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**Conduct and reporting of acceptability, attitudes, beliefs and experiences of pregnant women in randomised trials on diet and lifestyle interventions: A systematic review**

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## **Abstract**

### **Objective**

To evaluate the conduct and reporting of views of pregnant women on the acceptability, attitudes, beliefs and their experiences in randomised trials on diet and lifestyle interventions.

### **Study design**

We undertook a systematic review of literature of randomised trials identified from our previous search in major electronic databases (until February 2017) without language restrictions. We included trials on diet and lifestyle interventions that reported acceptability, attitudes, beliefs and experiences of pregnant women. The quality of papers was evaluated using the Critical Skills Appraisal Programme (CASP) framework. Data were extracted for the following domains: acceptability, intention, behaviour, attitudes and factors influencing participation. The proportion of studies that reported the various components in each domain was reported in percentages.

### **Results**

Of the 110 trials on diet and lifestyle in pregnancy, 24 reported on views of pregnant women. Acceptability of the provided information to the woman was reported in 84% (20/24), compared to 12% (3/24) on acceptability to partner or to family. Mother's intention to adhere to intervention in pregnancy was reported in 68% (17/24) of studies vs. only 16% (4/24) on family's intentions to support adherence. Changes in mother's behaviour were reported for consuming specific components of diet such as nuts (8%, 2/24), olive oil (12%, 3/24) and fruit (40%, 10/24) vs. 16% (4/24) of trials reporting changes in family's behaviour. While knowledge of food ingredients (72%, 18/24), and attitude to gestational weight gain were commonly reported (66%, 16/24) in over two-thirds of studies, only half assessed attitude to

participation in research (45%, 11/24). All studies reported facilitators for uptake of intervention such as personalised support (100%, 24/24), with half (52%, 13/24) on beliefs about weight, and less than 10% (2/24) about baby's health.

## Conclusion

The focus on studies is mainly on the mother, and less on family. Further studies are needed with a holistic approach to ensure that such interventions when implemented are accepted by women and their families.

Keywords: pregnancy, randomized controlled trial, acceptability, diet, lifestyle intervention

## Abstract

### Objective:

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### Results:

Of the 122 trials on diet and lifestyle in pregnancy, 24 reported on views of pregnant women. Acceptability of information provided was reported in 84% (20/24), compared to acceptability to partner or to family (12%, 3/24). Intention to adhere to intervention in pregnancy was reported in 68% (17/24) of studies, with only 16% (4/24) on family's intentions. Behavioural change in intake of specific components of diet such as nuts (8%, 2/24), olive oil (12%, 3/24) and fruit intake (40%, 10/24) were reported for women, but family's change in only 16% (4/24) of trials. Knowledge of food ingredients (72%, 18/24), and attitude to gestational weight gain were commonly reported (66%, 16/24); attitude to participation in research in less than half of all trials (45%, 11/24). Studies reported facilitators for uptake of intervention such as personalised support (100%, 24/24), and beliefs about weight (52%, 13/24), and less about baby's health (8%, 2/24).

### Conclusion:

There is a wide variation in the research reporting views of women participating in trials, with the focus mainly on the mother. Further studies are needed with a holistic approach to ensure that such interventions when implemented are accepted by women.

## **Introduction**

The global obesity epidemic has led to an increasing number of studies on diet and lifestyle interventions in pregnancy to assess their effects on gestational weight gain and pregnancy outcomes.<sup>1,2</sup> Although individual studies on lifestyle interventions vary in the magnitude of benefit,<sup>1,3,4</sup> overall they are beneficial in reducing weight gain in pregnancy, and improving pregnancy outcomes. Adherence to the intervention in pregnancy is crucial for improved outcomes.<sup>2,4,5</sup> Dietary adherence depends on the acceptability of the recommended diet. The most pressing question is not whether the diet will work but whether it is sustainable.

Many practitioners and researchers have concerns about the participant's capacity to understand and adhere to the proposed diet. In addition to the women's preferences, numerous logistical factors affect uptake and adherence of intervention. Group sessions, one-to-one support, family or peer support or lack of this, and continuous or one-off input affect the acceptability and the adherence to an intervention. Social support, motivational techniques and flexibility are keys to acceptability and adherence. Process evaluation and qualitative data are essential to identify the role of these key elements in studies. Often, randomised trials include a qualitative evaluation component to assess women's experience, and obtain their partners' views to improve the uptake of a healthy lifestyle in pregnancy.<sup>6</sup>

The impact of mixed-methods research is maximised when the quantitative and qualitative aspects of a trial are integrated.<sup>7</sup> There is an acknowledged gap in the integration of the qualitative and the trial findings.<sup>7,8</sup> We undertook a systematic review to evaluate the conduct, and reporting of research on acceptability, attitudes, beliefs and experiences on pregnant women in randomised trials of diet and lifestyle interventions.

### **Literature search**

The 2012 Health technology Assessment (2012)<sup>9</sup> report identified citations from the main databases: Medline, Embase, LILACS, BIOSIS, Science Citation Index, Cochrane Database of Systematic reviews (CDSR), Cochrane Central Register of Controlled Trials (CENTRAL) and Psycinfo. Database Abstracts of Reviews of Effects (DARE) and the Health Technology Assessment database (HTA) were also used. Relevant unpublished studies and grey literature was sought using Inside Conferences, Systems for Information in Grey Literature (SIGLE), and general Internet search engines such as Google. The search terms encompassed the notion of pregnancy and weight. Integrated MeSH, free text and word variants included pregnancy, childbirth, weight, over-weight, BMI, and randomised controlled trial. No language restrictions

were applied in their search which was carried out from inception to 2012. The search was further updated from 2013 to 2017 to identify new studies using the same search technique.<sup>10</sup>

Study selection included randomised controlled trials that evaluated any dietary or lifestyle interventions with potential to influence maternal weight during pregnancy and outcomes of pregnancy. Inclusion Criteria: Randomised controlled trials on diet and physical activity (one or other, or both), or interventions with behavioural change components. Exclusion Criteria: studies that only included women with gestational diabetes at baseline, studies which involved animals, studies which reported only non-clinical outcomes and studies on women who were underweight

This review includes 88 citations from the above HTA report (2012)<sup>9</sup> and the 22 additional citations from the 2017 search.<sup>10</sup> These randomised controlled trials were then reviewed for any qualitative component.

### **Study selection and quality assessment**

Two reviewers (AH and AN) independently assessed the identified randomised trials for potential qualitative components. Full manuscripts of all randomised trials were obtained, and studies that contained a qualitative component or any reporting of research on acceptability, attitudes, beliefs and experiences of pregnant women were included. We excluded research which did not include a nested qualitative component, quality of life evaluation or which did not contain any participant or clinician input or opinion. When there was more than one publication of the same trial, we selected the version that contained the largest sample size in qualitative evaluation, and those which contained the most detailed component regarding research on acceptability, attitudes, beliefs and experiences on pregnant women. Two independent reviewers assessed the methodological quality of the reporting of included studies

using the Critical Appraisal Skills Programme (CASP) framework.<sup>11</sup> Any disagreements were resolved through discussion with third reviewer (ST).

### **Data extraction and analysis**

Two independent reviewers (AH and AN) extracted qualitative data in duplicate using the predesigned and piloted data extraction forms. Data were extracted on the characteristics of the interventions, study objectives, methods and relevant outcomes that were reported. We extracted data on adequacy of evaluation of the following components:<sup>12</sup> Awareness and knowledge; acceptability of intervention, intention to adhere, change in behaviour, knowledge and attitudes and influencing factors. Each component in the domains were scored as yes, or no / unclear. We calculated the proportion of studies that reported these, and provided the results in percentages.

### **Results**

Overall, of the randomised trials on diet and lifestyle in pregnancy, 24 contained qualitative evaluation, including evaluation of acceptability, attitudes, beliefs and experiences of women (Fig 1).

#### *Characteristics of the included studies and interventions*

The interventions in the trials were categorised into two main groups: those on diet [2] and those on mixed lifestyle interventions [22]. No studies on physical activity contained the desired components in the domains we were examining. The studies originated from North and South America and Canada [8], Europe [8], Australia and New Zealand [5] and Far East [3]. The included trials studied the effect of interventions on women who were normal/overweight



[4]; overweight & Obese [7]; obese [5] or all women [8]. The total number of women included in the trials was 3,581; trials varied in size from 20 to 445 participants, with an average of 149 women (Table 1).

The dietary interventions ranged from intensive dietary therapy and group sessions focusing on energy expenditure using a weekly food diary to mixed interventions using individualised assessment, counselling and weight monitoring. Behavioural interventions using goal-setting<sup>10</sup> video, websites, Facebook chats with weight-control elements;<sup>13-15</sup> individualised diet<sup>16</sup> and lifestyle interventions,<sup>17-21</sup> with regular health trainer and/or weekly energy expenditure measurement. Regular diet, exercise;<sup>22</sup> personalised counselling;<sup>4,23</sup> and also group-based interventions were also used.<sup>1,24</sup> Some interventions used home-based approaches,<sup>2,25</sup> with pedometers,<sup>26</sup> stationery bicycles,<sup>27</sup> whilst others employed intensive aerobics,<sup>28</sup> personalised weight graphs with regular monitoring,<sup>5,29,30</sup> or group trainer-led exercises with private diet counselling.<sup>3</sup> The many health behavior models employed in the studies were based largely on social cognitive theory and health belief model.

### **Quality assessment**

The relationship between the researcher and participants was reported suitably in all studies, and the appropriateness of the participants discussed in 92% (23/24) of studies. 76% (19/24) of the studies had a clear statement of the aim of the research, and a similar proportion (80%, 20/24) reported the subject experience of participants. Data were collected to address the research issue in 52% (14/24) of the studies; congruity between the research question and data analysis, and congruity between the research question and data analysis were reported in 28% (7/24) of the studies. Data analysis was sufficiently rigorous in 20% (5/24) of studies (Fig 2).

*Acceptability of diet and lifestyle intervention*

The most commonly reported component regarding acceptability of the intervention were for information received (80%, 20/24) and the acceptability of the intervention for the woman (68%, 18/24). The timing of the intervention and the resources provided were evaluated in 64% (16/24) of the studies and time required for the intervention in 52%, (13/24), the location used in 50% (12/24), and the cost in 40%, (10/24) of the studies. Fewer studies reported on incentives provided during the intervention (20%, 5/24), and very few reported on the acceptability of the intervention to partners and family members (12%, 3/24) (Fig 3).

*Intention to adhere to diet and lifestyle intervention*

Two-thirds of trials assessed women's intention to adhere to the intervention during pregnancy (68%, 17/24), and half evaluated specifically to physical activity (50%, 12/24). The women's intention to adhere after childbirth was less commonly reported (16%, 4/24), as were the family's intention to adhere to lifestyle changes (16%, 4/24), and mother's intention to adhere outside the home environment (8%, 2/24) (Fig 4a).

*Change in behaviour on diet and lifestyle intervention*

Most studies assessed any improvements in women's dietary and lifestyle behaviours (92%, 23/24); only half specifically reported on change in intake of fruit and vegetables (40%, 10/24). Less commonly reported changes in behaviour included family involvement in decision-making about diet and lifestyle (16%, 4/24), consumption of fish (20%, 5/24) the use of olive oil (12%, 3/24) and inclusion of nuts in the diet (8%, 2/24) (Fig 4b).

*Knowledge and attitudes on diet and lifestyle intervention*

Knowledge of food nutrients and women's attitudes to weight gain (64%, 16/24) were commonly reported (72%, 18/24). Information about women's attitude to research participation was reported in 44% (11/24), and women's awareness of difficulty of postpartum weight loss in 28% (7/24) of studies. Less commonly reported aspects included women's knowledge of food labeling and saturated fats (24%, 6/24). Reports of women's attitude to the weight of health care professionals and knowledge of any previous diet were of insignificant proportion merely (4-8%, 1-2/24) (Fig 4c).

#### *Factors influencing participation in study on diet and lifestyle intervention*

Beliefs about receiving personalised support were evaluated in all studies, but for group meetings was reported in only 40% (10/24) of the studies. Specific beliefs regarding control of diabetes with lifestyle changes were evaluated in a third (32%, 8/24) of studies, and few studies assessed the supportive role of partners, family and friends (24%, 6/24). Beliefs about potential benefit of the diet such as lowered cholesterol levels (12%, 3/24), and impact on baby's health (8%, 2/24) were seldom reported. While the role of travel as the main factor negatively affecting women's participation was assessed in 84% (21/24) of the studies, life events as barriers to participation was only reported in 16% (4/24) of studies. Potential barriers such as nausea and pregnancy symptoms, women's own beliefs about baby's needs, and beliefs about pregnancy (myths) were assessed in less than a tenth of all trials (4-8%, 1-2/24) (Fig 5).

## **Discussion**

There are wide variations in the reporting of acceptability, attitudes, beliefs and experiences on diet and lifestyle interventions in randomised trials on pregnant women. The main focus is the mother in isolation, and less on engagement with the woman's social network, social engagements and activities away from home. There is considerable diversity in the use and the

reporting of models and theories underpinning interventions to gauge the determinants of women's intentions and support the application of a life-style intervention in pregnancy. In the main such theories would posit that feedback and support facilitate change in health behavior and they put a varying emphasis on belief of self-efficacy. Self-efficacy is a person's own belief in their ability to complete a task or solve a problem. The ideal self-efficacy is slightly above a person's ability, high enough to present a challenge. There was a distinct lack of involvement of family members and support persons within the interventions, furthermore, researchers have commented that psychological factors such as feelings, emotions, thoughts, beliefs - about body image, self-efficacy and motivation, may impede change of behavior, therefore need also to be targeted. Outside of pregnancy, personality traits have been found to be as accurate as other well-established health risk factors, such as socio-economic status and smoking, in predicting poor health and may be key to women's change of behavior and improvement of population health.<sup>31,32</sup> Psychological disposition, indicated by measures of personality and the personality trait conscientiousness (high conscientiousness is described as being self-disciplined, task oriented, well organized; low conscientiousness as lacking in self-control and long-term planning) is strongly associated with obesity.<sup>32</sup> The value of personality and other psychological traits exemplifies an important opportunity to optimise gestational weight in all pregnant women.<sup>31</sup>

We found that evaluation of the acceptability of the intervention from the woman's perspective was sparse, with no detail of the methods used to collate or analyse these data. Although the intentions of women to adhere to the diet either during or after the intervention were somewhat present in the studies, these were not commonly reported. Intentions comprise a person's motivation towards a goal regarding direction and intensity and are a mandatory prerequisite for lifestyle change and must be made apparent if change is to occur.<sup>13,18</sup> The importance of

working with women's family members and social connections is essential to the success of change in behavior as this is related to beliefs about social support.<sup>13,18</sup> This was not commonly reported in the studies examined. Change in behaviour was reported in a small proportion of the studies and this was in relation to family members being involved in discussion about change.

The strength of this review lies in its uniqueness regarding the reporting of acceptability, attitudes, beliefs and experiences on diet and lifestyle interventions in randomised trials on pregnant women. The use of a validated checklist to assess the quality of the included studies ensures legitimacy. This review seeks to address factors such as women's intentions, their behavior, knowledge and attitudes, and factors influencing participation on the intervention. It is theory-based and systematically organised. The wide variety of definitions and the insufficient detail of reporting of how data was acquired, and how these were analysed, limit the usefulness of the research we examined. We were constrained by the sparsely reported information on women's perceived benefits and women's beliefs about diet and lifestyle, which was lacking in the studies.

Previous studies show equivocal findings on difficulties with engaging women, with no clear details on ideal setting, frequency and timing of the intervention.<sup>24,26</sup> It is also known that pregnant women have poor knowledge about obesity, weight gain and its consequences, and are not aware of management strategies.<sup>33</sup> Women are more aware of long-term health risks than that of obesity-related perinatal risks. Hence improving awareness of perinatal complications associated with excess weight gain in pregnancy may be a motivating factor for women to keep their weight within normal limits. Our review showed that women were not

aware of the difficulty of post-partum weight loss, and such awareness may significantly improve outcomes for mothers and babies.

Perceived behaviour control of diet appears to be related to beliefs about social support and beliefs about lack of self-efficacy seem to reduce perceived control over eating behaviours. Interventions resulting in significant changes in intention are also likely to lead to change in behaviour. Women's intentions to adhere to the intervention during and after pregnancy were reported however, little evidence about how change of behavior occurred is provided. As information regarding women's intentions is essential for effective diet and behaviour change an intervention approach based on knowledge and insights into women's individual intentions and beliefs is needed.

The timing of the intervention is an important factor to its success. Pregnancy is a transition and as such may be the best time to introduce changes in lifestyle as intervention during pregnancy is depicted by a unique treatment adherence.<sup>14,17,29</sup> It may be possible to identify high risk women early in pregnancy, as weight gained in the first 20 weeks has been shown to be a good indicator of overall weight gain. The studies recruited women at booking, the majority by twelve weeks gestation therefore improving efforts to control weight-gain. Our results show that women found the timing of the intervention reasonably suitable, however, it was the time that it took which made the intervention less acceptable to them.

The challenge facing health care researchers is to uncover the factors and mechanisms that that increase engagement with a healthy lifestyle, and to sustain such changes in the woman, her partner, and children in the long run. Incorporating significant others and weight loss strategies within interventions for a healthier family lifestyle should be taken into consideration when

developing research and population health. There is a need to include families and consider the psychological, social and professional functions of women which would enable them to find a more realistic and dependable way to change diet and lifestyle in pregnancy. Diet and lifestyle changes require a sustained approach to promote women's health and well-being and facilitate the application of the intervention to practice, moreover, women have individual and inimitable experiences of food and knowledge of these could be used to influence families to engage in and adopt an enduring, healthy lifestyle. Studies within the review demonstrated that weekly contacts and ongoing feedback and education result in participants' success to control their gestational weight-gain. <sup>1,5,15,29,30,34</sup>

Pregnancy is a stage of a woman's life characterised by change and is an opportune time to influence diet and lifestyle together with the family. Weight control endeavors may also have incidental effects on other family members and friends. Providing women with knowledge, skills and attitudes to facilitate and support weight management during and following pregnancy is essential in tackling obesity in this group. More evidence is urgently needed to examine ways in which the problems of logistics, feasibility, acceptability and retention are handled and this from the person's own perspective, together with her/his entourage. Furthermore, women from disadvantaged backgrounds and from specific ethnic groups have more complex health concerns, and need a targeted approach to improve their engagement in research. <sup>13,14,21</sup>

As complex interventions are difficult to describe and replicate it would be useful to elaborate upon the mechanism or active ingredient that engender their success. <sup>35</sup> Qualitative research methods can provide insights into the elements of interdependence and independence within a trial and also account for multidimensional explanatory pathways. The effects of complex

health and social care interventions comprise of many social and behavioural processes that are not fully discernible, solely using quantitative means.<sup>35</sup> The design and process as well as the content and delivery of the randomised trial must be acceptable, as these are essential to its success.

## Conclusions

Factors relating to women's social support and their beliefs and understanding of their lifestyle choices are remarkably absent in the literature examined. There is a need to identify factors that not only improve uptake of healthy interventions but also which support adherence throughout pregnancy and beyond.

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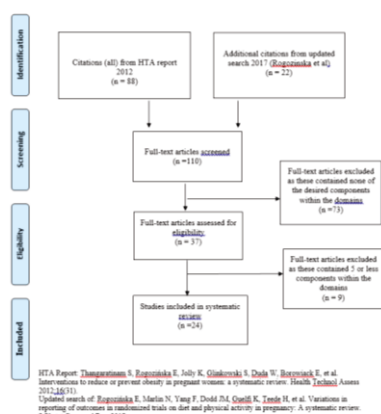
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Figure 1. Flow-diagram describing the process of study selection about diet and lifestyle in pregnancy, based on PRISMA guideline (2009)



**Figure 1. Flow-diagram describing the process of study selection about diet and lifestyle in pregnancy, based on PRISMA guideline (2009)**

HTA Report: Thangaratinam S, Rogozińska E, Jolly K, Glinkowski S, Duda W, Borowiack E, et al. Interventions to reduce or prevent obesity in pregnant women: a systematic review. *Health Technol Assess* 2012;16(31).

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Figure 2. Quality assessment of randomised trials on diet and physical activity that reported details on views of women

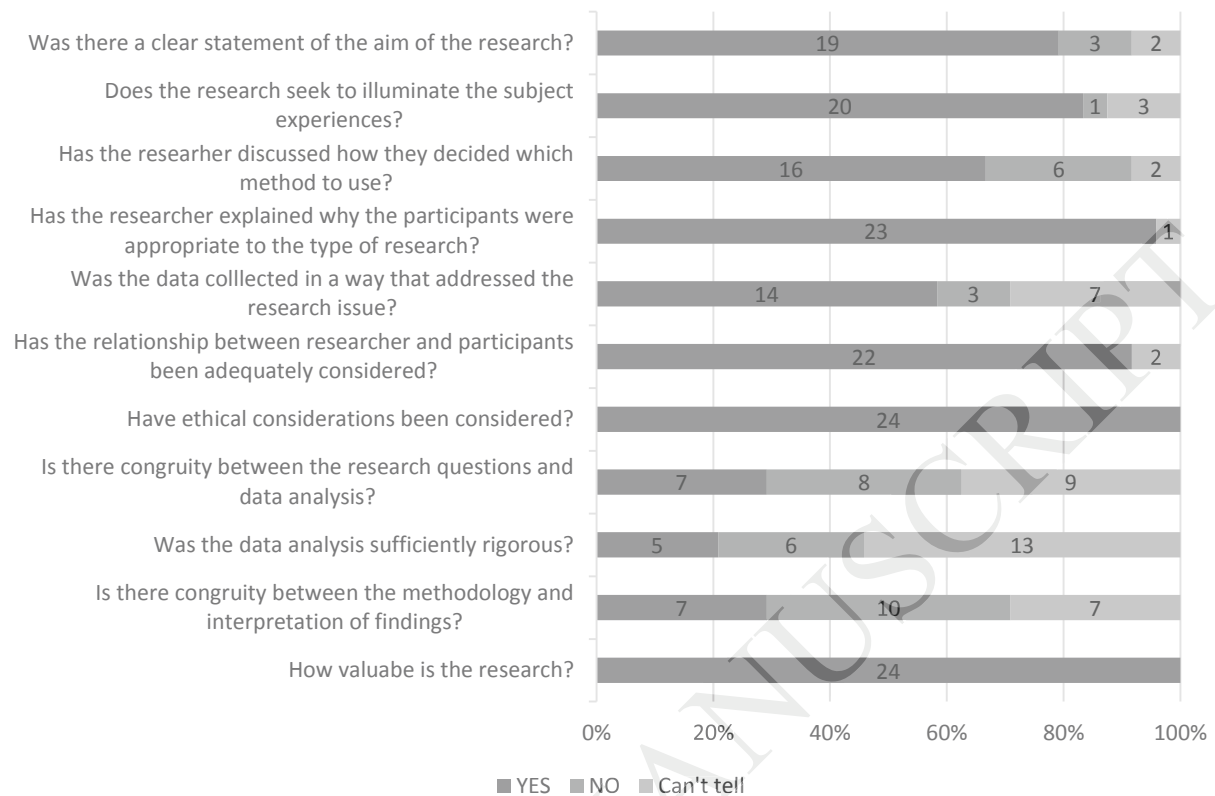


Figure 3. Acceptability of the various components of the intervention reported in randomised trials on diet and physical activity in pregnancy

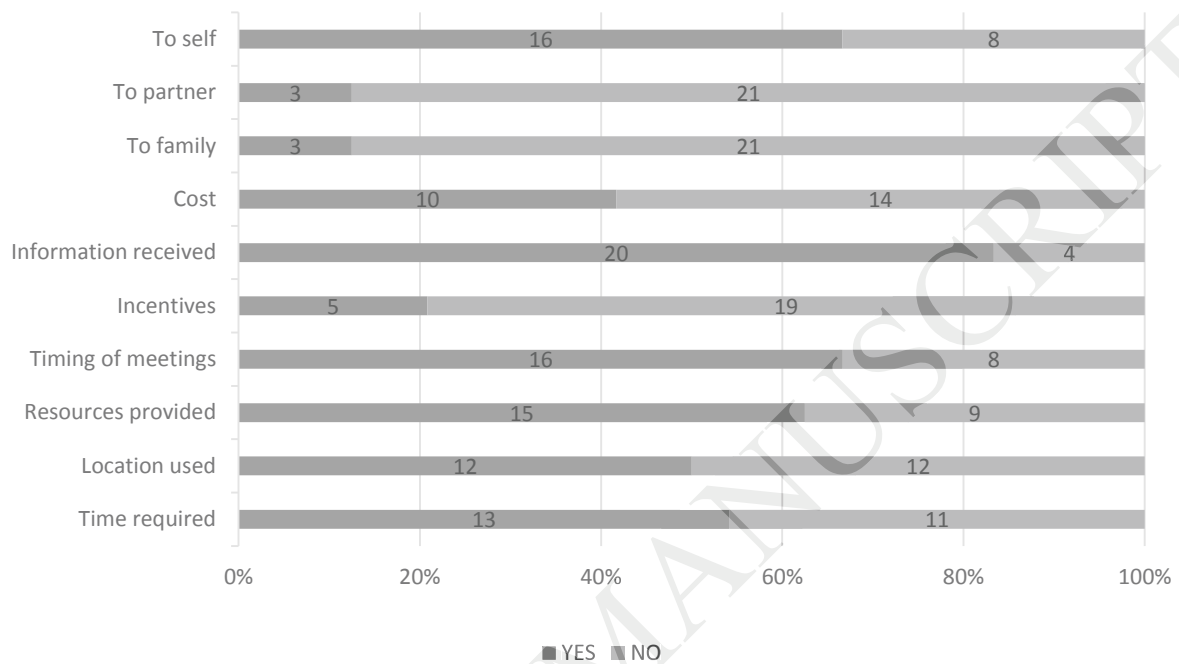
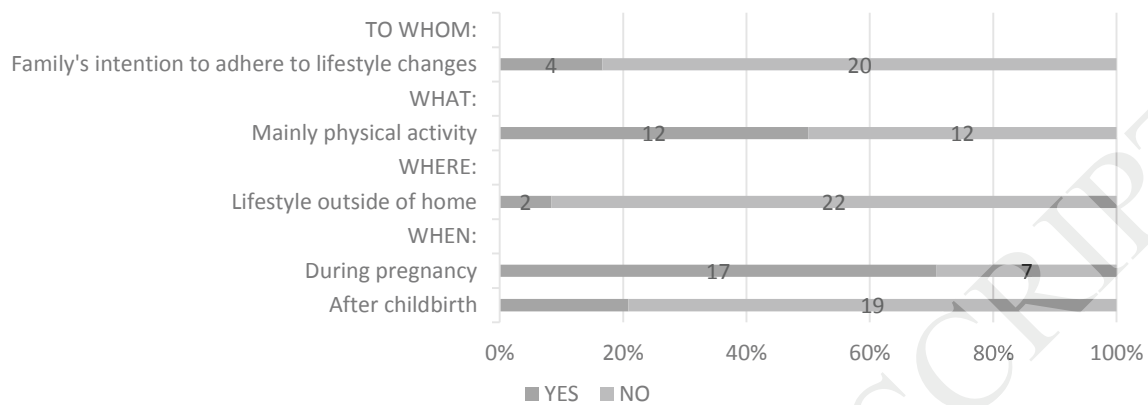
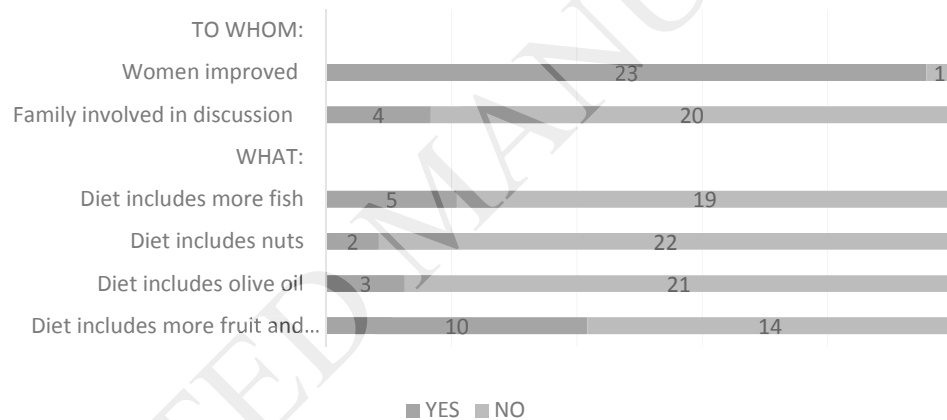


Figure 4. Trials reporting women's intention to adhere to diet and lifestyle intervention, change in behaviour and their knowledge and attitudes

a. Intention to adhere



b. Change in behaviour on diet and life style intervention



c. Knowledge and attitudes

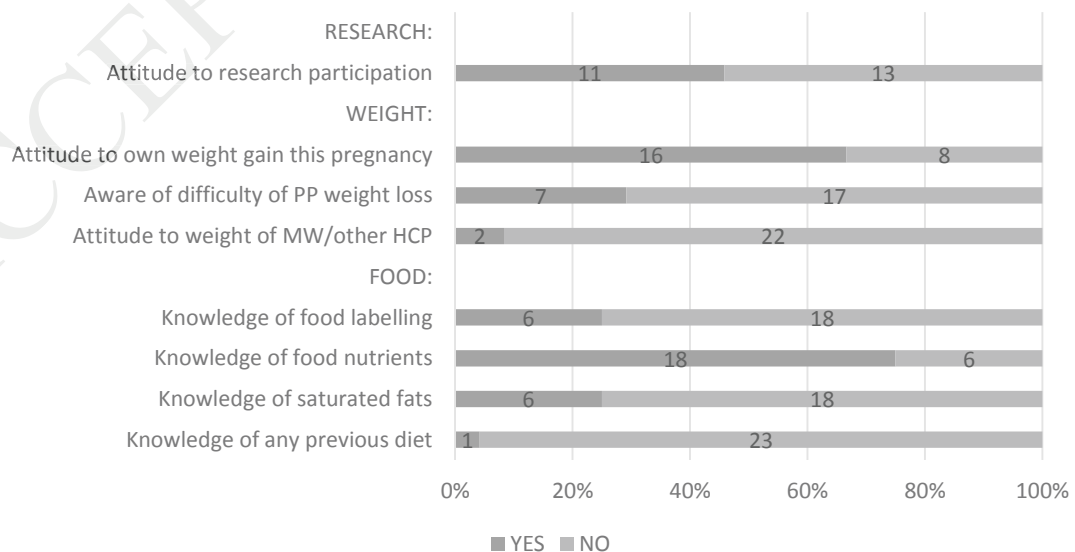
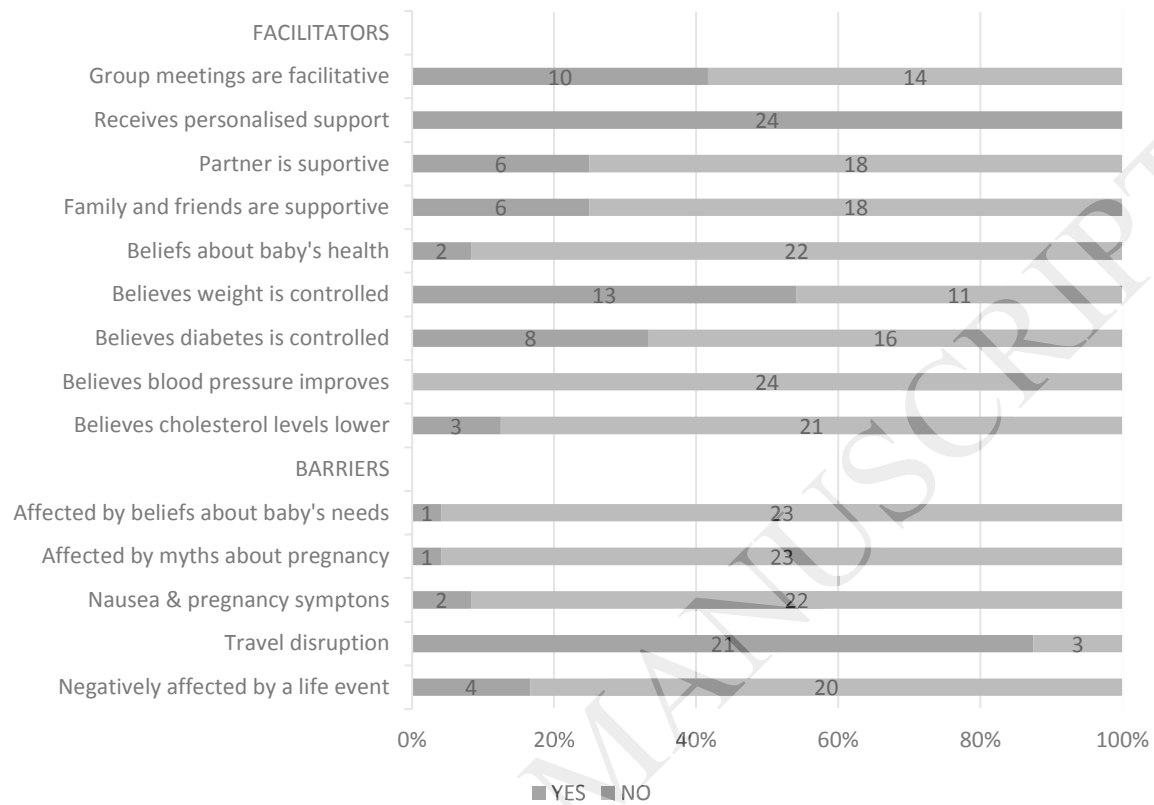


Figure 5. Factors influencing participation reported in randomised trials on diet and physical activity in pregnancy



**Table 1. Characteristics of the women and details of the randomised controlled trials included in the study**

<b>Author, Country of origin</b>	<b>Type(s) of intervention: Diet/ Physical Activity/Diet</b>	<b>Outcomes Measures</b>	<b>Informed by psychological, health promotion or health belief model or contains quality of life element? Y/N</b>	<b>Population description</b>	<b>Population of women for qualitative component</b>	<b>Setting (Location, context)</b>	<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
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<p><b>1. Vesco 2014, USA</b></p>	<p>Individualised calorie goals, dietary advice to maintain weight within 3% of randomisation, weekly group meetings. Pedometer provided and daily activity record kept <b>D &amp; PA</b></p>	<p>Maternal weight change at 34 weeks, 2 weeks postpartum &amp; newborn weight</p>	<p>Y Behavioural self-management techniques</p>	<p><b>114 Obese pregnant women</b> (recruited at 7-21 weeks gestation) INT=56, C=58</p>	<p>Intervention group</p>	<p>Portland, Oregon, Minimal ethnic diversity, only insured women, non-profit health maintenance organisation serving 470,000 population</p>	<p>English speaking, BMI&gt;30, Aged 18 or older, at 7-21 weeks gestation</p>	<p>GDM or other medical condition, plans to leave area within 1st year postpartum. &gt;21 weeks gestation at recruitment</p>
<p><b>2. Daley 2015, UK</b></p>	<p>Weighing and plotting weight on a weight-gain chart, setting limit targets, giving brief feedback at each antenatal appointment, self-weighing weekly, women &amp; MWs interviewed about the intervention</p>	<p>Feasibility and acceptability of the intervention to women with a process evaluation, attrition, weight change, measure the experience of the CMWs and the women of the trial, physical activity, depressions and anxiety, SAEs.</p>	<p>Y Self-regulation theory and Relapse prevention model</p>	<p><b>76 Low risk pregnant women</b> INT=40, C=36</p>	<p>12 women on the intervention, 7 community midwives involved in community care</p>	<p>Birmingham (Ethics) otherwise no information, low risk women cared for in the community by midwives</p>	<p>Low risk pregnant women receiving community midwifery care, aged &gt;18yrs, BMI 18-29.9 at 1st AN visit 6-8 weeks gestation</p>	<p>BMI &gt;30, any woman receiving weight management support, any high risk (women receiving consultant led care)</p>

**3. Bogaerts  
2012, Belgium**

Group sessions of max 3 pregnant women 4X during pregnancy focusing on energy intake and energy expenditure.  
Weekly food diary  
**D**

Maternal data: age, marital status, occupation, ethnicity, previous miscarriage, smoking/alcohol, psychiatric history, current mental health status, BMI, GWG, Anxiety symptoms, pregnancy induced hypertension

Y Principles of lifestyle intervention programme based on Prochaska model

**205 Obese pregnant** women were randomised to 3 groups  
Control n=63,  
Brochure n=58,  
Lifestyle n=76

Same (all women completed anxiety and depression scores)

Antenatal units in 3 regional hospitals in Flanders

Obese pregnant women <15weeks gestation

>15 weeks gestation, type1 diabetes, multiple pregnancy, primary need for nutritional advice, Dutch speaking

<b>4. Callaway 2010, Australia</b>	Individualised exercise programme with a weekly energy expenditure goal <b>PA</b>	Physical activity and metabolic outcomes (fasting Insulin and glucose), and Insulin resistance	N but goal centred	<b>50 Obese pregnant women</b> recruited at 12 weeks gestation	All	Women's hospital, Brisbane	Aged 18-45, BMI>30, pregnant women at 12 weeks gestation, able to consent	Non-English speaking, contra-indication or inability to exercise, medical or obstetric complication, type 1 diabetes, heavy smoker
<b>5. Harrison 2014, Australia</b>	4X45min individual behaviour change lifestyle sessions at 14-16, 20,24,28, weeks, Goals, weight-chart, Pedometer <b>D &amp; PA</b>	Anthropometrics, physical activity, GDM diagnosis	Y Social cognitive theory	<b>228 Overweight and obese</b> pregnant women of mixed ethnicity and moderate socio-economic advantage	Intervention group	Mixed ethnicity (3 large metropolitan teaching hospitals in Victoria)	Overweight and obese pregnant women 12-15 weeks gestation, agreeable to glucose tolerance test at 28 weeks gestation	Multiple pregnancy, diagnosed type 1 or 2 diabetes, BMI>45, pre-existing chronic medical condition, non-English speaking
<b>6. Hawkins 2014, USA</b>	A 6-month antenatal programme using motivationally targeted, individually tailored strategies, with follow-up to 6 weeks postpartum, pedometers <b>D &amp; PA</b>	Behavioural, physiological, sociodemographic and medical history collected at baseline, mid pregnancy and at 6 weeks postpartum.	Y trans theoretical model & social cognitive theory employed	<b>68 Overweight or obese,</b> Hispanic, pregnant women	Intervention group	Hispanic women living in USA	Overweight or obese, Hispanic, pregnant women, aged 18-40 years, <18 weeks pregnant, self-reported participating in <30 mins of moderate-intensity activity per week.	History of type ii diabetes, hypertension, heart disease or chronic renal disease, current medication that influence glucose tolerance, contraindications to participating in mod intensity physical acativity or a low-fat, high-fibre diet, self-reporting moderate exercise

<b>7. Herring 2016, USA</b>	A technology-based behavioural weight control intervention using text messaging, Facebook and telephone counselling with a health coach <b>D &amp; PA</b>	GWG, demographics, neonatal weight, Maternal obstet. Outcomes, examine intervention engagement by calculating self-response (texts etc) monthly until 24weeks, then 2-3 weekly >36weeks gestation	Y with acceptability questionnaire Social Cognitive theory & Social ecological model	<b>66 overweight and obese</b> Socially disadvantaged, low income, African-American pregnant women	Intervention group	2 Large outpatient, University, obstetric practices	>18years, self-identifies as African American, <20 weeks gestation, 1st trimester BMI 25-45, income proxy (support), cell-phone with unlimited text usage, Facebook member	Specialised dietary needs, endorsed current tobacco use, multiple pregnancy, obstetric provider consent
<b>8. Huang 2011, Taiwan</b>	Regular, individualised dietary and PA education plan 16weeks - 6 months postpartum Two intervention groups: Group1: pregnancy to 6 months postpartum, Group 2: birth to 6 months postpartum <b>D &amp; PA</b>	Weight, BMI, health-promoting behaviour and psycho-social variables	Y with acceptability questionnaire Social Cognitive theory & Social ecological model	<b>189 all</b> North Taiwanese pregnant women attending an obstetric clinic	2 Intervention groups & 1 control group	Taiwan obstetric unit	<16 weeks gestation, >18years old, no cognitive or psychiatric impairment, Chinese reading and speaking, non-participant in any other study, intends to birth at the site	N/A
<b>9. Hui 2014, Canada</b>	Weekly trainer-led group exercise sessions instructed home exercise 3-5X/week from 20-36 weeks gestation and private dietary counselling twice during pregnancy <b>D &amp; PA</b>	BMI, GWG, physical activity, nutrition data, NN birthweight	Y employed the Food Choice Map	<b>113 Normal weight and overweight</b> pregnant women	Intervention group	Recruited from prenatal classes and community antenatal clinics in Winnipeg	<20 weeks gestation, no existing diabetes, with signed consent	Medical or obstetric contraindication to exercise in pregnancy

<b>10. Jackson 2010, USA</b>	Video-doctor counselling tool on diet and exercise and pregnancy weight-gain <b>D &amp; PA</b>	Nutrition knowledge, GWG	Y Used Video doctor based on principles of motivational interviewing	<b>321 all weights, ethnically diverse, low-income, English speaking American women</b>	All women	5 Prenatal care practices in the SF bay area including 3 public hospital practices, 2 academic practices and a community hospital	Non-smoking, non-alcohol users, English speaking, >18years, <26weeks,	N/A
<b>11. Jing 2015, China</b>	A personalised educational, intervention on health-belief model, with manual and a 121 counselling session by trainer <b>D &amp; PA</b>	Demographics, GWG, dietary intake, time, intensity and categories of PA	Y Health belief model	<b>262 all weights, Chinese pregnant women</b>	Intervention group	University, city, hospital in Chengdu, China	Chinese pregnant (singleton) women, >18years, Chinese writing/speaking,	Preexisting diabetes, any pregnancy-related complication, or medical disorder
<b>12. Koivusalo 2016, Finland</b>	Individualised counselling on diet, PA and weight control +1 group meeting with dietitian (1X2hr group counselling sessions and 3Xnurse visits) <b>D &amp; PA</b>	Incidence of GDM, 2nd: fasting plasma glucose, weight change, incidence of PIH and mode of delivery	N	<b>293 Obese pregnant, women at high risk to GDM in Helsinki</b>	Intervention group	Helsinki metropole (3 maternities) The Finnish GDM prevention study	Pregnant women, >18years, with a history of GDM and/or pre pregnancy BMI >30 enrolled at 20 weeks	Type i or ii diabetes, GDM diagnosed <20 weeks, corticosteroids or metformin use, multiple pregnancy, physical disability, substance user, severe psychiatric disorder, non-Finnish speaking

<b>13 Nascimento 2011, Brazil</b>	Weekly exercise under supervision with home exercise counselling (included nutrition element) Inclusion and 36 weeks <b>D &amp; PA</b>	Sociodemographic data, GWG, increased arterial BP perinatal outcomes and quality of life outcomes	Y as quality of life element	<b>82 Overweight and obese pregnant women</b>	Intervention group	Pregnant women seen at antenatal clinic of the women's healthcare centre, Campinas, Brazil	BMI >26, >18 years, 14-24 weeks gestation,	Multiple pregnancy, regular exerciser, contraindications to exercise ie cervical incompetence, severe arterial hypertension, diabetes with vascular disease and risk of abortion
<b>14. Polley 2002, USA</b>	Stepped-care behavioural intervention on gaining appropriate GWG, exercise in pregnancy, healthful eating <b>D&amp;PA</b>	GWG, demographic information, food intake, energy expenditure, NN birthweight, pregnancy & birth outcomes	N but behavioural goals set	<b>120 Normal weight and overweight pregnant women,</b>	Intervention group	Obstetric clinic in Pittsburgh	Low-income, <20 weeks, 4 cells, normal weight, overweight, black, white.	Underweight women, <18 yrs, 1st prenatal visit >12 weeks, high risk pregnancy, previous complications in pregnancy, multiple gestation
<b>15. Rauh 2013, Germany</b>	2 Individual counselling sessions on diet, physical activity and weight monitor <b>D &amp; PA</b>	GWG, weight retention, obstetric and neonatal outcomes	N but behavioural goals were set	<b>250 all weight Healthy German pregnant women</b>	Intervention group	8 Gynaecological practices in Munich	>18 years, singleton, <18 weeks gestation, BMI > 18.5, German speaking	Obstetric condition preventing physical activity, pre pregnancy diabetes, medical disease, mental ill health
<b>16. Ronnberg 2014, Sweden</b>	Education on GWG according to IOM, application of personalised weight graph, exercise and regular monitoring at every antenatal visit <b>PA</b>	Proportion of women with GWG above IOM guidelines, GWG	N but used motivational tools	<b>445 all weights Swedish, healthy with BMI &gt;19</b>	Intervention group	County in central Sweden, 14 antenatal clinics	Age >18, Orebo county, at or <16 weeks on US	Eating disorder, earlier IUGR, chronic illness, Swedish speaking, BMI<19, multiple pregnancy

<b>17. Price 2012, USA</b>	moderate aerobic exercise 45-60min/4Xweek <b>PA</b>	Cardio-respiratory fitness; Strength, flexibility and discomfort; Pregnancy complications, delivery data, PP recovery, Maternal weight at 6 weeks postnatal	N	<b>91 all weights, Sedentary, Texan women</b>	All women	Texan obstetric practices	Non-aerobic exerciser, singleton, 12-14weeks, BMI<39, cleared by obstetrician	Exerciser, chronic heart/lung disease, poorly controlled diabetes, hypertension, epilepsy, hyperthyroidism, severe anaemia, no orthopaedic limitations, no history of premature labour, previous IUGR, or IUD
<b>18. Korpi-Hyovalti 2012, Finland</b>	Intensive dietary therapy including advice 6X/pregnancy <b>D</b>	Incidence of GDM, changes in nutrient intake, GWG and neonatal birthweight	N	<b>54 normal and overweight pregnant women at high risk to GDM</b>	Intervention group	Community-based setting	Women at high risk to GDM: One or more risk factor: 8-12 weeks gestation, BMI>25, history of GDM, Birthweight of baby>4500g, >40yrs, family HO diabetes	Women diagnosed as having GDM, women who had risk factors to GDM
<b>19. Seneviratne 2015, NZ</b>	A structured, home-based AN programme utilising magnetic sttionary bicycles from weeks 20-35 <b>PA</b>	NN birthweight, GWG, aerobic fitness, QoL, pregnancy outcomes, PN body composition, Exercise compliance	Y as quality of life element	<b>75 overweight &amp; obese Multiethnic, pregnant women</b>	Intervention group	Auckland region	18-40years, BMI>25, singleton, <20weeks,	Living outside Auckland area, smoker, multiple pregnancy, pre-existing contraindications to antenatal exercise

<b>20. Poston 2013, UK</b>	1-2-1 session with health trainer >week 17<week 17, 8week programme on diet and lifestyle <b>D&amp;PA</b>	Attitudinal assessment questionnaire, Health status and mental health, dietary assessment, PA assessment, qualitative interviews (no number, ?all intervention women)	Y as quality of life element	<b>183 Obese pregnant women from urban areas of high socio-economic deprivation</b>	All women as control and intervention women were interviewed face-to-face ( <i>n</i> =17), or telephone ( <i>n</i> =4). Control ( <i>n</i> =12), INT ( <i>n</i> =9)., All sites included and maximum diversity sampling used. Audio diaries completed by health trainers	4 UK urban study sites for antenatal clinic	BMI>30, singleton, >15, <17weeks at recruitment	Unable to consent, preexisting diabetes or raised BP, renal disease, multiple pregnancy, SLE, APS, haemoglobinopathy, coeliac disease, taking metformin, thyroid disease, mental illhealth
<b>21. Willcox 2017, Australia</b>	Text messaging, weighing, checking of behavioural goals (weekly/fortnightly), study information website (video & Facebook chat) <b>D &amp; PA</b>	Feasibility & Recruit/retention, protocol delivery & fidelity, contacts and use of elements delivered, acceptability, GWG, diet and physical activity	Y Social cognitive theory	<b>100 Overweight &amp; obese Pregnant women</b>	Intervention group	Australian University maternity hospital	Singleton, 10+6 - 17+6 weeks, self-reported pre-pregnancy BMI>25, English speaking and writing, owning a mobile	<18years, multiple pregnancy, requiring medical/nutritional management, discontinuation of hospital care
<b>22. Sun 2016, China</b>	Diet, exercise and weight gain counselling weeks 8-12 and monthly plans 2nd trimester, feedback and followup phone calls/emails <b>D&amp;PA</b>	GDM, GWG, Demographics	N but used goal setting and identification of barriers	<b>74 Overweight &amp; obese pregnant women</b>	Intervention group	Peking O&G dept of a medical college hospital	Primigravid, prepregnancy BMI >24, booking at 8-12weeks gestation, singleton,	Preexisting diabetes, abnormal GTT, vaginal bleeding or severe medical condition preventing PA, mental illness



<b>23. Asci 2016, Turkey</b>	Individualised LS intervention on diet exercise and weight monitoring (12-5, 16-8, 20-4 & 37 weeks) <b>D &amp; PA</b>	GWG, diet, lifestyle behaviours, post partum weight retention and obstetric outcomes	Y Pender's health promotion model	<b>102 all weights, Middle-income, high immigrant population, pregnant, accessible free healthcare service in Istanbul</b>	Intervention group	Family health centre in Istanbul, Turkey	Healthy pregnant, >18yrs, natural conception, P1 or P2, <12wks gestation	Pregnancy complications
<b>24. Briley 2002, Australia</b>	6 ante-natal individualised in-home nutrition assessment and counselling visits <b>D &amp; PA</b>	Demographic data, weight gain, infant birthweight, nutrient consumption, energy intakes during pregnancy	N	<b>20 all weight pregnant women, volunteers, African American</b>	All	County in USA with representative rates of LBW, recruited through local county health department WIC Program	African-American pregnant women 24 weeks gestation or < no pre-existing health condition not following prescribed diet,	>24 weeks gestation,

**Abbreviations:** **D:** Diet, **PA:** Physical activity, **C:** Control, **INT:** Intervention, **BMI:** Body mass index, **GDM:** Gestational diabetes mellitus, **GWG:** Gestational weight gain, **Y:** Yes, **N:** No