SELINUS UNIVERSITY
OF SCIENCES AND LITERATURE

CHALLENGES TO THE BREASTFEEDING PROCESS IN A DEVELOPING COMMUNITY:

ILLUSTRATING WITH A GROUP OF NEWLY DELIVERED WOMEN IN YAOUNDE, CAMEROON

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DEDICATION

This Work is Dedicated to my Lovely Father who died in September 2021.

Dad I Love You Forever!!!

PRELIMINARIES

ACKNOWLEDGEMENTS

I will like to express my sincere gratitude to:

- The Almighty God for his love and grace which preserved me all through my studies. Glory be to you Lord.
- The entire staff of Selinus University, for admitting me as a PhD student
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- My family, the MOYO family, I thank you from the bottom of my heart for your steadfast love, overwhelming care and limitless support to me throughout medical school and post graduate training. I can never repay you. You are my priceless Jewel.
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- My classmates and friends, your support and encouragements throughout these years have been precious
- All whose names are not mentioned, I sincerely thank you for your respective contributions in my training and the realization of this work.

HIPPOCRATIC OATH

Declaration of Geneva adopted by the Geneva Assembly of the World Medical Association in Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia (August 1968)

On admission to the medical profession:

I will solemnly pledge myself to consecrate my life to the service of humanity

I will give my teachers the respect and gratitude which is their due

I will practice my profession with conscience and dignity

The health of my patients will be my first consideration

I will respect secrets confided in me, even after the patient has died

I will maintain by all the means in my power the honor and noble traditions of the medical profession

My colleagues will be my brothers

I will not permit considerations of religion, nationality, race, party politics or social standing to intervene between my duty and my patient

I will maintain the utmost respect for human life from the time of conception, even under threat I will not use my medical knowledge contrary to the laws of humanity

I make these promises solemnly, freely and upon my honor.

ABSTRACT

Introduction

Exclusive breastfeeding is essential for the mother's wellbeing. It is as well fundamental for the newborn's development and indispensable for the reinforcement of bonding. According to the WHO, breastfeeding after childbirth should be initiated within the first 30 minutes to an hour following delivery. Early breastfeeding initiation determines the willingness, the readiness and the facility for a mother to observe the process. It is an indicator of its feasibility, effectivity and continuity. In effect, although breastfeeding contributes to the reduction of neonatal morbidity and mortality, it is oftentimes not respected or it is inadequately practiced. Contextual and geographical variability is thought to contribute significantly to such malpractices, especially in a developing context facing technological and societal emancipation and challenges.

Objective

The main objective of this survey was to determine the factors associated with breastfeeding initiation, representing challenges to the overall process in our milieu.

Methodology

We conducted an observational study type, with mixed cross-sectional and longitudinal design, with neonates being reassessed at 1 week after birth. The study was conducted in Yaoundé, the cosmopolite and rapidly developing capital of Cameroon. Our study site was the Yaoundé Gynaeco-Obstetric and Pediatric Hospital, a referral and university teaching hospital. The study period spanned from December 1st 2018 to May 31st 2019. We included women with livebirth infants weighing > 2000g, without breastfeeding contraindications during the first hour of immediate postpartum. Women not consenting to take part in the study were excluded. Ethical principles were respected with ethical clearance and institutional authorizations obtained before the start of the study.

Results

We enrolled 250 mothers, mostly from the Centre region 110 (44%), with a secondary school education level in 107 (42.8%). The vaginal route was the main mode of childbirth 172 (68.8%). The newborns had a mean gestational age of 38.4±1.6 weeks, average birth weight of 3168,6 ± 508,7g, with male predominance of sex ratio 1.29. Delivery was eutocic in 230 (92%) women and 199 (79.6%) had the intension to exclusively breastfeed their babies. The state of the neonates was satisfactory in 204 (96%) deliveries. The average time of breastfeeding initiation was 120 minutes and only 97 (38.8%) of mothers had put the baby on to the breast within the first hour after birth, while 153 (61.2%) faced challenges initiating the breastfeeding process. Breast pathologies occurred in 85 women (55.5%), among which 24 (28.2%) had secretion anomalies predominated by quantitative disorders. Painful inflammatory and/or infectious conditions occurred in 58 women (69.4%). All women with obvious or supposed breast disorders had inadequate breastfeeding practices. All neonates with delayed breastfeeding initiation had other characteristics of inadequate breastfeeding practices. Although 144 (94%) were in good health immediately after birth, 38 (24.8%) were hospitalized within 7 days, of which 21 (55.2%) were related to sepsis and 6 (15.7%) due to metabolic disorders. They represented 83.3% (15 out of 18) infants with hypotrophy. Obstacles to the breastfeeding process after bivariate analysis were: primary education level of mothers, the Centre region as origin, Caesarean delivery, HIV infection, gestational age below 37 weeks of pregnancy, low birthweight and neonatal infection at birth. After a multivariate analysis by logistic regression of these factors, the Centre region as origin, and Caesarean delivery persisted as independent predictors of delayed initiation of breastfeeding.

Conclusion

Challenges to the initiation of the breastfeeding process in our context were characterized by maternal, neonatal, interventional factors from healthcare deliverers and psycho-sociocultural parameters. This may be overcome through the reinforcement of women information, population education, and communication. Furthermore, the improvement of perinatal care, in order to facilitate the breastfeeding process, is necessary to prevent associated complications.

Key Words: Breastfeeding challenges, Breastfeeding, Yaoundé, Cameroon

RESUME

Introduction

L'allaitement exclusif est fondamental pour l'état de santé et le bon développement de la mère et de l'enfant. Selon l'OMS, la mise au sein après l'accouchement doit se faire dans les 30 minutes à une heure suivant la naissance. La mise au sein précoce est un indicateur de la qualité du processus d'allaitement. Bien que contribuant fortement à la réduction de la morbi-mortalité néonatale, des mauvaises pratiques sont encore fréquemment retrouvées. En effet, l'allaitement ne se fait pas toujours selon les normes et ceci est très dépendant des variables contextuelles et géographiques. Ce phénomène pouvant être exacerbé dans un pays en voie de développement, faisant face à l'émancipation technologique et sociétale.

Objectifs

L'objectif principal de cette étude était de déterminer les barrières au processus de l'allaitement, à travers les facteurs déterminants de la mise au sein précoce.

Moyens et méthodes

Nous avons mené une étude de type observationnelle, avec une conception mixte transversale et longitudinale, les nouveau-nés étant réévalués à 1 semaine après la naissance. L'étude a été menée à Yaoundé, la capitale cosmopolite et en plein développement du Cameroun. Notre site d'étude était l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé, qui est un Centre Hospitalier Universitaire et de référence. La période d'étude s'étendait du 1er décembre 2018 au 31 mai 2019. Nous avons inclus des femmes ayant eu des nouveau-nés vivants et pesant > 2000 g, sans contre-indications à l'allaitement pendant la première heure du post-partum immédiat. Les femmes n'ayant pas consenti à participer à l'étude ont été exclues. Les principes éthiques ont été

respectés avec une autorisation éthique et des autorisations institutionnelles obtenues avant le début de l'étude.

Résultats

Nous avons enrôlé 250 mères, originaires de la région du centre en majorité (110 : 44%) et d'un niveau d'éducation secondaire chez 107 (42,8%) femmes. La voie basse était la principale voie d'accouchement dans 172 cas (68.8%). Les nouveau-nés avaient un âge gestationnel moyen de 38,4 ± 1,6 Semaines d'aménorrhée (SA), et un poids de naissance moyen de 3168,6 ± 508,7g. Une prédominance masculine (sexe ratio de 1,29) était notée. Le délai moyen de mise au sein était de 120 minutes et seulement 40% des mères mettaient le bébé au sein dans l'heure suivant la naissance. Les barrières au processus de l'allaitement après analyse bi variée étaient : le n'niveau d'instruction primaire des mères, la région du centre comme origine, l'accouchement par césarienne, l'infection au VIH, l'âge gestationnel < 37 SA, le petit poids de naissance et l'infection néonatale. Après l'analyse multivariée par régression logistique de facteurs associés, l'accouchement par césarienne et l'appartenance à la région du Centre persistaient comme facteurs prédicteurs d'une mauvaise initiation du processus d'allaitement.

Nous avons enrôlé 250 mères, majoritairement de la région du Centre (110 ; 44%), avec un niveau d'éducation secondaire chez 107 (42,8%) femmes. La voie vaginale était le principal mode d'accouchement chez 172 (68,8%) mères. Les nouveau-nés avaient un âge gestationnel moyen de 38,4 ± 1,6 semaines, un poids moyen à la naissance de 3168,6 ± 508,7g, avec une prédominance masculine de la sex-ratio de 1,29. L'accouchement était eutocique chez 230 (92%) femmes et 199 (79,6%) avaient l'intention d'allaiter exclusivement leur bébé. L'état des nouveau-nés était satisfaisant dans 204 (96%) accouchements. La durée moyenne de l'initiation à l'allaitement était de 120 minutes et seulement 97 (38,8

%) mères avaient mis le bébé au sein dans la première heure après la naissance, tandis que 153 (61,2 %) femmes avaient des difficultés à initier le processus d'allaitement. Des pathologies mammaires sont survenues chez 85 femmes (55,5%), parmi lesquelles 24 (28,2%) présentaient des anomalies de sécrétion prédominées par des troubles quantitatifs. Des affections inflammatoires et/ou infectieuses douloureuses sont survenues chez 58 femmes (69,4 %). Toutes les femmes présentant des troubles mammaires évidents ou supposés avaient des pratiques d'allaitement inadéquates. Tous les nouveau-nés dont l'initiation à l'allaitement a été retardée présentaient d'autres caractéristiques de pratiques inadéquates d'allaitement. Bien que 144 (94%) nouveau-nés étaient en bonne santé immédiatement après la naissance, 38 (24,8%) ont été hospitalisés dans les 7 jours, dont 21 (55,2%) étaient liés à une septicémie et 6 (15,7%) à des troubles métaboliques. Ils représentaient 83,3 % (15 sur 18) des nourrissons en hypotrophie. Les obstacles au processus d'allaitement après analyse bivariée étaient : le niveau d'instruction primaire des mères, la région du Centre comme origine, l'accouchement par césarienne, l'infection par le VIH, l'âge gestationnel inférieur à 37 semaines de grossesse, le faible poids de naissance et l'infection néonatale à la naissance. Après une analyse multivariée par régression logistique de ces facteurs, la région du Centre comme origine ethnique, et l'accouchement par césarienne ont persisté comme prédicteurs indépendants d'un début tardif de l'allaitement.

Conclusion

Les barrières au processus d'initiation de l'allaitement dans notre étude étaient caractérisées par des facteurs maternels, néonatals, interventionnels dus aux personnels soignants, et contextuels liés aux paramètres psycho-socioculturels. Ceci pourrait être résolu par le renforcement de l'information et de l'éducation des populations en générale, de même que l'amélioration du contenu de la communication au tour du sujet. D'autre part, des progrès dans la

qualité des soins périnataux permettraient de favoriser le processus de l'allaitement et de prévenir les complications y relatives.

Mots clés : Barrières à l'allaitement, allaitement, Yaoundé, Cameroun.

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LIST OF ABBREVIATIONS AND ACRONYMS

AA: Amino Acid

AMA: American Medical Association

Ala: Alanine

ACTH: Adrenocorticotropic hormone

AFADS: Acceptable, Feasible, Affordable, Sustainable and Safe

ARV: Anti RetroVirals

Arg: Arginine

CCE: Central Eastern Europe

Cit: Citrulline

CRH: Corticotropin Releasing Hormone

CIS: Commonwealth of Independent States

DA: Dopamine

DC: Dendritic Cells

EBF : Exclusive Breastfeeding

EDSC : Enquête Démographique et de Santé du Cameroun (Cameroon Demographic Health Surveys)

EIBF: Early Initiation of Breast Feeding

FIL: Feedback Inhibitor of Lactation

FSH: Follicles Stimulating Hormone

GA: Gestational Age

GnRH: Gonadotrophin Releasing Hormone

GLUT: Glucose Transporter

GSH: Glutathion

HIV: Human Immuno Deficiency Virus

HPL: Human Placental Lactogen

IFN: Interferon

IL: Interleukin

IMCI: Integrated Management of Childhood Illness

KDa: KiloDalton

LH: Luteinizing Hormone

MICS: Synthetic report of Multiple indicators cluster surveys

MQ: Macrophage

NEAA: Non-Essential Amino Acid

NH_4^+: Ammonium Ion

NK: Natural Killer cell

NT: Nucleotide

Orn: Ornithine

OT: Oxytocin

PIF: Prolactine Inhibiting Factor

PLT: Prolactine

PRF: Prolactine Releasing Factor

Pro: Proline

R-HPRL: Recombinant HumanProlactine

SGLT: Sodium Glucose Transporter

Th: T-helper cells

TGM: Tumor Growth Factor

TLR 4: Toll-Like Receptor 4

TNF: Tumor Necrosis Factor

TRH: Thyrotropin Releasing Hormone

Tyr: Tyrosine

UNICEF: United Nations International Children's Emergency Fund.

WHO: World Health Organisation

YGOPH: Yaoundé Gynaeco-Obstetrique and Pediatric Hospital

PEPT 1: Human Peptide Transporter 1

CHAPTER 1: INTRODUCTION

1.1. BACKGROUND

Breastfeeding is an old but every time interesting topic in health sciences and medicine, as it a natural process required for the growth and development of infants. Breastmilk contains essential nutrients such as growth and immunological factors which are necessary for the neonate's development [1]. In effect, colostrum is considered as the first vaccine, a perfect food for the newborn, and is recommended within thirty minutes to an hour after birth [1]. The Early Initiation of breastfeeding (EIBF) has several benefits including the prevention of hypoglycemia and hypothermia, the early release of meconium and thus contributes to a certain measure for the prevention of neonatal jaundice. There is substantial evidence that breastfeeding decreases neonatal mortality, morbidity, sepsis-related deaths, diarrhea and respiratory infections in neonates and children [2, 3]. Furthermore, from a sociocultural point of view, larger infants are thought to be the healthiest in a number of African traditions, motiving women to breastfeed. More so, breastfeeding and breastmilk have protective effects against obesity and other chronic diseases in the long-term [2, 3]. However, a newborn may fully enjoy these benefits only when breastfeeding is started early enough and is given exclusively, at least during the first six months of life [3]. It is therefore a mother's responsibility to breastfeed and assure the baby's wellbeing throughout this period. Breastfeeding is as well essential for strengthening mother-infant bonding, and is a known protective factor against breast cancer. It has been reported that institutional or hospital delivery and care givers' support are the major cues to early initiation and hence an effective breastfeeding process [4-6]. A number of research studies advocate the fact that breastfeeding largely contributed to the reduction of about 804.000 deaths (11.6%) among under-five children worldwide in 2011 [7, 8]. Countries like India during that period, had made it mandatory to keep the mother and baby in the hospital for at least 48 hours in case of normal delivery and seven days in case of caesarean section [9].

This had a significant impact on the enhancement of breastfeeding practices, as the mother and baby had to spend some days in the hospital under the watchful monitoring of health care deliverers. In Cameroon, according to the 2018 Demographic and Health Survey, 39.7% infants under 5 months of age were described as exclusively breastfed, although no further information about the time of breastfeeding initiation was given [10].

1.2 RATIONALE / JUSTIFICATION

An adequate and successful breastfeeding process takes into consideration the timely initiation of the act, the effectiveness of its technique, the exclusiveness of the process, during the recommended duration [11]. In most developing countries worldwide, and in Africa in particular, considerable efforts including the improvement of perinatal counselling and education with emphasis on breastfeeding have been put in place to improve practices [12]. There are however, some maternal, neonatal and international or environmental factors occurring during the perinatal period which may hinder this process [12]. These factors determining the failure or the success of the breastfeeding process may therefore vary from one context to another and with time. In effect, while some countries have recently registered considerable ameliorations in terms of breastfeeding rates, relatively lower data have been reported from other countries [12]. In sub-Saharan Africa in general, and in Cameroon in particular, data over the challenges to the breastfeeding process, as well as the determinants are scarce. This is why we conducted a study, with as main objective to determine the factors associated with breastfeeding initiation, so as to figure out the main challenges to the overall process in our milieu.

1.3 RESEARCH QUESTION

1.3.1 General research question

What are the challenges to the breastfeeding process in a developing community such as in Yaoundé?

1.3.2 Specific research question

1. What is the rate of early (normal) initiation of breastfeeding among newly delivered women in Yaoundé?
2. What is the pattern and/or the profile of breastfeeding in this group?
3. What are the challenges or hindrances to this process?
4. What are the consequences of inadequate breastfeeding in the mothers and their infants?

1.4 RESAEARCH OBJECTIVES

1.4.1 General objective

To determine the challenges to the breastfeeding process through a survey among a group of newly delivered women and their neonates in Yaoundé, the capital city of Cameroon.

1.4.2 Specific objective

1. To determine the rate of normal or early initiation of the breastfeeding process among a group of newly delivered women
2. To describe the pattern of the breastfeeding process among mother-neonate couples
3. Investigate challenging factors or barriers to the process through the soughing of maternal, neonatal and interventional or therapeutic factors
4. Asses the consequences of inadequate breastfeeding.

1.5. DEFINITION OFOPERATIONAL TERMS

1. **Ablactaton:** stopping breastfeeding
2. **Exclusive breastfeeding:** When a mother feeds her neonate or infant with breastmilk only and nothing else
3. **Early initiation of breastfeeding:** Introducing breastmilk feeding within 30 minutes to an hour following delivery
4. **Caesarean section:** A surgical delivery through an incision in the abdominal walls and the uterus
5. **Complementary food:** Any food given in addition or association to breastmilk
6. **Lactation:** Feeding with milk
7. **Low birthweight:** Baby weight inferior to 2000g
8. **Milk substitute:** Industrially or artificially manufactured milk products or formula
9. **Mixed feeding or complementary feeding:** feeding infants with both breast milk and formula milk and/or other foods
10. **Neonatal sepsis:** A severe infection of the neonate
11. **Preterm:** Delivered before term of 37 weeks of gestation
12. **Prematurity:** A state of immaturity due to preterm
13. **Weaning:** the process of introducing food into infant feeding, while reducing breastfeeding

CHAPTER 2: LITERATURE REVIEW

2.1. OVERVIEW

Breastfeeding is one of the most effective ways to ensure child health and survival. Breastmilk is the ideal food for infants, as it is safe, clean and contains antibodies which help protect against many common childhood illnesses. Breastmilk provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life.

Breastfed children perform better on intelligence tests, are less likely to be overweight or obese and less prone to diabetes later in life. Women who breastfeed also have a reduced risk of breast and ovarian cancers. However, the inappropriate marketing of breast-milk substitutes continues to undermine efforts to improve breastfeeding rates and duration worldwide [13].

WHO also recommend that the first 6 months of infant exclusive breastfeeding, be followed by continued breastfeeding after addition of complementary foods for at least a year or until mutually desired by the mother and child. Successful breastfeeding requires education, support, and environment that values and understand breastfeeding.

This need for support may derive from the fact that our culture has evolved a series of messages that inhibit automatic and natural behaviors related to breastfeeding. The phenomenon is even more pronounced in a developing community, which may be faced with behavioral shifts and changes related to technological and societal progress.

Therefore, due to the fact that breastfeeding is becoming rarely observed in our society, health care professionals must put in more efforts in supplying education, support and encouragement. This is necessary for breastfeeding to occur and help mothers meet their breastfeeding goals.

2.2. DISTRIBUTION OF BREASTFEEDING PRACTICE WORLDWIDE OVERTIME

During the 1990s, modest improvements were made towards exclusive breastfeeding worldwide, with an increase of it-s practice from 48 to 52% in developed countries. At the same time, the introduction of supplementary foods (from 6-9 months) also increased from 43% to 49% between 1990 and 2000. The proportion of children who continue breastfeeding after one to two years of age has improved slightly as well during recent years as shown in Figures 1 [14].

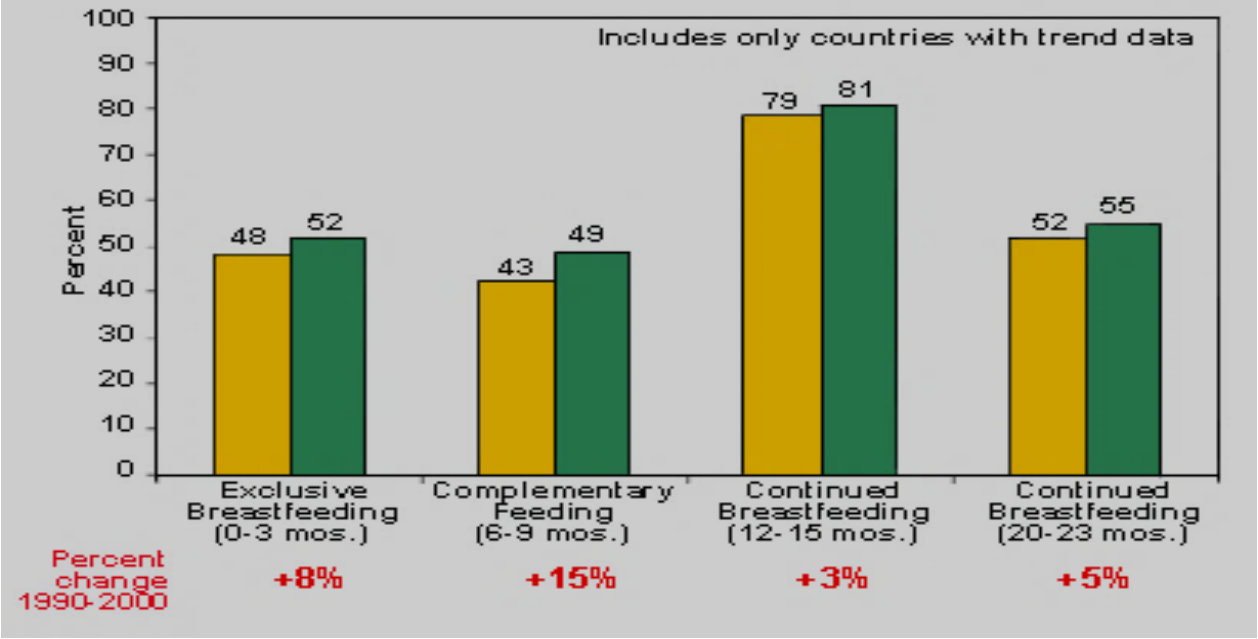

Figure 1: Trends in breastfeeding patterns 1990-2000. **[**14**]**
Source: http://www.unicef.org/ programme/breastfeeding/facts.htm

In general, the largest improvements have been noted in Latin America and the Caribbean for all of these 4 indicators of breastfeeding, showing significant improvements. However, the region is still among the lowest rates with regard to each of the 4 breast milk indicators. Considering a continental analysis of exclusive breastfeeding exclusive shows that the greatest rates are in east Asia and the Pacific (57%) and the lowest in the CCE/ CIS regions, as shown in Figure 2 [15].

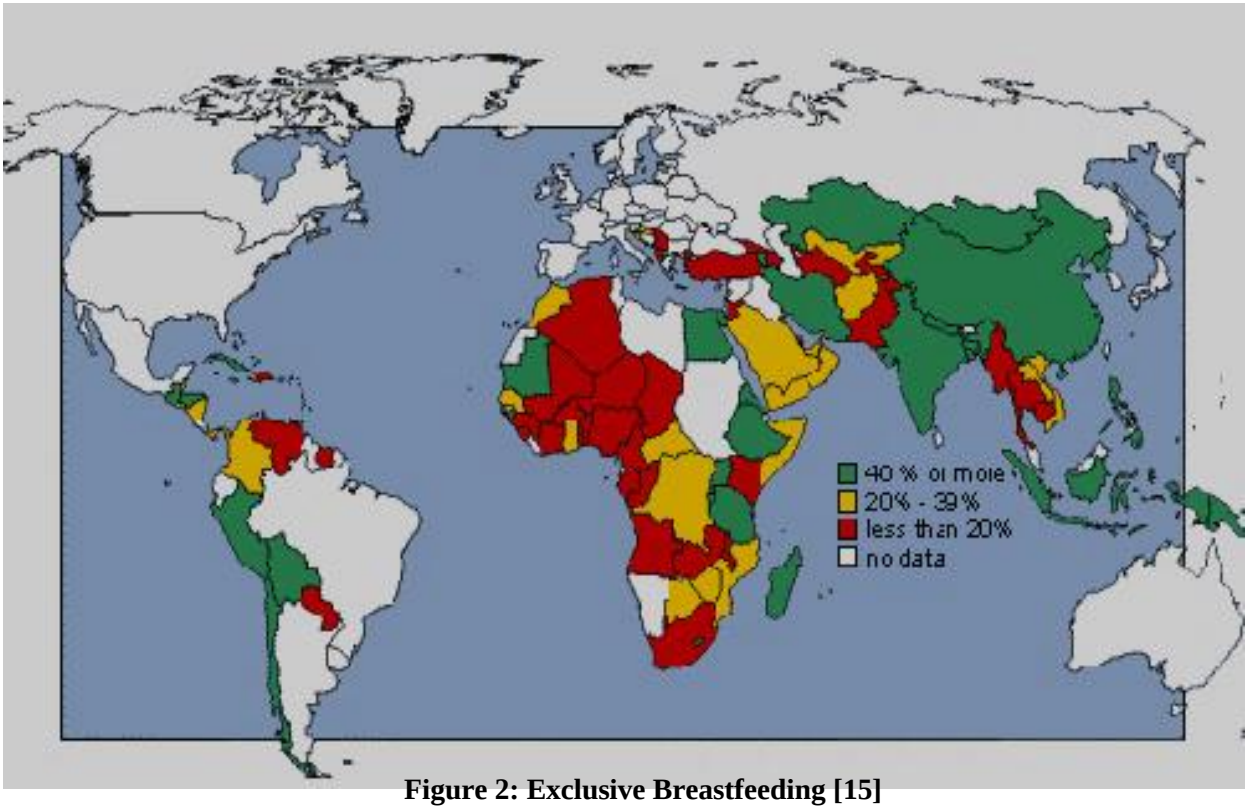

Figure 2: Exclusive Breastfeeding [15]

Source: http://www.unicef.org/ Program/Breastfeeding/Facts.htm

Among the first 10 countries in the world where exclusive breastfeeding is practiced the most during the first 4 months of life, the last 5 nations do not reach 80% rate of this practice as shown in Figure 3 [15].

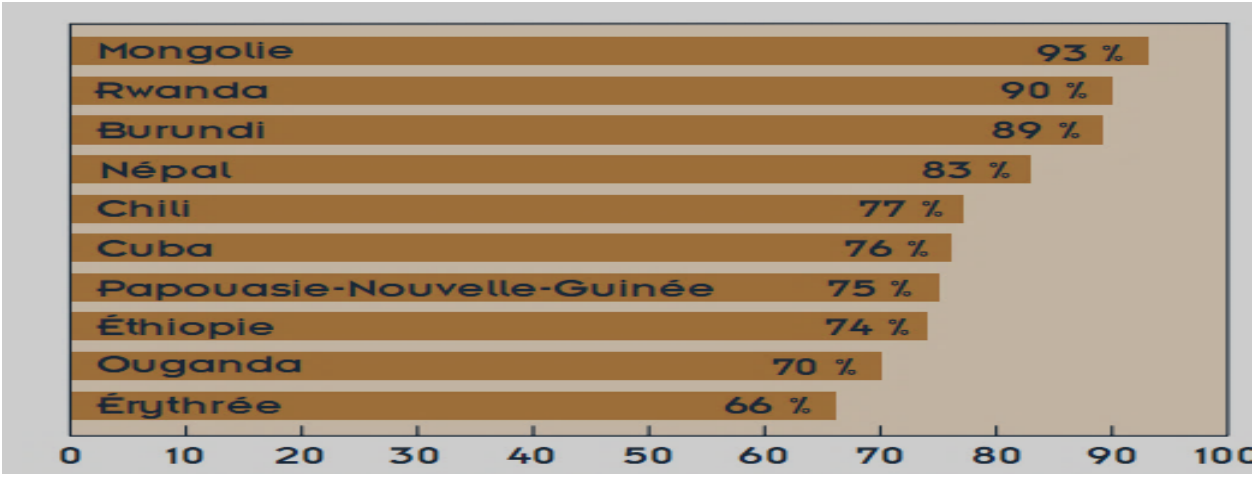

Figure 3: The first 10 countries with exclusive breastfeeding rates during the first 4 months of life [15].

Source: Unicef. Breastfeeding: to grow in good health. 1999 (August)

In Cameroon, the rate exclusive breastfeeding in infants aged 0-6 months seems to be decreasing overtime. It went from an already low value of 24% in 2004, to 20% in 2011. However, the proportions other infants feeding modes including breastfeeding and water, breastfeeding and formula milk, as well as breastfeeding and food supplements remained almost constant in the meantime as shown in Figure 4 [16]. In 2018, the Cameroon demographic and health Survey, reported the rate of 39.7% infants under 5 months of age being exclusively breastfed, but no further data were published thereafter [17].

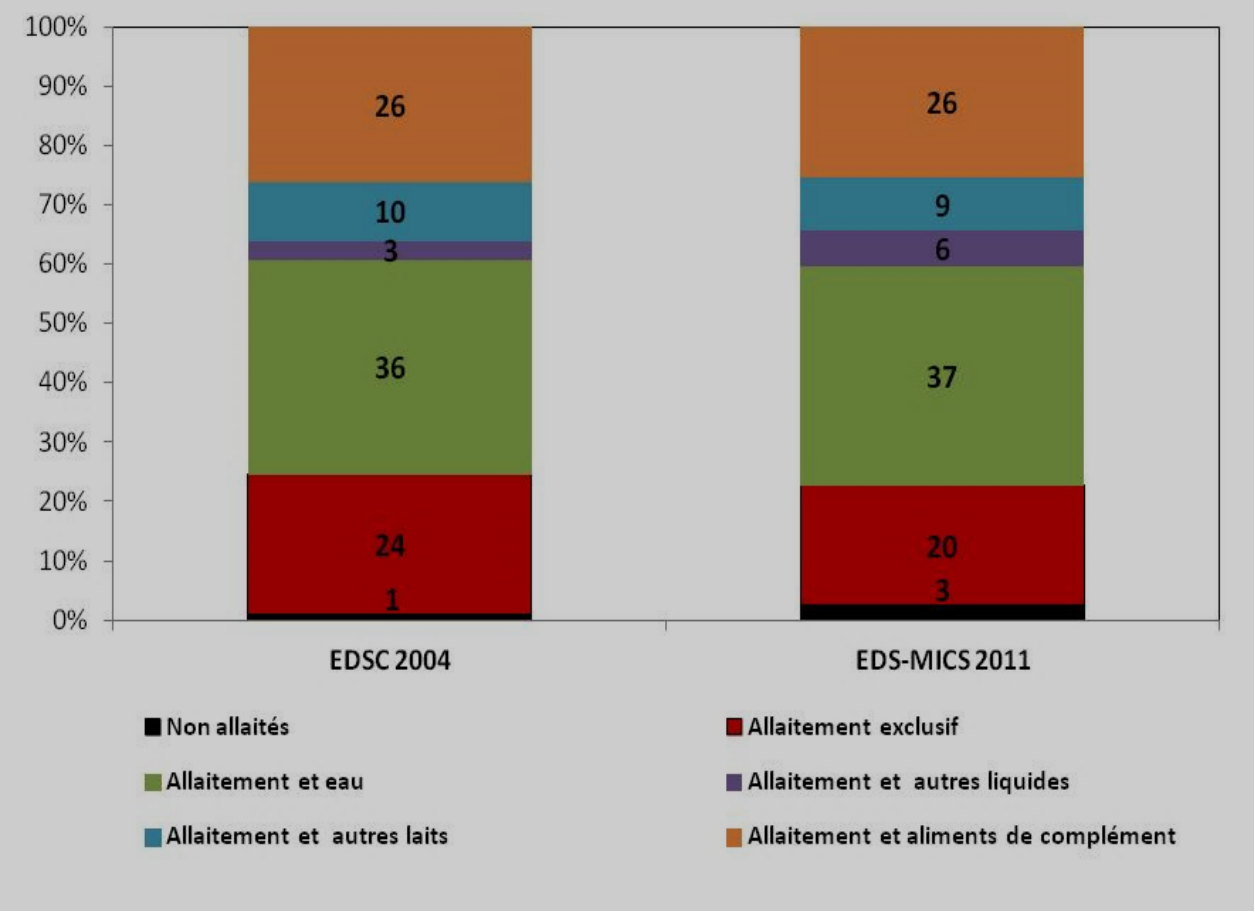

Figure 4: Breastfeeding and diet of children under 6 months old EDSC 2004, EDS-MICS 2011

Source: EDS-MICS 2011

2.3. THE BREAST AND THE BREASTFEEDING PROCESS

The defining characteristic of mammals is the provision of milk: a fluid whose composition exactly mirrors the needs of the young of the species. In the human breast, milk is produced and stored in differentiated alveolar units, often called lobules. These lobules contain small ducts, which coalesce into main ducts that drain sectors of the gland and open directly on the nipple. The amount of milk produced is regulated by the hormone prolactin and local factors. Removal of the milk from the breast is accomplished by a process called milk ejection brought about by a neuroendocrine reflex. In effect, afferent stimuli lead to the secretion of oxytocin from the posterior pituitary into the bloodstream, where it is carried to the myoepithelial cells that surround the breast's ducts and alveoli. The contraction of these cells leads to milk ejection [13].

2.3.1. Stages in Breast Development

The breast, or mammary gland, like most reproductive organs, is not fully developed until sexual maturity. Development of the mammary gland can be divided into five major stages: embryogenesis, pubertal development, development in pregnancy, lactation, and involution [18].

i. Embryogenesis

This stage begins in the 18- to 19-week in the fetus when a bulb-shaped mammary bud can be discerned extending from the epidermis into the dense sub-epidermal mesenchyme. At the same time, a loose condensation of mesenchyme extends sub-dermally to form the fat pad precursor. The ducts elongate to form a mammary sprout, invade the fat pad precursor, branch, and canalize to form the rudimentary mammary ductal system that is present at birth in the connective tissue just below the nipple. Limited milk secretion may take place at birth under the influence of changes in maternal hormones. After birth, the gland remains as a set of inactive small branching ducts that grow in parallel with the child [18].

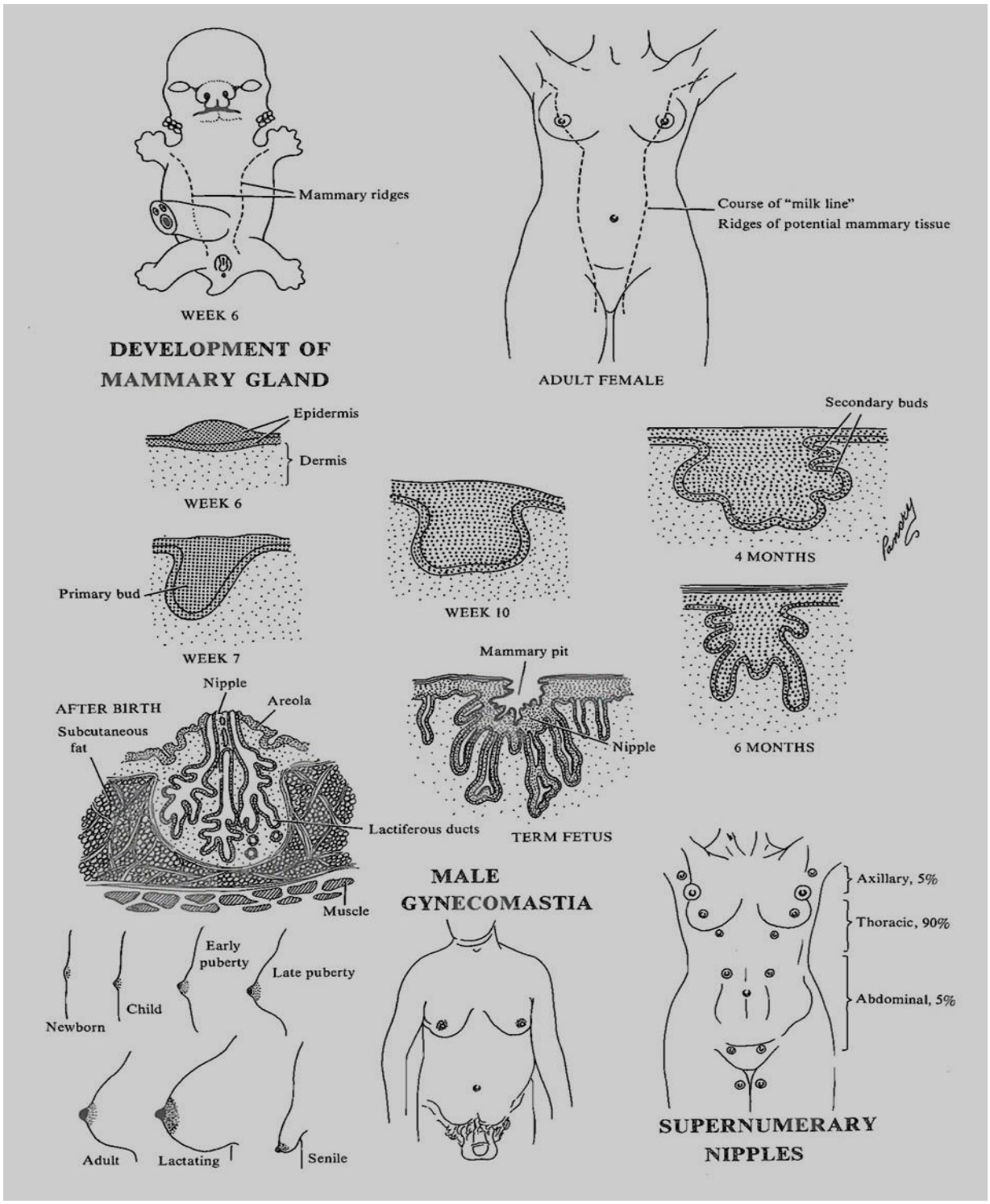

Figure 5: Development of the mammary gland

Source : https://discovery.lifemapsc.com/library/review-of-medical-embryology

ii. Mammogenesis During Puberty

Thelarche, which indicates the beginning of puberty, is the period during which breast development occurs. The first sign of puberty in girls is thelarche, which is considered normal after the age of 8 years, although, over the past decades, the appearance of breast tissue at younger ages has been reported [18]. Normal breast development takes an average of 3 to 3½ years. Thelarche typically occurs approximately 2½ to 3 years before the onset of menstruation (menarche). Ethnic and environmental factors accounting for the variation. Some authors consider normal the development of thelarche among African American girls after the age of 6 years and among Caucasian girls after 7 years [19]. During the early phase of breast development, estrogens induce adipose tissue deposition, proliferation of the supporting stromal tissue and ductal elongation. Subsequently, progesterone induces ductal side branching that gives rise to acini, as well as alveolar budding, lobular growth, and secretory growth of lobules and alveoli. A collection of acini from one terminal duct and the surrounding stroma is called a terminal duct lobular unit, which is the functional unit of the female breast [20] . In early puberty, bare ducts course through the fat. With the onset of the menses and ovulatory cycles, the progesterone secreted by the ovary during the luteal phase brings about some lobulo-alveolar development. The alveolar clusters are dynamic structures that increase in size and complexity during each luteal phase but tend to regress with the onset of the menses and the loss of hormonal support. However, there is a gradual accretion of epithelial tissue with each successive cycle. Normal development of the breast occurs over a 2- to 4-year period and is classified by the Tanner system into five stages [21].

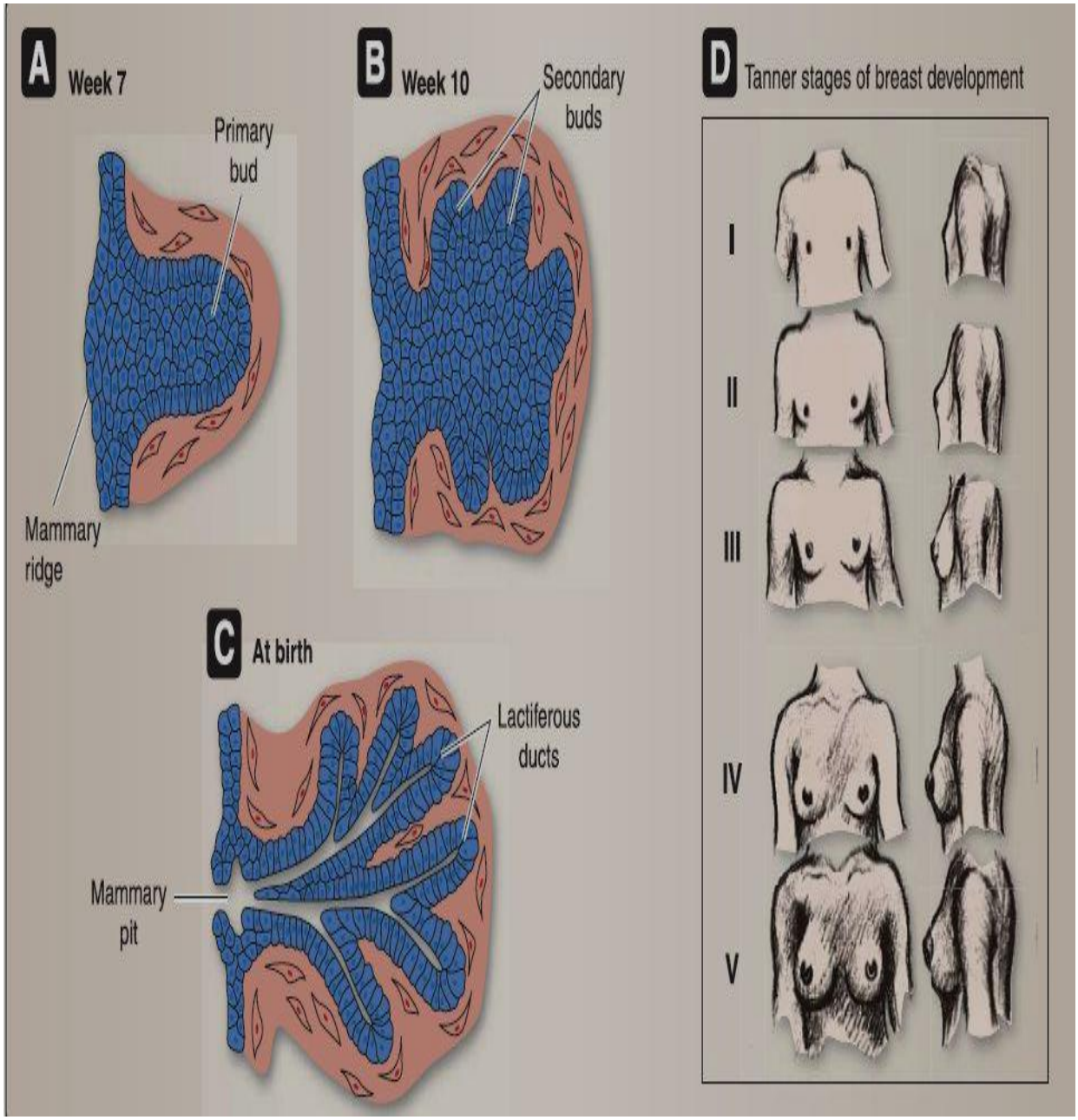

Figure 6: Development of the mammary gland at puberty

Source : https://almerja.net/reading.php?idm=154377

iii. The Mature Mammary Gland

Each of the 6 to 10 lobes of a mature mammary gland has a single opening (galactophore) in the nipple. Each mammary acinus consists of epithelial-lined ductules that form a round alveolus. Myoepithelial cells surround the cuboidal cells of the alveolus and contract under the influence of oxytocin during milk ejection. Multiple alveoli are clustered into lobules, which are then connected via lactiferous ducts to form a distinct mammary lobe. Each lobe is anatomically separate from other lobes. This is important to remember when examining the breast for abnormal nipple discharge.

Ultrasound studies have shown that the number of mammary ducts is lower than thought previously, with a mean of nine ducts in each breast, and that they do not dilate into small sinuses, but rather open directly at the galactophore at the nipple (Figure 2-1). The areola contains numerous small sebaceous glands, Montgomery tubercles, which usually are not visible before pregnancy and lactation. Their function is to secrete a cleansing and lubricating fluid that is bacteriostatic[22].

2.3.2. Anatomy of the Breast

The breast contains a tubule-alveolar parenchyma embedded in a connective and adipose tissue stroma. In the mature breast of the non-pregnant, and non-lactating woman, 6 to 10 branching ducts form a tree-like pattern that extends from the nipple to the edges of a specialized fat pad on the anterior wall of the thorax. Lobules of varying complexity extend from these ducts. These lobules form the acinar structures that will become the milk-secreting organ. The milk-secreting unit is composed of a single layer of epithelial cells with surrounding supporting structures that include myoepithelial cells, contractile cells responsible for milk ejection, and a connective tissue stroma containing many adipocytes and a copious blood supply [23].

The mature breast is located within the anterior thoracic wall, between the second and sixth inter-costal cartilage. More specifically, the innermost portion of the breast lies atop the pectoralis fascia of the pectoralis major, serratus anterior, external oblique abdominal muscles, and the upper extent of the rectus sheath; it measures from 10 to 12 cm in diameter. Breasts are cone shaped structures. That extend from each lateral border of the sternum to the anterior axillary line. During puberty the onset of the menstrual cycle and changes in hormones such as estrogen and progesterone in the body leads to the incomplete development of the breast. Only during pregnancy will the female breast mature to its full capacity [23].

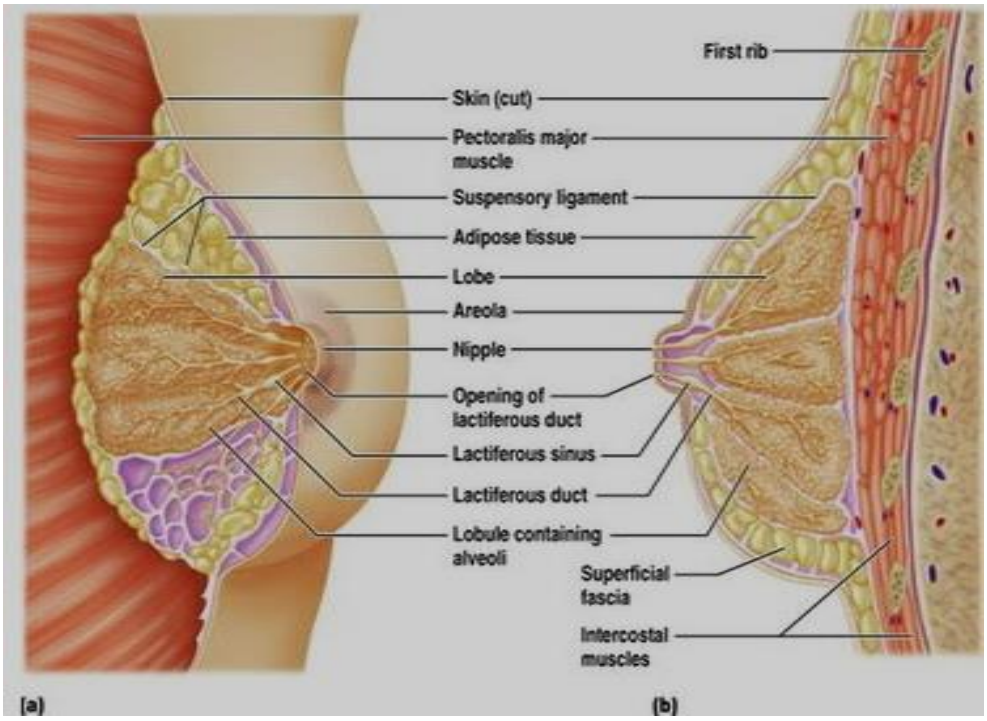

Figure 7: A cross-section through the mammary gland

Source : https://www.pinterest.com/pin/103019910214816448/

Most of the incompletely developed breast consists of adipose tissue, but also comprises fibroglandular parenchyma and connective tissue. The breast parenchyma contains 15-20 units called lobes. These lobes are made up of 20−40

lobules and each lobule consists of 10-100 hollow cavities known as alveoli that are a few millimeters in size [13]. Cuboidal epithelium capable of synthesizing the protein and lipid components of breast milk, and myoepithelial cells capable of contracting epithelial cells compose each alveolus. The lobes of the breast drain into lactiferous ducts which broaden to form a sinus prior to converging with the nipple. Major ducts are made up of double layers of cuboidal epithelial cells and minor ducts are made up of a single layer of cuboidal cells while the lactiferous sinus is lined by stratified squamous epithelial cells.

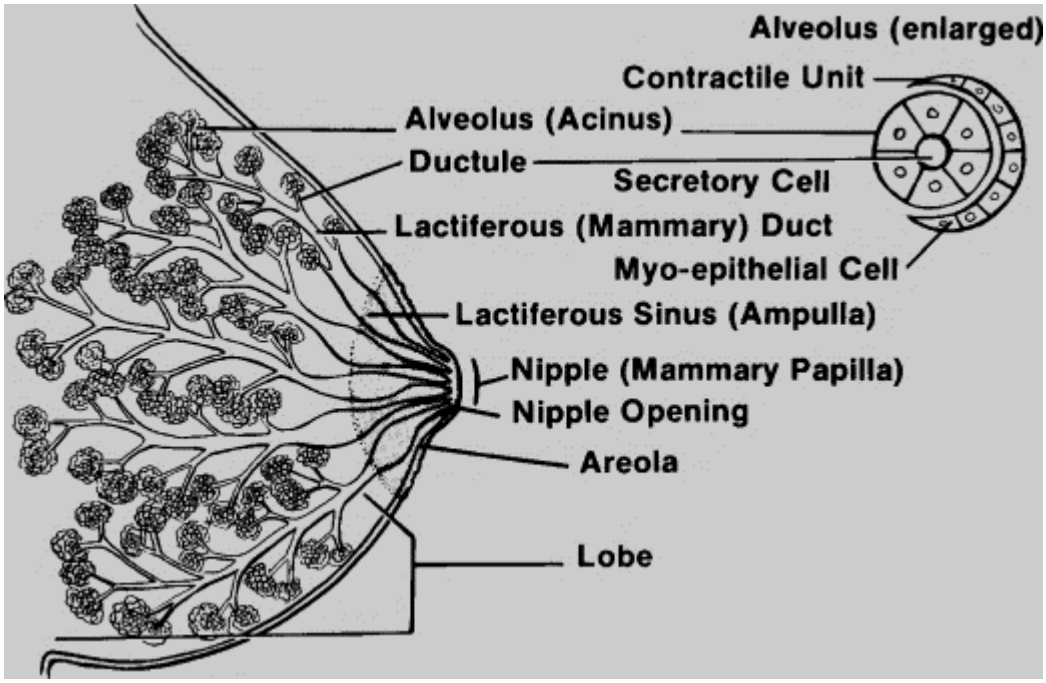

Figure 8: Structure of breast alveoli with lactiferous ducts

Source : https://emedecine.medscape.com/article/1835675-overview

The lactiferous sinus drains to the nipple areola complex the more pigmented circular area on the vertex of the breast. Underneath the areola, smooth muscle fibers lie in a circular pattern in the dense connective tissue and parallel to lactiferous ducts in order to erect nipples in response to appropriate stimuli.

The areola also contains sweat, sebaceous and accessory glands called the Montgomery tubercles, which secrete oils [23].

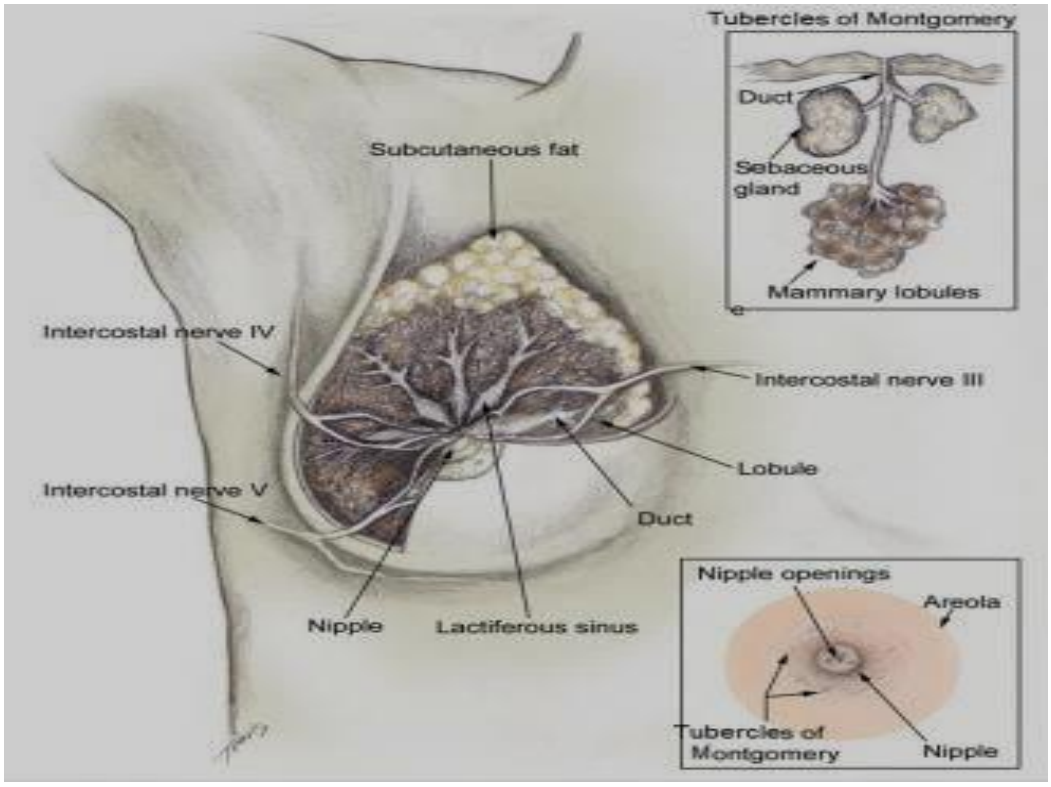

Figure 9: Anterior view of a cross-section through the mammary gland

Source : https://emedecine.medscape.com/article/1835675-overview

2.3.3. Breast Development in Pregnancy

Lactogenesis is the process of developing the ability to secrete milk and involves the maturation of alveolar cells. It takes place in 2 stages: secretory initiation and secretory activation.

i. Lactogenesis: Stage I (secretory initiation)

The breast undergoes marked changes during pregnancy. Physically, the breasts experience a doubling of weight, an increase in blood flow, lobular and alveolar growth, and increased secretory activity. Pregnancy hormones bring about full alveolar development. In addition to increasing levels of progesterone, a lactogenic hormone, either prolactin or human placental lactogen (HPL), is

thought to be essential for the final stages of mammary growth and differentiation. By mid-pregnancy, the gland has developed extensive lobular clusters and, indeed, small amounts of secretion product are formed, and lactose can be detected in the blood and urine. Furthermore, patients will begin to notice superficial veins as their breasts enlarge, as well as enlargement and darkening in pigmentation of the areola; the Montgomery tubercles will begin to protrude from the areola. The gland continues to develop until parturition, with the secretory process being held in check by the high circulating concentrations of progesterone The placenta supplies high levels of progesterone which inhibit further differentiation. In this stage, small amounts of milk can be secreted by week 16 gestation. By late pregnancy, some women can express colostrum [24].

ii. Lactogenesis: Stage 2 (secretory activation)

It starts with copious milk production after delivery. With the removal of the placenta at delivery, the rapid drop in progesterone, as well as the presence of elevated levels of prolactin, cortisol, and insulin, are what stimulate this stage. Usually, at days 2 or 3 in postpartum, most women experience swelling of the breast along with copious milk production.

In primiparous women, the secretory activation stage is slightly delayed, and early milk volume is lower. Lower milk volume is also observed in women who had cesarean births compared with those who delivered vaginally. Late onset of milk production has also been seen in women who have had retained placental fragments, diabetes, and stressful vaginal deliveries. Although milk volume is low during the first 2 days postpartum, the amount of colostrum is usually sufficient to meet the needs of the term infant. Lactation is initiated regardless of whether the newborn breastfeeds, so even non-breastfeeding mothers experience breast fullness and leaking of milk. The process is marked by an increase in blood flow to the breasts, an increase in milk volume, and a change in composition so that the milk appears somewhat creamy in color and consistency, compared with

the thick, yellow colostrum. Some women experience engorgement, or extreme fullness of the breasts, during this stage, especially if the newborn is not feeding frequently. During this stage and after, continued milk production becomes dependent on regular milk removal. With retained placental fragments, lactogenesis stage II could be inhibited by the continued secretion of progesterone and would continue to be inhibited until removal of the remaining placental fragments [24].

iii. Delayed Lactogenesis

Commonly defined as the maternal perception of lactogenesis occurring after 72 hours into postpartum. Failed lactogenesis can be further described in the contexts of two other conditions including a primary inability to produce adequate milk volume, or a secondary condition occurring as a result of improper breastfeeding management and/or infant-related problems [25]. Mothers of preterm infants who express milk within the first hour have earlier stage 2 lactogenesis.

Factors associated with maternal glucose tolerance are also important; 56% of the variation in time to lactogenesis stage 2 has been explained by maternal insulin and adiponectin concentrations. Insulin availability to the mammary alveoli are thought to be a limiting factor in the upregulation of lactose synthesis, which is the key determinant of lactogenesis stage 2, whereas the hormone adiponectin increases sensitivity to insulin. The number of glands on the areola (Montgomery tubercles) also has been associated with the speed to lactogenesis stage 2. A possible mechanism is that more secreting glands on the areola cause the newborn to suck more effectively, leading to more stimulation and earlier onset of lactation. At first postpartum visits, health professionals should ask mothers if their milk “came in” within 3 days, and thereby identify mothers at risk for breastfeeding cessation [26].

iv. Lactation

The process of milk secretion, lactation, continues as long as milk is removed from the gland on a regular basis. Prolactin is required to maintain milk secretion and oxytocin to produce letdown, to allow the infant to extract milk from the gland [13].

v. Involution

The process of involution takes place at weaning (i.e., when regular extraction of milk from the gland ceases or in many, but not all species, when prolactin is withdrawn). Like the initiation of lactation, this stage involves an orderly sequence of events to bring the mammary gland back nearly to the prepregnant state [27].

2.3.4. Hormonal Regulation of Milk Secretion

As mammary gland growth and differentiation, lactation is regulated by hormones, but also through interactions between the mammary gland and the central nervous system. Prolactin signals through the JAK2/STAT5 pathway to regulate the expression of target genes, and also stimulates lipid synthesis and exocytosis. On the other hand, oxytocin is rapidly released in response to suckling and induces the contraction of myoepithelial cells surrounding the alveoli, thus triggering milk ejection [28]

i. Prolactin

It is a pleiotropic hormone produced by the anterior pituitary which is involved in homeostasis, reproduction, and lactation. Prolactin secretion is both positively and negatively regulated, but its main control comes from hypothalamic inhibitory factors such as dopamine which act on the D2 subclass of dopamine receptors present in lactotrophs. Prolactin stimulates mammary gland ductal growth and epithelial cell proliferation and induces milk protein synthesis. Emptying of the breast by the infant's suckling is thought to be the most

important factor. Prolactin concentration increases rapidly with suckling of the nipple which stimulates nerve endings located there [24].

During the mammary gland development and differentiation, prolactin exerts morphogenic effects, while during lactation this hormone displays lactogenic effects by stimulating milk protein and lactose synthesis and secretion, as well as other metabolic processes in mammary luminal epithelial cells. Prolactin is thus required to maintain milk yield but also for alveolar mammary luminal epithelial cells survival and maintenance of tight junctions. During pregnancy, the serum prolactin level slightly increases from ~10 ng/mL in the non-pregnant women up to 200 ng/mL at term [29]. In the course of lactation, levels of circulating prolactin gradually decrease to return to ~10 ng/mL after~6 months postpartum. Prolactin is episodically released in response to suckling to reach a peak in concentration in the blood 45 minutes after the beginning of breastfeeding, for up to 75 minutes in duration [29].

However, while the amount of prolactin released is related to the intensity of nipple stimulation, plasma prolactin concentration does not appear to be directly correlated with the volume of milk produced. Interestingly, in serum and milk, several molecular forms of prolactin are found, which arise from prolactin processing such as cleavage [18-29].

Whether this molecular heterogeneity can account for the various effects of prolactin remains unclear. For example, while binding of the 23-kDa prolactin to its cognate receptor on the BPM of mammary luminal epithelial cells stimulates milk protein genes transcription, the internalization of the prolactin/prolactin receptor complex enable the trans cytosis of prolactin to the lumen, which is required for milk protein secretion [30].

ii. Oxytocin

Oxytocin is involved in the milk ejection or letdown reflex. The tactile stimulation of the nipple-areolar complex by suckling leads to afferent signals to the hypothalamus that trigger release of oxytocin. This results in contraction of the myoepithelial cells, forcing milk into the ducts from the alveolar lumens and out through the nipple. Oxytocin also has a psychological effect, which includes inducing a state of calm, and reducing stress. It may also enhance feelings of affection between mother and child, an important factor in bonding [24].

As soon as it begins, suckling is detected by mechanoreceptors of sensory nerve terminals in the areolus of the nipple which send afferent cholinergic impulses to the paraventricular nuclei and supraoptic nuclei in the hypothalamus, that in turn stimulate the pulsatile release of oxytocin, a nonapeptide hormone, from the posterior pituitary. Once in the bloodstream, oxytocin reaches the mammary gland where it interacts with specific G-protein-coupled receptors localized on myoepithelial cells, and induces their asynchronous contraction. As oxytocin receptors are also present in mammary luminal epithelial cells [18-29]. This hormone may also exert direct effects on the secretory activity of mammary luminal epithelial cells [18-29]. Milk is then expelled out of the alveoli into the ducts and lactiferous sinuses.

Contraction of the myoepithelial cells also shortens and widens the ducts, thus increasing the intraductal pressure and consequently the milk flow rate, ultimately leading to milk ejection from the nipple. Thus, oxytocine mediates the milk ejection reflex (or let-down reflex), which is essential for the efficient removal of milk from the breast. As oxytocin is released in a pulsatile manner, there are several ejections of milk during a feeding [21]. The number of ejections is significantly correlated to the volume of milk consumed but not to the duration of the feeding [18-29]. Suckling also causes an inhibition of the release of

Luteinizing Hormone (LH)-releasing hormone by the hypothalamus that results in the inhibition of ovulation and a natural form of birth control.

There is also a significant psychological component in the let-down reflex, as oxytocin release also occurs in response to stimuli such as the sight or sound of the baby. In addition, to mediate the milk ejection reflex, oxytocin also has significant roles on the central nervous system for the psychological integration bonding. This involves interactions between the mothers and the suckling neonate, with corresponding maternal behavior. Furthermore, physical and psychological stress or pain of the mother has been shown to decrease milk output through the inhibition of oxytocin release [18-29]. However, responses to stress seem to be reduced, as illustrated by the plasma levels of adrenocorticotropic hormone (ACTH), cortisol, and epinephrine which are significantly decreased in lactating women. Whereas, they are exposed to greater stressing factors, as compared to non-lactating women. Oxytocin release is likely to be involved as its pulsatile release in response to suckling is accompanied by a decrease in plasma ACTH and plasma cortisol levels in lactating women.

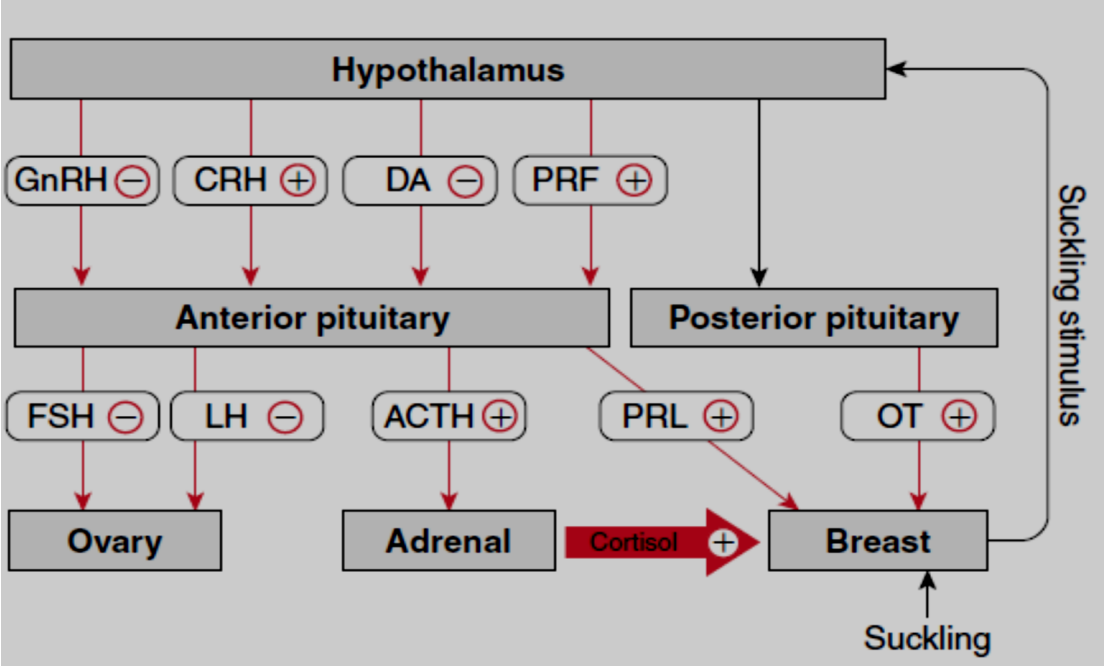

Figure 10: Hormonal involvement in breastfeeding.

Source: Rhoades & Tanner. Medical Physiology

2.3.2. Physiology of Breast Changes During Pregnancy and Lactation

Anatomical and physiological changes occur in the mature breast as a result of elevated hormone levels during pregnancy. The alveolar epithelium increases in size and begins the secretion of components of the milk in response to elevated estrogen levels as early as ovulation. During the second week of pregnancy, the corpus luteum secretes estrogen and progesterone; while the placenta takes on this role during later stages of pregnancy. Prior to pregnancy, the ratio of adipose tissue to glandular and ductal tissue is large in mammary glands.

During the first trimester, the ductal system expands and branches out into the adipose tissue in response to the increase of estrogen. Elevated levels of estrogen also cause a decrease in adipose tissue. Approximately 8 weeks after fertilization, trophoblasts, the cells that eventually become the placenta, produce the human chorionic gonadotropin (hCG) hormone. HCG works to prevent degradation of the corpus luteum and stimulate the corpus luteum to continue the production of progesterone and estrogen. HCG peaks at around the ninth week of pregnancy and declines afterward [31].

During early pregnancy, serum progesterone levels increase from 27 ng/ml (range, 20.0-42.2 ng/ml) to 138 ng/ml (range 105-215ng/ml) during late pregnancy. Elevated concentration of progesterone induces lobular branching and enlargement in the breast. On the other hand, serum estrogen levels rise from 2 ng/ml (range,1.19–4.00 ng/ml) during early pregnancy to 22 ng/ml (range, 13.6–35.6 ng/ml) during late pregnancy [31]. Increased concentration of estrogen leads to some increase in the proliferation of adipose tissue but mainly leads to ductal proliferation and elongation. These lobular-ductal units replace a fair amount of adipose tissue during eration and elongation. These lobular-ductal units replace a fair amount of adipose tissue during mammary gland development in pregnancy

[23, 28]. As these hormone concentrations rise, ductal-lobular proliferation continues to occur.

Estrogen levels also impact the size and activity of the anterior pituitary gland in the brain. The pituitary gland can increase up to 36% in size when estrogen stimulation leads to an increase in the number and size of lactotroph cells within the gland [23, 28]. This stimulation results in the synthesis and secretion of prolactin by lactotroph cells.

Prolactin is a hormone that induces lactation in alveolar cells of lobules in mammary glands. By the twentieth week of gestation, mammary glands are sufficiently developed to produce components of milk due to prolactin stimulation. Some ejection of milk occurs when myoepithelial cells respond to oxytocin and contract milk-producing alveolar cells.

However, higher concentrations of estrogen and progesterone circulating in the blood inhibit milk production during pregnancy. The second trimester of pregnancy involves the accumulation of colostrum through milk acini, which include milk-producing cuboidal epithelial cells and myoepithelial cells that contract them [23, 28].

Colostrum is any milk that is released during the first couple of days after parturition. A key characteristic of colostrum is the presence of an abundance of antibodies produced by lymphocytes compared to the presence of low quantities of lipids produced by epithelial cells.

When the breast increases in size as a response to increased hormone levels, lymphocytes, eosinophils, and plasma cells aggregate within the connective tissues contributing to the release of antibacterial compounds into the alveoli. As immune cells and plasma cease to accumulate in the breast, the production of colostrum decreases and lipid-rich breast milk increases. During the third trimester, the ductal system continues to expand, dilate and fill with colostrum.

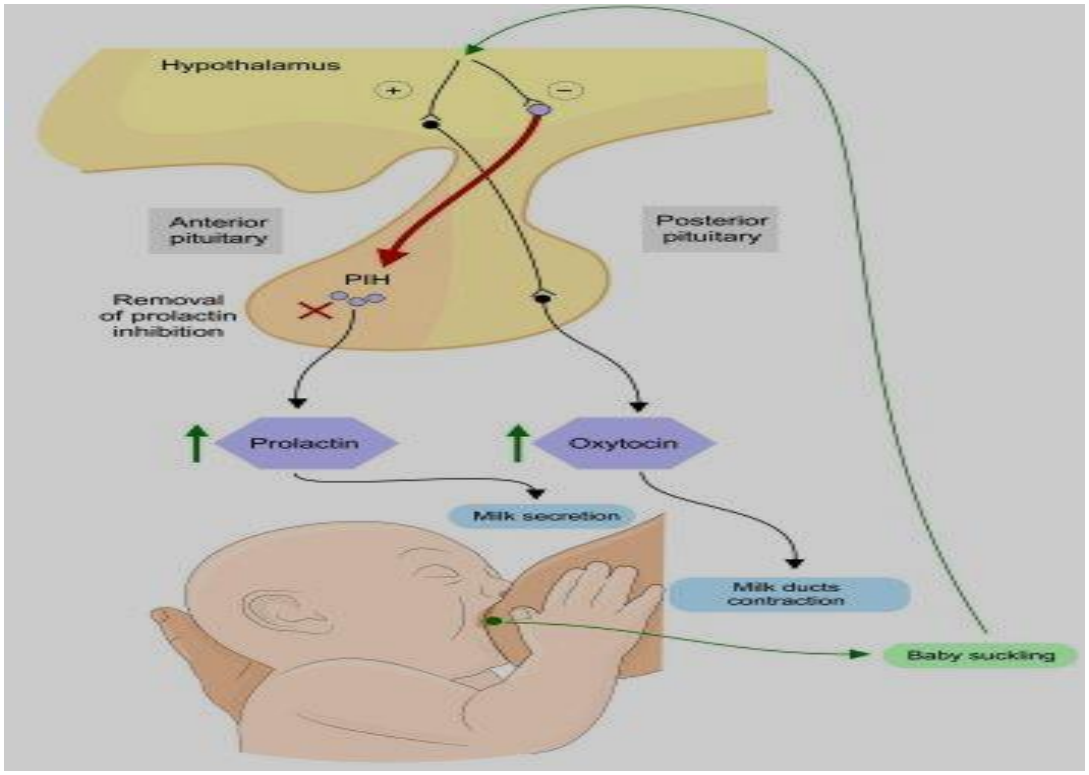

Figure 11: Structure of breast alveoli with lactiferous ducts

Source: **https://study.com/academy/practice/quiz-worksheet-overview-of-lactation**

After birth, there is a rapid decrease in progesterone while there is an increase in prolactin and oxytocin. Prolactin pushes forward milk production, while oxytocin triggers the let-down reflex that allows the infant to withdraw breast milk from the milk ducts.

The let-down reflex is a neuroendocrine reflex that results in the release of milk when the nipple-areola complex is stimulated. When an infant sucks on the nipple, it stimulates the intercostal nerve present in the breast, causing the hypothalamus to release oxytocin [32]. Myoepithelial cells around the alveoli contract and squeeze the milkout, pushing it down the ducts and out of the nipple in response to oxytocin. Most pregnancies cause the areola to darken, breast to increase in size, and the Montgomery glands to become more prominent; indicating that the body is ready for lactation. Failure in these changes can create problems with breastfeeding, typically associated with producing inadequate

milk [23, 31]. One point to notice here is that all of these changes lead to the enlargement of the breasts, but the size of the breast does not equate to its functional capacity. The maximum capacity of storing milk varies from 80 ml to 600 ml in volume. During breastfeeding, breasts capable of storing a lower volume of breast milk empty quickly, but alveolar cells within the mammary glands synthesize breast milk rapidly in contrast to alveolar cells in breasts with larger capacity [20]. Post-lactational involution occurs at the cessation of milk production caused by a decline in prolactin. Massive apoptosis and cell death occur in the mammary gland and the tissue in the breast is remodeled. The connective tissue of the lobules goes from a loose to a dense structure. Acini lose lining cells and the basement membrane of the acini becomes thicker [21].

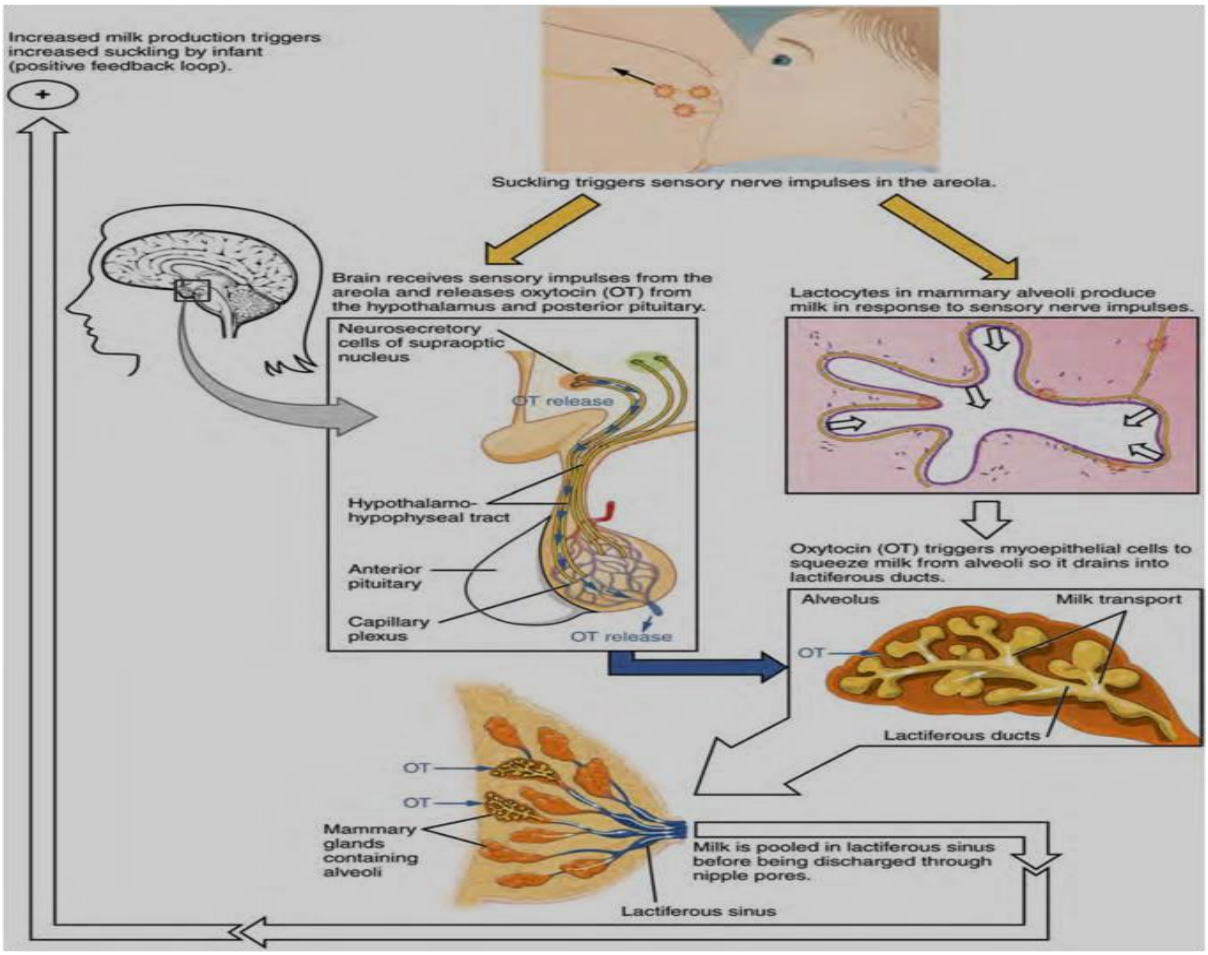

Figure 12: The physiological mechanisms of lactation and breastfeeding

Source : https://courses.lumenlearning.com/boundless-ap/chapter/lactation

2.3.3. Effect of Emotional State and Drugs

Psychological stress, pain, or fatigue can decrease milk output because of inhibition of oxytocin release. Oxytocin release begins with the onset of suckling in relaxed, undisturbed mothers, but may occur before suckling if the infant cries or becomes restless. Alcohol and opioids inhibit oxytocin release.

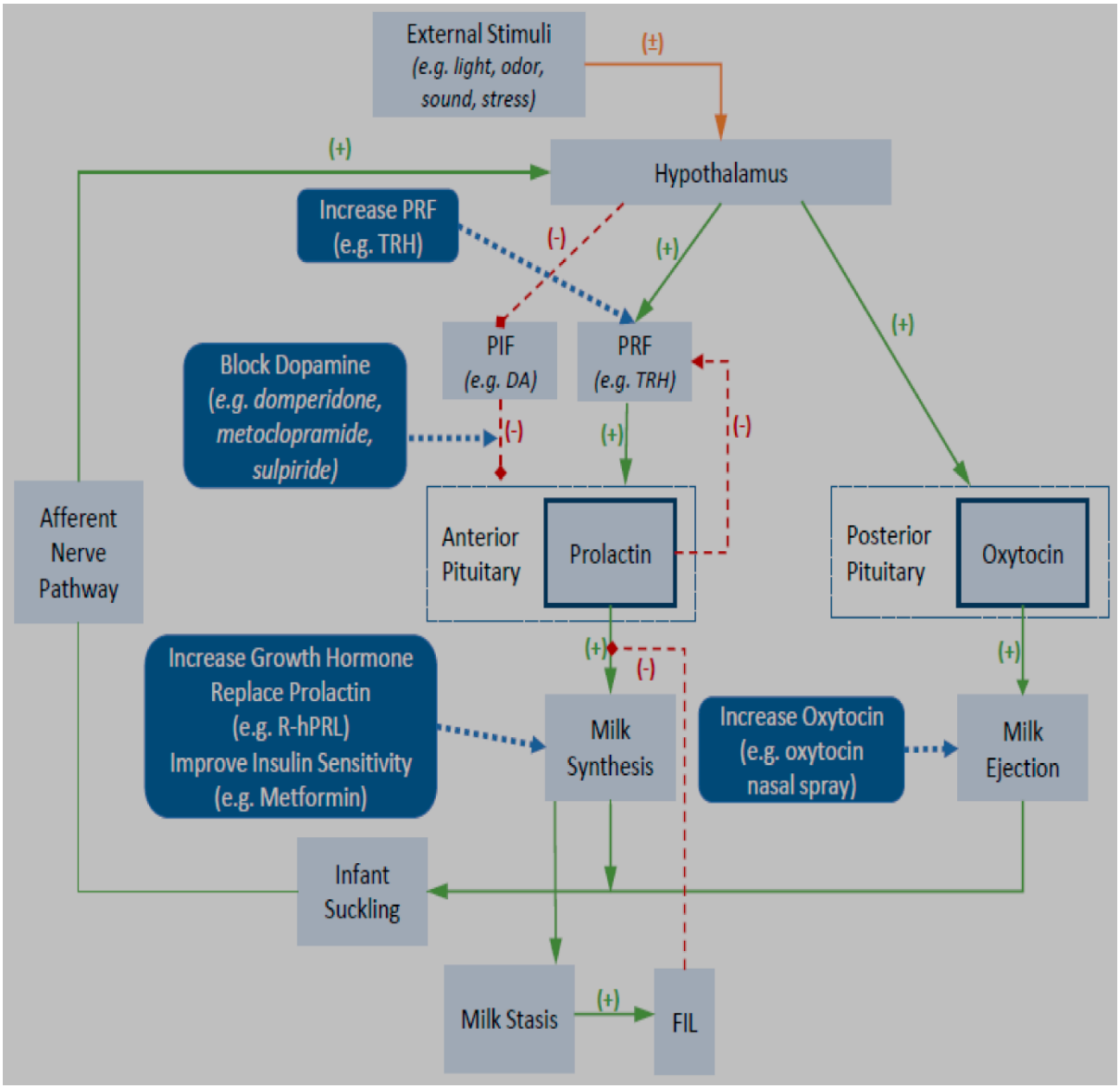

Figure 13: Effect of external stimuli and drugs on lactation and breastfeeding

Source : https://courses.lumenlearning.com/boundless-ap/chapter/lactation

2.4. INFLUENCE OF INFANT ANATOMY AND PHYSIOLOGY

After the baby's birth, it undergoes a transition phase within a short period of time, to enable it adapt to extra uterine life, including feeding through the mouth. Most of these changes have direct effect on breastfeeding and they are as well impacted by breastfeeding. The newborn infant has a number of anatomic and physiologic peculiarities, together with natural feeding reflexes, just as nutritional needs that are intimately related with breastfeeding. The mechanical acts of latching, suckling, swallowing and breathing for example must all occur in a synchronic and coordinated manner to render the breastfeeding process feasible and effective.

2.4.1. The Infant Functional Anatomy and Physiology of Breastfeeding

For effective breastfeeding to occur, there must be perfect coordination between suckling, swallowing and breathing most essentially, as the structures involved in these functions are close to one another and regulated by common cerebral commands or involvements in the brainstem. The knowledge of these anatomical and physiological patterns are therefore important for understanding the act of breastfeeding in neonates. This permits to identify abnormalities and resolve them [33].

The oral cavity or mouth comprises the lips, the upper jaw or maxilla, the lower jaw or mandible, the cheeks, the tongue, the floor of the mouth, the gum ridges, the hard and soft palate and the uvula. The mouth through its various parts is involved in nipple location, positioning of the nipple-areolar complex into the mouth, and its stabilization during the act of breastfeeding.

During the sucking movements of breastfeeding, the tongue Through its peristaltic movements is placed in the palatal regions of the central incisors, where it prevents air passage through the buccal cavity thereby enabling nasal

breathing. The tongue through its peristaltic movements, together with the jaws contribute to the setting of an important vacuum. Air that is inspired during breastfeeding passes through the nasal cavity where the palatine bone separates the oral cavity, when the soft palate is fully elevated [33].

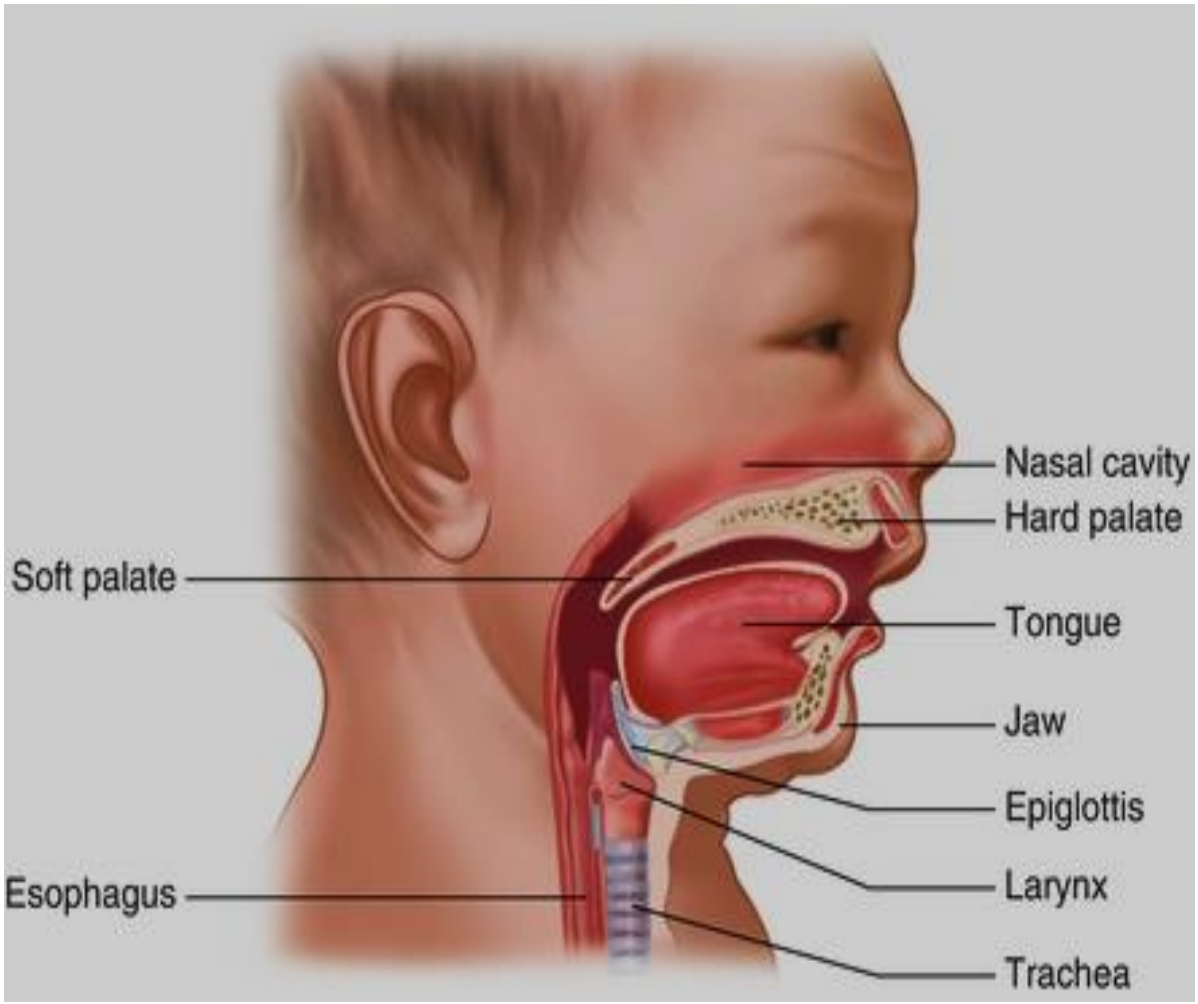

Figure 14: Functional anatomy of the infant concerned with the act of breastfeeding
Source: https://entokey.com/anatomy-and -physiology-of-breasfeeding

The larynx that is composed primarily of cartilages contains structures necessary for producing sounds and protecting airways during swallowing. The leaf-like bony structure that is known as the epiglottis is normally meant to be elevated in order to allow air to flow freely through the larynx into the trachea.

However, during breastfeeding, it falls down in the course of swallowing to close and seal off the inlet to the larynx and trachea, thereby preventing liquids and food from entering the air ways. Breathing phases during breastfeeding is halfway between inspiration and expiration but not apnea. The changes in the head positioning of the breastfeeding infant through flexion, extension, and sideways movements influence the diameter of the pharynx which is thought to be related with the protection of the airways.

The swallowed milk progresses down the esophagus to the stomach through peristalsis. The lower esophageal sphincter remains closed at rest and provides protection from the reflux of stomach content into the esophagus [33].

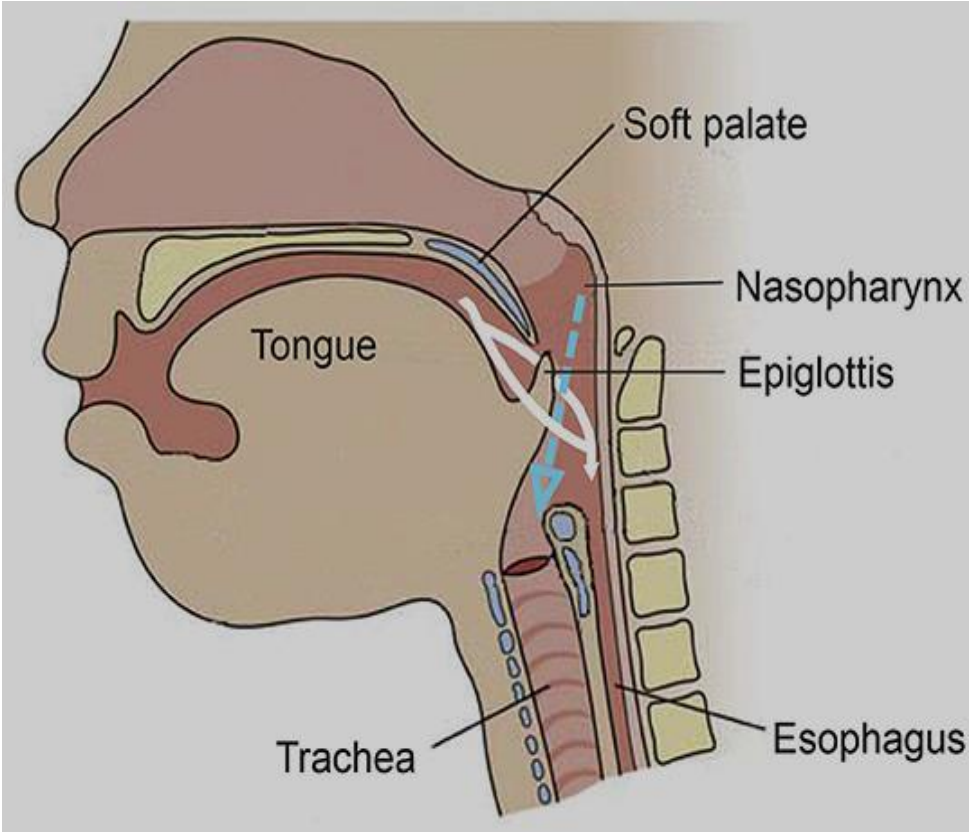

Figure 15: Functional anatomy of the infant concerned with the act of breastfeeding, showing the means for airways protection during sucking and swallowing
Source : https://www.frontiersin.org/article/10.3389/fped.2020.599633

2.4.2. Neural Coordination of Breastfeeding in Infants

The process of swallowing is indispensable to breastfeeding. It consists of three phases comprising the oral, pharyngeal and oesophageal phases. They are under the control of the cranial nerves that function in tandem under the control of the central nervous system.

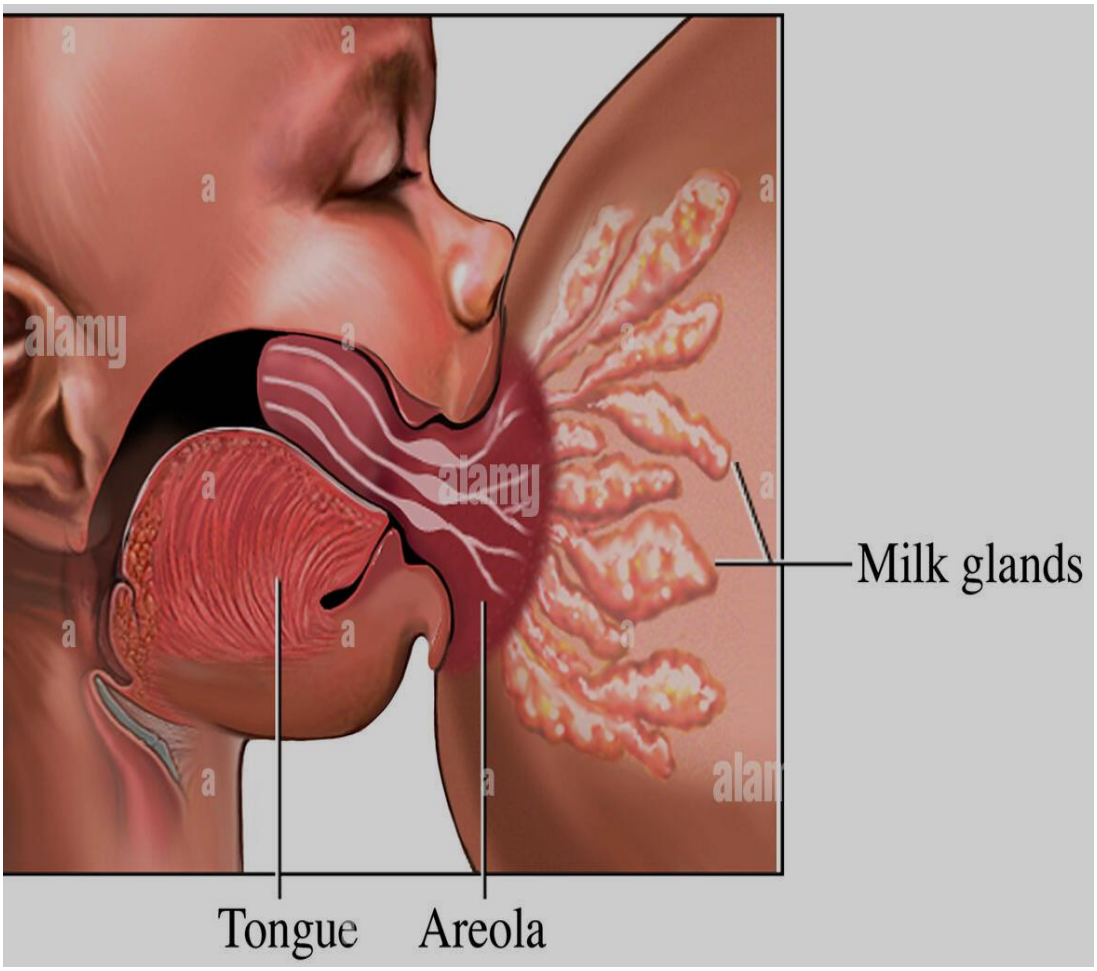

Figure 16: The preponderant role of the buccal cavity in sucking during breastfeeding
Source : https://www.esiencephoto.com/media/1030899/view/breastfeeding

The main neurological controls involved in breastfeeding including sensitivity, sensoriality, motricity, and automativity is located in the brainstem with pathways being expressed through the cranial nerves. In fact, the cranial nerve I, also known as the olfactive nerve serves for regulations with smell and

taste involvements. The vagus nerve (X) have sensory, somatic and automatic coordination functions. The trigeminal nerve (V) have motor functions with tongue, lips and cheeks movements, just as the hypoglossal nerve (XII) which is also specific for the muscles of the tongue. The facial nerve (VII) is responsible for the tongue sensoriality, together with the glossopharyngeal nerve (IX) which has taste perception involvement as well [33].

The vast majority of breastfeeding components such as sucking, swallowing and breathing, along with their inter-coordination of the three processes mature at different rates and time depending on the gestational or postnatal age of the infant.

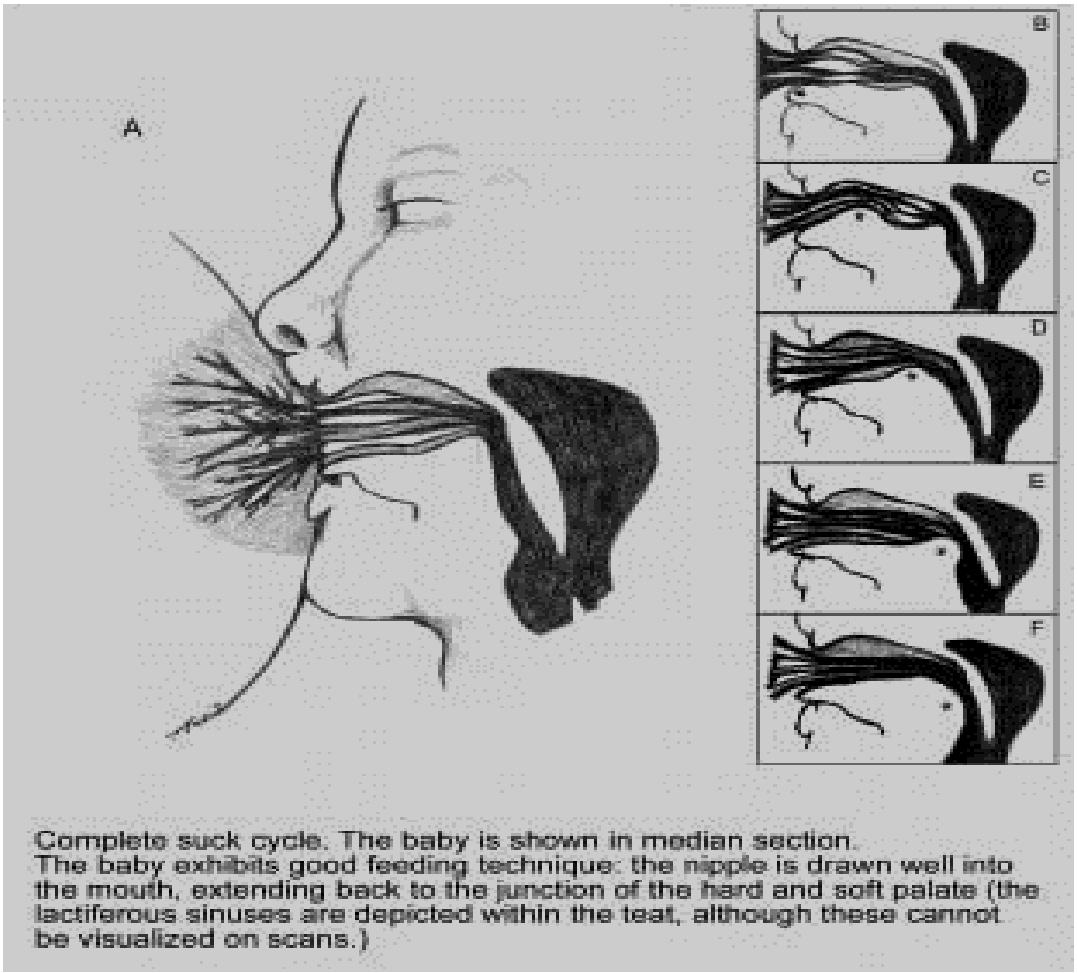

Figure 17: Cross-section of an infant buccal cavity showing the cycle of suction

Source : https://emedecine.medscape.com/article/979458.overview

The main important reflexes in breastfeeding neonates include the sucking reflex which occurs as early as during the 24th week of gestation and becomes mature at birth. By the postnatal age of 3 months, the infant can acquire total control over this reflex which becomes voluntary. Whereas, the gag reflex develops and is effective as from the 26th week of gestation.

Neonates suckle in bursts that are separated by brief and transient rests. This is classically described as sequences of suckling with intersuck intervals of less than 2 seconds. The sucking rate on the breast is proportional to the rate of breast milk flow. Meaning that the higher the breastmilk flow rate is, the slower is the sucking rate. It is estimated that the intersuck interval rages from 0.5-1.3 seconds, depending upon the milk flow rate.

Fluid movement during breastfeeding occurs from a starting point which is the breast with important hydrostatic pressure created by milk volume, of which the water component is predominant. This is followed by reflex-induced breastmilk ejection to a second point or area with lower pressure, which is the inside of the infant's mouth. This is favoured by a pre-existing vacuum created by suction and maintained by relative sealing of the buccal cavity, which may further be enhanced by jaw and tongue drop [33].

2.4.3. Digestion and Assimilation of Breastmilk

Except for functional immaturity, the digestive system of the infant is structurally not very different from that of adults with all organs present at birth although with low grade performance.

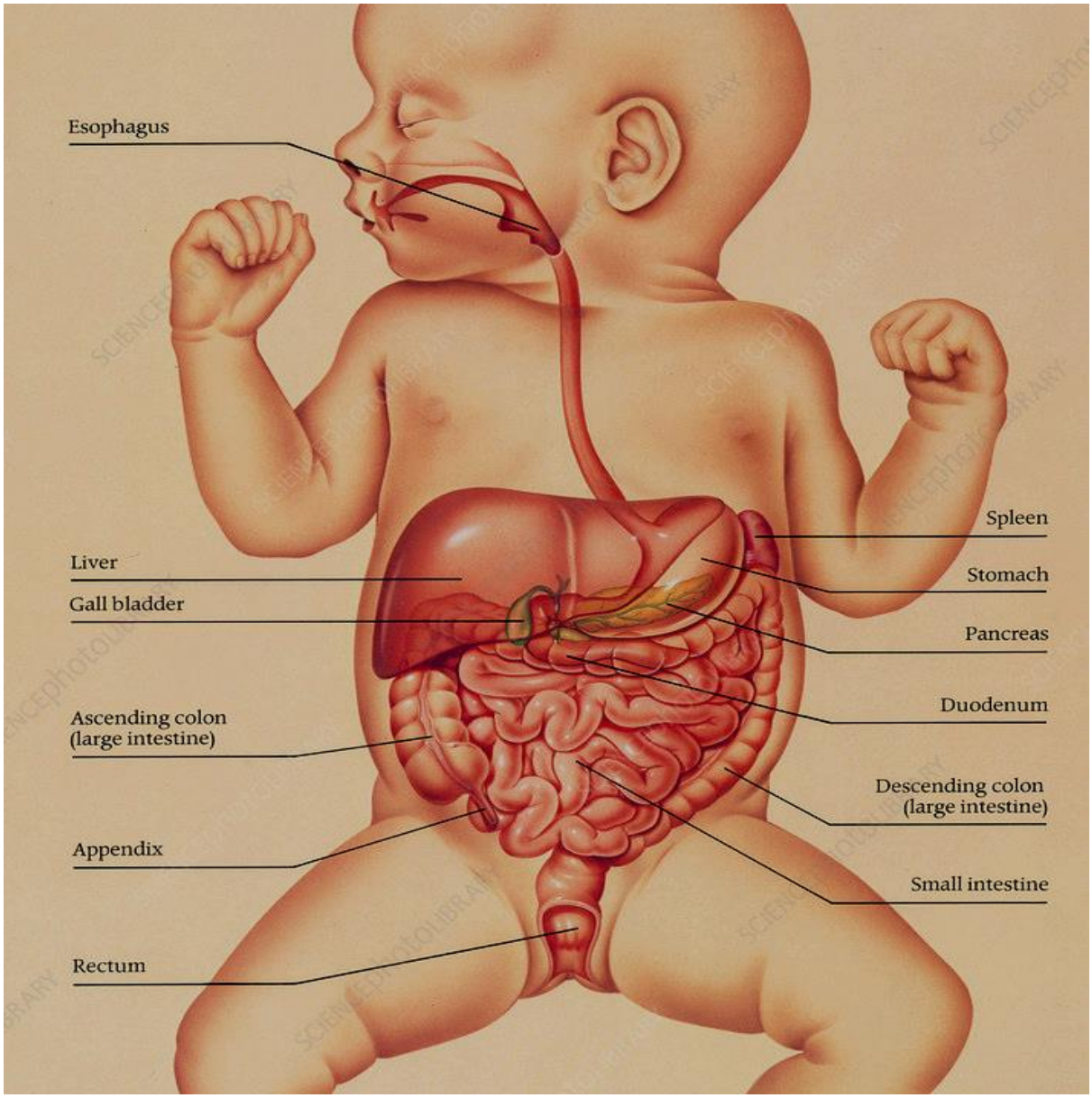

Figure 18: Digestive system of a newborn baby not different from adult

Source : https://www.science photo.com

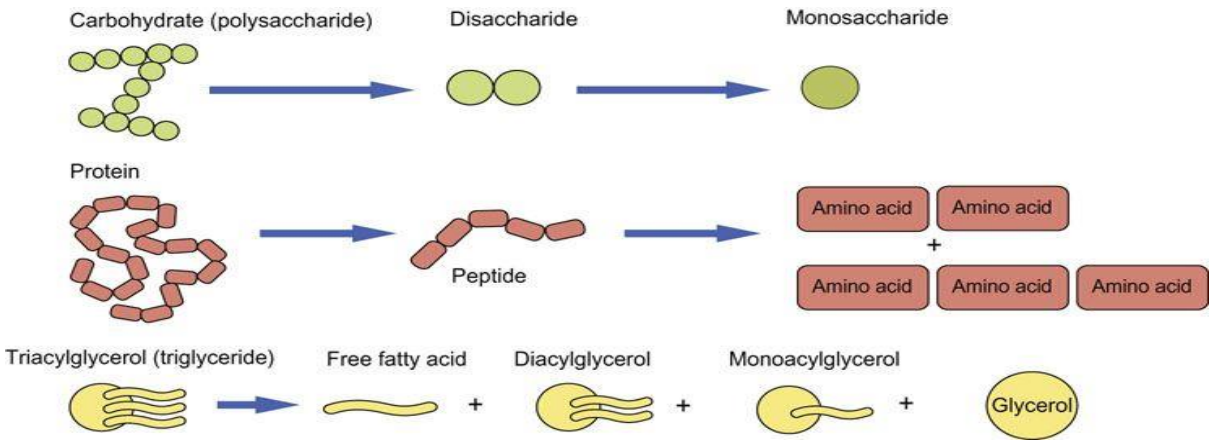

Figure 19: A simplified representation of biochemical processes involved in digestion

Source : https://www.kristaveteto.com

i. Carbohydrate Content

The carbohydrate content of breast milk is mainly made up of lactose. Lactose content is fairly constant in mature milk after 21 days postpartum. The stable concentration of lactose is important in maintaining a constant osmotic pressure in human milk. Lactose also aids the absorption of minerals and calcium. In breast milk, many carbohydrate-based bioactive compounds, such oligosaccharides, are attached to lactose. If the small intestine does not produce enough of the enzyme lactase as well as oligisaccharidases to digest these sugar complexes, lactose malabsorption and intolerance syndromes can be observed. Lactase deficiency malabsorption and disease are extremely rare in the exclusively breastfed infant. The end products of carbohydrates digestion and hydrolysis are essentially monosaccharides which are absorbed and assimilated through the duodenum and jejunum by cotransport with sodium ions and facilitated diffusion via enterocytes' transporters [34].

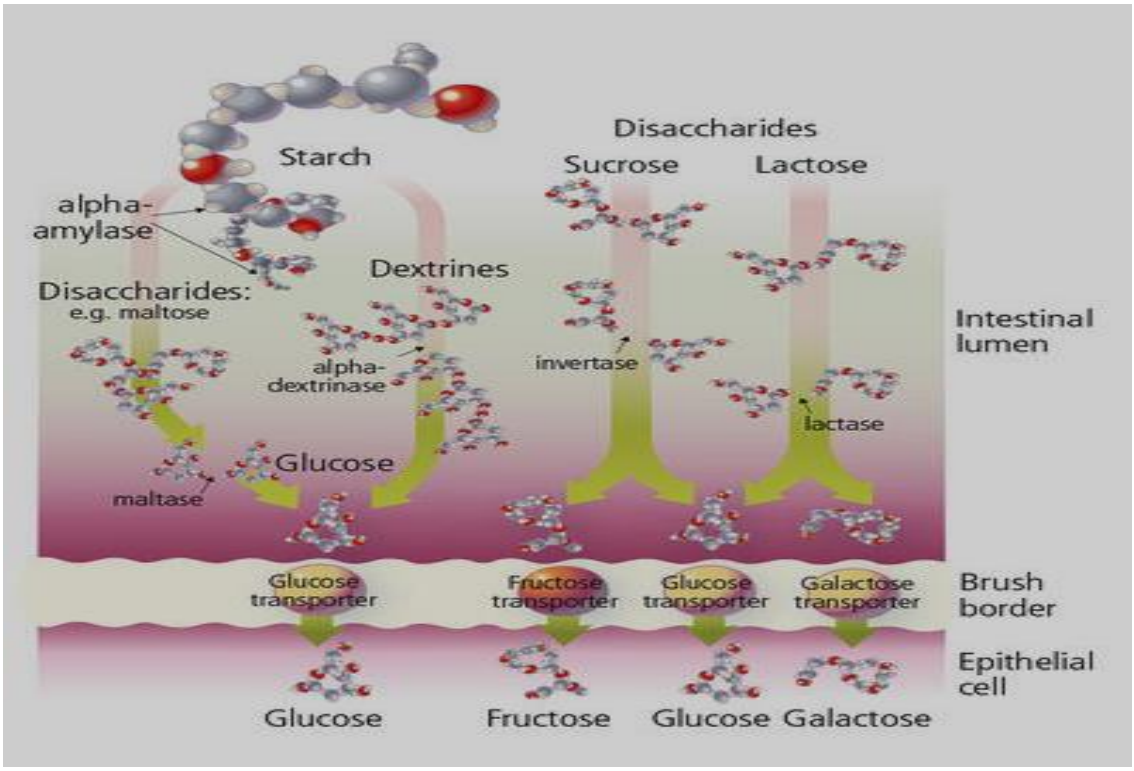

Figure 20: Digestion and absorption of carbohydrates

Source: http//pressbooks-dev.over.hawaii.edu/humannutrition/chapter/digestion

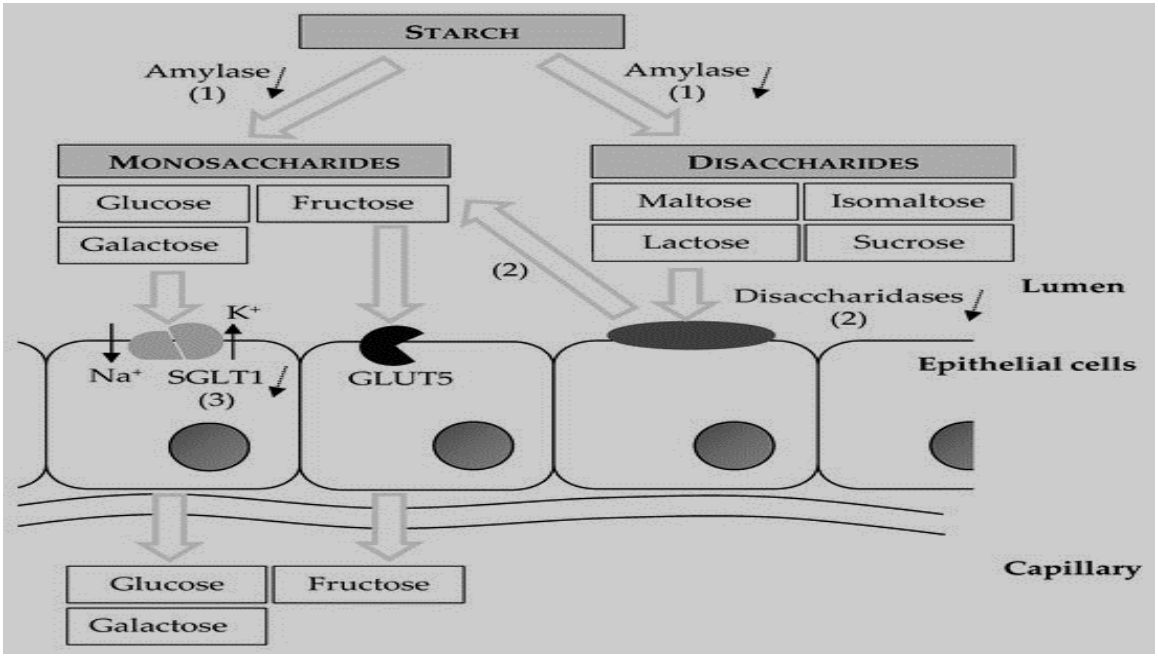

Figure 21: Digestibility of carbohydrates

Source: http//en.wikivet.net/digestibility_of_carbohydrates

ii. Proteins Content

There are two classes of protein in breast milk: Casein and whey. Casein becomes clots or curds in the stomach; while whey remains as a liquid and is easier to digest. Depending on the stage of milk, 80% to 50% of protein in breast milk is whey [35]. The whey/casein ratio in human milk fluctuates between 70/30 and 80/20 in early lactation and decreases to 50/50 in late lactation [36]. This proportion is significantly greater compared to the milk of other mammals. In cow's milk, whey proteins represent only 18% of milk protein. Traditionally, infant formulas are high in casein, making them harder to digest compared to human breast milk. Because the amino acid profiles of casein and whey proteins are different, the overall amino acid profile of human milk varies depending on the stage of lactation. Glutamine, the most abundant free amino acid, is nearly 20 times higher in mature milk than its lowest value in colostrum [37]. However, free essential amino acids derived from proteins are obtained via digestive proteolytic enzymes and pepetidases' action and assimilated through the brush border enterocytes by diffusion and active transport requiring adenosine triphosphate.

Glutamine is important for providing ketoglutaric acid for the citric acid cycle, possibly acting as a neurotransmitter in the brain, and serving as a major energy substrate for intestinal cells [38]. The main whey proteins are alpha-lactalbumin, lactaferrin and secretory IgA. Other proteins include lysozyme, folate-binding protein, bifidus factor, casein, lipase and amylase, alpha1-antitrypsin and antichymotrypsin, and haptocorrin [39]. After ingestion, these proteins are broken down rapidly to free amino acids for absorption and utilization. Most of these proteins also have bioactive functions and non-nutritive functions [38]. For instance, alpha-lactalbumin is essential for lactose synthesis

and binding of Calcium and Zinc ions. Casein assists to form masses with calcium and phosphorus.

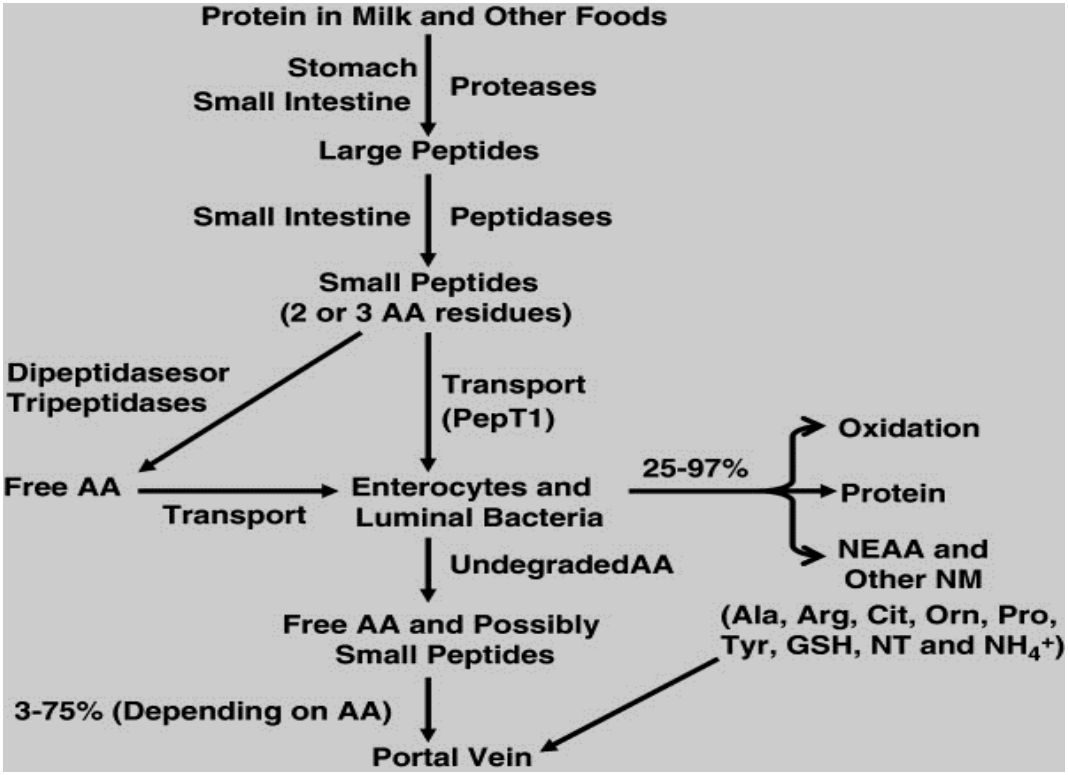

Figure 22: Digestion of proteins

Source: https//www.researchgate.net

iii. Fats in Human Breast Milk

Fats are the most important composition of breast milk, supplying energy and helping the development of the central nervous system. Moreover, milk fat is a carrier of taste and aroma. In general, human breast milk fat content ranges from 3.5% to 4.5% during lactation. The main lipid fraction are triglycerides, which account for about 95% of total lipids, and would require lipases during digestion for breaking down into simpler fatty acids. Simple fatty acids and monoglycerides in micelles are absorbed by the intestinal brush border and villi through simple diffusion and endocytosis into the lacteals.

Near half of milk fatty acids are saturated fatty acids, with 23% palmitic acid (C16:0) in total fatty acids [39]. The monounsaturated fatty acid, oleic acid (18:1w9), is in the highest percentage (36%) in milk. Human breast milk also contains two essential fatty acids, linoleic acid (C18:2w6) at 15% and alpha-linolenic acid (C18:3w3) at 0.35% [39]. These two essential fatty acids are, respectively, converted to arachidonic acid (C20:4w6) and eicosapentaenoic acid (EPA, C20:5w3), the latter of which is further converted to docosahexaenoic acid (22:6w3). arachidonic acid, eicosapentaenoic acid and docosahexaenoic acid are important for regulating growth, inflammatory responses, immune function, vision, cognitive development and motor systems in newborns.

Long chain polyunsaturated fatty acids are transferred from mother to fetus in the third trimester through the placenta, and to infants through breast milk after birth [40]. The required amounts arachidonic acid and eicosapentaenoic acid mainly comes from the mother through breast milk after birth. One study has showed that the fat content and the percentage of all polyunsaturated fatty acids in breast milk increase significantly between the sixth week and sixth month of lactation [41]. There is evidence that slowly turning-over maternal body pools of arachidonic acid are the major source of milk arachidonic acid [42].

The most essential fatty acid concentration in breast milk is dose-dependently associated with the consumption of fatty acid foods in lactating mothers [43, 44].

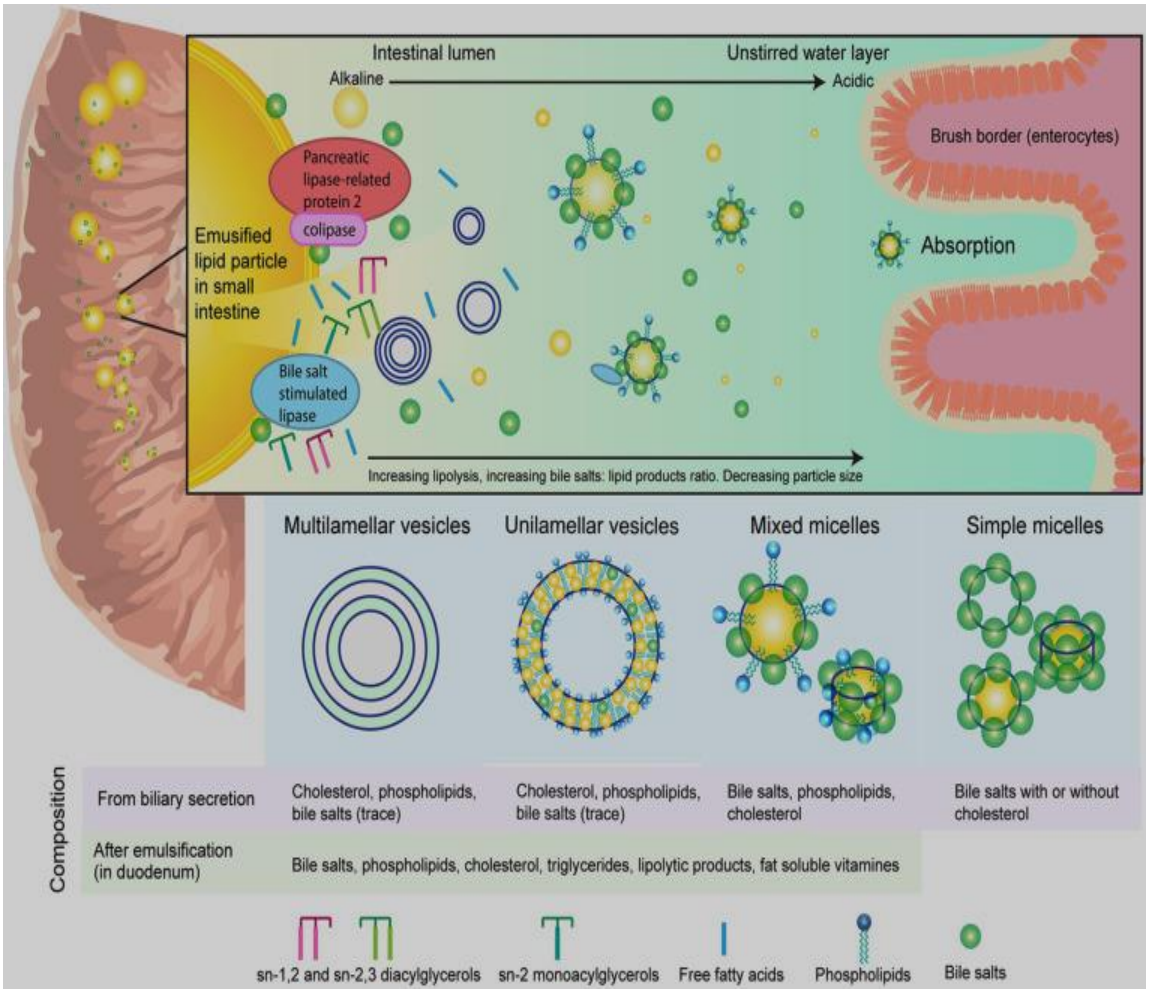

Figure 23: Digestion of human fats in healthy infant

Source:http //www.sciencedirect.com

However, the effects of human milk fatty acids on neurodevelopment is complex, particularly because neurodevelopment is assessed after the period of the first six month of exclusive human milk feeding. In premature birth, the transmission of these fatty acids is interrupted from the placenta to the fetus during the critical last trimester. Studies also showed that decreased postnatal docosahexaenoic and arachidonic acid blood levels in premature infants are associated with neonatal morbidities [45]. Thus, after birth, the preterm infant is dependent on an adequate diet for sufficient fatty acid levels with beneficial

effects on visual acuity, visual attention and cognitive development compared with infant receiving no supplementation [46-48].

iii. Vitamins, Minerals and Other Bioactive Components in Breast Milk

Human breast milk contains adequate amounts of most vitamins to support normal infant growth, except for vitamins D and K. Infants who are exclusively breastfeeding receive below the minimum recommended intake of vitamin D, and much lower than the recommended dietary intake. These infants are at the risk for vitamin D deficiency, inadequate bone mineralization and conditions such as rickets. However, the overall risk of vitamin D deficiency in breastfed infants is also correlated with overall sun exposure with increasing risk in climates with a lower sun index. Maternal supplementation with 400–2000 IU (International Unit). of vitamin D/day can increase the levels of vitamin D in breast milk, but only a higher dose (2000 IU) achieves satisfactory levels of 25-OH-D in the infant [39]. Normal vitamin D stores present at birth are depleted within eight weeks. Sunlight exposure and vitamin D supplementation are recommended for breastfed infant. Formula-fed infants often have higher serum concentration of vitamin D metabolites than breastfed-infants. Vitamin K is essential to the protein involved in blood coagulation. However, only limited amounts of vitamin K is transferred from the placenta to fetus. Thus, a newborn infant often has an extremely low concentration of vitamin K, and is at risk of developing hemorrhagic disease. After birth, vitamin K supplementation is recommended. These vital vitamins are fat-soluble and easily assimilated through diffusion via enterocytes.

In human breast milk, minerals contribute to a variety of physiological functions, forming essential parts of many enzymes and are of biological important to molecules and structures. The contents of minerals are comparable between human milk and bovine milk.

2.5. DESCRIPTION OF WELL-CONDUCTED BREASTFEEDING

2.5.1. Skin-to-skin Contact

The early skin-to-skin contact with the newborn has the advantage of inducing timely breastfeeding, in addition to maintain the baby's temperature to degrees that improve its well-being. This occurs through metabolic regulation and strengthened interactions with the mother, which also reduces baby crying [49].

2.5.2. Practicing Breastfeeding on Demand

This is a key aspect for a successful breastfeeding process. In effect, baby sucking on demand maintains and regulates milk secretion. There is intimate proportionality between the baby's frequency of breastfeeding and the mother's breast secretion rate. During the first months of life, the majority of infants breastfeed 8 to 12 times per day. This rhythm is necessary to counteract extra-uterine environment-induced dehydration, weight loss and hypoglycemia.

Mother adhesion to baby breastfeeding pace reduces the risks of engorgement and favors physiological lactation, this with baby satisfaction and prevention of complication with breastfeeding process. However, the number and duration of feeds varies with time for the same child, and from one child to another. The duration of a feeding should be determined by the newborn. Once satisfied, the infant let's go the breast by itself.

There is a latency period between latching and milk flow, and because of the variability in the composition of the breastmilk during feeding, it is essential to let the infant suckle as much as possible, and at will. Allowing the ingestion of highly concentrated lipids at the end of feeding is responsible for satiety. The physical proximity or togetherness of mother and baby permits breastfeeding on demand. This is calming for both protagonists and favors milk secretion [50].

2.5.3. Correct Positioning for Breastfeeding

i. Mother Positioning:

Adequate breastfeeding involves time consecration, up to several hours a day. Therefore, comfortable positioning of the mother is essential to render the process less constraining, bearable, and even enjoyable. Unstable positions that can cause back pains and muscle contractures must be avoided as much as possible. Mothers must always take the time to settle in a comfortable position. Various breastfeeding positions are recommended for mothers, including: lying on the side and face-to-face with the baby. An alternative is sitting in bed with the back resting on pillows, the knees and pelvis flexed. Another possibility is sitting in an armchair, with the back being well supported on the backrest [51].

Figure 24: Breastfeeding positions for the mother

Source: WHO. Infant and Young children feeding: Model Chapter for textbooks for medical students and allied health professionals

ii. Baby Positioning:

Correct positioning of the baby takes into consideration the following aspects: the child's neck should be straight or slightly leaning back. The child's body should be turned towards the mother. The baby's body should be close and in contact with the mother (belly to belly) and the baby's body and breastfeeding position should be fully supported [51].

Figure 25: Correct baby positioning during breastfeeding

Source: WHO/UNICEF. IMCI: Integrated Management of Childhood Illness.2005

iii. Proper Attachment of the Baby

The chin of the baby should be against the breast and the newborn's mouth should be wide open. The lips should be rolled up over the areola. The baby should suck the whole areola and not just the nipple.

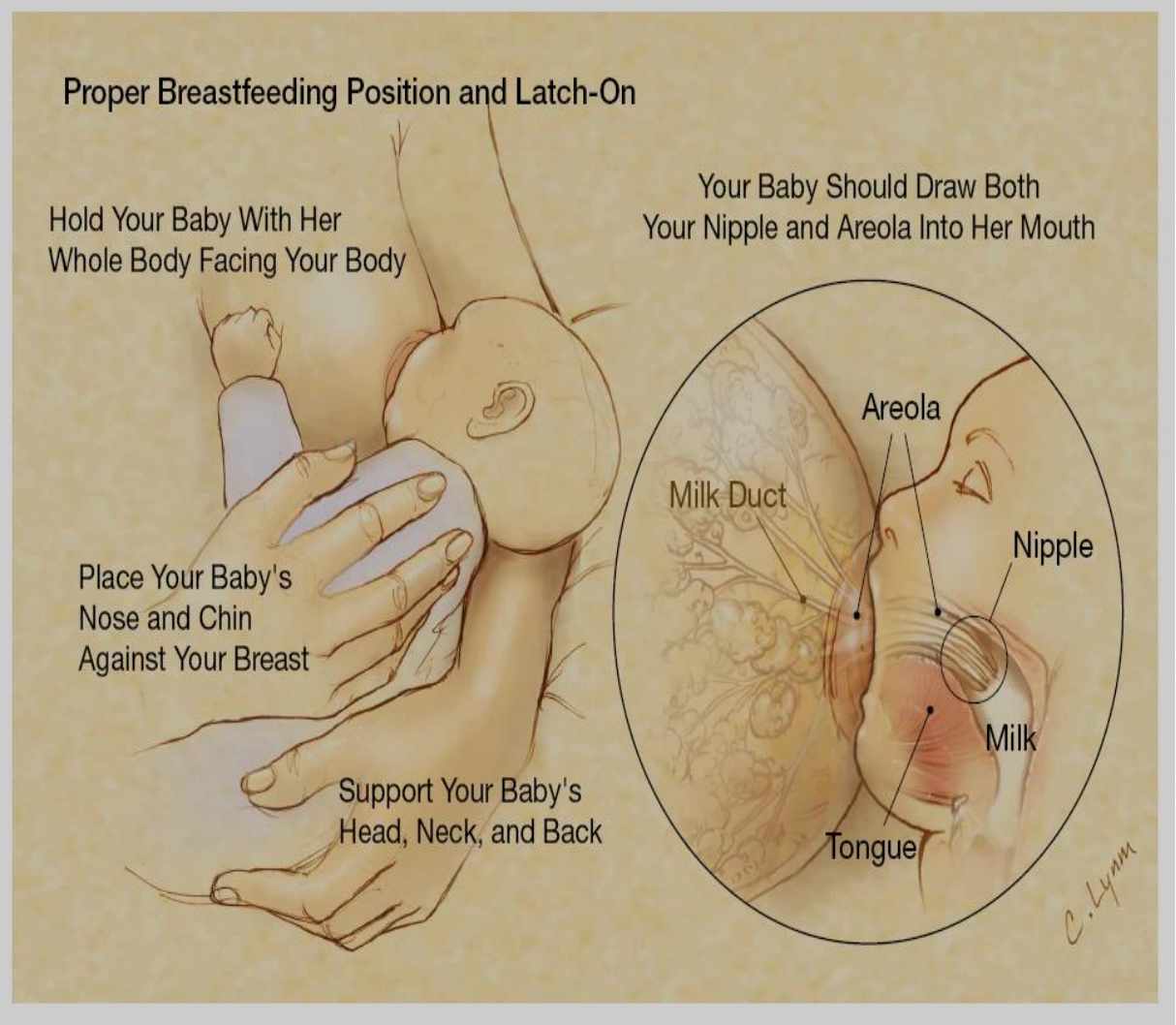

Figure 26: Correct baby positioning and attachment to the breast.
Source. The American Academy of Pediatrics. The AMA Complete Guide to Your Children's Health, The AMA Complete Guide to Women's Health

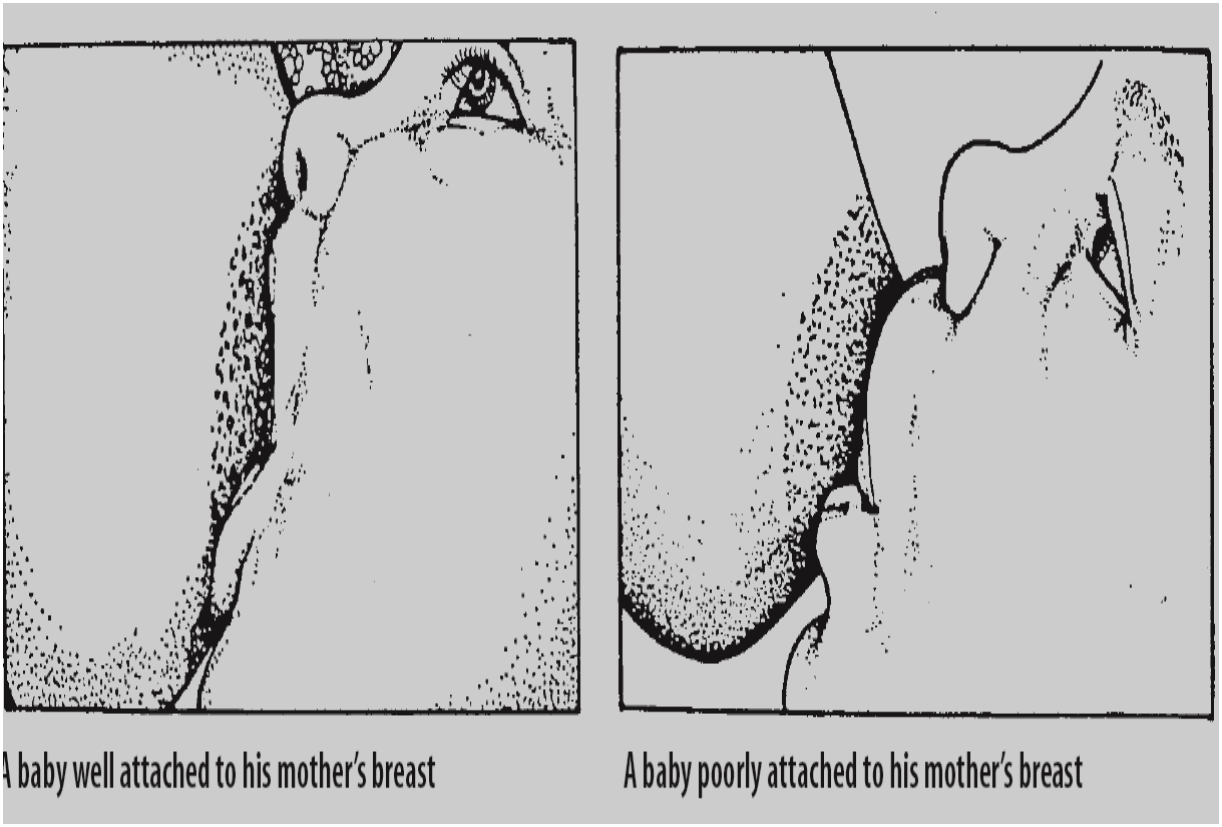

Figure 27: Correct baby attachment to the breast through the areola.
Source: WHO/UNICEF.IMCI: Integrated Management of Childhood Illness (2005)

iv. Encourage Mother-Baby Cohabitation and togetherness 24h-24h

After birth, the first feeding is favored by this intimate contact. Although putting the newly born infant immediately on to the breast is recommended by most societies of neonatologists, minutes delay less than an hour cannot completely disrupt the breastfeeding process. Therefore, breastfeeding is not necessarily compromised if the baby does not suckle immediately at birth because babies exhibit a variety of behaviors and are not all ready to suckle at the same time, neither with the same pattern [51].

2.6. COMPOSITION OF HUMAN MILK

There is no other stage in life where a single food serves as the sole source of adequate nutrition as human milk does in early infancy. Human milk is a dynamic, complex fluid that contains nutrients and bioactive factors needed for infant health and development [52].

2.6.1. Nutritional Components

Human milk has a changing nutrient composition that may vary through lactation, over the course of a day, within a feeding, and from one woman to another.

The variable composition of human milk provides nutrients specifically adapted to the changing needs of the infant and provides an array of flavors and tastes to stimulate sensory integration.

It is important to understand that human milk has unique specificity for human babies. Many components in human milk serve dual roles; a single component may enhance nutrition and host defense, or nutrition and neurodevelopment.

Colostrum is the milk produced in the first few days, a relatively denser milk characterized by high concentrations of protein and antibodies. The transition to mature milk begins around days 3 to 5 postpartum with the onset of stage 2 of lactogenesis, and mature milk appears by about day 10 postpartum. The following tables list representative values for the various constituents of mature human milk, for an energy potential between 650-700 Kcal [52].

.

Table I: Representative values for macronutrient constituents per litre of mature human breast milk (after 2 weeks' lactation)

Source: Dror DK, Allen LH. Overview of Nutrients in Human Milk. Adv Nutr. 2018 May 1; 9(suppl_1):278S-294S. Available from: https://academic.oup.com/advances/article/9/suppl_1/278S/5017778

Macronutrient	Content / l
Lactose (g)	67-70
Oligosaccharides (g)	12-14
Total nitrogen (g)	1.9
Non-nitrogenous proteins (% total protein)	23
Nitrogenous proteins (% total protein)	77
Total proteins (g)	9
Total lipids (g)	35
Triglycerides (% total lipids)	97-98
Cholesterol (% total lipids)	0.4-0.5
Phospholipids (% total lipids)	0.6-0.8

Table II: Representative values for principal micronutrients constituents per litre of mature human breast milk (after 2 weeks' lactation)

Source: Dror DK, Allen LH. Overview of Nutrients in Human Milk. Adv Nutr. 2018 May 1; 9(suppl_1):278S-294S. Available from: https://academic.oup.com/advances/article/9/suppl_1/278S/5017778

Principal Micronutrients	Content / l
Calcium (mg)	200-250
Magnesium (mg)	30-35
Phosphorus (mg)	120-140
Sodium (mg)	120-150
Potassium (mg)	400-550
Chloride (mg)	400-450

Table III: Representative values for trace element constituents per litre of mature human breast milk (after 2 weeks' lactation)

Source: Dror DK, Allen LH. Overview of Nutrients in Human Milk. Adv Nutr. 2018 May 1; 9(suppl_1):278S-294S. Available from: https://academic.oup.com/advances/article/9/suppl_1/278S/5017778

Trace element	Content / l
Iron (mg)	0.3-0.9
Zinc (mg)	1-3
Copper (mg)	0.2-0.4
Manganese (µg)	3
Selenium (µg)	7-33
Iodine (µg)	140
Fluoride (µg)	4-15

Table IV: Representative values for water-soluble vitamins constituents per litre of mature human breast milk (after 2 weeks' lactation)

Source: Dror DK, Allen LH. Overview of Nutrients in Human Milk. Adv Nutr. 2018 May 1; 9(suppl_1):278S-294S. Available from: https://academic.oup.com/advances/article/9/suppl_1/278S/5017778

Water-soluble vitamins	Content / l
Ascorbic acid (mg)	100
Thiamin (µg)	200
Riboflavin (µg)	400-600
Niacin (mg)	1.8-6.0
Vitamin br>6 (mg)	0.09-0.31
Folate (µg)	80-140
Vitamin br>12 (µg)	0.5-1.0
Panthotenic acid (mg)	2.0-2.5
Biotin (µg)	5-9

Table V: Representative values for fat-soluble vitamins constituents per litre of mature human breast milk (after 2 weeks' lactation)

Source: Dror DK, Allen LH. Overview of Nutrients in Human Milk. Adv Nutr. 2018 May 1; 9(suppl_1):278S-294S. Available from: https://academic.oup.com/advances/article/9/suppl_1/278S/5017778

Fat-Soluble Vitamins	Content / l
Retinol (mg)	0.3-0.6
Carotinoids (mg)	0.2-0.6
Vitamin K (µg)	0.33
Vitamin D (µg)	0.33
Vitamin E (mg)	3-8

2.6.2. Non-Nutritional Components in Human Milk (Bioactive Proteins)

Specific factors such as lactoferrin, lysozyme, and IgA reside in the whey fraction of human milk. Lactoferrin is an acute-phase protein that exhibits antimicrobial activity when not conjugated to iron (apolactoferrin). By binding with excess iron, it prevents bacterial iron uptake and fosters nonpathogenic bacterial growth. Lactoferrin also functions with other host defense proteins to kill bacteria and viruses. A growth-promoting effect on intestinal epithelium also has been attributed to lactoferrin [52].

Lysozyme has antibacterial effects through cleaving amino acids in bacterial cell walls. Secretory IgA (sIgA) is the most common immunoglobulin in human milk. IgA is synthesized by maternal intestinal lymphoid tissue in response to challenge by specific antigens and rapidly transfers into milk. It acts to neutralize foreign antigens. The concentration of IgA is greatest in colostrum and declines in the first 4 weeks postpartum. The lowest content is observed at 6 months, and thereafter the values increase slightly to levels that remain relatively constant through 2 years of lactation. IgM, IgG, IgD, and IgE also are present in human milk [52].

Cytokines are multifunctional proteins that are produced by immune cells and affect the function and development of the immune system. Pro-inflammatory cytokines include the interleukins (ILs). IL-6 and IL-8 are pro-inflammatory, stimulating B cell activation and recruitment of neutrophils.

Anti-inflammatory cytokines include IL-10 and transforming growth factor-β. Certain free amino acids may exert dual roles in infants. Taurine is trophic for intestinal growth, and glutamine is a fuel for the enterocyte and also affects the gut immune system [52].

It is worth mentioning that most nutrients that are found in the breastmilk are derived from maternal systemic reserves, which need to be replenished and preserved through adequate and balanced feeding with enough hydration.

Figure 28: Breastfeeding mothers should feed adequately and drink enough water

Source : https//humanhealth.iaea.org/HHW/Portfolio

2.6.3. Human Milk Options, Milk Donors and Milk Banks

The World Health Organization and the American Academy of Pediatrics recommends pasteurized human donor milk for preterm infants when a mother's own milk is unavailable. Donor milk undergoes a pasteurization process, which reduces many of the normal commensal microbes, as well as significantly reducing or obliterating live immune cells, bioactive proteins, and enzymes, collectively limiting some of the health benefit compared to a mother's own milk. Research efforts to optimize donor breast milk are ongoing. Before using donor breast milk, the mother should consult with their baby's health care providers [53].

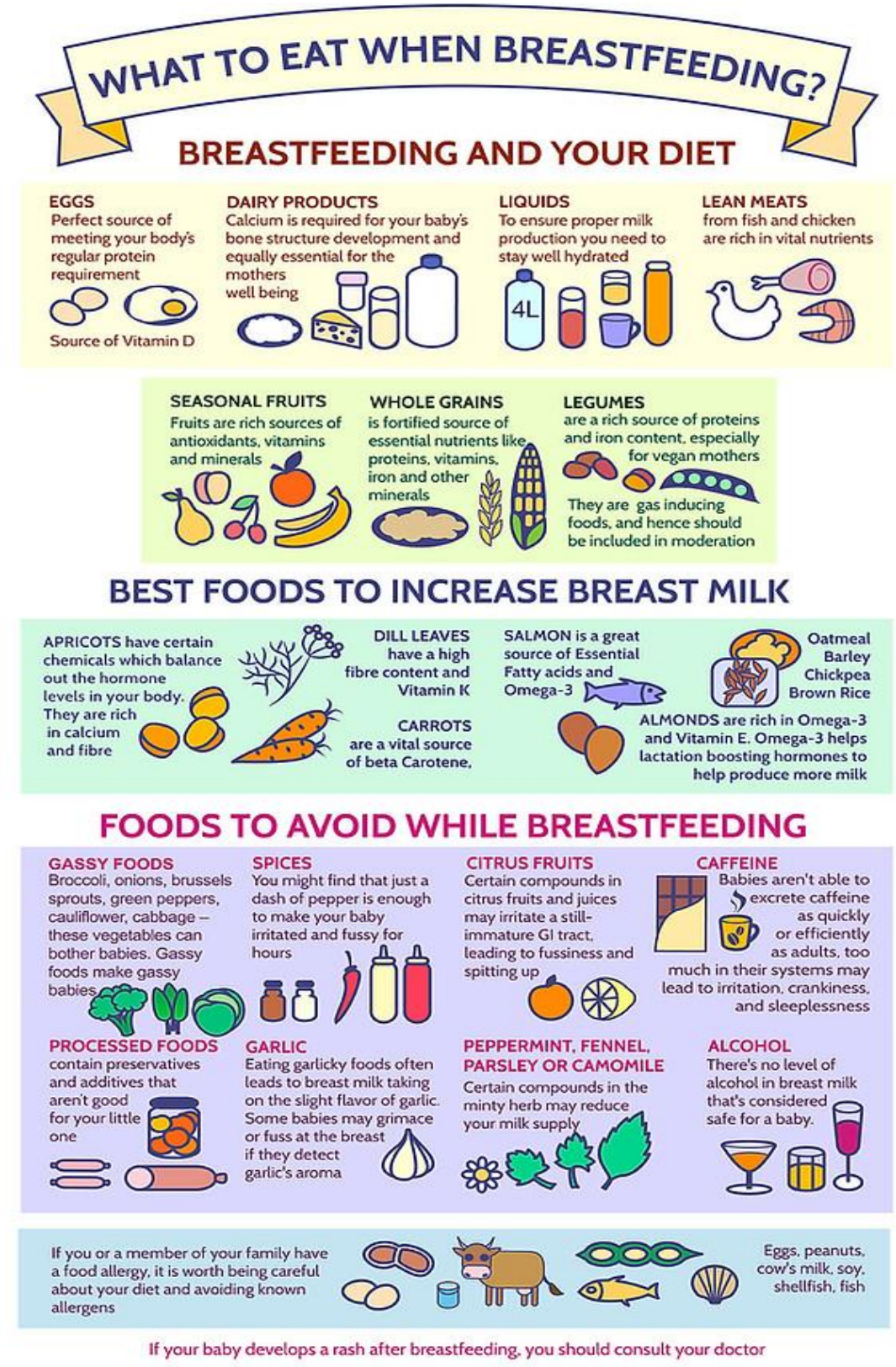

Figure 29: What to eat and what not to eat during breastfeeding

Source: https//dianabakerphotography.com

2.6.3. Comparing human milk with other milks (formula and cow milk)

The milk of each mammal is specific to the species and is not exchangeable. Its composition is genetically imposed. Mothers' own milk is the best source of nutrition for nearly all infants. Beyond somatic growth, breast milk as a biologic fluid has a variety of other benefits. Although breastfeeding is highly recommended, it may not always be possible, suitable or solely adequate. Infant formula is an industrially produced substitute for infant consumption. Infant formula attempts to mimic the nutritional composition of breast milk as closely as possible, and is based on cow's milk or soymilk.

Although production of an identical product to breast milk is not feasible, every effort has been taken to mimic the nutrition profile of human breast milk for normal infant growth and development. Cow milk or soymilk are most commonly used as the base, with supplemental ingredients added to better approximate the composition to human breast milk and to attain health benefits, including iron, nucleotides and compositions of fat blends. The fatty acids of arachidonic acid (AA) and docosahexenoic acid (DHA) are added. Probiotics and compounds, produced by genetic engineering, are either added or currently being considered for addition to formula.

A number of alternatives to cow's milk-based formula also exist. It is possible to highlight the benefits and advantages of the human breast milk over other milk preparations for infants. This can be done by comparing breast milk contents with specific milk preparations for infants and cow's milk. Bearing in mind that during the first six months of infant life, providing optimal nutrition is critical as the consequences of inadequate nutrition can be very severe.

Such comparison provides healthcare deliverers with scientific rational to convince mothers to privilege breastfeeding above all other options for infants' feeding. Table VI shows figure-based comparison of various forms of milk, most frequently used for feeding infants.

Table VI: Energy contents, proteins, lipids, carbohydrates and minerals from breast milk, cow's milk and infants' formula milk, for infants at 4-6 months (on January 1, 2004) (Directive, 1991). (22)

Source: Breastfeeding: the health benefits of the child and mother. The synthesis of the National Nutrition Health Program, Ministry of Solidarity, Health and Family of France; 2005.

Component	Cow milk (100ml)	Formula milk (12.5-15g)	Breast milk (100ml)
Calories (Kcal)	**65**	**66-73**	**67**
Protides	**3.7**	**1.5-1.9**	**1**
- Casein (%)	80	60-80 44-50	40
Lipids (g)	**3.5**	**2.6-3.8**	**3.5**
- linoleic acid	90	350-740	350
- Alpha-linoleic acid	Trace	30-100	37
Carbohydrates (g)	**4.5**	**6.7-9.5**	**7.5**
-Lactose (%)	100	47-100	85
- Dextrine-maltose (g)	0	1.1-2.6	0
- Other carbohydrates	None	Starch, glucose, fructose, saccharose	Oligosaccharides
Minerals (mg)	**900**	**250-500**	**210**
- Sodium (mg)	48	16-28	16
- Calcium (mg)	125	43-93	33
- Calcium/Phosphorus	1,25	1.2-1.9	2
- Iron (mg)	0,03	0.7-1	0.05

2.7. BENEFITS AND ADVANTAGES OF BREASTFEEDING

2.7.1. For the Mother

Breastfeeding is healthier for mothers physically due to the fact that it promotes fast weight loss after birth, consuming about 500 extra calories per day to build and maintain adequate milk supply.

Secreted oxytocin which has an essential role for breastmilk ejection, is also responsible for uterine contraction, thereby enabling the organ to return to its normal size during postpartum after pregnancy distension. By so doing, induced uterine contractions reduce postpartum hemorrhage as well, by favouring blood coagulation through intramural uterine vessels' obliteration. Consequently, newly delivered women without postpartum hemorrhage have less chances of manifesting anemia during this period. The anatomical and physiological restoration of the genital tract which is improved by breastfeeding reduces the chances of onset of urinary tract infections during the puerperium.

The rising levels of prolactin in lactating women makes them less prone to conceiving a new pregnancy in the meantime, thus serving as a natural contraceptive method that is important for family planning and mother's systemic restoration during the intergenesic period [54-56].

The positive emotional involvement which is derived from the satisfaction of breastfeeding promotes more positive moods in mothers and reduces the risk of postpartum depression. Furthermore, breastfeeding produces the naturally soothing hormones oxytocin and prolactin that promote stress reduction and positive feelings in the nursing mother. This accompanied with increased confidence, self-esteem and calmness. Physical and emotional bonding between the mother and child is increased during skin-to-skin positioning and contact in the course of breastfeeding, as well as during holding and stroking.

Because of the fact that breastfed babies' overall cries are less, together with reduced risk for neonatal infections and admission to neonatal intensive care unit for these infants, breastfeeding accounts for maternal motivation and serenity. Therefore, the breastfeeding process can support the wellness of the body, mind and spirit for the whole family. Moreover, breastfeeding mothers learn to read their infant's cues while babies learn to trust caregivers. This participates in the shaping of the infant's early behaviour.

Figure 30: Effect of external stimuli and drugs on lactation and breastfeeding

Source : https://www.bumpnbub.com/blog/2019/6/20

Breastmilk is almost always available in breastfeeding women, being clean and flowing in adequate amount at the right temperature. These implies there is no need for special preparation nor cooking, and therefore enables new mothers to pursue some other indispensable activities such as traveling.

Breastfeeding in mothers may also procure benefits for life such as lowering the risks for breast, ovarian and vagina cancers, rheumatoid arthritis, lupus, endometriosis, osteoporosis, cardiovascular diseases, hypertension and

diabetes. However, even though these associations have been documented, the mechanisms through which they occur are not all well described yet [54-56].

2.7.2. For the Infant

The family of Immunoglobulins or antibodies help to protect the child from various viral infections with which the infant may be encountered during the first weeks or months of life. These antibodies also help in the development of the immune system and its strengthening.

Breast milk contains immune elements called "mucins" which are defined as various mucoproteins that specially occur in secretions of mucous membranes. Because of the fact that they are mainly constituted of lots of proteins and "carbohydrates", these substances adhere to bacteria and viruses. Through this process, they permit pathogens complete elimination without side effects, compared to drugs.

Adequate breastfeeding, through breast milk takes part in the development of the digestive system, and serves for its protection, including the respiratory tract. This systemic defence occurs through the establishment of effective and essential microbiota or microbiome with probiotics in the bowel, which induces immunomodulation. The process of immunomodulation is crucial for body defence. In effect, probiotics are microorganisms ingested during feeding, with the capacity of colonizing the bowel with protective functions due to their presence. This is the case with saprophytic flora comprising bifidobacteria and lactobacilli. By so doing, they serve as protection against diarrhoea and respiratory tract infections which are serious conditions in paediatrics, through immunomodulation. Therefore, adequate breastfeeding helps reduce infant morbidity and mortality as well [54-56].

More so, breastmilk by its bioactive content is essential for the prevention and recovery from the well-known necrotising enterocolitis, which is a digestive medico-surgical emergency of neonates and most specially of preterm. This other protective function is assumed when among bioactive factors, some unknown but speculated ones reduce the enzyme glycogen synthase kinase 3β activity, with Toll-Like Receptor 4 (TLR 4) inhibition. Indeed, it is worth mentioning that TLR 4 in the premature gut under normal circumstances participates to the regulation of intestinal development. However, during the "cross-switching phenomenon", TLR 4 hyperactivity occurs in response to bowel colonization by microorganisms in the postnatal period. This leads to deleterious effects including enhanced pro-inflammatory cytokine release, mesenteric ischemia, impaired mucosal healing, necrosis and enterocyte apoptosis. Furthermore, there is reduced goblet cell secretion of mucus and altered Paneth cells, which is responsible for reduced bowel protection [57, 58]. This pathogenesis is preventable through adequate breastfeeding.

Because breastfeeding has been associated with protection against early respiratory infections, the observed association between breastfeeding and asthma at early ages may be mediated through the protection of breastfeeding against infections. This is the case with bronchiolitis, which is a respiratory tract infection predisposing to asthma in young infants, especially beyond two or severe episodes.

Childhood asthma prevalence worldwide has been increasing over decades, and a number of theories are proposed to explain this trend. An overview of current thinking in relation to the breastfeeding, asthma, and allergic disease debate is given from epidemiological, nutritional, immunological, and gut microbial colonization perspectives. It has been noted that modern day society, with increased standards of hygiene especially in developed countries, changes the gut flora of infants. This potentially impacting the risk of developing immune-

mediated diseases including allergic disease and asthma. Lower bacterial diversity and altered intestinal microbiota in the first few weeks of life is associated with an increased risk of eczema and asthma. Whereas the favorable gut colonization through continued breastfeeding may promote tolerance as well as protection when complementary feeding is initiated [54, 56].

Ccompared to formula-fed infants, breastfed infants have a healthier microbiota that may be linked to a reduced risk of allergic disease. This implies that breast milk decreases the risk of allergy for the child and may serve for prevention as well. Breast milk contains immunological components that protect against infections and allergic disease in infancy. The composition of human breast milk is complex, containing factors that interact with the infant immune system and intestinal milieu including allergens, cytokines, immunoglobulins, polyunsaturated fatty acids, and chemokines. These co-actions with the transforming growth factor β which is a cytokine in human milk is involved in maintaining intestinal homeostasis, inflammation regulation, and oral tolerance development to allergens.

During the first feeding, the newborn benefits from the advantages of colostrum both as a laxative to promote the evacuation of meconium, thereby serving as test for digestive functions. On the other hand, this digestive evacuation also helps preventing precocious neonatal jaundice.

Breastmilk content of proteins and fats is relatively inferior to that of other milk preparations, and this procures some protection against childhood obesity and associated risks such as metabolic syndrome and cardiovascular risks, as well as pancreatic disorders.

Furthermore, breastfeeding gives the child a psychic balance and assistance with sleep, it is the best calming for the child. Visual and tactile interaction between the mother and baby during breastfeeding is paramount for

the consolidation of bonding. During Breastfeeding there is a mutual sensation of satisfaction and pleasure in both protagonists, with some degree of emotional affection necessary for the neurodevelopmental process of the neonate infant [59-63].

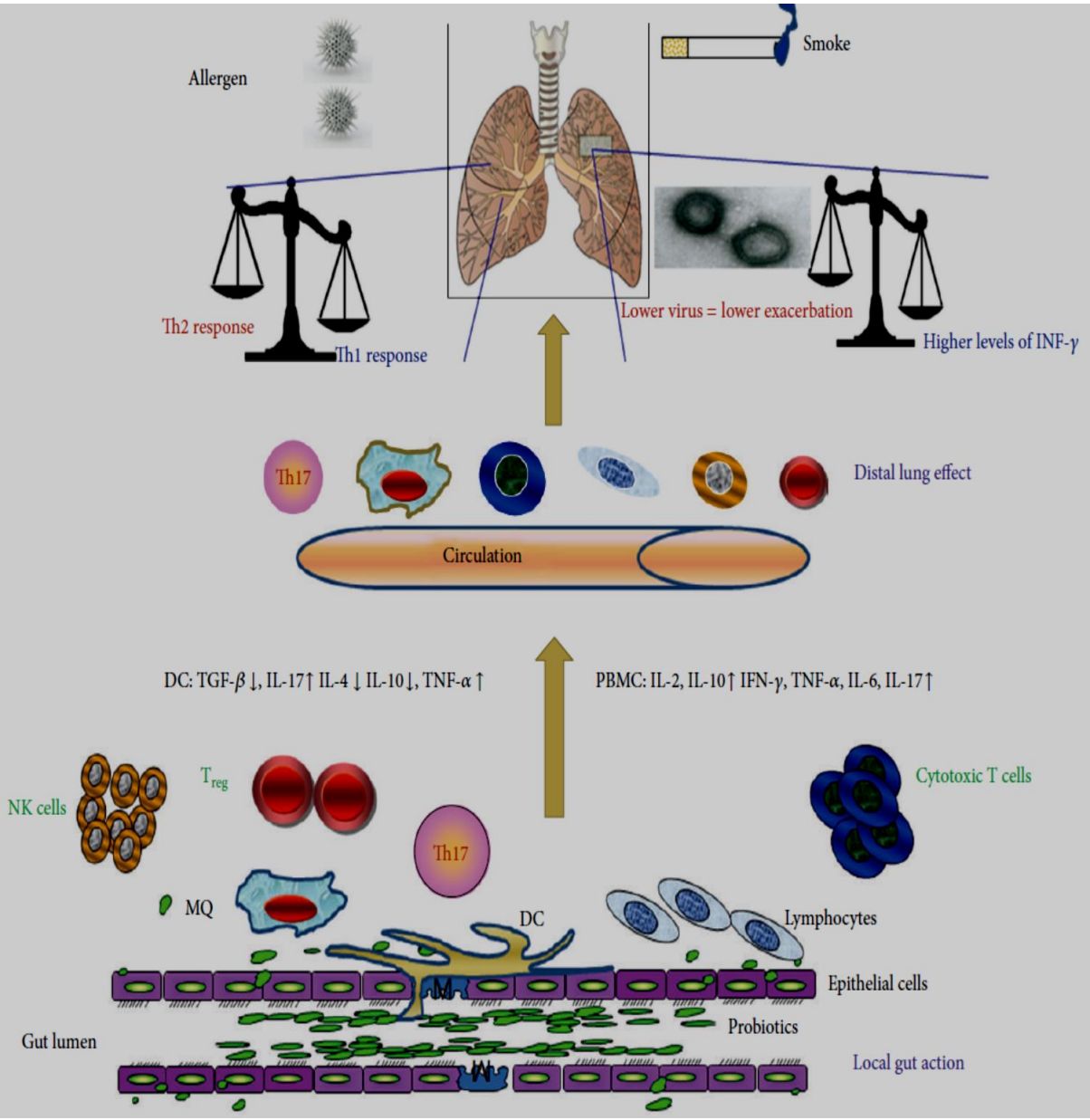

Figure 31: Immunomodulatory functions of probiotics on lung disease and allergic asthma

Source : http://dx.doi.org/10.1155/2013/751068

Table VII: Dietary supplementation with lactobacilli that have shown enhanced immune response and protection against respiratory tract pathogen challenge.

Source : http://dx.doi.org/10.1155/2013/751068

LAB treatments	Immune response
The immune stimulation induced by *L. rhamnosus* CRL1505 (Lr05) and *L. rhamnosus* CRL1506 (Lr06) on the resistance to infection with an intestinal pathogen (*Salmonella typhimurium*) and a respiratory pathogen (*Streptococcus pneumoniae*)	Both strains were able to improve resistance against the intestinal pathogen. Only Lr05 was able to induce a significant decrease in the number of *S. pneumoniae* in the lung, prevent its dissemination into the blood, and induce a significant increase in Th1 (INF-γ) and Th2 (IL-6, IL-4 and IL-10) cytokine levels in the bronchoalveolar lavages (BAL)
2 days before feeding of *L. casei* prior to pathogen challenge	Increased rate ofclearance of *P. aeruginosa* from the lungs increased phagocytic activity of alveolar macrophages, and increased levels of IgA in BAL fluid
Prefeeding of *L. casei* (Shirota strain) for 4 months prior to challenge	Reduced viral titre in nasal washings; increased NK activity of splenocytes and nasal tract mononuclear cells; increased IFNQ and TNFK production by mitogen-stimulated nasal lymphocytes
OVA-sensitized mice were orally administered with *Bifidobacterium breve* M-16V, *B. infantis* NumRes251, *B. animalis* NumRes252 and NumRes253, *Lactobacillus plantarum* waNumRes8, and *L. rhamnosus* NumRes6. After challenge by OVA inhalation in the lungs, the response to methacholine was measured Pulmonary inflammation assessed by analyzing BALF for the presence of inflammatory cells and mediators	Of the panel of 6 strains, *B. breve* M-16V and *L. plantarum* NumRes8 inhibited (1) the response to methacholine, (2) reduced the number of eosinophils in the bronchoalveolar lavage fluid, and (3) reduced both OVA-specific IgE and (4) OVA-specific IgG1, whereas the other strains did not affect all these parameters simultaneously. *B. breve* M-16V but not *L. plantarum* NumRes8 reduced interleukin 4, interleukin 5, and interleukin 10 Furthermore, *B. breve* M-16V but not *L. plantarum* NumRes8 reduced acute allergic skin reactions to OVA

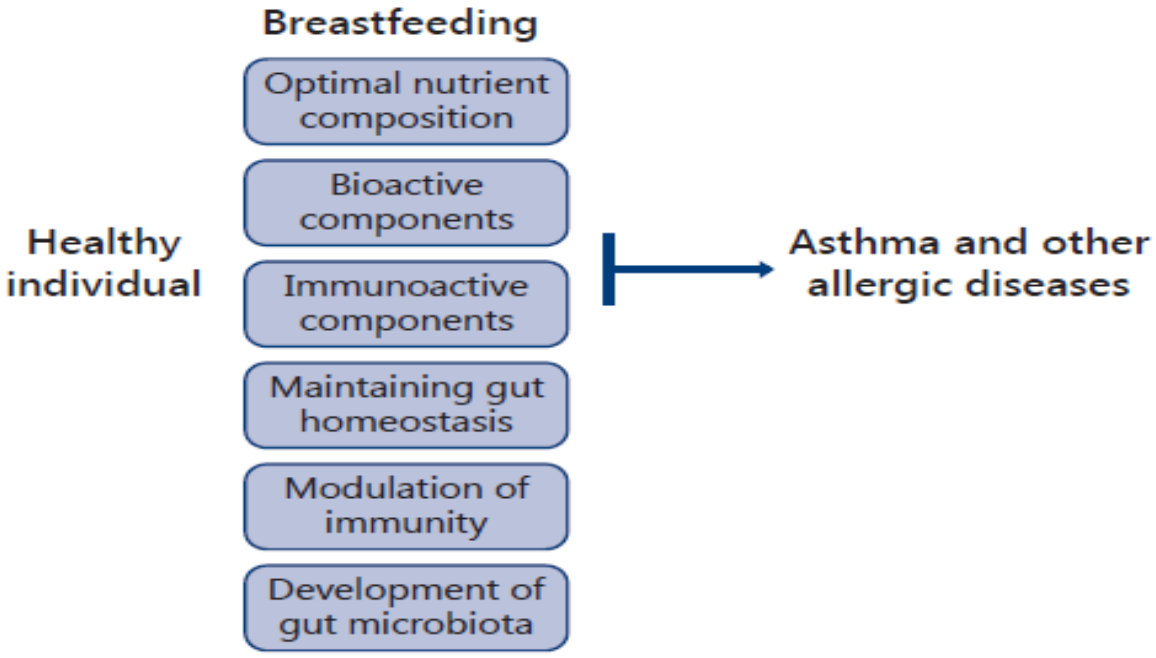

Figure 32: Protective effect of breastfeeding against asthma and allergic diseases.

Source: www.karger.com/anm

Table VIII: Factors in breast milk that are being evaluated as inducing or protecting against food allergies

Source : www.karger.com/anm

	Inducing	Protective
Antigens	sensitizing allergens	tolerizing allergens
Cytokines	IL-4 IL-5 IL-13	TGF-β soluble CD14
Immunoglobulins		s-IgA to ovalbumin
Polyunsaturated fatty acids	arachidonic acid C22:4n-6 C22:5n-6	eicosapentaenoic acid docosapentaenoic acid docosatetraenoic acid α-linoleic acid n-3 polyunsaturated fatty acids
Chemokines	RANTES IL-8	
Eosinophil-derived granular proteins	eosinophil cationic protein	
Polyamines		spermine spermidine

2.7.3. Economic implications

Apart from the medical benefits for the health of the mother and the child, the family and the society derive substantial saving from the cost of purchasing infant formula milk and other requirements for its preparation and consumption. This is the case with mineral water, baby bottles, drinking cups, heat and electrical energy.

More so, the cost of the maintenance of baby bottles, including washing and sterilization are to be considered as well. In the same vein ecological preservation is promoted with breastfeeding which is purely biological in its process and content, contrarily to formula feeding which generates industrial enterprising. Withstanding that industrialization does not only contribute to socioeconomic progress, but also environmental and/or ecological deterioration.

Most important is the financial cost for medical assistance, health care, medication, medical analysis and investigations that accompany the follow-up of infectious diseases and supposedly avoidable by breastfeeding. This is even more considerable in poor and developing countries with important risks for disease communication and transmission.

Considerable savings can also be made from the cost of maternal contraception which is guaranteed by exclusive breastfeeding, at least throughout the first six months of postpartum. Likewise, savings are also made through the avoidance of maternal and infants' health associated issues with poor family planning. This is the case of gestational diabetes, preeclampsia, eclampsia and maternal hypertension, with incidences and complications being related with increasing parity. Malnutrition and respiratory tract infections susceptibilities in all family members, but most especially in children, due to limited financial means to provide food for a large family [54, 56].

2.8. PARTICULAR SITUATRIONS WITH BREASTFEEDING

2.8.1. The Case with HIV Infection

Among children infected with HIV throughout the world, 30 to 35% may be contaminated through breast milk according to UNAIDS/UNICEF/WHO in 1998. The duration of breastfeeding is the main risk factor for HIV transmission during breastfeeding. The risk is more considerable in case of high viremia (blood viral load) of the mother. More so, certain breast pathologies including mastitis, abscess, nipple lesions, as well as the presence of oral lesions in the infant such as candidiasis, are independent risk factors [64].

Since 2006, the WHO recommended ARVs should be provided to HIV-positive pregnant women in the third trimester of pregnancy as from the 28th week to prevent transmission of HIV to the child. At the time, there was not enough data on the protective effect of ARVs during breastfeeding. Since then, several clinical trials have demonstrated their effectiveness in preventing transmission during breastfeeding.

Three years later in 2009, recommendations promoted the use of ARVs at an earlier stage of pregnancy, as from the 14th week and until the end of the breastfeeding period. Most recently, WHO recommends continued breastfeeding until the age of one year, provided that the HIV-positive mother or child takes ARVs during this period, which will reduce the risk of transmission and improve child's chances of survival. This new recommendation is clear about the fact that if access to ARVs exists, breastfeeding is a good option for every child, even when the mother is HIV-positive [64].

2.8.2. The Case with Viral Hepatitis

i. Hepatitis B Virus (HBV)

Screening for the HBV antigen (Hbs) is part of the routine examinations during antenatal consultations. The risk of transmission of the virus from mother to child during breastfeeding is quite negligible compared to that posed by exposure to blood and body fluids of the mother at the time of childbirth. Mothers infection with the hepatitis B virus is not a contraindication to breastfeeding, even during active viral replication with the presence of the Hbe antigen and circulating viral DNA.

Exposed neonates from mothers with HBV benefit seroprophylaxis and prompt vaccination which are carried out during the first few hours following birth. The actual vaccination schedule in Cameroon include a first dose of vaccine at birth, the second dose is administered after six weeks from birth (that is at 1 month of age), the third dose occurs after 10 weeks (2 months of age), and the third dose after 14 weeks (3 months of age). Therefore, there is no formal contraindication to breastfeeding in mothers with HBV infection [65].

iii. Hepatitis C Virus (HCV)

There is no evidence that the risk of transmission of the hepatitis C virus from mother to child is increased during breastfeeding. The 1997 French consensus conference concluded: “transmission through breast milk seems exceptional although the presence of hepatitis C virus RNA, searched for by PCR in colostrum or breast milk, has been reported…”.

In case of maternal infection, viral RNA is only found in breast milk in less than a third of cases, and its concentration in milk is about 100 times lower than in serum. The last two American and European consensus conferences, and

the 2002 ANAES recommendations do not contraindicate breastfeeding when the mother is a carrier of the hepatitis C virus [64, 65].

2.8.3. The Case with Tuberculosis infection

The recommendations of the Global Program for Vaccination and Immunization of Children at risk for infection with Mycobacterium tuberculosis is to immunize them with BCG as soon as possible after birth. Although some studies have shown protection against all forms of tuberculosis with BCG, there is a general consensus on protection in the first year against tuberculous meningitis and miliary tuberculosis. In case of active pulmonary tuberculosis, the mother must be separated from the child during the infectious period (usually during the first 2 weeks of treatment). During this period, she can express her milk and this will be given to the child. No side effects have been reported in the child when the mother is treated with first-line anti-tuberculosis drugs. As a matter of facts, isoniazid, rifampicin, streptomycin, ethambutol and pyrazinamide are considered compatible with breastfeeding by the American Academy of Pediatrics [66].

2.8.4. The Case with COVID-19 Infection

The Coronavirus Disease 2019 (COVID-19) has spread worldwide, to become a pandemic of great concern since its discovery few years ago. This with very high morbidity and mortality rates. The safety of breastfeeding practice in mothers infected with the coronavirus is a major concern for lactation specialists. To date, there is no formal consensus among the scientific community, healthcare providers, experts, health organizations nor governments.

However, the current evidence demonstrate that the majority of infants breastfed by infected mothers were negative for COVID-19. Furthermore, breast milk samples from suspected/infected mothers mainly demonstrate negative

results of the viral tests. This means there as of now, there is insufficient evidence proving the infectivity of breast milk from infected mothers.

Although recent studies found other transmission modalities through breastmilk, infants feeding bottles, containers and the skin as factors associated with breastfeeding. Specific antibodies in the breast milk of infected mothers were also found, implying protective effects for their breastfed children. Therefore, it is currently believed that breast milk of infected mothers is unlikely to transmit COVID-19.

Nevertheless, owing to the low quality of the current evidence, studies with more robust design are needed to strengthen the conclusions regarding the safety of breastfeeding. Further studies to follow up the health status of infants who are directly breastfed by their suspected/infected mothers, are needed as well. These may include collecting breast milk samples at multiple time points for viral testing and specific antibodies examination.

The current recommendations on breastfeeding during COVID-19 from different organizations are controversial. However, direct breastfeeding with contact precautions is generally suggested as the first choice for infected mothers in the meantime [67].

2.9. EXPRESSION AND STORAGE OF BREASTMILK

. Breast milk expression and storage for later use in feeding the infant appears to be an alternative for the continuation of exclusive breastfeeding for women who are not always available for their babies. However, this practice entails rigorous hygiene practices, from the time of breastmilk expression to the time of breastfeeding, including storage and transport if necessary [68].

The cleaning of the equipment to use in the process consists in washing the infant feeding bottle, cups and other accessories, as well as the breast pump. They should be thoroughly cleaned with soap, well rinsed with very clean water, sterilized through boiling water by preference and during 20-30 minutes at least, or by other means. The breastmilk feeding accessories should then be allowed to dry without wiping and kept in sterile hermetic containers before they are used [68].

The safest way for the collection of breast milk starts by thorough handwashing with soap, mother settling in a clean place, then place the bottle and/or the breast pump on a well-cleaned work surface. Then breastmilk expression from one or both breasts as needed is done.

When comes the time to store the breastmilk, the date and time of the first collection should be noted on the feeding bottle. The bottles must be stored in a sterile, closed container or in a specially designed sterile bag that can be bought in pharmacies. Storage duration varies according to the storage temperature. The recommended storing durations are 4 hours at room temperature, 48 to 72 hours in the refrigerator (+4°C), 6 months in the freezer (-18°C°) [68].

When necessary, the bottle of cold breast milk may be transported in a cooler or in an insulated bag with a refrigeration pack. It is recommended not to exceed an hour of transport [68].

2.10. MEANS OF PROMOTING BREASTFEEDING

In 1981, the World Health Assembly adopted through 118 countries the international code of marketing for breastmilk substitutes which regulates their sale. This code was transcribed into the national laws of each of these signatory countries. In 1991, the WHO and UNICEF became aware of the barriers to breastfeeding that existed in maternity hospitals and produced a conjoint declaration, setting out the 10 conditions for the success of breastfeeding. Two years later, the Initiative "Hôpital Amis des Bébés (IHAB)" was set up, to mean "Baby Friendly Hospital Initiative". With their mission consisting in issuing "Hospital Amis des Bébé labels" to hospitals agreeing to comply with a charter including the 10 conditions for the success of breastfeeding, and not to distribute milk substitutes. These 10 recommendations were for all facilities with maternity and newborn care to:

1. Adopt a written breastfeeding policy
2. Equip all health care workers with the skills to implement this policy
3. Inform all pregnant women of the benefits of breastfeeding
4. Help mothers initiate breastfeeding within half an hour of birth
5. Instruct mothers on how to breastfeed and how to maintain lactation even if they are separated from their babies.
6. Not to give newborns any food or drink other than breast milk unless medically indicated
7. Leave the child with his mother 24 hours a day
8. Encourage breastfeeding at the request of the child.
9. Not to give breast-fed children any artificial teats or pacifiers
10. Encourage the creation of breastfeeding support associations and refer mothers to them as soon as they leave the hospital or clinic [69].

Figure 33: The ten steps to successful breastfeeding

Source: World Health Organisation and UNICEF

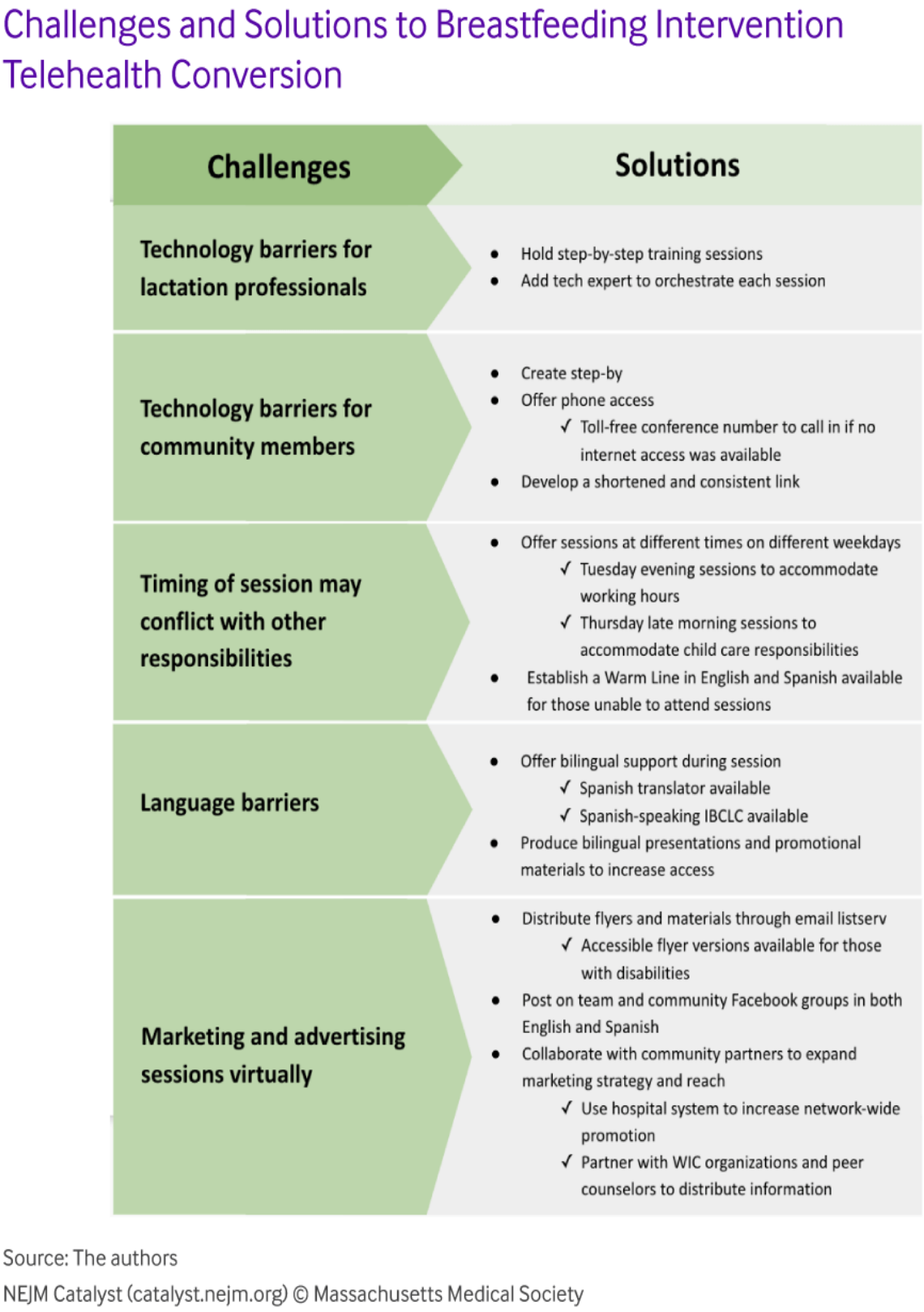

Figure 34: Challenges and solutions to breastfeeding intervention telehealth conversion. Source: catalyst.nejm.org

CHAPTER 3: SUMMARY OF ARTICLES ON THE SUBJECT

3. SUMMARY OF ARTICLES ON THE SUBJECT

3.1. Around the world

Several studies have been carried out to determine the factors that influence breastfeeding around the world. According to Ludvigsson's study at the Pediatric Hospital of La Paz in Bolivia, southern America in 1995, prelactational food use, non-feeding, and the Latino ethnicity were associated with duration of exclusive breastfeeding. Rural mothers were four times more likely to throw away colostrum than urban mothers [70].

In North America, Al Sahab et al, from February to May 2006, analyzed the prevalence and predictors of exclusive breastfeeding in infants aged 6 months old and less in Canada. They came to the conclusion that, the six-month exclusive breastfeeding rate was 13.8% and that women with a higher level of education, residing in the northern territories and western provinces, living with a partner, having multiple gestation, low body mass index in pre-pregnancy and giving birth at older ages were associated with a greater likelihood of exclusively breastfeeding for six months. Also, smoking during pregnancy, cesarean delivery, admission of the child to the intensive care unit, and maternal occupational status before 6 months of child's age were negatively associated with exclusive breastfeeding [71].

In Europe, Bonet et al assessed regional differences in breastfeeding from French maternities in 2003 and came up with the conclusion that individual social characteristics and regional levels influence breastfeeding rates in maternities [72]. In the North East of England, Agboado et al in 2007 estimated, in their study that there was rather no significant association between the cessation of breastfeeding and marital status, mode of delivery, timing of breastfeeding initiation and adverse socioeconomic status in women from their study group [73].

In Asia, Narayan et al in 2003, searched for maternal and fetal factors that negatively influence breastfeeding in the neonatal period in a maternity ward of India. They found that primiparity negatively affected breastfeeding rates. Suggesting that, counseling and supports should be emphasized among this group of women [74].

The early initiation of breastfeeding (EIBF), or timely initiation of breastfeeding, is another important aspect of the breastfeeding process defined as the starting of breastfeeding within the first hour following childbirth. According to the WHO, breastfeeding should take place within 30 minutes or an hour after childbirth. EIBF practice in low and middle-income countries is relatively higher than in developed countries [16].

Recent studies in Ethiopia, Ghana, Bolivia and Madagascar found that breastfeeding could prevent up to 20% - 22% of neonatal deaths. In these countries, the average time for early breastfeeding initiation could reach up to an hour after delivery, but varied within this timeframe from one study to another. This rate was more than 70% in France and Canada in 2016, 68.7% in Iran in 2016 and 83.7% in Ethiopia in 2017. In the literature, numerous reasons have been put forward as possible explanations for the delay in breastfeeding, among which: the lack of knowledge of the nursing staff and mothers, the geographical origin of mothers, and delivery by caesarean section, just to name a few. In India in the year 2017, the reasons recorded from health workers were: the lack of knowledge about breastfeeding techniques, breast anomalies, obstetric and neonatal complications and cultural practices [75].

The concept of adequate breastfeeding seems to be more complex to apprehend. Although this was for a good number of years in the past considered as exclusive breastfeeding. Nevertheless, recent advances in knowledge about the breastfeeding process allows to understand that other important parameters of the act must be considered as well for its adequate qualification.

3.2. In Africa

Bouguerra et al, in Tunisia, revealed from their study in 2002 that the determinants of exclusive breastfeeding were the level of education of the mother, the number of feeds per day and maternal complications during the process of breastfeeding [76]. In 2003, Agho et al, on a sample of 7864 households, searched for the determinants of breastfeeding in Nigeria and found that, the rate of exclusive breastfeeding was low compared to the level required to achieve a significant reduction in child mortality. More so, they reported increasing infant age, mothers' antenatal visits ≥ to four, female children, mothers living in the central geopolitical region of the north, as being positively associated with exclusive and adequate breastfeeding practices [77]. Alemayehu et al in 2005, stated in their study that the extent of maternal and child health attributes such as marital status, economic status and age of the child influence the practice of exclusive breastfeeding in Ethiopia [78].

3.2. In Cameroon

A cross-sectional survey carried out at the Mother and Child Protection Centre of Essos in Yaoundé among 152 mother-child couples in 1992 by Nlend et al found a low rate of adequate and exclusive breastfeeding of 17.3%. This was associated with a duration of exclusive breastfeeding from 28 to 43 days in average. In women with exclusive and adequate breastfeeding, the process was stopped around 8 months, and was correlated with increasing maternal age. The main determinant of inadequate breastfeeding and precocious breastfeeding interruption mentioned was the "drying-up of the breasts" or insufficient amount of breastmilk flow. There was no statistically significant correlation between the duration of exclusive maternal feeding and the socio-professional category of mothers, nor their level of education [76].

Kobela et al study in 1993 on the factors influencing the choice of mode of infant feeding in Yaoundé found that 66.3% of mothers planned to do mixed

feeding. However, 30% were interested with exclusively breastfeeding and 3.8% planned for breastmilk substitutes with infant formula milk feeding. They also found that age, parity, level of education, mother's occupation and urban environment were factors with negative influence on breastfeeding practice. Several reasons for the practice of mixed breastfeeding were mentioned, the main reason being maternal out-house job occupation [76, 80].

Ngofika et al in 1997, by studying the influence of health personnel on the knowledge and attitudes of mothers with regard to breastfeeding in Yaoundé, came to the following conclusions: 69.7% of mothers had been informed about early breastfeeding initiation within 30 minutes of delivery, 30.3% of mothers planned to breastfeed exclusively for 6 months and 5.5% planned to continue breastfeeding during 24 months, while 67.3% knew the baby should be breastfed on demand [80].

Siyou et al in 2006 studied the food diversification and weaning practices in mothers and infants consulting at the mother and child center of the Chantal Biya's Foundation in Yaoundé. Their main results revealed a 10% rate of exclusive breastfeeding in infants up to six months of age. The reasons for not practicing exclusive breastfeeding up to six months according to mothers were: insufficient breastmilk flow (29.8%), "Infants' desire to eat" (16.7%), maternal out-house job occupation (15.9%), the influence grandmother advice (12.7%) and other family members (24.8%) [81].

Kamga et al, assessed breastfeeding practices in a cross-sectional survey in two health facilities in the city of Bafoussam. This included the Bafoussam Regional Hospital and the Mother and Child Protection Centre of Bafoussam. Their overall sample was 195 mothers from which breastfeeding data of the West region was obtained in 2008. They described breastfeeding as the most common means of feeding in the two health facilities (99.48%). Concluding it was correct according to WHO standards and deserved to be preserved. However, the rate of

exclusive breastfeeding among newborns was as low as (20%). This rate seemed to be negatively influenced by the parity and profession of mothers. Furthermore, marital status for married women, as well as high level of education of mothers negatively influenced the duration of breastfeeding in general. Only 33.8% of mothers knew to exclusively breastfeed up to six months and only 7.8% knew about the early initiation of breastfeeding within 30 minutes to an hour after delivery [82].

The results of the EDS-MICS 2011 showed that 98% of children under six months were breastfed. However, only one of five children (20%) exclusively received breast milk. A significant number of children received water in addition to being breastfed (37%). A considerable proportion of children were fed with infant feeding bottle (15%) [16].

In 2014, Chiabi et al conducted a cross-sectional study at the Yaoundé Gynaeco-Obstetric and Pediatric Hospital, interviewing 310 mothers. They found that the exclusive breastfeeding rate at birth was 84.8%, but this rate continuously decreased to 23.5% by the age of six months. Medical and health advice (49.3%), as well as the knowledge of breastfeeding benefits for infants by mothers (42.5%) were the two main motivations for women who practice exclusive breastfeeding during the first six months. Whereas, resuming work or studies and the belief that breastmilk alone doesn’t suffice the infant were the main reasons for introducing other foods (34.2%). The majority (87.1%) of women breastfed their child on demand, but breast pain was the main difficulty encountered by these mothers (60.5%). The mother's work and her level of education were statistically significantly associated with the practice of exclusive breastfeeding during the first six months of the child's life. They concluded and recommended the reinforcement of media communication and breastfeeding education during antenatal consultations. This with emphasis on benefits in order to encourage exclusive breastfeeding as well as its continuation up to 6 months. Moreover,

propositions were made towards the provision of breastfeeding breaks and means for breastmilk storage at workplaces for women with outhouse job occupation [83].

According to the 2018 Demographic and Health Survey, 39.7% infants under 5 months of age were described as adequately breastfed in Cameroon. However, no further information about the time of breastfeeding initiation nor other aspects of the breastfeeding process were explicitly detailed [84, 75]. Based on observations made from daily clinical practice, the initiation of breastfeeding at birth seems to be long in our hospitals and this may impact the overall breastfeeding process at large. There is scarcity of data in our context concerning challenging factors that inhibit the initiation of the breastfeeding process. This justified the present study whose results and findings may contribute to reinforce public health actions to reduce of maternal and infant morbidity and mortality.

CHAPTER 4: METHODOLOGY

4.1. STUDY SETTING

Cameroun is often referred to as Africa in miniature with regards to its geo-sociocultural nature which is representative of all African features and possibilities. From the economical, technological and political stand points, the path of Cameroon is similar to those of most sub-Saharan African countries that have evolved from former colonies, to poor countries and gradually to developing nations.

Cameroon comprises 10 regions, with marked diversity as far as cultures, traditions, level of development and urbanization are concerned, influenced by geographical factors. Because of these differences, population migration is constant, mainly with the youth through rural exodus. The youngsters emigrate from rural areas towards great metropoles with higher living standards and level of urbanization. This gives rise to sociocultural intermixing, impacting mentalities and behaviors on one hand, but procures labor force with further community development on the other hand. This is the case of rapidly developing and spanning cities such as Yaoundé and Douala.

Our study was conducted in Yaoundé which is the capital city of the country and the main town of the Central region as well. Yaoundé is a cosmopolite city and one of the most densely populated of the country. The main countries' institutions, and principally politico-administrative ones are found in this town. First-category hospitals are also found in this city and serve as medical referral centers for the country at large, although gradual regional decentralization is ongoing.

Yaoundé hosts the first created and most developed faculty of medicine and biomedical sciences of the country which serves for the training of physicians including general practitioners and specialists. The training is further reinforced through the various university teaching hospitals which serve for practical application of lessons taught in amphitheaters at the faculty, as well as for medical

research. One of such referral hospitals is the Yaoundé Gynaeco-Obstetric and Pediatric Hospital (YGOPH).

This hospital has an administrative and financial department as well as a medical department that coordinates a number of services including Gynecology/Obstetrics, Pediatrics, Pediatric Surgery, Anesthesia and Resuscitation, Ophthalmology, Ear, Nose and Throat specialty, Emergency, Anatomopathology, Radiology and Medical Imaging, Acupuncture and Physiotherapy**.**

The Gyneco-Obstetric and Pediatric Hospital of Yaoundé is one of the fruits of the Sino-Cameroonian cooperation. It was born out of the desire of the Cameroonian and Chinese governments to improve the health care system for women, mothers and children in Cameroon. The institution was inaugurated on March 28, 2002 by the Head of State and the Chinese Vice Minister of Public Health. The activities started on March 29 of the same year with free consultations.

The gynecology and obstetrics service has three different parts including the maternity ward, hospitalization wards and external consultations. Outpatient consultation activities are supervised by a chief nurse who coordinates a team of nurses. The ward also comprises offices and outpatient boxes for gynecologic consultations. The gynecologists carry out antenatal consultations and receive an average number of 150 patients per month.

For pregnant women in labor, there is an admission room where case histories of internal patients are taken before they are admitted to the delivery room. The service also has two specialist offices, a midwife's office, two post-partum rooms with six beds each, an office for the Head nurse and the secretary of the service, a six-bed delivery room with two showers, a room for instrumental and dystocic deliveries, a special delivery room for very important personalities.

The rate of attendance to this hospital structure excluding emergency cases was 327.932 consultations, with 102.446 in gynaecology and obstetrics between the years 2008-2012. The frequency of deliveries at the maternity unit was 2,721 deliveries in 2012. There is continuity and interconnexion between de maternity unit and the neonatology unit of the pediatric service. This enables transfer of ill neonates from the delivery room to neonatology in case of necessity. The neonatal unit is divided into a subunit for preterm neonates and a second subunit for full-term neonates.

As for the part of the gynecology and obstetrics service reserved for hospitalization, the structures are: seven hospitalization rooms with a total of 32 beds, there is also an archive room, a nurse's room, a special consultation room with its secretariat, a nursing station, and four doctor's offices.

4.2. METHODOLOGY

We conducted an observational study with a mixed cross-sectional with prospective design over a six-month period from December 1st, 2018 to May 31st, 2019, in the gynecologic, obstetrics and neonatal departments of the Yaoundé Gynaeco-Obstetric and Pediatric Hospital, which is a referral and Teaching Hospital in Cameroon.

We included all mothers of full-term or premature newborns weighing at least 2000 grams, who agreed to participate. Mothers with contraindications to breastfeeding were excluded.

The questionnaire was pretested at the maternity service of another hospital in Yaoundé, with standards similar to our study site. For the instance we coosed the Yaoundé Central Hospital (YCH). This permitted us to correct misunderstandings and complete information necessary for the reliability of the questionnaire, before its use. The questionnaire was then administered by a principal researcher and two research assistants. Some of the enquiry questions

were open and inductive, thus generating a new set of answers that were analysed and taken into consideration as well.

Mothers phone numbers were registered to keep contact and this enabled to reassess the neonates at 1 week after birth during routine consultation of neonates. Neonates were then wholly examined and checked for anthropometric parameters, to enable comparative analyses in terms of hospitalization rate, infection, jaundice, nutritional and metabolic disorders, growth rate, and mortality rate.

The sample size for mothers and their neonates was estimated using Cochran formula available from: http://www.ifad.org/gender/tools/hfs/anthropometry/f/ant_3.htm.

Thus: $\mathbf{N= \frac{t^2 \times P (1-P)}{M^2}}$

Where: N = Sample size,

t = Precision at 95%, with typical value of 1.96

P = Prevalence, with 20% considered as pilot value from EDS-MICS 2011

M = Confidence Interval at 5%, with typical value of 0,05

Applying the formula: $N= (1.96)^2 \times 0.2 \times 0.927 \div (0.05)^2$

N = 285 mother-infant couples

However, the sampling procedure was meant to be consecutive and exhaustive over the study period. The variables recorded comprised sociodemographic information, maternal and neonatal clinical parameters. Mothers were submitted to the questionnaires through interviewing.

Quantitative data were entered and analyzed using CS Pro version 6.2 software and SPSS version 20.0. Chi-square testing was used to establish statistical associations between the variables. Qualitative variables were

integrated into a simple logistic regression model to determine the Odd Ratio. A p-value < 0.05 was considered statistically significant for all analyzes.

4.3. Ethical Considerations

Ethical clearances from the Institutional Ethics and Research Committee of the Faculty of Medicine of the University of Yaoundé 1. Administrative authorization for the research was obtained from the services of the director general of the Yaoundé Gynaeco-Obstetric and Pediatric Hospital before the beginning of the study. The data collected was kept strictly confidential and used only for the purposes of the study. Mothers were informed of all aspects of the research and their consent obtained. Confidentiality and innocuity were guaranteed.

CHAPTER 5: RESULTS

5. RESULTS

We enrolled 250 women and their neonates who met the inclusion criteria during the study period.

5.1. Sociodemographic Characteristics

The average age was 27.9 +/- 6.2 years, with extremities at 15 and 44 years. The recruited women were mostly housewives, with a secondary school education level, and mainly originating from the Centre region. Other important sociodemographic characteristics are shown in the following tables.

Table IX: Age distribution of mothers

Variables	Values (250)	Percentages (%)
Age in years		
< 20	18	7.2
[20 – 25[	72	28.8
[25 – 30[	60	24
[30 – 35[	59	23.6
[35 – 40[	30	12
[40 – 45[	11	4.4

Tableau X: Distribution of mothers' parity

Variables	Values (250)	Percentages (%)
Number of children		
1	76	30.4
[2 – 3]	118	47.2
[4 – 5]	44	17.6
≥ 6	12	4.8

The average number of children of the women recruited in our study sample was 2.6 ± 1.6; with extremities at 1 and 10 children.

Tableau XI: Distribution of mothers' level of education

Variables	Values (250)	Percentages (%)
Level of education		
Non scholarised	14	5.6
Primary	28	11.2
Secondary	107	42.8
High	101	40.4

Table XII: Distribution of marital status and baby sex

Variables	Values (250)	Percentages (%)
Baby sex		
Male	141	56.4
Female	109	43.6
Matrital status (n = 70)		
Single unmarried	32	45.7
Married	34	48.6
Widow	1	1.4
Divorced	3	4.3

Table XIII: **Socio-demographic characteristics**

Variables	Values (250)	Percentages (%)
Profession		
Housewifes	97	38.8
Civil servant	43	17.2
Student	38	15.2
Other	72	28.8
Region of Origin (n = 250)		
Centre	110	44.6
West	68	27.2
Other	72	28.2
Level of education		
Out of school	14	5.6
Primary	28	11.2
Secondary	107	42.8
University	101	40.4

5.2. Delay to Initiate Breastfeeding

The average time to start breastfeeding after delivery in our series was 120 minutes which corresponds to 2 hours. Only 97 (38.8%) mothers had put the baby to breast within one hour of delivery as recommended by WHO standards. While 153 (61.2) women actually succeeded in putting the neonate on to the breast within the first hour following delivery. The various characteristics of breastfeeding initiation are detailed in table XII.

Table XIII: Distribution according to breastfeeding initiation

Variables	Values (250)	Percentage (%)
Time of breastfeeding initiation (minutes)		
> 60	153	61.2
≤ 60	97	38.8
< 30	49	19.6
[30 – 60]	48	19.2

All neonates with delayed breastfeeding initiation had other characteristics of inadequate breastfeeding practices. The classification of inadequate breastfeeding was based on four criteria, including the timely initiation of the process, its effectiveness, the exclusiveness and duration according to WHO recommendations.

Table XIV: **Characteristics of Inadequate Breastfeeding**

Variables	Values (250)	Percentage (%)
Inadequate breastfeeding practices*	**153**	**61.2**
- Delayed breastfeeding initiation > 60 minutes	153	61.2
- Formula use or other breastmilk substitutes	102	66.8
- Ineffective breastfeeding technique	77	50.3
- No intention for 6 months exclusive breastfeeding	51	33.3

5.3. Mothers' Pathologies in Pregnancy

In our series, 36 mothers had a pathology associated with pregnancy among which 18 cases of HIV infection (7.2%), 11 cases of hypertension (4.4%), 5 cases of infection with hepatitis B virus (2%), 1 case of tuberculosis (0.4%).

Tableau XV: Distribution of Mothers' Pathologies in Pregnancy

Variables	Values (250)	Percentages (%)
Pathology in pregnancy		
Yes	36	14.4
No	214	85.6
HIV infection		
Yes	18	7.2
No	232	92.8
Hepatitis B		
Yes	5	2
No	245	98
Tuberculosis		
Yes	1	0.4
No	249	99.6
Hypertension		
Yes	11	4.4
No	239	95.6
Diabetes		
Yes	3	1.2
No	247	98.8
Other pathologies		
Yes	4	1.6
No	246	98.4

Delivery was eutocic in 230 (92%) women and 199 (79.6%) had the intension to exclusively breastfeed their babies. The state of the neonates was satisfactory in 204 (96%) deliveries. Inadequate breastfeeding was noted in 153 mothers (61.2%), with breast pathologies occurring in 85 women (55.5%), among which 24 (28.2%) had secretion anomalies predominated by quantitative disorders.

Painful inflammatory and/or infectious conditions of the breast occurred in 58 women (69.4%) including nipple crevices, breast engorgement, inverted nipples, mastitis and abscess. All women with obvious or supposed breast disorders had inadequate breastfeeding practices.

Table XVI: Breast pathologies in women with inadequate breastfeeding

Breast disorder	**Values (85)**	**Percentage (%)**
Secretion anomalies	24	28.2
Nipple crevices and fissures	21	24.7
Breast engorgement	15	17.6
Inverted nipples	09	10.6
Mastitis	07	8.2
Abcess	07	8.2
Lactating adenoma	02	2.3

Table XVII: Breastmilk secretion disorders

Breast secretion disorder	N (24)	Percentage (%)
Quantitative secretion disorder:	15	62.5
1st day agalactorrhea	08	33.3
Hypogalactorrhea	07	29.1
Qualitative secretion disorders:	09	37.5
Pus stained breastmilk	07	29.1
Blood stained breastmilk	02	8.3

Table XVIII: Practices among women and neonates with inadequate breastfeeding

Variables	Values (153)	Percentage (%)
Delayed initiation of breastfeeding > 60 minutes	153	100
Formula use or other breastmilk substitutes	102	66.8
Ineffective breastfeeding technique	77	50.3
No intention for 6 months exclusive breastfeeding	51	33.3

Table XIX: Ability, frequency and satisfaction in breastfeeding

Variables	Value (250)	Percentage (%)
Breastfeeding ≥ 8 times in a day	207	82.8
Baby satisfaction and satiety	183	73.2
Mothers' satisfaction and relief	221	88.4
Breastfeeding inability	85	34

5.4. Perinatal characteristics

The mean gestational age was 38.4 ± 1.6 weeks; the mean birth weight was 3168.6 ± 508.7g. Vaginal delivery was the main route of delivery and 96% of the newborns had a good adaptation to extra-uterine life. Postpartum was generally uncomplicated but 24% of babies were admitted to the neonatology unit with the main diagnosis being the risk of infection (Table XVII and XVIII).

Table XX: Perinatal characteristics 1

Variables	Values (250)	Percentages (%)
Mode of delivery		
Vaginal	172	68.8
Caesarean	78	31.2
Postpartum		
Simple	230	92
Complicated	20	8
Gestational age		
< 37	21	8.4
[37 – 42[	122	88.8
≥ 42	7	2.8
Birth weight		
< 2500	18	7.2
[2500 – 4000[	216	86.4
≥ 4000	16	6.4
Type of complication (n = 20)		
Shock	2	10
Sepsis	7	35
Postpartum hemorrage	11	55

Table XXI: Perinatal characteristics 2

Variables	Values (250)	Percentages (%)
Mode of delivery		
Lower route	172	68.8
Ceasarean section	78	31.2
Post – Partum		
Simple	230	92
Complicated	20	8
Gestational age		
< 37	21	8.4
[37 – 42[	222	88.8
≥ 42	7	2.8
Birthweight		
< 2500g	18	7.2
[2500 – 4000[	216	86.4
≥ 4000g	16	6.4
Diagnosis at entry		
Risk of infection	15	25
Neonatal infection	14	23,3
Neonatal jaundice	14	23,3
Mild birth asphyxia	4	6,7
Other	13	21,7

5.5. Clinical Characteristics of Neonates with Delayed Breastfeeding

Table XXII: Clinical characteristics of neonates

Variables	Timely breastfeeding initiation		OR (IC à 95%)	p-value
	> 60 min (cases)	≤ 60 min (controls)		
Normal state at birth				
Yes	144 (60)	96 (40)	0.2 (0.02 – 1.3)	0.094
No	9 (90)	1 (10)		
Hospitalization in the mean time				
Yes	38 (63.3)	22 (36.7)	1.1 (0.6 – 2.1)	0.697
No	115 (60.5)	75 (39.5)		
Pathology				
Neonatal sepsis	13 (92.9)	1 (7.1)	10.9 (1.3 – 90.5)	0.009
Birth Asphyxia	3 (75)	1 (25)	1.8 (0.2 - 18.4)	1.000
Jaundice	8 57.1)	6 (42.9)	0.7 (0.2 – 2.4)	0.583
Risk of sepsis	8 (53.3)	7 (46.7)	0.6 (0.2 – 1.1)	0.353
Metabolic disorders	6 (46.2)	7 (53.8)	0.4 (0.1 – 1.4)	0.146
Weeks of gestation				
< 37	18 (85.7)	3 (14.3)	4.2 (1.2 – 14.6)	0.016
[37 – 42[	130 (58.6)	92 (41.4)	0.3 (0.1 – 0.8)	0.016
≥ 42	5 (71.4)	2 (28.6)	1.6 (0.3 – 8.4)	0.709
Weight at 7 days				
< 2500	15 (83.3)	3 (16.7)	3.4 (1.01 – 12.1)	0.045
[2500 – 4000[	128 (59.3)	88 (40.7)	0.5 (0.2 - 1.2)	0.112
≥ 4000	10 (62.5)	6 (37.5)	1.1 (0.4 – 3.01)	0.912

Although 144 (94%) infants with delayed and inadequate breastfeeding were in good health immediately after birth, 38 (24.8%) were hospitalized within 7 days, of which 21 (55.2%) were related to sepsis and 6 (15.7%) due to metabolic disorders. These neonates represented 83.3% (15 out of 18) infants with hypotrophy. These characteristics are summarized in tables XIX.

The mean gestational age was 38.4 ± 1.6 weeks, with an average birth weight of 3168.6 ± 508.7g. The state of the neonate was satisfactory immediately after birth in 230 (92%) cases. The average time for breastfeeding initiation was 120 minutes (2 hours) and 97 (38.8%) neonates were put to the breast within the first hour after birth. All neonates with delayed breastfeeding initiation suffered inadequate breastfeeding practices, with a rate of 61.2% (153). Although 144 out of 153 inadequately breastfed newborns were in good health immediately after birth, 38 (24.8%) were hospitalized within 7 days, of which 21 (55.2%) were related to sepsis and 6 (15.7%) due to metabolic disorders. Neonates with inadequate breastfeeding represented 83.3% (15 out of 18) infants with hypotrophy. The rate of caesarean delivery was 31.2% (78 out of 250), and 92.3 % of such women had inadequate breastfeeding practices. Up to 16 neonates out of 18 (88.9%) from mothers with HIV infection were poorly breastfed.

5.6. The Psycho-sociocultural Aspects

Poor breastfeeding practices was found in 153 mothers (61.2%). Among which 60 women (39.2%) originated from the Centre region, with 37 (61.6%) having traditional beliefs and practices antagonizing breastfeeding, though 48 women (80%) had school education ≥ secondary level. Caesarean section delivery was practiced in 78 women (31.2%), with 72 (92.3%) evoking it as motif for breastfeeding refusal.

Table XXIII. Psycho-sociocultural aspects evoked by women with inadequate breastfeeding

Reasons	N (153)	Percentages (%)
"Spoiled Milk" or "bad milk" concept	107	69.9
Colostrum apprehensions	101	66
“Dried breast” or agalactorrhea	86	56.2
Instruction from mother or family relatives	81	52.9
Delivery by caesarean section	72	47
Falling or sagging breasts	58	37.5
Need for traditional treatment and cleansing	54	35.2
Mystical beliefs and practices	46	30
The transmission of illnesses and undesired traits	40	26.1
Previous death of a baby due to breastfeeding	45	29.4

5.7. Challenges to the Initiation of Breastfeeding

Primary education level, Centre region, Caesarean delivery, HIV infection, gestational age below 37 weeks of pregnancy, low birthweight and neonatal infection at birth were associated with challenges to initiate breastfeeding after bivariate analysis. Logistic regression isolated the Centre region as origin, and Caesarean delivery as independent predictors of delayed initiation of breastfeeding (Table 4 and 5).

Table XXIV: Challenges to the initiation of the breastfeeding process

Variables	Time of breastfeeding		OR	p-Value
	> 60 min	≤ 60 min		
Primary education	22(78.6)	6(21.4)	2.5	0.045
Centre region	60(66.7)	30(33.3)	2.4	0.002
HIV infection	16(88.9)	2(11.1)	5.5	0.012
Caesarean section	72 (92.3)	6 (7.7)	13.5	<0.001
Gestational age < 37 weeks	18 (85.7)	3 (14.3)	4.2	0.016
Low birthweight <2500g	15 (83.3)	3 (16.7)	3.4	0.045
Neonatal infection	13 (92.9)	1 (7.1)	10.9	0.009

Table XXV: Logistic regression of determining factors

Variables	Adjusted OR (CI à 95%)	Adjusted p-value
Primary school education level	2.3 (0.8 – 6.5)	0.110
Centre region	**2.54 (1.8 – 4.5)**	**0.033**
HIV Infection	4.5 (0.9 – 22.3)	0.062
Caesarean section	**11.3 (4.6 – 27.7)**	**< 0.001**
Gestational age <37months	2.3 (0.5 – 10.4)	0.267
Low birthweight <2500g	1.2 (0.2 – 5.8)	0.847
Neonatal infection	6.6 (0.8 – 56.9)	0.088

CHAPTER 6: DISCUSSION

6. DISCUSSION

6.1. Breastfeeding Practices

The assessment of breastfeeding practices was based on four main characteristics including timely initiation, the use of breastmilk substitute or not, the effectiveness of the breastfeeding technique and the duration of exclusive breastfeeding. Among these various characteristics, the delay of breastfeeding initiation was the most contributive, occurring in all women with poor breastfeeding practices [85].

In effect, the rate of inadequate breastfeeding in this survey was quite high with more than one newly delivered woman out of two having poor breastfeeding practices. This was mainly as a result of delayed breastfeeding initiation, as the rate of EIBF was as low as 39% in this survey, which is lower than values reported from a number of surveys in some other African countries [86, 87]. Due to the said delay of breastfeeding initiation, up to 66.8% neonates received other fluids than breastmilk and 33% of such women were not interested by exclusive breastfeeding over the first six months. This is slightly higher than values obtained from earlier surveys conducted in Cameroon, according to which 20-28% of women do not abide to the first six months exclusive breastfeeding recommendation [88-90]. This may be due to progressive "urbanization and development effect", which is responsible for the modernization of behaviors, with changing local feeding practices, and the perception of breastfeeding in modern African communities [91-94].

The rate of delayed Breastfeeding initiation in this survey was thus 61.2%, which is quite higher than values obtained in most developed countries as well, where the culture of breastfeeding is supposedly lower. This is the case of countries such as Australia, where the percentage of mothers, and hence neonates with timely breastfeeding initiation among some communities could be as high

as 98% [95]. This with consequent lower rates of delayed initiation of breastfeeding.

Our results are also higher than the delayed breastfeeding ignition incidences reported in some Middle-East countries such as Saudi Arabia (22.2%) and Nepal (33.6%), as well as in some African developing countries such as Ethiopia (26.9%), where relatively lower percentages of mothers and neonates with delayed breastfeeding initiation have been reported [86, 96-98]. Possible reasons to this discrepancy may be a low level of education and a weakness of antenatal counselling, as far as the necessity to promptly initiate breastfeeding is concerned. More so, increasing women job occupation, adopted cultures of breastmilk substitution with formula, and the hyper "sexualization" of the breast to the detriment of its lactation function may have this adverse effect of reducing adequate breastfeeding practices among African women [11]. The end result of these new habits in African women could be responsible for reduced neonatal protection in terms of food security and immunity.

Furthermore, it appeared that all neonates with delayed breastfeeding initiation had other characteristics of inadequate breastfeeding as well, including ineffectiveness of the act, unexclusiveness, and briefness. In facts, there is evidence that neonates with delayed breastfeeding initiation stand greater chances to receive breastmilk substitutes in the first three days of life, and are as well less susceptible to breastfeed exclusively during the first six months [99, 100]. Therefore, high rates of delayed breastfeeding initiation may be responsible for poor breastfeeding practices by inducing other malpractices.

On the other hand, the effectiveness of the act of breastfeeding was defined by deep, tonic and slow suctions separated or not by short pauses and yielding breastmilk into the baby's mouth. The duration or briefness of the breastfeeding process was assessed in terms of mothers' intention to breastfeed

exclusively during the first six months. This was due to the difficulty to follow all women over a six-month period. However, a number of research works have revealed positive associations between breastfeeding intension and initiation with exclusive breastfeeding [85]. This may provide some rationale to our procedure.

The early skin-to-skin contact which is encouraged immediately after delivery was used to describe any physical interaction between the mother and the newborn within the first hour of life. This intimate contact during the first minutes after birth is thought to facilitate bonding and interactions between the mother and the baby through sensory stimuli such as touch, warmth and smell. In fact, early skin-to-skin contact usually allows for the newborn to find and hold the mother's breast by itself. It has the additional advantage to favor early breastfeeding initiation.

Among the various operational terms used in this survey, the notion of breastfeeding quantification and satisfaction were based on observable criteria such as the child's vigor in suckling, the type of arousal, swallowing, and the number of breastfeeding in a day. As a matter of facts, the overall levels of breastfeeding inability and dissatisfaction were respectively 34% and 11.6% in mothers. Most women (82.8%) were breastfeeding at least 8 times per day, and 73.2% breastfeeding neonates seemed satisfied. Satiety was estimated by the baby calming and sleeping after breastfeeding. A whole analysis of the level of satisfaction associated with the process of breastfeeding in this survey showed that mothers and infants' satisfaction were increased when the number of breastfeeding in a day was ≥ 8, as provided by physiology [85]. On the other hand, breastfeeding inabilities were likely assimilated to breast anomalies and probably causing up to 26.8% infants' dissatisfaction and unsatiety after breastfeeding.

Despite the WHO recommendations and its countless benefits, the time to initiate breastfeeding after delivery as found in our survey was very long. This

was influenced a number of factors, among which the belonging to the Centre region and delivery through caesarean section appeared to be independent predictive factors. Therefore, special emphasis should be laid antenatal visits with problem solving so as to prevent pregnancy complications and reduce emergency caesarean deliveries. Furthermore, information, education and communication on the necessity to initiate breastfeeding as soon as possible after delivery should be emphasized, and the message reinforced or adjusted with socio-anthropological considerations to ease adherence. The main challenges to the breastfeeding process as found in this survey could be grouped into maternal, neonatal, interventional and psycho-sociocultural factors. They will be discussed accordingly in the following paragraphs.

Some limitations to this survey may include the sample size which was relatively smaller compared to similar studies conducted in other contexts. The study was circumscribed to a given group at a particular time and so results may only be specific to the said group. Whereas, a larger sample size adds more power and significance to a survey, with the possibility of trans posing results to the general population with considerable reliability. More so, in considering the duration of six months exclusive breastfeeding, assimilating the intension to do so, with the act might involve some selection, analysis and eventually interpretation bias. A longitudinal study may have enabled to identify more determinants due to better elaborated prospective or retrospective 'follow-up' of subjects' characteristics.

6.2. Maternal Factors

Breastfeeding women may develop a number of breast disorders during the postpartum period. Such disorders could involve masses of varying sizes, breastmilk secretion anomalies and painful-inflammatory or infectious conditions. Though very few of these conditions may be absolute contraindications to breastfeeding, they are however a significant source of worry for newly delivered women and may disrupt the breastfeeding process.

From this survey, it appeared that age maturity and school education alone may not be sufficient enough to guarantee adequate breastfeeding in mothers. This could be deduced from the fact that, even though more than 50% of women enrolled had an education level greater than secondary school, and close to 69% had past experience of breastfeeding, yet the level of inadequate breastfeeding was as high as 61.2% which is quite much, as compared with other African developing countries [86, 88]. All the same, this rate was neither improved by the fact that up to 92% of deliveries were without complications and that in more than 79.6% of cases, the mother-infant couple had good predispositions for breastfeeding. This permitted to suspect that the breast and its related issues were a main obstacle to breastfeeding in our series.

However, among 55.5% mothers with inadequate breastfeeding practices who had breast disorders as well, breastmilk secretion anomalies which were either quantitative or qualitative, were the most predominant in 28.2% women, when all factors were assessed separately. Whereas, on a cumulative basis, painful conditions including nipple crevices, breast engorgement, inverted nipples, mastitis and abscess, in order of frequency, occurred in over 69% women with breast disorders. Breast tumors were rare in our series, with the benign lactating adenoma diagnosed in 2.3% women.

Quantitative secretion disorders involved initial agalactorrhea and hypogalactorrhea which are most frequent during the immediate postpartum

period [101]. Amelioration of breastmilk synthesis was noted thereafter, with continuous nipple stimulation by baby suckling and a balanced diet for the mother, including supplementary hydration.

Qualitative anomalies involved nipple discharges which were either isolated or mixed with breastmilk, producing particular staining. Yellow and green discharges were associated with abscess and were unilateral, while rusty brown and bloody discharges were bilateral, intermittent and spontaneously resolving [102, 103]. Bloody discharges in this survey were physiological, due to hormone-induced hyper vascularization, congestion, structural and functional epithelial modifications [104, 105]. This differs from unilateral bloody discharges which are generally associated with nipple trauma including crevices [106].

Breast engorgement as defined in this study was considered as overfilled breasts becoming hard, edematous, and painful, with transient fever, nipple flattening or inversion, and the overall modifications altering the breastfeeding process [107]. In effect, there existed a vicious cycle between engorgement and other breast pathologies as described in the literature. Women with breast engorgement who were unable to breastfeed, later on developed aggravation, nipple crevices, inversion and mastitis with further inflammation [107, 108]. Such women were thought breast emptying techniques including shower before expressing, warm compress application over the breast few minutes before pressing [108, 109]. Whereas, women with engorgement, and able to breastfeed were encouraged to do so more frequently in order to prevent accumulation [108, 109].

There were two forms of acquired inverted nipples: retracted nipples were only partly inverted, whereas invaginated nipples were completely inverted. Nipple inversion in lactating women is most often secondary to underlying inflammatory changes [110]. Short-lasting acute inversion were more frequent in this survey. Just as in many similar research studies, women with inverted nipples

were more likely to suffer from mastitis and infectious complications [110]. However, Nipple cracks and crevices occurred mostly in women with pour breastfeeding techniques, poor milk flow or duct obstruction [104].

Mastitis is defined by the WHO as an inflammatory condition of the breast which may be accompanied by infection or not. It is described to occur in about 6.6-33% women [111]. Although various risk factors such as milk stasis, duct obstruction, and engorgement likely exist, a more common theory is that poor attachment of the infant to the breast leads to cracking of the nipple epithelium, which creates a retrograde path with inflammation and entry point for infection [111]. Most breast infections are due to Staphylococcus Aureus which is more prompt in causing local infection with abscess, than β-hemolytic Streptococcus which rather has more tendency to generalized infection [104]. These bacteria are found on the mother's skin surface, in the baby's throat and nostrils mainly, thus facilitating infection through breastfeeding [104].

Typical manifestations of mastitis are breast pains, redness, swelling and sometimes flu-like symptoms [112]. In this survey, infectious mastitis was generally easy to treat with Amoxicillin-Clavulanic acid association. Purulent breastmilk was a contraindication to breastfeeding, while continuous breastfeeding was recommended in the absence of purulent discharge in women under effective antibiotics therapy. This served for reducing milk stasis and inflammation [113, 114]. Nevertheless, severe infection with Methicillin-Resistant Staphylococcus Aureus may lead to death when poorly managed [104]. Therefore,

breast abscess may complicate poorly managed acute bacterial mastitis in 4.8-11% cases, following delayed treatment or inefficient antibiotic therapy [104].

The lactating adenoma is a benign tumor, mainly caused by physiological changes occurring during lactation. It is similar to other physiological breast impairments such as fibroadenoma, tubular adenoma, or lobular hyperplasia [115,

116]. Lactating adenoma is a tumor made of epithelioid hyperplasia alone, contrary to other resembling tumors which may contain varying amounts of connective tissue proliferation. Lactation adenoma is softer in consistence and filled with breastmilk [104]. It often disappears at the end of lactation and relapses are quite rare [117].

Therefore, there are considerable physiological changes occurring in the postpartum period which may favor breast pathologies. Such disorders are a source of worry for the mother and the medical staff, as a result of the impact they have on the breastfeeding process. Most of these disorders are secretion anomalies of which initial agalactorrhea is the most predominant. However, painful inflammatory and/or infectious pathologies represented by nipple crevices, breast engorgement, inverted nipples, mastitis and abscess, are frequent as well. All of these disorders are essentially benign in nature and favored by inadequate breastfeeding practices. The awareness of these conditions, their prevention by good hygiene and adequate breastfeeding techniques such as proper nipple and areolar positioning into the baby's mouth, and their effective management with painkillers and antibiotics when need be may help to protect the breastfeeding process, with favorable repercussions on infant development.

Contrarily to the WHO 2007 recommendations for six months exclusive breastfeeding in HIV-exposed neonates, under maternal antiretroviral therapy (ART) and infant prophylaxis to reduce transmission, there still persist a reluctance to breastfeed in such women [110, 111]. This may be associated with a self-protective behavior bound to the fear of infecting one's own infant. In effect, a number of studies report mother infection especially with HIV as a barrier to breastfeeding [110, 111]. However, this may be overcome through the reinforcement of antenatal counselling with an accent on the advantage of breastfeeding, in order to strengthen the neonates' immunity, reduce morbidity, mortality and assure normal growth [112-113, 118].

Very few mothers presented with other infectious or contagious diseases that could impact the process of breastfeeding. This was the case with infection with hepatitis B virus which occurred in 2% mothers and tuberculosis in 0.4% women. These few cases benefited adequate management and breastfeeding was made feasible.

6.4. Neonatal Factors

Apart from neonates delivered through caesarean section, other neonatal subpopulations with particular characteristics seemed to register higher rates of inadequate breastfeeding. This was the case of preterm neonates, infants with low birthweights, and those affected with neonatal sepsis. This may be due to the fact that such neonates can present with life-threatening conditions necessitating emergency care which might considerably hinder the normal breastfeeding process [119]. The Highest rates of hypotrophy and postnatal hospitalization mainly due to neonatal sepsis were recorded among neonates with delayed breastfeeding initiation and inadequate breastfeeding during the first week of life, with obviously possible associations between these parameters.

Neonates that were delivered through caesarean section had a greater prediction for inadequate breastfeeding, as provided by the literature. Actually, caesarean delivery is a known risk factor for inadequate breastfeeding practice among newly born infants. This is principally due to considerable delayed initiation of the process.

In fact, general anesthesia, post-operative pains and the use of opioid analgesics in the mother may be responsible for neonatal impregnation and sedation with these drugs through placental blood or breastfeeding. This can cause oversleeping, altered consciousness and hence delayed initiation of breastfeeding during the immediate postpartum [120, 121].

Furthermore, neonates delivered through elective caesarean section encounter less stress, little cortisol secretion and poor lung maturation. They may

thus develop transient tachypnea which is responsible for respiratory distress, resulting in delayed breastfeeding initiation and the use of breastmilk substitutes. It has been described that newborns that have gone through labor, and delivered by vaginal route develop more appetite and improved suckling reflexes than others [122, 123].

More so, indications of emergency caesarean delivery in close to 50% of cases may be associated with acute fetal distress which could yield ill neonates, unfit to breastfeed. As such, the mother and newborn separation for more attention and care, is a common practice immediately after caesarean delivery, but with undesired disruption of breastfeeding practices in both protagonists [124].

Although there is evidence that breastmilk feeding reduces mortality, short and long-term morbidity in high risk infants including those with infection, prematurity, and low birthweight, a delay in initiating breastfeeding and inadequate breastmilk feeding is often observed [125-127]. This is due to the fact that such newborns may be delivered with immediate neonatal emergencies such as neurologic, infectious, thermal regulation, digestive and feeding disorders. In fact, a neonatal emergency may be considered as a potentially life-threatening disorder or anomaly which occurs within the first 28 days after birth [128].

In a cross-sectional study to determine neonatal emergencies in our context, a prospective recruitment of neonates showed that 88% of all neonatal emergencies were medical or non-surgical, and more than 5% neonates had mixed emergencies. These emergencies are predominated by neonatal infections or sepsis, prematurity, birth asphyxia and jaundice worldwide. In more than 50% of cases, they occur within the first week of life, and the related mortality rate may be as high as 5% in our context [122, 127, 128]. There may exist a vicious cycle between breastmilk feeding and neonatal illness, given that the absence of breastfeeding

or an inadequate breastmilk feeding could be responsible for illness and complications in newborns, which in turn alters the feeding process and vice versa. The acknowledgement of this relationship justifies the promotion of early breastfeeding initiation for immunological and nutritional purposes.

Prematurity may be considered as the delivery of a neonate infant beyond 22 and before 37 completed weeks of gestation. Preterm infants are generally characterized by a low-birth weight between 500g-2400g which may be associated with hypotrophy in some cases. Nevertheless, normal size or eutrophy, as well as macrosomia with respect to gestational age, may also occur among preterm infants, though rare. However, premature infants born too early usually lack sufficient biological equipment to cope with various life necessities and exigencies immediately after birth, thus requiring appropriate assistance. Among various deficiencies, these infants present with weak neonatal suckling reflex and low enzyme secretion including amylases, peptidases, and lipases, due to hepatic, pancreatic and intestinal immaturity among others. These are responsible for ingestion, digestion and absorption anomalies associated with inadequate breastfeeding.

Moreover, necrotizing enterocolitis (NEC) is a particular intestinal disorder of the preterm infant which may be associated with poor breastmilk feeding. Though its overall incidence has been reducing steadily during the past few years, NEC has been recognized for decades as the most common life-threatening medico-surgical intestinal emergency in newborns. The disease might be associated with short and long-term complications, prolong hospitalization, and be cost worthy. Nevertheless, primary prevention by breastfeeding promotion is pertinent in improving neonatal outcome [129].

In this survey, we chose to reassess neonates after 1 week of life, in a follow-up perspective which gave a prospective and a longitudinal dimension to

our study design. We specifically chose reassessment at 1 week after birth because of three main reasons.

Firstly, for convenience reasons, due to the fact that routine assessment of neonates at 1 week is systematic at the Yaoundé Gynaeco-Obstetric and paediatric hospital which was our study site. This is the case with the majority of referral hospitals in Cameroon. Secondly, this period corresponds to the time when postnatal counselling is most reinforced. In order to promote breastfeeding practice and immunization, including the cross-checking of immunization status and vaccines. As such, BCG, hepatitis B immunoglobulins with antigens and Oral Polio vaccines which are ideally administered as from the first day or week after birth according to the current Enlarged Program for Immunization (EPI) in Cameroon could be controlled. The third reason is that during this period, developing disorders may be promptly dealt with. Given that some hypothesis suggests neonatal emergencies mostly occur within the first week of life, described as the most critical period for neonate infants [128].

In effect, the overall rate of hospitalization within the first week among neonates enrolled in this survey was 24%, out of which more than 63% were neonates with delayed breastfeeding initiation. The mortality rate in this group was 7.9% (3 out of 38 neonates), while that in the group of neonates with early breastfeeding initiation was lower at 4.5% (1 out of 22 neonates). From this, it may be suggested that neonates with delayed breastfeeding initiation had weaker immunological protection and were therefore likely to develop illnesses which might have been fatal in some cases.

In fact, a statistically significant association occurred in this survey between the onset of neonatal sepsis and the notion of delayed breastfeeding initiation at birth, with close to 55% of hospitalizations in such infants being related to sepsis. Moreover, 85.7% preterm infants enrolled in this survey were not breastfed in due time and required adapted feeding to catch-up with their

growth process. Whereas, 83.3% neonates with hypotrophy within this time interval, were those whom had a delayed breastfeeding initiation. These results seem coherent, as contrarily to adequate breastfeeding, failure to early initiate the breastfeeding process may pave the way for other feeding malpractices in neonates. This is responsible for increased rates of morbidity and mortality in high risk infants, including those with infection, prematurity, and low birth weight [127, 128]. Therefore, challenges to adequate breastfeeding initiation may have considerable repercussions on neonates' health conditions, leading to increased rates of nutritional disorders such as growth retardation, metabolic disturbances and infectious disorders, with a direct effect on the rate of hospitalization among this population [11].

6.5. Caesarean Delivery

Though caesarean section has been recognized as an indispensable intervention to improve infants and mothers' outcomes in dystocic deliveries, recent research emphasizes the fact that it is associated with a lower rate of breastfeeding initiation. Whereas, suboptimal breastfeeding may be responsible for up to 11% deaths in children under 5 years. However, continuously rising levels of caesarean section due to poor antenatal follow-up, poor delivery practices, progressive psychological accommodation, acceptation and requests of the intervention may further worsen the situation [124].

In this survey, 31.2% neonates were delivered through caesarean section of which 64.1% were emergency caesarean sections. Complications after caesarean delivery occurred in 8.9% women, with postpartum hemorrhage representing 57.1% and sepsis in 42.9% of all complications. A notable finding was the fact that among all neonates with inadequate breastfeeding, up to 47% had been delivered through caesarean section. Likewise, 92.3% neonates delivered through caesarean section had inadequate breastfeeding, and this was mainly due to delayed initiation of the process. Close to 69.6% of women who

delivered through caesarean section had at least 02 living children, previously delivered through vaginal route and so had experience of the breastfeeding practice. This therefore indicates that in these mothers and neonates with inadequate breastfeeding, caesarean section was imputable.

In this survey, caesarean section appeared as the main predictive factor for maternal indispositions to breastfeeding. This was mainly due to mother infant separation immediately after the intervention, as well as post-surgical pains, hemodynamic instability, initial agalactorrhea, hypogalactorrhea, emotional and mood disorders. Indeed, caesarean section is a well-known and documented determinant for delayed breastfeeding initiation, already described by a number of researchers in various contexts [124]. It was even more strongly associated to inadequate breastfeeding in this study, occurring as an independent predictive factor. There are some pertinent hypotheses according to which women delivering through caesarean section may have less endocrinal and psychological preparedness to breastfeeding. The reinforcement of maternal education and counselling, as well as special training sessions on breastfeeding after caesarean delivery for the medical staff, should be considered in order to reinforce related competencies. This would serve to promote early breastfeeding initiation and adequate breastfeeding at large in such women [124].

There are various hormone variations after caesarean section including the drop of endorphin, prolactin, and oxytocin blood levels, which have been incriminated for reducing galactorrhea and breastfeeding desire in the immediate post-operative period. While a drop of prolactin hormone synthesis from the anterior pituitary gland is responsible for reduced breastmilk production from alveolar cells of the breast acini, a drop in oxytocin release from the hypothalamus through the posterior pituitary gland into the blood, causes reduced stimulation of perialveolar and ductal myoepithelial cells, and so diminishes milk ejection [124].

On the other hand, endorphin enhancement of positive emotional and affective interaction in the mother, which is generally associated with the desire and the satisfaction in breastfeeding is reduced as well. Therefore, there may exist an inclination to agalactorrhea, hypogalactorrhea and reduced lactation after caesarean section, which contrasts with the normal expected hormonal changes after vaginal delivery to favor breastfeeding. In theory, lactation is thought to be higher after emergency caesarean section, as labor would have induced higher oxytocin and prolactin secretion in the mother. However, a newborn which has gone through labor and delivered by vaginal route is thought to have more appetite and improved suckling reflexes [124].

The improvement of antenatal care involving early diagnoses and management of some pregnancy-related disorders would considerably reduce the increasing rate of caesarean section, with favorable repercussions on breastfeeding. In such a context, most caesarean sections would be elective with regional anesthesia which has less impact on the breastfeeding process. Husband's presence may be allowed in the theatre during the intervention as well, as advocated by some studies which showed positive effects with anxiety relief and better lactation [124].

Caesarean section is generally associated with considerable maternal sedation, pain, post-operative complications such as hemorrhage, infection, and post-traumatic stress, which may further render breastfeeding undesirable. After caesarean section, especially when practiced with general anesthesia, mother and baby are generally separated for a while, to enable the mother's continuous monitoring and awakening. Furthermore, opioid pain killers administered to mothers post-operatively may induce sleep in the baby preventing it from feeding regularly and reducing the suckling tonus. The avoidance of mother-infant separation may be achieved by designing hospital services such that the delivery room, the theatre, the recovery room and the neonatology unit should not be far

separated from each other. Better still, mother and newborn skin-to-skin contact immediately after caesarean delivery should be enabled right from the theatre. Recovery rooms should be provided with cradles and incubators to keep the baby near its mother thus favoring the early initiation of breastfeeding. The necessary staff for mother and baby care should be allocated, with special emphasis on nursing support. Side-lying and clutch positions are recommended as comfortable postures for breastfeeding after caesarean section. More so, placing the baby on properly positioned pillows relieve pressure and pain from the incision site [124].

From an epidemiological stand point, the admitted rate of caesarean section which is 15% deliveries, may consequently induce a risk for inadequate breastfeeding in almost 15% neonates if no appropriate intervention is put in place to support and improve breastfeeding practices. This tendency should seriously be considered, as the rate of caesarean delivery continuously rises with time, especially among urban communities. Moreover, it has been shown that once the rate of caesarean section exceeds 15%, adverse maternal and neonatal outcomes become more prevalent. Therefore, caesarean delivery should not be a hindrance for breastfeeding, especially in a context of limited financial resources, where it may have considerable economic value in addition to its medical importance. As a matter of fact, rigorous vigilance for timely initiation of breastfeeding after caesarean delivery is recommended [124].

Therefore, the rate of caesarean section seems to be continuously rising in developing countries, especially among urban communities such as in Yaoundé, where there is increasing emergency obstetrical care. From this survey, it appeared that caesarean section was a predictive factor for inadequate breastfeeding in mothers, giving way to the use of substitutes including formula milk. This implies, more emphasis should be laid on the improvement of antenatal follow-up in order to reduce the rate of emergency caesarean section. Maternal

education, medical staff training on breastfeeding and post-operative delivery care, should be reinforced as well, in a bid to improve breastfeeding practice.

6.6. Education Level of Mothers

One of the main significant challenges of breastfeeding initiation and adequate breastfeeding practice was the low level of education of most concerned mothers, corresponding to primary school level [12]. Discussing with mothers enabled us to understand a number of challenges they encountered with breastfeeding.

The majority of mothers who had a delay in breastfeeding initiation linked it to caesarean delivery (47.0%). Although majority (56.2%) had an acceptable volume of milk flow, this reason was most of the time advanced by those women who were not counseled. For example, half of these women confessed "they didn't know the baby had to be put on to the breast immediately after delivery, and even after the caesarean section delivery". Some mothers reported "they thought some time period would be necessary for they body's system to evacuate anesthetic medication before they can start breastfeeding". Others responded " They were afraid the anesthetics would cause damage to the baby by passing through the breastmilk".

Ignorance was very often (17.0%) recorded in combination with other reasons. For instance, some women acknowledged "they never knew the baby should be put to the breast within an hour after delivery". Some respondents declared "early breastfeeding initiation was the cause of death of one of their lost children", and this is a deeply-rooted cultural belief in some localities. They responded "Their first baby was breastfed early and died few days later". Other mothers attached to common practices argued "they usually give their babies formula first, until the moment they mothers are well enough to breastfeed", or also some multipara said "They always gave formula first before continuing later

on with breastmilk after all their deliveries and could not understand why to change ".

A number of women complained of "low or insufficient milk flow from their breasts and defended it was their body's nature not to produce breastmilk nor breastfeeding and so they would not force their selves to it". This reason was very often related to unawareness, as these mothers did not know that lactation could also be influenced by initial unproductive sucking and breastfeeding. The milk being produced in respond to a demand and according to solicitation. Some women would wait for the milk secretion to be effective before putting the baby to the breast, as they stated "they would wait until the milk starts to flow before putting the baby to the breast". This because "they thought the baby would get angry and cry the more if it got deceived without breastmilk flow after sucking the breast for a moment". In the mean time these women confessed being "tempted to give the baby mineral water to quench its thirst".

There was a set of mothers (37.5%) that refused to put the baby early on to the breast, for a variety of reasons including "to avoid breasts damage", as some responded "breastfeeding the baby would cause their breasts to fall of". Some other women, because their out-house job occupations argued "They would resume work soon and estimated there was no need to initiate breastfeeding since they would soon interrupt it. Therefore, they didn't want the baby to get use to it as it won't breastfeed for long".

Mothers who chose infants formula for medically proven reasons were also ill mothers. In effect, a few mothers (8.0%) were hospitalized in the intensive care unit for postpartum complications such as eclampsia, postpartum hemorrhage which contributed to further delaying early breastfeeding initiation. Close to 6% of women evoked illnesses such as hemorrhage and infection, while extreme fatigue and asthenia were evoked by 2% mothers. Others health conditions such as perineal lesions, pelvic pain, headaches, cramps or myalgia

were reported by a number of women too. Indeed, they felt they were not "healthy and were worried about the possibility of transmitting their malaises to the breastfeeding neonate".

There were a number of complaints from these women pertaining to newborn-related reasons for not initiating the breastfeeding process. Despite recommendations from the medical staff, these mothers (24.0%) felt the breastfeeding and breastmilk could worsen the health condition of the hospitalized newborn. This not withstanding the fact that their condition did not contraindicate breastfeeding. Nevertheless, One-third of such neonates effectively had conditions such as respiratory distress, prematurity or severe malformations that contraindicated breastfeeding [129].

The "sleeping baby" was also evoked as a principal reason for delaying breastfeeding or not breastfeeding frequently. In such situations, a number of mothers were "waiting for the baby wake-up before breastfeeding. Some of them declared: "When the baby is asleep, they have the opportunity to rest too and recover from their tiredness before envisaging to breastfeeding afterwards"

Some reasons were related to health care providers about instructions given to the mother. In effect, 3.6% of the mothers with inadequate breastfeeding practices revealed "they had never received any instructions from the health personnel concerning the early initiation of breastfeeding". Meanwhile, 2.6% other mothers falsely advised to "stop worrying about breastfeeding, because there was supposedly no in delaying its initiation". The reason being that "the health personnel explained newborn has enough reserves constituted during pregnancy from the mother that could stand for days until it is put to the breast".

According to some women with infectious diseases (69.9%) such as HIV, hepatitis, and tuberculosis, in addition to the fact that they were worried about the possibility of contaminating their neonates, they argued they were instructed as well never to breastfeed their babies [12].

Sociocultural reasons, especially with the "spoiled milk" concept and issue was also reported by mothers, with almost 30.0% of them believing their breastmilk was a danger for their newborn. Among these mothers with such beliefs, 29.4% had previously lost a child and attributed this to breastfeeding.

In Cameroon, just as in most countries worldwide, education on breastfeeding starts at school and is generally relayed by mass communication through the media. Information and breastfeeding training may equally be provided by some health facility staffs including midwives and physicians during antenatal visits, briefing women on its importance and advantages. This motivates pregnant women and enhances predispositions to EIBF [12].

Nevertheless, a low level of school education goes with poor understanding of instructions, ignorance, reinforcement of socio-cultural believes such as the "spoiled or bad milk" concept, which induces breastfeeding refusal.

On the other hand, highly educated women may as well have job occupations, reducing their availability for breastfeeding. However, failure of EIBF is more likely to occur in women with low level of school education, as it was the case in this survey [12].

Although 83.2% mothers had an acceptable level of education corresponding to secondary school, primary school level was the most prevalent among mothers with poor breastfeeding practices principally due to limitations in the comprehension of the explained. This indicates an important need for targeted language adaptation that suits various strata of the society and according education standards. In this sense, a more illustrative approach might be privileged, just as the use of community relay communicators and translators should be envisaged as well [12, 75].

Some Authors demonstrated that vaginal delivery and maternal knowledge of correct breastfeeding practices were associated with early breastfeeding initiation in up to 87.0% of mothers. The lack of information may

therefore account as well among the main reasons for the late initiation of breastfeeding [12, 75]. We found that up to 20.4% of the mothers interviewed, were unaware of the concept of early breastfeeding initiation, and so they could therefore not apply it. The lack of knowledge in our context may be due to the health system that fails to provide enough counselling on infant feeding to women [12, 75]. There is a necessity to reach women and assist them throughout pregnancy, delivery and postpartum by skilled practitioners for reliable counseling and necessary interventions where need be [75]. In Nigeria, the social support during childbirth has catalyzed the early breastfeeding initiation especially for first-time mothers [28]. In the present study, 3.6% of women with delayed breastfeeding mentioned that they had respected instruction given by the attending medical staff. This could reflect the lack of training or qualification of some delivery room staff on breastfeeding.

6.7. The Psycho-sociocultural considerations

The "act of breastfeeding" seems important as well, because of the affective and emotional interactions involved between the mother and her baby [59-63]. This has a key role in neuropsychological development of newborns and helps relieve stress in breastfeeding mothers. However, lactation and breastfeeding may have psychological, environmental or sociocultural determinism, impacting mothers' readiness to breastfeeding [12].

The psycho-sociocultural impact on the breastfeeding process was investigated through the regional provenance of recruits, their ethnic origin, with a link to traditional, religious believes and practices. Inductive questions were asked to mothers who further explained traditional concepts and their meanders, rooted in cultural beliefs.

Based on these principles, we noted that the Centre region as origin was a predictor of inadequate breastfeeding in this survey, with more than 66% of women belonging to this geo-sociocultural background or ethnicity having poor

breastfeeding practices. This result is inline with similar studies showing that the breastfeeding practice may be influenced by geographical, socioeconomic and even cultural-related factors [130].

In this survey, the Centre region was the most represented background among women with poor breastfeeding (39.2%), although a selection bias may have occurred, due to the fact that the study was carried out in Yaoundé, which is the capital city of the Centre region. Yaoundé is as well the capital of Cameroon, with a standard of life which may be considered as higher compared with other regions. This is supposedly correlated with improved and modernized mentalities, emancipation, job occupation and probably insufficient maternity leaves for women, which makes them less prone to breastfeeding [130].

Whereas, in regions with lower life standards, breastfeeding might be readily practiced, given its cost-free accessibility and natural availability. This has led to suggestions for geographically-focused promotion campaigns for breastfeeding, education and interventions in indigenous communities in order to encourage and improve breastfeeding [12].

Just as in a number of African countries, different regions in Cameroon may have specific cultures, traditions and different levels of socioeconomic development. Though the level of school education was acceptable in average, there existed limited knowledge about breastfeeding in women enrolled in our survey. This further paved the way for the reinforcement of sociocultural considerations with negative beliefs concerning colostrum and wrong thoughts about “spoiled breastmilk” or “bad milk transformation” [130].

Such beliefs are frequently encountered in Cameroon, especially in the Centre region, where some women believe their breastmilk may be spoiled by some processes, including the initial yellowish colostrum, at times referred to as “bad milk”, not good enough for neonate infants. Some women described sexual intercourse as not recommended for lactating women, given that it is thought to

render breastmilk unsafe for infants as well. In close to 70% of cases, these recommendations were opportunistic, when women, mainly primiparous in 55% of cases had difficulties to breastfeed. The recommendations were mediated by mothers or elder sisters and rooted in family inheritance as origin, or past experience [130].

In the same vein, a number of women attributed the previous death of an infant to breastfeeding, evoking some mystical and cynic traditional practices related to witchcraft. Such mothers were the most difficult to counsel, as they were characterized by strong, inflexible convictions that only a traditional indigenous cleansing would be the definite solution for them. Moreover, the fear of "breast sagging" led to the refusal of exclusive breastfeeding in many women, as shown by their recorded intentions. These women thought continuous breastfeeding is responsible for breast falling-off with undesirable effects on their beauty and attractiveness [75, 130].

On the other hand, women with initial agalactorrhea and relatively smaller breasts, were referred to as "dried breasts" and were either considered as a family-inherited anomaly or a curse from the "Gods" or the "evil eye" [130]. These women were not receptive to the demand for continuous stimulation through repeated baby suckling of mother's nipples. The rejection of this advice was mainly due to misunderstandings. Whereas these women were more susceptible to drink specific traditional galactogues including some herbal infusions and local beers.

A considerable number of women avoided breastfeeding because of the fear to transmit malaises such as abdominal cramps whereas related to oxytocin-mediated uterine involution. The fear of baby contamination with mother infection and the communication of undesired traits through breastmilk was equally evoked by some women. Nevertheless, they were encouraged to

breastfeed by family, medical staff, education, counselling, and model influencing based on idealistic representations of breastfeeding.

On the other hand, caesarean section which appeared as the main cause of maternal indisposition, may be responsible for psychological modifications causing inability and unwillingness to breastfeed. Close to 36% of postoperative women evoked caesarean section as a motif for not breastfeeding. Indeed, caesarean section is a well-known and documented determinant of delayed breastfeeding initiation, already described by a number of researchers in various contexts [124, 130].

The increasing rate of caesarean section noted in some urban communities may suggest progressive acceptation and vulgarization of its culture in our context. However, in some few deeply traditionally encultured, and illiterate African women, mainly primiparous and women who had not delivered by caesarean section before, the intervention may be wrongly apprehended from a psychological standpoint, with considerable emotional involvement. Undesirable feelings may thus occur as a result of anxiety and victimization, associated with a first-time experience of a foreign practice which is unnatural in essence. Especially in the African context, where “the strong woman” is considered as one whom has gone through labor pains of vaginal delivery [75, 124, 130].

This psychosociological conflict may lead to the "carry-over phenomenon" which is marked by the occurrence of psychological impairments during the postpartum, as a result of prenatal exposition or predispositions, with parturition being a decompensation. Some of these disorders include the post-traumatic stress, baby blues, postpartum depression and psychosis, which are all susceptible to alter lactation and breastfeeding. However, these do not appear as absolute contraindications to breastfeeding [59-63].

Some pertinent hypotheses on various psychophysiological hormone variations after caesarean section, including the drop of blood endorphin level in

the immediate post-operative period have been evoked to explain the effects of caesarean delivery on delayed breastfeeding initiation. In fact, endorphin as a neuro-peptide whose secretion is stimulated by intense physical activity and pain such as during labor, excitation and orgasm, is responsible for positive emotional and affective interactions in mothers, including "desire and satisfaction" in breastfeeding. After caesarean delivery these sensations are diminished or late coming, thereby impacting negatively the breastfeeding process [124, 130].

Despite WHO's 2007 recommendations for maternal antiretroviral therapy (ART) and infant prophylaxis to reduce HIV transmission among exposed neonates, exclusive breastfeeding during the first six months in such infants is not always guaranteed in our context. There still persist a reluctance to breastfeed in such women which may be due to difficulties in overcoming psychological barriers of fear and anxiety related to frustrations and stigmatization. This may as well be associated with a mental self-protective behavior bound to the fear of infecting one's own infant [12, 130].

In effect, a number of studies report mother infection especially with HIV as a factor of poor breastfeeding practices. This may however be overcome through the reinforcement of antenatal counselling with an accent on the advantages of breastfeeding in such infants compared to deleterious consequences of not breastfeeding. As such mothers would be confronted with a stronger motivation to keep their infants safer through protected breastfeeding which strengthens neonates' immunity, reduces morbidity, mortality and assures normal growth [12, 130].

CONCLUSION

CONCLUSION

The rate of early breastfeeding initiation in this series was law with consequent important delay of the breastfeeding process at large. This was influenced by a number of factors pertaining to maternal, neonatal, interventional and Psycho-sociocultural determinants which in total constituted serious challenges to the breastfeeding process in our sample.

In effect, this survey revealed that despite the WHO recommendations and its countless benefits towards promoting adequate breastfeeding in both mothers and neonates, the time to initiate breastfeeding after delivery still remains very long in a considerable number of mothers. This with a negative impact on other aspects of the breastfeeding process including exclusivity, frequency, and duration, indicating a need to rethink the concepts of adequate and optimal breastfeeding.

We noted as well that perinatal-related physiological involvements in mothers was responsible for some breast pathologies, prompted by poor breastfeeding techniques. This beside main challenges such as psycho-sociocultural influences through the belonging to particular ethnic groups with impeding traditional beliefs and ideological conceptions. The effect of low level of education was equally perceived with difficulties to accommodate with important instructions and notions related to breastfeeding, such as in HIV infection. More so the impregnation of community development through enculturation and acceptation of rapidly established medical techniques such as caesarean section proves to obstruct the breastfeeding process in some conditions. Although, indications are most often undeniable, especially when mothers' and/or babies' lives are at stake. However, such interventions can't solve all possible perinatal complications such as preterm delivery with low birth weight and neonatal infections which appear to be considerable challenges to breastfeeding as well.

Beyond challenging factors, more pronounced statistical analyses through logistic regression, permitted to identify independent predictive determinants of inadequate breastfeeding. This was the case with the influence of sociocultural and traditional beliefs inherent to geo-regional origin of mothers with the Centre region, and caesarean section delivery.

Repercussions with altered nutritional status and metabolic imbalances in neonates majorated growth issues and vulnerability to infections with a consequent high rate of hospitalisation during the first week of life.

RECOMMENDATIONS

With respect to the findings in this survey, the following recommendations can be made in order to improve the practice of breastfeeding.

1. To health centres and personnel:

- Special emphasis should be laid on antenatal visits and counselling, with problem solving so as to prevent pregnancy complications and reduce emergency caesarean deliveries
- Elective caesarean sections should be favored as much as possible and emergency caesarean section avoided
- When indispensable, emergency caesarean section should be practiced with regional anesthesia as much as possible and techniques such as peridural should be perfectionated to favor post-operative recovery and breastfeeding process.
- Husband's presence may be allowed in the theatre during the intervention as well, as advocated by some studies which showed positive effects with anxiety relief and better lactation
- Post operative care should be improved and the management of pain in newly delivered women optimised
- Information, education and communication on the necessity to initiate breastfeeding as soon as possible after caesarean delivery should be emphasized, and the message reinforced or adjusted according to maternal level of understanding
- Just as in most countries, mothers and babies should be kept hospitalized even after eutocic deliveries for supplemental counselling and education on breastfeeding benefits and techniques
- Women with breast pathologies should be thoroughly examined, treated and counselled not to interrupt breastfeeding as breast emptying is part of management and very few breast conditions are contraindications to breastfeeding

- Special training sessions for the health personnel on breastfeeding practice updates should be regularly organised
- Improve the management, follow-up, counselling and psychological assistance when necessary for women with infectious diseases such as HIV AIDS.
- Improve the management of preterm neonates and other neonatal emergencies with breastmilk feeding as soon as possible

2. To governments:

- The reinforcement of health promotion through the creation of public health centres and the improvement of existing ones especially in remote areas
- To improve the management of well-known pandemics such as the HIV-AIDS, anticipate and make provisions for future pandemics such as the COVID-19
- Reinforce populations' education through schools, especially in developing regions and remote areas of the country
- The reinforcement of health education through the empowerment of community relays
- Adapting approach and language in community or mass education with geo-sociocultural-focused interventions to promote good feeding, adequate breastfeeding in mothers and infants, thereby breaking harmful traditional beliefs
- Improve the regulation of milk substitutes manufacturing and prescription

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APPENDICES

Questionnaire

General information

Patient's code……

Date ……/……. / ……

Date of birth :……./……../……

Phone number :…….

S1. <u>Maternal data</u>

Sociodemographic data

S1.Q1. Age (years) /_____/, marital status _____

S1.Q2. Occupation: Housewife /_/ Civil servant/_/ Student/_/ Others /_/

S1.Q3. Region of origin / Adamaoua/_ / Centre /_ / East/_/ Far North/_/ Littoral/_/ North/_/ North-West/_/ South/_/ South-West/_/ West/_/

S1.Q4. Level of education: Primary /_ / Secondary/_ / University/_ / Out-of-school/_ /

S1.Q5. Number of children: /_____/ Chronic disease? Yes /_ / No /_ /

S1.Q6. Do you intend to breastfeed? Yes /_ / No /_ / if not precise why_____

_____

S1.Q7. How will you go about breastfeeding? _____

S1.Q8. Exclusiveness during first six months? Yes /_ / No /_ / if not precise why and how then_____

S1.Q9. Duration_____ Precise why_____

S1.Q10. According to you can other food be given the baby during the first six months? Yes /_ / No /_ / Precise_____

S2. <u>Delivery data</u>

S2.Q1. Delivery route or mode: Eutocic vaginal /_ / Dystocic /_ / caesarean section/_ /

S2.Q2. Maternal complications Yes /_ / No /_ / Precise: _____

S2.Q3. Neonatal complications Yes /_ / No /_ / Precise: _____

S3.Q4. Breast anomalies or pathology: Yes /_ / No /_ / Precise: _____

S3.Q5. Milk flow Yes /_ / No /_ / Precise quality: _____ Quantity _____

S4. <u>Newborn data</u>

S4.Q1. Gestational age at birth (if possible): /_____ / Birth weight: _____

S4.Q2. Average number of feeds/day____ , satisfaction: Yes /_ / No /_ /

S4.Q3. Hospitalization at birth: Yes /_ / No /_ /, If yes, precise diagnosis_____ Duration_____ outcome_____

Vital parameters at discharge _____ anthropometrical parameters of baby at entry _____ discharge _____

S4.Q4. Average time to initiate breast feeding (in minutes) _____

If time > 60 minutes, ask the questions below:

S4.Q5. Why did you take more than one hour to start breastfeeding your baby? (open answer) _____

Further enquiries according to answer given_____

S4.Q6. What about the health care provider? Did they give you information about the average time to initiate breastfeeding after delivery? If yes, what did they say? (open answer) _____

S4.Q7. According to you and according to the doctors or health care providers, how was your baby's general state after birth? _____

S4.Q8. Was the baby able suck? Yes /_ / No /_ /, If yes, describe_____

S4.Q9. Have you observed any belief concerning breastfeeding? Yes /_ / No/_ /, If yes, precise and explain the meaning_____

S4.Q10. Opinion of family members and relation with mother_____