

The Impact of the Place of Delivery, Type of Birth and Number of Antenatal Visits on the Apgar Score

O Impacto do Local de Parto, Tipo de Nascimento e Número de Visitas Pré-Natal no Índice de Apgar

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Abstract

The Apgar score is applied immediately after birth to clinically evaluate the newborn, at the first and fifth minutes of life. The Apgar score can help diagnose scenarios of neonatal anoxia or hypoxia. This is a retrospective, descriptive, and analytical study that used secondary data from DATASUS (Department of Informatics of the Unified Health System), from 1994 to 2018. The studied population includes all live births in Brazil during this period. The inclusion criteria were pregnant women over 15 years old, and the exclusion criteria were multiple pregnancies, pregnancies lasting less than 37 weeks, and newborns with congenital anomalies. These criteria were established to reduce potential confounding factors in the analysis that could lead to errors in interpretation of the results. The variables studied were place of delivery, type of delivery, and number of prenatal consultations. As results, having 7 or more prenatal consultations is a protective factor for alterations in the Apgar score, as well as cesarean delivery and hospital delivery. It was observed that pregnancy care, regarding the studied variables, influences the Apgar score. However, future studies in different populations are necessary to confirm these results.

Keywords: Apgar Score. Infant, Newborn. Pregnancy. Parturition. Prenatal Care

Resumo

O índice de Apgar é aplicado imediatamente após o nascimento, para avaliação clínica do recém-nascido, no primeiro e quinto minutos de vida. O índice de apgar é capaz de ajudar a diagnosticar cenários de anóxia ou hipóxia neonatal. Trata-se de um estudo retrospectivo, descritivo e analítico, que utilizou dados secundários do DATASUS (Departamento de Informática do Sistema Único de Saúde), de 1994 a 2018. A população estudada compreende todos os nascidos vivos no Brasil nesse período. Cujo critérios de inclusão foram: gestantes maiores de 15 anos e os critérios para a exclusão das gestantes, foram: gestações duplas, triplas e mais, gestações com menos de 37 semanas e recém-nascidos com anomalias congênitas, tais critérios foram estabelecidos afim de diminuir potenciais fatores de confusão a análise, que possam direcionar a discussão dos resultados ao erro de interpretação. As variáveis estudadas foram: local de parto, tipo de parto e número de consultas de pré-natal. Como resultados, possuir 7 ou mais consultas pré-natais, é um fator protetor para alterações no índice de Apgar, assim como parto cesáreo e parto hospitalar. Observou-se que os cuidados com a gravidez, no que diz respeito às variáveis estudadas, têm influência no score de Apgar, entretanto futuros estudos em diferentes populações se torna necessário para confirmação desse resultado.

Palavras-chave: Índice de Apgar. Recém-Nascido. Gravidez. Parto. Cuidado Pré-Natal.

1 Introduction

The Apgar score is performed during the first and fifth minutes of life to assess the newborn's clinical status.¹ However, the application of this score has certain parameters, including heart rate, respiratory movements, skin color, reflex irritability, and muscle tone.^{2,3} All of these signs are related to neonatal anoxia or hypoxia scenarios.⁴ Although the Apgar score is widely used, it cannot predict the clinical conditions of the neonate in the long term by itself.^{5,6}

Recent studies suggest that this score is associated with maternal risk and fetal morbidity/mortality.^{7,8} Maternal mortality refers to any deaths occurring during pregnancy or within 42 days of giving birth.⁹ A study of 587,002 live births in Ontario, Canada, found that the rate of maternal death within the first 24 hours after birth was 8.4/10,000 women

when the Apgar score at the fifth minute was between 0 to 6, and for mothers whose newborns' score ranged from 7 to 10, the rate was 0.12/10,000 women.¹⁰ This demonstrates that the Apgar score has the potential to influence maternal morbidity and mortality, as well as the health of the newborn¹¹.

In Brazil, a study using population data from the live births database of the information technology department of the Brazilian Unified Health System (DATASUS) evaluated the differences in Apgar scores according to the birth environment: hospital and domicile, with worse scores in non-hospital settings.¹² The chance of a low persistent Apgar score was 20.4 times higher in these settings (Odds ratio (OD) = 20.4 [Confidence Interval 95% (CI95%) 17-24.6]; p<0.0001).¹²

Based on these data, the present study aims to evaluate environmental factors, such as the place of delivery, type of birth, and number of antenatal visits that may influence

changes in the Apgar score, as well as the newborn's weight, as understanding these factors is important for prenatal care.¹³

2 Material and Methods

This is a retrospective, descriptive and analytical study, which used secondary data available in DATASUS (<http://www.datasus.gov.br>). The population studied is composed by all live births between 1994 and 2018 in Brazil, whose inclusion criteria were: to be from pregnant women over 15 years of age and the exclusion criteria were: double or triple pregnancies, or having more than three pregnancies, pregnancies lasting less than 37 weeks and newborns with congenital anomalies, to decrease the potential confounding during the analysis.¹⁴

The variables of interest used in this study were: place of delivery (classified into hospital, other health facilities, non-health facilities); type of birth (vaginal, cesarean, forceps/other, unknown), antenatal visits (none, 1-3, 4-6, 7 or more, unknown), 1-minute-Apgar (0-7, 8-10), 5-minute-Apgar (0-7, 8-10) available in the database.

The data extraction was organized in Microsoft Excel and for statistical analysis was performed in Graphpad Prism 6.0 and the statistical tests used were Chi-square test or Fisher's exact test (Odds ratio). We consider the value of p significant, the value of $p \leq 0.05$. The present work follows the ethical norms of Resolution 466/12.

There was no need to submit the study to the Research Ethics Committee and the application of Informed Consent Term, because all the data used were secondary and public domain.

3 Results and Discussion

During the period spanning from January 1994 to December 2018, a total of 74,215,086 live births were registered in Brazil. Most of these births, amounting to 70,542,189 individuals, occurred in a hospital setting, which represents 95.05% of all live births. Among the hospital births, vaginal deliveries were the most common, accounting for 39,296,187 (52.95%) of the total, followed by cesarean deliveries with 34,187,914 (46.07%). In terms of antenatal care, 38,340,661 (51.66%) of mothers had 7 or more visits, while the remaining 35,874,425 (48.34%) had fewer visits or no record of them. Regarding the Apgar score, 55,662,421 (75%) of newborns had a score between 8 and 10 in the first minute, which increased to 64,140,249 (86.42%) at the 5-minute mark (Table 1). After applying our inclusion and exclusion criteria, we obtained a sample of 66,867,267 live births eligible for the study. To increase the analytical power, we grouped some variables such as place of occurrence, domicile, indigenous village, and "others" into a single category called non-health establishments, which represented 743,623 (1.11%) of the sample (Table 2).

Table 1 - Description of Datasus population

1 - minute- Apgar, n (%)	
0 - 2	852671 (1.15%)
3 - 5	2204300 (2.97%)
6 - 7	8212380 (11.07%)
8 - 10	55662421 (75%)
Unknown	7283314 (9.81%)
5 - minute- Apgar, n (%)	
0 - 2	472334 (0.64%)
3 - 5	407268 (0.55%)
6 - 7	1568773 (2.11%)
8 - 10	64140249 (86.42%)
Unknown	7626462 (10.28%)
Place of delivery, n (%)	
Hospital	70542189 (95.05%)
Other Health Facilities	1026506 (1.38%)
Domicile	784316 (1.06%)
Indigenous village	9928 (0.01%)
Other	76258 (0.1%)
Unknown	1775891 (2.39%)
Type of birth, n (%)	
Vaginal	39296187 (52.95%)
Cesarean	34187914 (46.07%)
Forceps/other	51562 (0.07%)
Unknown	679425 (0.92%)
Antenatal visits, n (%)	
None	2380788 (3.21%)
1 - 3 visits	4683842 (6.31%)
4 - 6 visits	17378404 (23.42%)
1 - 6 visits, non-specified	4198414 (5.66%)
7 or more visits	38340661 (51.66%)
Unknown	7232979 (9.75%)

Source: DATASUS.

Table 2 - Characteristics description of studied population after inclusion and exclusion criteria applied

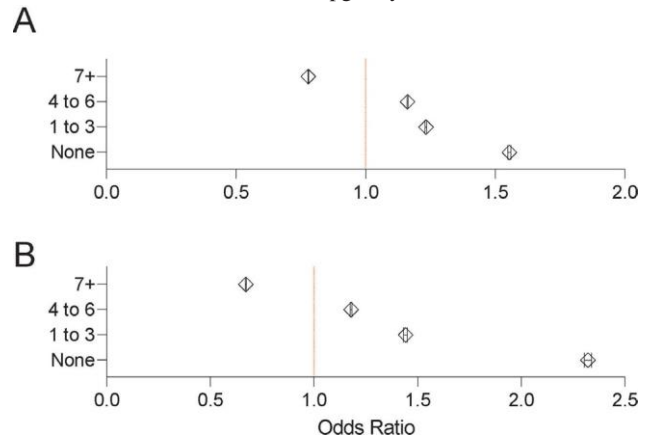
- MINUTE- APGAR	
Place of delivery, n (%)	
Hospital	63426942 (94.85%)
Other Health Facilities	939280 (1.4%)
Non-health facilities	743623 (1.11%)
Unknown	1757422 (2.63%)
Type of birth, n (%)	
Vaginal	35712608 (53.41%)
Cesarean	30453157 (45.54%)
Forceps/other	48572 (0.07%)
Unknown	652930 (0.98%)
Antenatal visits, n (%)	
None	2057651 (3.27%)
1 - 3 visits	3855668 (6.12%)
4 - 6 visits	15137885 (24.02%)
7 or more visits	35225411 (55.9%)
Unknown	6737798 (10.69%)
5 - MINUTE- APGAR	

- MINUTE- APGAR	
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None	2057651 (3.27%)
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Source: DATASUS.

After applying our inclusion and exclusion criteria, we investigated the relationship between antenatal visits and Apgar score alterations in the first and fifth minutes. When comparing the Apgar score alterations with the number of antenatal visits, we found that the risk of Apgar score alterations was 1,555 times higher for mothers who missed their antenatal follow-up, with a confidence interval of 95% (CI95%) ranging from 1,549 to 1,561. Compared to pregnant women who had between 1 and 3 antenatal visits, the risk was 1,233 times higher, with CI95% = 1.23 - 1.237 for Apgar score alterations. For those with 4-6 antenatal visits, the risk was 1.162 times higher, with CI95% ranging from 1.160 to 1.164. However, pregnant women who had more than 7 visits showed protection against Apgar score alterations, with ODDS of 0.7794 and CI95% = 0.7782 - 0.7806. Therefore, it became evident that a smaller number of antenatal visits posed a higher risk for children to be born with Apgar scores between 0-7, while having more visits (more than 7) was associated with a greater chance of individuals obtaining an Apgar score between 8-10 in the first minute (Figure 1A). Evaluating the Apgar score in the fifth minute, the risk of Apgar score alterations was 2.322 times higher for pregnant women who did not have antenatal follow-up, with CI95% = 2.305 - 2.339. Pregnant women with 1-3 antenatal appointments had a 1.442-fold lower risk, with a 95% CI = 1.433 - 1.451. Similarly, pregnant women with 4-6 antenatal visits had a lower risk of 1.179 times, with CI95% = 1.175 - 1.184. Having more than 7 appointments was a protective factor for pregnant women, with an OD of 0.6713 and CI95% = 0.669 - 0.673. In summary, we showed that antenatal follow-up also impacts the Apgar score at the fifth minute, and mothers who had 7 or more antenatal visits had a protective factor against changes in the Apgar score (Figure 1B).

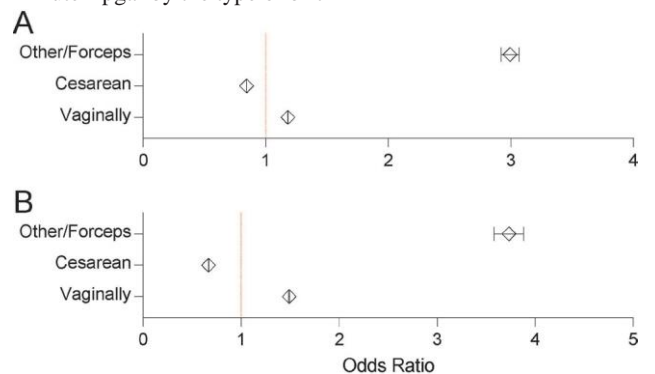
Figure 1 - Forest plot of the risk of Apgar score alterations by antenatal visit's number. A. First-minute Apgar by antenatal visit's number. B. Fifth-minute Apgar by antenatal visit's number



Source: the authors.

The subsequent analysis focused on the influence of delivery type on Apgar scores. Babies born vaginally had a 1.181-fold increased risk (CI95% = 1.18 - 1.183) of having an Apgar score between 0 and 7, whereas those born via cesarean section had a protective effect of 0.8441 (CI95% = 0.8429 - 0.8453) against unfavorable Apgar scores. Forceps or other assisted deliveries had the highest risk of all delivery types, with a risk of 2.994 (CI95% = 2.921 - 3.069) for Apgar scores below 8. Notably, only cesarean section delivery showed a protective effect against unfavorable changes in the Apgar score in the first minute (Figure 2A). In the fifth minute, vaginal births had a 1.491-fold increased risk (CI95% = 1.486 - 1.495) for an unfavorable Apgar score, while cesarean delivery had a protective effect of 0.6675 (CI95% = 0.6654 - 0.6696). Similarly, to the first minute, forceps or other assisted deliveries had the highest risk, with a 3.7-fold increase (CI95% = 3.585 - 3.883) for Apgar scores below 8. These findings indicate that cesarean section delivery may be a good predictor of favorable Apgar scores, particularly at the fifth minute (Figure 2B).

Figure 2 - Forest plot of the risk of Apgar score alterations by the type of birth. A. First-minute Apgar by the type of birth. B. Fifth-minute Apgar by the type of birth

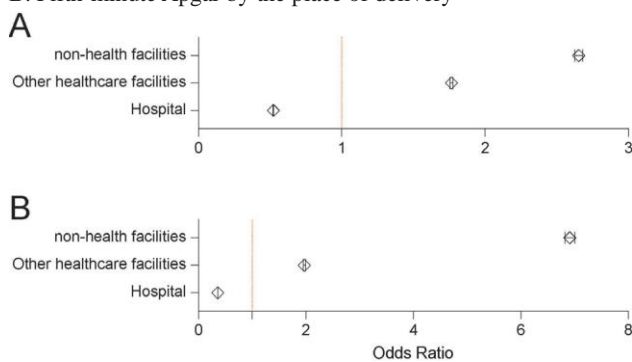


Source: the authors.

Next, we investigated the impact of the place of childbirth on Apgar scores. Our analysis revealed that children born in

hospitals had a protective factor of 0.5226 (CI95% = 0.5201 - 0.5251) against unfavorable Apgar scores, while those born in other healthcare facilities had a risk of 1.765 (CI95% = 1.1755 - 1.774) for altered Apgar scores. Non-healthcare establishments showed an even higher risk of 2.653 (CI95% = 2.625 - 2.681) for altered Apgar scores. These findings suggest that the hospital environment has a positive impact on Apgar scores, with a greater tendency towards scores between 8 and 10 (Figure 3A). When considering the variable of place of occurrence and Apgar scores in the fifth minute, we found that hospital births represented a protective factor of 0.3561 (CI95% = 0.3561 - 0.3619) against altered Apgar scores. In contrast, births in other healthcare facilities had a risk of 1.971 (CI95% = 1.951 - 1.991) for scores lower than 8, while non-health facilities showed the highest risk of 6.913 (CI95% = 6.821 - 7.006) for unfavorable Apgar scores. In summary, the only protective factor against Apgar scores below 7 in the fifth minute was being born in a hospital, with most scores between 8 and 10 prevailing (Figure 3B).

Figure 3 - Forest plot of the risk of Apgar score alterations by the place of delivery. A. First-minute Apgar by the place of delivery. B. Fifth-minute Apgar by the place of delivery



Source: the authors.

The scientific literature has established a relationship between neonatal mortality and the quality of antenatal care, as many deaths could be avoided with better follow-up^{11,13,14}. Considering this premise, our objective was to evaluate the risks associated with a low number of antenatal visits, the place of delivery, and the type of birth on the Apgar score of newborns. Our analysis revealed that a lower number of antenatal visits is associated with a higher risk of an altered Apgar score in newborns. A study conducted in the state of São Paulo showed that as the frequency of antenatal visits increased, the probability of neonatal death decreased significantly¹⁴. In addition, another study demonstrated that an insufficient number of antenatal visits can also be a risk factor for low birth weight¹⁵.

On the other hand, some studies have found that complications during birth are not significantly associated with the mother's prenatal care. In these studies, most newborns from mothers who attended antenatal visits did not experience any complications at birth, as did those born to mothers who did not attend these visits.¹⁶ Another similar study found no

association between prenatal care and in-hospital mortality of newborns. This may be due to the small proportion of mothers in the sample who did not receive prenatal care or because the quality of care was more important than the number of appointments.¹⁷ It is worth noting that some studies indicate that prenatal care cannot prevent the most common complications of childbirth, such as hemorrhages, septicemia, and labor obstructions. However, specific interventions during pregnancy can improve the maternal prognosis.¹⁸

The Ministry of Health recommends a certain number of antenatal visits for pregnant women, and it has been found that neonates born to mothers who have undergone adequate prenatal care with at least six appointments during pregnancy tend to have better Apgar scores in the first minute of life and in the fifth minute. These antenatal visits typically involve physical examinations and tests, which promote healthy fetal development and help prevent complications during pregnancy. As a result, the likelihood of the newborn having an Apgar score of seven or higher in both the first- and fifth-minutes increases.

After investigating the relationship between the number of antenatal visits and Apgar scores, the present study explored the impact of childbirth type on Apgar scores. A study conducted in Nepal in 2020¹³ found that the average Apgar score in the first minute was less than 7 for both vaginal and cesarean deliveries, with a mean difference of 0.04 between the two types. However, the Apgar score at the fifth minute was greater than 7 for both types, with a mean difference of 0.06 between them. In contrast to the present study, the Nepal study accepted the null hypothesis and concluded that there was no significant difference between Apgar scores in vaginal and cesarean deliveries in the first and fifth minutes of life. However, a study conducted in Iran in 2013 showed that cesarean deliveries seemed to affect and reduce the Apgar score at the fifth minute of life. The study found an increased risk of Apgar scores of^{7,8} in the emergency cesarean group, with no significant difference in Apgar scores between newborns born vaginally and those delivered by elective cesarean section. The differences in findings between the cited literature and the present study may be due to the significant underreporting rate of the DATASUS Live Births database and differences between the health systems being analyzed. Additionally, biological/genetic and environmental factors may play a role, as Brazil has a high rate of cesarean sections, accounting for around 80% of deliveries in the private sector in 2008¹⁹.

Our previous investigation analyzed the role of childbirth in altered Apgar scores. Consistent with the results reported here, hospital births were found to be protective against Apgar alterations (odds ratio [OD] = 0.3561; 95% confidence interval [CI95%] = 0.3561 - 0.3619). According to Resolution n° 111/04 of the São Paulo Regional Medical Council (CREMESP), "childbirth care, including low-risk care, should be provided in a hospital institution equipped

with infrastructure for greater safety of the mother and baby, as the possibility of low-risk childbirth becoming high-risk is unpredictable.” Additionally, a Brazilian study from 2018 identified the hospital environment as a protective factor for altered Apgar scores in the first and fifth minutes. There is an increased risk of death and cerebral palsy when Apgar scores at 1 and 5 minutes are less than 4.²⁰ Neonatal resuscitation support is the primary factor responsible for the difference in Apgar scores between the first and fifth minutes. Hospital neonatal resuscitation maneuvers, such as suction cannulas, oxygen, ventilation masks, intubation materials, and adrenaline, are readily available, which can impact live births in a residential environment¹².

There are several limitations to the present investigation. First, relying solely on Apgar score assessment may not provide an accurate representation of the neonate’s long-term clinical outcome, and the results may be evaluator dependent. In fact, the same newborn could receive different Apgar scores from two different doctors.²¹ Moreover, an Australian study found significant differences in stillbirth rates when comparing hospital and homebirth environments, even if the Apgar scores of live births were similar²⁰. Another limitation is the lack of reporting systems for newborn evaluations in non-hospital environments. Recent studies have shown that 63% of home births did not have an Apgar score recorded on the birth certificate, despite there being a specific field for this information.

To minimize potential biases in this study, we have excluded pregnant women under the age of 15, as well as pregnancies involving twins or triplets, those with a gestational age of less than 37 weeks, and newborns with congenital anomalies.

4 Conclusion

The present study suggests that antenatal visits may serve as a protective factor for alterations in the Apgar score. Among the various types of childbirth, only cesarean section was found to be protective against an altered score. Hospitals were found to be protective against minor fluctuations in the Apgar score when the place of delivery was considered. It was also observed that non-healthcare facilities posed the highest risk for an altered Apgar score. Our findings suggest that the quality of care provided to pregnant women during antenatal visits can effectively reduce infant morbidity and mortality rates. Factors such as the number of antenatal visits, type of delivery, and delivery environment may all have an impact on the Apgar score.

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