# New debate: is it time for infertility weight loss programmes to be couple-based?

Running title: Should weight loss programmes be couple based?

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## Abstract

With obesity on the rise in the general population, it has also become more prevalent among people of reproductive age. Weight loss has shown benefits in overweight women and men experiencing fertility problems. However, the existing weight loss interventions for individuals with infertility are associated with high drop-out rates and limited success. In this article, we argue for the development of weight loss programmes targeting couples, as couples are routinely seen in fertility clinics, rather than individuals. Couples may have correlated weights, and similar eating and activity patterns. Involving both partners may facilitate mutual support, behaviour change, weight loss, and programme continuation, at very little additional cost. A successful couple-based intervention could improve the chances of achieving pregnancy and delivering a healthy baby, with a reduction in pregnancy complications. In the longer run, both partners and their baby could benefit from maintained behaviour change with better health across the lifespan. We conclude that there is a need for research to systematically develop a couple-based weight loss intervention with state-of-the-art design that is tailored to both partners' needs.

**Keywords:** body mass index / BMI / fertility / weight loss / couple-based intervention / couples / obesity / overweight / pregnancy

## Introduction

With obesity on the rise in the general population (World Health Organization, 2016), it has also become more prevalent among people experiencing fertility problems (Vahratian and Smith, 2009). It is widely recognised that being overweight in the face of central adiposity may contribute to delayed conception. Much of the prevailing literature uses weight and body mass index (BMI) as surrogates for adiposity, and while muscle mass may increase these measures, persons with BMI of 30 $kg/m^2$ or more mostly have excess body fat, as do as many as 50% of those below (Romero-Corral *et al.*, 2008).

In women, insulin resistance secondary to overweight and obesity can disrupt ovulation through its effect on the sex hormone pathway, as well as through leptin and other adipokines (Klenov and Jungheim, 2014; Zain and Norman, 2008; Pantasri and Norman, 2014). Oocyte quality may also be compromised (Klenov and Jungheim, 2014), as embryos derived from the oocytes of obese women have been noted to be of poorer quality (Carrell *et al.*, 2001; Metwally *et al.*, 2007; Metwally *et al.*, 2007). High body mass index may also affect endometrial quality and implantation, as obese recipients of oocytes from normal weight donors are less likely to conceive following in-vitro fertilisation (IVF) than normal weight recipients (Bellver *et al.*, 2007).

In men, increased body weight may also compromise fertility. Excessive lower abdominal fat can increase testicular temperature during episodes of prolonged sitting, which may have implications for spermatogenesis (Hammoud *et al.*, 2012). Obese men have been shown to have increased oestrogen levels, with disruption of the hypothalamo-pituitary-gonadal axis (Shukla *et al.*, 2014; Schneider *et al.*, 1979; Schneider *et al.*, 1979). Such high circulating oestrogen levels have also been shown to have a deleterious effect on spermatogenesis in animal studies (Goyal O *et al.*, 2003). In humans, higher BMI and more central adiposity are associated with reduced sperm concentration, lower total motile sperm count (Eisenberg *et al.*, 2014; Hammiche *et al.*, 2012; Hakonsen *et al.*, 2011; Hammiche *et al.*, 2012; Hakonsen *et al.*, 2011) and abnormal sperm morphology (Hammiche *et al.*, 2012; Hakonsen *et al.*, 2011; Hakonsen *et al.*, 2011). In a systematic review investigating the impact of BMI on sperm parameters (Sermondade *et al.*, 2013) across 21 studies and 13,007 men attending fertility clinics, oligozoospermia and azoospermia were more common among overweight (OR 1.11, 95% confidence interval(CI) 1.01-1.21), obese (OR 1.28, 95% CI 1.06, 1.55), and morbidly obese men (OR 2.04, 95% CI 1.59-2.62) (Sermondade *et al.*, 2013).

Few researchers have studied the association between weight and fertility in both partners. One study of 47,835 couples sought to explore the effect of obesity on couple infertility, over and above the effects on each individual (Ramlau-Hansen *et al.*, 2007). Among couples where both partners were either overweight or obese, the adjusted odds of a delay of over one year in achieving pregnancy were 1.41 (95% CI

1.28, 1.56) for overweight and 2.74 (95% CI 2.27, 3.30) for obese couples, compared to normal weight couples, with a dose-response relationship with increasing BMI. Obesity in both partners was associated with greater difficulty achieving pregnancy (Ramlau-Hansen *et al.*, 2007). Another study found that couples where both partners' BMI exceeded 35.0 kg/m$^2$ experienced a delay in time to pregnancy, or reduced fecundity, when compared to couples with a BMI below 25 kg/m$^2$ (adjusted fecundity odds ratio aFOR 0.41; 95% CI: 0.17, 0.98) (Sundaram *et al.*, 2017).

For assisted conception, it would appear that IVF live birth rates (Petersen *et al.*, 2013), but not those with intracytoplasmic sperm injection (ICSI) (Petersen *et al.*, 2013; Wang *et al.*, 2016), might be reduced by couple obesity, though further research seems warranted to confirm whether this is truly the case (Schliep *et al.*, 2015).

## Potential benefits of weight loss

Weight loss has shown benefits in overweight women and men experiencing fertility problems (Best, 2016). In overweight women, a weight loss of 10% or more has been shown to improve insulin resistance (Zain and Norman, 2008), spontaneous pregnancy (Lan *et al.*, 2017; Mutsaerts *et al.*, 2016; Duval *et al.*, 2015) and live birth rates (Kort *et al.*, 2014). A reduction of body weight by 2-5% has been associated with restoration of ovulation and a 71% increase in insulin sensitivity (Huber-Buchholz *et al.*, 1999). Weight loss exceeding 3 kg has been associated with an improvement in the numbers of mature oocytes retrieved in IVF cycles (Chavarro *et*

*al.*, 2012). However, it is uncertain whether this translates into improved pregnancy or live birth rates in these cycles, as some studies suggest no added benefit (Einarsson *et al.*, 2017; Moran *et al.*, 2011; Chavarro *et al.*, 2012; Moran *et al.*, 2011), while others do (Clark *et al.*, 1998; Sim *et al.*, 2014a). In obese men, a weight loss programme was associated with improvement in semen quality (Hakonsen *et al.*, 2011), while a dietary programme resulted in reduced abdominal fat, decreased sperm DNA fragmentation, and improvement in metabolic and hormone profiles, with all spouses in the latter case series becoming pregnant (Faure *et al.*, 2014). In a prospective uncontrolled pilot study (Homan *et al.*, 2012), 23 infertile couples received motivational face-to-face interviews on an on-going basis with one to two weekly phone calls over four months. The weight loss achieved was not precisely described, but 47% were reported to having "a modest loss of between 1 and 5 kg". Eight of the twenty-three couples conceived by the end of the follow-up period (Homan *et al.*, 2012).

## Individual-based weight-loss interventions

Weight loss requires dietary modification, with or without a change in physical activity, to induce a caloric deficit resulting in the body metabolising fat. Individual-based programmes described in the literature to improve fertility have utilized such strategies as low calorie diets, usually low in fat and saturated fat and added sugars, (Turner-McGrievy *et al.*, 2014; Qublan *et al.*, 2007; Mavropoulos *et al.*, 2005; Thomson *et al.*, 2009; Qublan *et al.*, 2007; Mavropoulos *et al.*, 2005; Thomson *et al.*, 2009), low glycaemic index diets (Becker *et al.*, 2015), very low calorie diets (Kiddy

*et al.*, 1992; Tsagareli *et al.*, 2006; van Dam *et al.*, 2004; Tsagareli *et al.*, 2006; van Dam *et al.*, 2004), and a variety of different diets with exercise (Karimzadeh and Javedani, 2010; Moran *et al.*, 2011; Moran *et al.*, 2003; Thomson *et al.*, 2008; Salama *et al.*, 2015; Khaskheli *et al.*, 2013; Hollman *et al.*, 1996; Mahoney, 2014; Mutsaerts *et al.*, 2016; Sim *et al.*, 2014b; De Frene *et al.*, 2015; Miller *et al.*, 2008; Moran *et al.*, 2011; Moran *et al.*, 2003; Thomson *et al.*, 2008; Salama *et al.*, 2015; Khaskheli *et al.*, 2013; Hollman *et al.*, 1996; Mahoney, 2014; Mutsaerts *et al.*, 2016; Sim *et al.*, 2014b; De Frene *et al.*, 2015; Miller *et al.*, 2008). Motivational interviewing has also been described as a useful tool (Koning, 2015; Karlsen *et al.*, 2013; Karlsen *et al.*, 2013).

Poor programme compliance has been a problem in many weight loss programmes. In a systematic review of discontinuation rates in such interventions among obese infertile women (Mutsaerts *et al.*, 2013), 10 of 15 studies reported discontinuation, with the median discontinuation rate at 24% (range 0-31%). The programmes ranged from 6-32 weeks in duration, with a median of 24 weeks. Given the small number of studies, it was difficult to identify correlates of discontinuation, but the authors noted that weight loss and pregnancy rates were lower in non-compliant persons (Mutsaerts *et al.*, 2013). Two studies suggest that very stringent diets (e.g., vegan or low-carbohydrate ketogenic) may be particularly hard to follow with even higher discontinuation rates than less restricted diets (Turner-McGrievy *et al.*, 2014; Mavropoulos *et al.*, 2005; Mavropoulos *et al.*, 2005). Studies aiming to improve motivation seem to achieve greater success. Two programmes integrated motivational interviewing and had relatively low discontinuation rates of 10.6% at 6

months (Mutsaerts *et al.*, 2016), and 10.9%, respectively (Koning, 2015). An exercise programme for obese infertile women to improve psychological well-being (Galletly *et al.*, 1996) showed a discontinuation rate of 33.3%, with women who dropped out having higher anxiety and depression scores and lower self-esteem at baseline. In summary, weight loss interventions which are mainly focussed on the individual, have high discontinuations rates, even for patients thought to be motivated in order to improve their fertility, and this results in less weight loss associated with lower pregnancy rates.

## The rationale for a couple-based intervention

Partner support in everyday life may facilitate behaviour change and continuation in programmes. Infertility clinics are relatively unique in medicine, as they accommodate the needs of couples rather than individuals. Partners support each other during treatment and the emotional upheavals engendered by it. Where weight loss is required as part of their management, it is reasonable to expect that this support would be useful, particularly in facilitating programme continuation. Perhaps it is time to consider the development of weight loss programmes targeting couples, rather than individuals.

### Couples may have similar weight and eating and activity patterns

Couples tend to have similar body mass indices, and weight change in one partner can go hand in hand with weight change in the other. A systematic review (Di Castelnuovo *et al.*, 2009) found correlations between partners with regards to BMI

175 ($r$ = 0.15 across 34,582 couples in 19 studies) and weight ($r$ = 0.11 across 6,765
176 couples in 9 studies). A representative study of 11,979 Dutch couples replicated
177 correlations for BMI between partners ($r$ = 0.23) (Monden, 2007). A study including
178 3356 expectant couples attending antenatal clinics (Edvardsson *et al.*, 2013) found
179 a positive partner correlation for BMI (r = 0.21). A woman's odds of being obese
180 were more than six times higher if their partner was also obese, in comparison with
181 women whose partner was of normal weight (OR 6.2, 95% CI 4.2-9.3). More than
182 one third (37.8%, p<0.001) of couples in a study investigating semen parameters
183 were concordant for obesity (Polotsky *et al.*, 2015). A Danish population cohort
184 study reported that couples presenting for IVF resembled each other in BMI, though
185 they did not supply supportive data (Petersen *et al.*, 2013). In a study of weight
186 change in 3722 older couples, the probability of weight loss in women was 36%
187 when the partner also lost weight compared to 15% if the partner's weight was
188 static (Jackson *et al.*, 2015).
189
190 Weight correlations between partners may be attributed to similar eating and
191 activity patterns. For example, an 18-month home-based weight loss trial with 132
192 couples found concordance in daily caloric intake, food intake, including that outside
193 the home, physical activity and sedentary behaviours between partners (Scherr and
194 Gorin, 2011). Prior epidemiological studies have found concordance in many health
195 behaviours in couples, including physical activity and diet (Brummett *et al.*, 2008;
196 Meyler *et al.*, 2007; Homish and Leonard, 2008; Pachucki *et al.*, 2011; Simonen *et al.*,
197 2002; Wilson, 2002) The main barriers to exercise reported by women in another

198 study (Banting *et al.*, 2014) were lack of time and fatigue, and their main physical
199 activity supports were their partners (Banting *et al.*, 2014). This compels us to
200 consider whether couple-based interventions might in fact be more useful than
201 individual interventions.
202
203 **Partner involvement may facilitate behaviour change, programme**
204 **continuation, and prove cost-effective**
205 Social support from close others has been a long-standing treatment
206 recommendation for weight loss interventions (Brownell, 1984; Kalodner and Lucia,
207 1990; Look AHEAD Research Group *et al.*, 2006; Perri *et al.*, 2008; Kalodner and
208 Lucia, 1990; Look AHEAD Research Group *et al.*, 2006; Perri *et al.*, 2008). Existing
209 trials involving partners often show greater weight loss effects with interventions
210 involving persons participating with family members rather than individually
211 (Cousins *et al.*, 1992; Black and Lantz, 1984; Murphy *et al.*, 1982; Pearce *et al.*, 1981;
212 Rosenthal *et al.*, 1980; Wing *et al.*, 1991; Avenell *et al.*, 2004; McLean *et al.*, 2003;
213 Black and Lantz, 1984; Murphy *et al.*, 1982; Pearce *et al.*, 1981; Rosenthal *et al.*,
214 1980; Wing *et al.*, 1991; Avenell *et al.*, 2004; McLean *et al.*, 2003). Involving support
215 partners proved beneficial, particularly if the partners actively participated in the
216 programme (Kumanyika *et al.*, 2009) and if they also lost weight (Gorin *et al.*, 2005).
217 Couple-based interventions may be an effective and cost-effective public health
218 approach, as two individuals could lose weight as inexpensively as one (Black and
219 Threlfall, 1989).
220

Trial data illustrate the fact that partners may facilitate behaviour change and weight loss. A meta-analysis in 1990 compared behavioural weight-control programmes involving partners to individual programmes (Black *et al.*, 1990). The programmes contained couples with both concordant and discordant need for weight loss. The authors concluded that couple based programmes were superior to individual interventions immediately post treatment (estimated effect size = 0.331, 95% CI 0.13, 0.54; $p < 0.05$), and at 2- to 3-months' follow-up (estimated effect size = 0.279, 95% CI 0.008, 0.566; $p = 0.06$), though the latter did not reach statistical significance. Participants in a small weight loss trial (N = 23) lost more weight when their partners had normal weight than when their partners were overweight (at 12 months: 12.7 kg vs. 9.2 kg; at 15 months: 13.4 kg vs. 7.9 kg) (Black and Threlfall, 1989), supporting the argument for couple enrolment, even when one partner has no excess weight to lose.

Another small trial (N = 29) of overweight men and women found greater weight loss at 6 months when the partner was cooperative and participated in the programme (13.4 kg) than when the programme was delivered individually, either with a cooperative partner (8.8 kg) or a non-cooperative partner (6.9 kg) (Brownell *et al.*, 1978). Participants in this couple intervention reported that mutual monitoring was key in the early weeks of the programme, and subsequent support and encouragement from their partner enabled them to adhere (Brownell *et al.*, 1978). One further small trial (N = 49) found that overweight women, but not men, with diabetes lost more weight when enrolled with their spouses (Wing *et al.*, 1991). Lastly, 393 UK council employees were enrolled in a large trial to reduce the levels of saturated fat in their diets, either individually or with their partner (Prestwich *et al.*, 2014). Participants receiving the partner-based intervention increased the ratio of 'good' fats to 'bad' fats at 3 and 6 months, and also managed to decrease their waist circumference more than those receiving the individual intervention (effect size not given; p = 0.04).

## Preparation for parenthood as a teachable moment for adopting a healthier lifestyle with long-term benefits for both partners and their baby

A successful weight loss intervention could improve the chances of achieving pregnancy and delivering a healthy baby (Best, 2016) via higher spontaneous pregnancy rates (Lan *et al.*, 2017; Mutsaerts *et al.*, 2016; Duval *et al.*, 2015) and possibly better IVF treatment outcomes (Clark *et al.*, 1998; Sim *et al.*, 2014a),

including fewer pregnancy complications (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2011) and more live births (Kort *et al.*, 2014). In the longer run, both partners in addition to their baby could benefit from maintained behaviour change with better health across the lifespan. A healthy weight is related to loer risk for cardiovascular disease, type 2 diabetes, and all-cause mortality (National Clinical Guideline Centre, 2014). Weight loss is related to reduced incidence of Type 2 diabetes in women and men (Avenell *et al.*, 2004; Robertson *et al.*, 2014) and erectile dysfunction in men (Robertson *et al.*, 2014). The point at which couples experience fertility problems could thus become a teachable moment for long-term changes towards a healthier lifestyle, with benefits to the couple and their family over their life course (Cohen *et al.*, 2011).

## What is needed for a couple-based intervention?

### Need for a systematic approach to intervention development

The existing studies have a number of weaknesses. First, most suffered from small sample sizes. Second, few studies have been conducted outside the United States. Strong cultural differences in eating, physical activity, and close relationships call for adequately powered studies in other countries to establish the generalizability of these findings. Third, most studies were not based on systematic intervention development such as an intervention mapping approach (Eldredge *et al.*, 2016). Studies based on systematic intervention development draw on theory and behaviour change methods; thus, they have the potential to focus interventions on the active ingredients of behaviour change, and systematically improve intervention

effect sizes and weight loss maintenance. In summary, the current evidence underlines the need for systematic intervention development in this field.

## Need for a tailored intervention

A weight loss intervention for couples seeking fertility treatment would need to be tailored to the individual needs of both partners. If both partners are obese or overweight, the intervention would need to focus on weight loss in both partners. For non-obese partners, the intervention would focus on supporting weight loss in the obese partner and changing relevant health behaviours for the non-obese partner, for example, eating a healthier diet or becoming more active.

## Need for measures to maximize retention

As stated above, a prior review of intervention studies for overweight and obese infertile women had a median discontinuation rate of 24% (Mutsaerts *et al.*, 2013), with lesser weight loss and fewer spontaneous pregnancies in dropouts compared to retained participants. Measures to maximize retention will therefore be critical in the design of future lifestyle interventions for infertile women and their partners. These could encompass tailored information and behavioural recommendations based on participants' prior knowledge and preferences (e.g., offering individualized sessions to develop behavioural recommendations).

## Need to address a comprehensive set of behavioural outcomes for fertility

An intervention for overweight partners should include standard recommendations for a calorie-reduced diet, and could include meal replacements, dependent on participant preference. Prior trials have found that exercise alone has minimal effects on weight loss (Franz *et al.*, 2007). However, exercise may help to maintain weight loss, and may be important to include, particularly for its ability to appeal to the male partner (Robertson *et al.*, 2014). Thus, the intervention should include a behavioural goal to increase physical activity, such as gradually increasing walking towards a daily 10,000-step goal, or by taking at least 30 minutes of moderate-to-vigorous activity per day. Non-overweight partners could receive a standard recommendation to eat a healthy diet and increase physical activity, if necessary. Because general recommendations for infertile couples' treatment include advice regarding alcohol and smoking, the intervention should include elements to support either partner in quitting these habits as required. Last, but not least, a couples' intervention could also include a module to improve social processes to facilitate behaviour change.

## Need for a better understanding of underlying social processes in weight loss

Few trials so far have assessed the underlying social processes in weight loss, even with inclusion of social network members in some studies. Therefore, there is ample room for improvement in delineating active ingredients and optimising these interventions. Behaviour change methods aimed at changing social support and social influence should boost effects when a behaviour is at least partly influenced

by the social environment (Eldredge *et al.*, 2016). Baseline data from a weight loss trial in women (Kiernan *et al.*, 2012) found low support from family and friends. Many women reported "never" or "rarely" receiving support for healthy eating (from family: 77.9%, from friends: 90.3%) or for physical activity (from family: 77.2%, from friends: 87.6%). Women also reported some sabotaging behaviour from close others, e.g., they "ate high-fat or unhealthy foods in front of me" or they "refused to eat healthy or low-fat foods with me".

The few available trials including partners have used a variety of intervention approaches. These have included partner training for social support to increase positive reinforcement (e.g. praise), role modelling healthier eating, setting goals, and focusing on problem solving; also reduction of negative social control including criticism, punishment, and nagging (McLean *et al.*, 2003). To identify the social processes most relevant to couples seeking fertility treatment, it will be necessary to study support, but also processes that have received less attentions such as social control, companionship, person-to-person contact, and access to resources and material goods (Berkman *et al.*, 2000). Skilled support and positive influence should facilitate behaviour change (Rafaeli and Gleason, 2009; Scholz *et al.*, 2013; Cutrona and Russell, 1990; Scholz *et al.*, 2013; Cutrona and Russell, 1990). Diminishing negative control and sabotaging behaviours (e.g., tempting the dieting partner with high-caloric food) should benefit weight loss additionally (Gorin *et al.*, 2014). Last but not least, the intervention should also promote relationship-strengthening behaviours such as companionship and emotional and physical intimacy (e.g. date

nights, joint fun activities) to counter the distress and irritability that accompanies attempts at behaviour change.

### A weight-loss intervention will need state-of-the art methodology

It is feasible and acceptable to use real-time assessments via smartphone apps, passive sensors, and text messages in individuals and couples. Examples have been given for diet (Inauen *et al.*, 2016), physical activity (Berli *et al.*, 2016), alcohol intake (Muench *et al.*, 2017), and for smoking. These assessments could boost intervention effects and facilitate the maintenance of behaviour change. These methods should be tested in couples experiencing fertility problems, underscoring the need for careful pilot work during intervention development.

## Conclusion

Overweight and obesity in both men and women attending infertility clinics is a growing challenge. Accumulating evidence demonstrates the effects of weight on reproductive function, and the benefits of weight loss in both sexes. Individual interventions for weight loss in women are often unsuccessful - mainly due to lack of compliance. A couple-based intervention may achieve more efficient weight loss at little additional cost and promises considerable public health benefits. Further clinical trials are warranted to develop and evaluate such an intervention in terms of efficacy, cost and compliance.

## Author Roles

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## Conflicts of Interest

AA, DB, GS and SB have no conflicts of interest to declare.

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