

# Effect of Supplemental Oxygen on Apgar Score of Newborns in Pregnant Women Undergone Cesarean Section with Spinal Anesthesia

Nima Nazari<sup>1</sup>, Afzal Shamsi<sup>2,\*</sup>, Husam Kareem Mghames<sup>3</sup> and Aymen Othman Fattah<sup>4</sup>

<sup>1</sup>Anesthesia, Critical Care and Pain Management Research Center, Tehran university of medical sciences, Tehran, Iran.

<sup>2</sup>School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran. Nursing and Midwifery Care Research Center, Tehran University of Medical Sciences, Tehran, Iran.

<sup>3</sup>Fellowship of the Iraqi Medical Board in Anesthesia and Intensive Care. Head of ICU, Al Imam Ali General Hospitals. Lecturer, Al Salam College University. Baghdad, Iraq.

<sup>4</sup>Department of Anesthesia, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.

Corresponding author: Afzal Shamsi (e-mail: [afzal\\_sh63@yahoo.com](mailto:afzal_sh63@yahoo.com)).

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**Abstract Background:** In obstetrics, there have been discussions and changes in procedures surrounding the provision of extra oxygen during cesarean sections performed under spinal anesthesia. Despite its recognized benefits in maintaining maternal cerebral oxygenation, concerns persist about its impact on neonatal health, especially regarding newborn oxygen saturation levels. This gap in understanding the direct effects on immediate neonatal outcomes, particularly Apgar scores, underscores the need for further research. This study aimed to determine the effectiveness of O<sub>2</sub> supplement on Apgar scores at one and five minutes post-delivery in newborns of mothers undergoing cesarean sections with spinal anesthesia. **Methodology:** Through randomized sampling, 100 patients from two hospitals in Iraq were included in this interventional trial. Following approval for research and establishment of inclusion and exclusion criteria, the researcher gathered patient sociodemographic information and average score. The sample is divided into two groups: (50) participants as a study group and (50) participants considered as a control group. With a significance threshold 0.05, the gathered data were examined using descriptive and inferential statistics in Statistical Package for the Social Sciences software version 22. **Results:** The results demonstrated that the most represented age group in both study and control groups was 25-30 years, and the least represented was 35-40 years. The highest BMI category was 'overweight' in both groups, while 'obese' was the least common. Regarding birth weights, the study group had a higher percentage of normal birth weights than the control group. In APGAR scores after 5 minutes, a significantly higher percentage of newborns in the study group had reassuring scores (7 to 10) compared to the control group. Furthermore, a relevant difference in outcomes was shown by a significant link between the study group and the impact of O<sub>2</sub> supplement on APGAR score at (p-value 0). Sociodemographic factors such as age, education level, occupation, BMI, and gestational age showed no significant correlation with APGAR scores, underscoring the complexity of these factors' influence on neonatal outcomes. **Conclusion:** The study found that supplemental oxygen positively affects newborns' APGAR scores during Cesarean sections with spinal anesthesia, with the study group showing better scores than the control group. It suggests that improving prenatal care, training in neonatal care, ensuring medical equipment availability, and enhancing obstetric research and education are vital for better neonatal and maternal care in Iraq, ultimately leading to improved health outcomes for mothers and newborns.

**Key Words** Supplemental oxygen, Apgar score, Newborns, Pregnant women, Cesarean section, Spinal anesthesia

## 1. Introduction

Under regional anesthesia, the various effects of additional oxygen delivery have been thoroughly studied in participants planned for a Cesarean section, elective, or emergency (C/S) [1]–[3]. Research demonstrating how the mother's oxygen transport affects the fetus during C/S while under epidural

anesthesia was published in 1982 [4]. When a healthy woman has an elective C/S procedure while sedated, additional oxygen is deemed unnecessary [5]. This historical viewpoint lays the groundwork for a more thorough comprehension of the subtleties and developing standards in oxygen augmentation during cesarean procedures.

Oxygen supplementation during cesarean sections can have several advantages. Following spinal anesthesia, it can successfully reduce the mother's cerebral blood deoxygenation while preserving the mother's cerebral oxygenation of the blood [6]. With a high-flow nasal cannula (HFNC) oxygen treatment, the patient can get a large amount of heated oxygen. Improving tissue oxygenation and potentially resolving acute respiratory failure [7]. However, there are also potential disadvantages. For instance, the newborn's weight at birth may increase as a result of the mother's intrapartum IV fluids for anesthetic passing transplacental, which can lead to unnecessary supplementation due to concerns about dehydration [8]. While oxygen supplementation during cesarean sections offers benefits such as enhanced maternal cerebral oxygenation and improved tissue oxygenation, it also raises considerations regarding neonatal health, particularly about oxygen saturation levels in newborns.

As for the effect on newborns, studies have shown that oxygen saturation can be lower in babies delivered by cesarean section compared to those born vaginally, and they may take longer to reach an oxygen saturation level above 85% [9]. This could lead to a need for additional medical intervention. However, it is important to note that using oxygen supplementation does not directly affect the newborn's gut microbiota or the need for probiotic supplementation [10]. Nor does it influence the need for vitamin D supplementation [11]. While concerns about lower oxygen saturation in newborns delivered via cesarean section highlight the need for careful monitoring and potential medical intervention, the American Society of Anesthesiologists standards and advancements in optical monitoring techniques reinforce the importance of precise oxygenation measurement in maternal and fetal health during childbirth.

The American Society of Anesthesiologists (ASA) has established the Standards for Basic Anesthetic Monitoring, which state that persons undergoing either regional or general anesthesia should use a quantitative technique to measure oxygenation, such as pulse oximetry [12]. Moreover, primatologists have demonstrated that optical techniques like near-infrared spectroscopy (NIRS) and pulse oximetry are relevant to fetuses and valuable for monitoring fetal health during childbirth (1, 2). Except for obstetrics, cerebral oximetry, a non-invasive continuous flow non-invasive sensor, is utilized in several surgical anesthetic techniques to estimate real-time oxygenation measurements in the brain (regional cerebral saturation of oxygen, or  $rS_2$ ) [13].

This study aim is to evaluate the effect of administering supplemental oxygen to pregnant women undergoing cesarean sections with spinal anesthesia on the immediate neonatal outcome as Apgar scores measured post-delivery at one and five minutes.

## 2. Method & Materials

This study, characterized as a randomized clinical trial, was meticulously conducted at a renowned public hospital in Iraq. The focal point of the research was to rigorously evaluate

The hospital of study	Number of the patients	Proportion of the patients in each hospital
Al-Imam sadiq hospital	112	50
Al- Hila hospital	119	50
Total	231	100

Table 1: Hospital selected for results

the impact of supplemental oxygen administration on the Apgar scores of neonates born to mothers undergoing cesarean sections under spinal anesthesia. In alignment with the highest ethical standards, the research team secured all requisite ethical clearances, meticulously documented under the registration code IR.TUMS.SPH.REC.1401.307, ensuring full compliance and integrity of the study.

### Sampling

The study was conducted in Babylon City, Iraq, in public hospitals, namely Al-Imam Al Sadiq and Al-Hila Teaching Hospital. Stratified random sampling was utilized to determine the study population. With this method, the population is divided into discrete sections or strata that have comparable traits. Each subgroup is then randomly sampled proportionally to its size relative to the total population. This method ensures that all population segments are represented in the sample, enhancing the study's accuracy and applicability. The sample size for this study was set at 100 cases. These hospitals were selected for the study (Table 1).

### Selection of the Sample

One hundred ten nurses have met the study criteria and agreed to contribute to the study. At first, 10 participants were excluded from the original sample for the Pilot Study. Finally, the sample included in the present study is 100 participants. The sample is divided into two groups: 50 participants as a study group and 50 participants considered as a control group.

### Data Collection

The data for this study were predominantly collected from patients undergoing surgery, with measurements directly acquired from monitors in the operating room. The study specifically included patients scheduled for elective Cesarean Sections (C/S) in prenatal wards, all of whom were under spinal anesthesia. A crucial aspect of the research process involved the lead researcher, who was tasked with obtaining informed consent. This researcher ensured that each patient provided explicit consent for both the surgery and their participation in the study. Additionally, the tools used in the study were organized into two distinct categories: one focusing on collecting the socio-demographic data of the patients, and the other dedicated to evaluating the APGAR scores, which are critical assessments of newborn health.

### Procedure

In this randomized clinical trial, we aimed to comprehensively evaluate the effects of supplemental oxygen on the Apgar scores of newborns born to women who underwent

cesarean sections with spinal anesthesia. The study had two distinct groups: those who received supplemental oxygen and those who did not. The oxygen group was given nasal cannula oxygen immediately before administering spinal anesthesia, which was administered in the lateral position using either a pencil point or a Quincke needle (sizes 25 or 27 G) between the lumbar vertebrae. The anesthesia involved 0.5% hyperbaric bupivacaine and morphine. After receiving anesthesia, patients were positioned supine with a 15 cm left lateral tilt. The study's specific objectives included evaluating the Apgar scores in both groups, assessing the side effects and acceptability of oxygen supplementation, and exploring its association with maternal age, gestational age, duration of cesarean section, mother's educational level, and BMI status.

#### Measures/ Instruments

Through a review of the related literature and studies, the questionnaire is developed as a means of data collection. The questionnaires of this study included socio-demographic data of patients and an Apgar score questionnaire. Moreover, they were divided into two parts:

- 1) Socio-demographic information: includes Age, Educational level, Occupation, BMI, Go on diet, Gestational age).
- 2) Apgar score

#### Validity of the Questionnaire

The capacity of an instrument to collect the necessary data is a measure of its validity. A panel of experts determines the content validity of the early-developed instrument by examining the questionnaire's sufficiency, relevance, and clarity in measuring the idea of interest. The reliability of the questionnaire was ascertained by calculating the Alpha Correlation Coefficient (Cronbach's alpha) and confirming the instrument's internal consistency. The Statistical Procedures for Social Science Analysis Program (IBM SPSS) edition 22.0 was used to compute the coefficient alpha. The result was 0.921, which is an outstanding result.

### 3. Result

According to the descriptive analysis of the sample in Table 2, 52% of the patients were between the ages of 25 and 30, followed by those who are between the ages of 20 and 25 (30%). In contrast, 42% of the control group was between the ages of 25 and 30, and 40% was between the ages of 20 and 25. With regard to education, (32%) of the mothers in both groups could only read and write; this is equivalent to the research group's secondary school graduates, followed by (22%) of the control group's secondary school graduates. Most people are unemployed in both the research group (74%) and the control group (80%). Table 2 demonstrates that, based on body mass index indications, 34% of research participants and 36% of control groups are overweight. In both the research group (56%) and the control group (60%) over half of the individuals did not follow a diet. Furthermore, 52% of the research group's members stated they had never

used calcium and vitamin D supplements. Precisely (42%) of the research group's participants had gestational ages between 34 and 38 weeks, whereas a greater percentage (46%) of the control group's individuals did the same.

The descriptive analysis presented in Table 3 shows that 56% of the children in both groups had a normal birth weight. Concerning the Apgar score, 86% of the children in the study group scored between 7 and 10. In contrast, only 40% of the children in the control group scored within this range. Moreover, supplementary oxygen provided to the mother was found to have a highly significant effect on the Apgar score, with a p-value of 0.00.

The results in Table 4 indicate that none of the socio-demographic factors (age, level of education, occupation, BMI, and gestational age) show a statistically significant correlation with either APGAR score, as denoted by the notation "N.S." (Not Significant) in the Pearson Chi-Square tests. The p-values for these factors are all above the typical threshold of 0.05 for statistical significance. This suggests that within this study, these socio-demographic factors do not significantly influence the APGAR scores outcomes of the subjects.

### 4. Discussion

In the dynamic field of obstetrics, particularly concerning Cesarean sections under spinal anesthesia, understanding the impact of supplemental oxygen on neonatal outcomes is crucial. The study titled "Effect of Supplemental Oxygen on Apgar Score of Newborns in Pregnant Women Undergone Cesarean Section with Spinal Anesthesia" focuses on this aspect. Our approach began by analyzing the mothers' demographic characteristics. We aimed to assess the correlation between these factors and the newborns' APGAR scores. For the study group, we explored the association with newborns' Apgar scores. For the control group, we investigated the influence of supplemental oxygen on APGAR scores, considering the mothers' diverse backgrounds. This holistic approach seeks to unravel the complex interplay between maternal health factors and neonatal outcomes in Cesarean deliveries under spinal anesthesia.

In the study, 50 cases from each of the study and control groups were analyzed. Within these groups, the age range with the highest representation was 25-30 years, comprising 52% in the study group and 42% in the control group. The total mean age was 27.1 for the study group and 26.5 for the control group. The least represented age range was 35-40 years, with 4% in the study group and 2% in the control group. Regarding BMI, the most common category in both groups was 'overweight,' with 34% in the study group and 36% in the control group. The 'obese' category was the least common, at 12% in the study group and 4% in the control group. The findings of this research align with those from similar studies, for example, studies carried out in Turkey and India, which showed comparable results in maternal age and BMI across different geographic regions [14]–[16].

In the study group, 26% had low birth weight, 56% had

Demographic Variables	Study Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
<b>Age, years</b>				
20-25	15	30	20	40
25-30	26	52	21	42
30-35	7	14	8	16
35-40	2	4	1	2
Mean (SD)	27.1(3.85)		26.5(3.87)	
<b>Education level</b>				
Not read and write	3	6	3	6
Read and write	16	32	16	32
Primary school	11	22	15	30
Secondary school	16	32	11	22
Graduated	2	4	3	6
Post graduated	2	4	2	4
<b>Occupation</b>				
Unemployed	37	74	40	80
Employed	13	26	10	20
<b>BMI</b>				
Under weight	15	30	17	34
Normal weight	12	24	13	26
Overweight	17	34	18	36
Obese	6	12	2	4
<b>Go on diet</b>				
No	28	56	30	60
Yes	22	44	20	40

Table 2: Demographic Data of the Mother Sample Group

Demographic Variables	Study Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
<b>Birth weight</b>				
Low birth weight	13	26	18	36
Normal birth weight	28	56	23	46
High birth weight	9	18	9	18
Total	50	100	50	100
<b>Apgar score after 5 minutes</b>				
7 to 10 "reassuring"	43	86	20	40
4 to 6 "moderately abnormal"	5	10	20	40
0 to 3 "need increased intervention"	2	4	10	20
Total	50	100	50	100

Table 3: Distribution of Socio-Demographic Characteristics and Apgar Scores in the Sampled Babies

Socio demographic factors	APGAR Score Sig. (Pearson Chi-Square) Study Group	APGAR Score Sig. (Pearson Chi-Square) Control group
Age	.079 (N.S.)	.131 (N.S.)
Level of education	.051 (N.S.)	.797 (N.S.)
Occupation	.799 (N.S.)	.090 (N.S.)
BMI	.606 (N.S.)	.334 (N.S.)
Gestational age	.604 (N.S.)	.620 (N.S.)

Table 4: Comparative Analysis of Sociodemographic Factors Influencing APGAR Scores for both group

normal birth weight, and 18% had high birth weight. In contrast, the control group had 36% with low birth weight, 46% with normal, and 18% with high birth weight. Regarding the Apgar score after 5 minutes, 86% of the study group had a reassuring score (7 to 10), while only 40% in the control group fell into this category. In the study group, 10% had a moderately abnormal score (4 to 6) and 4% needed increased intervention (0 to 3), compared to 40% and 20%, respectively, in the control group. These results are in line with those of other studies, such as those conducted in India and Turkey, which assessed the Apgar scores under similar conditions [14], [15].

Furthermore, the performance level in the study group

showed a mean of 44.33, with 98 degrees of freedom (df). The P-value was .000, indicating high significance (HS). This suggests that the observed effect or difference between the study and control groups is statistically significant, implying that the variables or interventions being studied had a notable impact on the performance level in this group. These results are consistent with other studies, like one conducted in 2020 at Gandhi Memorial Hospital in Addis Ababa [17].

Moreover, the results indicate that none of the socio-demographic factors, including age, level of education, occupation, BMI, and gestational age, have a statistically significant correlation with the APGAR scores in both groups. This is denoted by the notation "N.S." (Not Significant) in



the Pearson Chi-Square tests, with p-values (e.g., .079 for age and .606 for BMI) above the typical threshold of 0.05 for statistical significance. This suggests that in this study, these socio-demographic factors do not significantly impact the APGAR scores. Similar findings were observed in studies conducted in Thailand, India, and Ethiopia [15], [16], [18].

## 5. Conclusion

The study revealed that supplemental oxygen significantly impacts the APGAR scores of newborns during Cesarean sections under spinal anesthesia, with the study group showing higher reassuring APGAR scores compared to the control group. To improve neonatal and maternal care in Iraq's healthcare system, enhancing prenatal care accessibility, training healthcare workers in advanced neonatal care, ensuring the availability of necessary medical equipment for Cesarean sections, and promoting obstetric research and education are crucial steps. These measures will help in elevating care standards for mothers and newborns, ultimately leading to better health outcomes.

## Ethical approval

The study adhered to stringent ethical guidelines, ensuring no additional costs were imposed on patients due to the research: data collection and publication-maintained anonymity and confidentiality, safeguarding patient privacy. The research protocol did not interfere with routine treatment and procedures, and participants could withdraw at any time without affecting their treatment. Ethical approval was obtained from the Ethics Committee of the Health Faculty at Tehran University of Medical Sciences, after which the study commenced. Informed consent was secured from all participants before data collection. Collected data excluded identifiable information like names or national codes, and individual data was not published.

## Limitations of the Study

One notable limitation of the study was participant recruitment, as some potential cases opted not to participate.

## Conflict of Interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

## Authors Contribution

All authors contributed equally in this paper.

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