoceles [48]. In 2013, Rais et al. examined 1.3 million Israeli males for required medical exams and discovered that overweight and obese men had a significantly lower risk of varicoceles, whereas underweight men had a significantly higher risk of varicoceles [49]. BMI was shown to be inversely related to the existence of varicoceles in another research. Even after accounting for potential confounders, the negative relationship remained statistically significant. An intervention study or prospective cohort study is needed to investigate the causal relationship between BMI and the incidence of varicoceles [30].

5. CONCLUSION

Varicoceles are dilatation of veins inside the pampiniform plexus that affects around 15% of the male population. However, a few percentages of these men have reproductive issues. The current systematic review focused on the relationship between varicoceles, varicoceles and obesity or body mass index (BMI). Most cases in our systematic review included body mass index and risk of varicoceles or varicoceles, a few involved obesity and risk of varicoceles or varicoceles, while some included varicoceles relevant cases.

ETHICAL APPROVAL

It is not applicable.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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