

Evaluation of the Newborn Infant--Second Report (1958), by Virginia Apgar et al.

Virginia Apgar and colleagues wrote "Evaluation of the Newborn Infant—Second Report" in 1958. This article explained that Apgar's system for evaluating infants' condition after birth accurately predicted the health of infants. Apgar had developed the scoring system in 1953 to provide a simple method for determining if an infant needed medical attention after birth. The research team, working at Columbia University College of Physicians and Surgeons in New York City, New York, studied the Apgar scores of over 15,000 infants from Sloane Hospital for Women in New York City, New York, over a period of five years. In "Evaluation of the Newborn Infant—Second Report," Apgar and colleagues established that Apgar scores correlated with infants' health directly after birth and indicated when medical personnel should treat the infant.

Apgar worked as a professor of anesthesiology at Columbia University College of Physicians and Surgeons, teaching and researching how anesthesia was used during childbirth. Apgar also worked as an obstetrical anesthesiologist, administering pain medication to pregnant women before birth. She treated patients at Sloane Hospital for Women, a part of Presbyterian Hospital, later called Columbia-Presbyterian Medical Center, in New York City. Apgar collaborated with university colleagues, including L. Stanley James and Duncan A. Holaday, to conduct research using her patient records from Sloane Hospital. In 1953, Apgar, James, who specialized in newborn health, and Holaday, an anesthesiologist, wrote their first article introducing the Apgar scoring system. For the second report, Apgar also worked with physician Irvin M. Weisbrot and nurse Cornelia Berrien.

The Apgar score, created by Apgar, compiles five scores across five categories. An infant can receive up to two points in each category, making for a high score of ten. The categories include: heart rate, breathing rate, response to stimuli, muscle activity, and skin color. A healthy infant, one who requires no medical attention after birth, receives a score of two in every category and a ten overall. An infant with an Apgar score of ten is a healthy shade of pink instead of blue, responds to stimuli, displays muscle activity, and has a normal heart rate and breathing rate. An infant with trouble breathing, usually indicated by the lack of loud crying, may only receive a score of eight. As the health of the infant worsens, the Apgar score decreases.

In "Evaluation of the Newborn Infant—Second Report" ("Second Report"), Apgar and her team reviewed five years of data on infants evaluated with the Apgar score, collected from over 15,000 births between 1953 and 1958. They compared the scores with corresponding death rates and biochemical data of the infants, such as oxygen and carbon dioxide content in the infants' blood. Apgar and her team used the death rates and biochemical data to make small adjustments to the 1953 version of the scoring system and concluded that the Apgar score was a useful evaluation of the health of infants, particularly infants born prematurely.

"Second Report" begins by reviewing the Apgar score and how it is determined. The authors explain that the composite score is obtained within sixty seconds after birth. Following their overview of the Apgar score, the authors move into the results of the study. Of the 15,348 infants evaluated, six percent were in poor condition, receiving a total score of zero, one, or two. Twenty-four percent of the infants were in moderate condition, receiving a score from three to seven, and seventy percent were in excellent condition, receiving an eight, nine, or ten for their total score. In the study, the researchers split the infants by the three major types of delivery methods. Vaginal births include those deliveries in which the infant leaves the woman's vagina head first, what the researchers considered a normal delivery. A cesarean section occurs when the physician surgically delivers the infant by cutting through the woman's abdomen to remove the infant and placenta. Finally, a breech

delivery happens when an infant's buttocks or feet, instead of its head, emerge from the woman's vagina first.

A larger percentage of infants delivered via cesarean or breech delivery received the lowest scores compared to infants delivered vaginally. Apgar and colleagues found that infants with the lowest scores also corresponded with the highest number of deaths. Lastly, within the results section, the authors note that the majority of deaths occurred in infants born premature, at ninety percent of deaths recorded for the study.

After listing the delivery and death rates of the pregnant women and infants in the study, the authors discuss how the Apgar score helped doctors determine when an infant in distress should be treated with oxygen. The authors note that of all of the infants studied, those with an Apgar score of four or below died far more frequently than those infants with a score of five or higher. They hypothesized that those lower scores correlated with lack of oxygen after birth. To determine why infants with lower scores died more frequently, the authors used two years of lab tests from infant blood drawn after birth to see if the scores related to lack of oxygen. The researchers measured the oxygen levels as well as the acidity of the infants' blood after birth. The researchers discovered that if an infant's blood had low oxygen and high acidity, the infant also received a score of zero, one, or two and was more likely to die. That result indicated that the external indicators of health measured by the Apgar score could indicate internal problems, like lack of oxygen. Therefore, the authors suggest using a score of four or lower to indicate that an infant needs help to breathe to increase blood oxygen levels and to reduce acidity.

In the article, following their discussion of when to resuscitate an infant, the authors discuss how they improved Apgar's 1953 guidelines. The researchers proposed a second score for the infants after the initial score, citing that the longer an infant's score remained low, the worse that infant fared in the minutes after birth. If at fifteen minutes after birth, an infant still has a score of zero, one, or two, the infant is unlikely to survive.

Conversely, the authors note that when an infant with an initial score of eight, nine, or ten then receives a lower score later on, the causes of that decrease are often preventable. Usually decreasing scores over time occurred when a physician or nurse attempted to perform a medical procedure too soon. For example, when the tip of a tube used to suck fluid out of an infant's throat touched the infant's vocal cords, the voice box often had a spasm and caused the infant to stop crying. The lack of a cry, a sign of a poor breathing rate, thus lowered the infant's Apgar score. A delayed reaction to drugs used on the pregnant woman could also cause infants to have a briefly lower Apgar score.

Finally, the authors summarize their three conclusions in "Second Report." First, they state that the Apgar scores and death rates of infants vary according to the type of delivery: vaginal births, cesarean sections, and breech births. Next, they report that evaluating infants using the Apgar score helped doctors determine when medical intervention is required for the infant, especially in the case of premature infants who have trouble breathing. Finally, they note that biochemical evidence, in the form of oxygen and acidity levels in the blood of infants, support the reliability of the Apgar score. The scoring system accurately detected internal health problems.

The article helped popularize the Apgar score while proving its effectiveness. In the 1950s, before and in the early days of the Apgar score, one in thirty infants died at birth. Many of those infants were born malformed, too small, or blue, leaving nurses and physicians to set them aside as too sick to survive without giving them medical attention to improve their condition.

With the Apgar score, nurses and physicians could determine an infant's condition at sixty seconds and then provide treatment. According to Apgar and her team, many infants studied in "Second Report" improved drastically by the time they were evaluated again fifteen minutes later. In 1964, researchers from the National Institute of Neurological Diseases and Blindness in Bethesda, Maryland, reported that Apgar scores taken at five minutes were also strong predictors of infant health. In the early twenty-first century, partly because of the Apgar score and its indication of the need for medical assistance, only one in five hundred infants died at birth. Into the twenty-first century, hospitals worldwide use Apgar's system, where nearly every infant born receives an Apgar score at one minute and five minutes after birth.

Sources

1. Apgar, Virginia. "A Proposal for a New Method of Evaluation of the Newborn Infant." *Current Researches in Anesthesia and Analgesia* 32 (1953): 260-7.
2. Apgar, Virginia, Duncan A. Holaday, L. Stanley James, Irvin M. Weisbrot, and Cornelia Berrien. "Evaluation of the Newborn Infant-Second Report." *Journal of the American Medical Association* 168 (1958): 1985-8.
3. Apgar, Virginia, Duncan A. Holaday, L. Stanley James, C. Edward Prince, Irvin M. Weisbrot, and Iris Weiss. "Comparison of Regional and General Anesthesia in Obstetrics: With Special Reference to Transmission of Cyclopropane across the Placenta." *Journal of the American Medical Association* 165 (1957): 2155-61.
4. Drage, Joseph S., Clyde R. Kennedy, and B.K. Schwarz. "The Apgar Score as an Index of Neonatal Mortality." *Obstetrics & Gynecology* 24 (1964): 222-30.
5. Gawande, Atul. "The Score: How Childbirth Went Industrial." *The New Yorker*. 6 October 2006. <http://www.newyorker.com/magazine/2006/10/09/the-score> (Accessed September 10, 2016).
6. James, L. Stanley., Virginia A. Apgar, E.D. Burnard, and Frank Moya. "Intragastric Oxygen and Resuscitation of the Newborn." *Acta Paediatrica* 52 (1963): 245-51.
7. Kaneshiro, Neil K. "Apgar Score." *MedlinePlus*. Updated 2014 November 11. <https://www.nlm.nih.gov/medlineplus/ency/article/003402.htm> (Accessed July 16, 2016).
8. Weisbrot, Irwin. M., L. Stanley James, C. Edward Prince, Duncan A. Holaday, and Virginia Apgar. "Acid-Base Homeostasis of the Newborn Infant during the First 24 Hours of Life." *The Journal of Pediatrics* 52 (1958): 395-403.