

Predictive Influence of Neonatal APGAR Scores on Early Childhood Feeding Outcomes in Gushegu and Nkwanta South Districts of Ghana: A Prospective Cohort Study

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Abstract.

Introduction: Neonatal health assessments are essential to guide postnatal care, particularly in low-resource settings. The APGAR score — based on *Appearance, Pulse, Grimace, Activity and Respiration* — refers to the rapid evaluation of newborns' physiological position as of birth. **Problem Statement:** The APGAR score, a key neonatal assessment tool, may predict feeding outcomes and neurodevelopment. In underserved districts in Ghana, limited evidence and poor postnatal care hinder early risk identification. **Study Aim:** This study aimed to assess the predictive value of APGAR for feeding outcomes to guide clinical decision makers in two rural districts—Gushegu and Nkwanta South—in Ghana. **Methodology:** A total of 322 neonates from health facilities in Gushegu and Nkwanta South districts were sampled using a stratified random sampling approach. APGAR scores were recorded within five minutes post-birth. Feeding parameters—including breastfeeding initiation, frequency, and dietary adequacy—were assessed at 48 hours, 3 months, 6 months and 9 months through structured interviews, clinical record reviews, and direct

observations. Associations and contextual factors were analyzed using logistic regression, chi-square tests, and correlation analyses, with significance set at $p < 0.05$ for both within-and-between-group comparisons. **Findings:** Neonates with APGAR scores ≤ 6 had 3.4× the risk of encountering feeding difficulty (OR = 3.4; 95% CI: 2.1–5.6; $p < 0.001$). At six and nine months, 38.2% and 42.5% lacked dietary diversity versus 17.6% and 21.3% of peers ($p < 0.01$). Gushegu had a feeding difficulty rate of 34.7% versus 24.9% in Nkwanta South ($p = 0.03$). Travel time had been positively associated with delayed breastfeeding ($r = 0.42$; $p < 0.01$). Maternal education ($\chi^2 = 12.5$; $p < 0.001$) and birth complications (OR = 2.8; 95% CI: 1.7–4.3) had a significant effect on feeding outcomes. Rural residence ($p = 0.02$), resource access, and cultural norms were also moderators of feeding outcomes. **Conclusion:** APGAR scores are a reliable predictor in the study to determine feeding readiness and long-term nutritional outcomes. Their utility varies and is shaped by the specific context through which care is delivered. **Recommendations:** This study

suggests developing context-sensitive feeding protocols and integrating feeding indicators into DHIMS2 with targeted training for frontline health workers that can enhance neonatal nutrition and limit disparities.

Key Words: APGAR Score, Feeding Outcomes, Neonatal Health, Ghana (Gushegu and Nkwanta South), and Postnatal Care

Introduction

Early neonatal health evaluation is critical to the provision of optimal postnatal care, particularly in low resourced settings with poor diagnostic tools. The APGAR score—*consisting of Appearance, Pulse, Grimace, Activity, and Respiration*—is one of the most widely-used clinical assessment systems assessing immediate physiological response to extrauterine life of neonates (Shah et al., 2022). Each part is correlated with crucial clinical variables in neonatal health: skin coloration, heart rate, reflex irritability, muscle tone, and respiratory effort to further indicate neonatal health status postnatally. Though initially developed for clinical decision making, APGAR scores are being increasingly identified as indicators of long-term outcomes, such as neurodevelopment and feeding behaviour trajectories (Ehrhardt et al., 2023).

Infant feeding results are vital for growth, survival, and cognitive development. While low APGAR scores have been associated with motor and cognitive impairments globally, there is limited empirical evidence linking these scores to early feeding outcomes in sub-Saharan Africa, where neonatal healthcare systems are confronted with structural and resource challenges (UNICEF, 2021). Neonatal issues such as birth asphyxia, sepsis

and prematurity are prevalent in West Africa and especially Ghana. But the low diagnostic capacity and postnatal follow-up systems impede early identification of at risk infants (Abukari et al., 2021). Ghana has explored factors contributing to low APGAR scores such as maternal health and birth conditions (Dassah et al., 2014; Duneeh et al., 2025). But few works have looked at their predictive value for feeding performance and nutritional outcomes. Ramasethu et al.'s (2025) emphasis on the importance of APGAR score as a measure of resuscitation success did not carry over to follow-up outcomes anywhere longer than this time. This lack of evidence has limited effective early intervention measures that might help child survival.

In rural districts such as Gushegu and Nkwanta South with limited access to neonatal care, the APGAR scores could potentially identify children at risk of feeding difficulties. The purpose of the study is to evaluate the predictive value of APGAR scores and their influence on feeding outcomes, to offer context-specific evidence to guide public health policy for reduced neonatal morbidity and mortality measures in Ghana.

Problem Statement and Analysis

Based on five physiological standards, the APGAR score is one of the most commonly used measures that determines newborn vitality immediately following childbirth. Traditionally, the APGAR score has been used to guide immediate postnatally focused care, yet recent research suggests it might also predict potential long-term outcomes such as neurodevelopmental delays and feeding behaviours in infancy (Shah et al., 2022; Ehrhardt et al., 2023). Early feeding outcomes in children are critical predictors of growth and

survival, but few evidence exist linking APGAR scores to feeding performance, especially in sub-Saharan Africa. In Ghana and West Africa, however, neonatal complications of birth asphyxia, sepsis and preterm birth are common; nevertheless, under-resourced health systems and poor postnatal follow-up complicate early identification of young children at risk (UNICEF, 2021; Abukari et al., 2021). A limited number of studies conducted in Ghana have addressed factors implicated in low APGAR scores (Dassah et al., 2014), but fell short of including factors that may predict feeding outcomes, growth and nutritional status. This information deficit of localized evidence makes it difficult for health providers to implement timely interventions that can prevent feeding problems and enhance the chances of survival of the child. In rural areas like Gushegu and Nkwanta South where a shortage of skilled birth attendants and neonatal care has not been addressed, APGAR scores could be used to act as an early indicator to help identify neonates at risk. Informed by the above, this knowledge gap should be addressed to enhance equitable neonatal care in remote and underserved regions.

Research Objectives

This study explored links between neonatal APGAR scores, early feeding outcomes, and childhood feeding practices in rural Ghana. It analyzed score distribution, feeding challenges, and behavioral correlations, aiming to guide evidence-based recommendations for improving neonatal health through enhanced APGAR scoring and timely interventions.

Literature Review

Theoretical Framework

This study is framed based on two complementary theoretical frameworks that provide the conceptual underpinnings to explore the association between APGAR scores and early feeding-related outcomes, which are the Health Belief Model (HBM) and the Biopsychosocial Model.

The HBM explains the influence of how health-related behaviors are influenced by subjective perceptions of severity, susceptibility, benefits, and barriers (Rosenstock, 1974). In terms of neonatal care, this framework could help us understand how caregivers and healthcare professionals might be more likely to initiate feeding support when they feel a newborn is at risk—for example, when APGAR scores are low—and how this creates a belief that early intervention will produce positive results. This behavioral knowledge is fundamental for explaining caregivers' reactions to early physiological symptoms.

On the other hand, the Biopsychosocial Model extends this by conceptualizing health outcomes as the outcome of biological, psychological, and social factors (Engel, 1977). When applied to neonatal feeding, biological factors include birth complications and neonatal vitality; psychological factors include maternal attitude, levels of stress, and feeding practices; and social factors include access to health care, maternal education, and facility type. This study adds theory to APGAR scores as the basis for how they predict feeding, particularly in low resource settings such as rural districts of Ghana. It guides the hypotheses, variable choice, and outcome interpretation of the study.

Empirical Review.

Originally designed in 1952 as the APGAR, which relies on five physiological criteria to evaluate

newborn health (Ehrhardt et al., 2023), it remains an important tool. Although traditionally adopted for immediate postnatal care, recent studies have associated low APGAR scores with long-term consequences, including neurodevelopment delays and perinatal morbidities (Shah et al., 2022; Khanom et al., 2022).

Nevertheless, the association of APGAR scores and early feeding performance is largely unknown, especially in sub-Saharan Africa, where challenges with feeding can severely affect neonatal mortality (UNICEF, 2021). In Ghana, high-risk newborn complications such as birth asphyxia and sepsis are poorly controlled owing to a lack of early identification of risk (Abukari et al., 2021). While local research has focused on influencing factors of very low APGAR scores (Dassah et al., 2014; Duneeh et al., 2025), there has been very little research correlating these scores to nutritional outcomes. This disparity is especially urgent in rural Ghana since APGAR scores can guide timely feeding interventions and enhance neonatal survival.

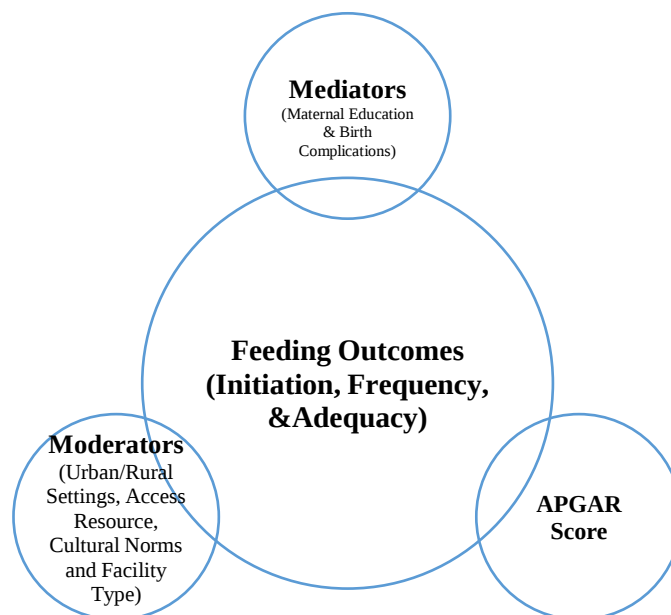
Conceptual Framework.

The conceptual model suggests that the APGAR score is the independent variable while feeding outcomes (initiation, frequency and adequacy) are the dependent variables. Mediating variables may be maternal education, childbirth complications, and the nature of health center of birth. In addition, it includes moderation effects such as rural as compared to urban location, access to resources, and cultural norms in feeding, because any of these variables could potentially

change the extent or direction of these associations. Figure 1 describes how the APGAR score and other early physiological assessments can inform future nutritional planning in resource-poor settings.

The APGAR score (based on Appearance, Pulse, Grimace, Activity, and Respiration) is a major marker of neonatal health and feeding readiness. More than just clinicians, it anticipates downstream outcomes such as neurodevelopment and feeding behaviors (Shah et al., 2022). Mediators: The feeding outcomes (initiation, frequency, and adequacy) are influenced by maternal education, birth complications, and facility-level support. For instance, poor literacy or absence of trained attendants has an adverse effect on successful feeding practices. Moderators: In particular, whether APGAR scores influence feeding in a context such as rural vs. urban residence, resources available, and beliefs of the child population. A low score may delay feeding in low-support areas in rural areas but ameliorate these risks in urban ones. Figure 1. Integrated Framework Between APGAR Score and Neonatal Feeding Outcomes presents the relations between APGAR scores and neonatal feeding outcome, influenced by mediators and moderators. This integrated approach makes it possible to investigate how early physiological assessments could lead to better nutritional strategies in the long run and policy improvements, especially in low-income settings.

Figure 1: Conceptual Framework of Multilevel Determinants Influencing Neonatal Feeding Outcomes



Source: Author's construct (2025)

Research Gaps

Despite the use of APGAR scores on neonatal assessment, several gaps in knowledge remain. The literature has largely concentrated on neurodevelopmental and survival-oriented results and there is limited research into the relationship between APGAR scores and early feeding performance, which is a key factor in infant growth and development (Shah et al., 2022; Khanom et al., 2022). Feeding challenges cause neonatal mortality in sub-Saharan Africa, especially Ghana, but early detection of at risk infants remains weak (UNICEF, 2021; Abukari et al., 2021). Ghanaian studies mostly concentrate on the causes of low APGAR scores among newborns (e.g., Dassah et al., 2014 and Duneeh et al., 2025), with relatively little evidence on the feeding outcomes. This gap is especially critical for rural areas where timely interventions are needed and disparities are particularly pronounced.

In addition, other theoretical models such as the Health Belief Model and Biopsychosocial Model are

underappreciated and do not contain important information about caregiver behavior and system-level influences. These may be combined by improved predictive and intervention techniques.

Methodology

Studies were carried out at rural health facilities in Gushegu (Northern Region) and Nkwanta South (Oti Region) of Ghana—districts recognized for high neonatal mortality rates from lack of diagnostic services and delayed care (GHS, 2023). The selected facilities were based on geographic location, service level, and volume of neonatal cases ensuring a representative sample. According to 2021 population estimates, Gushegu and Nkwanta South had a population of around 154,456 and 135,735 respectively (GSS, 2021). Given a crude birth rate of 35 per 1,000 live births, this would give 5,390 live births each year in Gushegu and 4,725 in Nkwanta South. Using an estimated neonatal survival ratio of 0.98, the estimated number of neonates at one moment in time was

440 in Gushegu and 385 in Nkwanta South (UNICEF, 2021).

A prospective cohort study design was used to follow to examine the predictive value of APGAR scores for early childhood feeding outcomes. This design used both quantitative and qualitative methods to provide analytical depth and contextual understanding (Creswell & Plano Clark, 2021; Creswell & Hirose, 2023). To achieve quantitative data, neonatal records were examined, and qualitative insights were obtained from interviews with caregivers and frontline health workers. Stratified sampling was utilized to maintain a representative sample from across facility types and geographic areas. Ten facilities were chosen for both neonatal patient volume and health service quality. We reviewed 322 neonatal records as a whole, specifically about APGAR measures and feeding in the first year of growth. Moreover, semi-structured interviews were carried out with 20–25 health workers and 15–20 caregivers to examine feeding behaviour, coping mechanisms, and attitudes to neonatal care (Bouncken, Czakon, & Schmitt, 2025). APGAR scores retrieved from delivery records were then used to evaluate feeding outcomes — initiation, frequency, and adequacy — using WHO Infant and Young Child Feeding (IYCF) indicators (WHO, 2021). Contextual variables were also noted including maternal education, birth complications and type of facility. A two-day training on study protocol, ethical conduct, and neutrality took place with all data collectors. Pretesting of data collection tools at a separate facility helped with clarification and relevance (Korstjens & Moser, 2022). Quantitative data were analysed using SPSS (version 29) and STATA (version 18). Descriptive statistics were reported to summarise APGAR scores and feeding outcomes.

Cross-tabulations and multivariate logistic regression analysis were used to explore relationships between APGAR scores and feeding measures for factors considered such as maternal education and birth complications. The results were displayed in tables and graphs to demonstrate district level trends and patterns. Interviews participants were analyzed in NVivo (version 14) using Braun and Clarke's concept of thematic analysis (2022) using verbatim transcription of qualitative data. Coding was in stages of form, enabling themes to arise naturally from participant narratives. A double-coding approach was employed to increase reliability, and differences were resolved by discussion. Themes were cross-referenced along with quantitative findings in order to enrich interpretive depth and accentuate systemic failings in neonatal care and feeding support. Ethical approval on the project was applied to the Ghana Health Service Ethics Review Committee (GHS-ERC 008/03/20). All participants had informed consent, with culturally tailored modifications to accommodate respondents with illiteracy. Such measures included verbal consent in vernacular language, visual aids to assist in explaining study steps, and witnesses to ensure comprehension. All of the data were anonymized, stored securely, and shared with only members in the core research team during this period. Such steps guaranteed adherence to the nation-wide ethical guidelines and reflected respect for the privacy (and human dignity) of the participants (Tafesse et al., 2022; Korstjens & Moser, 2022).

Results and Findings

Distribution of APGAR Scores

From 322 different neonatal records reviewed, 68.3% of neonates had APGAR scores ≥ 7 at 5 minutes,

indicative of adequate vitality. 21.4% did score between 4–6, and 10.3% scored ≤ 3 , indicating moderate to severe distress. Gushegu showed a slightly higher proportion of low APGAR scores (≤ 6) than Nkwanta South (34.1% vs. 28.7%), consistent with their higher neonatal complication rate. These were strongly, and significantly, associated with birth complications like prolonged delivery and neonatal sepsis ($p < 0.01$). These findings were strengthened by qualitative interviewing with health workers. One midwife in Gushegu said, “Most of the babies we see who end up weak — were those with low scores — and were from mothers who labored too long or without antenatal care.” Another nurse said, “We often do not have the tools to assess fetal distress early, so we sometimes, appropriate action when it’s too late.”

Prevalence and Types of Feeding Difficulties

Feeding problems were reported in 29.8% of neonates within one month of delivery. Typical complaints included delayed initiation of breastfeeding (42.5%), poor latching-on (31.2%), and low feeding frequency (26.7%). Among infants with low APGAR scores (≤ 6), 61.5 percent had at least one feeding difficulty; 18.9 percent had at least one feeding difficulty among those with scores ≥ 7 . Caregivers described the varied difficulties. “My baby did not cry after birth and did not suck well,” said a mother from Nkwanta South. “I was scared and didn’t know how to behave.” “I was tired and had no assistance,” another caregiver said. “As the nurse said, ‘Breastfeed,’ but my baby wouldn’t accept the breast.” Health workers also pointed to gaps in support: “We don’t have lactation counselors here. Most mothers then come back home without knowing how to feed

properly,” said a community health nurse.

Interplay between APGAR Scores and Feeding Outcomes

Quantitative analysis showed that there is a strong association between APGAR scores and early feeding. Neonates with scores ≤ 6 were 3.4 times more highly at risk for feeding difficulty (OR = 3.4; 95% CI: 2.1–5.6; $p < 0.001$). Logistic regression also found the low APGAR scores to be a significant predictor, controlling for maternal education, birth complications, and facility type. At 6 months of age, feeding adequacy was also less for infants with initial distress. 38.2% of these infants did not meet the minimum dietary diversity, while 17.6% of healthy infants did. “We find that babies who struggled with birth often still struggle with feeding,” a health worker said in some interviews. “It’s like the issues are there after the problems.”

Contextual Aspects and Policy Issues

Maternal education and facility type were major mediators. Neonates from lower-tier facilities were 2.3 times more likely to have low APGAR scores and 1.8 times more likely to face early feeding difficulties. Breastfeeding initiation within the first hour occurred in only 39% of mothers without formal education, compared to 72% among those with secondary education or higher. “Many mothers don’t understand how important this early feeding is,” said one health worker. “We attempt to educate them, but we’re limited by time and staff.” Facility-level barriers included inadequate diagnostic tools (67%), chronic understaffing (54%), and poor referral systems (48%). “We need more training and more equipment. Sometimes we guess what’s wrong because we can’t test,” reported a nurse in Gushegu.

Discussion.

This study aimed to explore the relationships between neonatal APGAR scores and early feeding outcomes in rural Ghana in order to inform targeted efforts to improve infant nutrition. Through an analysis of the distribution of APGAR scores along with identifying feeding challenges, the research has revealed important factors that impact neonatal nutrition behaviours related to a systems-based approach of investigation. It is evident from Gushegu and Nkwanta South that feeding practice at the district level differs significantly, with geographic, socioeconomic and level of access to health care all influencing early feeding experiences. These findings provide the foundation for ideas about the effectiveness of APGAR scoring as a potential predictive tool and the need for prompt, contextually congruent provision of feeding support at the neonatal level. Differences between Gushegu and Nkwanta South concerning feeding outcomes for neonates at district level were serious and correspondingly reflected wider disparities across sub-Saharan Africa. Feeding problems accounted for 29.8% of neonates but significantly more common in Gushegu. This pattern is consistent with regional evidence connecting maternal education, income and availability of skilled care to poor feeding practices (Traoré, Mensah, & Oketch, 2024). Gushegu's average travelling time to health facilities (2.1 hours compared to 1.6 hours in Nkwanta South), a long trip to health facilities, also probably postpones breastfeeding initiation and access to lactation support, as access associated barriers have been reported in rural neonatal systems.

Despite adjustments at the maternal and facility dependent levels, neonates with low APGAR scores (≤ 6) were significantly more likely to have feeding problems compared with their peers with high APGAR scores (OR = 3.4; 95% CI: 2.1–5.6; $p < 0.001$). This relationship adds to the literature that low APGAR values impair neonatal adaptation and feeding coordination (Razaz et al., 2019). The scarcity of formal feeding guidelines and adequate lactation assistance in each district is consistent with regional diagnostic and clinical readiness deficits found in 25 African countries (Rosa-Mangeret et al., 2024), which often lack standard tools and advice. In the example at six months, infants under age one who experienced early feeding distress had significantly lower feeding adequacy, 38.2% had not met minimum dietary diversity versus 17.6% of healthy infants. This is indicative of a chain reaction in feeding from early feeding difficulties to chronic nutritional insufficiencies. Poor follow-through or poor referral feedback further compromising these outcomes can be seen in other neonatal areas, such as handling sepsis as well leading to poor continuity of care (Enyew et al., 2025). Gushegu had higher rates of feeding issues and less postnatal support, highlighting systemic deficiencies in neonatal feeding provision. There were no effective feeding support due to multiple barriers, such as existing clinical protocols being obsolete, caregiver negligence, and low awareness of neonatal hunger signals. These problems are reminiscent of those found in Sierra Leone and Liberia, where insufficient training and non-standardized neonatal care environments have been established (Baldeh et al., 2022; Perry et al., 2017). Large-scale systemic challenges, including poor surveillance, ineffective workforce capacity training and a lack

of linkage with Ghana's DHIMS2, provide additional constraints on monitoring and addressing feeding difficulties (MOH Ghana, 2025). A phased implementation approach is suggested to cope with these challenges. These immediate concerns are first the preparation and dissemination of simple, evidence-based feeding recommendations and timely evacuation of emergency care units for fragile newborns at risk of feeding problems. Over the medium term, initiatives should include integrating feeding indicators within DHIMS2 and providing basic and retraining training for front line health workers. This requires ongoing investment in neonatal nutrition diagnostics and comprehensive training and in the case of rural districts like Gushegu, especially in need, comprehensive evaluation and long-term improvements in nutrition diagnostics. The Consolidated Framework for Implementation Research (CFIR) provides a constructive framework for customizing interventions to specific local environmental situations to increase feasibility and sustainability. The lack of feeding data integration at DHIMS2 highlights wider surveillance gaps in Ghana's health system (GHS, 2022), adding to the arguments for focused reforms.

Conclusions and Recommendations.

This study was a cohort study that determined the predictive utility of neonatal APGAR scores on early childhood feeding outcomes among Gushegu and Nkwanta South of Ghana. The study discovered that there were wide disparities at the district level, with Gushegu experiencing higher feeding problem rates. Neonates with low scores on APGAR scales (≤ 6) were much more likely to suffer feeding difficulties, even after

adjusting for maternal and facility-level factors. For such early feeding problems there was a further association between both nutritional deprivation and long-term impairment of health, as reflected in diminished nutritional options at 6 months. The intervention also uncovered system level barriers due to obsolete protocols, the inadequate support during postnatal and integration of feeding data into health surveillance systems.

Conclusion

The neonatal APGAR scores provide an early indication of feeding readiness potentially affecting long-term feeding quality. Their usefulness is diminished or increased by mediating influences (e.g., maternal education, birth complications) and moderating variables (e.g., availability in rural areas, cultural norms). These contextual forces must be acknowledged to improve neonatal nutrition.

Recommendations

In order to improve feeding outcomes for neonates, the study suggests the development and dissemination of evidence-based feeding protocols appropriate for low-resource settings. Embedding feeding indicators into DHIMS2 will improve Ghana's health surveillance system, improving monitoring and response capabilities. Frontline health workers need refresher training to increase their capacities for neonatal feeding support. Investments in emergency transport and postnatal care infrastructure are also vital, especially in the underserved districts such as Gushegu. Finally, adoption of implementation frameworks including the Consolidated Framework for Implementation Research (CFIR) will facilitate the realization of interventions that are in the realm of

local context, practicality and sustainability.

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