

Maternal Knowledge of Umbilical Cord Care and Its Association With Cord Separation Duration: A Cross-Sectional Study in Simalungun Regency

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ABSTRAK

Sejarah artikel:

Penyerahan 24 Januari 2026

Revisi 27 Februari 2026

Diterima 28 Maret 2026

Latar Belakang: Masa pascapersalinan merupakan periode kritis bagi kelangsungan hidup bayi baru lahir, di mana perawatan tali pusat secara langsung memengaruhi waktu pemisahan tali pusat dan risiko infeksi. Ibu pascapersalinan berperan sebagai pengasuh utama, Namun pemahaman mereka tentang perawatan tali pusat yang tepat sangat bervariasi berdasarkan pendidikan, tradisi budaya, dan akses terhadap informasi kesehatan. **Tujuan:** Penelitian ini mengkaji hubungan antara pengetahuan ibu pascapersalinan tentang perawatan tali pusat dan durasi pemotongan tali pusat pada bayi baru lahir di Kecamatan Raya Kahean, Kabupaten Simalungun, serta faktor-faktor sosiodemografi tertentu. **Metode:** Studi analitik observasional potong lintang dilakukan dengan menggunakan metode sampling total terhadap ibu pascapersalinan yang memenuhi syarat di wilayah penelitian. Pengetahuan dinilai melalui kuesioner terstruktur yang telah divalidasi; durasi pemisahan tali pusat ditentukan melalui pengamatan langsung dan laporan pengasuh; serta hubungan antara variabel kategorikal diuji menggunakan uji Chi-Square. **Hasil:** Sebagian besar ibu berada pada usia reproduksi prima dengan tingkat pendidikan SMP, dan sebagian besar mengidentifikasi diri sebagai ibu rumah tangga. Pengetahuan tentang perawatan tali pusat tergolong dalam kategori sedang, sementara sebagian besar bayi baru lahir mengalami pemisahan tali pusat dalam rentang waktu yang diharapkan secara fisiologis. Ditemukan hubungan yang sangat kuat antara pengetahuan ibu dan durasi pemisahan tali pusat, di mana ibu yang lebih berpengetahuan jauh lebih mungkin mengalami pemisahan yang cepat. Tingkat pendidikan juga menunjukkan hubungan yang signifikan dengan hasil pemisahan tali pusat, sedangkan usia ibu dan status pekerjaan tidak. **Kesimpulan:** Pengetahuan ibu pascapersalinan muncul sebagai penentu utama waktu pemisahan tali pusat, yang secara substansial lebih berpengaruh daripada usia dan pekerjaan, sementara latar belakang pendidikan berperan sebagai pendorong struktural yang memperkuat hal tersebut. Temuan ini menyoroti pentingnya pendidikan kesehatan

Kata kunci:

Pengetahuan Ibu Pasca Persalinan;
Perawatan Tali Pusat; Pemisahan
Tali Pusat; Bayi Baru Lahir;
Simalungun

yang terstruktur dan responsif terhadap budaya dalam layanan
perawatan primer di kabupaten ini.

ABSTRACT

Keywords:

*Postpartum Maternal Knowledge;
Umbilical Cord Care; Cord
Separation; Neonate; Simalungun*

Background: The postnatal period is a critical window for newborn survival, during which umbilical cord care directly influences separation timing and infection risk. Postpartum mothers serve as primary caregivers, yet their understanding of appropriate cord care varies considerably based on education, cultural tradition, and access to health information. **Objective:** This study examined the association between postpartum maternal knowledge of umbilical cord care and cord separation duration among newborns in Raya Kahean District, Simalungun Regency, alongside selected sociodemographic factors. **Methods:** An observational analytic cross-sectional study was conducted using total sampling of eligible postpartum mothers in the study area. Knowledge was assessed via a structured, validated questionnaire; cord separation duration was determined through direct observation and caregiver report; and associations between categorical variables were tested using the Chi-Square test. **Results:** Most mothers were of prime reproductive age with junior secondary education, predominantly identifying as homemakers. Cord care knowledge clustered in the moderate category, while most newborns achieved separation within the physiologically expected timeframe. A markedly strong association was found between maternal knowledge and cord separation duration, with better-informed mothers considerably more likely to experience prompt separation. Educational attainment also showed a significant association with separation outcomes, whereas maternal age and occupational status did not. **Conclusion:** Postpartum maternal knowledge emerged as the dominant determinant of cord separation timing, substantially outweighing age and occupation, while educational background served as a reinforcing structural enabler. These findings highlight the strategic importance of structured, culturally responsive health education within primary care services in this district.

Introduction

Newborns (neonates) represent the most vulnerable age group, facing life-threatening risks of infection and complications in a remarkably short time following birth. This vulnerability stems from an incompletely developed immune system, compounded by several physiological entry points for pathogenic microorganisms, one of which is the umbilical cord stump still attached to the infant's abdominal wall. Among the various aspects of neonatal care, the condition of the umbilical cord receives particular attention because it serves as a potential gateway for infection-causing pathogens, particularly omphalitis. Neonatal omphalitis is a genuine medical emergency that can rapidly progress to sepsis and even death if not promptly diagnosed and treated (Yohannes et al., 2025). The pathophysiology of this infection occurs when the still-moist cord tissue becomes an ideal growth medium for bacteria, particularly *Staphylococcus aureus* and *Streptococcus pyogenes*, which can proliferate rapidly under humid conditions.

The freshly cut umbilical cord is essentially devitalized tissue rich in Wharton's jelly, a gelatinous substance that protects umbilical blood vessels during pregnancy, but after birth becomes an ideal organic substrate for bacterial colonization if not properly managed. The natural process of cord drying and separation depends on a complex interplay between intrinsic biological factors, such as cellular apoptosis and leukocyte infiltration at the cord base, and extrinsic environmental factors, including humidity, air circulation, and the presence or absence of external contaminants. Understanding this interplay forms the basis for dry cord care recommendations now widely endorsed by global health organizations.

Globally, neonatal infections including omphalitis remain a significant contributor to neonatal mortality. The World Health Organization (2020) reports that neonatal deaths occur in very large numbers annually, with infection ranking as one of the three leading causes alongside complications of prematurity and birth asphyxia. In developing countries including Indonesia, this situation is compounded by limited healthcare access, non-evidence-based traditional care practices, and maternal knowledge levels that still need improvement. Ironically, the majority of neonatal deaths from umbilical cord infection could be prevented through simple, inexpensive, and easily performed home care by mothers, requiring no sophisticated medical equipment or significant cost. This gap between the ease of prevention and the still-high incidence of infection constitutes the central concern in global maternal and child health.

Data from the Indonesian Ministry of Health (2022) indicate that the neonatal mortality rate remains far from the Sustainable Development Goals (SDGs) targets for 2030. Umbilical cord infection is among the contributing factors, particularly in areas with low maternal knowledge and limited access to healthcare providers. Disparities between urban and rural areas in neonatal health outcomes remain an unresolved structural challenge, where regions with difficult topography and uneven health infrastructure tend to record lower maternal and child health indicators compared to urban areas. The national Maternal and Child Health (KIA) Programme has integrated cord care education into postnatal visits, yet its field implementation still faces numerous constraints, from limited human health resources and high workloads to geographic disparities that restrict the frequency of home visits by community health workers and village midwives.

Physiologically, umbilical cord separation takes between seven and ten days after birth, although individual variation can occur due to factors such as care method, cord size, and the infant's general health status. This process is highly influenced by the care technique applied. Dry cord care, as recommended by the WHO, has been shown to accelerate drying and separation compared to excessive use of antiseptics or inappropriate traditional materials (Sari et al., 2025). This natural drying process, termed desiccation, depends on adequate air circulation around the cord stump; thus, any wrapping, whether with cloth, bandages, or other materials, directly impedes this physiological process. Delayed cord separation is not merely an aesthetic or comfort issue, but has direct implications for the duration of exposure to bacterial colonization risk: the longer the cord remains, the wider the time window for pathogens to invade vulnerable tissue.

Traditional umbilical cord care practices are still common in many parts of the world, including the use of herbal oils, kitchen ash, ground spices, talcum powder, and wrapping with cloth as symbolic or practical protection according to ancestral beliefs. These practices are generally based on the belief that the umbilical cord requires additional protection from exposure to the outside air, an understanding that directly contradicts the scientific principle of desiccation, which instead emphasizes the importance of air exposure. The paradigm shift from a covered to an open approach requires not only the transfer of information, but also a process of sensitive cultural negotiation so that evidence-based recommendations can be accepted without generating social resistance.

Raya Kahean District is one of the sub-districts of Simalungun Regency, North Sumatra Province, characterized by hilly and semi-rural geography. Based on data from the Simalungun Regency Health Office (2023), postnatal visit coverage (KF3) in this district remains below the regency average. This indicates that some postpartum mothers do not receive optimal monitoring and postnatal education, a condition that could widen the knowledge gap between mothers with full access to healthcare services and those without. The strong influence of Batak Simalungun culture, including the use of herbal concoctions on the umbilical cord and wrapping with cloth, constitutes a contextual factor that must be considered in any health intervention in this area. Such cultural traditions are typically passed down orally from generation to generation, often carrying strong social authority from senior family members, making changes to practice impossible through one-way information provision alone; rather, they require a dialogic approach involving community leaders and extended family.

A preliminary survey conducted by the researcher in Raya Kahean District found that most postpartum mothers interviewed still practiced cord wrapping with cloth, while others used local herbal remedies, with only a small proportion applying dry cord care as recommended. This indicates a significant gap between expected knowledge and applied practice, and reinforces the urgency of research focused on the determinants of cord care knowledge and behavior in this area. These initial findings also underscore that the problem is not merely a lack of information, but also a competition between evidence-based information delivered by healthcare workers and deeply entrenched cultural narratives in local daily life.

Various previous studies at national and international levels have examined the relationship between maternal knowledge and neonatal care practices in general, yet studies specifically targeting the context of hilly geographic areas with a Batak Simalungun cultural background remain relatively limited. Local characteristics such as these play an important role in shaping community health behavior patterns, as the interaction between social structures, geographic access, and belief systems collectively determines how health information is received, interpreted, and applied in daily practice. This research gap motivates the need for a study focused specifically on Raya Kahean, so that future health interventions can be better targeted and responsive to local conditions.

Based on this background, this study aims to analyze the relationship between postpartum maternal knowledge of umbilical cord care and the duration of cord separation in Raya Kahean District, Simalungun Regency, while also identifying the role of sociodemographic factors including age, educational level, and occupation, as variables contributing to neonatal health outcomes. This research is expected to provide an empirical contribution that can serve as a basis for the formulation of more targeted health education policies and programmes, particularly for primary healthcare facilities in areas with similar sociocultural characteristics.

Method

This research is an observational analytic study with a cross-sectional design. This design allows for the simultaneous measurement of independent and dependent variables, making it efficient in describing associations between variables within a population at a single point in time (Sofya et al., 2024). The selection of this design was based on considerations of time and resource efficiency, given that the phenomenon under study, the relationship between maternal knowledge and cord separation duration, can be adequately observed without requiring a prolonged longitudinal observation period, though it is acknowledged that this design has limitations in establishing definitive causal relationships. The study was conducted in the working area of Puskesmas Raya Kahean, Raya Kahean District, Simalungun Regency, North Sumatra Province, a region selected based on preliminary survey results demonstrating a gap between recommended cord care practices and actual field conditions.

The target population consisted of all postpartum mothers who delivered term infants (gestational age 37-42 weeks) with normal birth weight (2,500-4,000 grams) in Raya Kahean District

during the study period. Limiting the population to term infants with normal birth weight was intended to control for confounding variables that could independently influence cord separation duration beyond maternal knowledge, such as prematurity or low birth weight, which are known to have different tissue healing characteristics. The sampling method used total sampling, in which all mothers meeting the inclusion criteria were included, an approach selected because the available population in the study area was relatively limited, allowing all eligible population members to be included without requiring probabilistic sampling techniques.

Inclusion criteria were: postpartum mothers of term infants with normal birth weight; mothers residing in the district; infants without congenital abnormalities; and mothers willing to participate by signing informed consent. Exclusion criteria included mothers with a history of severe postpartum complications and infants admitted to the Neonatal Intensive Care Unit (NICU), as these conditions generally require specialized medical intervention on the umbilical cord that could confound the measurement of cord separation duration as a pure outcome variable of home care practices.

The primary independent variable was postpartum maternal knowledge of umbilical cord care, measured using a structured questionnaire containing twenty items covering definitions, purposes, techniques, materials, and warning signs of cord care. Questionnaire items were developed based on the WHO dry cord care conceptual framework, with language and local context adjustments to ensure comprehensibility for respondents with varied educational backgrounds. Knowledge levels were categorized as Good, Moderate, and Poor based on the adaptation of Nursalam (2020) categories, with percentage thresholds for correct answers established as standards in nursing methodology literature.

The dependent variable was cord separation duration, categorized as Early, Normal, and Delayed based on the number of days from birth until spontaneous cord separation from the umbilical base. Measurement was performed through a combination of direct observation by the researcher during home visits and reporting by mothers who had received brief education on accurately recognizing the time of separation, to minimize recall bias. Sociodemographic variables (age, education, occupation) were measured through an identity questionnaire completed at the beginning of the interview.

The questionnaire instrument underwent validity testing using Pearson Product Moment correlation and reliability testing with Cronbach Alpha, with results indicating excellent reliability, rendering the instrument suitable for data collection. Instrument piloting was conducted on a group of respondents with similar characteristics but located outside the main study area, to prevent data contamination between the piloting and actual data collection phases. Questionnaire completion was performed through guided interviews to accommodate respondents with literacy limitations, with each question read aloud and explained verbally by the researcher or trained research assistant to ensure uniform understanding of each item's intent.

Data collection was carried out by first coordinating with Puskesmas Raya Kahean staff and local village midwives to identify postpartum mothers meeting the research criteria. Home visits were scheduled during routine postnatal visit periods to avoid imposing excessive time burdens on respondents. Each interview was conducted over a reasonable duration in a comfortable environment for the respondent, typically at their own home, to minimize psychological pressure that could affect response quality.

Data were analyzed using SPSS version 25 statistical software. Univariate analysis produced frequency distributions and percentages for each variable, presented in tabular form to facilitate descriptive interpretation of respondent characteristics. Bivariate analysis used the Chi-Square test (χ^2) to examine associations between categorical variables, with a significance level of $\alpha = 0.05$ as

the standard threshold in public health research. Prior to the Chi-Square test, expected count values in contingency tables were examined to ensure the validity of the test application.

All respondents received complete explanations of the study's purpose, procedures, benefits, and risks before signing informed consent, and data confidentiality was fully guaranteed through anonymization of respondent identities at all stages of data processing and reporting. Respondents were also granted the right to decline or withdraw from the study without any consequences to the healthcare services they received from Puskesmas Raya Kahean.

Results and Discussion

Results

The sociodemographic characteristics of the 43 respondents are presented in Table 1 below.

Table 1.
Frequency Distribution of Respondent Characteristics in Raya Kahean District

Characteristic	Frequency (n)	Percentage (%)
Age		
< 20 Years	5	11.6
20–35 Years	35	81.4
> 35 Years	3	7.0
Total	43	100.0
Education		
Primary School (SD)	5	11.6
Junior High School (SMP)	16	37.2
Senior High School (SMA)	13	30.2
Diploma	4	9.3
Bachelor's Degree	5	11.6
Total	43	100.0
Occupation		
Homemaker	25	58.1
Self-employed	8	18.6
Employed	10	23.3
Total	43	100.0

Source: Primary Data, 2026

Based on Table 1, the majority of respondents were in the reproductive age group of 20–35 years (81.4%). Regarding education, the dominant level was junior high school (37.2%), followed by senior high school (30.2%). The majority of respondents were homemakers (58.1%), reflecting the socioeconomic conditions of Raya Kahean District society, which is still largely based on household economies. The age distribution concentrated in the prime reproductive range aligns with the general population pattern of postpartum mothers in similar studies across North Sumatra, and suggests that the study sample is reasonably representative of postpartum mothers in semi-rural settings.

Table 2.
Distribution of Postpartum Maternal Knowledge and Cord Separation Duration

Variable	Frequency (n)	Percentage (%)
Postpartum Maternal Knowledge		
Poor (<56%)	9	20.9
Moderate (56–75%)	20	46.5
Good (76–100%)	14	32.6

Total	43	100.0
Umbilical Cord Separation Duration		
Delayed (> 10 days)	7	16.3
Normal (7–10 days)	24	55.8
Early (< 7 days)	12	27.9
Total	43	100.0

Source: Primary Data, 2026

Based on Table 2, nearly half of respondents (46.5%) had moderate knowledge of umbilical cord care, with only 32.6% having good knowledge. The distribution of cord separation duration showed that 55.8% fell within the normal category, 27.9% experienced early separation, and 16.3% experienced delayed separation (>10 days). This distribution pattern illustrates that, while most infants ultimately experienced cord separation within a physiologically acceptable timeframe, a non-trivial proportion experienced delay, which could increase the risk of infectious complications if not managed appropriately.

Table 3.
Association Between Postpartum Maternal Knowledge and Cord Separation Duration in Raya Kahean District

Knowledge	Delayed n (%)	Normal n (%)	Early n (%)	Total n (%)	p-value
Poor	6 (85.7%)	3 (12.5%)	0 (0.0%)	9 (20.9%)	$\chi^2=53.379$
Moderate	1 (14.3%)	19 (79.2%)	0 (0.0%)	20 (46.5%)	
Good	0 (0.0%)	2 (8.3%)	12 (100%)	14 (32.6%)	
Total	7 (100%)	24 (100%)	12 (100%)	43 (100%)	

*Significant at $\alpha=0.05$ Source: Primary Data, 2026

Table 3 demonstrates a very clear pattern of association: virtually all mothers with poor knowledge (85.7%) experienced delayed cord separation, while all mothers with good knowledge (100%) experienced early separation. The Chi-Square test yielded $\chi^2=53.379$ with $p=0.000$, far below the $\alpha=0.05$ threshold, indicating a statistically significant association between maternal knowledge and cord separation duration. No cases of early separation were observed among mothers with poor or moderate knowledge, reinforcing the impression that good knowledge is a near-absolute prerequisite for optimal cord separation outcomes in this study population.

Table 4.
Summary of Bivariate Analysis: Sociodemographic Factors and Cord Separation Duration

Variable	χ^2	df	p-value
Age * Cord Separation Duration	6.757	4	0.149
Education * Cord Separation Duration	16.711	8	0.033*
Occupation * Cord Separation Duration	0.321	4	0.988

*Significant at $\alpha=0.05$ Source: Primary Data, 2026

Based on Table 4, only the education variable demonstrated a significant association with cord separation duration ($p=0.033$). The age variable ($p=0.149$) and occupation variable ($p=0.988$) did not show a meaningful association. The p-value for the occupation variable approaching unity indicates

that the distribution of cord separation duration across occupational groups showed virtually no meaningful difference, a pattern relatively rarely found to such an extreme degree in sociodemographic studies of reproductive health.

Discussion

The majority of respondents in this study were in the reproductive age group of 20–35 years (81.4%). This age range represents the peak of fertility and simultaneously the period of optimal cognitive maturity for receiving new information. According to Tong et al. (2024), individuals in the young adult phase are more responsive to health education interventions. This finding is consistent with Banu & Meera (2025), who found that optimal cognitive capacity in young adults supports the uptake of new information, and with Sidabutar et al. (2022) in Sidikalang City. This demographic condition actually represents a strategic opportunity for educational intervention, as this age group is in an active life stage of seeking information about infant care, particularly at the first or second birth, when curiosity and anxiety about newborn care are generally at their highest.

The educational distribution of respondents reveals that the majority had junior high school education (37.2%), followed by senior high school (30.2%). This reflects the educational reality of the semi-rural population of Raya Kahean District, which still faces challenges in the accessibility and affordability of higher education, due both to the distance to advanced educational institutions and economic considerations that drive some girls not to continue schooling beyond junior high level. Educational level is a proximal factor influencing a person's health literacy capacity. Mothers with higher education generally have a better ability to understand written instructions, access information from various sources, and think critically about health recommendations (Notoatmodjo, 2018). The dominance of homemakers (58.1%) reflects that most mothers have relatively flexible time at home, yet are constrained by women's workload, reliance on informal sources for health information, and practical barriers such as internet data limitations and unfamiliarity with official health websites (Filyani & Marika, 2025). Women's workload encompasses not only infant care but also other household tasks and, in some families, assisting with agricultural or small family business activities, leaving progressively less time for attending health education sessions or reading educational materials.

Results showed that 46.5% of respondents had moderate knowledge, 32.6% good knowledge, and 20.9% poor knowledge of cord care. The dominance of the 'moderate' category indicates that mothers in Raya Kahean District have a basic understanding of cord care, most likely obtained through antenatal counseling and information from healthcare workers, yet this understanding has not reached the level optimal for producing entirely correct care practices. This condition aligns with Bloom's taxonomy of knowledge, which states that knowledge at the basic level (knowing) does not necessarily lead to correct application (applying) (Savitri et al., 2023). A mother may know that the umbilical cord should be kept clean, but not specifically understand why wrapping with a damp cloth or using herbal remedies should be avoided. This gap between declarative knowledge (knowing what) and procedural knowledge (knowing how and why) is frequently the weak point in health education programs that focus solely on transmitting facts without accompanying explanation of the underlying mechanisms.

Aspects of knowledge most frequently lacking among respondents included: the principles of dry cord care; prohibitions against using traditional materials such as ash, oil, or spices; how to detect early signs of infection such as redness, odor, and discharge; and first-aid response when the cord appears abnormal. A substantial proportion of postpartum mothers having a moderate level of knowledge indicates that, while mothers possess basic understanding, further educational improvement is needed for cord care to be practiced optimally and infection prevented in newborns (Ningtias et al., 2023). These findings suggest that the dry cord care knowledge gap is not merely a local phenomenon in Raya Kahean District, but a broader issue rooted in maternal-neonatal health

education patterns that generally still underemphasize the mechanistic understanding behind each care recommendation.

The primary finding of this study is a highly significant association between postpartum maternal knowledge of umbilical cord care and cord separation duration ($\chi^2=53.379$; $p=0.000$). The very high chi-square value indicates that knowledge is a very strong predictor of cord separation outcome in the studied population. The pattern of association found is highly consistent: 85.7% of mothers with poor knowledge experienced delayed separation (>10 days), while 100% of mothers with good knowledge experienced early separation (<7 days). This consistency demonstrates a clear dose-response gradient, the better the maternal knowledge, the faster the cord separation. Such a gradient, in epidemiology, is often considered a supporting indicator of a causal relationship, although it must still be interpreted carefully given the cross-sectional study design.

The biological mechanism underlying this relationship is the process of cord desiccation (drying). Wharton's jelly tissue in the umbilical cord dries progressively through oxidation and evaporation. This process occurs optimally when the cord is left open to air (good aeration), kept dry, and free from contaminants. Mothers with good knowledge tend to be more consistent in applying dry cord care principles, maintaining cord cleanliness and dryness, not wrapping the cord, and preventing contamination by urine and feces. Adequate maternal knowledge has been shown to play an important role in improving adherence to evidence-based cord care practices and reducing the risk of neonatal infection (Obeagu & Obeagu, 2024; Israel et al., 2024). Conversely, mothers with poor knowledge tend to maintain traditional practices inconsistent with dry cord care principles, such as wrapping the cord with cloth, applying herbal oil, and sprinkling powder on the cord. These practices can impede the desiccation process by maintaining local humidity, reducing evaporation, and increasing the opportunity for bacterial colonization that could cause neonatal omphalitis (Obeagu & Obeagu, 2024; Coffey & Brown, 2017). Furthermore, moisture trapped by wrapping also creates relative anaerobic conditions on the cord tissue surface, which is favorable for the growth of certain facultative anaerobic pathogens, meaning the risk of infection increases not only due to delayed drying but also due to changes in local microecology that are more conducive to pathogenic bacterial growth.

These findings are corroborated by Merter et al. (2023), who found that mothers with good knowledge tended to be more consistent in applying dry cord care principles, contributing to faster and more physiological cord separation. Maternal knowledge of cord infection warning signs such as spreading redness, purulent discharge, malodor, swelling, and fever, plays an important role in promoting early detection and health-seeking behavior. Mothers with good knowledge tend to seek medical care more promptly for their infants, thereby reducing treatment delays and improving neonatal clinical outcomes (Alinaitwe et al., 2025; Dida et al., 2024). The consistency of these findings demonstrates that maternal knowledge is a universal determinant for the success of cord care, regardless of the specific cultural context in which the research is conducted.

From the perspective of health behavior theory, the relationship between knowledge and cord separation can be explained through the Health Belief Model (HBM). Mothers with good knowledge possess higher perceived susceptibility (awareness of infection risk) and perceived severity (understanding of infection severity), making them more motivated to act via appropriate care practices as cues to action. Conversely, mothers with poor knowledge tend to face greater perceived barriers in adopting evidence-based cord care practices, particularly when traditional practices are reinforced by social norms, the influence of senior family members, and community environment (Ezeogu et al., 2026). In the Batak Simalungun cultural context, these perceived barriers are often reinforced by the dimension of respect for elders and traditional leaders, such that a young mother

may feel reluctant to refuse traditional care recommendations from a mother-in-law or other senior family member, even if she has already received evidence-based information from a healthcare worker.

This study found a significant association between educational level and cord separation duration ($\chi^2=16.711$; $p=0.033$). This finding supports the hypothesis that education is a structural determinant influencing a person's ability to obtain, understand, and effectively apply health information. Cross-tabulation analysis revealed that respondents with diploma and bachelor's degree education all experienced cord separation in the normal or early category, while the majority of delayed separation cases occurred among mothers with junior high school education. This educational gradient pattern is highly consistent and reflects the real influence of literacy capacity on neonatal health outcomes.

The mechanism explaining this relationship is multifaceted. First, from a cognitive perspective, mothers with higher education have better literacy capacity, the ability to read, understand, and process information from various sources, including maternal-child health books or oral guidance from healthcare workers. Second, from an attitudinal perspective, higher educational level is associated with improved health literacy, enhanced ability to evaluate information, and better health decision-making. This enables mothers to more readily adopt evidence-based health practices and reduce dependence on non-recommended traditional practices (Moon et al., 2020; Zeyneloglu & Kisa, 2018). Third, from a behavioral perspective, more highly educated mothers tend to have more proactive health-seeking behavior and are more diligent in attending prenatal classes and adhering to healthcare worker recommendations. Dessalegn et al. (2022) found that mothers with secondary to higher education tended to have better adherence to cord care recommendations compared to those with lower educational levels. Balaj et al. (2021) confirmed that each additional year of formal maternal education is associated with reduced risk of neonatal mortality, indicating a protective effect of maternal education on newborn survival. Fourth, the social network dimension also plays a role, as more highly educated mothers tend to have broader and more diverse social networks, including access to online discussion groups or mother communities that can serve as additional information sources beyond formal healthcare services.

This study found no significant association between maternal age and cord separation duration ($p=0.149$). Methodologically, the disproportionate sample distribution with the majority in the 20–35 age group resulted in the statistical test lacking sufficient power to detect differences between age groups. From a substantive perspective, the absence of association suggests that within the reproductive age range studied, age does not directly determine cord care practices. Older age does not automatically mean better experience, as prior experience may also have been experience with incorrect and intergenerational practices, a mother who has given birth several times may have continued the same cord wrapping practice since her first child's birth without ever receiving correction, so experience alone does not guarantee improved practice without accompanying knowledge updates. This aligns with Singh et al. (2019) and Molina-Garcia et al. (2019), who also found no significant association between maternal age and neonatal care practices.

For the occupation variable, the absence of a significant association ($p=0.988$) is consistent with findings from Kasadha et al. (2025) and Abdi et al. (2025). The nearly identical distribution of cord separation duration across the three occupational categories indicates that occupational status has no direct effect on cord care practices. Working mothers do not automatically have better knowledge because workplace exposure is generally unrelated to neonatal care. Conversely, homemakers, despite not working outside the home, do not necessarily have better knowledge if they have not received adequate education from healthcare workers. This finding underscores that the source of neonatal health knowledge fundamentally derives from formal health education channels, such as antenatal counseling, prenatal classes, and postnatal visits, rather than from incidental workplace exposure, rendering occupational status directly irrelevant as a proxy for cord care knowledge level.

The findings of this study need to be interpreted within the specific context of Raya Kahean District. The Batak Simalungun community culture, which still strongly features traditional practices in newborn care, is a factor that must be considered in designing education programs. An approach that respects local wisdom while gradually integrating evidence-based practices will be more effective and acceptable to the community compared to unidirectional, prohibition-centered approaches (Notoatmodjo, 2018). Strengthening the capacity of village midwives and community health workers is highly crucial, as they represent the first point of contact for providing education to postpartum mothers during KF1, KF2, and KF3 visits. Village midwives and community health workers, as members of the community themselves, have a comparative advantage in terms of established social trust, making educational messages they convey more likely to be accepted than if delivered by outside parties less familiar to the local population.

The practical implications of these findings are considerable. At the individual level, results affirm the need for every postpartum mother to receive adequate, concretely applicable education, not merely general, normative information. At the institutional level, Puskesmas and village midwife networks need to re-evaluate health education delivery methods, considering more participatory and demonstration-based approaches over one-way lectures. At the policy level, findings regarding education as a structural determinant indicate that long-term investment in women's formal education also contributes to improved neonatal health outcomes, such that the education and health sectors should ideally not work separately, but rather complement each other in improving human resource quality from early age.

This study has several limitations that should be acknowledged. The cross-sectional design does not allow for definitive causal inference, so the associations found are associative in nature. The relatively small sample size ($n=43$) limits statistical power, particularly for subgroup analyses. Knowledge data collection through self-report questionnaires is susceptible to social desirability bias, where respondents may answer according to what they perceive as correct rather than their actual knowledge. Confounding variables such as parity, prior cord care history, and home environmental conditions were not examined and may influence results. Additionally, cord separation duration measurement that partially relied on maternal reporting potentially contains recall bias, although minimization was attempted through brief education before measurement. Further research employing a prospective cohort design, larger sample coverage, and more comprehensive variable measurement is strongly recommended to strengthen the existing evidence base.

Conclusion

This study concludes that postpartum maternal knowledge of umbilical cord care has a very strong and consistent association with the duration of umbilical cord separation in newborns in Raya Kahean District, Simalungun Regency. Mothers with good understanding of cord care consistently experienced rapid and physiologically expected cord separation, while mothers with limited understanding tended to experience more prolonged separation, forming a clear gradient between level of understanding and the speed of clinical outcome in their infants. This pattern affirms that knowledge is not merely a supplementary variable, but the primary determinant that directly shapes the daily care practices mothers apply at home.

Beyond knowledge, maternal formal educational level was also demonstrated to function as a structural factor influencing the speed of cord separation, reinforcing the understanding that literacy capacity and critical thinking ability formed through educational attainment provide a foundation for more effectively receiving and applying health information. Conversely, maternal age and type of

occupation showed no meaningful association with cord separation outcomes, indicating that such demographic characteristics are not primary determinants in the context of neonatal care in the study area. These findings collectively affirm that knowledge and education are two mutually reinforcing determinants that are far more dominant than age or occupational status in shaping infant health outcomes in the early days of life.

Accordingly, improvement of neonatal health outcomes in Raya Kahean District is highly dependent on the success of health education programs specifically targeting enhancement of postpartum maternal understanding, supported by approaches sensitive to the local cultural context and social structure. Primary healthcare services in this area have a strategic role as the frontline in ensuring that every postpartum mother receives adequate knowledge before returning home with her infant, so that risks of complications that can truly be prevented need not occur due to information gaps that should be addressable through simple, affordable, and sustained educational interventions.

Recommendations

Based on the findings of this study, it is recommended that Puskesmas Raya Kahean improve the quality of cord care education at all postnatal visits (KF1–KF3) using direct hands-on demonstration methods proven to improve knowledge retention more effectively than verbal education alone. Direct demonstration enables mothers to observe, practice, and receive immediate correction of their technique, so that the learning process does not stop at conceptual understanding but extends to practical skill mastery. Development of educational media appropriate for the local community's literacy level, such as demonstration videos in the local language (Batak Simalungun), simple illustrated flipcharts, and illustrated pocket cards, should be prioritized in the district KIA program budget, as visual and auditory media in regional language tend to be more readily understood by mothers with lower educational levels than written materials in formal language.

Regular training for midwives and community health workers on effective counseling techniques and cross-cultural communication must be included in the healthcare worker development agenda. This training should not only emphasize technical aspects of cord care, but also equip midwives and health workers with cultural negotiation skills, so they can convey evidence-based recommendations without appearing to belittle or blame traditional practices that families have observed across generations. Integration of cord care education into ongoing prenatal classes, along with empowerment of community health workers to conduct home visits to postpartum mothers with low educational levels, should be strengthened as a strategy to compensate for formal educational limitations.

In the long term, improving access to and quality of formal education for women, particularly ensuring women complete education to at least senior secondary level, represents a strategic investment in maternal and child health improvement. Cross-sectoral collaboration between the health office, education office, and district government can be explored to design mutually reinforcing programs, for instance by integrating reproductive health and infant care modules into secondary school curricula, so that young women in this area possess basic knowledge before entering pregnancy and childbirth at a later stage of life.

Further research using a prospective cohort design, larger sample coverage, and more comprehensive measurement of confounding variables is strongly recommended to strengthen the evidence base for intervention in this area. Future research may also consider qualitative approaches to explore more deeply the perspectives of mothers, families, and community leaders regarding traditional cord care practices, so that designed intervention strategies can be more responsive to the actual sociocultural dynamics occurring in the field, rather than being based solely on normative assumptions about what the community should do.

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