Evolution of the 5-minute Apgar Score in the United States, 1978-2012

Nicole DeVille
Andrew Noymer
Population Science and Disease Prevention
University of California, Irvine

150-Word Abstract

Since 1953, the Apgar score has been a significant delivery room biomarker for identifying newborns with compromised health. Previous studies have focused on Apgar trends in conjunction with other outcomes at local and state levels, but no long-term studies have been conducted examining Apgar trends on a national level. Utilizing natality data from The National Center for Health Statistics from 1978-2012, the objective of this research is to investigate the evolution of the 5-minute Apgar score over the 35-year time period, examining differences by predictors such as race and birth weight. With advances in medical technology and intervention since the inception of the Apgar score, the expected result is an increase in the average 5-minute Apgar score over time; however, preliminary analyses reveal a steady decline in the average 5-minute Apgar score over time.

Background

Dr. Virginia Apgar created the Apgar scoring system in 1952 as a method of evaluation of newborns. The purpose of the scoring system was to establish a simple and clear classification of newborns, which could be used to compare obstetric practices, types of maternal pain relief and results of resuscitation efforts.[i] The five criteria assessed at one and five minutes are: color, heart rate, reflex irritability, muscle tone, and respiration, each assigned a score of zero, one or two. Apgar scores ranging from 7-10 are considered healthy, and further scores are usually not assigned. If scores of 7-10 are not achieved at the 5-minute assessment, further scores are taken every five minutes until a 7-10 score is assigned.[ii] In 2006, the American Academy of Pediatrics and American College of Obstetricians and Gynecologists proposed an expanded Apgar score sheet accounting for resuscitative interventions.[iii]

Low Apgar scores, ranging from 0-3, indicate abnormal conditions in newborns but do not suggest a specific etiology. Low Apgar scores can reflect non-asphyxial factors, such as low weight and prematurity.[iv] Low one-minute Apgar scores have not been found to correlate with future outcomes, such as negative neurological outcomes, and are poor sensitivity markers for asphyxia.[v] However, low Apgar scores at the 5-minute assessment are associated with increased mortality in premature newborns.[vi] Statistically significant differences in the distribution of the 5-minute Apgar score have been observed for infants' gestational age, birth weight, method of delivery and maternal education. Associations found in previous studies and in this research have the potential to inform clinicians in assessing prognosis for newborns, as well as, to support the sustained use of the 5-minute Apgar score as a risk predictor variable in infant research.

Research Design & Expected Results

An ecological study design will be used to investigate the evolution of the 5-minute Apgar score in relation to variables such as birth weight and race, using 35 years of natality data from The National Center on Health Statistics. The number of live births in the United States per year ranges from 3-4 million, yielding an estimated sample size of 100-120 million newborns. Observations with missing 5-minute Apgar scores will be excluded from the analysis. The primary outcome variable is 5-minute Apgar score, and predictor variables to be examined include race and birth weight. Exploratory analyses and descriptive statistics will be conducted using Stata version 13.1, and a logistic regression model will be constructed including the primary outcome and significant predictor variables.

This study will be the first to examine the 5-minute Apgar score over a long period of time and in a national context. The average 5-minute Apgar score is expected to increase over the 35-year time period, and exploratory analyses may reveal significant predictors that have not been addressed in existing literature. Birth weight should be positively correlated with the 5-minute Apgar score, with higher birth weight translating into higher Apgar scores. Racial disparities are expected in the 5-minute Apgar score. This study has the potential to add to the body of current Apgar literature. Furthermore, the public health implications of this work are illustrating the importance of the 5-minute Apgar score as a biomarker for newborn health and a risk prediction variable for future studies on newborns and infants, as well as, informing prognosis decisions for clinicians caring for newborns.

Preliminary Results

Five Minute Apgar Score	Frequency	Percentage
0	80,482	0.07
1	240,195	0.21
2	133,402	0.12
3	139,248	0.12
4	196,105	0.17
5	354,221	0.31
6	742,093	0.66
7	1,905,382	1.68
8	9,212,030	8.14
9	85,923,626	75.90
10	14,279,460	12.61
Total	**113,206,244**	**100.00**

Table 1—Frequency distribution of the 5-minute Apgar score, 1978-2012. After excluding live births with missing five-minute Apgar scores, the final sample size for the study is 113,206,244 observations over the 35-year time period. The frequency distribution of scores indicates that high scores (7-10) are exceedingly more prevalent than low (0-3) or moderate (4-6) over the time period.

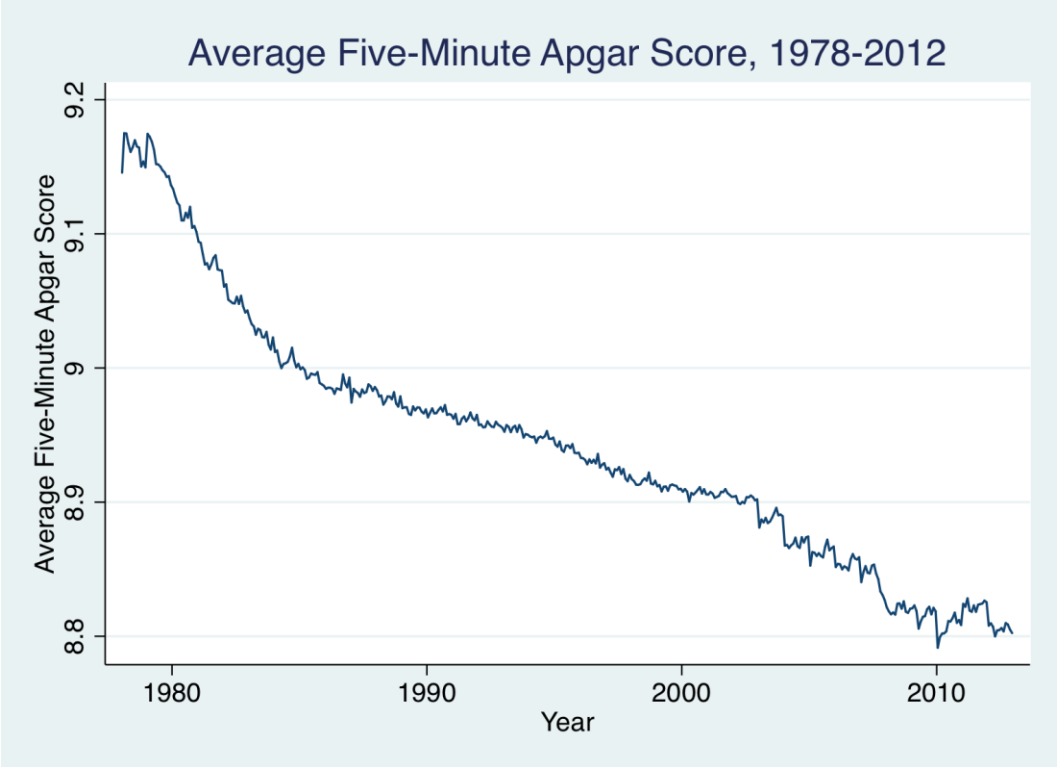

Figure 1—Average Five-Minute Apgar Score, 1978-2012. The data show a steady decrease in average five-minute Apgar score over time. In 1978, the average Apgar score was just under 9.2. By 2012, the average Apgar score is approximately 8.8.

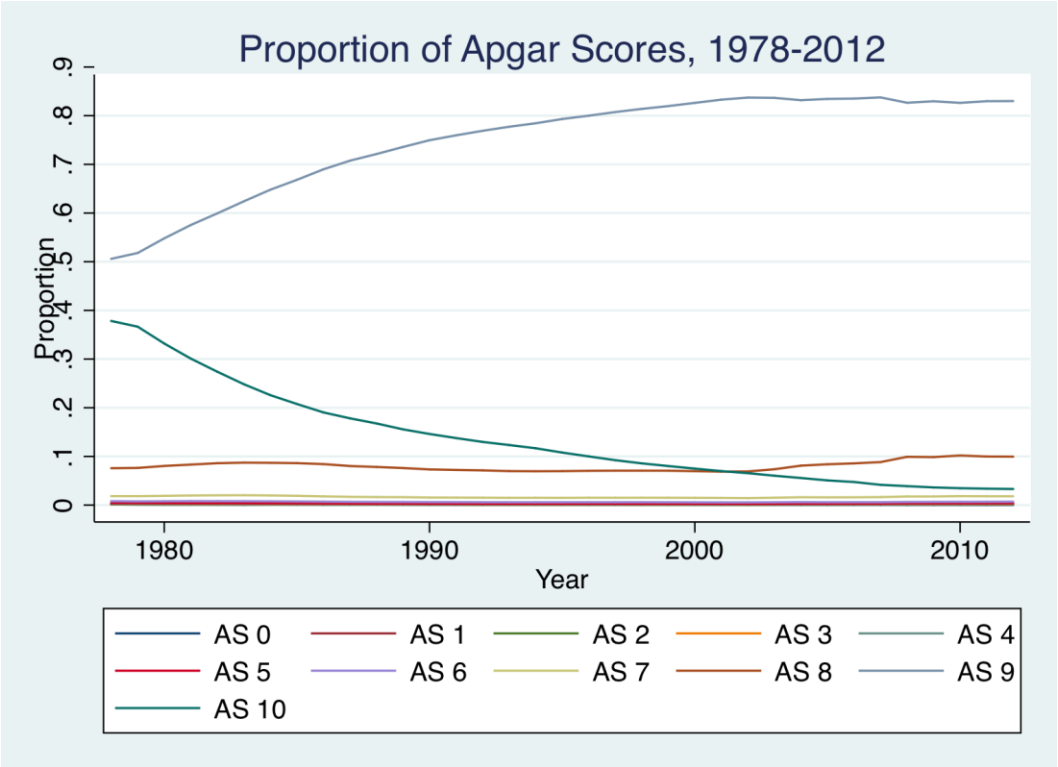

Figure 2—Proportion of All Apgar Scores, 1978-2012. This figure illustrates how the proportion of each Apgar score has changed over the 35-year time period. The most notable observations are a significant decrease in the proportion of tens assigned accompanied by an increase in the proportion of nines.

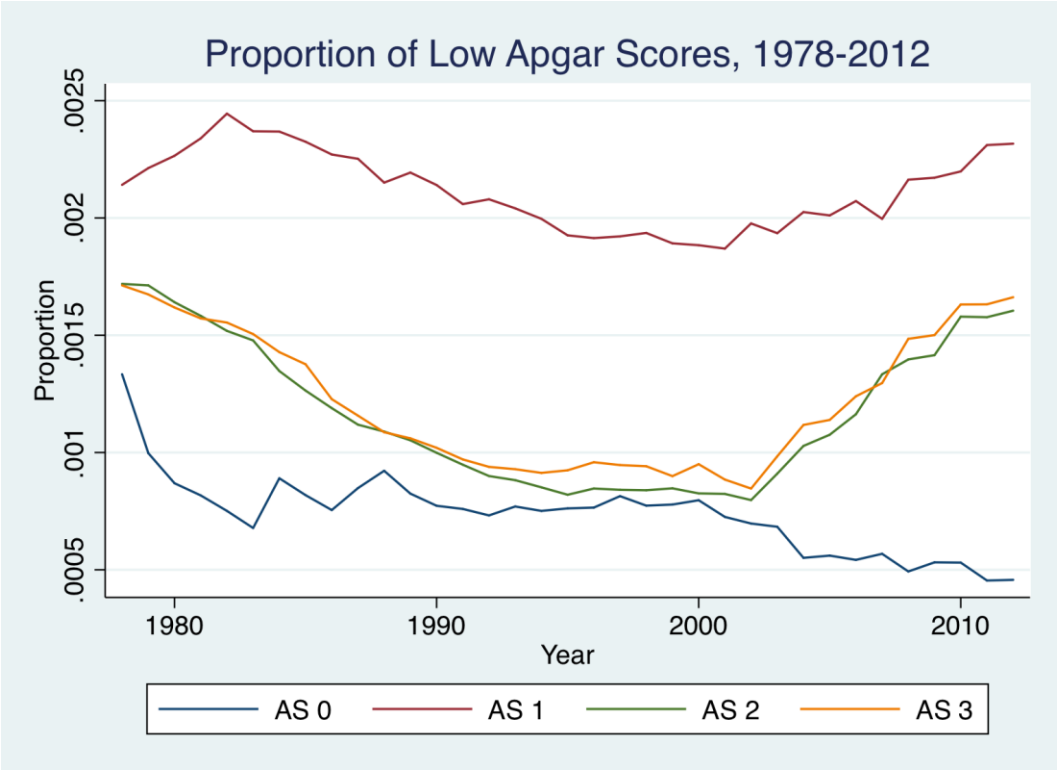

Figure 3—Proportion of Low Apgar Scores, 1978-2012. A slight decrease in zeroes is observed, while the proportion of scores 1, 2, and 3 have steadily increased since 2000.

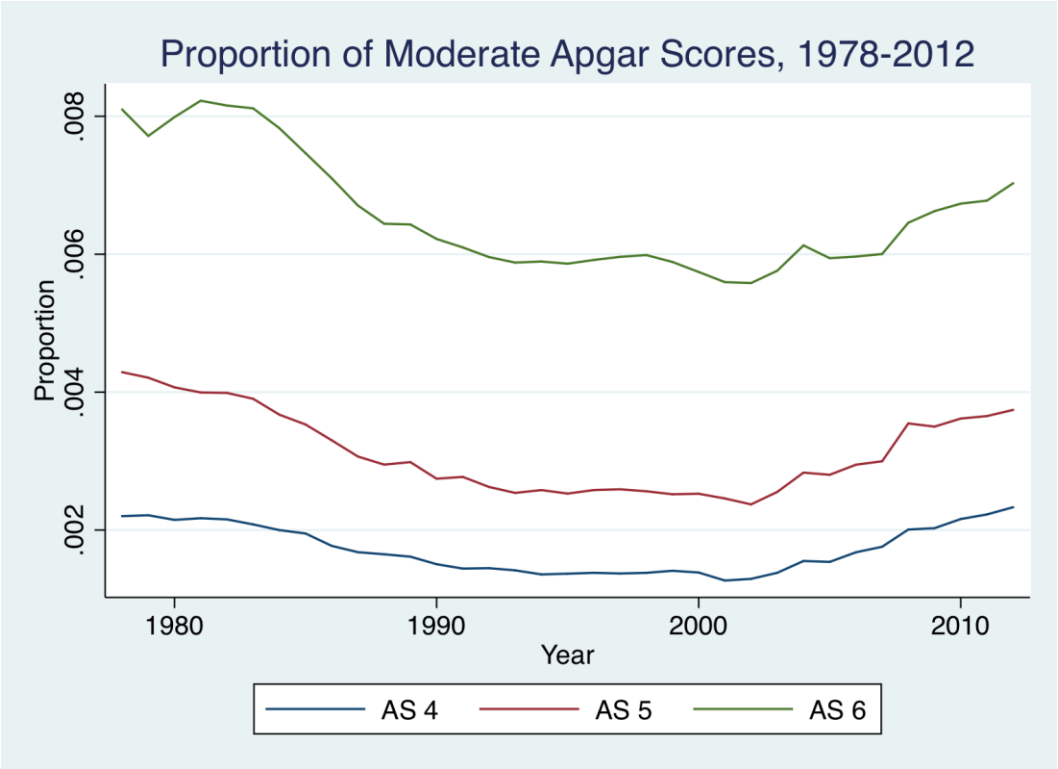

Figure 4—Proportion of Moderate Apgar Scores, 1978-2012. The proportions of moderate Apgar scores (4-6) remain relatively consistent over the 35-year time period.

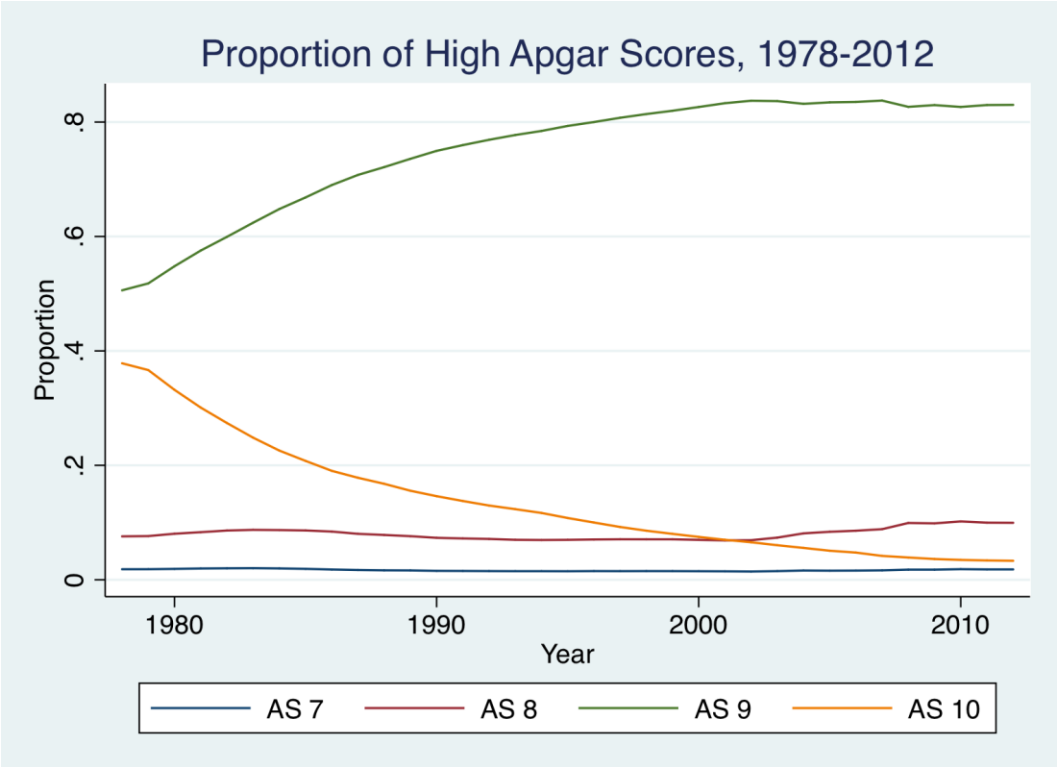

Figure 5—Proportion of High Apgar Scores, 1978-2012. The proportions of high Apgar scores demonstrate the most dramatic changes, particularly scores of 9 and 10, which have increased and decreased significantly, respectively. The proportions of Apgar scores of 7 and 8 have remained relatively constant over the 35-year time period.

References

[i] Finster M and Wood M. (2005). The apgar score has survived the test of time. *Anesthesiology*, 102: 855-857.

[ii] Apgar V. (1966). The newborn (Apgar) scoring system—reflections and advice. *Pediatric Clinics of North America*, 13: 645-650.

[iii] American Academy of Pediatrics, Committee on Fetus and Newborn, American College of Obstetricians and Gynecologists, and Committee on Obstetric Practice. (2006). The Apgar score. *Pediatrics*, 117: 1444-1447.

[iv] Casey BM, McIntire DD and Leveno KJ. (2001). The continuing value of the Apgar score for the assessment of newborn infants. *New England Journal of Medicine*, 344(7): 467-471.

[v] Jepson HA, Talashek ML and Tichy AM. (1991). The Apgar score: Evolution, limitations, and scoring guidelines. *BIRTH*, 18(2): 83-92.

[vi] Lee HC, Subeh M and Gould JB. (2010). Low Apgar score and mortality in extremely preterm neonates born in the United States. *Acta Paediatrica*, 99: 1785-1789.