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Review

Effect of male body mass index on assisted reproduction treatment outcome: an updated systematic review and meta-analysis

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KEY MESSAGE

Published research suggests that raised body mass index (BMI) has a negative effect on IVF and intracytoplasmic sperm injection treatment outcome. Future well-designed, robust prospective studies adhering to the World Health Organization definitions of BMI categories and considering important confounding variables are needed to confirm our study results.

A B S T R A C T

Men with a body mass index (BMI) of 30 or over are more likely to have reduced fertility and fecundity rates. This systematic review and meta-analysis evaluated the effect of male BMI on IVF and intracytoplasmic sperm injection (ICSI) outcome. An electronic search for published literature was conducted in *MEDLINE* and *EMBASE* between 1966 and November 2016. Outcome measures were clinical pregnancy rates (CPR) and live birth rates (LBR) per IVF or ICSI cycle. Eleven studies were identified, including 14,372 cycles; nine reported CPR and seven reported LBR. Pooling of data from those studies revealed that raised male BMI was associated with a significant reduction in CPR (OR 0.78, 95% CI 0.63 to 0.98, $P = 0.03$) and LBR (OR 0.88, 95% CI 0.82 to 0.95, $P = 0.001$) per IVF–ICSI treatment cycle. Male BMI could be an important factor influencing IVF–ICSI outcome. More robust studies are needed to confirm this conclusion using standardized methods for measuring male BMI, adhering to the World Health Organization definitions of BMI categories, accounting for female BMI, IVF and ICSI cycle characteristics, including the number of embryos transferred and embryo quality, and use the live birth rate per cycle as primary outcome.

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https://doi.org/10.1016/j.rbmo.2018.01.002

Please cite this article in press as: Rabia Mushtaq, et al., Effect of male body mass index on assisted reproduction treatment outcome: an updated systematic review and meta-analysis, Reproductive BioMedicine Online (2018), doi: 10.1016/j.rbmo.2018.01.002

Introduction

Obesity is a global pandemic, which carries major health consequences and negative effect on quality of life. Worldwide obesity has more than doubled since 1980 (Nguyen and El-Serag, 2010), and is projected to increase further owing to anticipated demographic changes (Popkin et al, 2012).

Male factors are thought to contribute to up to 50% of subfertility cases, with 31.5% being attributed solely to a male factor cause (Agarwal et al., 2015; Thonneau et al., 1991).

Men who have a body mass index (BMI, measured as kg/m^2) of 30 or more are more likely to have reduced fertility and fecundity rates (NICE, 2013; Sundaram et al., 2017). Several mechanisms have been attributed to the reduced fecundity in obese men, including lower serum testosterone and raised serum oestradiol levels, impaired spermatogenesis and erectile dysfunction (Andersson et al., 2008; Katib, 2016).

Recent data evaluating the relationship between waist circumference and semen parameters in men without known infertility, indicated higher prevalence of lower ejaculatory volume and oligozoospermia in men with increasing waist circumference and BMI (Eisenberg et al., 2014). In addition, lower sperm concentration and higher percentage of abnormal sperm morphology were associated with increasing body adiposity in a recent cross-sectional cohort study (Tsao et al., 2015). Evidence also shows that raised male BMI could be associated with a lower success rate after IVF treatment. A large cohort study showed that couples in whom both partners were either overweight or obese had the lowest odds for live birth after IVF (Petersen et al., 2013). Furthermore, a large observational study demonstrated that male partner BMI had a greater effect on embryo quality and IVF outcome than semen analysis parameters (Anifandis et al., 2013). Increased level of sperm DNA damage associated with male obesity has been shown to be related to lower pregnancy and higher miscarriage rates in both IVF and ICSI cycles (Zhao et al., 2014).

The results of published studies addressing the relationship between raised male BMI and IVF–ICSI outcome, however, are conflicting, with some studies reporting a negative effect of raised male BMI (Bakos et al., 2011; Merhi et al., 2013; Umul et al., 2015), and others reporting no effect (Braga et al., 2012; Schliep et al., 2015; Thomsen et al., 2014).

In this study, we sought to systematically review and summarize the existing evidence related to the effect of male BMI on clinical pregnancy and live birth rates after IVF–ICSI treatment.

Materials and methods

Literature search methodology

Electronic searches for published literature in *MEDLINE*, and *EMBASE* were conducted from database inception until November 2016 to capture citations including male partner BMI and reproductive outcome after IVF–ICSI treatment. A combination of medical subject headings (MeSH) and text words were used to generate two subsets of citations: one including 'male body mass index' (paternal obesity, BMI, paternal body mass index, male adiposity, overweight men) and the second subset for assisted reproductive techniques (assisted reproductive technology, assisted reproduction, ART cycles, IVF, ICSI, in vitro fertilisation, invitro fertilisation, in-vitro fertilization, invitro fertilization and intra-cytoplasmic sperm injection). These subsets were combined with 'AND' to generate a subset of citations relevant to our research question. No language restrictions were applied. The reference lists of all known primary and review articles were examined to identify relevant articles not captured by electronic searches.

Study selection and outcome measures

We considered prospective and retrospective cohort studies, published in full or as abstracts, examining the effect of male BMI on the outcome of IVF and ICSI treatment. Participants were male partners of couples undergoing IVF or ICSI, for whom information about male BMI was available and who were using ejaculated sperm for IVF or ICSI treatment. Studies involving natural conceptions, oocyte donation cycles, intrauterine insemination, ovulation induction and those not using the World Health Organization (WHO) criteria for BMI reporting were excluded.

Studies were selected in a two-stage process. In the first instance, two reviewers (RM and CA) independently scrutinized all the titles and abstracts from the electronic searches and full manuscripts of all citations that definitely, or possibly, met the predefined selection criteria were retrieved. After examining the full manuscripts, final inclusion or exclusion decisions were made. Any disagreement about inclusion was resolved by consensus after consultation with a third reviewer (JP).

The outcome measures considered for this review were clinical pregnancy and live birth rates per cycle started.

Data extraction and quality assessment

Data extraction and quality assessment was carried out independently by two reviewers (RM and CA). For each study included, information was obtained on population size, study design, male BMI categories used, number of participants in each category and study outcome measures. Duplicate studies or studies with overlapping populations were excluded. In cases of missing or unclear data, the authors of the primary studies were contacted.

The selected studies were assessed for methodological quality by using the components of study design that are related to internal validity (Centre for Reviews and Dissemination, 2001). Meta-analysis of observational studies in epidemiology (MOOSE) guidelines were followed (Stroup et al., 2000). The methodological quality and risk of bias of each study was assessed using the Newcastle–Ottawa quality assessment scale (NOS) (Wells et al., 2000). A study with NOS score of 6 or higher was regarded as a high-quality study. We combined data from studies if they had similar design, intervention and outcome measures.

Data collected compared the clinical pregnancy rate (CPR) and live birth rate (LBR) in the study group (male BMI of 25 or more, i.e. overweight and obese men) with a control group of men with a normal BMI (18.5–24.9). A sensitivity analysis on overweight (BMI 25–29.9), obese (BMI 30–34.9) and morbidly obese (BMI ≥35) men was carried out, and each subgroup was compared with the normal BMI group (BMI 18.5–24.9) for both outcome measures. Similarly, studies that separated data for IVF and ICSI cycles were analysed in another subgroup analysis for the CPR and LBR. A further analysis was carried out including only studies that accounted for female BMI.

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