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Title: Large fetal weight alone in Robson-1 parturients doesn't translate into a risk of Caesarean delivery higher than that of a vaginal birth

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The authors analysed the Caesarean section rate as a function of birth weight among Robson-1 parturients and compared with that among the unselected obstetric population.

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A retrospective analysis of birth weight, maternal height and the route of delivery was carried out in an unselected obstetric population of 26012 parturients. The authors compared birth weight centile distributions of vaginally, and that of abdominally delivered fetuses between Robson-1 parturients as well as those of the total obstetric population.

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The 90th birth weight centile of fetuses delivered at 37, 38, 39, 40, 41, and 42 weeks gestation were 3960 g, 3960 g, 4000 g, 3950 g, 4000 g and 3820 g, respectively. Among Robson-1 parturients, 677 fetuses weighed >4000 g, and 448 patients (66%) were delivered vaginally. Maternal height did not influence either the birth-weight-percentiles or the Caesarean-rates substantially. Above the birth weight of 4000 g, the Caesarean-rate among Robson-1 parturient rose similarly to that of the total obstetric population. In the knowledge of the most accurately estimated fetal weight, the odds of a Caesarean delivery among Robson-1 parturients was not different from that of the total obstetric population. Among pregnancies with fetuses weighing less than 5000 g, the Caesarean-rate

was below 50% in both Robson-1 parturients and the total obstetric population of 10 years.

Conclusion

Even the best possible estimation of fetal weight cannot give a valid reason to downplay the intent of vaginal birth based on the fetal size above 3900g that would be associated with increased odds of Caesarean delivery.

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The rising Caesarean section rate is one of the most critical issues of contemporary obstetric practice. This trend is not unique in Europe or industrialised countries but also affects the developing world. Professional organisations, as well as governments, declared the reduction of Caesarean section rate as a priority in their programs for the future (1). Factors that can be influenced by obstetricians can be identified only by a meaningful comparison of Caesarean section rates between countries and service providers of individual countries. Comparison of any health-care related variables can be meaningful only if one performs that with a common denominator. Michael Robson developed a practical classification of Caesarean sections which made it possible to compare Caesarean frequencies between different service levels and different populations (2). The Robson's ten-group classification is

1 also suitable for auditing trends within one institution. Several reports confirmed that such  
2 audits could result in the reduction of Caesarean-rate (1). The spread of the use of the  
3 Robson-classification to all continents led WHO to issue a global recommendation in 2015  
4 for the universal introduction of this system (3). Several studies have confirmed that the rise  
5 in Caesarean section rate over the last decades was mainly due to the increase in Caesarean-  
6 rate in Robson #5 and #1 groups (4). Analysis of the rise in Caesarean-rate in Robson-5  
7 deliveries would be too complicated due to the large variety of compound indications and  
8 attitudes. Therefore, we restricted our study to the analysis of relation between birth weight  
9 and Caesarean section in primiparous spontaneously labouring women with singleton  
10 cephalic fetus at term. In the years between 2014 and 2017, obstetricians performed 11%,  
11 12%, 13%, and 13% of Caesarean sections in North-Eastern Hungary (25 thousand deliveries)  
12 with the leading indication of cephalopelvic disproportion, respectively (5). We see in more  
13 and more cases that the attending obstetrician makes notes of the larger than average fetal  
14 size before the onset of labour together with the notion that the chances of a Caesarean  
15 section might be higher. The use of ever improving ultrasound equipments and better  
16 expertise in fetal weight estimation lead obstetricians to the overuse this modality near  
17 term. By documenting the considerable fetal weight, they may raise the subconscious  
18 anxiety in pregnant women which can lead to a reduced threshold of reaction in both the  
19 parturient and her attendants during labour.

20 In this study, we aimed to analyse the relation between birth weight and route of delivery  
21 among Robson-1 parturients and used corresponding data of the total obstetric population  
22 of the same period as a reference.

## 23 Patients and Methods

24 A dedicated database of all deliveries between 2006 and 2015 was designed and built using  
25 the records of the hospital information system and validated manually by cross-checking  
26 with patients' notes. For this single institution retrospective study, we extracted and  
27 analysed composite data of Robson group, birth weight, maternal height, and the route of  
28 delivery. In the case of multiple gestations, we considered the birth weight of the first  
29 delivered fetus in our calculations. We used first-trimester CRL measurement for validation  
30 as wells as for correction of the gestational age at delivery. Distribution of the Robson  
31 groups among the deliveries in the studied period was validated manually by cross-checking  
32 with case-notes and published in another paper (3). Ultrasonography-derived fetal weight  
33 estimation (FWE) without clinical indication was not part of the routine antenatal care, and  
34 we did not attempt to analyse those cases -about 10% of large fetuses- in which FEW was  
35 eventually performed. We generated the birth weight distribution histogram by grouping  
36 our cases and controls into 100 g weight ranges of the birth weights rounded to the nearest  
37 digit of hundreds. We analysed the Caesarean frequency for each 100 g birth weight  
38 intervals for our study populations. Our calculations included a total of 26012 deliveries with  
39 9795 of them classified as Robson's group-1.

40 We defined the large fetus as one having a birth weight above the 90th percentile value of  
41 the studied population. We also determined the 90th percentile birth weight values among  
42 Robson-1 parturients for each gestational week.

43 We generated percentile plots using StatView v.5.0.1 (SAS Institute Inc. 1998) Software. We  
44 described our study populations with means, medians and percentiles. Statistical  
45 significance of the difference between frequencies of categorical variables was assessed by  
46  $\chi^2$ -test and we expressed the magnitude of their relationship with odds ratios and their 95%

confidence intervals. Logistic regression analysis was used to assess the effect of maternal height on the relation between large fetal weight and Caesarean section rate. We set the level of significance at  $p < 0,05$ . The plan and the execution of the study was approved by the local IRB.

## Results

In the total obstetric population of our institution, the 90th percentile of birth weight among vaginally delivered fetuses of the ten years was 3930 g, while that of fetuses delivered by Caesarean section was 3960 g. Figure 1 shows the birth weight distribution of vaginally and abdominally delivered fetuses of Robson-1 parturients. Figure 2 shows the birth weight percentile plots of the two groups. Among Robson-1 deliveries, the 90th percentile of vaginally and abdominally delivered fetuses were 3873 g and 3910 g, respectively.

In the total obstetric population, the gestational age-specific 90th percentile of birth weight at 37, 38, 39, 40, 41, and 42 weeks gestation were 3960 g, 3960 g, 4000 g, 3950 g, 4000 g, and 3820 g, respectively.

Figure 3 shows the birth-weight-specific Caesarean section rate among Robson-1 parturients and in the total obstetric population. In both Robson-1 and the total obstetric populations, we observed the lowest Caesarean section rate in the 100g birth weight range at 3600g (26% and 25%, respectively). Starting from that weight range, increasing birth weight as well as decreasing birth weight was associated with rising Caesarean section rate. Among deliveries with larger fetuses, Caesarean section rate reached 40% at the fetal weight of 4300 g among both Robson-1 parturients and the total obstetric population. The birth weight of 4900 g was associated with a fifty per cent Caesarean section rate in both groups. Therefore, Robson-1 parturient with this fetal weight may expect at least a 50% chance of vaginal delivery.

Two thousand ninety-four cases out of the total obstetric population had a birth weight of 4000g or larger, and 1413 of them were delivered vaginally (64%). Among Robson-1 parturients, 677 women delivered a fetus weighing >4000 g. Four hundred forty-eight (66%) of these parturients delivered their foetuses vaginally (Figure 1).

Caesarean section rate among Robson-1 parturients with a birth weight of >4000 g showed a rise with an increased birth weight similar to that in the total obstetric population (Figure 3). Decreasing birth weight from the nadir of Caesarean section rate (3600g) also showed an increase of Caesarean section rate in both populations with similar extent. Decreasing birth weight reached the 40% Caesarean section rate at 2100 g birth weight.

Supposing perfect accuracy of fetal weight estimation, a primiparous woman with cephalic fetus at term without an indication for labour induction has an odds of requiring Caesarean delivery which is not different from that of the total obstetric population. In the total obstetric population of the studied period, large fetal weight up to 5000 g incurred a less than 50% frequency of Caesarean section rate, and we observed the same association among Robson-1 parturients (Figure 3).

In the total obstetric population, 10th, 50<sup>th</sup>, and 90th percentile of maternal height were 157 cm, 165 cm, and 174 cm, respectively. Logistic regression analysis of the effect of maternal height on the Caesarean section rate among Robson-1 parturients with a fetal weight exceeding 3900 g showed no significant impact ( $p=0.3376$ ). Among the 688 Robson-1 parturients giving birth to a large fetus, the Caesarean section rate of short (<10th height-percentile), average height (10th-90th height-percentile), and tall (>90th height-percentile) women were 27.7%, 35.8%, and 32.7%, respectively (Table 1). The 10th, 50th, and 90th height-percentile of Robson-1 parturients with a large fetus were 156 cm, 165 cm, and 173

1 cm, respectively. The 10th, 50th, and 90th height-percentile of vaginally delivered Robson-1  
2 parturients with a large fetus were 156 cm, 165 cm, and 173 cm, while those of abdominally  
3 delivered counterparts were 158 cm, 165 cm, and 173 cm, respectively (Figure 4).  
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## 5 Discussion

6 Our data shows that even the best possible fetal weight estimation may not substantiate the  
7 notion that an estimated fetal weight exceeding 3900 g (90th percentile) reduces the odds of  
8 vaginal birth in comparison to that of the total obstetric population.  
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10 The epidemic level of Caesarean section frequency require urgent steps to reduce the  
11 number of unnecessary abdominal deliveries. It is of crucial importance to implement those  
12 tools which proved to be effective in promoting safe, natural birth among low-risk  
13 primiparous women with singleton cephalic fetus at term in spontaneous labour (6). These  
14 strategies include avoiding early admission to the delivery room, prevention of false  
15 diagnosis of dystocia, reduction of unnecessary inductions and oxytocin augmentation,  
16 extensive antenatal education of the pregnant woman and her partner, midwifery-led  
17 obstetric care for low-risk pregnant women, family-centred labour environment, and  
18 individualised management of labour-pain with the provision of full mobility. It is also of  
19 critical importance to show ample self-restraint in evaluating signs of fetal heart-rate  
20 abnormalities and dystocia during labour. The prevention of unnecessary interventions is the  
21 key to reduce the frequency of Caesareans performed on parturients with a previous  
22 Caesarean (6).  
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28 Tolba et al. confirmed in a double-blind randomised study that the use of “labour-scale”  
29 during spontaneous labour of low-risk primiparous women with an estimated fetal weight  
30 between 2500 and 3800 g results in significantly lower Caesarean-rate than the use of the  
31 traditional WHO-partogram (3.6% vs 18.2%,  $p=0.03$ ) (7). The authors suggested that  
32 graphical depiction of labour progress should be avoided before 5cm cervical dilation  
33 because it leads to the unsubstantiated diagnosis of dystocia in a significant proportion of  
34 cases (7). The role perceived dystocia, and relative cephalopelvic disproportion is identifiable  
35 in the rising trend of Caesarean section rate of our institution too (5). The suboptimal  
36 antenatal education of pregnant women poses a barrier in eliminating the subjectivity of  
37 labour assessment. Results of our study confirm that the odds of vaginal delivery of a  
38 spontaneously labouring primiparous women with a large singleton cephalic fetus at term is  
39 not worse than that of the total obstetric population with the large fetus.  
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45 Authors of an Australian study on 38 thousand deliveries of primiparous women found that  
46 the risk of Caesarean delivery is not increased among cases with a large fetus when they did  
47 not correct the definition of the large fetus for maternal height (8). However, the risk of  
48 Caesarean delivery was 4.64 times higher among primiparous women when they used the  
49 maternal-height corrected 90th percentile of fetal weight as the definition of a large fetus  
50 (8). In our study, maternal height did not influence the odds of a Caesarean delivery  
51 significantly. Among 688 Robson-1 parturients with a fetus weighing >3900 g, short, medium  
52 and tall women had a Caesarean rate of 27.7%, 35.8%, and 32.7%, respectively. Surprisingly,  
53 short primiparous women with a large fetus had a lower than average Caesarean-rate.  
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58 Salahuddin et al. analysed the risk factors of Caesarean delivery among 114 thousand  
59 singleton cephalic primiparous deliveries that occurred in the state of Texas in 2015 (9). The  
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1 Caesarean rate of this population (Robson-1 and Robson-2 parturients) was 27%. Among the  
2 analysed factors (age, race, education level, type of insurance, gestational diabetes, chronic  
3 hypertension, gestational hypertension, eclampsia, infertility, smoking, prepregnancy  
4 weight, gestational weight gain, and adequacy of antenatal care) obesity was the most  
5 prevalent (42%). The relative risk of Caesarean delivery in the presence of one, two, or three  
6 risk factors was 1.72, 2.58, and 3.91, respectively (9). In our study, we did not analyse risk  
7 factors beyond fetal weight because complications that indicate Caesarean delivery during  
8 established labour do not give a reason for concern and classical obstetric indications are  
9 usually not a subject for criticism in Hungary.  
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12 Cheng et al. studied the effect of labour induction for suspected macrosomia on Caesarean  
13 frequency and neonatal outcome among 132 thousand primiparous term deliveries (10). The  
14 authors selected their study subjects from all deliveries that occurred in the United States in  
15 2003. Subjects of the retrospective study included 10381 parturients having induced and  
16 32042 women having spontaneous deliveries at >39 weeks gestation with a cephalic fetus  
17 weighing between 3850 g and 4150 g. With the hypothesised weekly fetal weight gain of 200  
18 g, they analysed deliveries of newborns delivered by 40 weeks weighing between 4075 g and  
19 4325 g, and those delivered by 41 weeks weighing between 4275 g and 4525 g. In the 40-  
20 weeks cohort, there were 10119 induced and 14245 spontaneous labour. In the 41-weeks  
21 cohort, there were 5722 induced and 3509 spontaneous labour. The Caesarean frequency of  
22 induced vs spontaneous labours in the 39-weeks, 40-week and 41-weeks cohorts were  
23 35.2% vs 40.9%, 36.1% vs 40.6%, and 38.9% vs 41.8%, respectively. The difference in  
24 Caesarean frequency was statistically different in all three cohorts. Taking Caesarean rates of  
25 the induced groups as a reference, the 39-weeks, 40-weeks, and 41-weeks cohorts of  
26 expectative management had significantly higher relative risks of Caesarean section (RR  
27 1.25, 1.31, and 1.16, respectively). Five-minutes Apgar-score below 7 occurred with a  
28 significantly higher frequency only in the expectative managed 40-weeks cohort (RR=1,75),  
29 while birth injuries were significantly more frequent only in the expectative managed 41-  
30 weeks cohort (RR=1,15). The authors concluded that labour induction for macrosomia  
31 reduces Caesarean frequency as wells as neonatal morbidity (10). However, the lack of  
32 controlling for factors that could influence the decision for induction may restrict the  
33 generalisability of these results. The most important ones of such factors include associated  
34 maternal illnesses and disorders, maternal biometry, and cervical status. A further weakness  
35 of this study is that it excluded subjects with a fetal weight outside the predefined weight-  
36 range from the analysis. Drawing an upper limit of fetal weight among pregnancies with fetal  
37 macrosomia means that the cases, as well as the controls, do not represent the entire  
38 population. Since our study analysed only spontaneous labouring women, we could not  
39 study the beneficial effect of induction on the Caesarean section rate.  
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41 Our results showed in the case of larger fetuses, the Caesarean section rate reached the 40%  
42 frequency at 4300 g-os birthweights both in Robson-1 parturients and in the total obstetric  
43 population. Even in the group of deliveries with a fetal weight of 4900 g, the Caesarean rate  
44 was 50% among both Robson-1 parturients and the total obstetric population.  
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46 Fetal weight estimation near term is not a necessary element of antenatal care of low-risk  
47 women in Hungary (11). Undoubtedly, it may provide valuable additional information for  
48 caregivers in the presence of specific indications (e.g. lack of engagement at term, history of  
49 shoulder dystocia, discordant growth of twins). For plain curiosity, in the absence of a  
50 professional indication, fetal weight estimation of a well-grown fetus may result in the rise of  
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1 anxiety and the loss of expectation and confidence in natural birth. The American College of  
2 Obstetricians and Gynaecologists highlighted in its Practice Bulletin #173 that pregnant  
3 women with suspected fetal macrosomia should be provided individualized counseling  
4 about the risks and benefits of vaginal and Caesarean delivery based on the degree of  
5 macrosomia. (12). The Bulletin's list of recommendations ends with the suggestion that  
6 suspected macrosomia alone should not preclude the possibility of a TOLAC. We believe,  
7 that in the lack of appropriate cases-control and randomised studies in the literature,  
8 individual obstetric units could provide the most appropriate counseling by gathering best  
9 possible evidence from their own practice.  
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11 In conclusion, our data prove that even the best possible estimation of fetal weight cannot  
12 give a valid reason to downplay the intent of vaginal birth based on the fetal size above  
13 3900g that would be associated with increased odds of Caesarean delivery. Thorough  
14 physical assessment (station, engagement, lack of prominentia, maternal weight and height,  
15 pelvic biometry, Bishop-score, maternal and fetal functional test results) of primiparous  
16 women with an estimated fetal weight above the 90th percentile should include correct  
17 patient information about the chances of vaginal delivery.  
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Figure 1. Distribution of birth-weight of abdominally and vaginally delivered fetuses in Robson-1 population

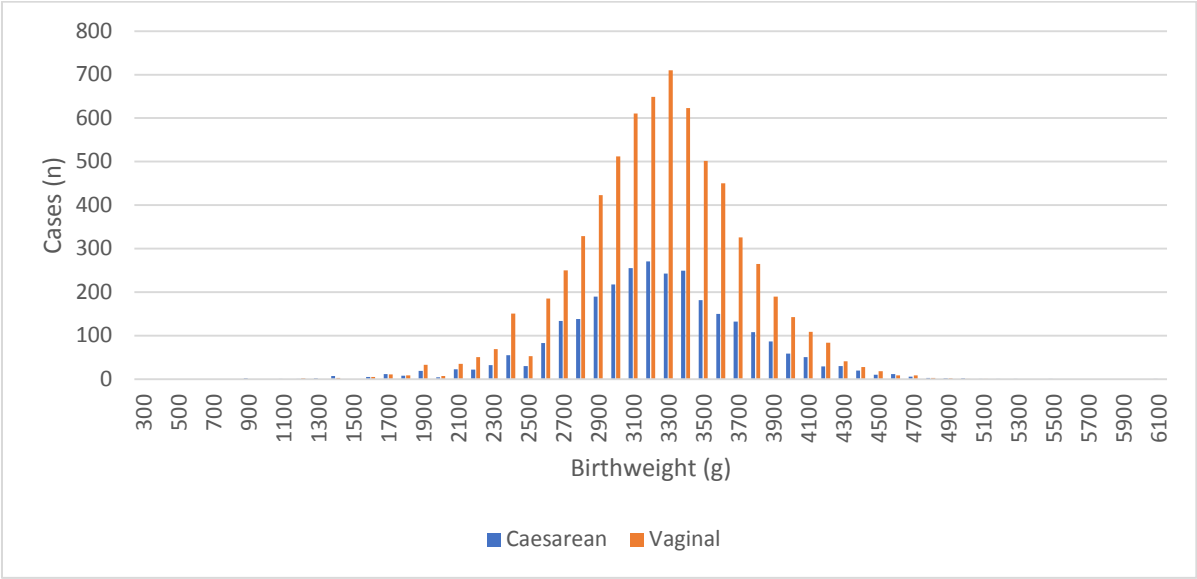


Figure 2. Percentile plots of abdominally and vaginally delivered fetuses in Robson-1 population

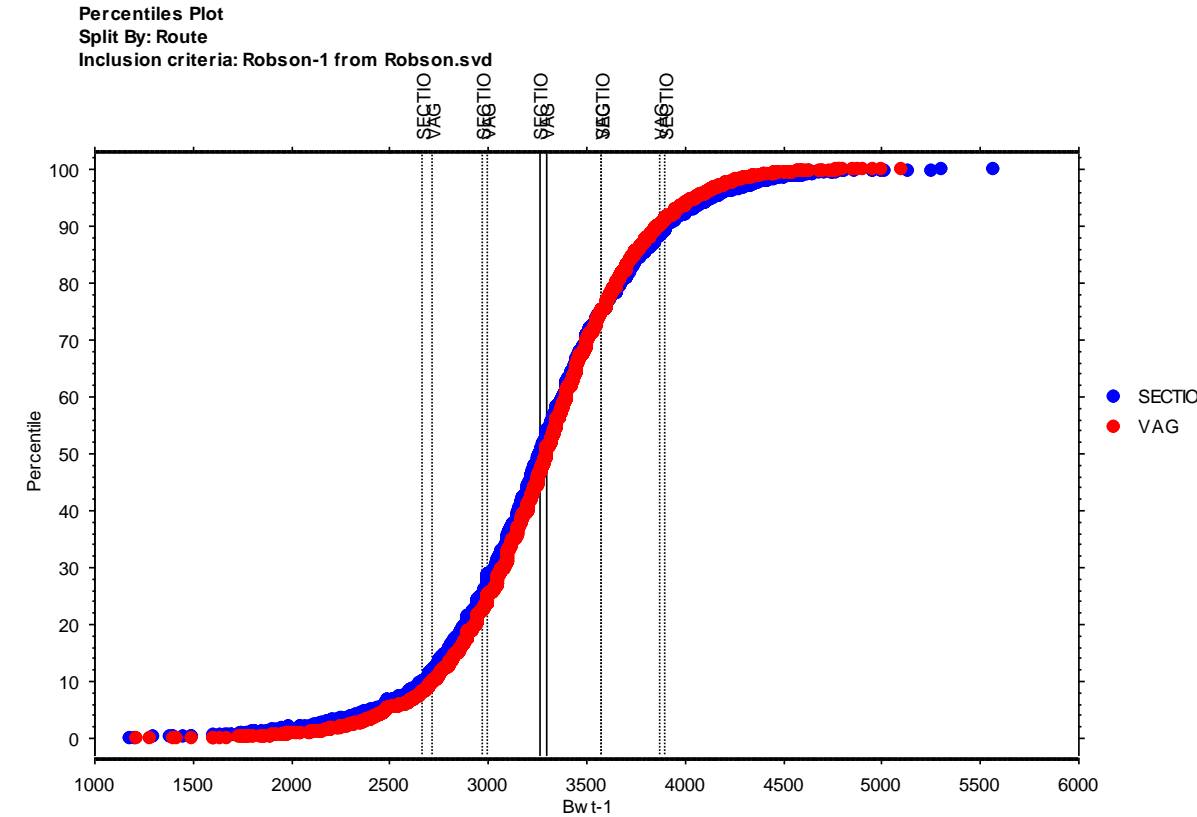


Figure 3. Caesarean-frequency as a function of birthweight in the total obstetric population (26012) and among Robson-1 parturients (9795)

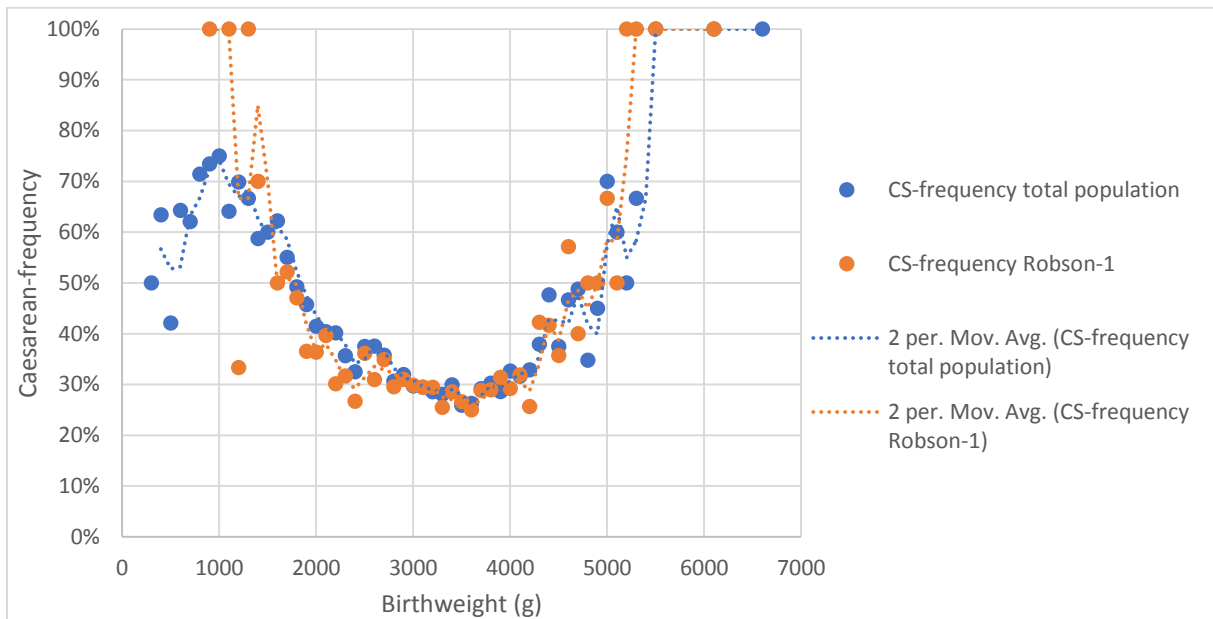
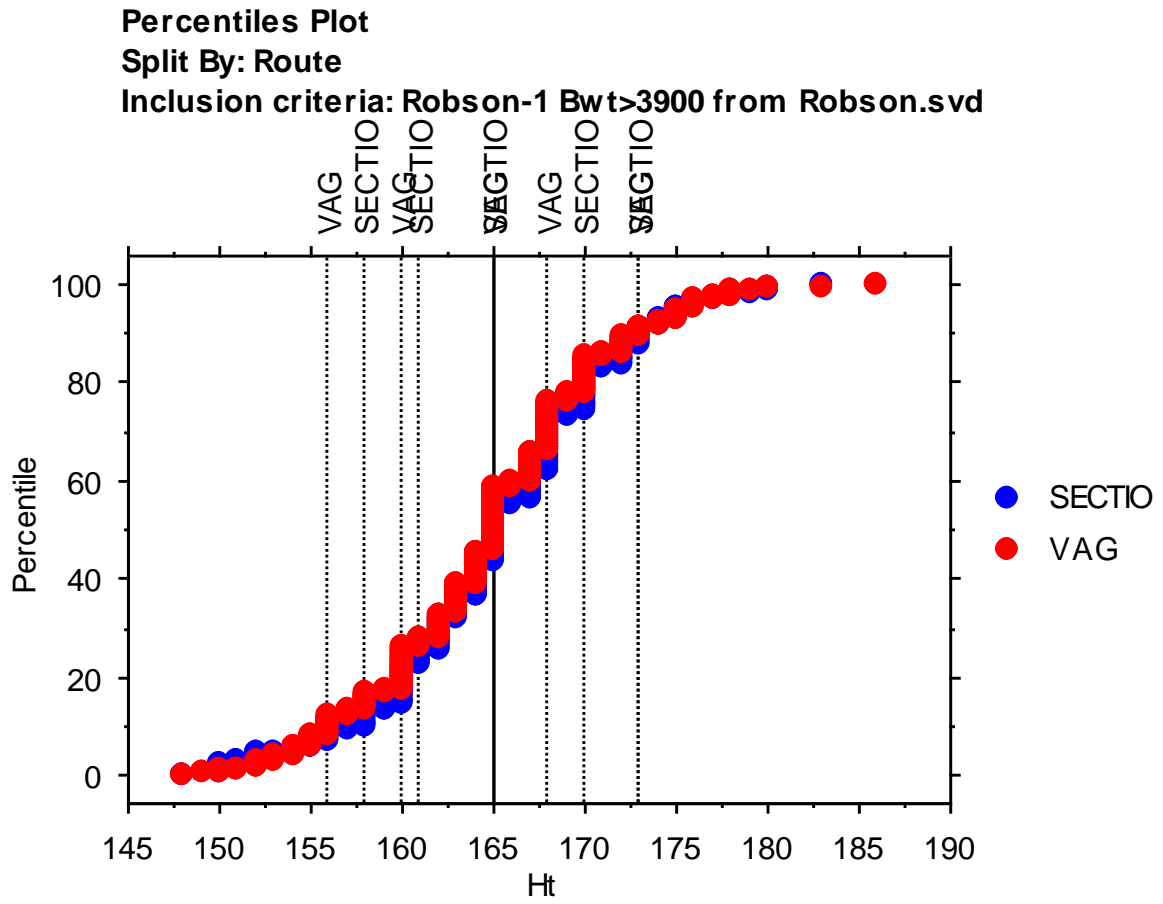


Table 1. Route of delivery among short, medium and tall parturients with a fetus weighing  $\geq 3900$  g in Robson-1 population

Route of delivery	Maternal height			Total
	Short	Medium	Tall	
Vaginal (n)	60	357	33	450
Caesarean section (n)	23	199	16	238
Total (n)	83	556	49	688
Caesarean-frequency	27.7%	35.8%	32.7%	34.6%

Figure 4. Percentile plots of maternal height among abdominally and vaginally delivered fetuses weighing  $\geq 3900$  g among Robson-1 parturients



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Figure 1. Distribution of birth-weight of abdominally and vaginally delivered fetuses in Robson-1 population

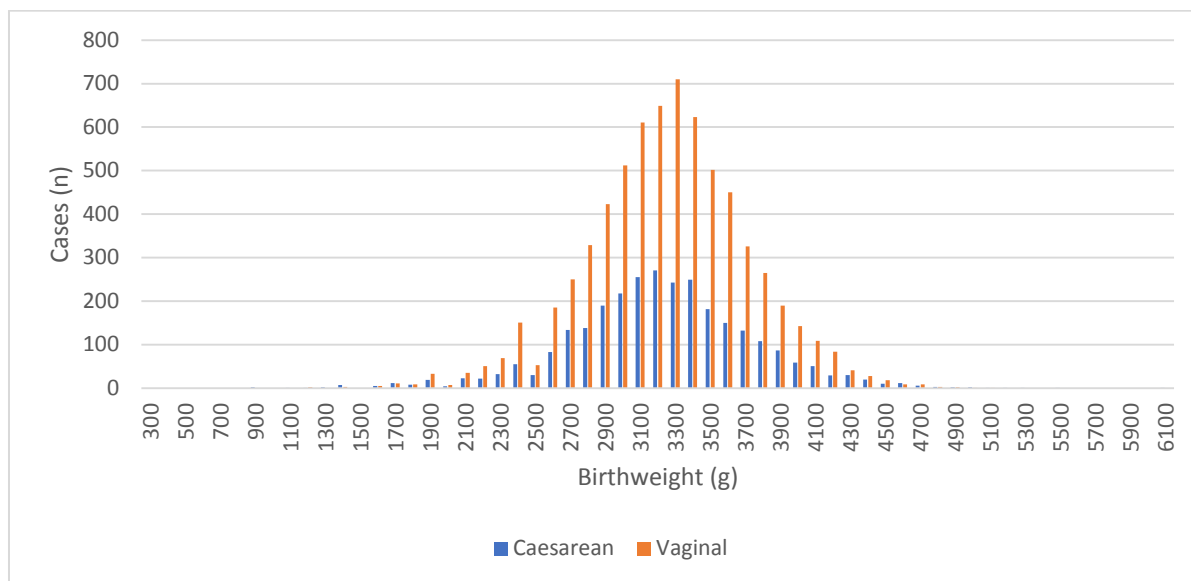


Figure 2. Percentile plots of abdominally and vaginally delivered fetuses in Robson-1 population

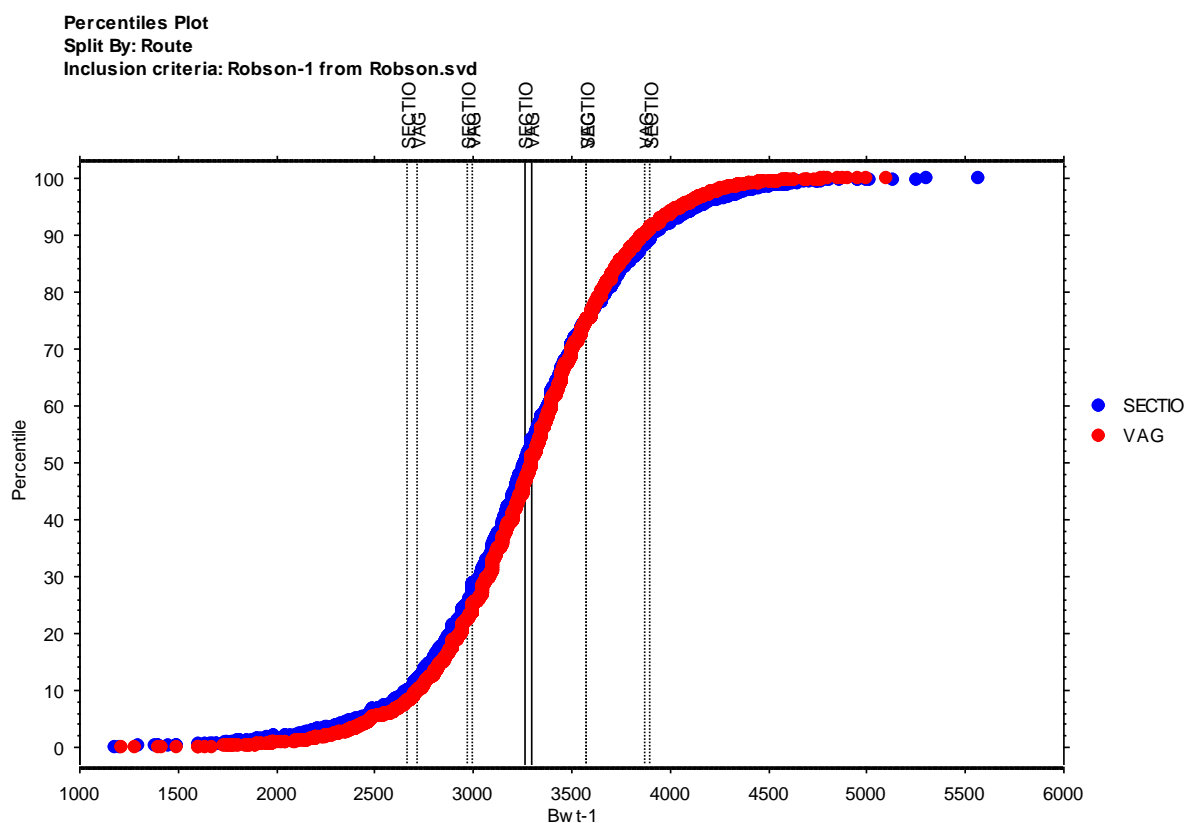


Figure 3. Caesarean-frequency as a function of birthweight in the total obstetric population (26012) and among Robson-1 parturients (9795)

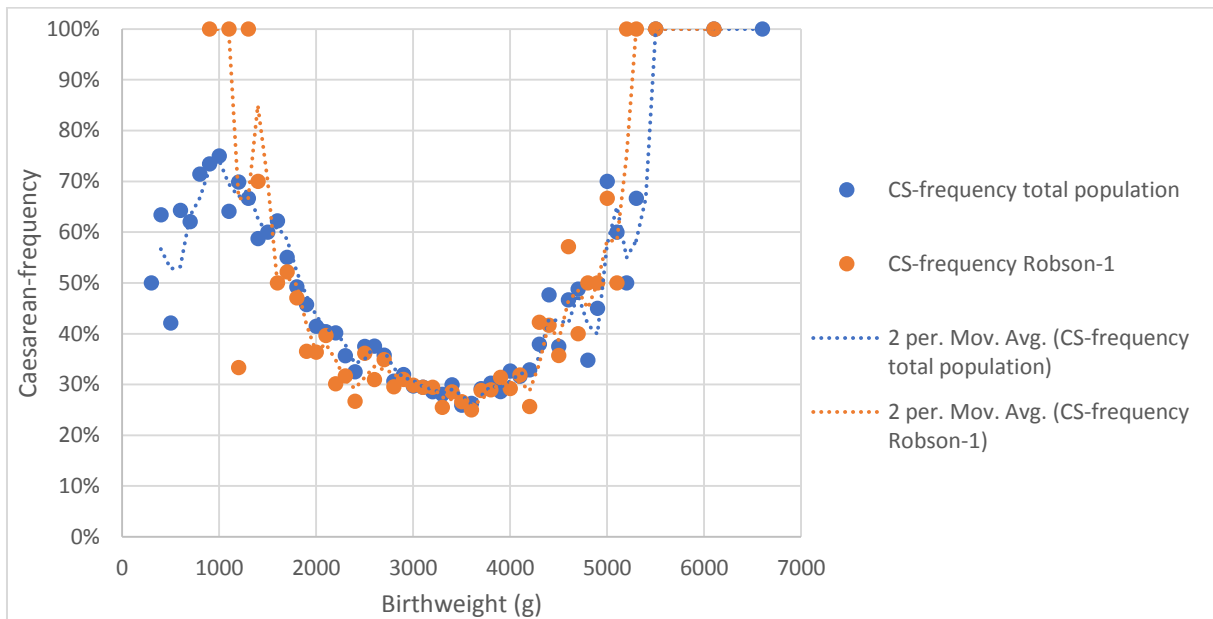
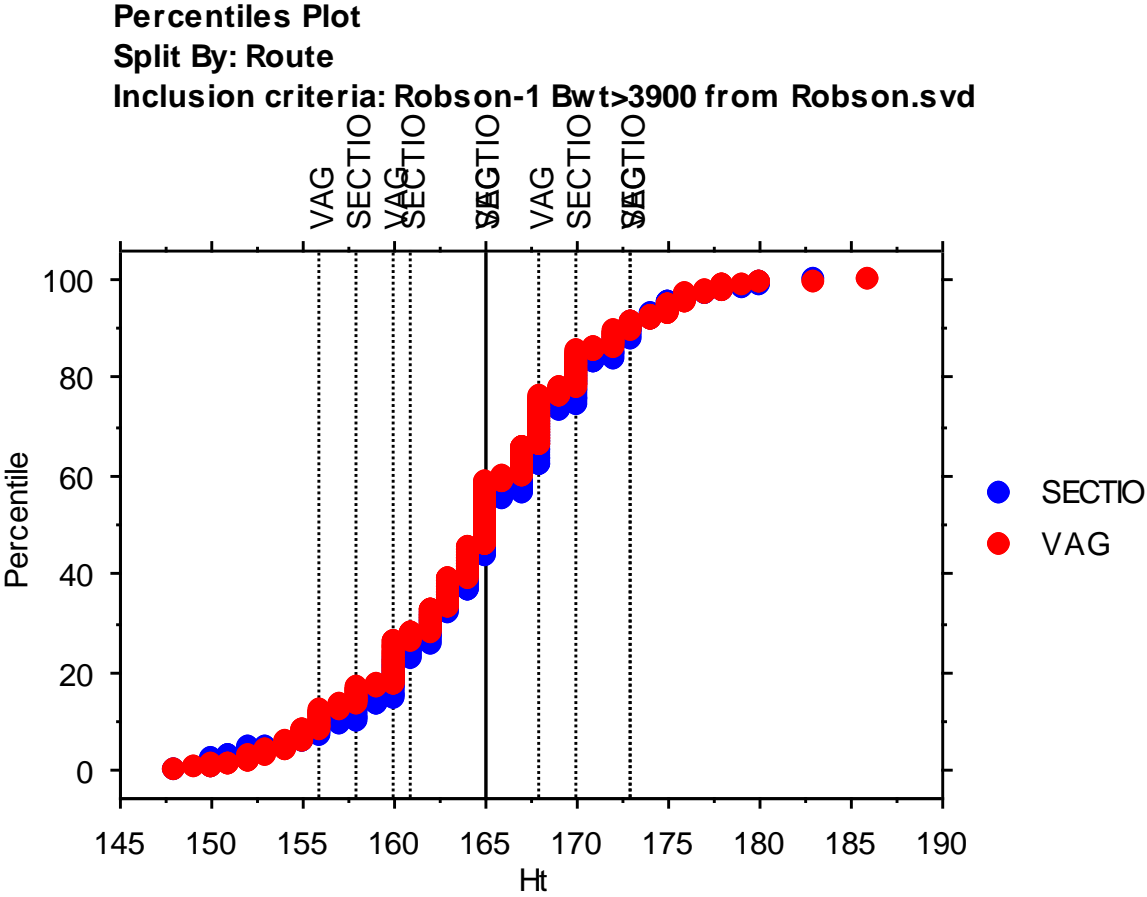


Table 1. Route of delivery among short, medium and tall parturients with a fetus weighing  $\geq 3900$  g in Robson-1 population

Route of delivery	Maternal height			Total
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Vaginal (n)	60	357	33	450
Caesarean section (n)	23	199	16	238
Total (n)	83	556	49	688
Caesarean-frequency	27.7%	35.8%	32.7%	34.6%

Figure 4. Percentile plots of maternal height among abdominally and vaginally delivered fetuses weighing  $\geq 3900$  g among Robson-1 parturients





To the Editor

This is to confirm that our submission entitled „Large fetal weight alone in Robson-1 parturients doesn't translate into a risk of Caesarean delivery higher than that of a vaginal birth” has no potential conflicts of interests.

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## Large fetal weight alone in Robson-1 parturients doesn't translate into a risk of Caesarean delivery higher than that of a vaginal birth

### Summary

#### Objective

The authors analysed the Caesarean section rate as a function of birth weight among Robson-1 parturients and compared with that among the unselected obstetric population.

#### Study design

A retrospective analysis of birth weight, maternal height and the route of delivery was carried out in an unselected obstetric population of 26012 parturients. The authors compared birth weight centile distributions of vaginally, and that of abdominally delivered fetuses between Robson-1 parturients as well as those of the total obstetric population.

#### Results

The 90th birth weight centile of fetuses delivered at 37, 38, 39, 40, 41, and 42 weeks gestation were 3960 g, 3960 g, 4000 g, 3950 g, 4000 g and 3820 g, respectively. Among Robson-1 parturients, 677 fetuses weighed >4000 g, and 448 patients (66%) were delivered vaginally. Maternal height did not influence either the birth-weight-percentiles or the Caesarean-rates substantially. Above the birth weight of 4000 g, the Caesarean-rate among Robson-1 parturient rose similarly to that of the total obstetric population. In the knowledge of the most accurately estimated fetal weight, the odds of Caesarean delivery among Robson-1 parturients was not different from that of the total obstetric population. Among pregnancies with fetuses weighing less than 5000 g, the Caesarean-rate was below 50% in both Robson-1 parturients and the total obstetric population of 10 years.

#### Conclusion

Even the best possible estimation of fetal weight cannot give a valid reason to downplay the intent of vaginal birth based on the fetal size above 3900g that would be associated with increased odds of Caesarean delivery.

Keywords: birthweight, Caesarean section, large fetus

The rising Caesarean section rate is one of the most critical issues of contemporary obstetric practice. This trend is not unique in Europe or industrialised countries but also affects the developing world. Professional organisations, as well as governments, declared the reduction of Caesarean section rate as a priority in their programs for the future (1). Factors that can be influenced by obstetricians can be identified only by a meaningful comparison of Caesarean section rates between countries and service providers of individual countries. Comparison of any health-care related variables can be meaningful only if one performs that with a common denominator. Michael Robson developed a practical classification of Caesarean sections which made it possible to compare Caesarean frequencies between different service levels and different populations (2). The Robson's ten-group classification is

also suitable for auditing trends within one institution. Several reports confirmed that such audits could result in the reduction of Caesarean-rate (1). The spread of the use of the Robson-classification to all continents led WHO to issue a global recommendation in 2015 for the universal introduction of this system (3). Several studies have confirmed that the rise in Caesarean section rate over the last decades was mainly due to the increase in Caesarean-rate in Robson #5 and #1 groups (4). Analysis of the rise in Caesarean-rate in Robson-5 deliveries would be too complicated due to the large variety of compound indications and attitudes. Therefore, we restricted our study to the analysis of relation between birth weight and Caesarean section in primiparous spontaneously labouring women with singleton cephalic fetus at term. In the years between 2014 and 2017, obstetricians performed 11%, 12%, 13%, and 13% of Caesarean sections in North-Eastern Hungary (25 thousand deliveries) with the leading indication of cephalopelvic disproportion, respectively (5). We see in more and more cases that the attending obstetrician makes notes of the larger than average fetal size before the onset of labour together with the notion that the chances of a Caesarean section might be higher. The use of ever improving ultrasound equipments and better expertise in fetal weight estimation lead obstetricians to the overuse this modality near term. By documenting the considerable fetal weight, they may raise the subconscious anxiety in pregnant women which can lead to a reduced threshold of reaction in both the parturient and her attendants during labour.

In this study, we aimed to analyse the relation between birth weight and route of delivery among Robson-1 parturients and used corresponding data of the total obstetric population of the same period as a reference.

## Patients and Methods

A dedicated database of all deliveries between 2006 and 2015 was designed and built using the records of the hospital information system and validated manually by cross-checking with patients' notes. For this single institution retrospective study, we extracted and analysed composite data of Robson group, birth weight, maternal height, and the route of delivery. In the case of multiple gestations, we considered the birth weight of the first delivered fetus in our calculations. We used first-trimester CRL measurement for validation as well as for correction of the gestational age at delivery. Distribution of the Robson groups among the deliveries in the studied period was validated manually by cross-checking with case-notes and published in another paper (3). Ultrasonography-derived fetal weight estimation (FWE) without clinical indication was not part of the routine antenatal care, and we did not attempt to analyse those cases -about 10% of large fetuses- in which FEW was eventually performed. We generated the birth weight distribution histogram by grouping our cases and controls into 100 g weight ranges of the birth weights rounded to the nearest digit of hundreds. We analysed the Caesarean frequency for each 100 g birth weight intervals for our study populations. Our calculations included a total of 26012 deliveries with 9795 of them classified as Robson's group-1.

We defined the large fetus as one having a birth weight above the 90th percentile value of the studied population. We also determined the 90th percentile birth weight values among Robson-1 parturients for each gestational week.

We generated percentile plots using StatView v.5.0.1 (SAS Institute Inc. 1998) Software. We described our study populations with means, medians and percentiles. Statistical significance of the difference between frequencies of categorical variables was assessed by  $\chi^2$ -test and we expressed the magnitude of their relationship with odds ratios and their 95%

confidence intervals. Logistic regression analysis was used to assess the effect of maternal height on the relation between large fetal weight and Caesarean section rate. We set the level of significance at  $p < 0,05$ . The plan and the execution of the study was approved by the local IRB.

## Results

In the total obstetric population of our institution, the 90th percentile of birth weight among vaginally delivered fetuses of the ten years was 3930 g, while that of fetuses delivered by Caesarean section was 3960 g. Figure 1 shows the birth weight distribution of vaginally and abdominally delivered fetuses of Robson-1 parturients. Figure 2 shows the birth weight percentile plots of the two groups. Among Robson-1 deliveries, the 90th percentile of vaginally and abdominally delivered fetuses were 3873 g and 3910 g, respectively.

In the total obstetric population, the gestational age-specific 90th percentile of birth weight at 37, 38, 39, 40, 41, and 42 weeks gestation were 3960 g, 3960 g, 4000 g, 3950 g, 4000 g, and 3820 g, respectively.

Figure 3 shows the birth-weight-specific Caesarean section rate among Robson-1 parturients and in the total obstetric population. In both Robson-1 and the total obstetric populations, we observed the lowest Caesarean section rate in the 100g birth weight range at 3600g (26% and 25%, respectively). Starting from that weight range, increasing birth weight as well as decreasing birth weight was associated with rising Caesarean section rate. Among deliveries with larger fetuses, Caesarean section rate reached 40% at the fetal weight of 4300 g among both Robson-1 parturients and the total obstetric population. The birth weight of 4900 g was associated with a fifty per cent Caesarean section rate in both groups. Therefore, Robson-1 parturient with this fetal weight may expect at least a 50% chance of vaginal delivery.

Two thousand ninety-four cases out of the total obstetric population had a birth weight of 4000g or larger, and 1413 of them were delivered vaginally (64%). Among Robson-1 parturients, 677 women delivered a fetus weighing >4000 g. Four hundred forty-eight (66%) of these parturients delivered their foetuses vaginally (Figure 1).

Caesarean section rate among Robson-1 parturients with a birth weight of >4000 g showed a rise with an increased birth weight similar to that in the total obstetric population (Figure 3). Decreasing birth weight from the nadir of Caesarean section rate (3600g) also showed an increase of Caesarean section rate in both populations with similar extent. Decreasing birth weight reached the 40% Caesarean section rate at 2100 g birth weight.

Supposing perfect accuracy of fetal weight estimation, a primiparous woman with cephalic fetus at term without an indication for labour induction has an odds of requiring Caesarean delivery which is not different from that of the total obstetric population. In the total obstetric population of the studied period, large fetal weight up to 5000 g incurred a less than 50% frequency of Caesarean section rate, and we observed the same association among Robson-1 parturients (Figure 3).

In the total obstetric population, 10th, 50<sup>th</sup>, and 90th percentile of maternal height were 157 cm, 165 cm, and 174 cm, respectively. Logistic regression analysis of the effect of maternal height on the Caesarean section rate among Robson-1 parturients with a fetal weight exceeding 3900 g showed no significant impact ( $p=0.3376$ ). Among the 688 Robson-1 parturients giving birth to a large fetus, the Caesarean section rate of short (<10th height-percentile), average height (10th-90th height-percentile), and tall (>90th height-percentile) women were 27.7%, 35.8%, and 32.7%, respectively (Table 1). The 10th, 50th, and 90th height-percentile of Robson-1 parturients with a large fetus were 156 cm, 165 cm, and 173

cm, respectively. The 10th, 50th, and 90th height-percentile of vaginally delivered Robson-1 parturients with a large fetus were 156 cm, 165 cm, and 173 cm, while those of abdominally delivered counterparts were 158 cm, 165 cm, and 173 cm, respectively (Figure 4).

## Discussion

Our data shows that even the best possible fetal weight estimation may not substantiate the notion that an estimated fetal weight exceeding 3900 g (90th percentile) reduces the odds of vaginal birth in comparison to that of the total obstetric population.

The epidemic level of Caesarean section frequency require urgent steps to reduce the number of unnecessary abdominal deliveries. It is of crucial importance to implement those tools which proved to be effective in promoting safe, natural birth among low-risk primiparous women with singleton cephalic fetus at term in spontaneous labour (6). These strategies include avoiding early admission to the delivery room, prevention of false diagnosis of dystocia, reduction of unnecessary inductions and oxytocin augmentation, extensive antenatal education of the pregnant woman and her partner, midwifery-led obstetric care for low-risk pregnant women, family-centred labour environment, and individualised management of labour-pain with the provision of full mobility. It is also of critical importance to show ample self-restraint in evaluating signs of fetal heart-rate abnormalities and dystocia during labour. The prevention of unnecessary interventions is the key to reduce the frequency of Caesareans performed on parturients with a previous Caesarean (6).

Tolba et al. confirmed in a double-blind randomised study that the use of “labour-scale” during spontaneous labour of low-risk primiparous women with an estimated fetal weight between 2500 and 3800 g results in significantly lower Caesarean-rate than the use of the traditional WHO-partogram (3.6% vs 18.2%,  $p=0.03$ ) (7). The authors suggested that graphical depiction of labour progress should be avoided before 5cm cervical dilation because it leads to the unsubstantiated diagnosis of dystocia in a significant proportion of cases (7). The role perceived dystocia, and relative cephalopelvic disproportion is identifiable in the rising trend of Caesarean section rate of our institution too (5). The suboptimal antenatal education of pregnant women poses a barrier in eliminating the subjectivity of labour assessment. Results of our study confirm that the odds of vaginal delivery of a spontaneously labouring primiparous women with a large singleton cephalic fetus at term is not worse than that of the total obstetric population with the large fetus.

Authors of an Australian study on 38 thousand deliveries of primiparous women found that the risk of Caesarean delivery is not increased among cases with a large fetus when they did not correct the definition of the large fetus for maternal height (8). However, the risk of Caesarean delivery was 4.64 times higher among primiparous women when they used the maternal-height corrected 90th percentile of fetal weight as the definition of a large fetus (8). In our study, maternal height did not influence the odds of a Caesarean delivery significantly. Among 688 Robson-1 parturients with a fetus weighing >3900 g, short, medium and tall women had a Caesarean rate of 27.7%, 35.8%, and 32.7%, respectively. Surprisingly, short primiparous women with a large fetus had a lower than average Caesarean-rate.

Salahuddin et al. analysed the risk factors of Caesarean delivery among 114 thousand singleton cephalic primiparous deliveries that occurred in the state of Texas in 2015 (9). The

Caesarean rate of this population (Robson-1 and Robson-2 parturients) was 27%. Among the analysed factors (age, race, education level, type of insurance, gestational diabetes, chronic hypertension, gestational hypertension, eclampsia, infertility, smoking, prepregnancy weight, gestational weight gain, and adequacy of antenatal care) obesity was the most prevalent (42%). The relative risk of Caesarean delivery in the presence of one, two, or three risk factors was 1.72, 2.58, and 3.91, respectively (9). In our study, we did not analyse risk factors beyond fetal weight because complications that indicate Caesarean delivery during established labour do not give a reason for concern and classical obstetric indications are usually not a subject for criticism in Hungary.

Cheng et al. studied the effect of labour induction for suspected macrosomia on Caesarean frequency and neonatal outcome among 132 thousand primiparous term deliveries (10). The authors selected their study subjects from all deliveries that occurred in the United States in 2003. Subjects of the retrospective study included 10381 parturients having induced and 32042 women having spontaneous deliveries at >39 weeks gestation with a cephalic fetus weighing between 3850 g and 4150 g. With the hypothesised weekly fetal weight gain of 200 g, they analysed deliveries of newborns delivered by 40 weeks weighing between 4075 g and 4325 g, and those delivered by 41 weeks weighing between 4275 g and 4525 g. In the 40-weeks cohort, there were 10119 induced and 14245 spontaneous labour. In the 41-weeks cohort, there were 5722 induced and 3509 spontaneous labour. The Caesarean frequency of induced vs spontaneous labours in the 39-weeks, 40-week and 41-weeks cohorts were 35.2% vs 40.9%, 36.1% vs 40.6%, and 38.9% vs 41.8%, respectively. The difference in Caesarean frequency was statistically different in all three cohorts. Taking Caesarean rates of the induced groups as a reference, the 39-weeks, 40-weeks, and 41-weeks cohorts of expectative management had significantly higher relative risks of Caesarean section (RR 1.25, 1.31, and 1.16, respectively). Five-minutes Apgar-score below 7 occurred with a significantly higher frequency only in the expectative managed 40-weeks cohort (RR=1,75), while birth injuries were significantly more frequent only in the expectative managed 41-weeks cohort (RR=1,15). The authors concluded that labour induction for macrosomia reduces Caesarean frequency as well as neonatal morbidity (10). However, the lack of controlling for factors that could influence the decision for induction may restrict the generalisability of these results. The most important ones of such factors include associated maternal illnesses and disorders, maternal biometry, and cervical status. A further weakness of this study is that it excluded subjects with a fetal weight outside the predefined weight-range from the analysis. Drawing an upper limit of fetal weight among pregnancies with fetal macrosomia means that the cases, as well as the controls, do not represent the entire population. Since our study analysed only spontaneous labouring women, we could not study the beneficial effect of induction on the Caesarean section rate.

Our results showed in the case of larger fetuses, the Caesarean section rate reached the 40% frequency at 4300 g-os birthweights both in Robson-1 parturients and in the total obstetric population. Even in the group of deliveries with a fetal weight of 4900 g, the Caesarean rate was 50% among both Robson-1 parturients and the total obstetric population.

Fetal weight estimation near term is not a necessary element of antenatal care of low-risk women in Hungary (11). Undoubtedly, it may provide valuable additional information for caregivers in the presence of specific indications (e.g. lack of engagement at term, history of shoulder dystocia, discordant growth of twins). For plain curiosity, in the absence of a professional indication, fetal weight estimation of a well-grown fetus may result in the rise of

anxiety and the loss of expectation and confidence in natural birth. The American College of Obstetricians and Gynaecologists highlighted in its Practice Bulletin #173 that pregnant women with suspected fetal macrosomia should be provided individualized counseling about the risks and benefits of vaginal and Caesarean delivery based on the degree of macrosomia. (12). The Bulletin's list of recommendations ends with the suggestion that suspected macrosomia alone should not preclude the possibility of a TOLAC. We believe, that in the lack of appropriate cases-control and randomised studies in the literature, individual obstetric units could provide the most appropriate counseling by gathering best possible evidence from their own practice.

In conclusion, our data prove that even the best possible estimation of fetal weight cannot give a valid reason to downplay the intent of vaginal birth based on the fetal size above 3900g that would be associated with increased odds of Caesarean delivery. Thorough physical assessment (station, engagement, lack of prominentia, maternal weight and height, pelvic biometry, Bishop-score, maternal and fetal functional test results) of primiparous women with an estimated fetal weight above the 90th percentile should include correct patient information about the chances of vaginal delivery.

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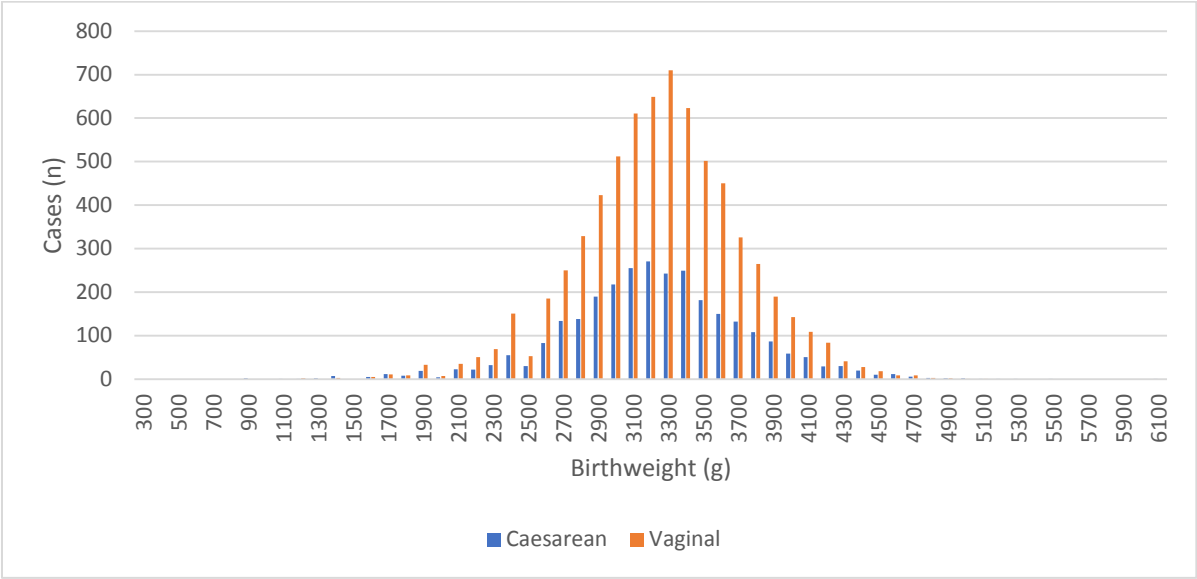


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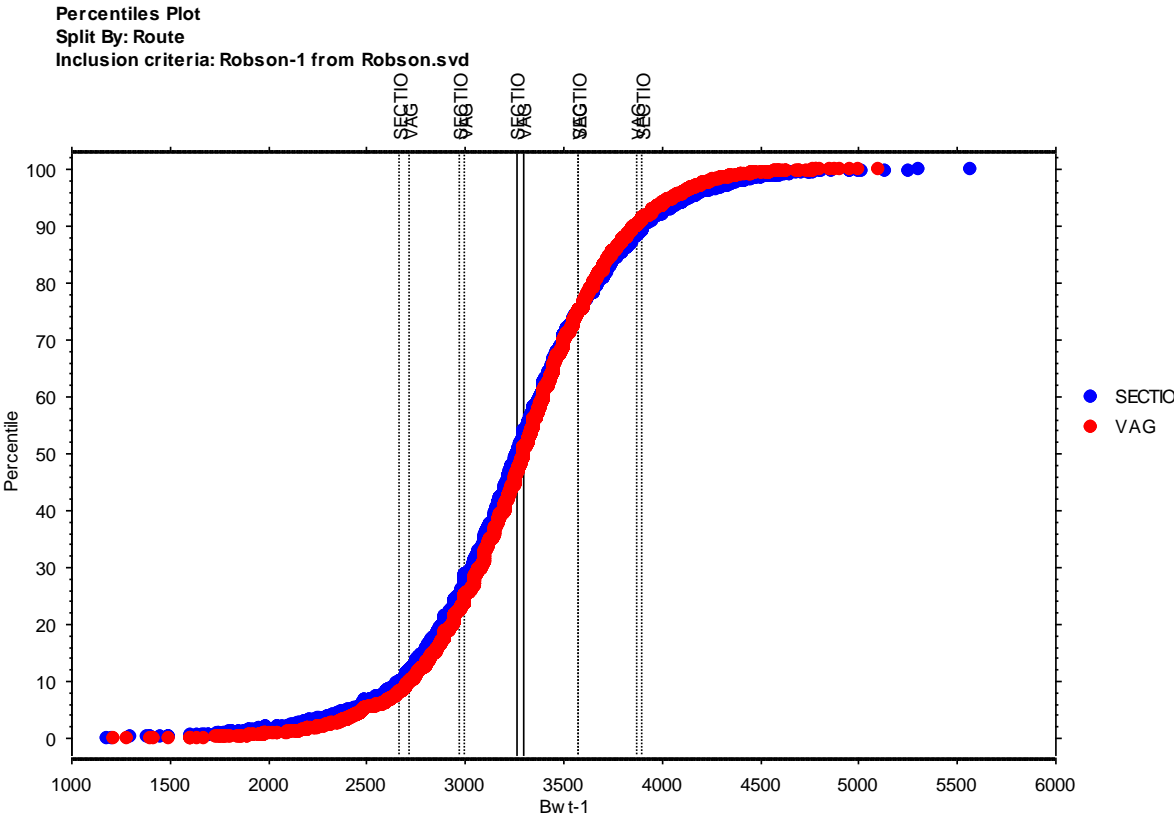


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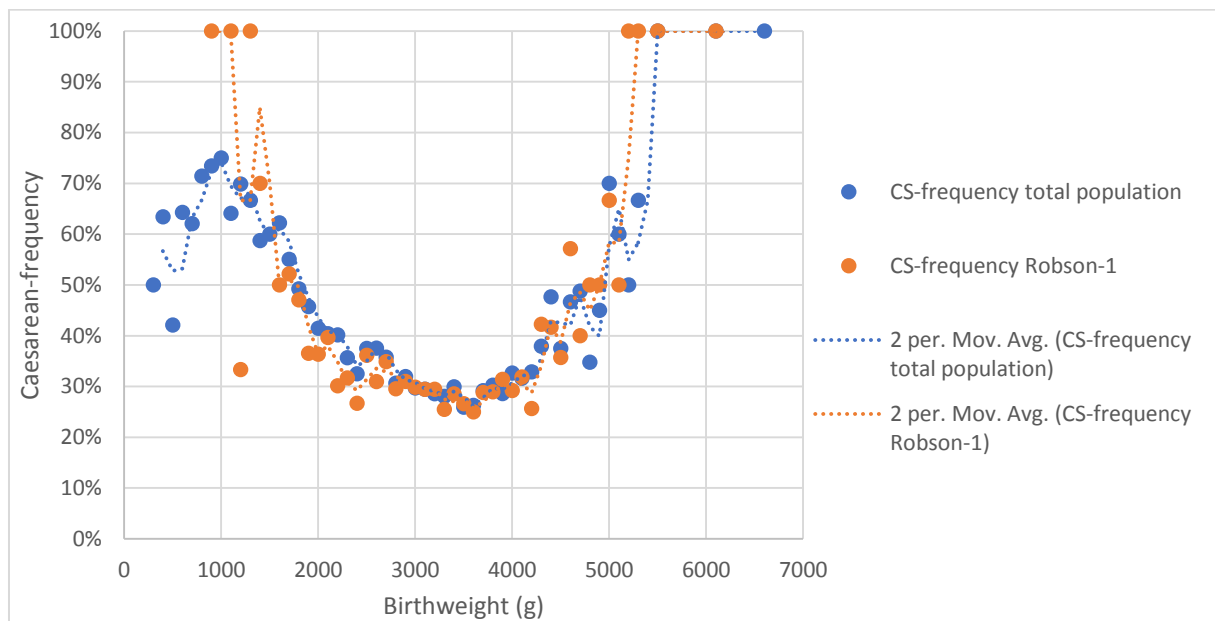


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