Effective psychological therapies to improve lifestyle behaviors in (pre)pregnant women: A systematic review

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ARTICLE INFO

Keywords:
- Pregnancy
- Lifestyle behavior
- Psychological therapy
- Nutrition
- Substance use

ABSTRACT

Poor lifestyle behaviors impact (pre)pregnant women by affecting pregnancy outcomes and offspring health. This systematic review provides an overview of psychological therapies to support lifestyle behavior changes among (pre)pregnant women.

Scientific databases were searched from their inception to 20 December 2020 for studies investigating the effects of psychological therapies on improvements in lifestyle behaviors. Studies were eligible if they included (pre)pregnant women, examined the effects of a psychological therapy on at least one lifestyle behavior and used a control group receiving usual pregnancy care or a non-psychological intervention. Lifestyle behaviors of interest were dietary intake, physical activity, smoking, alcohol consumption, drug use, body weight loss and body weight gain during pregnancy. Pregnancy complications were included as outcome measures.

Motivational interviewing (MI) (n = 21), cognitive behavioral therapy (CBT) (n = 8), incentive-based contingency management (IBCM) (n = 9), mindfulness (n = 1) and hypnosis (n = 1) were investigated as lifestyle behavior interventions. The findings revealed that MI was effective in reducing (self-reported) smoking and alcohol consumption and restricting gestational weight gain (GWG). CBT was only studied as an intervention to restrict GWG and the results predominantly confirmed its effectiveness. IBCM showed the strongest effect on reducing smoking and substance use. The studies using hypnosis or mindfulness to reduce smoking or restrict GWG, respectively, showed no associations.

The use of psychological therapies to improve lifestyle behaviors among (pre)pregnant women is new and the scientific proof is promising. Before wide implementation is legitimated, more evidence is needed on the consequences of lifestyle change for pregnancy outcomes.

1. Introduction

Having a healthy lifestyle is of great importance for women before and during pregnancy. Remarkably, only 7–15% of women of reproductive age adheres to healthy lifestyle behaviors (van der Windt et al., 2020; Zhao et al., 2012). Poor lifestyle behaviors during the periconception period impact (pre)pregnant women by affecting reproductive and pregnancy outcomes and offspring health. Additionally, exposing the developing fetus to an unfavorable environment in utero can cause transgenerational health effects (Gluckman et al., 2008). Thus, for (pre)pregnant women in particular, it is crucial to have a healthy lifestyle, since it affects both the individual’s well-being as the health of future generations.

A healthy lifestyle comprises a combination of behaviors that contribute to lower morbidity and mortality and a better quality of life (Li et al., 2020). In general, following a healthy diet, drinking limited amounts or even quit consumption of alcohol, not smoking, no usage of drugs, and regular exercises are essential components of a healthy lifestyle (Li et al., 2018; Loef and Walach, 2012). Additionally, having a normal body mass index (BMI) (18.5–24.9 kg/m²) is considered as an essential component of a healthy lifestyle as well as a result of an adequate balance between nutritional intake and physical exercise.
Preventive Medicine Reports 24 (2021) 101631

M. van der Windt et al.

Several proven effective lifestyle interventions have been developed to support the improvement of lifestyle behaviors in (pre)pregnant women (Oteng-Ntim et al., 2012; Van Dijk et al., 2016). However, adopting healthy lifestyle behaviors is challenging and interventions often do not lead to satisfactory results and sustainable change. Most lifestyle-targeted interventions focus on increasing external motivation by raising awareness and providing education, but lack elements that increase intrinsic motivation and support lifestyle change on the long term (Brandt et al., 2018; Lachman et al., 2018). In recent years, psychological therapies, as cognitive behavioral therapy, mindfulness, and contingency management, have increasingly been used in lifestyle interventions to improve lifestyle behaviors (Brandon, 2014; Haug et al., 2014). These psychological approaches intend to increase intrinsic motivation and to teach the participants skills including impulse control techniques, cognitive restructuring and problem-solving strategies to enhance change in lifestyle behaviors. Recently, a variety of psychological therapies have been investigated as lifestyle interventions for (pre)pregnant women (Blau and Hormes, 2020). However, no study performed a systematic review of the available literature on this subject. The current systematic review provides a unique overview that can be used for maternal preconception health improvements in daily clinical practice. We aim to explore which psychological therapies have been proven as effective interventions towards improving lifestyle behaviors and pregnancy outcomes among (pre)pregnant women.

2. Methods

Our systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Liberti et al., 2009; Page et al., 2021). A protocol of our systematic review was registered in PROSPERO International prospective register of systematic reviews (registration number: CRD42020201172).

2.1. Search strategy and information source

In consultation with an experienced information specialist, we developed Boolean search strategies including terms as pregnancy, preconception, smoking, alcohol, drugs, nutrition, physical activity, (cognitive) behavioral therapy, incentives, motivational interviewing, motivational enhancement therapy, mindfulness, hypnotherapy, maternal complications, mode of delivery, neonatal outcome, fetal malformations, gestational age at delivery, and birth weight (Appendix). We searched for clinical trials in the following databases: Embase, Medline (Ovid), Web of Science, PsycINFO, Cochrane Central Register of Controlled Trials, Google Scholar (top 200), all from their inception to 20 December 2020. Finally, we searched reference lists from included studies and systematic reviews to include relevant articles. We did not search gray literature, due to a lack of reproducibility and quality concerns (Adams et al., 2016).

2.2. Eligibility criteria and study selection

Studies were included if they met the following criteria: 1) included women contemplating pregnancy or already pregnant 2) examined the effects of a psychological therapy on at least one lifestyle behavior, 3) used a control group receiving usual pregnancy care or a non-psychological intervention. Studies without a clear definition of the tested psychological therapy were excluded. Lifestyle behaviors included dietary intake, physical activity, smoking, alcohol consumption and drug use, but also stress, sleep, and psychological state of mind, are considered as lifestyle behaviours (Abe and Abe, 2019). However, we decided to focus on factors not directly related to or representing mental health, since psychological therapies are widely investigated and proven effective for improving those factors. In general, BMI, and gestational weight gain (GWG) in particular, do not directly reflect dietary intake. However, they are considered as a composite outcome of lifestyle behaviors (Itani et al., 2020; Sun et al., 2020). Therefore, BMI and GWG are included as lifestyle behaviors in our systematic review.

Letters to the editor, conference abstracts, editorials, opinions, case reports and systematic reviews were not eligible. We did not apply a language limitation to our search strategy. Two independent reviewers examined each article for inclusion. If the two reviewers disagreed on whether to include an article, a third reviewer was consulted to resolve any disagreements.

2.3. Data extraction and assessment of risk of bias

The two reviewers filled out a data extraction form and used the ErasmusAGE quality assessment tool for assessing risk of bias of the individual studies. This tool is composed of 5 items based on previously published scoring systems (Thomas et al., 2004). Five study characteristics can be allocated either 0, 1, or 2 points giving a total score between 0 and 10, with a score of 10 representing a study of the highest quality.

2.4. Data synthesis

Results are presented in a narrative synthesis for each type of psychological therapy and displayed in several tables. It was not possible to perform a meta-analysis due to the large heterogeneity of content and intensity of the psychological therapy interventions.

Relative risks (RRs) were collected from all included studies and presented in a forest plot. RRs were calculated when not incorporated in the results of the included study, if required data were available. When studies compared three groups, the most intensive intervention, in frequency (number of counseling sessions) and intensity (length of counseling sessions), was compared with the least intensive intervention or the control group.

3. Results

3.1. Study selection

The study selection process is depicted in the flowchart (Fig. 1).

3.2. Study characteristics

Table 1 describes the studies’ characteristics. Of the 40 included articles, 21 studied motivational interviewing (MI) or motivational enhancement therapy (MET), 8 studied cognitive behavioral therapy (CBT) or social learning therapy (SLT), 9 studied incentive-based contingency management, 1 studied mindfulness and 1 studied hypnosis. To summarize, 70% (n = 28/40) of the included articles are published in the last decade, 60% (n = 24/40) are conducted in the USA and 75% (n = 30/40) are randomized controlled trials. Overall, the mean study quality score based upon the ErasmusAGE quality assessment was 6.8 (range 5–9).

3.3. Synthesis of results

An overview of included psychological therapies, their goal, and key concepts can be retrieved from Table 2.

3.3.1. Motivational Interviewing/Motivational enhancement therapy

Twenty-one studies reported the effects of MI or MET on lifestyle behaviors or pregnancy outcomes.

3.3.1.1. Smoking. Nine studies focused on the effectiveness of MI or
MET on smoking cessation during pregnancy, of which 4 studies showed positive effects (Mojahed and Navidian, 2018; Rigotti et al., 2006; Valanis et al., 2001; Zhang et al., 2017). The tested interventions comprised of 2–6 sessions including MI/MET, either individually, in a group or by telephone. The length of each session varies widely among studies, between a couple of minutes to 90 minutes. The least intensive intervention, in terms of session length and frequency, was conducted by Valanis et al, who provided sessions of MI that added no more than a few minutes to every regularly scheduled clinical contact (Valanis et al., 2001). A significant difference in rate of self-reported sustained smoking cessation during pregnancy between the two groups was reported (OR = 2.7, CI = 1.2–5.7). In a large trial of Zhang et al, 866 smoking pregnant women received 4 sessions of MI and 11,568 smoking pregnant women received routine prenatal care (Zhang et al., 2017). Results, based on self-reported data, showed that significant fewer cigarettes were smoked in the intervention group (high or low attendance; defined as attending 1–2 session(s) or attending 3–4 sessions) compared with the control group (4.7 versus 6.8 versus 9.7, \( P < .0001 \)). However, the retrospective selected control group existed of women who were eligible for inclusion, but did not participate in the study, which might have induced selection bias.

The 5 studies that did not demonstrate significant effects on smoking cessation all relied on verified smoking biochemically, either by plasma, salivary or urine cotinine testing (Ershoff et al., 2000; Haug et al., 2004; Hayes et al., 2013; Stotts et al., 2002; Tappin et al., 2005). Three out of 5 studies can be characterized as less intensive, since the intervention was provided either by telephone or comprised of only 3–10 min during regular antenatal visits (Ershoff et al., 2000; Hayes et al., 2013; Stotts et al., 2002). However, Tappin et al (2005) tested in a RCT among 762 pregnant women an intensive intervention with 2–5 MI sessions at home and did not show significant differences in biochemically verified smoking cessation between the intervention and control group (Tappin et al., 2005).

3.3.1.2. Dietary intake, gestational weight gain and weight loss before pregnancy.

One study using MI focused on dietary intake, specifically, vegetable and fruit intake (van der Windt et al., 2020). The study of van der Windt et al investigated a blended care periconception lifestyle intervention combining a lifestyle counseling session using MI with a 26-weeks eHealth coaching program Smarter Pregnancy for pregnant women or women contemplating pregnancy and their partner. They showed significant improvements in vegetable intake, fruit intake, and folic acid supplement use. The effects of MI or MET on dietary intake in (pre)pregnant women was not investigated by other studies.

Five studies focused on GWG or weight loss before conception, of which 4 studies showed positive results (Bogaerts et al., 2013; Claesson et al., 2008; Karlsen et al., 2013; Krukowski et al., 2017). All studies used a quite intensive MI intervention, varying between 4 group sessions in total throughout pregnancy till weekly invitations throughout pregnancy. Three studies focused on GWG among pregnant women with obesity and showed comparable results (Bogaerts et al., 2013; Claesson et al., 2008; Krukowski et al., 2017). In the intervention of Krukowski et al, for instance, MI sessions every 6 weeks resulted in significant less GWG as compared to the control group (9.0 ± 4.2 versus 13.6 ± 8.0 kg, \( P = .001 \))(Krukowski et al., 2017). The only included study that did not demonstrate significant effects on GWG was that of Æsbjörnsdóttir et al, which provided women with diabetes type 2 with 2-weekly sessions of MI combined with CBT (Æsbjörnsdóttir et al., 2019). The intervention
### Table 1
Characteristics of the included studies.

| Author                      | Year  | Country | Study design | Participants                                                                 | Sample size | Time period                  | Lifestyle behavior | Intervention     | Control          | Q5 |
|-----------------------------|-------|---------|--------------|-------------------------------------------------------------------------------|-------------|------------------------------|--------------------|------------------|------------------|----|
| M. van der Windt et al.     | 2019  | Denmark | Cohort study | Women < 20 weeks pregnant, aged ≥ 18 years, with type II diabetes             | N = 219     | August 2015 to February 2018 | Dietary intake     | MI               | Standard care   | 8  |
| Bogaerts et al.             | 2013  | Belgium | RCT          | Women < 15 weeks pregnant, with a BMI ≥ 29 kg/m²                             | N = 205     | March 2008 to April 2011    | Dietary intake     | I₁ = Brochure   | Standard care   | 7  |
| Claesson et al.             | 2008  | Sweden  | Case-control | Pregnant women with a BMI ≥ 30 kg/m²                                          | N = 348     | November 2003 to December 2005 | Dietary intake     | MI               | Standard care   | 7  |
| Epel et al.                 | 2019  | USA     | Trial        | Women 12–19 weeks pregnant                                                   | N = 215     | August 2011 to June 2013    | Physical activity  | Mindfulness      | Standard care   | 7  |
| Farhodimoghadam et al.      | 2020  | Iran    | RCT          | Women 20–24 weeks pregnant, aged > 19 years                                  | N = 70      | February to June 2017       | Dietary intake     | CBT              | Standard care   | 6  |
| Farhodimoghadam et al.      | 2019  | Iran    | RCT          | Women 20–24 weeks pregnant, aged > 19 years                                  | N = 66      | February to June 2017       | Dietary intake     | CBT              | Standard care   | 5  |
| Gesell et al.               | 2015  | USA     | RCT          | Women 10–28 weeks pregnant                                                   | N = 135     | January to April 2011       | Physical activity  | CBT/SLT          | Standard care   | 6  |
| Glover et al.               | 2015  | NZ      | RCT          | Māori women 2–30 weeks pregnant, aged ≥ 16 years, smoking daily              | N = 24      | December 2012 to June 2013  | Physical activity  | CM; incentives   | Standard care   | 5  |
| Handmaker et al.            | 1999  | USA     | RCT          | Pregnant women consuming ∼ 1 alcoholic drink in the past month              | N = 42      | Not described               | Alcohol consumption| MI               | Informational letters | 5  |
| Harrison et al.             | 2013  | NZ      | RCT          | Women 12–15 weeks pregnant with a BMI ≥ 25 kg/m² or a BMI ≥ 23 kg/m² with a Polyenian, Asian or African ethnicity, and with an increased risk for developing GDM | N = 228     | Not described               | Physical activity  | SLT              | ECC              | 8  |
| Haug et al.                 | 2004  | USA     | RCT          | Women ≤ 26 weeks pregnant opioid dependent receiving methadone pharmacotherapy, smoking ≤ 5 cigarettes/day | N = 63      | Not described               | Smoking            | MET              | Standard care   | 7  |
| Hayes et al.                | 2013  | Ireland | Controlled before-and-after-study  | Pregnant women, aged 16–40 years, smoking | N = 1,000 | June 2004 to June 2007 | Smoking            | MI               | Standard care   | 6  |
| Heil et al.                 | 2008  | USA     | RCT          | Women ≤ 20 weeks pregnant, smoking                                          | N = 82      | Not described               | Smoking            | CM; incentives   | Non-contingent vouchers | 5 |
| Higgins et al.              | 2014  | USA     | RCT          | Women ≤ 25 weeks pregnant, smoking (within the past 7 days)                 | N = 130     | December 2006 to June 2012  | Smoking            | CM; incentives   | Non-contingent vouchers | 8 |

(continued on next page)
| Author          | Year | Country | Study design | Participants                                                                 | Sample size | Time period                      | Lifestyle behavior | Intervention | Control | QS |
|-----------------|------|---------|--------------|-------------------------------------------------------------------------------|-------------|----------------------------------|--------------------|--------------|---------|----|
| Jones et al.    | 2011 | USA     | RCT          | Women ≤ 35 weeks pregnant, aged ≥ 18 years, with opioid and/or cocaine substance use disorder | N = 89 I = 47 C = 42 | September 2003 to November 2007 | Drug use           | I2 = Revised vouchers | RBT      | Standard care | 7  |
| Jones et al.    | 2001 | USA     | RCT          | Pregnant women aged ≥ 18 years old on methadone, with a BMI ≥ 30 kg/m² | N = 80 I = 44 C = 36 | October 1996 and August 1997 | Drug use | CM incentives | Standard care | 5  |
| Joya et al.     | 2016 | Spain   | RCT          | Pregnant women with a maternal hair length of ≥ 9 cm at delivery (hair growth 1 cm/month) | N = 168 I = 83 C = 85 | 2014 | Alcohol consumption | MI | ECG | 7 |
| Karlsmen et al. | 2013 | Denmark | Retrospective study | Women referred to a fertility center in Denmark with a BMI ≥ 30 kg/m² | N = 187 I = 110 C = 73 | 2006 to 2011 | Dietary intake | MI | MI by phone/ e-mail or no MI | 5 |
| Krukowsk i et al. | 2017 | USA     | Cohort study | Women planning pregnancy or < 10 weeks pregnant, aged ≥ 21 years, with a BMI 18.5–35 kg/m² | N = 458 I = 230 C = 228 | 2011 to 2014 | Dietary intake | MI | Standard care | 6 |
| Kurti et al.    | 2020 | USA     | Trial        | Women < 25 weeks pregnant, aged ≥ 18 years, smoking (within the past 7 days), with a smartphone | N = 60 I = 30 C = 30 | Time period | Smoking | CM incentives | Standard cessation care | 6 |
| Mojahed et al.  | 2018 | Iran    | RCT          | Pregnant women, consuming hookah | N = 140 I = 70 C = 70 | 2017 | Smoking | MI | Standard care | 7 |
| Osterman et al. | 2014 | USA     | RCT          | Women ≤ 36 weeks pregnant, aged 18–44 years, who have consumed alcohol in the previous year | N = 122 I = 62 C = 60 | Not described | Alcohol consumption | MI | Standard care | 7 |
| Phelan et al.   | 2018 | USA     | RCT          | Women 9–16 weeks pregnant, aged ≥ 18 years, with a BMI ≥ 25 kg/m² | N = 257 I = 129 C = 128 | November 2012 to May 2016 | Dietary intake | SLT with partial meal replacement | Standard care | 9 |
| Phelan et al.   | 2011 | USA     | RCT          | Women 10–16 weeks pregnant, aged ≥ 18 years, with a BMI 19.8–40 kg/m² | N = 401 I = 201 C = 200 | 2006 to 2008 | Dietary intake | SLT | Standard care | 9 |
| Phillips et al. | 2019 | USA     | RCT          | Women ≤ 16 weeks pregnant, aged 18–45 years, with a BMI ≥ 25 kg/m² | N = 136 I = 65 C = 71 | December 2013 to December 2017 | Dietary intake | CM incentives | Standard care | 7 |
| Poston et al.   | 2015 | UK      | RCT          | Women 15–18 weeks pregnant, aged ≥ 16 years, with a BMI ≥ 30 kg/m² | N = 1,555 I = 782 C = 772 | March 2009 to June 2014 | Dietary intake | CBT | Standard care | 7 |
| Rigotti et al.  | 2006 | USA     | RCT          | Women ≤ 26 weeks pregnant, aged ≥ 18 years, smoking (within the past 7 days) | N = 442 I = 220 C = 222 | September 2001 to June 2004 | Physical activity | Telephone counseling (MI + SLT) | “Best-practice” brief-counseling | 8 |
| Smith et al.    | 2016 | USA     | RCT          | Pregnant women who participated in < 3 sessions of exercise for ≥ 30 min/week for ≥ 6 months before conception, aged 18–45 years | N = 51 I = 26 C = 25 | January to September 2013 | Dietary intake | Physical activity | Web-based CBT | Standard care | 8 |
| Stotts et al.   | 2002 | USA     | RCT          | Women ≤ 20 weeks pregnant, aged ≥ 18 years, smoking ≥ 5 cigarettes/week before conception | N = 269 I = 134 C = 135 | Not described | Smoking | MI | Standard cessation care | 8 |
| Tappin et al.   | 2015 | UK      | RCT          | Women < 24 weeks pregnant, aged ≥ 16 | N = 609 | December 2011 to | Smoking | Standard cessation care | (continued on next page) | 7 |
group needed a higher insulin dose and experienced more often hypoglycemia at the late pregnancy visit compared with the control group. They argued that insulin is a growth factor and both insulin and hypoglycemia stimulate appetite and this may have influenced the effect on the GWG.

3.3.1.3. Alcohol consumption and drug use. The use of MI to reduce alcohol consumption among pregnant women was investigated by 5 RCTs (Handmaker et al., 1999; Joya et al., 2016; Osterman et al., 2014; Tzilos Wernette et al., 2018; Yonkers et al., 2012). None of the studies found a significant decrease in alcohol use. The intervention intensity of 3 of these studies is relatively low and comprised of only 1 session of MI to stop alcohol consumption during pregnancy (Handmaker et al., 1999; Joya et al., 2016; Osterman et al., 2014). However, Yonkers et al provided an intensive intervention of 6 MET-CBT sessions to women consuming alcohol or using an illicit drug and did not demonstrate any significant effects on alcohol or drug abstinence (Yonkers et al., 2012).

Since, this population has to deal with multiple problems, it is harder to find effective interventions to reduce substance use. Smoking is another important issue during pregnancy (Marchetti et al., 2013). Smoking in pregnancy is associated with an increased risk of adverse outcomes for the fetus and the mother (Batty et al., 2016). MI showed promising results in reducing maternal smoking during pregnancy, and the intervention intensity of 3 of these studies is relatively low and comprised of only 1 session of MI to stop smoking (Handmaker et al., 1999; Joya et al., 2016; Osterman et al., 2014; Tzilos Wernette et al., 2018; Yonkers et al., 2012).

Table 1 (continued)

| Author                  | Year | Country | Study design | Participants                                                                 | Sample size | Time period                  | Lifestyle behavior | Intervention                       | Control                          | QS |
|-------------------------|------|---------|--------------|------------------------------------------------------------------------------|-------------|------------------------------|--------------------|-----------------------------------|----------------------------------|----|
| Tappin et al.           | 2005 | UK      | RCT          | Women ≤ 24 weeks pregnant, smoking                                          | N = 762 I = 351 C = 411 | March 2001 to May 2003       | Smoking            | MI; incentives Vouchers            | Standard cessation care          | 8  |
| Tuten et al.            | 2012 | USA     | RCT          | Women ≤ 30 weeks pregnant, aged ≥ 18 years, nicotine dependent or smoking ≥ 10 cigarettes/day | N = 102 I₁ = 42 I₂ = 28 C = 32 | May 2005 to January 2009     | Smoking            | I₁ = MI; incentives                | Standard care                    | 6  |
| Tzilos Wernette et al.  | 2018 | USA     | RCT          | Women < 20 weeks pregnant (unplanned), who endorsed condomless vaginal/anal sex (at least once in the past 30 days), (at risk) of consuming alcohol or using drugs | N = 50 I = 31 C = 19 | December 2015 to April 2016 | Alcohol consumption Drug use | MI                                 | Computer-delivered assessment    | 7  |
| Valanis et al.          | 2001 | USA     | Cohort study | Pregnant women, smoking (within the past 7 days or within the month before conception but not within the 7 days before clinic registration) | N = 3,907 I = 2,055 C₁ = 1,028 C₂ = 824 | January 1992 to December 1996 | Smoking            | MI                                | C₁ historical – standard care    | 6  |
| Valbo et al.            | 1996 | Norway  | RCT          | Women ≤ 18 weeks pregnant, smoking                                          | N = 158 I = 80 C = 78 | January 1992 to June 1993    | Smoking            | Hypnosis                          | Standard care                    | 7  |
| Van der Windt et al.    | 2020 | The Netherlands | Before-and-after study | Women planning pregnancy or ≤ 12 weeks pregnant                           | N = 450 | June 2018 to December 2018 | Smoking             | Alcohol consumption Drug use       | MI                                | 5  |
| Winhusen et al.         | 2008 | USA     | RCT          | Pregnant women, aged ≥ 18 years, needing substance abuse treatment           | N = 200 I = 102 C = 98 | Not described                | Alcohol consumption Drug use | MET                               | Standard care                    | 8  |
| Yonkers et al.          | 2012 | USA     | RCT          | Women < 28 weeks pregnant, aged ≥ 16 years, consuming alcohol or using an illicit drug (other than opiates) during the 28 days prior to screening or scored ≥ 3 on the modified TWEAK | N = 183 I = 92 C = 91 | June 2006 to July 2010       | Alcohol consumption Drug use | MET-CBT                           | Brief advice                      | 6  |
| Zhang et al.            | 2017 | USA     | Cohort study | Pregnant women, smoking                                                      | N = 12,434 I = 866 C = 11,568 | April 2014 to June 2015 | Smoking            | MI                                | Standard care                    | 6  |

Abbreviations: BMI, body mass index; CBT, cognitive behavioral therapy; CM, contingency management; ECC, educational control condition; GDM, gestational diabetes mellitus; IVR, interactive voice response; MET, motivational enhancement therapy; MI, motivational interviewing; NZ, New Zealand; QS, quality score; RCT, randomized controlled trial; SLT, social learning therapy; UK, United Kingdom; USA, United States of America.
Table 2 Overview of included different psychological therapies in general, their intended goals, and key concepts.

| Type of psychological therapy                  | Characteristics                                                                 |
|------------------------------------------------|---------------------------------------------------------------------------------|
| Motivational interviewing (MI) (Rubak et al., 2005) and motivational enhancement therapy (MET) (Guydish et al., 2010) | • Counselling style for provoking behavior change by helping clients to explore and resolve ambivalence. |
|                                                 | • Overall goal: To increase the client’s intrinsic motivation for behavior change. |
|                                                 | • Key concepts: Ambivalence about current behavior is normal and constitutes an important motivational obstacle in behavior change. |
|                                                 | • Ambivalence can be resolved by working with a client’s intrinsic motivations and values. |
|                                                 | • While MI represents a broader therapeutic approach, MET has a strong focus on personalized assessment, feedback, and change plans. |
| Cognitive behavioral therapy (CBT) and social learning therapy (SLT) (Fabricatore, 2007; Hofmann et al., 2012) | • Class of structured, action-oriented interventions that focuses on identifying and restructuring negative patterns of thought and behavior. |
|                                                 | • Overall goal: To help the individual enact change in thinking patterns and behaviors, thereby improving quality of life not by changing the circumstances in which the individual lives, but by helping the individual taking control of his or her own perception of and behaviors in those circumstances. |
|                                                 | • Key concepts: Cognitions impact emotions and subsequent behaviors and it is possible to intentionally modify the manner in which someone responds to events or thoughts. |
|                                                 | • The core of SLT is to learn new behaviors by observing other people. This therapeutic strategy can be applied in itself, but is often also an element of CBT. |
| Incentive-based contingency management (Petry, 2011) | • A type of behavioral therapy in which individuals are ‘reinforced’, or rewarded, for evidence of positive behavioral change. |
|                                                 | • Overall goal: To stimulate positive behavior. |
|                                                 | • Key concept: Behaviors that are rewarded are more likely to continue and continue with increased frequency, intensity, and duration. |
| Mindfulness (Kabat-Zinn, 2003)                   | • The practice of reaching a ‘full awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment’. |
|                                                 | • Overall goal: To be in touch with the inner workings of our mental, emotional, and physical processes. |
|                                                 | • Key concept: Increasing awareness of how personal emotions influence decisions and behaviors, can positively change behavior and attitude to life. Focus is on raising awareness, not on actively tackling undesirable thoughts (in contrast to CBT). |
| Hypnosis (Gruzelier, 1998)                      | • Commonly referred to as hypnotherapy, is a trance-like state in which a person has heightened focus and concentration. |
|                                                 | • Overall goal: To set aside the conscious mind, and suggestions given directly to the subconscious mind, where behavior is programmed, bypassing the critical factor of the conscious mind. |
|                                                 | • Key concepts: Hypnosis causes a person to actively or voluntarily split their consciousness. |

3.3.1.4. Pregnancy outcomes. The intervention group in the study of Zhang et al, aimed at reducing cigarette smoking, showed fewer infants born with low birth weight (LBW) (OR = 0.51, 95% CI = 0.30–0.88) (Zhang et al., 2017). The study conducted by Asbjørnsdottrir et al demonstrated no significant effects on GWG, however, showed fewer LGA infants in the intervention group compared with the control group, 14% versus 27%, respectively (P = .04)(Asbjørnsdottrir et al., 2019).

Bogaerts et al and Claessens et al, showed no significant effects of the intervention on restricting GWG, and reported no effects on adverse pregnancy outcomes, such as prevalence of gestational diabetes mellitus (GDM), pre-eclampsia (PE) and pregnancy-induced hypertension (PIH), (acute or elective) caesarean section rate, instrumental delivery rate, birth weight, gestational age at delivery (Bogaerts et al, 2013; Claessens et al., 2008). The intervention provided in the study of Yonkers et al showed no significant effects on alcohol and drug abstinence and no difference on LBW prevalence (Yonkers et al, 2012).

3.3.2. Cognitive behavioral Therapy/Social learning therapy

Eight studies, all RCTs, investigated the effects of CBT or SLT on improving dietary intake and psychical activity, and thereby, restricting GWG (Farhodimoghdam et al, 2019; 2020; Gesell et al, 2015; Harrison et al, 2013; Phelan et al, 2011; Phelan et al, 2018; Poston et al, 2015; Smith et al, 2016). The effects of CBT or SLT on dietary intake, smoking, alcohol consumption or drug use were not investigated.
extensive way.

3.3.2.2. Physical activity. Three studies investigated the effects of CBT on physical activity parameters and all showed positive results (Harrison et al., 2013; Poston et al., 2015; Smith et al., 2016). In the studies of Harrison et al and Poston et al, 4 sessions of SLT and 6 sessions of social cognitive theory, respectively, were provided. Harrison et al showed that women in the intervention group retained a 20% higher step count compared to controls (5.203 vs. 4.140 steps/day, \(P < .007\)). Poston et al showed a median difference in physical activity of 295 min/week (95% CI: 105–485) between the intervention group and control group. Smith et al, who only provided access to an SLT-based website, showed comparable effects on physical activity in women contemplating pregnancy.

3.3.2.3. Pregnancy outcomes. Included studies reported no significant effects of CBT on adverse pregnancy outcomes, including GDM, PIH, PE, preterm birth, LBW, macrosomia, caesarean section rate, fetal anomalies and neonatal death (Giesell et al., 2015; Harrison et al., 2013; Phelan et al., 2018; Poston et al., 2015).

3.3.2.4. Incentive-based contingency management. Nine studies examined the effects of incentive-based contingency management on different lifestyle behaviors and pregnancy outcomes (Glover et al., 2015; Heil et al., 2008; Higgins et al., 2014; Jones et al., 2001; Jones et al., 2011; Kurti et al., 2020; Phillips et al., 2019; Tappin et al., 2015; Tuten et al., 2012).

3.3.2.5. Smoking. Six studies focused on the effects of cigarette smoking cessation and all found similar, positive effects. In these studies, more or less comparable financial incentives were used (Heil et al., 2008; Higgins et al., 2014; Kurti et al., 2020; Tappin et al., 2015; Tuten et al., 2012). In the large RCT of Tappin et al (2015), vouchers could be earned up to $400 by women allocated to the intervention group. This study showed higher biochemically verified cessation rates in the intervention group compared with the control group (22.5 versus 8.6%; RR of not smoking at the end of pregnancy = 2.63, \(P < .001\)) (Tappin et al., 2015). Although, Tappin et al (2015) used the highest incentives of included studies, this did not lead to the largest effect size. Heil et al and Higgins et al performed a RCT and rewarded women in the intervention group with vouchers up to $45 and demonstrated significantly higher cessation rates in the intervention group compared with the control group, 41 versus 10%, \(P = .003\) and 46 versus 13%, \(P = .007\), respectively (Heil et al., 2008; Higgins et al., 2014). Tuten et al used a comparable incentive and concluded that a contingent financial incentive intervention can significantly reduce cigarette smoking among methadone-maintained women (\(P < .0001\))(Tuten et al., 2012).

3.3.2.6. Gestational weight gain. One study investigated the effectiveness of a financial incentive-based intervention on the adherence with GWG guidelines and found no significant effects (Phillips et al., 2019). In the study of Phillips et al, pregnant women received an individual session every 2 weeks to inform them, among other things, on the principles of behavioral weight management. Up to $550 could be earned if they did not exceed GWG guidelines.

3.3.2.7. Alcohol consumption. Two studies focused on drug abstinence and tested either a financial incentive-based or a reinforcement-based intervention (Jones et al., 2001; Jones et al., 2011). Jones et al (2001) proved the effectiveness of an escalating voucher incentive schedule to earn a maximum of $70 among pregnant women who were opiate dependent with cocaine use (Jones et al., 2001). This resulted in a significantly greater biochemically verified drug-abstinence (opiates and cocaine) between the intervention group and the control group. Jones et al (2011) demonstrated no significant effects on drug abstinence of a reinforcement-based intervention in which positive behavior was not financially rewarded, but with the stay in a woman’s only recovery house and a more individualized treatment (Jones et al., 2011).

3.3.2.8. Pregnancy outcomes. Included studies reported no significant effects of incentive-based contingency management on pregnancy outcomes, including miscarriage, GDM, PIH, PE, preterm birth, LBW, macrosomia, neonatal intensive care unit admission and primary caesarean section (Heil et al., 2008; Higgins et al., 2014; Jones et al., 2001; Tappin et al., 2015; Tuten et al., 2012).

3.4. Mindfulness

3.4.1. Gestational weight gain

One study reported the effects of a mindfulness-based intervention on GWG among pregnant low-income women (Epel et al., 2019). In the RCT of Epel et al, 110 pregnant women in the intervention group received 8 weekly 2-h sessions, 2 “booster” telephone sessions, and 1 post-partum group session. The control group, including 105 pregnant women, attended routine prenatal care. No significant effects were reported between the two groups.

3.5. Hypnosis

3.5.1. Smoking

One RCT was performed to observe the effects of hypnosis on smoking cessation among pregnant women (Valbo and Eide, 1996). In this study of Valbo and Eide, the intervention group (n = 52) received 2 sessions in which relaxation techniques together with self-hypnotic methods were introduced to combat craving. The control group attended routine pregnancy care (n = 78). No significant difference in quit rate was obtained between the 2 groups, as it was 10% in both groups.

3.6. Relative risk

In Fig. 2 RRs of included studies are displayed. Two studies reported RRs. For 20 studies, we calculated RRs based on numbers provided in the articles. All studies that used incentive-based contingency management for smoking cessation, depicted as green triangles, proved the effectiveness. Moreover, this psychological therapy showed the most uniform results among all reviewed therapies for smoking cessation. The RRs of all other interventions for the improvement of lifestyle behaviors are inconsistent and do not seem to demonstrate their effectiveness convincingly.

4. Discussion

Financial incentive-based contingency management and, although less convincingly, MI can reduce smoking behavior among (pre)pregnant women. MI and MET do not show consistent results of effectiveness on improving dietary intake, physical activity, restricting GWG, alcohol consumption and drug use. CBT is not proven effective for improving dietary intake and physical activity. Likewise, incentive-based contingency management is not proven effective for decreasing smoking, drug use or restricting GWG. Additionally, hypnosis and mindfulness do not show positive effects on decreasing smoking and improving dietary intake, respectively. Since effects of psychological interventions on other lifestyle behaviors have not been studied, conclusions on effectiveness cannot be drawn.

4.1. Motivational interviewing/motivational enhancement therapy

A large meta-analysis of MI versus brief advice or usual care for smoking cessation involving over 16,000 participants yielded a modest but significant increase in quitting (RR 1.26; 95% CI 1.16 to 1.36) (Lindson-Hawley et al., 2015). Contrarily, not all studies included in this
review provided compelling evidence for the effectiveness of MI/MET for smoking cessation among (pre)pregnant women. This might be caused by some studies with a low intensive intervention, including telephone counseling or only 3–10 min counseling during regular antenatal visits.

4.2. Cognitive behavioral therapy

CBT is a therapeutic approach with the strongest scientific support for the treatment of anxiety disorders, depression, anger control problems, eating disorders, and general stress. (Hofmann et al., 2012) A meta-analysis involving 79 trials concluded that CBT is an evidence-based intervention for treating binge eating disorder, the most common eating disorder (Linardon et al., 2017). The goals of CBT for this group is to encourage participants to improve eating patterns and body image by setting goals, self-monitoring, restructuring distorted cognitions and self-perceptions, and managing stress in ways that do not involve food. Since the skills taught in CBT seem to be beneficial for individuals with binge-eating disorder, it is hypothesized that CBT might be an effective treatment modality for obesity as well. However, until now, no conclusive evidence on the effectiveness of CBT for obesity has been provided. The relatively low prevalence, about 5%, of binge eating disorders among obese women, suggests that an adapted approach is required (Kinzl et al., 1999).

Our results on the effectiveness of CBT for weight loss or restricting GWG among (pre)pregnant women correspond to the results for weight loss among the general population.

4.3. Incentive-based contingency management

The effectiveness of incentive-based contingency management for lifestyle behavior improvement is widely substantiated, mainly for substance use. A systematic review on smoking cessation among substance users showed that incentive-based contingency management was superior to control arms, with a RR of 2.56 (95% CI: 1.73, 3.78; P < .001) (Secades-Villa et al., 2020). This result is comparable to the RRs of incentive-based contingency management for smoking cessation calculated in our systematic review. However, some have argued that any effects are likely to be short-lived as the motivational benefit of rewards will end when the rewards stop (Petry, 2010). None of the studies in our systematic review included a follow-up period after the incentives had stopped.

4.4. Mindfulness

Practicing mindfulness could raise an individual’s metacognitive awareness of automatic processes associated with craving and substance seeking and using (Li et al., 2017). This awareness may enable an interruption of the cycle of maladapted cognitive, affective, and psychophysiological mechanisms (Garland et al., 2014) (Li et al., 2017; Witkiewitz et al., 2014). A meta-analysis of RCTs of mindfulness treatments for substance use showed an OR of −0.33 (95% CI −0.49 - −0.17). Yet, the current review only included one study on the effects of mindfulness on restricting GWG among pregnant women. However, according to the meta-analysis, it might be valuable to investigate the effects of mindfulness on substance use among (pre)pregnant women as well (Epel et al., 2019).

4.5. Hypnosis

Hypnosis has been suggested as an effective treatment modality to overweight and obesity problems. A recent review and meta-analysis
concluded that clinicians should view hypnosis as a promising treatment option for obesity, especially when used in conjunction with CBT techniques for weight loss (Milling et al., 2018). However, there is insufficient evidence to determine whether hypnosis is more effective for smoking cessation than other forms of behavioral support or unassisted quitting, according to a review (Barnes et al., 2019).

4.6. Recommendations for research and practice

Since we noticed that results differed strongly between studies with self-reported versus objectively measured outcomes, we recommend to include outcomes, as biochemically verified smoking, instead of self-reported smoking behavior. Additionally, we suggest to include an extensive follow up to determine how long intended effects will persist and to define triggers for setback to old habits.

We observed that intensive interventions, consisting of relatively more and longer sessions, were more often effective compared with less intensive interventions. We would, therefore, recommend that more intensive interventions would be preferred over less intensive interventions to increase the effectiveness. However, attention should be paid to attrition rates, since intensive interventions are associated with more participants that withdraw from participation.

In the current review, only one study measured components of dietary intake, while others used GWG as a proxy for dietary intake. Although GWG reflects dietary intake (Itani et al., 2020) and higher GWG is associated with adverse pregnancy outcomes (Sun et al., 2020), wide usage in daily practice and scientific research has been a subject of debate (Abrams et al., 2000). GWG is not a simple sum of the increased maternal body mass, weight of the fetus, placenta and amniotic fluid, but it is a complex biological phenomenon influenced by several changes in maternal physiology and metabolism, such as total body water accretion and fat accretion (National Research, 2010). Therefore, GWG shows considerable variability between individuals, and including GWG in both clinical practice and as an outcome measure in scientific research is doubtful. We encourage a greater focus on dietary intake instead of a sole focus on GWG in clinical and research settings.

Women with lower socioeconomic status more frequently have an unhealthy lifestyle, contributing to greater GWG (O’Brien et al., 2018), and are at greater risk for unintended pregnancies (Iseyemi et al., 2017), and are therefore, less likely to be included in an intervention study to improve lifestyle behaviors in the preconception period. However, women with a lower socioeconomic status may benefit more from lifestyle interventions, if the intervention is delivered in a proper way. Additionally, (pre)pregnant women might be unaware of the necessity and potential health benefits of improving lifestyle behaviors, since they do not experience, in general, any consequences of unhealthy lifestyle behaviors yet. Not only in research settings, but in general practice as well, raising awareness of healthy lifestyle behaviors in the group of (pre)pregnant women is needed.

Socio-economic status and geographical background influence lifestyle behaviors as well as pregnancy outcomes (Kim et al., 2018; Sundquist and Johanson, 1998). Therefore, the provision of individualized lifestyle interventions that take into account women’s socio-economic status, as well as culture and geographical background (Napier et al., 2014), are the key to successful improvement of lifestyle behaviors, reduction of GWG, and thereby, closing the gap in health inequalities (Terragni et al., 2018).

4.7. Strengths and limitations

With the majority of studies being well-designed RCTs, including large sample sizes and objective measurement of outcomes, the quality of included studies was high, with a mean quality score of 6.8 (range: 5–9). The included studies were conducted in different countries, and in a diversity of ethnicities and cultures. In contrast to focusing on one lifestyle behavior and one psychological therapy, the broad scope allowed us to compare the effectiveness of psychological therapies on the improvement of several lifestyle behaviors. However, other factors, such as stress, sleep, and psychological state of mind, are considered as lifestyle behaviors as well (Abe and Abe, 2019). To some degree, this makes our systematic review less comprehensive. However, we preferred to focus on factors not directed related to or representing mental health, since psychological therapies are widely investigated and proven effective for improving those factors.

This systematic review only included studies on cigarette smoking and one study on hookah smoking. Since e-cigarette use increases, among (pre)pregnant women as well, and associated health risk are becoming more evident (Marques et al., 2021), future studies investigating interventions aimed at lifestyle behaviors should include e-cigarette use as well.

Although most studies had a high quality score and included large sample sizes, some studies tested the intervention only on a small group. We tried to highlight these differences by applying the ErasmusAGE quality score that sample size takes into consideration. Additionally, a number of studies were published two decades ago. Since usual care has changed over time, as well as characteristics of, for example, smoking pregnant women (Männisto et al., 2016), comparing recently published studies and studies published longer ago might lead to erroneous conclusions.

At last, due to the large heterogeneity of content and intensity of the psychological therapy interventions, it was not possible to perform a meta-analysis. So, we did not have the opportunity to critically evaluate and statistically combine results of comparable studies or trials which could have led to a more precise estimate of the effect sizes and could have increased the generalizability of results of individual studies.

4.8. Conclusions

The use of psychological therapies to improve lifestyle behaviors among (pre)pregnant women is relatively new and the emerging scientific proof is promising. Before wide implementation is legitimated, clinical trials should be conducted to study which psychological therapy works for which specific lifestyle behavior and target group, and to study the effects on pregnancy outcomes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

We would like to thank Sabrina Meertens-Gunput, of the Medical Library Department of the Erasmus MC, Rotterdam, for her expertise and support in composing a search string and conducting the search in several databases.

Funding

This research was funded by the department of Obstetrics and Gynecology of the Erasmus Medical Center, Rotterdam.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101631.
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