

Factors Associated with Oligohydramnios and Related Neonatal Morbidity and Mortality: A Nested Case-Control Study in a Cohort

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Abstract

Objective: To study the factors associated with oligohydramnios and its related neonatal morbidity and mortality. **Materials and Methods:** This was a 10-year retrospective nested case-control study conducted at a level 2 maternity ward. Given that the prevalence of oligohydramnios ranges between 0.5% and 8%, the sample size of the cases was calculated using the following formula: $n = (z/\Delta)^2 \times p(1 - p)$. We selected 20 controls for each case. Data were exported to Excel and analyzed using the Statistical Package for Social Sciences (SPSS) and R Studio 4.1.3 software. The maximal deepest pocket of amniotic fluid or the amniotic fluid index was used to establish the diagnosis. Qualitative variables were described as proportions relative to the total. Data were compared using the chi-square test when normality conditions were met or non-parametric tests otherwise. The significance threshold was set at 0.05. **Results:** Out of a cohort of 56,775 deliveries, we collected 145 cases of oligohydramnios and 2953 controls. The prevalence of preeclampsia was seven times higher in cases of oligohydramnios (OR = 7.7 [5.12; 11.7]). The prevalence of small-for-gestational-age (SGA) fetuses was four times higher in the case group (OR = 4.3 [3.04; 6.21]). Oligohydramnios were associated with an increased risk of labor artificial induction and cesarean sections respectively 4.51 ([2.95; 6.99]) and 3.41 ([3.03; 3.78]). Perinatal asphyxia was nearly three times more frequent in children born in the context of oligohydramnios (OR = 2.7 [1.38; 5.30]). Vaginal delivery and SGA were not associated with neonatal morbidity or mortality in cases of oligohydramnios. **Conclusion:** Oligohydramnios is associated with obstetric pathologies and increased neonatal morbidity and mortality. However, vaginal delivery and labor induction do not

impact neonatal morbidity and mortality. The risk of perinatal asphyxia in oligohydramnios requires special monitoring in the delivery room. Further studies on the relationship between fetal heart patterns during and asphyxia in oligohydramnios will need to be conducted.

Keywords

Oligohydramnios, Obstetric Complications, Perinatal Asphyxia, Obstetric Interventions

1. Introduction

Oligohydramnios is defined as an amniotic fluid volume below the 5th percentile for gestational age [1]. The assessment of amniotic fluid volume is routinely performed via ultrasound by measuring the deepest fluid pocket or calculating the amniotic fluid index (AFI). The diagnosis is made when the amniotic fluid index is <5 cm or the deepest pocket is <2 cm [1]. Some studies suggest that oligohydramnios is significantly associated with fetal heart rate (FHR) abnormalities, cesarean delivery for FHR abnormalities, or meconium-stained amniotic fluid [2]. Amniotic fluid volume is also a marker of fetal well-being and is integrated into the biophysical profile score of Manning [3].

Many studies report an increase in adverse neonatal outcomes in cases of oligohydramnios (meconium aspiration and admission to intensive care units). Indeed, according to some authors, the risk of cesarean section is twice as high in cases of oligohydramnios (RR, 2.16 [95% CI: 1.64 - 2.85]). The risk of admission to neonatal intensive care unit is higher in cases of oligohydramnios (RR, 1.71 [95% CI: 1.20 - 2.42]), as is the risk of meconium inhalation syndrome (RR, 2.83 [95% CI: 1.38 - 5.77]).

Regarding neonatal risk, it is important to investigate an association between mode of delivery and risk of perinatal asphyxia. This raises the question of the mode of delivery in cases of oligohydramnios.

The objective of this study is to investigate the factors associated with oligohydramnios and its inherent morbidity and mortality.

2. Materials and Methods

This study was conducted at a level 2 facility in Dakar, with an average annual delivery rate of 5500. This study was a retrospective nested case-control study within a simple cohort. The study was conducted over 10 years: from January 1, 2011, to December 31, 2021. We included all patients who delivered at the facility during the study period.

Cases were represented by women who developed oligohydramnios, diagnosed based on the ultrasound definition (measuring the deepest fluid pocket or calculating the amniotic fluid index). Controls consisted of pregnant women admitted

to the maternity ward during the same period with normal amniotic fluid levels. Exclusion criteria included premature rupture of membranes, fetal malformations, multiple pregnancies, and intrauterine fetal demise.

The frequency of oligohydramnios ranges from 0.5% to 8%. The sample size for women with oligohydramnios was calculated using the following formula: $n = (z/\Delta)^2 \times p(1 - p)$:

- n represents the number of cases (optimal sample size);
- p corresponds to the proportion of oligohydramnios in the population, between 0.005 and 0.08;
- Δ is the first-type error threshold, set at 0.05;
- $z = 1.96$, the z -score for a 95% confidence level, and $(z/\Delta)^2 = 1536.64$;

For a prevalence of 0.005, the required number of cases is 8, while for a prevalence of 0.08, $n = 113$ cases.

In rare exposures, at least 8 controls per case are needed for a sensitivity of 70%. We selected 20 controls per case to ensure very high sensitivity of the Odds Ratio (OR). In a nested case-control design, the OR is an unbiased estimator of the relative risk (RR) of a cohort.

We first defined the number of controls to select for each study year, then proceeded with randomization to select the controls for each year. We studied the biometric data and medical histories of mothers, pregnancy and delivery data, fetal outcomes, and pregnancy-related pathologies. Data were extracted from an *e-Perinatal* database using FileMaker® software. Patients' information was recorded daily. The data were exported to Excel and analyzed using SPSS and R Studio 4.1.3 software. The diagnosis of oligohydramnios was based on ultrasound performed by senior obstetricians within the facility. Oligohydramnios was diagnosed when the deepest pocket was ≤ 2 cm or AFI ≤ 5 cm.

Continuous quantitative variables were described by their position and dispersion parameters. Qualitative variables were described by their proportions relative to the total. Data were compared using the chi-square test if normality conditions were met or non-parametric tests otherwise, as U Test of Mann-Whitney. We conducted Normality tests using the statistical software SPSS. When $P > 0.05$, the null hypothesis is accepted, and data are normally distributed.

The significance threshold was set at 0.05. We calculated the association strength using ORs.

Neonatal morbidity and mortality included all children who experienced perinatal asphyxia or perinatal death. Our study received approval from the local ethics committee.

3. Results

Our study focused on 145 cases of oligohydramnios from a historical cohort of 56,775 patients. These cases were compared to 2953 controls.

The average age of the patients was comparable between the two groups (Table 1).

Table 1. Characteristics of studied population.

	Case	Control	P
Age years (means \pm SD ^a)	27.75 \pm 6.05	27.51 \pm 6.24	0.944
Parity (means \pm SD ^a)	0.76 \pm 1.1	1.41 \pm 1.5	0.000
Uterine fundal high (means \pm SD ^a)	30.92 \pm 2.4	32.72 \pm 2.6	0.034

^aStandard deviation.

We found that premature deliveries were nearly four times more frequent among the cases (OR = 3.79). The same observation applied to post-term deliveries, with an OR of 3.47. The prevalence of preeclampsia was seven times higher in this group compared to the control group (OR = 7.7 [5.12; 11.7]). This indicates a strong association between preeclampsia and the presence of oligohydramnios.

The prevalence of small-for-gestational-age (SGA) fetuses was four times lower in the control group (OR= 4.3 [3.04; 6.21]). Thus, in the case of oligohydramnios, there is a high risk of small for gestational age. A similar trend was observed with intrauterine growth restriction (IUGR). Labor was induced in 15.2% of patients with oligohydramnios. Cesarean delivery prevalence was higher among the cases than the controls: 77.2% versus 22.8% (OR= 3.4 [3.03; 3.78]).

The diagnosis of non-reassuring fetal status was made in 9.7% of cases and 6.2% of controls, without significant difference between the two groups. There was no difference in the rate of non-reassuring fetal status in two groups.

However, perinatal asphyxia was almost three times more frequent in infants born in the context of oligohydramnios compared to the controls. We observed a prevalence of 6.2% and 3.2%, respectively, with an OR = 2.7 [1.38; 5.30]. Thus, we noted a higher risk of perinatal asphyxia when there is oligohydramnios. The same trend was noted regarding morbidity and mortality. The neonatal morbimortality was three times more frequent among the cases: OR = 2.7 [1.51; 5.07] (**Table 2**).

Table 2. Obstetrical conditions associated with oligohydramnios.

	Case (%)	Control (%)	P	OR [95% CI]
Term of pregnancy				
Terme	69.0	89.4	-	
Preterm labor	15.9	4.4	0.000	3.79 [2.57; 5.59]
Postterme	15.2	5.4	0.000	3.47 [2.26; 5.33]
Preeclampsia	25.5	4.2	0.000	7.70 [5.12; 11.7]
Diabetes mellitus	6.9	3.0	0.017	2.31 [1.20; 4.63]
Small for gestational age	46.2	16.5	0.000	4.32 [3.04; 6.21]
Fetal growth restriction	32.4	1.1	0.000	44.3 [23.6; 83.4]
Labor induction	15.2	3.4	0.000	4.51 [2.95; 6.99]
Meconium-stained amniotic fluid	3.4	11.1	0.017	2.30 [1.20; 4.63]
Cesarean section	77.2	22.8	0.000	3.41 [3.03; 3.78]
Non-reassuring fetal status	9.7	6.2	0.074 _{NS}	1.61 [0.91; 2.86]
Perinatal asphyxia	6.2	2.3	0.007	2.73 [1.38; 5.30]
Morbidity and mortality	9.0	3.4	0.002	2.72 [1.51; 5.07]

_{NS} = not significant.

No factors associated with neonatal morbidity and mortality in cases of oligohydramnios were identified (**Table 3**). There was no difference in neonatal morbidity and mortality rates between vaginal delivery and cesarean section or between spontaneous and artificial induction of labor.

Table 3. Associated factors with morbidity and mortality of fetus with oligohydramnios.

	Morbidity and mortality (%)	P
Induction of labor		
Spontaneous induction	9.1	0.952 _{NS}
Artificial induction	9.0	
Mode of delivery		
Cesarean section	8.0	0.495 _{NS}
Vaginal birth	12.1	
Small for gestational age		
Yes	13.4	0.073 _{NS}
No	9.0	
Postterm labor		
Yes	9.1	0.992 _{NS}
No	8.0	
Preterm labor		
Yes	13.0	0.747 _{NS}
No	8.0	
Preeclampsia		
Yes	8.1	0.867 _{NS}
No	5.6	

_{NS} = not significant.

Also, the small for gestational age does not present an additional risk of asphyxia compared to the eutrophic fetus in case of oligohydramnios. The contingency tables regarding labor induction, hypertension, and post-term pregnancies had fewer than five occurrences, making it impossible to determine an association or perform a stratified analysis (**Table 3**).

4. Discussion

4.1. Study Limitations and Strengths

This was a retrospective study, which may introduce information bias. Additionally, oligohydramnios is a rare condition, and even with an optimal sample size, subgroup analyses are sometimes not feasible.

One of the study's strengths is that it was a nested case-control study within a cohort, ensuring good sampling.

4.2. Main Results

We found significantly more pathological pregnancy outcomes in cases of oligohydramnios, including:

- premature deliveries: OR = 3.79 [2.57; 5.59];
- post-term deliveries: OR = 3.47 [2.26; 5.33];
- hypertensive disorders: OR = 7.7 [5.12; 11.7];
- gestational diabetes: OR = 2.3 [1.20; 4.63];
- IUGR: OR = 44.3 [23.6; 83.4]; and
- SGA: OR = 4.3 [3.04; 6.21].

Labor induction and cesarean rates were higher in the oligohydramnios group. The prevalence of perinatal asphyxia was significantly higher in patients with oligohydramnios, and the same trend was observed for morbidity and mortality.

We examined the parameters that could impact neonatal morbidity and mortality in cases of oligohydramnios. Labor induction, delivery mode, gestational age, and SGA status were not associated with neonatal morbidity or mortality.

4.3. Interpretation of Results

Jagatia *et al.*, in a study based on 100 cases of oligohydramnios, report 25% of hypertensive disorders [4]. According to Panda *et al.*, the rate of hypertensive disorders was 16% in the case group versus 4.2% in the control group [5]. These findings are consistent with those of Bangal *et al.* [6]. Oligohydramnios should be considered as a warning sign of hypertensive disorders.

Several studies have demonstrated a significant association between oligohydramnios and the prevalence of SGA infants. According to Locatelli *et al.* [7] and Jagatia *et al.* [4], there is a correlation between SGA or IUGR and oligohydramnios.

However, other authors as Couanon *et al.* [8] and Zhang *et al.* [9], through data from the multicenter RADIUS trial (Routine Antenatal Diagnostic Imaging with Ultrasound), showed that isolated oligohydramnios is not associated with fetal growth restriction.

In our study, we included isolated oligohydramnios and those associated with a pathology. This observation allows us to assume that the rate of SGA is linked to the underlying conditions.

In case of hypertensive disorders, fetal hypovolemia may lead to reduced fetal urine output. Moreover, the redistribution of blood flow to vital organs also explains the occurrence of oligohydramnios. It is now well recognized that some forms of hypertensive disorders during pregnancy may first manifest as fetal involvement. Thus, in cases of oligohydramnios, particularly when associated with a low-birth-weight fetus, it is important to screen for hypertensive disorders through proteinuria and ambulatory blood pressure monitoring. Based on these observations, should oligohydramnios lead to the reclassification of SGA fetuses as IUGR?

Many studies report a higher rate of labor induction [4] [7] [10].

Regarding cesarean rates, the results are somewhat contradictory and raise questions about the exact reason for cesarean delivery: fetal hypoxia, labor induction,

or a selection bias in clinical decision-making.

Conway *et al.* [11] highlighted an increased cesarean rate in cases of labor induction for oligohydramnios (15.8% vs. 6.6%, OR: 2.7; 95% CI: 1.3 - 5.4), not attributable to an increase in fetal heart rate abnormalities but rather to labor induction itself. Chauhan *et al.* [12], in a meta-analysis of 10,551 patients, concluded that an amniotic fluid index (AFI) of ≤ 5 cm is significantly associated with an increased risk of cesarean delivery for fetal heart rate abnormalities (24.1% vs. 8.8%, RR 2.2, 95% CI: 1.5 - 3.4).

The high cesarean section rate in the case arm may be inherent to the pathologies often associated with oligohydramnios. The risk of cesarean section delivery should not justify expectant management. We conclude that, in the presence of an obstetric complication indicating termination of pregnancy, artificial induction of labor may be performed.

In our series, the risk of perinatal asphyxia was 2.7 times higher in the oligohydramnios group. Similar conclusions were made by Zhang *et al.* [9] in a cohort study conducted in 2004. Study results on this topic are contradictory [9] [12]. It should be noted that, according to our findings, morbidity and mortality were not associated with the mode of delivery or the presence of a SGA. Based on the various studies, we can conclude that the fetus with oligohydramnios is at increased risk for fetal heart rate abnormalities during the active phase of labor. This risk should be considered by enhancing monitoring fetal heart rate during labor. However, this risk does not justify routine cesarean section delivery and does not contraindicate labor induction.

4.4. Implications for Research and Care

In light of our results, further prospective studies and more homogeneous meta-analyses are needed. Future studies should address the question of whether oligohydramnios justifies reclassifying SGA as IUGR.

Labor induction and cesarean delivery do not increase neonatal morbidity and mortality.

5. Conclusions

Oligohydramnios is significantly associated with several pathological obstetric conditions, including preterm delivery, post-term pregnancy, hypertensive disorders, maternal diabetes, SGA fetuses, and IUGR.

Furthermore, oligohydramnios increases the likelihood of interventions such as cesarean delivery and labor induction.

Finally, additional studies are needed to determine whether IUGR can also be defined by an estimated fetal weight below the 10th percentile combined with oligohydramnios.

Conflicts of Interest

We declare no conflicts of interest.

References

- [1] Rabie, N., Magann, E., Steelman, S. and Ounpraseuth, S. (2017) Oligohydramnios in Complicated and Uncomplicated Pregnancy: A Systematic Review and Meta-Analysis. *Ultrasound in Obstetrics & Gynecology*, **49**, 442-449. <https://doi.org/10.1002/uog.15929>
- [2] Sénat, M. (2024) Place de l'évaluation de la quantité de liquide amniotique, du score biophysique et du doppler dans la surveillance des grossesses prolongées. *Journal de Gynécologie Obstétrique et Biologie de la Reproduction*, **40**, Pages 785-795. <https://www.sciencedirect.com/science/article/abs/pii/S0368231511002572>
- [3] Manning, F.A., Snijders, R., Harman, C.R., Nicolaides, K., Menticoglou, S. and Morrison, I. (1993) Fetal Biophysical Profile Score. *American Journal of Obstetrics and Gynecology*, **169**, 755-763. [https://doi.org/10.1016/0002-9378\(93\)90002-z](https://doi.org/10.1016/0002-9378(93)90002-z)
- [4] Jagatia, K., Singh, N. and Patel, S. (2013) Maternal and Fetal Outcome in Oligohydramnios—Study of 100 Cases. *International Journal of Medical Science and Public Health*, **2**, 724-727. <https://doi.org/10.5455/ijmsph.2013.070520132>
- [5] Panda, S., Jayalakshmi, M., Shashi Kumari, G., Mahalakshmi, G., Srujan, Y. and Anusha, V. (2016) Oligoamnios and Perinatal Outcome. *The Journal of Obstetrics and Gynecology of India*, **67**, 104-108. <https://doi.org/10.1007/s13224-016-0938-3>
- [6] Bangal, V.B., Giri, P.A. and Sali, B.M. (2011) Incidence of Oligohydramnios during Pregnancy and Its Effects on Maternal and Perinatal Outcome. *Journal of Pharmaceutical and Biomedical Sciences*, **12**, 1-4.
- [7] Locatelli, A., Vergani, P., Toso, L., Verderio, M., Pezzullo, J.C. and Ghidini, A. (2003) Perinatal Outcome Associated with Oligohydramnios in Uncomplicated Term Pregnancies. *Archives of Gynecology and Obstetrics*, **269**, 130-133. <https://doi.org/10.1007/s00404-003-0525-6>
- [8] Couanon, P. (1990) Oligoamnios et rythme cardiaque foetal: Travail, issues obstétricales et devenir néonatal. Faculté de médecine de Nantes.
- [9] Zhang, J., Troendle, J., Meikle, S., Klebanoff, M.A. and Rayburn, W.F. (2004) Isolated Oligohydramnios Is Not Associated with Adverse Perinatal Outcomes. *BJOG: An International Journal of Obstetrics & Gynaecology*, **111**, 220-225. <https://doi.org/10.1111/j.1471-0528.2004.00060.x>
- [10] Ahmad, H. and Munim, S. (2009) Isolated Oligohydramnios Is Not an Indicator for Adverse Perinatal Outcome. *Journal of the Pakistan Medical Association*, **59**, 691-694.
- [11] Conway, D.L., Adkins, W.B., Schroeder, B. and Langer, O. (1998) Isolated Oligohydramnios in the Term Pregnancy: Is It a Clinical Entity? *The Journal of Maternal-Fetal Medicine*, **7**, 197-200. [https://doi.org/10.1002/\(sici\)1520-6661\(199807/08\)7:4<197::aid-mfm7>3.0.co;2-d](https://doi.org/10.1002/(sici)1520-6661(199807/08)7:4<197::aid-mfm7>3.0.co;2-d)
- [12] Chauhan, S.P., Sanderson, M., Hendrix, N.W., Magann, E.F. and Devoe, L.D. (1999) Perinatal Outcome and Amniotic Fluid Index in the Antepartum and Intrapartum Periods: A Meta-Analysis. *American Journal of Obstetrics and Gynecology*, **181**, 1473-1478. [https://doi.org/10.1016/s0002-9378\(99\)70393-5](https://doi.org/10.1016/s0002-9378(99)70393-5)