WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.074
Volume 8, Issue 5, 234-249. Review Article ISSN 2277– 7105

HEALTH BEHAVIOR CHANGE IN PREGNANT WOMEN WITH OBESITY

***Zainab Falah Hussein and Amal Mohammed Abbas**

Ministry of Health, Baghdad, Iraq.

Article Received on
03 Feb. 2019,

Revised on 24 Feb. 2019,
Accepted on 17 March 2019

DOI: 10.20959/wjpr20195-14589

***Corresponding Author**
Zainab Falah Hussein
Ministry of Health, Baghdad, Iraq.

ABSTRACT

Maintaining levels of physical activity, eating a healthy diet and weight management are important health behaviors for pregnant women and their unborn child. This study indicates that pregnancy provides an opportunity for women to reassess their current health behaviors and an opportunity for health professionals to support positive behavior change. Structuring health systems so that they support women to adopt and maintain positive health behaviors Women‟s reported health behaviors before and during pregnancy: A retrospective study 14 should be a public health priority. Further research should be conducted with health professionals to gauge how they perceive their role in the care of pregnant women, along with the exploration of appropriate interventions during the antenatal period.

KEYWORDS: Health behavior, pregnant women, obesity.

INTRODUCTION

Maintaining a health-promoting lifestyle is defined as controlling certain behaviors and selecting appropriate behaviors in daily life for one's own health. Health promotion behavior is a multifaceted model of perception, self-initiated action or practice.[1] It is a response to the World Health Organization's (WHO's) goal of "health for all".[2] According to Pender, health-promoting lifestyle behaviors include nutrition, exercise, stress management, health responsibility, spiritual improvement, and interpersonal relations.[3]

During pregnancy, health-promoting lifestyle leads to a reduction in risk factors and an improvement of infant's health. Nowadays, the mortality of pregnant women is one of the key indices of health in all countries. This has both direct and indirect impacts on pregnancy

outcomes. The health of pregnant women - as a vulnerable group - is of particular importance in the healthcare systems.[4] In fact, a large number of physiological, psychological, and social changes occur during pregnancy. The mother's adjustment to these changes is highly important.[5] Rubin stated that it is necessary for pregnant women to acquire 4 maternal duties, the most important of which is seeking for safety. Therefore, the following health-promoting behaviors are essential for giving birth to a healthy infant. Although a great body of evidence exists with respect to the benefits of health-promoting behaviors, getting people to adopt a healthy lifestyle is challenging.

Unfortunately, many women are against the application of healthy behaviors during pregnancy. For example, there is a decrease in the level of physical activity as pregnancy progresses. Physical activity on pregnancy has many positive effects on the health of the mother and fetus.[6] These include better health-related quality of life, reduction of stress and depressive symptoms, less delivery pain, a lower rate of cesarean delivery, lower risk of obesity, self-efficacy, and better body image.[7] Overall, pregnant women faced the challenge of continuing physical activity during pregnancy.[8] Self-efficacy has been defined as an individual's perceived belief in having the ability to benefit from one's personal sources of motivation and organization and acts to reach a specific goal.[9] Self-efficacy is a strong predictor of health behaviors, and also initiation and maintenance of exercise during pregnancy.[10] Bandura indicated that the theory of self-efficacy provides a convincing explanation of the reasons for behavior change.[11]

In fact, there exists an underlying structure for better performance.[12] Pregnancy provides an opportunity for behavioral interventions[13] and improvement of women's and their children's health.[14] Minimizing concerns related to behavior change is the best motivation for pregnant women.

Background

Women who are obese and pregnant have a higher prevalence of intrapartum and fetal complications and maternal health issues that can lead to negative effects and poor health outcomes.[15] The Centers for Disease Control and Prevention (2018) has stated that obesity rates are increasing across the life span. In the United States, 35.7% of the adult population is obese. The American College of Obstetricians and Gynecologists has defined women who have a body mass index of 30 kg/m2 or greater before pregnancy as being obese.[16]

Although obesity rates are similar for both men and women, approximately 8% of women are considered to have extreme obesity, which is defined as a body mass index greater than 40 kg/m2.[17] ACOG recommends limiting gestational weight gain in this group to 5 to 9 kg, or 11 to 20 pounds. Obesity in pregnancy can be associated with significant negative fetal and maternal health outcomes, including hypertension, preeclampsia, gestational diabetes, an increased incidence of mechanical birth interventions, and stillbirths. Interventions that enable obese women to avoid excessive or additional weight gain in pregnancy can positively affect a woman's health during the pregnancy but also in the long term by introducing healthful behavioral changes that may be maintained afterward.[18] The Centers for Disease Control and Prevention (2018) has determined that obesity is a complex problem requiring a multifaceted approach, including modifying behavior and environment to promote a lifestyle of healthful eating and physical activity. Olson and Blackwell[19] and Shelton and Lee[20] noted that significant lifestyle transitions, such as pregnancy, can act as motivators and offer a window of opportunity to implement new behavior changes into a person's life. Although improving gestational outcomes and decreasing gestational weight gain have been the emphases of multiple studies, identification of specific barriers for women who are obese and pregnant could also help women achieve a positive lifestyle behavior change. A lifestyle behavior change can have a lifelong effect on the health of a woman and her family. By identifying primary motivators for making lifestyle changes, clinicians can focus interventions to promote sustainable changes. The purpose of this integrative review was to explore the literature to identify what motivators and barriers can influence health behavior change among women who are obese when they become pregnant.[21]

Regular physical exercise is associated with better physical and mental health. In Sweden, as well as in the US, the general recommendation for adults, including pregnant women, for physical activity is at least 30 minutes of moderate intensity on most days of the week.

Two Norwegian studies investigated the level of physical activity among pregnant women and reported levels of activity for regular exercises of 81%, 69% and 11% before pregnancy, in the first and in the third trimester respectively, whereas a British study found that 65% of women in gestational week 13 achieved at least 30 minutes moderate or vigorous daily activity.

Some recent studies have investigated physical activity during pregnancy and the first year post-partum and report an association between physical activity and a lower risk of hypertensive complications, fewer symptoms of nausea, vomiting, and low back pain.[22]

Furthermore, physical activity during pregnancy was associated with an improved health-related quality of life, lower postpartum Body Mass Index (BMI) and fewer depressive symptoms.[23]

In a current meta-analysis by Streuling et al.[24] with randomized controlled trials on healthy pregnant women, with increased physical activity as the only intervention, the authors conclude that physical exercise during pregnancy might be successful in restricting gestational weight gain.

Over the past 3 decades, the incidence of obesity among children and adolescents has increased dramatically. In Europe, the incidence of overweight body mass index [BMI][25] kg/m2 or obesity (BMI >30 kg/m2) among pregnant women ranges between 33% and 50%. 2,3 Obesity is a high-risk factor for several pregnancies and delivery complications such as gestational diabetes, gestational hypertension, and preeclampsia.[26] The risk of giving birth to a macrosomic neonate increases proportionally with increasing BMI.[27] Birth traumas, severe asphyxia, and neonatal hypoglycemia are all related to fetal macrosomia.

The risk of macrosomia as well as the risk of pregnancy complications are independently related to gestational weight gain (GWG),[28] and high GWG is a predictor of obesity in infancy and adulthood.[29] The 2009 Institute of Medicine (IOM) recommendations advise obese women to limit their GWG to 5-9 kg. Additional weight gain is associated with a risk of 2- to 3-fold excess weight retention after birth. Some observational studies indicate that these limits for gestational weight gain are optimal for the outcome of mother and child,10 and even a GWG of 5 kg or less may reduce the number of complications without increasing the number of adverse outcomes.[30]

There are good opportunities to introduce lifestyle interventions during the antenatal period. A recent meta-analysis concluded that lifestyle interventions in Physical activity during pregnancy reduces the risk of macrosomia and gestational diabetes but may be difficult to achieve.

An economic evaluation of nonpharmacological interventions for weight management in nonpregnant women, undertaken by the National Institute for Health and Clinical Excellence, found that diet-based interventions were less costly than interventions based on physical activity.

Only a few studies have measured the isolated effect of a physical activity intervention based on a pedometer. Few studies have shown a beneficial effect on type 2 diabetes, and some have resulted in a modest weight loss in nonpregnant obese participants.

A randomized controlled study has shown that a pedometer-based intervention could reduce weight retention after birth, but no studies have investigated the isolated effect of a pedometer intervention on weight gain during pregnancy.[31]

a pregnant woman who is obese is understood to be dependent on the stage of change that she is in during this phase of her life. The pre-contemplation stage begins the cycle as a time of consciousness-raising; however, self-efficacy is low, and the negatives seem difficult to overcome, which makes change unlikely. The identification and elimination of barriers during this phase can assist in moving to the next stage of change. During the contemplation phase, a person is aware of the benefits of changing behavior but is also aware of the challenges of changing, which can cause ambivalent feelings toward modifying behaviors.

The motivation for a positive change is an important part of the contemplation phase that allows the person to move forward with a lifestyle change. The preparation phase allows for social liberation, during which time the pros begin to equal or outweigh the cons of making a significant lifestyle change, and self-efficacy increases. When a person reaches the action phase, there is a rapid increase of self-efficacy, the pros outweigh the cons, and self-liberation takes place.[32]

Identifying barriers and motivators for healthier lifestyle behaviors in a population of interest can help individuals in this population move through the stages of change.[33] Identifying barriers can also lead to the creation of a more successful intervention. Identifying barriers to change during the pre-contemplation stage and barriers and motivators during the contemplation stage can aid in creating focused interventions to promote positive health behavior change that leads to the action and maintenance stages of change.

Pre-Contemplation Stage of Change

The pre-contemplation stage of change is identified as the time when people do not intend to take action or make a change in the near future. This stage is further recognized as a time for consciousness-raising in which a person can experience negative emotions, such as worry and anxiety related to unhealthful behaviors and lifestyle.[34] noted that an environmental evaluation needs to occur through which the person can identify barriers to making positive lifestyle changes. The identification of barriers to making a lifestyle modification should occur during this stage. Barriers often have similarities in certain populations.[35]

Women participating in five studies identified barriers to achieving a positive lifestyle change that was specific to their own situations[36] lack time to make lifestyle modifications was identified in one study. A lack of awareness of the importance of routine care was identified as a barrier in another study. Stress, social norms, and a lack of structure and discipline were also identified as barriers to making a positive lifestyle change. Women reported that low self-esteem, tiredness, depression, and the physical constraints of pregnancy were barriers to making a lifestyle modification. Medical complications were identified as barriers to lifestyle change as well. Six of the studies did not include self-identified barriers to making lifestyle changes.

Over the last two decades overweight and obesity rates have reached epidemic proportions worldwide, with no evidence that these levels are abating. Globally, obesity rates have almost doubled in adults (2, 4, 5) and children are also „getting fatter".[37] In Australia, 54 percent of the adult population is overweight. More specifically, 35 percent of Australian women of child-bearing age (ages 25-35) is overweight or obese.[38] Similarly, in the United Kingdom (2004) 41 percent of women are overweight (25%) or obese (16%) and in the United States in the 20-39 age group, 52 percent are overweight and 29 percent are obese.[39] For women, most weight gain occurs between the ages of 25– 44, the period recognized as the child-bearing years.[40]

This has public health implications as obesity is associated with many medical conditions and is linked to an increase in mortality.[41] Associated medical conditions include; insulin resistance and type II diabetes, stroke, sleep apnoea, high blood pressure, dyslipidemia, cardiovascular disease, gall bladder disease, hyperuricemia, osteoarthritis, and some cancers.[42] Likewise, there is a risk to the fetus, such as congenital abnormalities and susceptibility to overweight and obesity in childhood and into adulthood.[43] Obesity is linked

to an imbalance between energy input and energy expenditure, which often results from a high-calorie diet and increasing sedentary behaviors. Studies indicate that a significant proportion of the population does not achieve the recommended levels of fat, fiber, sugar, zinc, calcium, and iron and that pregnancy is a life event which promotes a sedentary lifestyle.[44] Participation in physical activity is lower among pregnant women than non-pregnant women, with most women decreasing their level of physical activity within the first 20 weeks of pregnancy. This is despite the recommendations for pregnant women who have uncomplicated pregnancies to be physically active for 30 minutes or more on most, if not all days of the week.[45]

Despite the plethora of evidence regarding the benefits of a healthy lifestyle in disease prevention, women continue to conceive while having a BMI greater than 25, gain excessive gestational weight become increasingly less active and eat calorie dense nutrient poor foods. Transition into motherhood should occur with well-established health behaviors, so as to optimize the health outcomes of both mother and offspring.

This means that the short- and long-term health status of women and children are being significantly compromised by factors such as pre-pregnancy weight, excessive gestational weight gain, poor diet, and physical inactivity.[46]

DISCUSSION

Physical activity behavior Pregnancy is a life event that seems to support sedentary behaviors.[47] Although physical activity can be a protective factor for many pregnancy-related disorders, this research indicates that too few pregnant women are sufficiently active. This is a public health concern as physical inactivity may increase a pregnant woman‟s risk of gaining excessive weight and developing illnesses such as preeclampsia and gestational diabetes.[48] This study found that women who report being physically active before pregnancy are more likely to remain physically active during pregnancy, compared to those who report being physically inactive before pregnancy. However, a large number (40%) of healthy, otherwise active women decreased their physical activity during pregnancy.

Comments by the women gave some insight into why this was so. “I’ve got an exercise bike at home but I haven’t really been on that since I got pregnant cause I lost my energy” and “I was doing a lot of walking, Pilates and yoga. I didn’t do any of that at all while I was pregnant, I completely stopped”. Remaining physically active during pregnancy is extremely

important as it predicts a greater likelihood of post-partum physical activity.[49] Rarely does physical activity return to the same levels after childbirth, with an increase in physical activity post pregnancy unlikely for most women.[50] However, women indicated that the excess weight inhibited physical activity, with statements such as: "I tried to keep walking but by the end it lessened because Women"s reported health behaviors before and during pregnancy: A retrospective study 11 after about 10 minutes I was sore, I could feel the pressure and I couldn't be bothered… it took a long time to get back into it afterward". This supports the need for alternative forms of physical activity, such as water-based activities to be available and promoted by health practitioners to women in the early stages of pregnancy. Dietary behavior to date there are few studies that have investigated the dietary behaviors of pregnant women.[51]

In this study, almost two-thirds of women reported they met the Australian recommendations for fruit and vegetable consumption. This is in contrast to a study conducted in New South Wales (NSW) and Queensland (QLD) Australia with pregnant women, whereby few women reported eating the recommended daily intake of fruit (9.2% (NSW); 13% (QLD)) and vegetables (2.7% (NSW); 7% (QLD)), and about one-third reporting that they consumed half the recommended serves of fruit and one-third of the recommended serves of vegetables. The lower reported levels of fruit and vegetable consumption in these two studies may reflect the lower education level of the participants. More than 60% of participants in this study were university educated, while more than 60% of participants in the QLD study and 77% in the NSW study did not finish high school. The reported level of income was also lower in these studies, highlighting the impact of socioeconomic factors on health behaviors.[52]

The women in this study did report making significant changes to their diets during pregnancy. The decreased consumption of fast food may be related to public education in Australian aimed at women in the first trimester that informs them of foods to avoid for Listeria.[53] This demonstrates the capacity of public health education programs and the positive impact that health professionals can have on pregnant women"s health behavior. Women"s reported health behaviors before and during pregnancy: A retrospective study 12 also indicates that pregnancy is a life event that provides an opportunity to intervene and encourage the adoption of health-enhancing behaviors. Weight management Maternal obesity during pregnancy is linked to a number of adverse outcomes for mother and child.[54]

However, as with previous research, more than half the participants in this study reported that they gained weight beyond those recommended for pregnancy.[55] Assessment of weight is a routine antenatal care procedure, yet the majority of women had little or no idea of the importance of gestational weight gain on health, with typical comments such as, "I was weighed every time, but I had no idea what I should have weighed". The lack of concern for weight gain reported by the women in this study may reflect their lack of knowledge about the health implications of excessive weight gain. This indicates a need for weight management education during the antenatal period so that women understand the healthy weight gain parameters and the implications of excessive weight gain for themselves and their unborn child. Research indicates that education around weight management does affect pregnant women‟s weight gain. The optimal impact of weight management advice is achieved when medical professionals commence education at the time of pregnancy confirmation and this is continued throughout the pregnancy.

The growing prevalence of overweight and obesity among expectant mothers has a complex etiology. Although it may be driven by a diet rich in foods that are high in energy, fat, and sugar, and poor engagement in physical activity during pregnancy[56], contextual factors such as the physical environment and the mother's social network and emotional well-being likely also contribute. In pregnant women with increased adiposity, these behaviors have been associated with increased risk of excess gestational weight gain (GWG), heightening the incidence of adverse pregnancy outcomes and long-term health consequences for the mother and her offspring.[57] Improving diet and physical activity behaviors during pregnancy can improve short-term pregnancy outcomes as well as longterm maternal and offspring health.[58]

Women often perceive a number of barriers and facilitators to changing health behaviors during pregnancy.[59] However, compared with normal-weight women, women with a higher BMI may perceive greater barriers to adopting lifestyle changes, which can outweigh facilitating influences.[60] Thus, effective antenatal lifestyle interventions are urgently required to assist overweight and obese pregnant women to implement healthy behavior changes to improve health outcomes.

Formative qualitative research has identified obese women's perceptions of barriers and facilitators to changing diet and physical activity during pregnancy, which may be categorized as: physiological; emotional; environmental; cognitive; and interpersonal

factors.[61] Perceived barriers often outnumber facilitators among women, resulting in reduced self-efficacy to initiate change. Additionally, barriers and facilitators may differ depending on a woman's environment. Thus, identification of contextually relevant barriers to behavior change is a critical step in the design of effective interventions. Some trials have performed pilot or feasibility testing to gain participant feedback on planned interventions.[62]

Qualitative data and pilot testing during developmental stages of an intervention can refine methods for large-scale trials, increasing the likelihood of success. Two recent qualitative studies have explored pregnant women's thoughts, ideas, and perceptions of the design of trials to encourage healthy GWG. In the first study[63], to aid the development of an ongoing lifestyle intervention among overweight and obese African-American pregnant women, participant interviews based on the social-ecological model were used to assess women's perceptions of a healthy GWG and any barriers or enablers they perceived to healthy eating and physical activity.

In the second study among low-income, overweight and obese women, focus groups were conducted to inform the design of an ongoing stress-reduction intervention to target the root cause of lifestyle behaviors which influence GWG.[64] Assessing behavior change: measuring how an intervention leads to behavior change to assess whether an intervention changes behavior, we must measure any changes in target behaviors as well as behavioral constructs. In previous randomized controlled trials among overweight and obese pregnant women, subjective and/or objective measures of dietary and physical activity behaviors targeted by interventions to improve pregnancy outcomes have not always been reported.[65] Trials aiming to reduce GWG via a diet and exercise intervention and via a dietary intervention alone did not report changes in diet and physical activity – the behaviors directly influencing GWG. The former study employed behavior-change theory and techniques.

Similarly, an intense dietary–behavioral intervention aiming to reduce GWG, infant birth weight and the incidence of gestational diabetes, which also employed behavior-change techniques, reported only the frequency of certain foods consumed the day before the first and final study visits during pregnancy. Although this provides some knowledge of the participants' diet, it is not sufficient to provide a reliable estimate of changes in energy and nutrient intakes which may affect GWG. Some trials measure adherence to intervention recommendations for these behaviors, but not the overall improvement, if any, in dietary or nutrient intakes or activity levels.[66]

The tide may be shifting, however, as recently published antenatal intervention trials have reported changes in dietary and physical activity behaviors and clinical outcomes among overweight and obese pregnant women, namely the incidence of infants born large-for-gestational-age and gestational diabetes.[67] Contemporary trials have also measured changes in psychological behavioral constructs, such as self-efficacy, well-being, and depression.[68] Researchers are also now designing patient-informed interventions which have a strong psychological focus.[69] Measuring alterations in psychological behavioral constructs, or performing mediation analyses, might provide insight into the underlying mechanisms by which an intervention may change behavior. For example, a recent study protocol details how it will statistically measure the mediating effect of social support, self-efficacy, self-regulation, and motivation – as measured by individual questionnaires – among women enrolled in a dietary and physical activity intervention to manage GWG.

REFERENCES

1. Chasan-Taber L, Schmidt M, Roberts D, Hosmer D, Markenson G, Freedson P. Development and validation of a pregnancy physical activity questionnaire. Medicine and science in sports and exercise, 2004; 36(10): 1750.
2. Lewallen LP. Healthy Behaviors and Sources of Health Information Among Lowâ€•Income Pregnant Women. Public health nursing, 2004; 21(3): 200.
3. Johnson C, Corrigan S, Dubbert P, Gramling S. Perceived barriers to exercise and weight control practices in community women. Women and health, 1990; 16(3): 177-91.
4. Huberty J, Meendering J, Balluff M, Schram S, Roberts S, Mason M. Healthy wight in your perinatal women: exploring beliefs. Maternal and Child Health Journal, 2010; 14: 918-21.
5. Craig CL. International physical activity questionnaire: 12-country reliability and validity. Medicine and science in sports and exercise, 2003; 35(8): 1381.
6. Cioffi J, Schmied V, Dahlen H, Mills A, Thornton C, Duff M, et al. Physical Activity in Pregnancy: Women's Perceptions, Practices, and Influencing Factors. Journal of Midwifery & Women's Health, 2010; 55(5): 455.
7. Chuang C, Velott D, Weisman C. Exploring Knowledge and Attitudes Related to Pregnancy and Preconception Health in Women with Chronic Medical Conditions. Maternal and Child Health Journal, 2010; 14(5): 713.

8. Ohlin A, Rossner S. Trends in eating patterns, physical acitivty and socio-demographic factors in relation to postpartum body weight development. British Journal of Nutrition, 1994; 71: 457-70.
9. Östlund U, Kidd L, Wengström Y, Rowa-Dewar N. Combining qualitative and quantitative research within mixed method research designs: A methodological review. International Journal of Nursing Studies, 2011; 48(3): 369.
10. Gilligan C, Sanson-Fisher R, Eades S, D'Este C, Kay-Lambkin F, Scheman S. Identifying pregnant women at risk of poor birth outcomes. Journal of Obstetrics and gynecologic, 2009; 29(3): 181-7.
11. Wen L, Flood V, Simpson J, Rissel C, Baur L. Dietary behaviours during pregnancy: findings from first-time mothers in Southwest Sydney, Australia. International Journal of behavioural nutrition and physical activity, 2010; 7(13).
12. Kiel DW. Gestational weight gain and pregnancy outcomes in obese women: how much is enough? Obstetrics and gynecology, 2007; 110(4): 752.
13. Crozier S, Inskip H, Godfrey K, Cooper C, Harvey N, Cole Z, et al. Weight gain in pregnancy and childhood body composition: findings from the Southampton Women's Survey. The American Journal of Clinical Nutrition, 2010; 91(6): 1745.
14. Wilkinson S, Miller Y, Watson B. Prevalence of health behaviours in pregnancy at service entry in a Queensland health service district. Australian and New Zealand Journal of Public Health, 2009; 33(3): 228.
15. Artal R, O'Toole M. Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. British journal of sports medicine, 2003; 37(1): 6.
16. Poston L, Briley AL, Barr S, et al. Developing a complex intervention for diet and activity behaviour change in obese pregnant women (the UPBEAT trial); assessment of behavioural change and process evaluation in a pilot randomised controlled trial. BMC Pregnancy Childbirth, 2013; 13: 148.
17. Ferguson S, Davis D, Browne J. Does antenatal education affect labour and birth? A structured review of the literature. Women Birth, 2013; 26.
18. Campbell F, Johnson M, Messina J, Guillaume L, Goyder E. Behavioural interventions for weight management in pregnancy: a systematic review of quantitative and qualitative data. BMC Public Health, 2011; 11: 491.

19. ahdi F, Montazeri A, Balouchi M, Behboodi Moghadam Z. The impact of group prenatal care on pregnant women empowerment. Journal of the Iranian Institute for Health Sciences Research, 2014; 13: 229-34.
20. Tragea C, Chrousos GP, Alexopoulos EC, Darviri C. A randomized controlled trial of the effects of a stress management programme during pregnancy. Complement Ther Med., 2014; 22: 203-211.
21. Gharaibeh M, Al- Ma'aitah R, Al Jada N. Lifestyle practices of Jordanian pregnant women. Int Nurs Rev., 2005; 52: 92.
22. Wilkinson SA, McIntyre HD. Evaluation of the'healthy start to pregnancy'early antenatal health promotion workshop: a randomized controlled trial. BMC Pregnancy Childbirth, 2012; 12: 131. doi:10.1186/1471-2393-12-131
23. Kroll T, Kehn M, Ho P-S, Groah S. The SCI exercise selfefficacy scale (ESES): development and psychometric properties. Int J Behav Nutr Phys Act., 2007; 4: 34. doi:10.1186/1479-5868-4-34
24. Sen E, Sirin A. Healthy lifestyle behaviors and self-efficacy: the effect of education. Anthropologist Journal, 2015; 21: 89-97.
25. Mauriello L, Dyment S, Prochaska J, Gagliardi A, WeingradSmith J. Acceptability and feasibility of a multiple-behavior, computer-tailored intervention for underserved pregnant women. J Midwifery Womens Health, 2011; 56: 75-80.
26. Ko JM, Lee JK. Effects of a coaching program on comprehensive lifestyle modification for women with gestational diabetes mellitus. J Korean Acad Nurs., 2014; 44(6): 672-81.
27. Giroux I, Lander S, Charlesworth S, Mottola M. Weight History of Overweight Pregnant Women. Canadian Journal of Dietetic Practice and Research, 2009; 70(3): 127.
28. Smith D, Whitworth M, Sibley C, Taylor W, Gething J, Chmiel C, et al. The design of a community lifestyle programme to improve the physical and psychological well-being of pregnant women with a BMI of 30kg/m or more. Public Health, 2010; 10(284).
29. Vickers M, Sloboda D. Prenatal nutrition influences on obesity risk in offspring. Nutrition and dietary supplements, 2010; 2: 137-49.
30. Lillycrop K, Burdge G. Epigenetic changes in early life and future risk of obesity. Internationa Journal of obesitym, 2011; 35: 72-83.
31. Ogden C CM, Curtin L, et al. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA, 2006; 295: 1549-55.
32. Tsoi E SH, Robinson S, Teoh T, Obesity in pregnancy: a major healthcare issue. Postgraduate Medical Journal, 2010; 86(1020): 617-23.

33. Bouchard L, Thibault S, Guay S, Santure M, Monpetit A, St-Pierre J, et al. Leptin Gene Epigenetic Adaptation to Impaired Glucose Metabolism During Pregnancy. Diabetes Care., 2010; 33(11): 2436.
34. Dodd J, Grivell R, Crowther C, Robinson J. Antenatal interventions for overweight or obese pregnant women: a systematic review of randomized trials. BJOG., 2010; 117(11): 1316.
35. Sullivan E, Smith M, Grove K. Perinatal Exposure to High-Fat Diet Programs Energy Balance, Metabolism and Behavior in Adulthood. Neuroendocrinology, 2011; 93(1): 1.
36. World Health Organisation. Obesity: Preventing and managing the global epidemic. Geneva: WHO, 2000; 100-52.
37. Downs D, Hausenblas H. Women's exercise beliefs and behaviors during their pregnancy and postpartum. Journal of Midwifery & Women's Health, 2004; 49(2): 138.
38. Fell D, Joseph K, Armson B, Dodds L. The impact of pregnancy on physical activity level. maternal and Child Health Journal, 2009; (13).
39. Institute of Medicine. Weight gain during pregnancy: Reexamining the guidelines executive summary. Washington: National Research Council, 2009.
40. Melzer K, Schutz Y, Boulvain M, Kayser B. Physical Activity and Pregnancy. Sports Medicine, 2010; 40(6): 493.
41. Tobias D, Zhang C, van Dam R, Bowers K, Hu F. Physical Activity Before and During Pregnancy and Risk of Gestational Diabetes Mellitus: A meta-analysis. Diabetes Care, 2011; 34(1): 223.
42. McIntyre C, Rhodes R. Correlates of leisure-time physical activity during transition to motherhood. Women and health, 2009; 49(1): 66-83.
43. Brown WJ. Life events and changing physical activity patterns in women at different life stages. Annals of behavioral medicine, 2009; 37(3): 294.
44. National Health and Medical Research Council. Food for health-Dietary guidleines for Australians. In: Department of Health and Aging, editor. Canberra:: Commonwealth of Australia, 2003.
45. Laraia B, Siega-Riz A, Gundersen C, Dole N. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. The Journal of Nutrition, 2006; 136(1): 177.
46. Mishra G, McNaughton S, Ball K, Brown W, Giles G, Dobson A. Major dietary patterns of young and middle aged women: results from a prospective Australian cohort study. European journal of clinical nutrition, 2010; 64: 1125-33.

47. Anderson AS. Pregnancy as a time for dietary change? The Proceedings of the Nutrition Society, 2001; 60(04): 497.
48. Rode L, Kjaergaard H, Ottesen B, Damm P, Hegaard H. Assocaition between gestational weight gain according to body mass index and post partum weight in a large cohort of Danish women. Maternal and Child Health Journal, 2011.
49. Bish C, Chu S, Shapiro-Mendoza C, Sharma A, Blanck H. Trying to lose or maintian weight during pregnancy- United States, 2003. Maternal and Child Health Journal, 2009; 13: 286-92.
50. Tovar A, Guthrie B, Platek D, Stuebe A, Herring S, Oken E. Modifiable predictors associated with having a gestational weight gain goal. Maternal and Child Health Journal, 2010.
51. Laslett A, Brown S, Lumley J. Women's views of different models of antenatal care in Victoria, Australia. Birth, 1997; 24(2): 81.
52. Brunner Huber LR. Validity of self-reported height and weight in women of reproductive age. Maternal and Child Health Journal, 2007; 11(2): 137.
53. Poston, L., Briley, A. L., Barr, S., Bell, R., Croker, H., Coxon, K., … Sandall, J. (2013). Developing a complex intervention for diet and activity behaviour change in obese pregnant women (the UPBEAT trial); Assessment of behavioural change and process evaluation in a pilot randomised controlled trial. BMC Pregnancy and Childbirth, 13: 148.
54. Prochaska, J. O., Redding, C. A., & Evers, K. (2002). The transtheoretical model and stages of change. In K. Glanz, B. K. Rimer, & F. M. Lewis (Eds.), Health behavior and health education: Theory, research, and practice (3rd ed.). San Francisco, CA: Jossey-Bass, Inc.
55. Nigg, C. R., Geller, K. S., Motl, R. W., Horwath, C. C., Wertin, K. K., & Dishman, R. K. (2011). A research agenda to examine the efficacy and relevance of the Transtheoretical Model for physical activity behavior. Psychology of Sport and Exercise, 12(1): 7–12.
56. National Institute of Diabetes and Digestive and Kidney Diseases. (2017). Overweight & obesity statistics.
57. Kong, K. L., Campbell, C., Wagner, K., Peterson, A., & Lanningham Foster, L. (2014). Impact of a walking intervention during pregnancy on post-partum weight retention and infant anthropometric outcomes. Journal of Developmental Origins of Health and Disease, 5(3): 259– 267.
58. Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2015). Health behavior: Theory, research, and practice (5th ed.). San Francisco, CA: Jossey Bass.

59. Glanz, K., & Bishop, D. B. (2010). The role of behavioral science theory in development and implementation of public health interventions. Annual Review of Public Health, 31: 399–418.
60. Farajzadegan, Z., & Pozveh, Z. A. (2013). The design of maternal centered life-style modification program for weight gain management during pregnancy—A study protocol. Journal of Research in Medical Sciences, 18(8): 683–687.
61. Dodd, J. M., Turnbull, D. A., McPhee, A. J., Wittert, G., Crowther, C. A., & Robinson, J. S. (2011). Limiting weight gain in overweight and obese women during pregnancy to improve health outcomes: The LIMIT randomized controlled trial. BMC Pregnancy and Childbirth, 11: 79.
62. Dodd, J. M., Turnbull, D., McPhee, A. J., Deussen, A. R., Grivell, R. M., Yelland, L. N., … LIMIT Randomised Trial Group. (2014). Antenatal lifestyle advice for women who are overweight or obese: LIMIT randomized trial. BMJ, 348: g1285.
63. Davis, D. L., Raymond, J. E., Clements, V., Adams, C., Mollart, L. J., Teate, A. J., & Foureur, M. J. (2012). Addressing obesity in pregnancy: The design and feasibility of an innovative intervention in NSW, Australia. Women and Birth, 25(4): 174–180.
64. Cohen, J. H., & Kim, H. (2009). Sociodemographic and health characteristics associated with attempting weight loss during pregnancy. Preventing Chronic Disease, 6(1): A07. Retrieved from
65. Claesson, I. M., Klein, S., Sydsjo, G., & Josefsson, A. (2014). Physical € activity and psychological well-being in obese pregnant and postpartum women attending a weight-gain restriction programme. Midwifery, 30(1): 11–16. https://doi.org/10.1016/j.midw.2012 .11.006
66. Centers for Disease Control and Prevention. (2018). Overweight and obesity: Adult obesity facts. R.
67. Bertz, F., Sparud-Lundin, C., & Winkvist, A. (2015). Transformative lifestyle change: Key to sustainable weight loss among women in a post-partum diet and exercise intervention. Maternal & Child Nutrition, 11(4): 631–645.
68. American College of Obstetricians and Gynecologists. (n.d.). Obesity screening and assessment of patient readiness for weight loss.
69. Yao, R., Ananth, C. V., Park, B. Y., Pereira, L., Plante, L. A., & Perinatal Research Consortium.. (2014). Obesity and the risk of stillbirth: A population-based cohort study. American Journal of Obstetrics & Gynecology, 210(5): 457.e1–457.e9.