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# Analysis of the relationship between maternal-infant indicators and apgar score in the northern extreme of the Brazilian Amazon

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**ABSTRACT**

**Introduction:** The Apgar score evaluate the vitality of newborns. The Born Alive Declaration (BAD) is a questionnaire with the purpose of showing the distribution of clinical and epidemiological variables. **Objective:** To evaluate the association between variables in the Health Ministry's BAD and low Apgar score. **Methods:** It is a retrospective transversal study where data from 39.408 BAD from January 1st, 2008 to December, 31st 2012 in Roraima's public maternity hospital were analyzed. The statistical analysis used the chi-square method to compare differences between proportions of categorical variables. RR and CI95% were calculated under univariated analysis. The data were tabled and analyzed using the Epi Info® 7.0 version software. **Results:**Among the most associated factors to low Apgar at birth are: women above 20 years old (RR 1.69; CI95%: 1.34 – 2.13), first time mothers (RR 1.44, CI 95% 1.29 – 1.60, p<0.05), pregnant women who didn't had pre-natal care (RR 1.41, CI 95% 1.25 a 1.60, p <0.001), male newborns, newborns weighting less than 1.499g (RR 6.51, CI 95% 1.79 – 2.23), children born with gestational age (GA) smaller than 31 weeks, and GA from 32 to 36 weeks (RR 1.63, CI 95% 1.49 – 1.79). **Conclusion:** The BAD has proven to be a great instrument in evaluating Apgar and apprehending its risk factors. As expected, the age extremes, prematurity and insufficient pre-natal consults are related to low Apgar on the first minute. But, surprisingly, poorly educated mother didn't appear to be related to low Apgar score. We believe that it's necessary to better stratificate maternal age levels. .

**Keywords:** Apgar score, prenatal care, newborns.

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## 1. INTRODUCTION

The Born Alive Declaration (BAD) was implemented by the Ministry of Health in 1990, and is responsible for supplying the Live Births Information System (LBIS) of the Ministry of Health. The system was created with the purpose of solving quantitative deficits in the registry of live births and to know the distribution of these by important clinical and epidemiological variables[1]. The issuance and fulfillment of BAD is mandatory for all hospitals or health care facilities attending childbirth, according to the 10° article, item IV - Law 8069, of July 13, 1990[2].

Since the creation of BAD, the epidemiological profile of the population has been done using standardized declarations throughout the national territory. The document is filled in individually, facilitating the implementation of basic health actions in maternal and child health[3]. The last change in the document occurred in the year of 1999, with the inclusion of a new field to the registry of congenital malformations[4].

BAD can be filled by administrative staff, nurses or doctors, LBIS' statement describes the epidemiological profile of maternal and child health in detail, thus allowing the creation of specific interventionist policies[1].

Costa & Gotlieb[3] carried out a study with the objective of evaluating the association between the variables present in the BAD of the Ministry of Health and the low birth weight and concluded that BAD can be considered easy to handle, highlighting its important role for the analysis of obstetric and infant data.

Among the six variables about newborns contained in the statement, one specifically has historical and practical importance in pediatrics, the Apgar score system. This score was developed in 1952 by Virginia Apgar, with the objective of evaluating the vitality of the newborn (NB) shortly after birth. It should be performed in the first and fifth minutes of life of the newborn and is based on five variables: heart

rate (HR), respiratory effort (RE), muscle tone (TM), reflex irritability (RI) and color. Considering 0-2 the score of each item, the score will range from 0 to 10[5].

The method created 65 years ago continues to be practical and with excellent reproducibility, as it does not require equipment, uses variables that are easy to remember and requires simple training, and is used in all delivery rooms in the present day to evaluate the vitality of the newborns[6]. We can consider the Apgar score as an expression of the neonatal physiological state. However, it is not free of restrictions, it presents the reduced time of evaluation and can be influenced by maternal-infant factors, such as the degree of newborn maturity. By presenting these limitations, it should not be used alone to diagnose neonatal asphyxia and neurological disorders[5].

In addition, when the Apgar Score is used as a reference for the degree of asphyxia, the Ministry of Health (MH) classifies the score as: No asphyxia (Apgar 8 to 10); With mild asphyxia (Apgar 5 to 7); Moderate asphyxia (Apgar 3 to 4); With severe asphyxia (Apgar 0 to 2). Directing health professionals to use these criteria to fill[7]. Diverging from MH, the American Academy of Pediatrics, traditionally defines as low score of Apgar, a score of 0 to 3. Scores from 7 to 10 are considered normal, while 4 to 6 are intermediate[5].

Several studies have been carried out with the aim of associating factors to the Apgar score, because neonatal vitality can be influenced by maternal and obstetric determinants means that public measures can be directed towards these factors in order to improve the vital conditions of newborns[8]. The variables included in the Born Alive Declaration (BAD) are a reliable source of data, being a practical way of evaluating a large sample and describing the profile of the local population, as well as, suggests factors that influence the low Apgar score's, concern of all neonatologists.

The aim of this study was to correlate Apgar values of the first minute with maternal, obstetric and newborn (NB) variables; Such as age, parity, marital status, maternal education, number of prenatal consultations, delivery way, birth weight, gender and gestational age inferring possible risk factors for low Apgar score.

## 2. MATERIALS AND METHODOS

This is a cross-sectional, retrospective study in which data of 39.408 BAD were analyzed in the period from January 1st, 2008 to December 2012, in the public maternity of Roraima. The study was submitted to Research Ethics Committee (CAAE: 36086814.2.0000.5302). Statistical analysis used the chi-square test to compare differences in the proportions of categorical variables. Risk ratio (RR) and 95% CI were calculated in univariate analysis. Data were tabulated and analyzed using Epi Info® software version 7.0 (CDC, Atlanta, USA).

## 3. RESULTS

The sample consisted of 39.408 BAD. Of this total, 10.8% had Apgar smaller than 8 in the first minute. The first minute Apgar was between 8 and 10 in 89.3% of the sample; between 4 and 7 and 0 to 3 in 9.8% and 0.9%, respectively.

Analyzing, first, the relation between the low Apgar score (LAS) and maternal variables, maternal age was associated with LAS (p <0.001). Women younger than 20 years were 15% more likely than women aged between 21-40 to have an NB with Apgar < 7 (RR 1.15, CI 95% 1.08 – 1.22). However, mothers older than 40 years presented an even greater risk (RR 1.69, CI 95% 1.34 – 2.13).

About the number of prenatal consultations, pregnant women who performed less than six visits had a 41% higher chance of having a child with Apgar < 7 (CI 95% 1.25 a 1.60, p<0.001).

About the gestational age at birth, 90.2% of the infants between 37 and 41 weeks and six days, at term, presented a good Apgar score (8 to 10). When comparing this group with those born with gestational age between 32 and 36 weeks and those with less than or equal to 31 weeks, we observed an almost five-fold increased risk for LAS in both groups (RR 1.63, CI 95% 1.49 – 1.79) (Table1).

When marital status was evaluated, 15.1% of widows and divorced women's children were born with LAS, while 10.9% of the children of single women and 11% of the children of married women were born with a score < 7. Despite the observed difference, there was no statistically significant association (p=0.168).

Regarding the level of maternal education, there was no statistical significance between these variables (p=0.07) (Table 1). But, as for maternal parity, there was a statistically significant relation (p<0.001). The primigravidae presented 44% more chance of having LAS (CI 95% 1.29 – 1.60) (Figure 1).

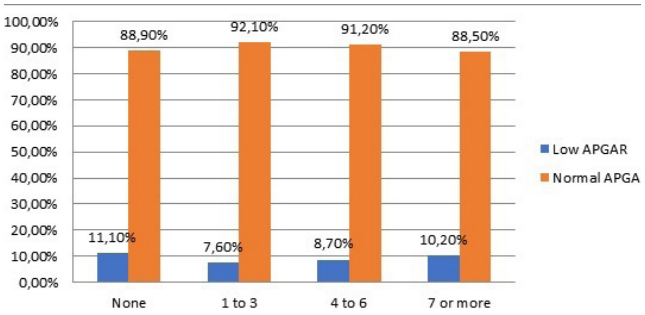


**Figure 1. Maternal parity according to the Apgar score in the 1st minute.**

Regarding birth weight, it was observed that there is a greater chance of LAS the lower the birth weight is. Infants weighing less than or equal to 1.499g had a six-fold increased risk of low Apgar, while those with 1.500 to 2.499g had twice as much, compared to infants between 2.500 and 2.999g (CI 95% 1.79 – 2.23). (Table 1) (Figure 2).

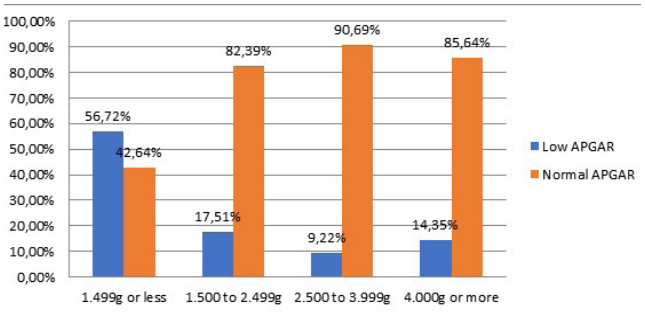


**Figure 2. Relation of Birth weight and Apgar score in the 1st minute.**

In addition, the way of delivery showed that the cesarean section had a statistically significant relationship with LAS (RR 1.42, CI 1.34 – 1.50). Where 13.1% of the children born of cesarean had LAS.

**Table 1. Maternal and neonatal factors associated with low Apgar score at birth with their respective prevalence ratios and chi-square.**

| Variable (Total*) | Apgar ≤ 7 | Apgar >7 | p *** | RR*** | CI 95% |
|---|---|---|---|---|---|
| **Age (39.375)*** | | | <0.001 | | |
| Less than 20 years | 1.510 (3.83%) | 11.535 (29.29%) | | 1.15 | 1.08-1.22 |
| 21 to 40 years ** | 2.620 (6.62%) | 23.335 (59.26%) | | | |
| Over 40 years | 64 (0.16%) | 311 (0.78%) | | 1.69 | 1.34-2.13 |
| **Marital status (32.570)*** | | | 0.168 | | |
| Single ** | 2.349 (7.21%) | 19.110 (58.67%) | | | |
| Married | 1.199 (3.68%) | 9.737 (29.89%) | | 1.00 | 0.94-1.07 |
| Widowed / divorced | 27 (0.08%) | 148 (0.45%) | | 1.41 | 0.99-2.01 |
| **Schooling (39.348)*** | | | 0.07 | | |
| 3 years or less | 294 (0.74%) | 2.151 (5.46%) | | 1.13 | 0.98-1.30 |
| 4 to 7 years | 1.013 (2.57%) | 8.257 (20.98%) | | 1.03 | 0.92-1.14 |
| 8 to 11 years | 2.458 (6.24%) | 21.156 (53.76%) | | 0.98 | 0.89-1.08 |
| 12 years and over** | 427 (1.08%) | 3.592 (9.12%) | | | |
| **Previous deliveries (15.378)*** | | | <0.001 | | |
| None | 594 (3.86%) | 4.776 (31.05%) | | 1.44 | 1.29-1.60 |
| 1 to 3** | 608 (3.95%) | 7.312 (47.54%) | | | |
| 4 to 6 | 145 (0.94%) | 1.527 (9.92%) | | 1.13 | 0.95-1.34 |
| 7 or more | 43 (0.27%) | 373 (2.42%) | | 1.35 | 1.00-1.81 |
| **Number of prenatal consultations (39.363)*** | | | <0.001 | | |
| None | 260 (0.66%) | 1.580 (4.01%) | | 1.41 | 1.25-1.60 |
| 1 to 6 | 2.352 (5.97%) | 19.362 (49.18%) | | 1.08 | 1.02-1.17 |
| More than 6** | 1.581 (4.01%) | 14.228 (36.14%) | | | |
| **Gender (39.372)*** | | | <0.001 | | |
| Male | 2.307 (5.85%) | 17.899 (45.46%) | | 1.16 | 1.10-1.23 |
| Female** | 1.885 (4.78%) | 17.281 (43.89%) | | | |
| **Weight at birth (39.375)*** | | | 1.303.6§ | | |
| Less than 1499g | 270 (0.68%) | 203 (0.51%) | | 6.51 | 5.81-7.29 |
| 1500-2499g | 428 (1.08%) | 2.013 (5.11%) | | 2.00 | 1.79-2.23 |
| 2500-2999g** | 736 (1.86%) | 7.653 (19.43%) | | | |
| 3000-3999g | 2.397 (6.08%) | 23.146 (58.78%) | | 1.07 | 0.99-1.16 |
| Greater than 4000g | 363 (0.92%) | 2.166 (5.50%) | | 1.64 | 1.45-1.84 |
| **Way of delivery (39.373)*** | | | <0.001 | | |
| Vaginal** | 2.317 (5.88%) | 22.744 (57.76%) | | | |
| Caesarean | 1.877 (4.76%) | 12.435 (31.58%) | | 1.42 | 1.34-1.50 |
| **Gestational age (39.355)*** | | | 876.2§ | | |
| Less than 31 weeks | 246 (0.62%) | 264 (0.67%) | | 4.97 | 4.45-5.55 |
| 32-36 weeks | 473 (1.20%) | 2.512 (6.38%) | | 1.63 | 1.49-1.79 |
| 37 to 41 weeks ** | 3.393 (8.62%) | 31.585 (80.25%) | | | |
| 42 weeks or more | 82 (0.20%) | 800 (2.03%) | | 0.96 | 0.78-1.18 |

** There are variations of the total due to exclusions of BADs that have been populated as 'ignored''or uninformed.*
*** Reference category.*
**** RR = relative risk; P = chi-square; CI = confidence interval.*

## 4. DISCUSION

The percentage of newborns with Apgar under 8 in the first minute (10.8%) was superior to the findings of Suka et al[9], Japão, Silva et al[10], Brasil, Ehrenstein et al[11], Berglund et al[12], that found 4.2%, 6.4%, under 1% and 0.41%, respectively.

In the present study, a statistically significant correlation between Apgar of ≤7 and the variables: mother's age, newborn's gender, weight at birth, parity, number of prenatal consultations, kind of birth and gestational age at birth was found. The only variables that were not associated with low Apgar score among the analyzed were marital status

and maternal education.

On what concerns maternal age, this study was similar to many others[3, 13, 14, 15] where the most prevalent age group was 21 to 30 years followed by teenagers, what suggests that early beginning of sexual activity with no use of birth control methods, is exposing such teenagers to, not only, an unwanted pregnancy but also to sexually transmitted infections[16].

The age group of 20 to 35 years old, according to obstetric literature is the best one to gestate[17]. In the present study, the age group from 21 to 30 years old was responsible for the best Apgar's scores, 90.2% of the newborns were born with Apgar from 8 to 10.

When comparing the probability of mothers under 20 years old and above 40 years old, having babies with LAS, with women in the age group between 21 to 40 years old, it was observed that the relative risk is 15% (CI95% 1.08% a 1.22%) and 69% (CI95% 1.34 to 2.13), respectively. Therefore, the risk of low Apgar is much higher in elderly mothers, agreeing with Kilsztajn et al[18].

It was observed that there was a loss in percentage of elderly women in the research, because, conceptually, the literature considers 'elder' the pregnant woman over 35 years old and SINASC divides the pregnant group in standard age groups, 10 to 20 years old, 21 to 30 years old, 31 to 40 years old and older than 40 years old. So, according to the SINASC division, pregnant women classified as Elder by the literature, are found both at the above 40 and at the 31 to 40 years old age groups, which makes analysis difficult.

Most mothers declared themselves single (54.5%), being above values found by other studies[8,14,11,] that were between 26% and 33.01%, just like in this study, a study realized in Japan in 20029 did not find any significant correlation between Apgar <8 and marital status. Even though in comparison, a study realized in São Paulo19 found a 23% higher risk of single mothers having children with Apgar <7, when compared to married ones. (RR 1.23, CI95% 1.148 to 1.321)

When it comes to parity, we found 13.6% of nulliparous women, a lower percentage than the one found by similar studies[3,13,20], where numbers went from 35.5% to 45.9%. when comparing them with women with 1 to 3 previous gestations, there's a 44% higher risk of the first ones having children with LAS (CI95% 1.29 to 1.6; $p<0.05$). Increasing risk in multiparous women was not observed.

Straube et al[18] considered the absence of previous births as a risk factor for LAS, when comparing newborns with Apgar from 7 to 10, but in the first minute. (RR 1.52, CI95% 1.37 to 1.7), in contrast with the work of Ehrenstein and colleagues, 2009, where nulliparity had an inverse proportionality to Apgar's Score.

In the current paper 89.8% of pregnant women had under 12 years of study, while Li et al[8]., in the US, found 18.81%, there was also no statistically significant correlation between LA and maternal education ($p>0.05$). As opposed by Odd et al[21] that described that the risk of LAS drops as maternal education levels increases.

Evaluating the number of pre-natal consultations, 55.1% of the women had from 1 to 6 appointments and 4.7% of them didn't have any appointments. Guimaraes and Velasquez-Mendelez[22], Itauna-MG, found an even higher percentage of pregnant women with six or less pre-natal appointments (68.1%). Nascimento and Gotlieb[13], Guaratinguetá-SP found 80% of pregnant women with 7 or more appointments. Haidar, Oliveira and Nascimento[22], described that 32.5% of new mothers had went through 6 or less appointments. Such diversity reflects the geopolitical disparity amongst Brazilian regions.

The Ministry of Health advocates that a minimum of 6 appointments is accomplished during the gestational period. We call for attention to the fact that what's evaluated is the number of appointments and not the quality of such appointments. The present study found a statistically significant relation between number of appointments and LAS. Patients that didn't have pre-natal care presented a 44% higher risk of having a baby with Apgar under 8 when compared to pregnant women that went through 6 or more appointments (CI95% 1.25 to 1.6%). The ones that had from 1 to 6 appointments also presented a higher risk (RR 1.08, CI 95% 1.02 to 1.17), but not as significantly.

Similar to our sample, Carniel et al[14], in Campinas-SP, observed elevated percentages of women with inadequate pre-natal care (44.3%). Oppositively, Li et al[8] reported that only 0.93% of the US sample didn't have pre-natal care.

Kilsztajn et al[19] found a significant correlation between Apgar below 7 and number of pre-natal appointments both in simple logistic regression and in multiple logistic regression with OR values of 1.6 (CI95% 1.49 to 1.694) and 1.248 (CI95% 1.163 to 1.137), respectively.

On what comes to gender, the male newborn showed a higher chance of having a LAS than the female one (CI95% 1.1 to 1.23), agreeing with another study[12] that found a OR of 1.6 (CI95% 1.2 to 2.2)

The most prevalent weight at birth gap was from 3.000g to 3.999g (64.9%). Odd et al[21], Pinto & Nascimento[23] and Nascimento & Gotlieb[13] found an average weight of 3.604g, 3.132g and 3.203g, respectively.

According to definitions adopted by the World Health Assembly (WHA resolutions 20.19 and WHA 43.24), where a weight under 2.500g is low weight at birth, under 1.500g is very low weight and under 1kg is extreme low weight.

Using this classification, in the present study, was found a strong association of low weight and Apgar score. Newborn babies with very low weight and extremely low weight were 6.51 times more likely to present LAS (CI95% 1.79 to 2.23), being a risk factor to LAS (RR 2, CI95% 1.79 to 2.23), although, a weight over 4.000g also elevated in 64% the risk of having LAS (CI95% 1.45 to 1.84), similarly, Berglund et al[12] described that both elevated weight and low weight increased the risk of LAS. But, very low weight has a bigger relevance, because it elevates in 5 times the risk of LA (CI95% 1.4 to 1.8). Kilsztajn et al[19] found a statistical association between low weight and Apgar under 7 in the fifth minute.

Brazil has one of the higher rates of caesareans in the world. Although the surgical procedure has the potential of mitigating maternal and perinatal mortality, the abusive use of such procedure has the opposite effect[24]. The world health organization (WHO) considers 15% an acceptable caesarean rate. The rate of caesarean births from 2008 to 2012 was 36.3%, more than 2 times the recommended. Evaluating the relation to Apgar under 7, the authors didn't find any statistically significant correlation.

Carniel et al[14] found more than 50% of births by surgical way, newborns of caesareans showed 42% more chance to have LA (CI95% 1.34 to 1.5). Zorzi et al[25] also described

caesareans as a risk factor to Apgar under 7, but, in the fifth minute (OR 3.5, CI95% 1.2 to 10.6). Kiljsztajn et al[19] found divergent values on their research, which despite initially having found a relation in simple regression, found no statistical relevance when evaluating the data through multiple logistic regression (OR 0.89, CI95% 0.836 to 0.948 and OR 1.045, CI95% 0.977 to 1.117, respectively).

Most newborns analyzed in the present study (88.8%) were born on term, as in Li et al[8], that found 86.9% of on term newborn babies. The percentage of prematurity on the sample (8.8%) was higher than the one described by Carniel et al[14], Costa & Gotlieb[3], Rodrigues & Zagonel[26], that described respectively 6.5%, 4.8% to 9% and 5.4% to 7.3%.

When comparing gestational age with Apgar's Score, pre-term babies presented higher risk of LAS, especially those with under 32 weeks (RR 4.97, CI95% 4.45 to 5.55). The ones born with gestational age from 32 to 36 weeks and six days, presented 63% more chance of LAS (RR 1.63 CI95% 1.49 to 1.79)

Berglund et al[12] found a statistical correlation between pre-term labor and Apgar under 7 (OR 3, CI95% 1.4 to 6.1 in simple logistical analysis), as in post-term labor (OR 2.7, CI95% 1.5 to 4.7), fact not found in the present study (RR 0.96, CI95% 0.78 to 1.18).

## 5. CONCLUSION

The profile of patients assisted by Hospital Materno-Infantil Nossa Senhora de Nazaré from January, 2008 to December, 2012 was of women with ages between 21 and 30 years old, single, with 1 to 3 previous births, 8 to 11 years of study and that went through over 6 pre-natal appointments. As to the profile of newborn babies, there was a bigger prevalence of male newborns, with weight at birth varying from 3.000g to 3.999g, on term, by vaginal birth, with Apgar from 8 to 10. There was a significant statistical correlation between low Apgar score and the variables: maternal age, parity, number of pre-natal appointments, kind of birth, gestational age, weight at birth and gender of the newborn. Marital status and mother's educational degree showed no correlation with neonatal vitality in the first minute. An update on SINASC, with better stratification of maternal age groups would be useful in evaluating the proportion of elder mothers, over 35 years old. There is also the need of an uniformization in the concepts of LAS to facilitate the analysis of this variable. Another update that we see fit is the number of pre-natal appointments, 1 to 6, 6 to 8, considering the recent incorporation by the Ministry of Health of a minimum of 8 pre-natal appointments.

## CONFLICT OF INTEREST

The authors declares that there is no conflict of interest regarding the publication of this paper.

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