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Original Article

The effect of obesity on the onset of spontaneous labor and scheduled delivery rates in term pregnancies

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ABSTRACT

Objective: To determine the effect of obesity on the onset of spontaneous labor, scheduled delivery rates and perinatal outcomes in term pregnancies.
Material and methods: 242 obese and 244 non-obese pregnant women ≥37 gestational weeks were compared in terms of the onset of spontaneous labor, scheduled delivery rates and perinatal outcomes.
Results: Obese pregnant women had statistically significantly lower onset of spontaneous labor and higher rates of scheduled delivery. No difference was determined in respect of the type of delivery, 1st and 5th minutes APGAR scores and the need for intensive care. Higher values of birth weight, large for gestational age, macrosomia, gestational diabetes mellitus and preeclampsia were determined in obese women.
Conclusion: The onset of spontaneous labor rates in term obese pregnancies were lower and scheduled delivery rates were higher than in the non-obese pregnancies. However, more extensive studies are needed to better understand this relationship.

Introduction

With increased prevalence over the last century, obesity in women of reproductive age has become a major health problem in Turkey as it has throughout the world [1–4]. Obesity and central adiposity are particularly frequent in women with PCOS and type 2 diabetes with an increased risk of pregnancy-related complications [5,6].

Maternal and neonatal complications such as gestational diabetes mellitus, pregnancy-induced hypertension, labor induction, failure of labor induction, cesarean delivery, macrosomia, shoulder dystocia and admission to neonatal intensive care units have been reported to increase with obesity [7–14]. Furthermore, obesity is associated with an increased risk of uterine fibroids, which may affect pregnancy outcomes and require specific clinical management [15,16]. There has also been reported to be an increase in obesity-related post-term pregnancy rates [17,18]. Although the precise cause of the increase in the incidence of post-term pregnancies in obese pregnancies is not fully known, it has been suggested that it could be due to a decrease in the onset of spontaneous labor rates [19,20]. The effect mechanism of obesity on the onset of spontaneous labor rate is not fully understood, but may be due to abnormal myometrial contractility caused by obesity, as this effect has been shown in invitro studies [21]. To date, only a few studies have investigated the role of obesity on the onset of spontaneous labor and scheduled delivery rates in term pregnancies [19,22,23]. The primary aim of this study was to determine the effect of obesity on the onset of spontaneous labor and scheduled delivery rates in term pregnancies. A secondary aim was to compare perinatal outcomes between obese and non-obese pregnancies.

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Material and methods

This prospective cohort study was conducted between January 20, 2018 and February 20, 2018 at the Health Sciences University Diyarbakır Gazi Yaşargil Training and Research Hospital, where the annual number of births exceeds 25,000. The study was approved by the Local Ethics Committee (n.13, January 19, 2018) and prepared in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines [24]. Informed consent was obtained from all participants. Consecutive patients were recruited as they were admitted for labor. Women with preterm births (<37 weeks), multiple pregnancies, previous uterine (cesarean or myomectomy etc.) or vaginal surgery (cystorectocele repair, prolapse, or incontinence surgery) and stillbirth were excluded from the study. Body mass index (BMI) was calculated by measuring height and weight at the time of admission to the delivery room. BMI of $\geq$30 kg/m^2 was accepted as obesity [25]. The study included a total of 496 pregnant women at $\geq$37 gestational weeks who were admitted to the delivery room, of whom 242 were obese. Obstetric ultrasound was performed on all patients at the time of admission to the delivery room for labor. The date of the last menstrual period and/or the first trimester obstetric ultrasound measurements was used to determine the gestational age.

The primary outcome of this study was to compare the rates of onset of spontaneous labor and scheduled delivery, between the groups separated according to weight. Additional comparisons of the obese and non-obese pregnant women were made in terms of mean age, gravida, parity, systolic and diastolic blood pressure values, gestational week, post-term pregnancy ($\geq$42 gestational weeks), onset of spontaneous labor, scheduled delivery (defined as initiation of induction of labor for an obstetric reason such as early membrane rupture, pre-eclampsia, post-term), birth type (vaginal, cesarean or instrumental vaginal delivery), birth weight, 1 and 5 min APGAR scores, small for gestational age (SGA: birth weight <10th percentile according to gestational age), large for gestational age (LGA: birth weight >90th percentile according to gestational age), macrosomia (baby weight of $\geq$4000 g), pre-eclampsia and admission to neonatal intensive care unit rates. The rates of onset of spontaneous labor and scheduled delivery were calculated within different scales of BMI.

Sample size

Sample size was calculated to find a difference of 10% in the proportion of onset of spontaneous labor between obese and non-obese pregnant women, considering an alpha of 0.05, and beta of 20% using a one-sided test. A sample size of 197 women per group was required.

Statistical analysis

Data obtained in the study were analyzed statistically using SAS version 9.2 software. Descriptive statistics (mean, standard deviation, minimum, median, maximum) were used to describe continuous variables. The Mann Whitney U-test was used to compare two groups of independent variables not showing normal distribution. The Chi–Square test or Fisher Exact test, as appropriate, was applied to examine the relationship between categorical variables. Univariate and multivariate logistic regression analyses were performed to determine the association between the primary variable of exposure (obesity and weight categories) and the outcome of interest (onset of spontaneous labor and scheduled delivery). The associations were expressed as odds ratios (OR) and 95% confidence intervals (CI); multivariate analysis was adjusted for potential confounding factors, such as age, parity, systolic and diastolic blood pressure, SGA, LGA, macrosomia, GDM, and pre-eclampsia. A value of $p < 0.05$ was accepted as statistically significant.

Results

A total of 486 patients were considered eligible for the study (Fig. 1). The clinical characteristics and perinatal outcomes of patients are summarized in Table 1. Statistically significant differences were determined between the obese and non-obese women in terms of age, gravida, parity, diastolic blood pressure, systolic blood pressure, onset of spontaneous labor, scheduled delivery, birth weight, LGA, macrosomia, GDM and pre-eclampsia rates. No statistically significant differences were determined in terms of gestational age, term pregnancy, post-term pregnancy, vaginal delivery, cesarean delivery, instrumental vaginal delivery, 1-min APGAR score, 5-min APGAR score, SGA and NICU hospitalization rates.

The rates of onset of spontaneous labor and scheduled delivery in the different groups of BMI values are summarized in Table 2. As BMI increased, there was seen to be a significantly lower rate of onset of spontaneous labor and a significantly higher rate of scheduled delivery.

Logistic regression analysis revealed that obese women were almost 2-fold more likely to have scheduled delivery (Table 3). When the analysis was stratified for the different BMI categories, a trend toward higher obesity levels was revealed, showing that severely obese women were most associated with scheduled delivery.

Discussion

The findings of this study showed that the rates of onset of spontaneous labor in term obese pregnancies were lower and scheduled delivery rates were higher than in non-obese pregnancies. Furthermore, as BMI increased, lower rates of onset of spontaneous labor and higher rates of scheduled delivery were determined. There are only a few studies in literature on this subject and in those studies, the rate of onset of spontaneous labor in term obese pregnant patients has been shown to be lower than in term non-obese pregnant patients, which is similar to the current study results [19,22,23]. When considering these studies in terms of the onset of spontaneous labor rates in term pregnancies, Frolova et al. [19]reported a rate of 50.7%, Denison et al., 77% [22], and Hermesch et al., 78% [23]. In the current study, the onset of spontaneous labor rates in term obese pregnancies were similar to the results of Denison et al. [22] and Hermesch et al. [23], but higher than the results of Frolova et al. [19] (Table 4). Although the pathophysiology of this decrease in the onset of spontaneous labor rates in term obese pregnancies compared to non-obese pregnancies is not fully understood, *in vitro* studies have shown that obese women have abnormal contractility in the myometrium [21] and that when oxytocin is required, higher doses are used in obese pregnancies [26]. Therefore, this decrease in the onset of spontaneous labor rates in obese pregnancies may be due to this abnormal myometrial contractility [21].

In a study by Frolova et al., the post-term pregnancy rate was found to be significantly higher in obese pregnancies than in non-obese pregnancies (10.8% vs 8%) [19]. In contrast, in the current study, the post-term pregnancy rate was not significantly higher in obese pregnancies than in non-obese pregnancies. The results of the current study support the hypothesis that the factors determining the length of gestational age are not fully known.

In the current study, the mean age in obese pregnancies was significantly higher than in non-obese pregnancies. Similar to these results, Frolova et al. [19] also showed this difference. In addition,

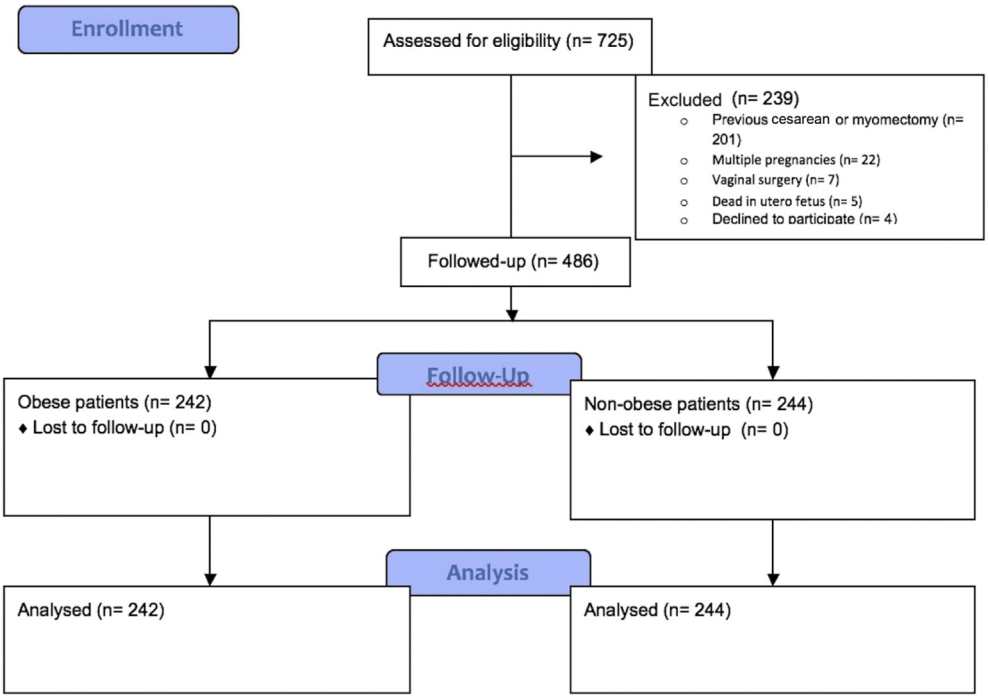

Fig. 1. Flow diagram of the study.

Table 1
Clinical characteristics and perinatal outcomes of obese and non-obese pregnancies.

	BMI ≥30 kg/m^2 n = 242	BMI<30 kg/m^2 n = 244	P-value
Age (years),[mean ± SD]	28.02 ± 6.4	25.8 ± 5.9	< **0.001**
Gravida, [mean ± SD]	3.2 ± 2.03	2.79 ± 1.9	**0.004**
Parity, [mean ± SD]	2.05 ± 1.9	1.62 ± 1.8	**0.005**
Blood pressure (mmHg), [mean ± SD]			
Diastolic	66.9 ± 8.3	65.1 ± 7.2	**0.002**
Systolic	107.8 ± 12	104.8 ± 10.3	**0.016**
Gestational age (w),[mean]	38.9 ± 1.1	38.8 ± 1.2	0.535
Onset of spontaneous labor, n (%)	180 (74.4)	206 (84.4)	0.009
Scheduled delivery, n (%)	62 (25.6)	38 (15.6)	0.008
Term pregnancy[a], n (%)	222 (91.7)	229 (93.9)	0.445
Post-term pregnancy[b], n (%)	18 (7.4)	14 (5.7)	0.565
Type of delivery, n (%)			
vaginal	217 (89.7)	227 (93.0)	0.257
cesarean	22 (9.1)	15 (6.1)	0.281
Instrumental vaginal	3 (1.2)	2 (0.8)	0.989
Birth weight (g), [mean ± SD]	3370.7 ± 406.1	3256.6 ± 419.3	**0.007**
First minute APGAR score [mean ± SD]	7.9 ± 0.7	7.9 ± 0.7	0.288
Fifth minute APGAR score [mean ± SD]	8.9 ± 0.6	8.9 ± 0.4	0.342
SGA, n (%)	3 (1.2)	11 (4.5)	0.056
LGA, n (%)	36 (14.9)	15 (6.1)	**0.002**
Macrosomia, n (%)	19 (7.8)	8 (3.3)	**0.03**
GDM, n (%)	25 (10.3)	12 (4.9)	**0.037**
Pre-eclampsia, n (%)	18 (8.0)	5 (2.0)	**0.005**
NICU, n (%)	9 (3.7)	3 (1.2)	0.087

w: week, d:day, g:gram, BMI: body mass index,SGA: small for gestational age, LGA: large for gestational age, GDM: gestational diabetes mellitus, NICU: neonatal intensive care unit.
Bold values indicate $p < 0.05$.
[a] 37w0d-41w6d.
[b] ≥42w0d.

Table 2
Onset of spontaneous labor and scheduled delivery rates in different scales of BMI.

	Onset of Spontaneous Labor n, (%)	Scheduled Delivery n, (%)	P value
BMI (<25 kg/m^2), n = 54	47 (87%)	7 (13%)	< **0.001**
BMI (25–29.9 kg/m^2), n = 190	159 (83.6%)	31 (16.4%)	
BMI (30–34.9 kg/m^2), n = 182	145 (79.6%)	37 (20.4%)	
BMI (≥35 kg/m^2), n = 60	35 (58.3%)	25 (41.7%)	

Bold value indicates $p < 0.05$.

Table 3
Association between onset of delivery, obesity and BMI status.

	Scheduled delivery, OR (95% CI)	
	Model 1[a]	Model 2[b]
Obesity status		
Non-obese (BMI<30 kg/m^2)	1	1
Obese (BMI ≥30 kg/m^2)	1.88 (1.20–2.96)	1.91 (1.15–3.18)
BMI status		
Normal	1	1
Overweight	2.47 (0.56–10.90)	3.13 (0.64–15.37)
Obese	3.40 (0.77–14.93)	4.65 (0.94–22.85)
Severely obese	15.17 (3.05–75.52)	15.83 (2.72–91.85)
P for trend	<0.001	<0.001

[a] Univariate analysis.
[b] Multivariate analysis adjusted for age, parity, systolic and diastolic blood pressure, SGA, LGA, macrosomia, GDM, and pre-eclampsia.

Table 4
The rates of onset of spontaneous labor of obese pregnancies in different studies.

	BMI ≥30 kg/m^2	
	Onset of Spontaneous Labor	Scheduled Delivery
Frolova et al. [19]	50.7%	49.3%
Denison et al. [22]	77%	23%
Hermesch et al. [23]	78%	22%
Current study	74.4%	25.6%

BMI:body mass index.

Caderlund et al. [27] reported that obesity frequency increases with increasing age, which supports the significant increase in age in obese pregnancies in the current study. Furthermore, the gravida and parity rates in the current study patients were significantly higher in the obese group, which may also be due to the older age of this group.

Several studies have shown that in obese pregnancies, there is an increase in maternal and neonatal complications [7–10]. Likewise, in the current study, mean systolic-diastolic blood pressure values, infant birth weights, LGA, macrosomia, GDM and pre-eclampsia ratios were significantly higher in obese patients compared to non-obese subjects. Given the increased risks for both mother and fetus, many cases with these complications are delivered with scheduled delivery and induced labor. The rate of scheduled delivery in the current study obese pregnant group, where these complications were higher, was statistically significantly higher than that of the non-obese pregnant group. At the same time, higher doses of oxytocin may be needed during this labor induction in obese pregnancies, resulting in increased maternal and neonatal complications [26].

In a study by Frolova et al. [19], a significant difference was determined between obese and non-obese pregnancies in terms of vaginal delivery (57.3% vs 69%), cesarean delivery (35.6% vs 21.2%) and instrumental vaginal delivery (7% vs9.8%) rates. Unlike the study of Frolova et al. [19], there was no difference between obese and non-obese pregnancies in terms of types of delivery in the current study. In addition, both cesarean delivery and instrumental vaginal delivery rates in obese and non-obese pregnant women were lower than those reported by Frolova et al. [19], while vaginal delivery rates were higher. However, unlike the Frolova et al. [19] study, the current series did not include multiple pregnancies, or pregnant patients with previous uterine (cesarean or myomectomy) or vaginal surgery (cystorectocele repair, prolapse and incontinence surgery), which could have been the reason for the low cesarean delivery and high vaginal delivery rates.

Jura et al. [28] showed that obesity increases with increasing age. Consistent with that finding, the mean age of obese pregnancies was higher than non-obese pregnancies in the current study. Moreover, Zoet et al. [29] reported that the prevalence of obesity increased with increasing parity. Likewise, the gravida and parity rates were higher in obese pregnancies than non-obese pregnancies in the current study.

The results of this prospective study presented here are of a sufficient series of patients in a tertiary -level birth center, and have generated valuable data. The main limitations of this study were the monocentric design and that deliveries were performed by different midwives and physicians; another limitation was that BMI was calculated at term of pregnancy.

Conclusion

In conclusion, the onset of spontaneous labor rates in term obese pregnancies were significantly lower and scheduled delivery rates were significantly higher than in non-obese pregnancies, while some perinatal complications were found to increase. Pregnant women should be informed about the negative effect of obesity at the time of delivery. However, further, more extensive prospective studies are required to better understand this effect of obesity on the onset of spontaneous labor and scheduled delivery rates in term pregnancies.

Declaration of Competing Interest

The authors declare no conflict of interests.

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References

[1] OECD. Health at a Glance 2015. Paris: OECD Publishing; 2015.
[2] World Health Organization. Obesity – situation and trends: global health observatory (GHO)data. http://www.who.int/gho/ncd/risk_factors/obesity_text/en/. [Accessed 30 August 2018].
[3] Erem C. Prevalence of overweight and obesity in Turkey. Int J Endocrinol Metab 2015;8:38–41.
[4] Vitale SG, Laganà AS, Nigro A, La Rosa VL, Rossetti P, Rapisarda AMC, et al. Peroxisome proliferator-activated receptor modulation during metabolic diseases and cancers: master and minions. PPAR Res 2016;2016:6517313. https://doi.org/10.1155/2016/6517313.
[5] Legro RS. Obesity and PCOS: implications for diagnosis and treatment. Semin Reprod Med 2012;30:496–506. https://doi.org/10.1055/s-0032-1328878.
[6] Reyes-Muñoz E, Sathyapalan T, Rossetti P, Shah M, Long M, Buscema M, et al. Polycystic ovary syndrome: implication for drug metabolism on assisted reproductive techniques—a literature review. Adv Ther 2018;35:1805–15. https://doi.org/10.1007/s12325-018-0810-1.
[7] Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. BJOG 2005;112:768–72. https://doi.org/10.1111/j.1471-0528.2004.00546.x.
[8] Heslehurst N, Simpson H, Ells LJ, Rankin J, Wilkinson J, Lang R, et al. The impact of maternal BMI status on pregnancy outcomes with immediate short-term obstetric resource implications: a meta-analysis. Obes Rev 2008;9:635–83. https://doi.org/10.1111/j.1467-789X.2008.00511.x.
[9] Jensen DM, Damm P, Sørensen B, Mølsted-Pedersen L, Westergaard JG, Ovesen P, et al. Pregnancy outcome and prepregnancy body mass index in 2459 glucose-tolerant Danish women. Am J Obstet Gynecol 2003;189:239–44.
[10] Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. Int J Obes Relat Metab Disord 2001;25:1175–82. https://doi.org/10.1038/sj.ijo.0801670.
[11] Salman H, Shah M, Ali A, Aziz A, Vitale SG. Assessment of relationship of serum Neurokinin-B level in the pathophysiology of pre-eclampsia: a case–control study. Adv Ther 2018;35:1114–21. https://doi.org/10.1007/s12325-018-0723-z.
[12] Ellekjaer KL, Bergholt T, Løkkegaard E. Maternal obesity and its effect on labour duration in nulliparous women: a retrospective observational cohort study. BMC Pregnancy Childbirth 2017;17:222. https://doi.org/10.1186/s12884-017-1413-6.

[13] Laganà AS, Vitale SG, Sapia F, Valenti G, Corrado F, Padula F, et al. miRNA expression for early diagnosis of preeclampsia onset: hope or hype? J Matern Fetal Med 2018;31:817–21. https://doi.org/10.1080/14767058.2017.1296426.
[14] Cody F, Unterscheider J, Daly S, Geary MP, Kennelly MM, McAuliffe FM, et al. The effect of maternal obesity on sonographic fetal weight estimation and perinatal outcome in pregnancies complicated by fetal growth restriction. J Clin Ultrasound 2016;44:34–9. https://doi.org/10.1002/jcu.22273.
[15] Pavone D, Clemenza S, Sorbi F, Fambrini M, Petraglia F. Epidemiology and risk factors of uterine fibroids. Best Pract Res Clin Obstet Gynaecol 2018;46:3–11. https://doi.org/10.1016/j.bpobgyn.2017.09.004.
[16] Vitale SG, Padula F, Gulino FA. Management of uterine fibroids in pregnancy: recent trends. Curr Opin Obstet Gynecol 2015;27:432–7. https://doi.org/10.1097/GCO.0000000000000220.
[17] Halloran DR, Cheng YW, Wall TC, Macones GA, Caughey AB. Effect of maternal weight on postterm delivery. J Perinatol 2012;32:85–90. https://doi.org/10.1038/jp.2011.63.
[18] Caughey AB, Stotland NE, Washington AE, Escobar GJ. Who is at risk for prolonged and postterm pregnancy? Am J Obstet Gynecol 2009;200:683.e1–5. https://doi.org/10.1016/j.ajog.2009.02.034.
[19] Frolova AI, Wang JJ, Conner SN, Tuuli MG, Macones GA, Woolfolk CL, et al. Spontaneous labor onset and outcomes in obese women at term. Am J Perinatol 2018;35:59–64. https://doi.org/10.1055/s-0037-1605574.
[20] Vitale SG, Marilli I, Rapisarda AM, Iapichino V, Stancanelli F, Cianci A. Diagnosis, antenatal surveillance and management of prolonged pregnancy: current perspectives. Minerva Ginecol 2015;67:365–73.
[21] Zhang J, Bricker L, Wray S, Quenby S. Poor uterine contractility in obese women. BJOG 2007;114:343–8. https://doi.org/10.1111/j.1471-0528.2006.01233.x.
[22] Denison FC, Price J, Graham C, Wild S, Liston WA. Maternal obesity, length of gestation, risk of postdates pregnancy and spontaneous onset of labour at term. BJOG 2008;115:720–5. https://doi.org/10.1111/j.1471-0528.2008.01694.x.
[23] Hermesch AC, Allshouse AA, Heyborne KD. Body mass index and the spontaneous onset of parturition. Obstet Gynecol 2016;128:1033–8. https://doi.org/10.1097/AOG.0000000000001678.
[24] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61:344–9. https://doi.org/10.1016/j.jclinepi.2007.11.008.
[25] World Health Organization. BMI classification. http://apps.who.int/bmi/index.jsp?introPage=intro_3.html/. [Accessed 30 August 2018].
[26] Roloff K, Peng S, Sanchez-Ramos L, Valenzuela GJ. Cumulative oxytocin dose during induction of labor according to maternal body mass index. Int J Gynaecol Obstet 2015;131:54–8. https://doi.org/10.1016/j.ijgo.2015.04.038.
[27] Cederlund M, Gillberg C. One hundred males with Asperger syndrome: a clinical study of background and associated factors. Dev Med Child Neurol 2004;46:652–60.
[28] Jura M, Kozak P. Obesity and related consequences to ageing. Age 2016;38:23. https://doi.org/10.1007/s11357-016-9884-3.
[29] Zoet GA, Paauw ND, Groenhof K, Franx A, Gansevoort RT, Groen H, et al. Association between parity and persistent weight gain at the age 40-60 years: a longitudinal prospective cohort study. BMJ Open 2019;9:e024279. https://doi.org/10.1136/bmjopen-2018-024279.