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

Running title: Should weight loss programmes be couple based?

Damian Best¹*, Alison Avenell², Siladitya Bhattacharya¹, Gertraud Stadler³

¹Aberdeen Fertility Centre, University of Aberdeen, Foresterhill, Aberdeen, AB25 2ZL, United Kingdom. ²Health Services Research Unit, University of Aberdeen Foresterhill, Aberdeen, AB25 2ZD, United Kingdom. ³Health Psychology Group, Department of Applied Health Sciences, University of Aberdeen Foresterhill, Aberdeen, AB25 2ZD, Scotland, United Kingdom.

*Correspondence address: Damian Best, Obstetrics & Gynaecology, Faculty of Medical Sciences, University of the West Indies Queen Elizabeth Hospital, St. Michael, BB1155, Barbados. Email dajbest1@gmail.com
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/m² 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% 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
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/m² experienced a delay in time to pregnancy, or reduced fecundity, when compared to couples with a BMI below 25 kg/m² (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
(r = 0.15 across 34,582 couples in 19 studies) and weight (r = 0.11 across 6,765 couples in 9 studies). A representative study of 11,979 Dutch couples replicated correlations for BMI between partners (r = 0.23) (Monden, 2007). A study including 3356 expectant couples attending antenatal clinics (Edvardsson et al., 2013) found a positive partner correlation for BMI (r = 0.21). A woman’s odds of being obese were more than six times higher if their partner was also obese, in comparison with women whose partner was of normal weight (OR 6.2, 95% CI 4.2-9.3). More than one third (37.8%, p<0.001) of couples in a study investigating semen parameters were concordant for obesity (Polotsky et al., 2015). A Danish population cohort study reported that couples presenting for IVF resembled each other in BMI, though they did not supply supportive data (Petersen et al., 2013). In a study of weight change in 3722 older couples, the probability of weight loss in women was 36% when the partner also lost weight compared to 15% if the partner’s weight was static (Jackson et al., 2015).

Weight correlations between partners may be attributed to similar eating and activity patterns. For example, an 18-month home-based weight loss trial with 132 couples found concordance in daily caloric intake, food intake, including that outside the home, physical activity and sedentary behaviours between partners (Scherr and Gorin, 2011). Prior epidemiological studies have found concordance in many health behaviours in couples, including physical activity and diet (Brummett et al., 2008; Meyler et al., 2007; Homish and Leonard, 2008; Pachucki et al., 2011; Simonen et al., 2002; Wilson, 2002) The main barriers to exercise reported by women in another
study (Banting et al., 2014) were lack of time and fatigue, and their main physical
activity supports were their partners (Banting et al., 2014). This compels us to
consider whether couple-based interventions might in fact be more useful than
individual interventions.

Partner involvement may facilitate behaviour change, programme
continuation, and prove cost-effective
Social support from close others has been a long-standing treatment
recommendation for weight loss interventions (Brownell, 1984; Kalodner and Lucia,
1990; Look AHEAD Research Group et al., 2006; Perri et al., 2008; Kalodner and
Lucia, 1990; Look AHEAD Research Group et al., 2006; Perri et al., 2008). Existing
trials involving partners often show greater weight loss effects with interventions
involving persons participating with family members rather than individually
(Cousins et al., 1992; Black and Lantz, 1984; Murphy et al., 1982; Pearce et al., 1981;
Rosenthal et al., 1980; Wing et al., 1991; Avenell et al., 2004; McLean et al., 2003;
Black and Lantz, 1984; Murphy et al., 1982; Pearce et al., 1981; Rosenthal et al.,
1980; Wing et al., 1991; Avenell et al., 2004; McLean et al., 2003). Involving support
partners proved beneficial, particularly if the partners actively participated in the
programme (Kumanyika et al., 2009) and if they also lost weight (Gorin et al., 2005).
Couple-based interventions may be an effective and cost-effective public health
approach, as two individuals could lose weight as inexpensively as one (Black and
Threlfall, 1989).
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 lower 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

All authors contributed to the ideas in this paper. DB and GS wrote the first draft. All authors contributed to revision of drafts.

Funding

No specific funding was sought. All authors were employed by the University of Aberdeen in a research capacity. The Health Services Research Unit is core funded by the Chief Scientist Office of the Scottish Government Health and Social Care Directorate.

Conflicts of Interest

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


Banting L, Gibson-Helm M, Polman R, Teede H, Stepto N. Physical activity and mental health in women with polycystic ovary syndrome. *BMC Womens Health* 2014;1; 51.


Black DR, Threlfall WE. Partner weight status and subject weight loss: Implications for cost-effective programs and public health. *Addict Behav* 1989;3; 279-289.


Eldredge LKB, Markham CM, Kok G, Ruiter RA, Parcel GS. Planning health promotion programs: an intervention mapping approach. 2016. John Wiley & Sons, USA.


Hammiche F, Laven JSE, Twigt JM, Boellaard WPA, Steegers EAP, SteegersTheunissen RP. Body mass index and central adiposity are associated with sperm quality in men of subfertile couples. *Hum Reprod* 2012:8; 2365-2372.


description of the lifestyle intervention and the evidence supporting it. *Obesity (Silver Spring)* 2006:5; 737-752.

Mahoney D. Lifestyle modification intervention among infertile overweight and obese women with polycystic ovary syndrome. *J Am Assoc Nurse Pract* 2014:6; 301-308.


Pantasri T, Norman J. The effects of being overweight and obese on female reproduction. Gynecol Endocrinol 2014;2; 90-94.


Qublan HS, Yannakoula EK, Al-Qudad MA, El-Uri FI. Dietary intervention versus metformin to improve the reproductive outcome in women with polycystic ovary syndrome. A prospective comparative study. Saudi Med J 2007;11; 1694-1698.


The Royal Australian and New Zealand College of Obstetricians and Gynaecologists. Ovarian stimulation in assisted reproduction. 2011; 1.

Thomson RL, Buckley JD, Noakes M, Clifton PM, Norman RJ, Brinkworth GD. The effect of a hypocaloric diet with and without exercise training on body composition, cardiometabolic risk profile, and reproductive function in overweight and obese women with polycystic ovary syndrome. *J Clin Endocrinol Metab* 2008;9; 3373-3380.


Vahatian A, Smith YR. Should access to fertility-related services be conditional on body mass index? *Hum Reprod* 2009;7; 1532-1537.


