

## **Awareness on Gestational Weight Gain among Pregnant Women in Chennai - A Survey**

**Jagadheeswari Ramamoorthy**

Saveetha Dental College & Hospitals  
Saveetha Institute of Medical and Technical Sciences  
Saveetha University  
Chennai - 77  
Email ID - 151701010.sdc@saveetha.com

**Jothi Priya**

Assistant Professor  
Department of Physiology  
Saveetha Dental College & Hospitals  
Saveetha Institute of Medical and Technical Sciences  
Saveetha University  
Chennai - 77  
Email ID - [jothipriya.sdc@saveetha.com](mailto:jothipriya.sdc@saveetha.com)

**Gayathri Devi**

Department of Physiology,  
Saveetha Dental College and Hospitals,  
Saveetha Institute of medical and technical sciences,  
Saveetha University,  
Chennai- 600077.  
Email id: [gayatri.physio88@gmail.com](mailto:gayatri.physio88@gmail.com)  
Lakshminarayanan Arivarasu  
Assistant Professor, Department of Pharmacology,  
Saveetha Dental College and Hospitals,  
Saveetha Institute of Medical and Technical Sciences, Saveetha University,  
Chennai - 600077.

Email id – [lakshminarayanan512@gmail.com](mailto:lakshminarayanan512@gmail.com)

Ph no - +-91-9176781718

**Corresponding author**

Lakshminarayanan Arivarasu  
Assistant Professor, Department of Pharmacology,  
Saveetha Dental College and Hospitals,  
Saveetha Institute of Medical and Technical Sciences, Saveetha University,  
Chennai - 600077.

Email id – [lakshminarayanan512@gmail.com](mailto:lakshminarayanan512@gmail.com)

Ph no - +-91-9176781718

## **ABSTRACT**

### **Introduction**

The amount of gestational weight gain during pregnancy can affect the immediate and future health of the mother and the foetus. In recent years, more women are overweight or obese at conception. There can be an association between excessive gestational weight gain and increased birth weight and postpartum weight retention of the foetus and also between inadequate weight gain and decreased birth weight of the foetus. Therefore it is essential to discuss and frame the appropriate weight gain, diet, and exercise periodically throughout the pregnancy.

### **Aim**

To assess the awareness on Gestational weight gain among pregnant women in Chennai

### **Materials and Method**

This is a survey based study carried out among pregnant women in Chennai through an online platform. A questionnaire consisting of 10 questions regarding pregnancy and gestational weight was circulated among 100 pregnant women. The responses were collected, tabulated in Excel and analysed statistically with the help of SPSS. The statistical tests done were Chi square and correlation analysis.  $p < 0.05$  was considered statistically significant.

### **Results**

Among the total participants 74% of them were aware of normal weight gain during pregnancy. Only 57% of the total participants were aware of the Maternal Body Mass Index. Only 55% of pregnant women who participated in the study were aware of the consequences of excess weight gain during pregnancy.

### **Conclusion**

Within the limits of this study, we conclude that awareness on gestational weight gain among pregnant women needs to be improved especially among the lower income groups. Education on Gestational weight gain and balanced diet during pregnancy is essential for every woman.

### **Keywords**

Gestation, Diet, Obesity, Maternity, foetus

## INTRODUCTION

Gestational weight gain is the amount of weight gained between conception and just before the birth of the infant. It is a complex biological phenomenon which aids in the growth and development of the foetus during pregnancy. Maternal physiology and placental metabolism influences the gestational weight gain(Quyen *et al.*, 2020). The placenta connects the maternal and fetal circulation. It functions as an endocrine organ, a barrier, and a transporter of substances between the mother and the foetus. Any changes occurring in maternal homeostasis can alter the placental structure and function and thus impact the growth rate of the foetus(Faucher and Mirabito, 2020). The functions of placenta may also influence maternal metabolism by altering the insulin sensitivity thereby influencing the gestational weight gain. Women who gain an excessive amount of gestational weight are at higher risk of requiring caesarean section. It is essential to maintain a healthy weight throughout and after pregnancy(Tore *et al.*, 2020) .Weight gain during pregnancy depends on the pre- pregnancy weight of a woman.Healthy weight is essential for a healthy foetus. Gaining the required amount of weight, based on the pre-pregnancy weight, will help in having a more comfortable pregnancy and delivery(Santos, no date).If proper weight gain is not achieved, growth of the foetus is affected . Excess weight gain increases the chances of longer labor and more difficult delivery. After excess weight gain, Women find it difficult to return to normal weight after the baby is born. However, losing weight during pregnancy is not recommended(‘Gestational Weight Gain’, 1999)

The Body mass index is an index indicating the weight-for-height .It is defined as a person’s weight in kilograms divided by the metre square of the heigh(Olson, Strawderman and Graham, 2017)t. Raised BMI may be a major risk factor for noncommunicable diseases like cardiovascular diseases , diabetes, musculoskeletal disorders and a few cancers. The danger for these non communicable diseases increases, with increases in BMI(Chasan-Taber *et al.*, 2014). Healthy eating habits, regular exercise and breastfeeding will all help in returning back to normal weight. Dietary guidelines during pregnancy provide evidence-based information on foods a pregnant woman should take and the frequency of food intake to achieve a healthy diet and the recommended Gestational weight gain(Shiehet *et al.*, 2018). Such information on diet plays a vital

role in characterizing women's awareness on dietary approaches for gestational weight gain management. Lack of awareness on gestational weight gain arises if pregnant women do not have or seek access to accurate information on recommendations of gestational weight gain (Gluckman *et al.*, 2015). This may specifically be the case as there is a misconception among pregnant women that they were already aware of such information. Regular exercise and being active are considered as the prime factors for a healthy pregnancy in women belonging to all weight ranges. Pregnant women need to engage in moderate-intensity exercise for at least 30 minutes a day on most days of the week. (Wang, no date)

Overweight and obese women are more likely to have excessive gestational weight gain compared to normal-weight women. Financial stress during pregnancy may be positively correlated with the levels of CRP postpartum, a stress hormone associated with increase in weight because people's eating habits become unhealthy when they are stressed (Vinter, 2012). Women from high income group may have a healthier gestational weight gain, while those from low socioeconomic background may experience excessive gestational weight gain. The vice versa may also be true. Women from wealthier families have reported to have higher postpartum weight retention than those in poverty (Pope, no date). However greater household income does not necessarily prevent excess gestational weight gain. Weight of the mother determined at the first prenatal visit during the first trimester of pregnancy is used in estimating the total weight gain and early-gestation weight gain, but they do not necessarily reflect prepregnancy weights. Even though average weight gain during the first trimester is less in relation to later trimesters of pregnancy, individual variation may be considerable (Koren *et al.*, 2018).

This study helps in assessing the knowledge and awareness on Gestational weight gain among pregnant women. A combined diet and physical activity intervention conducted in the community for women is more effective at preventing complications of pregnancy. Focusing on the causes may help in decreasing the complications and lead to a healthier society as a whole.

## **MATERIALS AND METHOD**

The study was conducted in an online platform with a sample size of 100 among pregnant women of Chennai population. Pregnant women of age group 18 years and above participated in

the study. The online study setup had certain advantages like flexibility in data collection and required sample size. A questionnaire containing 10 questions was prepared based on awareness on gestational weight gain, obesity and diet and circulated among 100 participants through the online platform called Survey Planet, using a convenience sampling methodology. The demographic details and the responses of the participants were also collected. The collected data was tabulated in Excel and filtered. The data from Excel was imported to SPSS software for statistical analysis. The data was summarized as percentage and represented through bar graphs showing the percentage of each response. The statistical tests done were Chi square tests and correlation analysis.  $p < 0.05$  was considered as statistically significant. The results were finally interpreted.

## RESULTS AND DISCUSSION

Pregnant women of age 18 years and above participated in the study. The participants were grouped as 18-22 years, 22-26 years, 26-30 years and above 30 years. Majority of the participants belonged to the age group of 22-26 years (40%) (Graph 1). Among the total participants 74% of them were aware of normal weight gain during pregnancy (Graph 2). 87% of the participants had a significant weight gain during pregnancy (Graph 3). 58% of them checked their weight regularly during pregnancy whereas 42% of them checked occasionally (Graph 4). Among the total participants, 18% of them consume food twice daily, 55% of them take thrice daily and 27% of them take food 4-5 times a day (Graph 5). 73% of the participants consumed a balanced diet during their pregnancy (Graph 6). Only 28% of them exercised regularly whereas the remaining 72% exercised occasionally or not at all (Graph 7). Among the total participants 41% of them had some health issues after gaining weight during pregnancy (Graph 8). 57% of the total participants were aware of the Maternal Body Mass Index (Graph 9). 60% of pregnant women noticed a significant weight gain during the third trimester, 28% of them noticed during the second trimester and the remaining 12% noticed at the end of the first trimester (Graph 10). Among the total participants only 55% of them were aware of the consequences of excess weight gain during pregnancy (Graph 11).

From the study it is clear that 74% of the participants were aware of normal weight gain during pregnancy in which majority of them belonged to the age group of 22-26 years (30%). Chi square test showed  $p$  value = 0.931 ( $p > 0.05$ , statistically not significant). Individualised care of

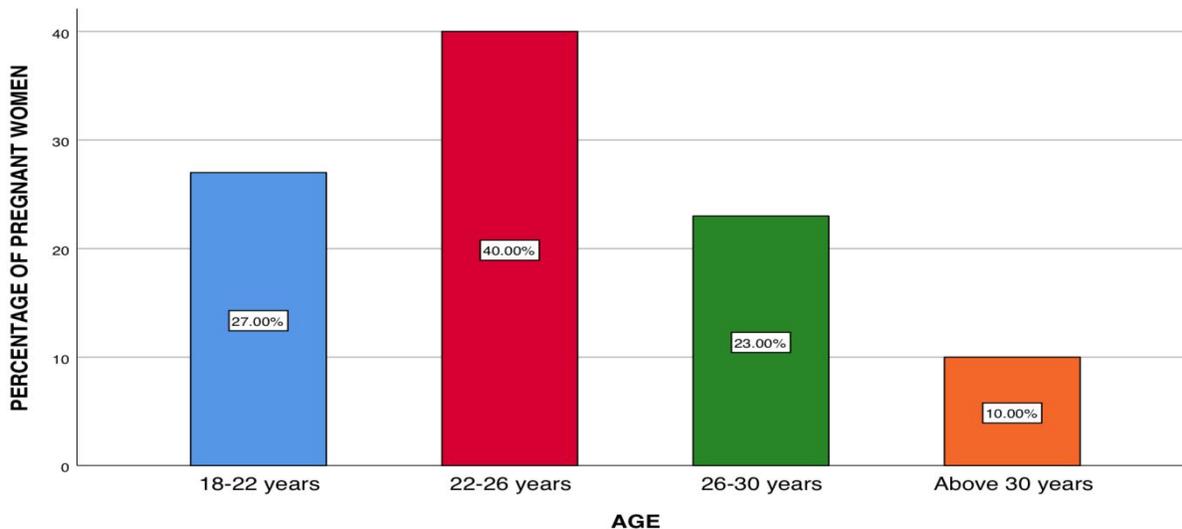
pregnant women and clinical judgment are necessary in the management of the overweight or obesity who has an appropriately growing fetus(Korenet *al.*, 2018). Gestational weight gain recommendations aim to optimise the outcomes for the pregnant woman and the foetus. In obese or overweight women who faces weight loss or limited gestational weight gain during pregnancy, the possible risk of caesarean delivery or postpartum weight retention(Korenet *al.*, 2019). 87% of them had a significant weight gain during pregnancy, majority of which belonged to the age group of 22-26 years (35%) . 13% of them didn't notice a healthy weight gain during pregnancy. Chi square test showed p value = 0.913 (  $p > 0.05$ , statistically not significant). Two major components during pregnancy contribute to gestational weight gain. The conception products such as the foetus, amniotic fluid, placenta and the expansion of blood volume and extracellular fluid, enlargement of uterus and mammary glands, and increased adipose tissue in the mother.Fat which is deposited during pregnancy is mainly subcutaneous(Bodnaret *al.*, 2015). In healthy pregnant women, fat appears to be deposited mainly in the hips, back, and upper thighs.This fat deposition pattern appears to be unique in pregnancy. Fat deposition in the body of the mother occurs primarily during the first 30 weeks of gestation under the stimulation of progesterone hormone(Harrison, 2017).58% of them checked their weight regularly during pregnancy whereas 42% of them checked occasionally . There was not much difference among different age groups. Chi square test showed p value = 0.065 (  $p > 0.05$ , statistically not significant). Regular weight check during pregnancy is essential to keep a track on the weight gain. Among the total participants, 18% of them consume food twice daily, 55% of them take thrice daily and 27% of them take food 4-5 times a day. Majority of them consume food thrice daily among which 11% belonged to 18-22 years, 23% belonged to 22-26 years, 15% belonged to 26-30 years and 6% belonged to 30 years and above. Chi square test showed p value = 0.412 (  $p > 0.05$ , statistically not significant). Dieting during pregnancy is not recommended as it can be harmful to the foetus if there is a lack of essential nutrients in dietary intake. Having a balanced diet and regular exercise are the best ways to stay healthy during pregnancy. Foods that are high in sugar and fat, and empty of nutrients need to be avoided(Harrison, 2017). Unprocessed foods, such as fruit and vegetables, protein, and healthy fats are recommended during pregnancy. For gaining healthy gestational weight, foods that are high in healthy fats need to be taken in diet regularly. The frequency of meals can also be increased if necessary (Robitaille, 2015)

73% of them consumed a balanced diet during their pregnancy in which majority of them belonged to the age group of 22-26 years (29%). Chi square test showed  $p$  value = 0.771 ( $p > 0.05$ , statistically not significant). Balanced diet is a major part of a healthy lifestyle especially during pregnancy. Healthy eating keeps the mother feeling good and gives the foetus the essential nutrients they need in the womb. Diet containing different types of food in recommended quantities and proportions so that there is adequate intake of calories, proteins, minerals and vitamins (Kong, Gissler and Lavebratt, 2019). Additionally, a balanced diet offers dietary fibre, antioxidants and nutraceuticals which has possible health benefits. Only 28% of them exercised regularly whereas the remaining 72% exercised occasionally or not at all. There was not much difference among the different age groups. Chi square test showed  $p$  value = 0.992 ( $p > 0.05$ , statistically not significant). Exercise during pregnancy is not meant for weight loss, however, proper and regular exercise will help in weight loss after the delivery of your baby. Exercise does not increase the risk for miscarriage in a normal pregnancy. Consultation with a health care provider before starting any new exercise routine is recommended (Kong, Gissler and Lavebratt, 2019; Pitocco, Di Leo and Lanzone, 2019). Regular physical activity also helps keep a person fit during pregnancy and improves the ability to cope with labor. Exercise makes it easier for a woman to get back to normal weight after the birth of the baby.

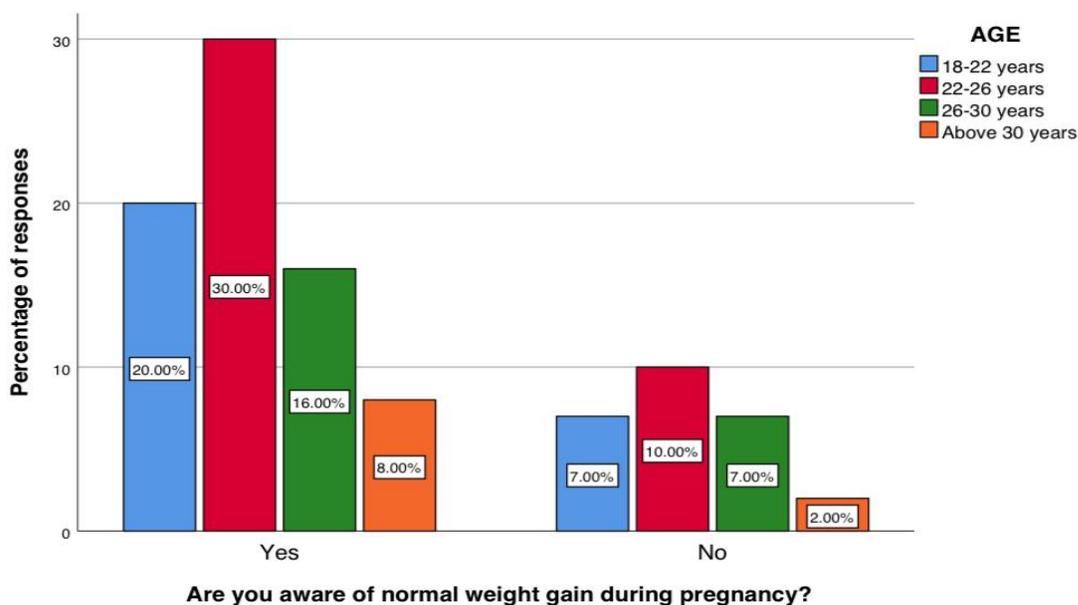
41% of them had some health issues after gaining weight during pregnancy, majority of them belonged to the age group of 22-26 years (22%). Chi square test showed  $p$  value = 0.141 ( $p > 0.05$ , statistically not significant). Women with excess weight before pregnancy have an increased risk of complications like gestational diabetes, high blood pressure which results in preeclampsia, sleep apnea and the need for a C-section. Overweight women are also more likely to have children who become overweight or obese. (Chen *et al.*, 2011) Gaining excess weight during pregnancy increases the risk of health problems in the foetus, such as increased weight by birth, and complications at birth such as shoulder dystocia or preterm birth. 57% of the total participants were aware of the Maternal Body Mass Index in which the majority 25% of participants belonged to the 22-26 years age group. Chi square test showed  $p$  value = 0.005 ( $p < 0.05$ , statistically significant). Low Maternal body mass index (BMI) and insufficient or excess weight gain during pregnancy are the major risk factors for the delivery of infants too small for gestational age. Weight of the infant during birth is a major predictor of neonatal

mortality and morbidity, growth failure, impaired cognitive development and chronic diseases which develops later in adulthood (Marie Sorbye *et al.*, 2020)

60% of them noticed significant weight gain during the third trimester, 28% of them noticed during the second trimester and the remaining 12% noticed at the end of the first trimester. Majority of the participants noticed significant weight gain during their third trimester. Chi square test showed p value = 0.967 (  $p > 0.05$ , statistically not significant). Weight gain during the third trimester is a significant part of the later pregnancy period and is not usually a cause for concern. Most of the women experience rapid weight gain during their third trimester of pregnancy . It is because the foetus typically gains the maximum weight during the third trimester. There is an average weight gain of 5 lbs in the foetus and they may grow around 4–6 inches during the third trimester . The expected amount of weight gain for a woman during her pregnancy depends on her pre-pregnancy BM(National Research Council *et al.*, 2010).I. Among the total participants only 55% of them were aware of the consequences of excess weight gain during pregnancy in which majority of them belonged to the age group of 22-26 years (27%). Chi square test showed p value = (  $p > 0.05$ , statistically not significant). Having a higher maternal body mass index during pregnancy is related to an increased risk of complications for the mother as well as foetus such as birth defects, foetalmacrosomia, Impaired growth, increased risk of Childhood asthma and obesity. Therefore proper weight maintenance during pregnancy becomes essential(Institute of Medicine and Committee on Nutritional Status During Pregnancy and Lactation, 1990).The study is limited by a few factors such as small sample size and Geographic limitations. It is also a unicentric study with no external validity. A multicentric study can be done on the awareness of gestational weight gain among pregnant women on a larger scale. A large study sample of people from different ethnicities is preferred for further studies. Longer duration of the study would give better results

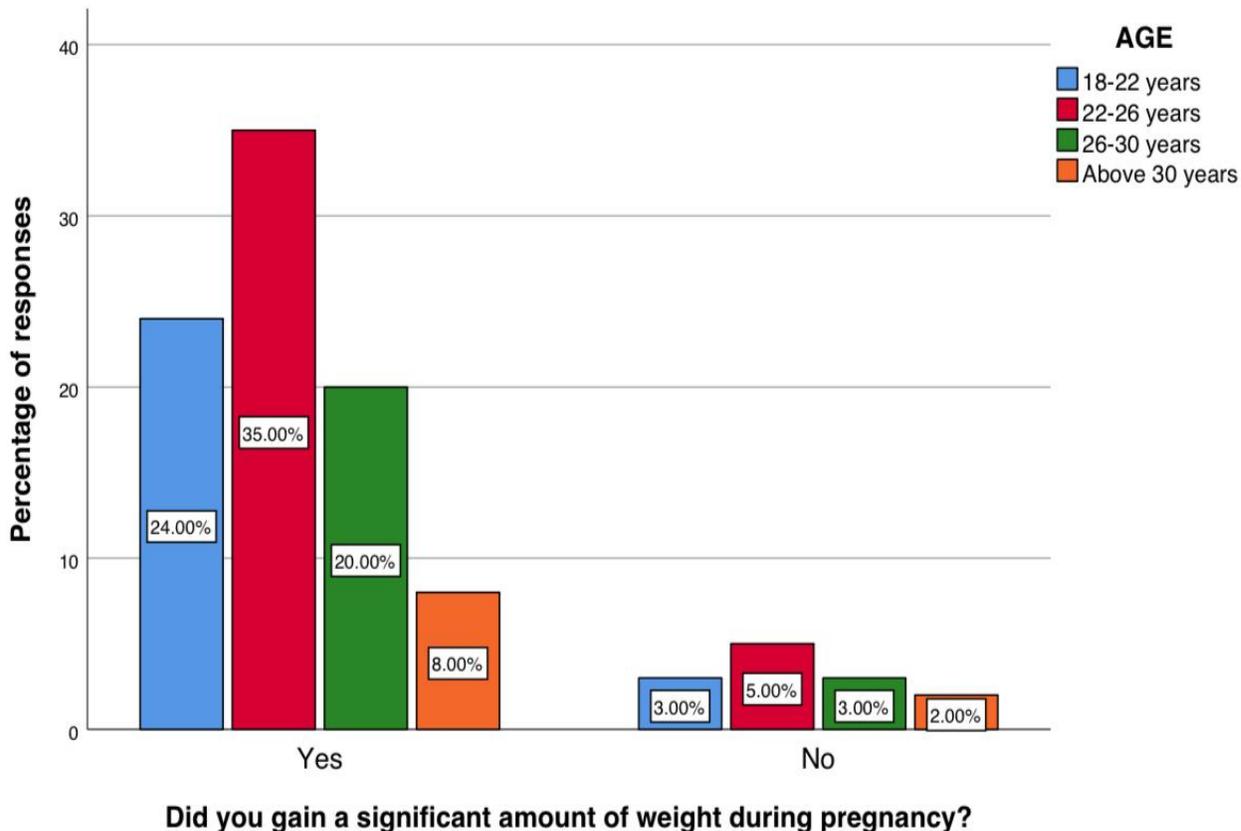


Graph 1 - Bar chart showing the percentage of age distribution of pregnant women taken for the study where X axis denotes the age group of the participants and Y axis denotes the percentage of distribution. The participants were grouped as 18-22 years (Blue), 22-26 years (Red), 26-30 years (Green) and above 30 years (Orange). Majority of the participants belonged to the age group of 22-26 years (40%).

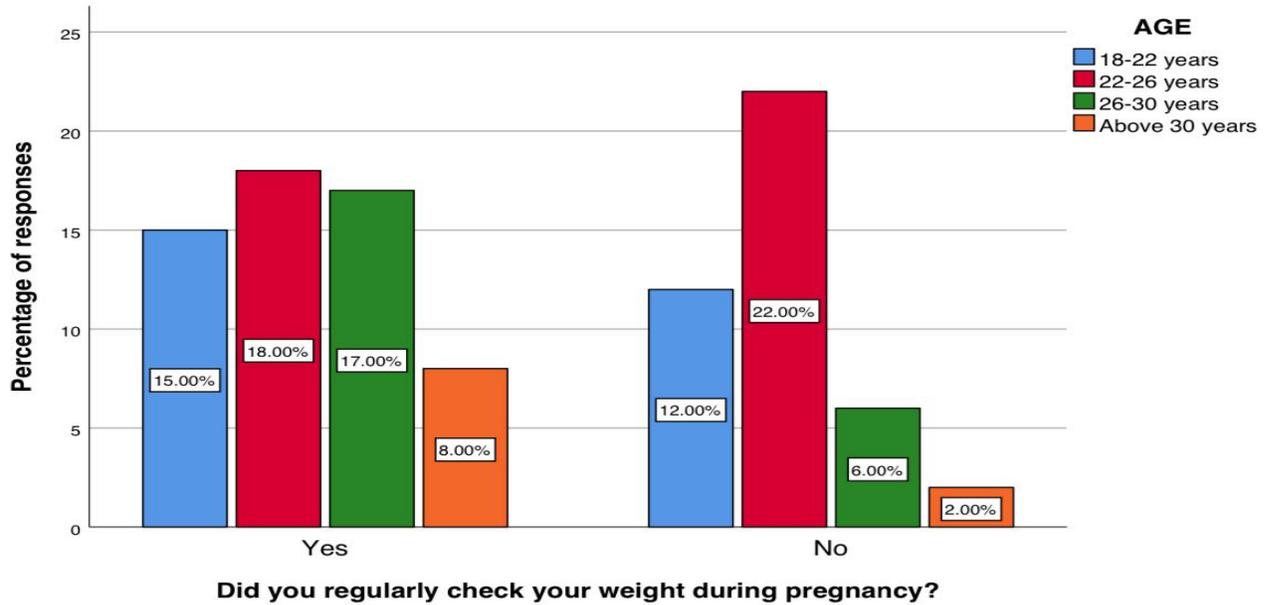


Graph 2 - Bar chart showing the association of age and the percentage of participants who were aware of normal weight gain during pregnancy, where X axis denotes the responses of the

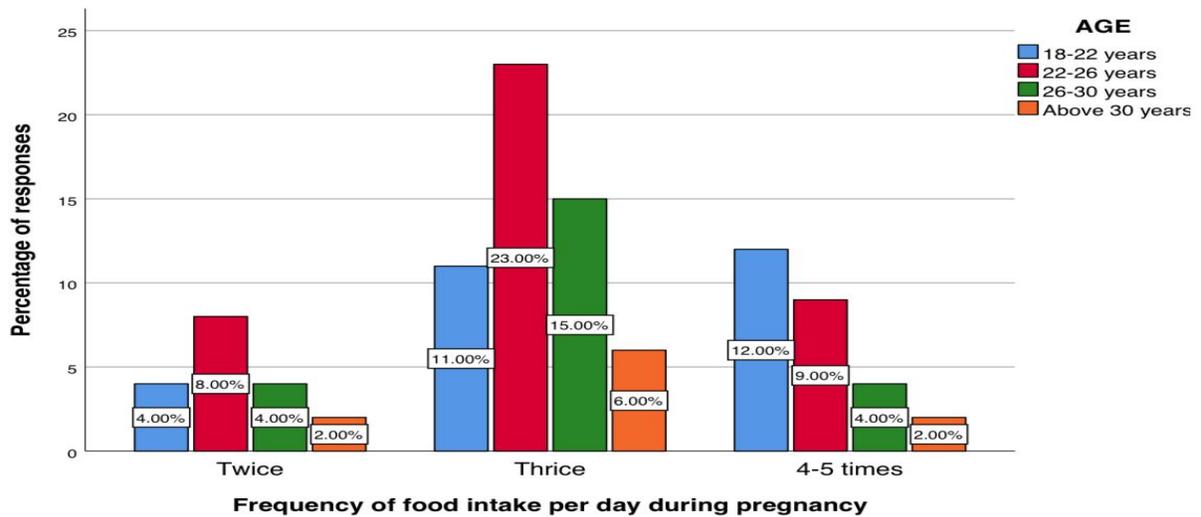
participants to the question and Y axis denotes the percentage of each response. Among the total participants 74% of them were aware of normal weight gain during pregnancy in which majority of them belonged to the age group of 22-26 years (30%). Chi square test showed p value = 0.931 (  $p > 0.05$ , statistically not significant)



Graph 3 - Bar chart showing the association of age and the percentage of participants who gained a significant amount of weight during pregnancy, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. Among the total participants 87% of them had a significant weight gain during pregnancy, majority of which belonged to the age group of 22-26 years (35%) . 13% of them didn't notice a healthy weight gain during pregnancy. Chi square test showed p value = 0.913 (  $p > 0.05$ , statistically not significant)

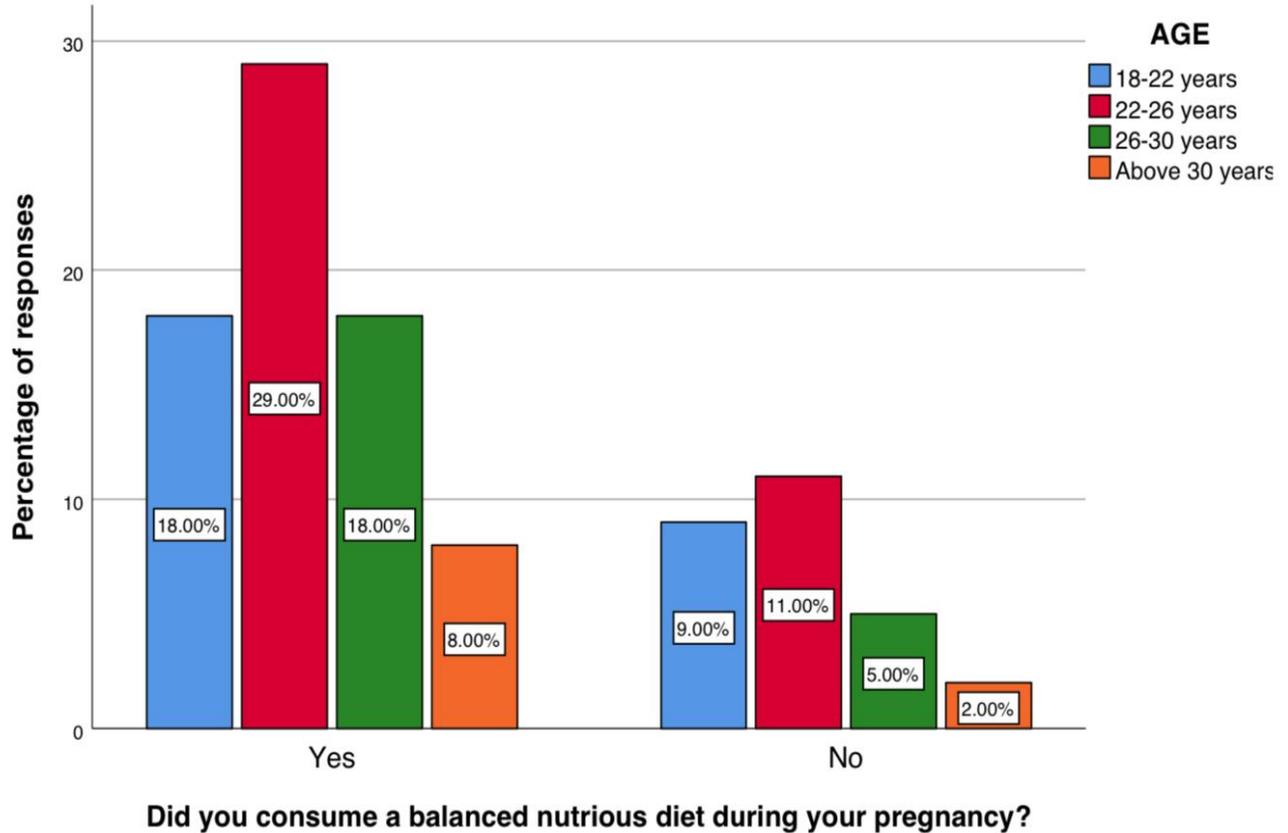


Graph 4 - Bar chart showing the association of age and the percentage of participants who checked their weight regularly during pregnancy, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. Among the total participants 58% of them checked their weight regularly during pregnancy whereas 42% of them checked occasionally . There was not much difference among different age groups. Chi square test showed p value = 0.065 (  $p > 0.05$ , statistically not significant)

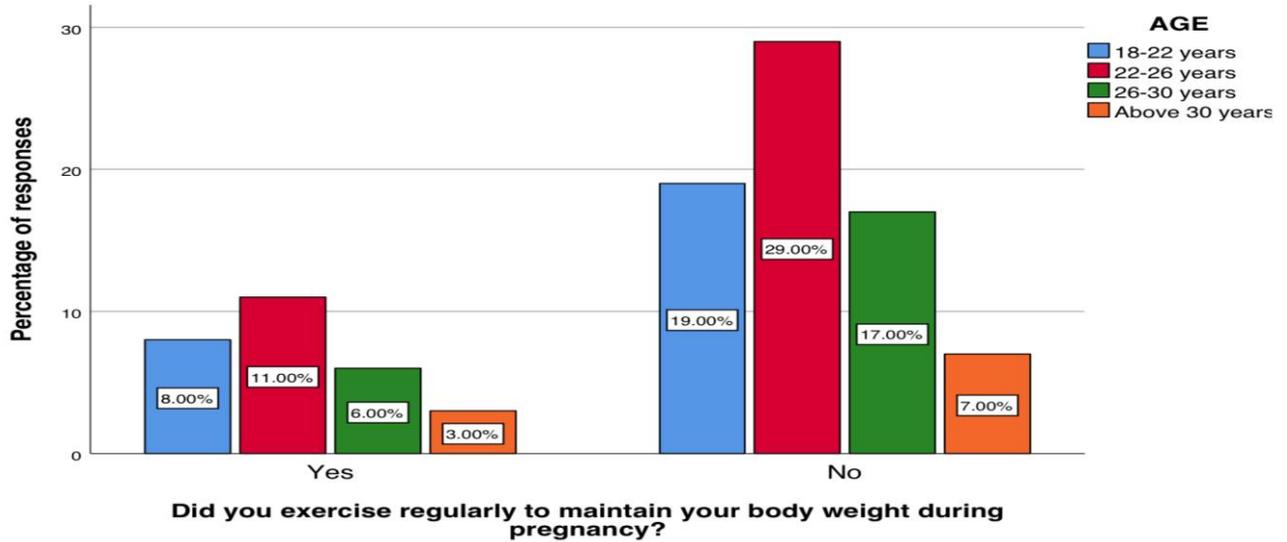


Graph 5 - Bar chart showing the association of age and the frequency of food intake per day during pregnancy, where X axis denotes the responses of the participants to the question and Y

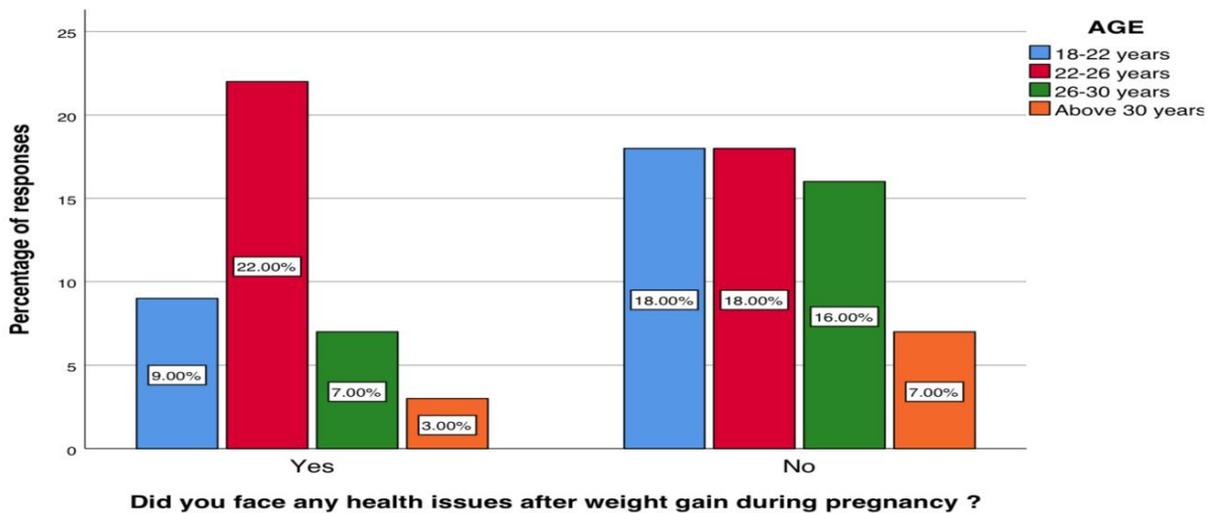
axis denotes the percentage of each response. Among the total participants, 18% of them consume food twice daily, 55% of them take thrice daily and 27% of them take food 4-5 times a day. Majority of them consume food thrice daily among which 11% belonged to 18-22 years, 23% belonged to 22-26 years, 15% belonged to 26-30 years and 6% belonged to 30 years and above. Chi square test showed p value = 0.412 (  $p > 0.05$ , statistically not significant)



Graph 6 - Bar chart showing the association of age and the percentage of participants who consumed a balanced nutritious diet during pregnancy, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. Among the total participants 73% of them consumed a balanced diet during their pregnancy in which majority of them belonged to the age group of 22-26 years (29%) .Chi square test showed p value = 0.771 (  $p > 0.05$ , statistically not significant)

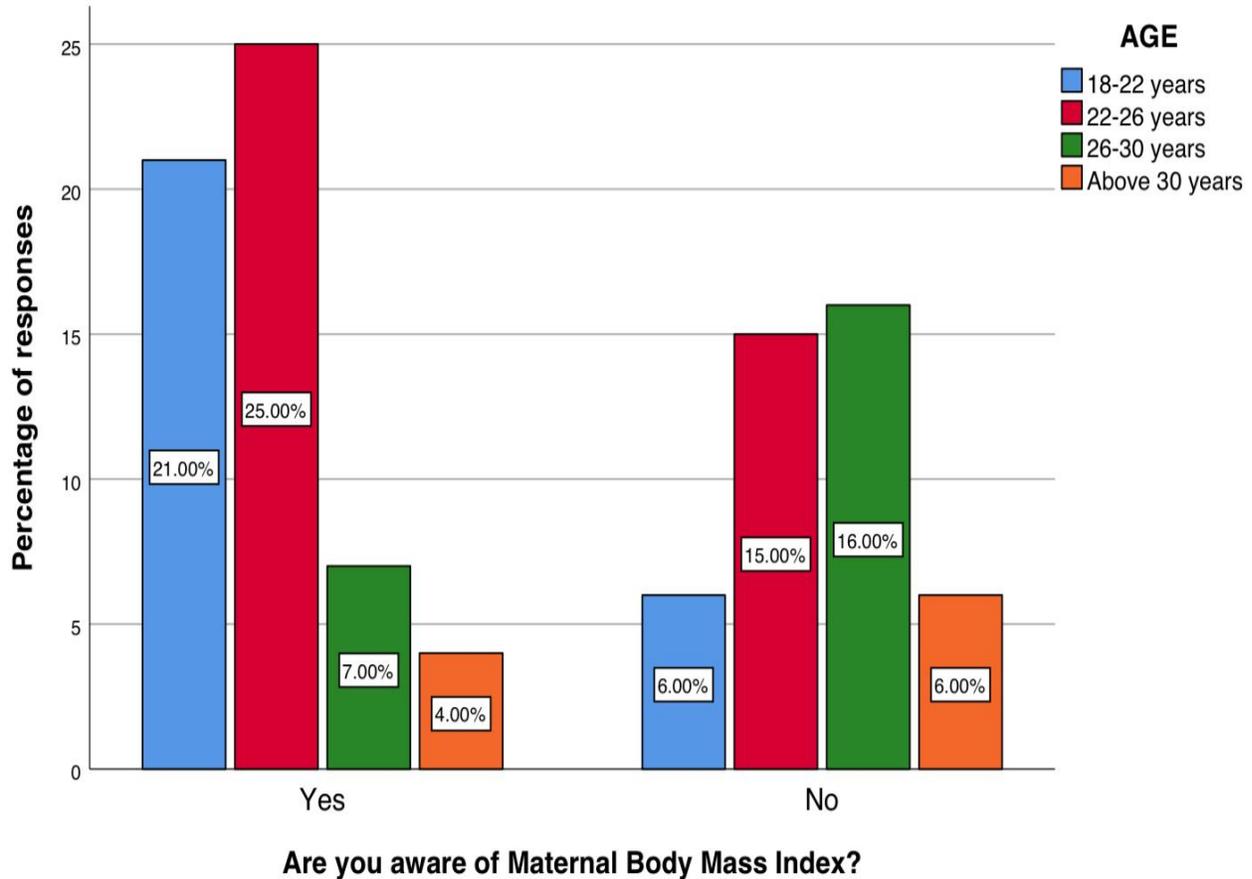


Graph 7 - Bar chart showing the association of age and the percentage of participants who exercised regularly to maintain their body weight during pregnancy, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. Among the total participants only 28% of them exercised regularly whereas the remaining 72% exercised occasionally or not at all. There was not much difference among the different age groups. Chi square test showed p value = 0.992 (  $p > 0.05$ , statistically not significant)

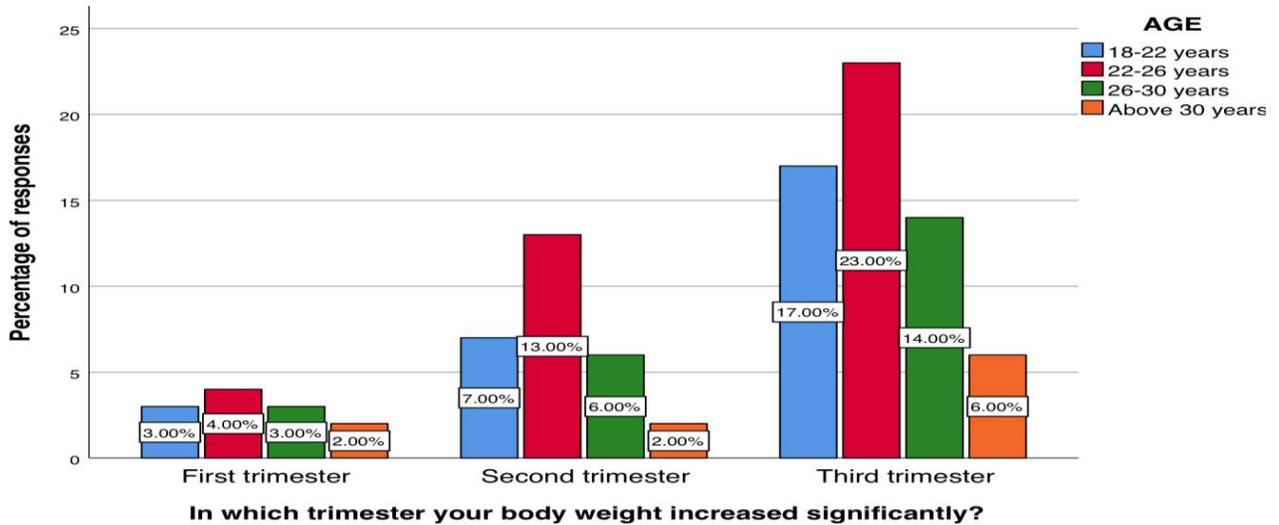


Graph 8 - Bar chart showing the association of age and the percentage of participants who faced health issues after weight gain during pregnancy, where X axis denotes the responses of the

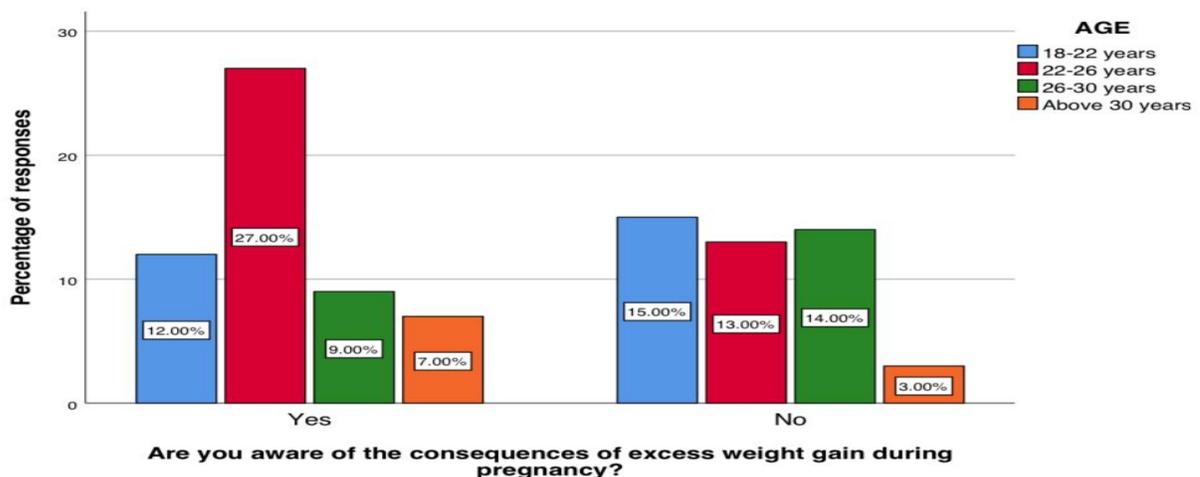
participants to the question and Y axis denotes the percentage of each response. Among the total participants 41% of them had some health issues after gaining weight during pregnancy, majority of them belonged to the age group of 22-26 years (22%). Chi square test showed p value = 0.141 ( $p > 0.05$ , statistically not significant)



Graph 9 - Bar chart showing the association of age and the percentage of participants who were aware of Maternal Body Mass Index, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. 57% of the total participants were aware of the Maternal Body Mass Index in which the majority 25% of participants belonged to the 22-26 years age group. Chi square test showed p value = 0.005 ( $p < 0.05$ , statistically significant)



Graph 10 - Bar chart showing the association of age and the trimester of significant weight gain among pregnant women, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response. 60% of them noticed significant weight gain during the third trimester, 28% of them noticed during the second trimester and the remaining 12% noticed at the end of the first trimester. Majority of the participants noticed significant weight gain during their third trimester. Chi square test showed p value = 0.967 (  $p > 0.05$ , statistically not significant)



Graph 11 - Bar chart showing the association of age and the percentage of participants who were aware of the consequences of excess weight gain during pregnancy, where X axis denotes the responses of the participants to the question and Y axis denotes the percentage of each response.

Among the total participants only 55% of them were aware of the consequences of excess weight gain during pregnancy in which majority of them belonged to the age group of 22-26 years (27%). Chi square test showed p value = (  $p > 0.05$ , statistically not significant)

## CONCLUSION

Within the limits of this study , we conclude that awareness on gestational weight gain among pregnant women needs to be improved especially among the lower income groups. These findings highlights the particular needs of overweight, obese and malnourished pregnant women for targeted attention during pregnancy. The study also highlights the specific needs of overweight and obese pregnant women for attention to the recommended guidelines for healthy weight gain during pregnancy. Health professionals who provide care for pregnant women must counsel them on the benefits of gaining healthy weight during their pregnancy and educate them about the recommended guidelines for weight gain and diet. Education on Gestational weight gain and balanced diet during pregnancy is essential for every woman.

## CONFLICT OF INTEREST

None declared

## REFERENCES

1. Bodnar, L. M. *et al.* (2015) ‘Comparison of Gestational Weight Gain z-Scores and Traditional Weight Gain Measures in Relation to Perinatal Outcomes’, *Paediatric and Perinatal Epidemiology*, pp. 11–21. doi: 10.1111/ppe.12168.
2. Chasan-Taber, L. *et al.*(2014) ‘Physical activity and gestational weight gain in Hispanic women’, *Obesity*, pp. 909–918.doi: 10.1002/oby.20549.
3. Chen, X. *et al.*(2011) ‘Gestational Hyperglycemia, Excessive Pregnancy Weight Gain and Risk of Fetal Overgrowth’, *Gestational Diabetes*.doi: 10.5772/21890.
4. Faucher, M. A. and Mirabito, A. M. (2020) ‘Pregnant Women with Obesity Have Unique Perceptions About Gestational Weight Gain, Exercise, and Support for Behavior Change’, *Journal of midwifery & women’s health*. doi: 10.1111/jmwh.13094.

5. 'Gestational Weight Gain' (1999) *PsycEXTRA Dataset*. doi: 10.1037/e574162006-001.
6. Gluckman, S. P. *et al.* (2015) 'Pre-conception maternal body composition and gestational weight gain', *Oxford Medicine Online*. doi: 10.1093/med/9780198722700.003.0028.
7. Harrison, C. L. (2017) 'Gestational Weight Gain and its Association with Infant Birth Weight', *Obesity*, pp. 1468–1469. doi: 10.1002/oby.21912.
8. Institute of Medicine and Committee on Nutritional Status During Pregnancy and Lactation (1990) *Nutrition During Pregnancy: Part I: Weight Gain, Part II: Nutrient Supplements*. National Academies Press.
9. Kong, L., Gissler, M. and Lavebratt, C. (2019) 'Implications of Gestational Weight Gain in Studies of Gestational Diabetes—Reply', *JAMA Pediatrics*, p. 889. doi: 10.1001/jamapediatrics.2019.2192.
10. Koren, R. *et al.* (2018) 'Effect of pre-gestational weight and gestational weight gain in women with gestational diabetes controlled with medication on pregnancy outcome—is recommended weight gain too liberal?', *Endocrine Abstracts*. doi: 10.1530/endoabs.56.p559.
11. Koren, R. *et al.* (2019) 'Effect of pre-gestational weight and gestational weight gain in women with gestational diabetes controlled with medication on pregnancy outcomes – is recommended weight gain too liberal?', *Gynecological Endocrinology*, pp. 328–331. doi: 10.1080/09513590.2018.1525701.
12. Marie Sorbye, L. *et al.* (2020) 'Interpregnancy weight change and recurrence of gestational diabetes mellitus: a population-based cohort study', *BJOG: an international journal of obstetrics and gynaecology*. doi: 10.1111/1471-0528.16364.
13. National Research Council *et al.* (2010) *Weight Gain During Pregnancy: Reexamining the Guidelines*. National Academies Press.
14. Olson, C. M., Strawderman, M. S. and Graham, M. L. (2017) 'Association between consistent weight gain tracking and gestational weight gain: Secondary analysis of a randomized trial', *Obesity*, pp. 1217–1227. doi: 10.1002/oby.21873.
15. Pitocco, D., Di Leo, M. and Lanzone, A. (2019) 'Implications of Gestational Weight Gain in Studies of Gestational Diabetes', *JAMA Pediatrics*, p. 889. doi: 10.1001/jamapediatrics.2019.2195.
16. Pope, S. (no date) 'Eating for Two Without Eating Too Much: Optimizing Gestational

Weight Gain'. doi: 10.22371/07.2020.015.

17. Quyen, P. N. *et al.*(2020) 'Effect of maternal prenatal food supplementation, gestational weight gain, and breast-feeding on infant growth during the first 24 months of life in rural Vietnam', *PloS one*, 15(6), p. e0233671.
18. Robitaille, J. (2015) 'Excessive gestational weight gain and gestational diabetes: importance of the first weeks of pregnancy', *Diabetologia*, pp. 2203–2205. doi: 10.1007/s00125-015-3725-2.
19. Santos, E. (no date) 'Appropriate Gestational Weight Gain'.doi: 10.22371/07.2016.021.
20. Shieh, C. *et al.* (2018) 'Intervention strategies for preventing excessive gestational weight gain: systematic review and meta-analysis', *Obesity Reviews*, pp. 1093–1109. doi: 10.1111/obr.12691.
21. Tore, E. C. *et al.* (2020) 'Gestational Weight Gain by Maternal Pre-pregnancy BMI and Childhood Problem Behaviours in School-Age Years: A Pooled Analysis of Two European Birth Cohorts', *Maternal and child health journal*. doi: 10.1007/s10995-020-02962-y.
22. Vinter, C. A. (2012) 'Gestational Weight Gain', *Maternal Obesity and Pregnancy*, pp. 119–131. doi: 10.1007/978-3-642-25023-1\_8.
23. Wang, X. (no date) 'Diet and physical activity interventions to prevent excessive gestational weight gain ': doi: 10.5353/th\_b5320696.