

A New form of N- Hexa Topological Approach to Reducing Maternal Anxiety After Delivery

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Abstract: Anxiety during pregnancy is associated with adverse outcomes in mothers and infants. Unfortunately, as anxiety is often synonymously mentioned with depression, the studies focusing solely on anxiety during pregnancy are not as robust as those in the field of depression are. This study employs the N-Hexa Topology framework to identify critical factors influencing maternal and newborn care outcomes. Six key domains were analyzed, each encompassing relevant maternal health variables, Early Childhood Health Service, Breastfeeding, Whole Body Massage (F1), Dietary Advice and Routine Antibiotic Prophylaxis (F2), Management of Postpartum Depression and Gestational Weight Gain (F3), Nutritional Interventions and Physical Activity (F4), Newborn Assessment (F5), and Maternal Assessment (F6). Using Nano topology Analysis, core attributes within these factors were isolated based on their impact on maternal health outcomes.

Keywords: N-Hexa Topology, Reducing Maternal Anxiety After Delivery.

1. Introduction and preliminaries

The days and weeks following childbirth the postnatal period are a critical phase in the lives of mothers and newborn babies. Most maternal and infant deaths occur in the first month after birth: almost half of postnatal maternal deaths occur within the first 24 hours, 1 and 66% occur during the first week. In 2013, 2.8 million newborns died in their first month of life million of these newborns died on the first day. Considerable progress has been made globally in improving maternal health. Around the world, 72 % of women give birth attended by skilled personnel, and the maternal mortality ratio has decreased from 380 to 210 per 100,000 live births between 2000 and 2013. Yet, in South-East Asia and sub-Saharan Africa only 67% and 48% of women give birth with the assistance of skilled personnel, respectively. Postnatal care reaches even fewer women and newborns less than half of women receive a postnatal care visit within 2 days of childbirth. 4 An analysis of Demographic and Health Survey data from 23 sub-Saharan African countries found that only 13% of women who delivered at home received postnatal care within 2 days of birth.

Postnatal Care for All Mothers and Newborns

- Provide postnatal care in the first 24 hours to all mothers and babies regardless of where the birth occurs. A full clinical examination should be done around 1 hour after birth, when the baby has had his/her first breastfeed. The baby should be checked again before discharge. For home births, the first postnatal contact should be as early as possible within 24 hours of birth and, if possible, an extra contact for home births at 24–48 hours is desirable. Mobile phone-based postnatal care contacts between mothers and the health system may be useful. The content of postnatal care is described in the next two sections.
- Ensure healthy women and their newborns stay at a health facility at least 24 hours and are not discharged early. This recommendation is an update from 2006, and the minimum duration of stay was lengthened from 12 to 24 hours. Evidence suggests discharge is acceptable only if a mother's bleeding is controlled, mother and baby do not have signs of infection or other diseases, and the baby is breastfeeding well.
- All mothers and babies need at least four postnatal checkups in the first 6 weeks. This is a notable change to the previous guidance, which recommended only two postnatal

checkups within 2 to 3 days and at 6 weeks after birth. Now, in addition to postnatal care with two full assessments on the first day, three additional visits are recommended: day 3 (48–72 hours), between days 7– 14 and 6 weeks after birth. These contacts can be made at home or in a health facility, depending on the context and the provider. Additional contacts may be needed to address issues or concerns.

Postnatal Care for Newborns

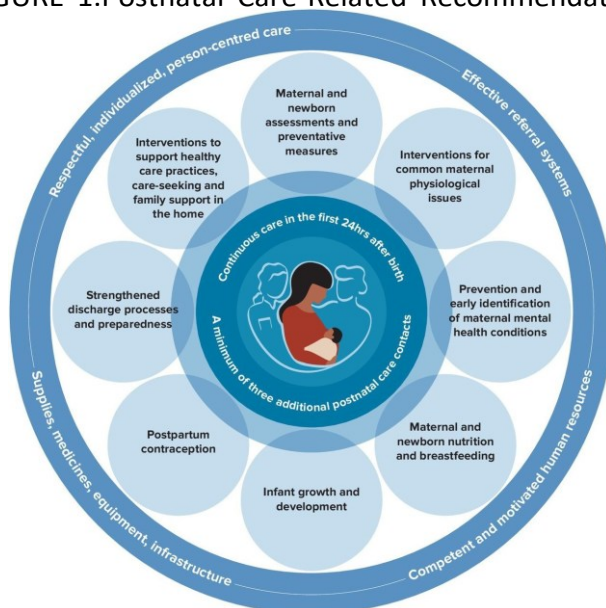
- Strengthen postnatal care through home visits and at health facilities.
- At each of the four postnatal care checkups, newborns should be assessed for key clinical signs of severe illness and referred as needed.
- Continue to promote early and exclusive breastfeeding (EBF) within delivery settings including antenatal care, at delivery, and in all postnatal care visits
- Consider the use of chlorhexidine for umbilical cord care for babies born at home
- Reinforce key newborn care messages among families and providers.

Postnatal Care for Mothers

- Strengthen postnatal care for mothers through home visits and at health facilities

Postnatal care recommendations:

FIGURE 1. Postnatal Care-Related Recommendations



Definition 1.1. Approximation Space and Rough Set Approximations

Let H be a non-empty finite set of objects (the universe), and let $R \subseteq H \times H$ be an equivalence relation on H , called the indiscernibility relation. The pair (H, R) is called an **approximation space**. Let $X \subseteq H$. Then the rough set approximations of X with respect to R are defined as follows:

- **Lower Approximation:**

$$L_R(X) = \{[x]_R \subseteq X \mid x \in H\}$$

- **Upper Approximation:**

$$U_R(X) = \{[x]_R \mid [x]_R \cap X \neq \emptyset, x \in H\}$$

- **Boundary Region:** $B_R(X) = U_R(X) \setminus L_R(X)$

Where $[x]_R$ denotes the equivalence class of x under R .

Definition 1.2. Let H be a universe, and let R be an equivalence relation on H . Define

$$\tau_R(X) = \{\emptyset, H, L_R(X), U_R(X), B_R(X)\}$$

where $X \subseteq H$.

Then, $\tau_R(X)$ satisfies the following axioms:

- (1) $\emptyset, H \in \tau_R(X)$
- (2) The union of any subcollection of $\tau_R(X)$ is in $\tau_R(X)$
- (3) The intersection of any finite subcollection of $\tau_R(X)$ is in $\tau_R(X)$

Therefore, $\tau_R(X)$ is a topology on H , called the **Nano Topology (NT)** with respect to X , and the pair $(H, \tau_R(X))$ is called a **Nano Topological Space (NTS)**. The elements of $\tau_R(X)$ are called **Nano-Open (NO)** sets.

Remark 1.3. If $\tau_R(X)$ is the Nano Topology (NT) on H with respect to X , then the set

$$B = \{H, L_R(X), U_R(X)\}$$

is a basis for the topology $\tau_R(X)$.

Definition 1.4. Let $(H, \tau_R(X))$ be a Nano Topological Space (NTS) with respect to $X \subseteq H$. For any $A \subseteq H$:

- The **Nano Interior** of A , denoted by $NaInt(A)$, is the union of all Nano-Open (NO) sets contained in A .

$$NaInt(A) = \{O \in \tau_R(X) \mid O \subseteq A\}$$

- The **Nano Closure** of A , denoted by $NaCl(A)$, is the intersection of all Nano-Closed (NC) sets containing A .

$$NaCl(A) = \{F \subseteq H \mid H \setminus F \in \tau_R(X), A \subseteq F\}$$

Definition 1.5. Let H be a non-empty set, and let $\tau_1, \tau_2, \tau_3, \tau_4, \tau_5, \tau_6$ be topologies on H . A subset $A \subseteq H$ is called a **hexa-open set (h-open)** if

$$A \in \bigcup_{i=1}^6 \tau_i$$

The complement of an h-open set is called a **hexa-closed set (h-closed)**.

The collection $I_h = \{\emptyset, H, \tau_1, \tau_2, \tau_3, \tau_4, \tau_5, \tau_6\}$ defines a **hexa topology** on H . The pair (H, I_h) is called a **hexa topological space (hTS)**.

Definition 1.6. Let (H, I_h) be a Hexa Topological Space (HTS), and let $A \subseteq H$. Then:

- (1) The **h-interior** of A , denoted by $hint(A)$, is the union of all h-open sets contained in A .

$$hint(A) = \{O \subseteq A \mid O \text{ is h-open}\}$$

- (2) The **h-closure** of A , denoted by $hcl(A)$, is the intersection of all h-closed sets containing A .

$$hcl(A) = \{F \supseteq A \mid F \text{ is h-closed}\}$$

2. Introducing a New Formulation of N-Hexa Topological Space

Definition 2.1. Let W be a non-empty universe, and let $\tau_{R_i}(Q)$ for $i = 1, 2, \dots, 6$ be N-Hexa Topologies (N_{HT}) on W with respect to $Q \subseteq W$.

A subset $A \subseteq W$ is called a **N-Hexa Open set** (denoted N_{HO}) if

$$A \in \bigcup_{i=1}^6 \tau_{R_i}(Q).$$

Its complement is called a **N-Hexa Closed set** (denoted N_{HC}).

The collection of all such sets forms a **N-Hexa Topological Space**, denoted by (W, N_{HT}) , satisfying all axioms of a topology for each $h = 1, 2, \dots, 6$.

Remark 2.2. Let W be a universe, G an equivalence relation on W , and let $Q \subseteq W$. Define the topology

$$\tau_{G_h}(Q) = \{\emptyset, W, L_{G_h}(Q), U_{G_h}(Q), B_{G_h}(Q)\}.$$

If $\emptyset, W \in \tau_{G_h}(Q)$ and $L_{G_h}(Q) \subseteq U_{G_h}(Q)$, then the following properties hold:

- (1) $L_{G_h}(Q) \cup U_{G_h}(Q) = U_{G_h}(Q) \in \tau_{G_h}(Q)$
- (2) $U_{G_h}(Q) \cup B_{G_h}(Q) = U_{G_h}(Q) \in \tau_{G_h}(Q)$
- (3) $L_{G_h}(Q) \cup B_{G_h}(Q) = U_{G_h}(Q) \in \tau_{G_h}(Q)$
- (4) $L_{G_h}(Q) \cap U_{G_h}(Q) = L_{G_h}(Q) \in \tau_{G_h}(Q)$
- (5) $U_{G_h}(Q) \cap B_{G_h}(Q) = B_{G_h}(Q) \in \tau_{G_h}(Q)$
- (6) $L_{G_h}(Q) \cap B_{G_h}(Q) = \emptyset \in \tau_{G_h}(Q)$

Definition 2.3. Let W be a universe, and G an equivalence relation on W . Let $Q \subseteq W$ and define the N -Hexa topology as

$$\tau_{G_h}(Q) = \bigcup_{i=1}^6 \tau_{G_i}(Q).$$

Then $\tau_{G_h}(Q)$ satisfies the following axioms:

- (1) $\emptyset, W \in \tau_{G_h}(Q)$
- (2) The union of any subcollection of sets in $\tau_{G_h}(Q)$ belongs to $\tau_{G_h}(Q)$
- (3) The intersection of any finite subcollection of sets in $\tau_{G_h}(Q)$ belongs to $\tau_{G_h}(Q)$

Thus, $\tau_{G_h}(Q)$ forms a topology on W called the **N -Hexa Topology** ($N_H T$), and the pair $(W, \tau_{G_h}(Q))$ is called a **N -Hexa Topological Space** ($N_H TS$). Elements of $N_H T$ are called **N -Hexa Open Sets** (denoted $N_H O$).

Proposition 2.4. If $\tau_{G_h}(Q)$ is the N -Hexa Topology ($N_H T$) on W with respect to $Q \subseteq W$, then the set

$$B = \{W, L_{G_h}(Q), B_{G_h}(Q)\}$$

forms a basis for $\tau_{G_h}(Q)$.

Definition 2.5. Let $(W, \tau_{G_h}(Q))$ be a N -Hexa Topological Space ($N_H TS$) with $Q \subseteq W$, and let $F \subseteq W$.

- The **N_H -interior** of F , denoted by $N_{Hint}(F)$, is the union of all N_H -open sets contained in F . It is the largest $N_H O$ subset of F .
- The **N_H -closure** of F , denoted by $N_{Hcl}(F)$, is the intersection of all N_H -closed sets containing F . It is the smallest $N_H C$ set containing F .

Properties 2.6. Let $(W, \tau_{G_h}(Q))$ be a $N_H T$ space with $Q \subseteq W$, and let $F, E \subseteq W$. Then:

- (1) $N_{Hint}(\emptyset) = \emptyset$ and $N_{Hint}(W) = W$
- (2) $N_{Hint}(F) \subseteq F$
- (3) If $F \subseteq E$, then $N_{Hint}(F) \subseteq N_{Hint}(E)$
- (4) $N_{Hint}(F)$ is an $N_H O$ set
- (5) $N_{Hint}(N_{Hint}(F)) = N_{Hint}(F)$
- (6) $N_{Hint}(F \cap E) = N_{Hint}(F) \cap N_{Hint}(E)$
- (7) $N_{Hint}(F) \cup N_{Hint}(E) \subseteq N_{Hint}(F \cup E)$

Example 2.7. Let $M = \{i, j, k, l, m\}$ with the following equivalence relations:

$$\begin{aligned} H/R_1 &= \{\{i\}, \{j, k\}, \{l, m\}\} \\ H/R_2 &= \{\{i\}, \{m\}, \{j, k, l\}\} \\ H/R_3 &= \{\{i\}, \{j\}, \{l, k, m\}\} \\ H/R_4 &= \{\{j\}, \{k, l\}, \{i, m\}\} \\ H/R_5 &= \{\{l\}, \{i, m\}, \{j, k\}\} \\ H/R_6 &= \{\{i, j\}, \{l, k, m\}\} \end{aligned}$$

We analyze a subset $Q_h \subseteq M$ for $h = 1, 2, 3, 4, 5, 6$, and compute the lower approximation $L_{G_h}(Q)$, upper approximation $U_{G_h}(Q)$, boundary region $B_{G_h}(Q)$, and topology $\tau_{G_h}(Q)$.

| h | Q_h | $L_{G_h}(Q)$ | $U_{G_h}(Q)$ | $B_{G_h}(Q)$ | $\tau_{G_h}(Q)$ |
|-----|---------------|--------------|------------------|---------------|--|
| 1 | $\{i, j\}$ | $\{i\}$ | $\{i, j, k\}$ | $\{j, k\}$ | $\{H, \emptyset, \{i\}, \{j, k\}, \{i, j, k\}\}$ |
| 2 | $\{i, k\}$ | $\{i\}$ | $\{i, j, k, l\}$ | $\{j, k, l\}$ | $\{H, \emptyset, \{i\}, \{j, k, l\}, \{i, j, k, l\}\}$ |
| 3 | $\{i, j, m\}$ | $\{i, j\}$ | $\{i, j\}$ | \emptyset | $\{H, \emptyset, \{i, j\}\}$ |
| 4 | $\{j, m\}$ | $\{j\}$ | $\{i, j, m\}$ | $\{i, m\}$ | $\{H, \emptyset, \{j\}, \{i, m\}, \{i, j, m\}\}$ |
| 5 | $\{j, k, m\}$ | $\{j, m\}$ | $\{i, j, k, m\}$ | $\{i, m\}$ | $\{H, \emptyset, \{i, m\}, \{j, k\}, \{i, j, k, m\}\}$ |
| 6 | $\{j, m\}$ | \emptyset | H | H | $\{H, \emptyset\}$ |

The set $\tau_{G_h}(Q)$ is the collection of all open sets under equivalence relation $G_h(Q)$. The elements of $\tau_{G_h}(Q)$ are called $N_H O(H)$ sets and their complements are called $N_H C(H)$ sets.

$$\tau_{G_n}(Q) = \{H, \emptyset, \{i\}, \{j\}, \{i, m\}, \{j, k\}, \{i, j\}, \{i, j, m\}, \{i, j, k\}, \{j, k, l\}, \{i, j, k, l\}, \{i, j, k, m\}\}$$

Result: We note that these cases are independent of each other in terms of structural formation of the N_{HTS} .

3. Exploring Maternal and Newborn Care for a Positive Postnatal Experience through a Novel N-Hexa Topological Space Framework

Women and newborns require support and careful monitoring after birth. Most maternal and infant deaths occur in the first six weeks after delivery, yet this remains the most neglected phase in the provision of quality maternal and newborn care.

KEY FACTORS FOR REDUCING MATERNAL DEPRESSION AFTER BIRTH

First Factor: Infant Growth and Development F_1

Variables:

- Early childhood health service
- Breastfeeding
- Whole body massage

Second Factor: Preventive Measures F_2

Variables:

- Dietary advice
- Routine antibiotic prophylaxis

Third Factor: Mental Health Interventions F_3

Variables:

- Manage postpartum depression
- Screening for postpartum anxiety

Fourth Factor: Nutritional Interventions and Physical Activity F_4

Variables:

- Physical activity
- Avoid high-fat foods

Fifth Factor: Newborn Assessment F_5

Variable:

- Identified abnormality

Sixth Factor: Maternal Assessment F_6

Variables:

- Physiological assessment
- Local cooling for perineal pain relief

Here, we apply the N-Hexa Topology framework to identify the most critical factors influence Maternal and Newborn Care. This analysis reveals the presence of six key areas of action essential for improving maternal healthcare.

DOMAINS

$A_{F_1} = \{ \text{Early Childhood Health Service (ECHS),}$
 $\text{Breastfeeding (AFF - BF),}$
 $\text{Whole Body Massage (ASSB - WBM)} \}$

$A_{F_2} = \{ \text{Dietary Advice (CEPA - DA),}$
 $\text{Routine Antibiotic Prophylaxis (GGP - RAP)} \}$

$A_{F_3} = \{ \text{Manage Postpartum Depression (MHT - MPD),}$
 $\text{Screening for Postpartum Anxiety (SPA)} \}$

$A_{F_4} = \{ \text{Physical Activity (BM - PA),}$
 $\text{Avoid High Fat Foods (AHFF)} \}$

$A_{F_5} = \{ \text{Identified Abnormality (NL - IA),}$
 $\text{Healthy Meals (HM)} \}$

$A_{F_6} = \{ \text{Physiological Assessment (CD - PA),}$
 $\text{Local Cooling for Perineal Pain Relief (PS - LCPP)} \}$

INFORMATION ON ENDING OBESITY VARIABLE

Table-1: Table of Information on Maternal Measures

TABLE 2. Maternal Attribute Mapping

| Maternal | F ₁ | F ₂ | F ₃ |
|----------|-----------------|----------------|----------------|
| M1 | {ECHS, BF, WBM} | {DA} | {MPD, MGWG} |
| M2 | {ECHS, BF, WBM} | {DA} | {MPD, MGWG} |
| M3 | {BF, WBM} | {RAP} | {MPD, MGWG} |
| M4 | {ECHS} | {RAP} | {MPD, MGWG} |
| M5 | {ECHS, BF, WBM} | {DA} | {MPD, MGWG} |
| M6 | {ECHS, WBM} | {RAP} | {MPD, MGWG} |
| M7 | {ECHS, BF} | {DA} | {MPD, MGWG} |
| M8 | {ECHS, BF} | {RAP} | {MPD, MGWG} |

| F ₄ | F ₅ | F ₆ | Result |
|----------------|----------------|----------------|--------|
| {PA, AHFF} | {IA, HM} | {PA} | Yes |
| {PA, AHFF} | {IA, HM} | {PA} | Yes |
| {PA} | {IA, HM} | {LCPP} | No |
| {PA} | {IA, HM} | {LCPP} | No |
| {PA, AHFF} | {IA, HM} | {PA} | Yes |
| {PA} | {IA, HM} | {LCPP} | No |
| {PA} | {IA, HM} | {PA} | Yes |
| {AHFF} | {IA, HM} | {LCPP} | No |

Table of Information on Maternal Measures

CASE 1: N-HEXA ANALYSIS OF MATERNAL WITH RESPECT TO DOMAIN F_1

Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of children, and $F_1 = \{ECHS (NF), BF (AFF), WBM (ASSB)\}$ be the set of domains.

The equivalence classes under H/F_1 are:

$$H/F_1 = \{\{M1, M2, M5\}, \{M3\}, \{M4\}, \{M6\}, \{M7, M8\}\}$$

Case 1.1: Reducing Maternal anxiety after delivery with Respect to F_1 . We compute the lower approximation $L_{F_1}(Q_i)$, upper approximation $U_{F_1}(Q_i)$, boundary region $B_{F_1}(Q_i)$, and rough set $\tau_{F_1}(Q)$ for various subsets Q_i :

| Q_i | $L_{F_1}(Q_i)$ | $U_{F_1}(Q_i)$ | $B_{F_1}(Q_i)$ |
|------------------|------------------|----------------------|--------------------------|
| $\{M1, M2\}$ | \emptyset | $\{M1, M2\}$ | $\{M1, M2\}$ |
| $\{M1, M5\}$ | \emptyset | $\{M1, M2, M5\}$ | $\{M1, M2, M5\}$ |
| $\{M2, M5\}$ | \emptyset | $\{M1, M2, M5\}$ | $\{M1, M2, M5\}$ |
| $\{M2, M5, M7\}$ | \emptyset | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7, M8\}$ |
| $\{M1, M2, M5\}$ | $\{M1, M2, M5\}$ | $\{M1, M2, M5\}$ | \emptyset |
| $\{M5\}$ | \emptyset | $\{M1, M2, M5\}$ | $\{M1, M2, M5\}$ |

| $\tau_{F_1}(Q_i)$ |
|--|
| $\{H, \emptyset, \{M1, M2\}\}$ |
| $\{H, \emptyset, \{M1, M2, M5\}\}$ |
| $\{H, \emptyset, \{M1, M2, M5\}\}$ |
| $\{H, \emptyset, \{M1, M2, M5, M7, M8\}\}$ |
| $\{H, \emptyset, \{M1, M2, M5\}\}$ |
| $\{H, \emptyset, \{M1, M2, M5\}\}$ |

Then we have:

$$\tau_{F_1}(Q) = \{H, \emptyset, \{M1, M2\}, \{M1, M2, M5\}, \{M1, M2, M5, M7, M8\}\}$$

$$B_{F_1}(Q) = \{H, \emptyset, \{M1, M2, M5\}, \{M1, M2, M5, M7, M8\}\}$$

Case 1.1.1: When Early Childhood Health Service (ECHS) was removed from F_1

$$H/(F_1 - ECHS) = \{\{M1, M2, M3, M5\}, \{M4\}, \{M6\}, \{M7, M8\}\}$$

we obtain $\tau_{(F_1 - ECHS)h}(Q) = \{H, \emptyset, \{M7, M8\}, \{M1, M2, M3, M5\}, \{M1, M2, M3, M5, M7, M8\},$

$$B_{(F_1 - ECHS)h}(Q) = \{H, \emptyset, \{M1, M2, M3, M5, M7, M8\}\} \neq B_{F_1h}(Q)$$

Case 1.1.2: When Breastfeeding (BF) was removed from F_1

$$H/(F_1 - BF) = \{\{M1, M2, M5, M6\}, \{M3\}, \{M4\}, \{M7, M8\}\}$$

we obtain $\tau_{(F_1 - BF)h}(Q) = \{H, \emptyset, \{M7, M8\}, \{M1, M2, M5, M6\}, \{M1, M2, M5,$

$$M6, M7, M8\}\}, B_{(F_1 - BF)h}(Q) = \{H, \emptyset, \{M1, M2, M5, M6, M7, M8\}\} \neq B_{F_1h}(Q)$$

Case 1.1.3: When Whole Body Massage (WBM) was removed from F_1

$$H/(F_1 - WBM) = \{\{M1, M2, M5, M7, M8\}, \{M3\}, \{M4, M6\}\}$$

we obtain $\tau_{(F_1 - WBM)h}(Q) = \{H, \emptyset, \{M1, M2, M5, M7, M8\}\},$

$$B_{(F_1 - WBM)h}(Q) = \{H, \emptyset, \{M1, M2, M5, M7, M8\}\} = B_{F_1h}(Q).$$

Therefore, CORE = {Early Childhood Health Service (ECHS), Breastfeed in (BF)} (1)

Case 1.2: Maternal with not reducing anxiety after delivery with respect to F_1 .

Then the corresponding upper, lower approximation and the boundary region of Q

| H/F_1 | $L_{F_1}(Q_i)$ | $U_{F_1}(Q_i)$ | $B_{F_1}(Q_i)$ |
|----------------------------|------------------|--------------------------|----------------|
| $Q_1 = \{M3\}$ | $\{M3\}$ | $\{M3\}$ | \emptyset |
| $Q_2 = \{M3, M6\}$ | $\{M3, M6\}$ | $\{M3, M6\}$ | \emptyset |
| $Q_3 = \{M6, M8\}$ | $\{M6\}$ | $\{M6, M7, M8\}$ | $\{M7, M8\}$ |
| $Q_4 = \{M3, M4, M6\}$ | $\{M3, M4, M6\}$ | $\{M3, M4, M6\}$ | \emptyset |
| $Q_5 = \{M4, M6, M8\}$ | $\{M4, M6\}$ | $\{M4, M6, M7, M8\}$ | $\{M7, M8\}$ |
| $Q_6 = \{M3, M4, M6, M8\}$ | $\{M3, M4, M6\}$ | $\{M3, M4, M6, M7, M8\}$ | $\{M7, M8\}$ |

Then

$$\tau_{F_1h}(Q) = \{H, \emptyset, \{M3\}, \{M6\}, \{M3, M6\}, \{M7, M8\}, \{M3, M4, M6\}, \{M6, M7, M8\}, \{M3, M6, M7, M8\}, \{M3, M4, M6, M7, M8\}\}, B_{F_1h}(Q) = \{H, \emptyset,$$

$$\begin{aligned} &\tau_{F_1}(Q_i) \\ &\{H, \varphi, \{M3\}\} \\ &\{H, \varphi, \{M3, M6\}\} \\ &\{H, \varphi, \{M6\}, \{M7, M8\}, \{M6, M7, M8\}\} \\ &\{H, \varphi, \{M3, M4, M6\}\} \\ &\{H, \varphi, \{M4, M6\}, \{M7, M8\}, \{M3, M6, M7, M8\}\} \\ &\{H, \varphi, \{M3, M4, M6\}, \{M7, M8\}, \{M3, M4, M6, M7, M8\}, \{M7, M8\}, \{M3, M4, M6\}\} \end{aligned}$$

Case 1.2.1: When Early Childhood Health Service (ECHS) was removed from F_1

$$H/(F_1 - ECHS) = \{\{M1, M2, M3, M5\}, \{M4\}, \{M6\}, \{M7, M8\}\}$$

we obtain

$$\tau_{(F_1-ECHS)h}(Q) = \{H, \varphi, \{M6\}, \{M4, M6\}, \{M7, M8\}, \{M6, M7, M8\}, \{M1, M2, M3, M5\}, \{M4, M6, M7, M8\}, \{M1, M2, M3, M5, M4, M6\}\},$$

$$B_{(F_1-ECHS)h}(Q) = \{H, \varphi, \{M4, M6\}, \{M1, M2, M3, M5, M7, M8\}\} \neq B_{F_1h}(Q)$$

Case 1.2.2: When Breastfeeding (BF) was removed from F_1

$$H/(F_1 - BF) = \{\{M1, M2, M5, M6\}, \{M3\}, \{M4\}, \{M7, M8\}\}$$

we obtain

$$\tau_{(F_1-BF)h}(Q) = \{H, \varphi, \{M3\}, \{M4\}, \{M3, M4\}, \{M1, M2, M5, M6\}, \{M1, M2, M4, M5, M6\}, \{M1, M2, M3, M4, M5, M6\}, \{M1, M2, M5, M6, M7, M8\}, \{M1, M2, M3, M5, M6, M7, M8\}\}$$

$$B_{(F_1-BF)h}(Q) = \{H, \varphi, \{M3, M4\}, \{M1, M2, M5, M6, M7, M8\}\} \neq B_{F_1h}(Q)$$

Case 1.2.3: When Whole Body Massage (WBM) was removed from F_1

$$H/(F_1 - WBM) = \{\{M1, M2, M5, M7, M8\}, \{M3\}, \{M4, M6\}\}$$

we obtain

$$\tau_{(F_1-WBM)h}(Q) = \{H, \varphi, \{M3\}, \{M4, M6\}, \{M3, M4, M6\}, \{M1, M2, M5, M7, M8\}, \{M1, M2, M4, M5, M6, M7, M8\}\},$$

$$B_{(F_1-WBM)h}(Q) = \{H, \varphi, \{M1, M2, M4, M5, M6, M7, M8\}, \{M3, M4, M6\}\} \neq B_{F_1h}(Q)$$

Therefore,

$$CORE = \{\text{Early Childhood Health Service (ECHS), Breastfeeding (BF)}\} \dots \dots \dots (2)$$

Note: From (1) and (2), we get $CORE_1 = \{\text{Early Childhood Health Service (ECHS), Breastfeeding (BF)}\}$

Case 2: Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of Maternal and $F_2 = \{DA, RAP\}$ be the set of domains. Let $H/F_2 = \{\{M1, M2, M7, M5\}, \{M3, M4, M6, M8\}\}$

Case 2.1: Maternal reducing anxiety after delivery with concerning F_2 .

Then the corresponding upper, lower approximation and the boundary region of Q

$$\text{Then } \tau_{F_2h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\}, \quad B_{F_2h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\}$$

| H/F_2 | $L_{F_2}(Q_i) (i = 1, 2, 3, 4, 5, 6)$ | $U_{F_2}(Q_i)$ | $B_{F_2}(Q_i)$ |
|------------------------|---------------------------------------|----------------------|----------------------|
| $Q_1 = \{M1, M2\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |
| $Q_2 = \{M1, M5\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |
| $Q_3 = \{M2, M5\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |
| $Q_4 = \{M2, M5, M7\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |
| $Q_5 = \{M1, M2, M5\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |
| $Q_6 = \{M7\}$ | φ | $\{M1, M2, M5, M7\}$ | $\{M1, M2, M5, M7\}$ |

Case 2.1.1: When Dietary Advice (DA) was removed from F_2

$$H/(F_2 - DA) = \{\{M3, M4, M6, M8\}\}$$

$$\tau_{(F_2-DA)h}(Q) = \{H, \varphi\},$$

$$B_{(F_2-DA)h}(Q) = \{H, \varphi\} \neq B_{F_2h}(Q)$$

$$\begin{aligned} \tau_{F_2}(Q_i) & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \\ \{H, \varphi, \{M1, M2, M5, M7\}\} & \end{aligned}$$

Case 2.1.2: When Routine Antibiotic Prophylaxis (RAP) was removed from F₂
 $H/(F_2 - RAP) = \{\{M1, M2, M5, M7\}\}$ we obtain

$$\begin{aligned} \tau_{(F_2-RAP)h}(Q) &= \{H, \varphi, \{M1, M2, M5, M7\}\}, \\ B_{(F_2-RAP)h}(Q) &= \{H, \varphi, \{M1, M2, M5, M7\}\} = B_{F_2h}(Q). \end{aligned}$$

Therefore CORE = { Dietary Advice }..... (3)

Case 2.2: Maternal with not reducing anxiety with respect to F₂.

Then the corresponding upper, lower approximation and the boundary region of Q
 Then

$$\tau_{F_2h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\}, \quad B_{F_2h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\}$$

Case 2.2.1: When Dietary Advice (DA) was removed from F₂
 $H/(F_2 - DA) = \{\{M3, M4, M6, M8\}\}$ we obtain

$$\tau_{(F_2-DA)h}(Q) = \{H, \varphi\}, \quad B_{(F_2-DA)h}(Q) = \{H, \varphi\} \neq B_{F_2h}(Q)$$

Case 2.2.2: When Routine Antibiotic Prophylaxis (RAP) was removed from F₂
 $H/(F_2 - RAP) = \{\{M1, M2, M5, M7\}\}$ we obtain

$$\begin{aligned} \tau_{(F_2-RAP)h}(Q) &= \{H, \varphi, \{M3, M4, M6, M8\}\}, \\ B_{(F_2-RAP)h}(Q) &= \{H, \varphi, \{M3, M4, M6, M8\}\} = B_{F_2h}(Q) \end{aligned}$$

Therefore, CORE = {Dietary Advice}..... (4)

Note: From (3) and (4), we get CORE 2 = {Dietary Advice }

Case 3: Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of Maternals and $F_3 = \{MPD, MGWG\}$ be the set of domains. Let

$$H/F_3 = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

Case 3.1: Reducing Maternal anxiety after delivery concerning F₃.
 Then

$$\tau_{F_3h}(Q) = \{H, \varphi, \{M2, M4\}, \{M3, M5, M6\}, \{M1, M7, M8\}, \{M2, M3, M4, M5, M6\}, \{M1, M3, M5, M6, M7, M8\}\},$$

$$B_{F_3h}(Q) = \{H, \varphi\}$$

Case 3.1.1: When Manage Postpartum Depression (MPD) was removed from F₃

$$H/(F_3 - MPD) = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

we obtain

$$\tau_{(F_3-MPD)h}(Q) = \{H, \varphi\}, \quad B_{(F_3-MPD)h}(Q) = \{H, \varphi\} = B_{F_3h}(Q)$$

Case 3.1.2: When to Screening for Postpartum Anxiety (SPA) was removed from F₃

$$H/(F_3 - MGWG) = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

we obtain

$$\tau_{(F_3-MGWG)h}(Q) = \{H, \varphi\}, \quad B_{(F_3-MGWG)h}(Q) = \{H, \varphi\} = B_{F_3h}(Q)$$

Case 3.2: Maternal with not reducing anxiety after delivery concerning F₃.
 Let

$$H/F_3 = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

Then

$$\tau_{F_3h}(Q) = \{H, \varphi\}, \quad B_{F_3h}(Q) = \{H, \varphi\}$$

Case 3.2.1: When Manage Postpartum Depression (MPD) was removed from F₃

$$H/(F_3 - MPD) = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

we obtain

$$\tau_{(F_3-MPD)h}(Q) = \{H, \varphi\}, \quad B_{(F_3-MPD)h}(Q) = \{H, \varphi\} = B_{F_3h}(Q)$$

Case 3.2.2: When Screening for Postpartum Anxiety (SPA) was removed from F_3

$$H/(F_3 - MGWG) = \{M1, M2, M3, M4, M5, M6, M7, M8\}$$

we obtain

$$\tau_{(F_3-MGWG)h}(Q) = \{H, \varphi\}, \quad B_{(F_3-MGWG)h}(Q) = \{H, \varphi\} = B_{F_3h}(Q)$$

Therefore

$$CORE_3 = \{Nil\}$$

Case 4: Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of Maternals and $F_4 = \{PA, BF\}$ be the set of domains. Let

$$H/F_4 = \{\{M1, M2, M5\}, \{M3, M4, M6, M7\}, \{M8\}\}$$

Case 4.1: Reducing Maternal anxiety after delivery concerning F_4

Then

$$\tau_{F_4h}(Q) = \{H, \varphi, \{M1, M2, M5\}, \{M3, M4, M6, M7\}, \{M1, M2, M3, M4, M5, M6, M7\}\}$$

and

$$B_{F_4h}(Q) = \{H, \varphi, \{M1, M2, M3, M4, M5, M6, M7\}\}$$

Case 4.1.1: When Physical Activity was removed from F_4

$$H/(F_4 - PA) = \{\{M1, M2, M5, M8\}\}$$

we obtain

$$\tau_{(F_4-PA)h}(Q) = \{H, \varphi, \{M1, M2, M5, M8\}\},$$

$$B_{(F_4-PA)h}(Q) = \{H, \varphi, \{M1, M2, M5, M8\}\} \neq B_{F_4h}(Q)$$

Case 4.1.2: When avoid high fat foods (AHFF) was removed from F_4

$$H/(F_4 - BF) = \{\{M1, M2, M3, M4, M5, M6, M7\}\}$$

we obtain

$$\tau_{(F_4-BF)h}(Q) = \{H, \varphi, \{M1, M2, M3, M4, M5, M6\}\},$$

$$B_{(F_4-BF)h}(Q) = \{H, \varphi, \{M8\}, \{M1, M2, M3, M4, M5, M6\}\} \neq B_{F_4h}(Q)$$

$$CORE = \{\text{breast milk, avoid high fat foods}\} \dots (5)$$

Case 4.2: Maternal not reducing anxiety after delivery concerning F_4 .

Let

$$H/F_4 = \{\{M1, M2, M5\}, \{M3, M4, M6, M7\}, \{M8\}\}$$

Then

$$\tau_{F_4h}(Q) = \{H, \varphi, \{M3, M4, M6\}, \{M3, M4, M6, M7\}, \{M3, M4, M6, M7, M8\}\},$$

$$B_{F_4h}(Q) = \{H, \varphi, \{M8\}, \{M3, M4, M6, M7\}\}$$

Case 4.2.1: When Physical Activity (PA) was removed from F_4

$$H/(F_4 - PA) = \{\{M1, M2, M5, M8\}\}$$

we obtain

$$\tau_{(F_4-PA)h}(Q) = \{H, \varphi, \{M1, M2, M5, M8\}\},$$

$$B_{(F_4-PA)h}(Q) = \{H, \varphi, \{M1, M2, M5, M8\}\} \neq B_{F_4h}(Q)$$

Case 4.2.2: When avoiding high-fat foods (AHFF) was removed from F_4

$$H/(F_4 - BF) = \{\{M1, M2, M3, M4, M5, M6, M7\}\}$$

we obtain

$$\tau_{(F_4-BF)h}(Q) = \{H, \varphi\},$$

$$B_{(F_4-BF)h}(Q) = \{H, \varphi\} \neq B_{F_4h}(Q)$$

$$CORE = \{\text{Physical Activity, avoid high fat foods}\} \dots (6)$$

Note: From (5) and (6), we get

$$CORE_4 = \{\text{Physical Activity, avoiding high-fat foods}\}$$

Case 5: Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of Maternals and $F_5 = \{IA, HM\}$ be the set of domains. Let

$$H/F_5 = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

Case 5.1: Reducing Maternal anxiety after delivery concerning F_5 .

Then

$$\tau_{F_5h}(Q) = \{H, \varphi\}$$

and

$$B_{F_5h}(Q) = \{H, \varphi\}$$

Case 5.1.1: When identified Abnormality (IA) was removed from F_5

$$H/(F_5 - IA) = \{\{M1, M2, M5, M7\}\}$$

we obtain

$$\tau_{(F_5-IA)h}(Q) = \{H, \varphi\},$$

$$B_{(F_5-IA)h}(Q) = \{H, \varphi\} = B_{F_5h}(Q)$$

Case 5.1.2: When healthy meals (HM) was removed from F_5

$$H/(F_5 - HM) = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

we obtain

$$\tau_{(F_5-HM)h}(Q) = \{H, \varphi\}, \quad B_{(F_5-HM)h}(Q) = \{H, \varphi\} = B_{F_5h}(Q)$$

Case 5.2: Maternal with not reducing anxiety after delivery concerning F_5 .

Let

$$H/F_5 = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

Then

$$\tau_{F_5h}(Q) = \{H, \varphi\}, \quad B_{F_5h}(Q) = \{H, \varphi\}$$

Case 5.2.1: When identified Abnormality (IA) was removed from F_5

$$H/(F_5 - IA) = \{\{M1, M2, M5, M7\}\}$$

we obtain

$$\tau_{(F_5-IA)h}(Q) = \{H, \varphi\},$$

$$B_{(F_5-IA)h}(Q) = \{H, \varphi\} = B_{F_5h}(Q)$$

Case 5.2.2: When healthy meals (HM) was removed from F_5

$$H/(F_5 - HM) = \{\{M1, M2, M3, M4, M5, M6, M7, M8\}\}$$

we obtain

$$\tau_{(F_5-HM)h}(Q) = \{H, \varphi\}, \quad B_{(F_5-HM)h}(Q) = \{H, \varphi\} = B_{F_5h}(Q)$$

Therefore,

$$CORE = \{Nil\}$$

Case 6: Let $H = \{M1, M2, M3, M4, M5, M6, M7, M8\}$ be the set of Maternal and $F_6 = \{PA, LCPP\}$ be the set of domains. Let

$$H/F_6 = \{\{M1, M2, M5, M7\}, \{M3, M4, M6, M8\}\}$$

Case 6.1: Reducing Maternal anxiety after delivery with concerning F_6 .

Then

$$\tau_{F_6h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\}$$

and

$$B_{F_6h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\}$$

Case 6.1.1: When Physiological Assessment (PA) was removed from F_6

$$H/(F_6 - PA) = \{\{M3, M4, M6, M8\}\}$$

we obtain

$$\tau_{(F_6-PA)h}(Q) = \{H, \varphi\},$$

$$B_{(F_6-PA)h}(Q) = \{H, \varphi\} \neq B_{F_6h}(Q)$$

Case 6.1.2: When Local Cooling for Perineal Pain Relief (LCPP) was removed from F_6

$$H/(F_6 - LCPP) = \{\{M1, M2, M5, M7\}\}$$

we obtain

$$\tau_{(F_6-LCPP)h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\},$$

$$B_{(F_6-LCPP)h}(Q) = \{H, \varphi, \{M1, M2, M5, M7\}\} = B_{F_6h}(Q)$$

Case 6.2: Maternal with not reducing anxiety after delivery concerning F_6 .

Let

$$H/F_6 = \{\{M1, M2, M5\}, \{M3, M4, M6, M7\}, \{M8\}\}$$

Then

$$\tau_{F_6h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\},$$

$$B_{F_6h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\}$$

Case 6.2.1: When Physiological Assessment (PA) was removed from F_6

$$H/(F_6 - PA) = \{\{M3, M4, M6, M8\}\}$$

we obtain

$$\tau_{(F_6-PA)h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\},$$

$$B_{(F_6-PA)h}(Q) = \{H, \varphi, \{M3, M4, M6, M8\}\} = B_{F_6h}(Q)$$

Case 6.2.2: When Local Cooling for Perineal Pain Relief (LCPP) was removed from F_6

$$H/(F_6 - LCPP) = \{\{M1, M2, M5, M7\}\}$$

we obtain

$$\tau_{(F_6-LCPP)h}(Q) = \{H, \varphi\},$$

$$B_{(F_6-LCPP)h}(Q) = \{H, \varphi\} \neq B_{F_6h}(Q)$$

Therefore

CORE = {Physiological Assessment and Local Cooling for Perineal Pain Relief are independent of each other

4. CONCLUSION

The analysis underscores the significance of specific maternal care practices in improving health outcomes. Early Childhood Health Services and Breastfeeding stand out as foundational components in early maternal and newborn care, necessitating focused promotion and support. Dietary Advice plays a crucial role in maternal health, surpassing the influence of routine antibiotic prophylaxis in this context. Physical Activity during pregnancy is a key factor that positively affects outcomes, more so than avoiding high-fat foods alone. The absence of a core attribute in managing postpartum depression and gestational weight gain indicates the need for further investigation into their complex effects. Overall, these insights provide a clear directive for healthcare providers and policymakers to prioritize evidence-based interventions, optimizing resource allocation and enhancing the effectiveness of maternal and newborn healthcare programs. Results indicate that within F1, Early Childhood Health Service and Breastfeeding are vital components, while Whole Body Massage is less critical. For F2, Dietary Advice emerged as the essential element over Routine Antibiotic Prophylaxis. No significant core attribute was identified for F3, suggesting a more complex interplay of variables or a less direct impact. Physical Activity proved to be the principal determinant over dietary fat avoidance. These findings highlight targeted areas for intervention to enhance maternal and newborn health, emphasizing the importance of early health services, breastfeeding promotion, dietary guidance and physical activity.

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