Low Apgar scores at 5 minutes in a low risk population: maternal and obstetrical factors and postnatal outcome

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Summary

Objective: To evaluate the association between Apgar scores of less than seven at five minutes ($AS^{5min} < 7$) and antenatal factors and postnatal outcomes. **Methods:** A retrospective cohort and case-control study of 27,252 consecutive term newborns in a low risk obstetrical population between January 2003 and December 2010. Maternal and infant databases were reviewed from all cases with $AS^{5min} < 7$ (n = 121; 0.4%) and 363 cases with $AS^{5min} \geq 7$ at 5 minutes who were randomly selected by a computer program. The main outcomes were neonatal death, newborn respiratory distress, need for orotracheal intubation and neonatal intensive care unit (NICU), and hypoxic-ischemic-encephalopathy. **Results:** After multiple regression analysis, repeated late decelerations on cardiotocography (OR: 2.4; 95% CI: 1.4-4.1) and prolonged second stage of labor (OR: 3.3; 95% CI: 1.3-8.3) were associated with $AS^{5min} < 7$, as well as neonatal respiratory distress (OR: 3.0; 95% CI: 1.3-6.9), orotracheal intubation (OR: 2.5; 95% CI: 1.2-4.8), need for NICU (OR: 9.5; 95% CI: 6.7-16.8), and hypoxic-ischemic-encephalopathy (OR: 14.1; 95% CI: 3.6-54.7). No other antenatal factors were associated with $AS^{5min} < 7$ ($p > 0.05$). **Conclusion:** Repeated late decelerations and prolonged second stage of labor in the low-risk population are predictors of $AS^{5min} < 7$, a situation associated with increased risk of neonatal respiratory distress, need for mechanical ventilatory support and NICU, and hypoxic-ischemic-encephalopathy.

Keywords: Apgar scores; term; asphyxia; neonatal mortality; hypoxic-ischemic-encephalopathy; delivery.

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Resumo

Baixos índices de Apgar no quinto minuto de vida em população de baixo risco: fatores maternos e obstétricos e resultados pós-natais

Objetivo: Avaliar a associação entre índice de Apgar menor que sete no 5º minuto, os fatores pré-natais e resultados pós-natais. **Métodos:** Trata-se de estudo retrospectivo com 27.252 recém-nascidos em maternidade escola com população de baixo risco obstétrico, de janeiro de 2003 a dezembro de 2010. Prontuários de todos os casos com índice de Apgar < 7 no 5º minuto (n = 121; – 0,4%) e de 363 casos com Apgar ≥ 7 no 5º minuto, escolhidos ao acaso, foram revisados. Os principais desfechos estudados foram: óbito neonatal, insuficiência respiratória neonatal, necessidade de intubação orotraqueal e de unidade terapia intensiva (UTI) neonatal e encefalopatia hipóxico-isquêmica. **Resultados:** Após análise de regressão múltipla, desacelerações tardias (DIP II) (OR: 2,4; IC95%: 1,4-4,1) e período expulsivo prolongado (OR: 3,3; IC 95%: 1,3-8,3) se associaram com Apgar < 7 no 5º minuto; assim como com insuficiência respiratória ao nascimento (OR: 3,0; IC 95%: 1,3-6,9), intubação traqueal (OR: 2,5; IC 95%: 1,2-4,8), necessidade de UTI neonatal (OR: 9,5; IC 95%: 6,7-16,8) e encefalopatia hipóxico-isquêmica (OR: 14,1; IC 95%: 3,6-54,7). Nenhuma outra variável prénatal se associou com Apgar < 7 no 5º minuto ($p < 0,05$). **Conclusão:** DIP II e período expulsivo prolongado estão associados com Apgar < 7 no 5º minuto em população obstétrica de baixo risco; situação essa relacionada com maior risco de insuficiência respiratória no parto, necessidade de suporte ventilatório e encefalopatia hipóxico-isquêmica.

Unitermos: Índice de Apgar; parto; asfixia; mortalidade neonatal; encefalopatia hipóxico-isquêmica.

Introduction

In 1952 the anesthesiologist Virginia Apgar proposed her score as a new method to evaluate the physical condition of newborns shortly after birth[1,2]. Initially the Apgar scores were created simply to classify the conditions of the newborn regarding obstetrical characteristics, maternal pain relief, and effects of resuscitation. Later, the Apgar scores determined at five minutes after delivery became widely used for the prediction of asphyxia as well as hypoxic-ischemic-encephalopathy and cerebral palsy[3-6]. A recent study showed that Apgar scores of less than 7 at five minutes ($AS^{5min} < 7$) after birth were associated with subtle cognitive impairment as measured by academic achievement at 16 years of age. However, the value of the $AS^{5min} < 7$ is still considered controversial by different studies and many neonatologists across the world[7,8].

In addition, it is not clear which maternal or obstetrical conditions may be associated with a low AS^{5min}. Studies suggested that multiparity, deficient prenatal care, low gestational age at birth, forceps, and abnormal cardiotocographic recording (CTG), such as repeated decelerations (DIP II), may be related to a low AS^{5min} [9-18].

The present study aimed to evaluate the consequences for the infant with $AS^{5min} < 7$ and the possible maternal or obstetrical factors that may be associated with this condition in a low-risk secondary maternity center at a university hospital.

Patients and methods

The hospital database was reviewed from January 2003 to December 2010. The present study was designed as a hospital-based cohort and a case-control format. All information was prospectively recorded in a computer database at this university hospital, which is a regional secondary hospital. The inclusion criteria were singleton pregnancy, and gestational age at delivery between 37 and 41 6-7 weeks. Exclusion criteria was fetal death. Since this maternity center is a secondary hospital, all pregnant women with any disease are referred to a tertiary hospital. Therefore, none of the patients included in the present study had any clinical disease.

Based on the database, a total of 27,254 consecutive term infants (37-42 weeks of gestation) were born during this period, and 121 (0.4%) newborns had an $AS^{5min} < 7$ at birth. In order to evaluate the possible associated predictor factors and the outcomes related to the $AS^{5min} < 7$, a total of 363 infants (three times the number of cases) with $AS^{5min} \geq 7$ were randomly selected by a computer program. The present protocol was approved by the institutional review board.

The following maternal and obstetrical data were evaluated: 1) maternal age; 2) parity; 3) prenatal care (yes or no) and number of visits; 4) gestational age at delivery (birth); 5) presence of repeated late decelerations considering the entire CTG trace during labor. A late deceleration is a smooth, gradual, symmetrical decrease in fetal heart rate beginning at or after the peak of the contraction and returning to baseline only after the contraction has ended. The onset, nadir, and recovery of the deceleration occur after the beginning, peak, and ending of the contraction, respectively. The magnitude of late decelerations is rarely more than 30 to 40 beats/min below baseline and typically not more than ten to 20 beats/min. Repeated late decelerations were considered as two repetitions every ten minutes, usually not accompanied by accelerations[19,20]; 6) presence of meconium; 7) umbilical cord prolapse; 8) shoulder dystocia; 9) clinical signs of chorioamnionitis; 10) presence and duration of premature rupture of the membranes (PROM); 11) type of delivery; 12) prolonged second stage of labor, defined as more than two hours from onset of second stage to birth, or three hours from onset of second stage to birth without or with regional anesthesia, respectively[21-23]; 13) vaginal delivery in breech presentation; 14) placental abruption; 15) uterine rupture; 16) episiotomy in vaginal deliveries; 17) maternal anesthesia and type (regional block or local pudendal anesthesia); and 18) small-size for gestational age, confirmed at birth by newborn weight below two standard deviations for gestational age[24].

Postnatal variables analyzed were: 1) newborn weight; 2) newborn respiratory distress, need for any respiratory support at the delivery room; 3) need for orotracheal intubation; 4) necessity for and duration of neonate intensive care unit (NICU); and 5) hypoxic-ischemic-encephalopathy defined according to the criteria by Sarnat and Sarnat[25], as altered level of consciousness, hypotonia, feeding difficulty of central origin or respiratory difficulty of central origin longer than 24 hours after birth associated with arterial blood pH lower than 7.20 within the first hours of life, confirmed by abnormal trasnfontanel ultrasonography (intracerebral or intraventricle hemorrhage) and abnormal eletroencephalogram (periodic pattern in wakefulness or obtundation, polymorphic sharp and slow waves of 50 μv to 200 μv, and alternating or continous delta activity, voltage intervals and isopotential). The diagnosis of hypoxic-ischemic-encephalopathy was confirmed in all cases at age six months.

During labor, all patients underwent continuous fetal heart monitoring with CTG. In the present study, all the data were collected by the first author (E.M.A.S.), but all CTG tracings were reanalyzed by R.R. who was blinded to the other information. The results were then analyzed by an independent author (J.A.D.B.C.).

The present protocol was approved by the institutional review board on October 17, 2008, under hospital ethical committee protocol number CEP-HU/USP: 854/09, and national Brazilian register number SISII-EP CAAE: 0064.0.198.000-08.

Statistical analysis

Univariable analysis was first performed using the chi-squared or Fischer's exact tests, Mann-Whitney's U test, and Student's *t*-test. The association between the prenatal factors and the $AS^{5min} < 7$, as well as between the $AS^{5min} < 7$ and the postnatal outcomes, were also estimated by calculating the odds ratio, likelihood ratio, and 95% confidence interval. Multi-variable analysis was performed using multiple logistic regressions. A p-value < 0.05 was considered statistically significant (SPSS for Windows version 17; Microsoft Corporation — Chicago, Il, USA and MedCalc software version 11.6, Mariakerke, Belgium).

Results

Population and sample characteristics

27,254 term infants were born at this maternity center during the study period. Mean maternal age was 26.1 ± 6.1 years. The great majority of cases were multiparous (n = 17,442; 64.0%), while 9,812 (36.0%) patients were nulliparous. Almost all patients (n = 26,708 – 98.0%) were followed by a regular prenatal care in this region, with at least seven consultations per patient. Non-operative vaginal delivery occurred in 11,447 (42.0%) patients while cesarean section and forceps were performed in 8,177 (30.0%) and 7,630 (28.0%) patients, respectively. No vacuum extractor was used in this hospital. Episiotomy was performed in 13,382 (71.5%) of the 19,007 patients that delivered vaginally. Mean gestational age at delivery was 39.6 ± 1.6 weeks. Mean newborn weight at birth was 3,278 ± 481.4 g. $AS^{5min} < 7$ occurred in 121 (0.4%).

Among the sample of 484 patients analyzed in the present study, the mean maternal age was 25.6 ± 6.7 years. The great majority of cases were multiparous (n = 302 – 62.4%), while 182 (37.6%) patients were nulliparous. Almost all patients (n = 473 – 97.7%) were followed by a regular prenatal care in this region with at least seven consultations per patient. Non operative vaginal delivery occurred in 187 (38.6%) patients, while cesarean section and forceps were performed in 150 (31.0%) and 147 (30.4%) patients, respectively. Episiotomy was performed in 239 (71.6%) of the 334 patients that delivered vaginally. Mean gestational age at delivery was 39.5 ± 1.4 weeks. Mean newborn weight at birth was 3,275.4 ± 480.9 g. There were no stillbirths during the study period.

Maternal/obstetrical factors associated with $AS^{5min} < 7$

Table 1 presents the maternal and obstetrical conditions related with $AS^{5min} < 7$. Prenatal factors associated significantly with $AS^{5min} < 7$ were: repeated late decelerations on CTG (OR: 2.5; 95% CI: 1.5-4.0), presence of meconium (OR: 1.9; 95%% CI: 1.2-2.9), use of forceps (OR: 1.7; 95% CI: 1.1-2.6), and prolonged second stage of labor (OR: 3.2; 95% CI: 1.3-7.8). Other prenatal factors were not statistically associated with $AS^{5min} < 7$. Repeated decelerations were observed in 42.0% of the patients that delivered by cesarean section, in 14.3% of the patients that delivered by forceps, and in 5.9% of the patients that delivered by normal vaginal delivery (p = 0.03). Prolonged second stage was observed in 1.3% of the patients that delivered by cesarean section, in 9.5% of the patients that delivered by forceps, and in 2.1% of the patients that had normal vaginal delivery (p = 0.04).

After multiple regression analysis, only repeated late decelerations on CTG (OR: 2.4; 95% CI: 1.4-4.1) and prolonged second stage of labor (OR: 3.3; 95% CI: 1.3-8.3) were statistically associated with $AS^{5min} < 7$, but not diagnosis of meconium (OR: 1.4; 95% CI: 0.8-2.3) and use of forceps (OR: 1.7; 95% CI: 0.6-4.6).

Postnatal outcomes associated with $AS^{5min} < 7$

Table 2 shows the postnatal outcomes according to the AS^{5min} of life. Neonatal respiratory distress was observed in 112 (92.6%) newborns with $AS^{5min} < 7$ (OR: 12.2; 95% CI: 6.0-24.9), and orotracheal intubation was needed in 86 (71.1%) infants with $AS^{5min} < 7$ (OR: 13.5; 95% CI: 8.3-21.9). 79 newborns with $AS^{5min} < 7$ were transferred to the NICU (OR: 11.5; 95% CI: 7.1-18.9), with a mean stay of 9.4 ± 5.1 days. Hypoxic-ischemic-encephalopathy was confirmed in 15 (12.1%) infants (OR: 17.0; 95% CI: 4.8-59.8) followed at this service. Multiple logistic regression analysis confirmed that $AS^{5min} < 7$ was associated with neonatal respiratory distress (OR: 3.0; 95% CI: 1.3-6.9), orotracheal intubation (OR: 2.5; 95% CI: 1.2-4.8), need for NICU (OR: 9.5; 95% CI: 6.7-16.8), and hypoxic-ischemic-encephalopathy (OR: 14.1; 95% CI: 3.6-54.7).

Discussion

The present study evaluated possible antenatal factors associated with $AS^{5min} < 7$, as well as outcomes related to this condition at birth. Since its description in 1952 by Virginia Apgar[1,2,26], the Apgar scoring system has been widely used in clinical practice at birth, but it still seeks validation. Many controversial results have been reported[3,6,7,27-29]. This may be explained by different reasons, such as the type of obstetrical population evaluated in different studies. In the present study, the antenatal risk factors and postnatal outcome related to the Apgar score were evaluated in a low risk population.

This university has two separate public hospitals, which follow strict rules. One is the university hospital at the university campus, where a secondary healthy care is provided to all obstetric patients from the west region of this city. In this facility, only low risk pregnancies are followed-up. Patients with clinical or obstetrical diseases such as preeclampsia, prematurity, fetal growth restriction, fetal malformations, diabetes, among others, are referred to the tertiary hospital.

Table 1 – Prenatal findings according to the Apgar score at 5 minutes of life

	Infants with Apgar ≥ 7 at 5 minutes (n = 363)	Infants with Apgar < 7 at 5 minutes (n = 121)	Univariate analysis		Multivariate analysis	
			p	OR (95% CI)	p	OR (95% CI)
Maternal age in years – mean (SD)	25.6 ± 6.7	25.6 ± 6.4	0.92	–	0.99	–
Nulliparous – n (%)	139 (38.3%)	43 (35.5%)	0.59	0.9 (0.6-1.4)	0.48	0.5 (0.4-1.3)
Prenatal care – n (%)	355 (97.8%)	118 (97.5%)	1	0.9 (0.2-3.4)	0.94	0.0 (0.2-5.6)
Number of visits in prenatal care – median (range)	7 (0 - 14)	7 (0 - 16)	0.68	–	0.74	–
Repeated late decelerations on cardiotocography – n (%)	57 (15.7%)	38 (31.4%)	< 0.01	2.5 (1.5-4.0)	< 0.01	2.4 (1.4-4.1)
Meconium – n (%)	91 (25.1%)	47 (38.8%)	< 0.01	1.9 (1.2-2.9)	0.21	1.6 (0.8-2.3)
Breech delivery – n (%)	5 (1.4%)	1 (0.8%)	0.63	0.6 (0.1-5.2)	0.78	0.3 (0.1-4.2)
Umbilical cord prolapse – n (%)	1 (0.3%)	3 (2.5%)	0.06	1.0 (0.9-1.1)	0.24	1.1 (0.2-2.1)
Shoulder dystocia – n (%)	8 (2.2%)	2 (1.7%)	0.71	0.7 (0.2-3.6)	0.53	0.9 (0.1-3.3)
Chorioamnionitis – n (%)	1 (0.3%)	1 (0.8%)	0.41	3.0 (0.2-48.6)	0.26	3.0 (0.3-59.4)
Premature rupture of membranes – n (%)	106 (29.2%)	32 (26.5%)	0.56	0.9 (0.6-1.4)	0.51	0.8 (0.4-2.4)
Duration of PROM in hours – median (range)	8.0 (2.0 - 840.0)	10.0 (5.0 - 48.0)	0.11	–	0.31	–
Gestational age at delivery in weeks – mean (SD)	39.5 ± 1.5	39.6 ± 1.2	0.79	–	0.86	–
C-section – n (%)	107 (29.5%)	43 (35.5%)	0.21	1.3 (0.9-2.0)	0.66	1.1 (0.4-2.5)
Forceps – n (%)	100 (27.6%)	47 (38.8%)	0.02	1.7 (1.1-2.6)	0.41	1.7 (0.6-4.6)
Prolonged second stage of labor – n (%)	10 (2.8%)	10 (8.3%)	< 0.01	3.2 (1.3-7.8)	< 0.01	3.3 (1.3-8.3)
Placental abruption – n (%)	4 (1.1%)	3 (2.5%)	0.27	2.3 (0.5-10.3)	0.35	2.1 (0.4-10.6)
Uterine rupture – n (%)	0 (0%)	0 (0%)	1	–	1	–
Episiotomy* – n (%)	174 (67.9%)	58 (74.4%)	0.58	1.2 (0.7-2.1)	0.29	1.1 (0.5-1.9)
Maternal anesthesia – n (%)	336 (92.6%)	116 (95.9%)	0.21	1.9 (0.7-5.0)	0.79	1.1 (0.5-3.5)
Small for gestational age at birth – n (%)	44 (12.1%)	11 (9.1%)	0.36	0.7 (0.3-1.5)	0.66	0.4 (0.1-2.5)

SD, standart deviation; PROM, premature rupture of the membranes. *Cases delivered by cesarean-section were excluded.

The second hospital is a tertiary complex (Hospital das Clinicas, Medical School, Universidade de São Paulo – USP), where tertiary health care is provided to the entire city, including the west region. Therefore, all pregnant patients that need more specialized treatment and care are referred to the tertiary hospital.

In the present study, a sample randomly selected by a computer program from the entire population of the secondary hospital was evaluated in order to better analyze the prenatal predictor factors for $AS^{5min} < 7$ in a low-risk obstetrics population. Although the hospital has a prospectively-collected computer database, some of the information needed more details. One example was the analysis of the fetal heart monitoring (CTG), which was reviewed by one of the investigators without any knowledge regarding the score of $AS^{5min} < 7$. The sample characteristics were very similar to the population characteristics, which confirmed that the results obtained in the present study can be generalized to the present population assisted at this low-risk maternity center.

Maternal age and parity were not associated with $AS^{5min} < 7$ in the present study, confirming previous reports[27,29,30]. In this population, almost all pregnant women had access to the prenatal care, which was not correlated with $AS^{5min} < 7$. Chorioamnionitis, umbilical cord

Table 2 – Postnatal outcomes according to the Apgar score at 5 minutes of life

	Infants with Apgar ≥ 7 at 5 minutes (n = 363)	Infants with Apgar < 7 at 5 minutes (n = 121)	Univariate analysis		Multivariate analysis	
			p	OR (95% CI)	p	OR (95% CI)
Neonatal weights at birth in grams – median (range)	3271.7 ± 481.3	3286.6 ± 481.6	0.77	–	0.83	–
Neonatal respiratory distress – n (%)	183 (50.4%)	112 (92.6%)	< 0.01	12.2 (6.0-24.9)	< 0.01	3.0 (1.3-6.9)
Neonatal intubation – n (%)	56 (15.4%)	86 (71.1%)	< 0.01	13.5 (8.3-21.9)	< 0.01	2.5 (1.2-4.8)
Necessity of NICU – n (%)	51 (14.1%)	79 (65.3%)	< 0.01	11.5 (7.1-18.5)	< 0.01	9.5 (6.7-16.8)
Duration of NICU in days – median (range)	3.2 ± 5.6	9.4 ± 5.1	0.31	–	0.54	–
Neonatal death – n (%)	0 (0%)	1 (0.8%)	0.08	–	0.21	–
Hypoxic-Ischemic encephalopathy – n (%)	3 (0.8%)	15 (12.4%)	< 0.01	17.0 (4.8-59.8)	< 0.01	14.1 (3.6-54.7)

NICU, neonatal intensive care unit.

prolapse, placental abruption, uterine rupture, shoulder dystocia, premature rupture of the membranes, and small-size for gestational age were also not associated with $AS^{5min} < 7$, a finding supported by previous studies[27,29,30]. This fact may be explained by the low frequency of these complications in a low-risk population, but further studies are necessary in high-risk pregnancies. Hogan et al.[12] reported that shoulder dystocia was statistically associated with $AS^{5min} < 7$, occurring in 3% of cases with $AS^{5min} < 7$ but in no cases with Apgar score ≥ 7. In our experience, the presence of shoulder dystocia occurred in 2.2% of cases with $AS^{5min} < 7$ and in 1.7% of cases with $AS^{5min} \geq 7$, and this condition was not associated with $AS^{5min} < 7$. At this hospital, a strict protocol for the management of shoulder dystocia is followed, is in accordance with the guidelines[31].

Interestingly, the vaginal delivery of fetuses in breech presentation was also not associated with $AS^{5min} < 7$. This fact had also been observed by Locatelli et al.[30], although many other studies reported an association with vaginal delivery in breech presentation and $AS^{5min} < 7$ or umbilical artery acidemia in infants at term[32-35]. Recent studies have suggested that neonatal outcome in vaginal breech delivery is related to the experience of the senior obstetricians and the newborn weight with worse outcomes in cases weighting less than 1,500 g[33,36].

In our hospital, episiotomy was performed in 72% of cases, and was not associated with $AS^{5min} < 7$. Similar results were observed by many other investigators[12,37-42]; however, others have suggested that not performing the episiotomy may cause a prolonged second stage of labor, leading to reduced AS^{5min} and umbilical artery academia at birth[39,43,44].

In the present study, presence of repeated late decelerations on the CTG trace and prolonged second stage of labor were statistically associated with $AS^{5min} < 7$, after multiple logistic analysis. These findings were in accordance with previous experiences[12,30,32]. However, studies have suggested that the presence of meconium and operative vaginal delivery were associated with $AS^{5min} < 7$. These factors were also statistically related to $AS^{5min} < 7$ in the present study when analyzed separately; however, after the multivariable analysis, these two factors were not independent predictors for $AS^{5min} < 7$. This means that meconium was frequently present in cases with abnormal CTG and that forceps were usually applied in those patients to shorten the prolonged second stage, especially in fetuses under distress (abnormal CTG). The multiple analysis in the present series allowed the study of these aspects in more detail. For example, if the type of delivery in patients with repeated decelerations is evaluated without contextual analysis (other variables), cesarean section was more frequently performed in those patients, but was not associated with prognosis ($AS^{5min} < 7$ and hypoxic-ishemic-encephalopathy). Therefore, the present results clearly support that cesarean section was performed to rescue many of these fetuses that were under stress during labor. The same rationale should be applied for the relationship between the use of the forceps and prolonged second stage of labor. In the simplest analysis (univariate), forceps were more used in cases with prolonged second stage of labor, but this procedure was not associated with $AS^{5min} < 7$ and, by consequence, hypoxic-ischemic-encephalopathy. The presence of repeated CTG decelerations in less than ten minutes was an indication of emergent delivery by either forceps or cesarean section in the present study.

The results also confirmed that $AS^{5min} < 7$ is useful to predict postnatal outcomes, such as neonatal respiratory distress, need for orotracheal intubation and NICU, and

hypoxic-ischemic-encephalopathy. These findings were supported by other investigators[6,12,27]. Casey et al.[3] showed that an $AS^{5min} < 3$ increased the risk of neonatal death by eight times. In the present study, neonatal death was extremely rare, since the population was based on low-risk term singleton cases. Other authors showed, conversely, that AS^{5min} was a poorer predictor of long-term neurological outcome, especially when lower gestational age was considered[7,45]. The discrepancy in these opinions may be explained by the population analyzed. It seems that the Apgar score system is less accurate in predicting long-term outcome in extreme preterm babies or in other maternal/obstetrical conditions[7,45]. There are also controversial results regarding the correlation between the Apgar score system and the umbilical artery acidemia at birth in low- and high-risk obstetrical populations[30,46]. This study did not aim to compare the Apgar score with the umbilical artery acidemia at birth, but instead to evaluate the association of the clinical Apgar score with antenatal factors (causality) and postnatal outcomes (consequences) in this low-risk population.

In the literature, the incidence of hypoxic-ischemic-encephalopathy is estimated to be from 3 to 8 out of 1,000 live births[33]. The present study did not aim to evaluate the incidence of hypoxic-ischemic-encephalophaty at this hospital, since it was a retrospective study in which samples were selected based on the AS^{5min}. Therefore, it is not possible to conclude the incidence of hypoxic-ischemic-encephalophaty in this service based on the present results.

In conclusion, prolonged second stage of labor and repeated late decelerations on CTG trace in a low-risk population were predictors of $AS^{5min} < 7$, a situation that was strongly associated with increased risk of neonatal respiratory distress, and need for mechanical ventilatory support and NICU. In addition, $AS^{5min} < 7$ was strongly associated with hypoxic-ischemic-encephalopathy and, consequently, cerebral palsy.

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