Association of natal and maternal risk factors with neonatal Apgar score in Mosul.

Abstract:

Background: The Apgar score is a recognized and practical way to report a newborn infant's condition at 1st and 5th minutes after birth and their reaction to resuscitation, if necessary; nonetheless, it has been improperly used to forecast specific negative neurologic outcomes.

Aim of the study: To identify the most frequent maternal risk factors associated with low Apgar scores among newborns and evaluate the effect of neonatal sex, type of delivery, mothers' age on Apgar score at Al-Batool Teaching Hospital in Mosul.

Methodology: This study used a cross-sectional Hospital based study design to achieve the study objectives. The data was obtained and collected from 93 maternal and neonatal record files for the mothers who delivered at Al-Batool Teaching Hospital for the period from 1st May 31st June 2023 with a simple random sampling method was used. All maternity data for women and full-term newborns, regardless of the delivery method, meet the inclusion criteria for this study. All maternal files involving home births, premature births, and referrals from other facilities following deliveries were disqualified. The information was gathered and examined by researchers.

Results: The current study involved 93 full term neonates; 58 were males and 35 were females with male: female ratio of 1.65:1. Of them 35 (37.6%) neonates delivered by normal vaginal delivery while the remaining 58 (62.4%) delivered through cesarean section. The mean Apgar score at 1 min was 5.311±2.274 while at 5 min. was 7.462± 1.891 and the mean maternal age was 27.57± as 5.942 years. The commonest risk factors found was obstructed labor with mean Apgar score of 3.381±1.687 at 1 min and 6.142±1.768 at 5 min, followed by previous 2 CS and meconium stained liquor. Neonates with no maternal risks had mean Apgar score of 8.285±0.755 at 1 min and 9.571±0.534 at 5 min. The statistical difference between Apgar score at 1 and 5 min was significant for each of males and females while the difference between males and females was not significant at each of 1 and 5 min. The mean Apgar score at 5 min was significantly higher than that at 1 min for those with maternal risk the difference between those with maternal risk and those with no maternal risk was statistically significant for both at 1 min and 5 min.

Furthermore, mean Apgar score at 5 min was significantly higher than that at 1 min for normal vaginal delivery and cesarean section while the difference between Apgar score in normal vaginal delivery and cesarean section at each of 1 and 5 min was not significant. The Apgar scores for at both 1 and 5 min were not significantly correlated with the mothers' ages.

Conclusions: Mothers who had obstructed labor, had newborns with low Apgar score. At both 1 and 5 minutes, there was a statistically significant difference between the groups with and without maternal risk. The difference in the Apgar score at 1 and 5 minutes for male and female newborns and between those who delivered vaginally normally and via cesarean section was not statistically significant.

Keywords: Apgar score, Maternal risk, Neonates

Introduction:

Dr. Virginia Apgar created a score in the early 1950s to evaluate the newborn's physical status and whether resuscitation is necessary [(1)].The score was initially

assessed at 1st minute post delivery, but it was later discovered that the Apgar score at 5 minutes was a stronger indicator of neonatal survival [2].The five factors that make up the Apgar score—heart rate, respiratory effort, muscular tone, reflex irritability, and color—are each assigned a number between 0 and 2. As a result, total scores might be anywhere from 0 to 10, with higher values indicating greater physical health. Among term newborns (born after 37 weeks), a low Apgar score (usually defined as less than 4 or less than 7) is linked to a higher risk of neonatal death [3]. The risk of newborn death was recently revealed to be higher among term infants with 5-minute Apgar scores in the normal range (7 to 10) than among those with scores of 7 or 8 [4].

The Apgar score is a recognized and practical way to report a newborn infant's condition at 1st and 5th minutes after birth and their reaction to resuscitation, if necessary; nonetheless, it has been improperly used to forecast specific negative neurologic outcomes [5].

The Neonatal Resuscitation Program recommendations specify that the examination should be repeated every 5 minutes for up to 20 minutes if the Apgar score is less than 7 at 5 minutes. However, a score given during resuscitation is not identical to one given to a baby that is breathing on its own [6].

Since many of the factors that affect the Apgar score are changed by resuscitation, there is no established standard for reporting an Apgar score in newborns receiving resuscitation after birth. Although the idea of an aided score that takes resuscitative efforts into account has been floated, the predictive validity has not been investigated. An enhanced Apgar score report form is recommended to accurately describe these infants, offer accurate documentation, and collect reliable data [7]. Numerous elements, such as maternal sedation or anesthesia, congenital defects,

gestational age, trauma, and inter-observer variability, might affect the Apgar score. Additionally, before the score is impacted, the metabolic disturbance needs to be considerable [8].

The purposes of this study were to identify the most frequent maternal risk factors associated with low Apgar scores among newborns and evaluate the effect of neonatal sex, type of delivery, mothers' age on Apgar score at Al-Batool Teaching Hospital in Mosul.

Methodology:

Study design:

This study used a cross-sectional Hospital based study design to achieve the study objectives.

Study setting:

The data was collected from 93 maternal and neonatal record files for the mothers who delivered at Al-Batool Teaching Hospital for the period from 1st May 31st June 2023 with a simple random sampling method was used. All maternity data for women and full-term newborns, regardless of the delivery method, meet the inclusion criteria for this study. Excluded were any maternal files including home births, premature births, or referrals from other facilities following births.

Data collection and analysis:

A document evaluation checklist created by the researchers in English was used to gather data. The data gathering tool's authenticity and dependability were guaranteed. Obstetric and pediatric specialists with more than five years of experience were asked to evaluate the data collecting tool's clarity, relevance, and simplicity in order to ensure validity. Prior to the actual trial, the instrument was

piloted on 10% of the maternal records to make sure that all crucial reliability-related characteristics were addressed. The Statistical Package for the Social Sciences (SPSS) version 26 was used to analyze the data. The maternal factors linked with the Apgar score at 1 and 5 minutes were investigated using the student t-test for independent and dependent two means, with a significance level of 0.05.

Results:

The current study involved 93 full term neonates; 58 were males and 35 were females with male: female ratio of 1.65:1.

Of them 35 (37.6%) neonates delivered by normal vaginal delivery while the remaining 58 (62.4%) delivered through cesarean section. The mean Apgar score at 1 min was 5.311±2.274 while at 5 min. was 7.462± 1.891and the mean maternal age was 27.57± as 5.942 years as shown in table (1).

Table (1): Study characteristics.

Study characteristics		**Frequency**	**Percentage**
Sex	Male	58	62.4
	Female	35	37.6
Types of delivery	NVD	35	37.6
	CS	58	62.4
Apgar score		**Mean**	**Standard deviation**
At 1 min		5.311	2.274
At 5 min		7.462	1.891
Maternal age		27.57	5.942

The distribution of the mother according to the maternal risk showed in figure (1), it illustrated that 7 mothers had no risk factors. The commonest risk factors found was obstructed labor in 21 mothers followed by previous 2 CS in 12 mothers, and meconium stained liquor in 11 mothers.

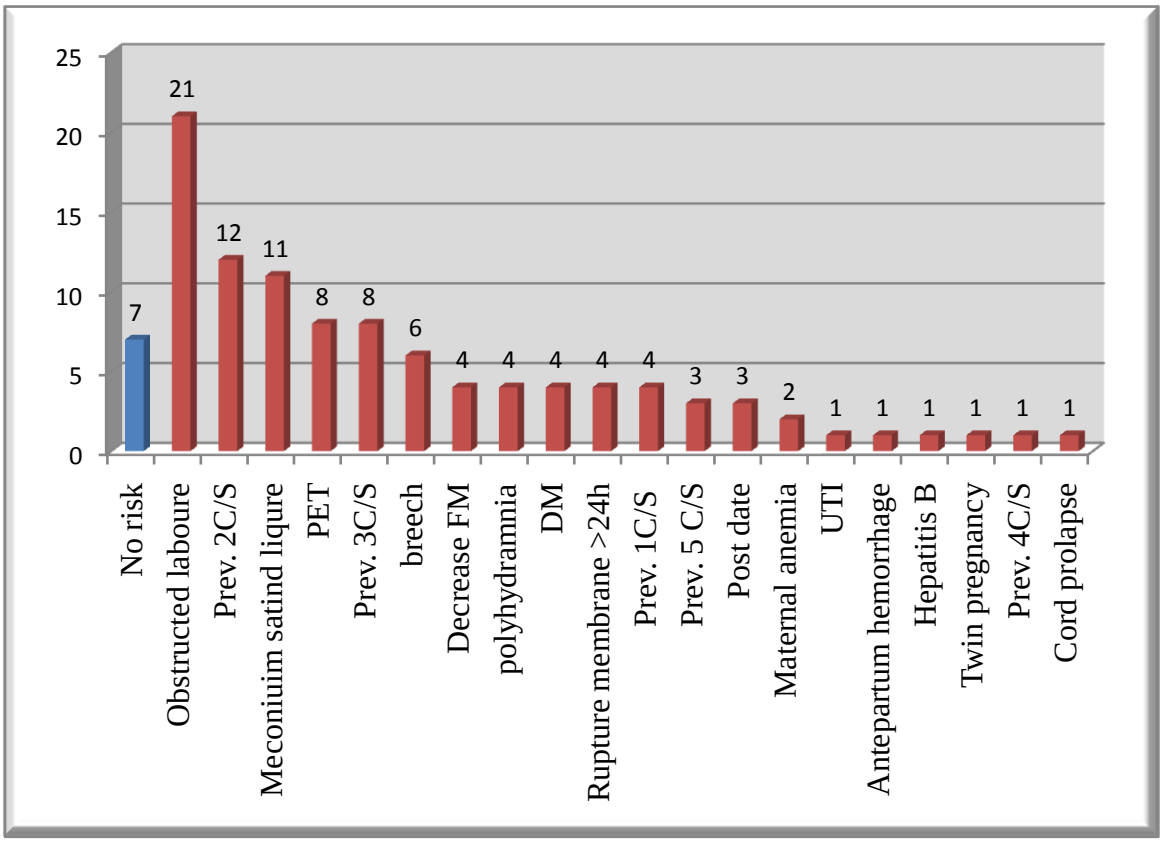

Figure (1): The distribution of the mother according to the maternal risk.

Mean of Apgar at 1 and 5 min according to maternal risk demonstrated in table (2). The table showed that neonates with no maternal risks had mean Apgar score of 8.285±0.755 at 1 min and 9.571±0.534 at 5 min. The risk of obstructed labor was the commonest among the mothers and their neonates had the lowest mean Apgar score of 3.381±1.687 at 1 min and 6.142±1.768 at 5 min.

Table (2): Mean of Apgar at 1 and 5 min according to maternal risk.

Maternal variables	Frequency	Apgar At 1 min	Apgar At 5 min
No risk	7	8.285±0.755	9.571±0.534

Obstructed labor	21	3.381±1.687	6.142±1.768
Prev. 2C/S	12	5.750±1.815	7.416±1.781
Meconiumstainedliquor	11	4.545±2.659	6.818±2.522
PET	8	5.375±2.133	7.375±2.065
Prev. 3C/S	8	5.875±2.416	7.500±1.511
breech	4	6.500±1.732	8.250±1.258
Decrease FM	4	6.000±1.414	8.000±0.816
Polyhdramnios	4	5.000±1.414	7.750±0.500
DM	4	4.250±2.217	6.250±2.362
Rupture membrane >24h	4	5.250±1.258	7.750±0.957
Prev. 1C/S	4	7.25±1.50	8.50±1.00
Prev. 5 C/S	3	4.33±3.055	6.33±2.886
Post date	3	6.333±3.055	9.000±1.732
Maternal anemia	2	5.50±2.121	8.50±0.707
UTI	1	8.0±0.0	9.0±0.0
Antepartum hemorrhage	1	3.0±0.0	9.0±0.0
Hepatitis B	1	8.0±0.0	9.0±0.0
Twin pregnancy	1	4.0±0.0	5.0±0.0
Prev. 4C/S	1	7.0±0.0	10.0±0.0
Cord prolapsed	1	4.0±0.0	8.0±0.0

The comparisons of Apgar score between 1 and 5 min and between sexes demonstrated in table (3) and revealed that mean Apgar score at 1 min was 5.362±2.157 among males and 5.228±2.486 among females while at 5 min was 7.431±1.758 among males and 7.514±2.119 among females. The statistical difference between Apgar score at 1 and 5 min was significant for each of males and females while the difference between males and females was not significant at each of 1 and 5 min.

Table (3): The comparisons of Apgar score between 1 and 5 min and between sexes.

Sex	**Apgar at 1 min.**	**Apgar at 5 min.**	**p-value ***
	Mean ± SD	**Mean ± SD**	
Males (n=58)	5.362±2.157	7.431±1.758	**0.000**

Females (n=35)	5.228±2.486	7.514±2.119	**0.000**
p-value **	0.785	0.838	

* Paired t-test has been used ; **t-test for independent two means

The comparisons of Apgar score between 1 and 5 min and between maternal risks was demonstrated in table (4). The table elicited that mean Apgar score at 5 min was significantly higher than that at 1 min for those with maternal risk (7.290 ±1.858 vs 5.069 ± 2.184) and those with no maternal risk (9.571± 0.534 vs 8.285± 0.755). Moreover, the difference between those with maternal risk and those with no maternal risk was statistically significant for both at 1 min (p=0.000) and (p=0.002) and 5 min.

Table (4): The comparisons of Apgar score between 1 and 5 min and between maternal risks.

Maternal risk	**Apgar at 1 min.**	**Apgar at 5 min.**	**p-value** *
	Mean ± SD	**Mean ± SD**	
With maternal risk (n=86)	5.069 ± 2.184	7.290 ±1.858	**0.000**
With no maternal risk (n=7)	8.285± 0.755	9.571±0.534	**0.000**
p-value **	**0.000**	**0.002**	

* Paired t-test has been used ; **t-test for independent two means

The comparisons of Apgar score between 1 and 5 min and between types of delivery demonstrated in table (5) and revealed that mean Apgar score at 5 min was significantly higher than that at 1 min for normal vaginal delivery (7.314±2.068 vs 4.885±2.620) and cesarean section (7.551±1.788 vs 5.569±2.018) while the difference between Apgar score in normal vaginal delivery and cesarean section at each of 1 and 5 min was not significant.

Table (5): The comparisons of Apgar score between 1 and 5 min and between types of delivery.

Types of delivery	Apgar at 1 min.	Apgar at 5 min.	p-value *
	Mean ± SD	Mean ± SD	
NVD (n=35)	4.885±2.620	7.314±2.068	**0.000**
CS (n=58)	5.569±2.018	7.551±1.788	**0.000**
p-value **	0.162	0.560	

* Paired t-test has been used ; **t-test for independent two means

The correlation of mothers' ages with Apgar score demonstrated in table (6). The Apgar scores for at both 1 and 5 min were not significantly correlated with the mothers' ages.

Table (6): The correlation of mothers' ages with Apgar score.

Pearson's R	*r*	Asymp. Std. Error[a]	Approx. T[b]	p-value
Apgar at 1 min	0.080	0.101	0.766	0.446[c]
Apgar at 5 min	0.122	0.097	1.176	0.243[c]
N of Valid Cases	93			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Discussion:

The mean maternal age for the mothers of neonates included in the present study was 27.57 years with standard deviation of 5.942 years. The correlations of the maternal age with Apgar scores at 1 and 5 min were statistically not significant. A comparable result showed in a study conducted by Lungameni*et al.*,[(9)] in which the mean mothers' age was 29 years and the study showed no significant correlation between the initial Apgar score and age (p>0.897). Also Getachew*et al.*,[(10)] study

reported that about 75.6% of the mothers were aged 21–34 years. Similarly, in Iran [11] and Malaysia [12], the studies reported no connection between low Apgar scores and maternal age groups. Straube*et al.,* 2010 [13] showed that the maternal age had an influence on Apgar score of newborns. Additionally, Ibrahim*et al.,*[14] study from Ethiopia found an association between maternal age with Apgar score.

The current study examined the question whether full term neonates show similar sex-related differences in their 1 and 5min Apgar scores. The current study found that there were significant improvements at 5 min in comparison to 1 min but there were no significant difference between males and females at both times of Apgar score. In contrary, Nagy *et al.,* [15] study reported that the lower Apgar scores was associated more with full-term, male, in comparing to female newborns. Moreover, a large population-based study conducted by Lima*et al.,*[16] found that male sex was independently associated with low Apgar score with subsequent neonatal death. The relationship between the male sex and lower Apgar scores thus, may be directly or indirectly related to the sexrelated gestational differences, instead of a direct sex–Apgar score link.

In the present study, the neonates of mothers with no maternal risks showed normal Apgar scores while those of mothers with different risk showed low Apgar scores especially at 1 min. Different risks were assessed in this study and the mothers with obstructed labor had lowest Apgar scores of their neonates. Mothers with previous 2 and 3CS, PET, breech,rupture membrane >24h, decrease fetal movement,polyhdramnios,post date, cord prolapsed, Antepartum hemorrhage, and maternal anemia showed Apgar score <7 at 1 min and improved at 5min while those with twin pregnancy, previous 5 CS, DM, and meconium stained liquor, the Apgar score at 5 min still below 7. Furthermore, the current work showed significant differences between those with and without maternal risk at 1 and 5 min

in addition to significant difference between Apgar score at 1 and 5 min for each of mothers groups.Similar finding regarding the prolonged obstructed laourwa detected by Altman *et al.,* in Sweden [17], by Salustiano*et al.,* in Brazil [18], and by Gudayu in Ethiopia [19]. The reason for low Apgar score could be due to fetal distress resulted from prolonged duration of labor.Studies carried out in Ethiopia found that 18.5% of newborns were delivered using meconium-stained amniotic fluid. The high proportion of newborns delivered following meconium-stained amniotic fluid with either grade 2 (3.1%) or grade 3 (96.9%) meconium can be used to explain the significant association between the meconium grades and the immediate Apgar score found in the study (p=0.000). These outcomes were in line with research by Sori[20], who noted that liquor was grade 2 or grade 3 meconium stained in 74.8% of the cases. Other studies from Gonder, Northwest Ethiopia [21] and India [22] also showed low Apgar scores in these patients. This may be because infants born to women who had amniotic fluid stained with meconium are more likely to aspirate it, filling the lung's tiny airways and alveoli. This may result in restricted lung mobility and airway blockage. A low Apgar score indicating birth asphyxia could then develop as a result of inadequate gas exchange. The two primary causes of cesarean sections linked with an immediate low Apgar score in China were observed to be fetal distress and eclampsia[23]. Comparing neonates whose mothers experienced antepartum hemorrhage to those whose mothers did not, it was discovered that the likelihood of having a poor Apgar score increased by around 3.96 times, a finding that was also made in studies carried out in Addis Ababa, Ethiopia [24] and Tigray, Ethiopia [25]. Because of the effects of antepartum bleeding, this theory may be plausible.

Lungameni*et al.*,[9] study found that diabetes mellitus (p>0.298), HIV (p>0.442), pregnancy induced hypertension(p>0.156), and UTI (p>0.140) werenot associated

with immediate Apgar score. On the opposite, in a study carried out in Turkey[26], an associated was found between diabetes mellitus and low Apgar score.

According to Adebami[27], low HB and intrauterine anemia put pregnant women in Nigeria at risk for giving birth to infants with low Apgar scores. According to other studies, mothers who neglected healthy eating habits or had iron deficiency anemia in the second trimester may have caused low nutrients, failing to meet the fetal development's nutritional needs, which resulted in the newborn's low Apgar score.

The outcomes of Lungameni*et al.*'s [9] study also show a correlation between poor initial Apgar scores and the following prenatal problems. Similar findings were reported in Brazil by Santos and colleagues [28] who found that inadequate vaginal examination could extend the second stage of labor and result in CPD, which is linked to a low Apgar score. Tewesa*et al.*[29] did not discover any correlation between APH, CPD, and a poor Apgar score.

According to Sahanak's[30] research, newborns whose mothers underwent general anesthesia for a CS had poor Apgar scores. This is because the concentration of anesthetic drugs in the mother's blood might lead to cardiovascular depression, which interferes with placental perfusion and fetoplacental exchange and may lower the Apgar score [31].

While variations between mean Apgar scores at 1 and 5 minutes were significant for both normal vaginal birth and CS, the mean difference between babies from vaginal delivery and cesarean delivery was not significant at either 1 or 5 minutes in this study. Similar result was reported by the study of Rahmanian*et al.*, 2014 [32] who concluded that difference between mean Apgar score was not significant at 5 minutes of birth from CS and NVD.Moreover, Lungameni*et al.*,[9] found significant connection between the types of deliveries and the instant low Apgar

score ($p<0.000$) whether CS or NVD. The relationship between NVD and Apgar score < 7 may be due to actionsas, well as, complications throughout childbirth, such as labor duration and breech presentation, which may had impact on choosingmethod of the delivery [33-35].Opposite to the present study, a study conducted by Paudyal[36],significant difference was found between the mean Apgar score in 1st and 5th minutes after birth while there is no significant difference between Apgar score among newborns in vaginal delivery and cesarean delivery in 1st and 5th minutes after birth.

In the present study Apgar score for normal vaginal delivery and CS were below 7 at 1 min and increased to be above 7 at 5 min.Tavares *et al.*, [37] study found that along with the factors linkedtoApgar score < 7 at 5th min, the NVD had a association of threefold times.A further study conducted by Lai *et al.*, 2017[38]stated thatdelivery by cesarean was linked with low to moderate Apgar score than NVD. However, the verificationconcerning the relationship between mode of delivery and Apgar score is contentiousas declared by Khalid *et al.*, 2018[39] and Rahmanian*et al.*, 2014[32]. A study prepared by Kilsztajn*et al.*,2007 [40]found that neonates born through CS had higher Apgar score compared to NVD. Likewise, study done by Fajar*et al.*,2017 [41]recommended that neonatal outcomes were better in breech presentation than NVD and found significant relationship between Apgar score and mode delivery. But some researchers proposed that mode of delivery had no impact on Apgar score as concluded by Burt *et al.*,[42] study.

Conclusions:

Mothers who had obstructed labor, had newborns with low Apgar score. At both 1 and 5 minutes, a significant statistical difference was observed between the groups with and without maternal risk. The difference in the Apgar score that calculated at 1 and 5 minutes for male as, well as, female newborns and between those who

delivered vaginally normally and via cesarean section was not statistically significant.

Ethical Approval and Consent:A detailed explanation of what the research is for pregnant women was done before entering the maternity hall, and verbal consent was taken for their newborn children to be included in the research.

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