AN IMMUNOLOGICAL AND PSYCHOLOGICAL COMPARATIVE STUDY BETWEEN BREAST FED AND ARTIFICIALLY FED INFANTS IN THEIR FIRST YEAR OF LIFE

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To

My Father

Thank you for everything

The soul of my mother

My brother

My sweet nephews

movements in breast fed infants were much higher than in bottle fed ones with the arm movements exceeding the leg movements. This was elicited at the age of three - three and a half months. Fear reaction to strangers, appeared earlier in breast fed infants and vanished earlier too than it did in bottle fed ones. Responsivity was stronger and more elicited in breast fed than in bottle fed infants at the age of eight months. A considerable number of breast fed infants walked with support at the age of one year, while only a minority of bottle fed infants were able to do so.

Key Words :

1- Immunology.

2- Salivary immunoglobulins.

3- Immunodiffusion technique.

4- Psychology.

5- Stress response.

6- Motoric activity.

7- Responsivity.

8- Fear reaction to strangers.

9- Motor development.

An Immunological and Psychological Comparative Study Between Breast fed And Artificially fed infants in their first year of life

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Abstract

The study included fifty infants. Twenty five were breast fed and the other twenty five were bottle fed. They were selected from a medical center in Guiza. This study started since the infants' birth and ended when they were one year old.

At the ages of one, three, six, and nine months, salivary samples were taken from the infants to measure their levels of immunoglobulins A, G, and M. The incidence of respiratory and gastrointestinal tract infections was measured in both bottle fed and breast fed infants throughout the months of that first year of age. Anthropometric measurements including weight, and length, were taken at the first, third, sixth, ninth and twelfth months. Finally the psychological status temperament of infants was assessed via questionnaire to the mother.

It was found that salivary IgA, IgG, and IgM levels were higher in bottle fed than in breast fed ones. Bottle fed infants suffered from a higher incidence of infections than breast fed ones. Salivary immunoglobulins levels rose with the increased incidence of infection whether respiratory or gastrointestinal. There were no major differences in the two groups heights (lengths) throughout that first year except for the third month where means of heights of breast fed infants were higher than those of bottle fed ones. As regards their weights, bottle fed infants were much heavier than breast fed ones throughout the first year.

Breast fed infants were more irritable than bottle fed ones. This was assessed at the age of two months. Arms and legs

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List of Abbreviations

*	Immunoglobulin	Ig
*	Salivary Immunoglobulin A	SIgA
*	Salivary Immunoglobulin G	SIgG
*	Salivary Immunoglobulin M	SIgM
*	Respiratory tract	RT
*	Gastrointestinal tract	GIT
*	Weight for age	WA
*	Weight for age Z score	WAZ
*	Weight for age Percentile	WAP
*	Height for age	HA
*	Height for age Z score	HAZ
*	Height for age Percentile	HAP
*	Escherichia coli	E.coli
*	Colistridia jejuni	C.jejuni
*	Artificially fed	AF
*	Breast fed	BF
*	Standard deviation	SD

INTRODUCTION

Introduction

Three synonymous names were used in this thesis to give one and the same meaning. These are, artificially fed infants, formula fed infants, and bottle fed infants. Accordingly, artificial feeding here neither meant Ryle-feeding nor intravenous fluid intake.

Human milk is considered to be the optimal source of nutrition for the infants (Naing, 1991). The benefits of breast feeding for the newborn infants are well recognized and current recommendations on infant feeding generally include a period of exclusive breast feeding for the first 3-4months of life (Prentice, 1991). Generally, breast milk is enough for covering the nutritional requirements of healthy infants during the first six months of life (Chatterjee et al., 1997).

One of the great advantages of breast milk is that it gives immunity to the infants because it contains a lot of antimicrobial factors which reinforce infants' immature system (Prentice 1991). Immunoglobulins represent one of the several antimicrobial factors contained by breast milk. These immunogobulins comprise IgA, IgG, IgM.

The immunoglobulin A secreted into the breast milk is called secretory IgA. It is of great importance in coating the gut mucosa, preventing bacterial adherence to the mucosal surfaces, and inhibiting invasion of the mucosa by enterobacteria and parasites. Accordingly, there will be a decrease in the incidence and severity of diarrhea caused by bacteria and viruses.

Immunogobulins IgG and IgM are also important in host defence at mucosal surfaces. The IgG antiviral antibodies can prevent infection, decrease viral replication, and eliminate or lessen the severity of the disease. In IgA deficient patients, mucosal production of IgG and IgM can compensate for IgA antibodies deficient production and secretion (Hahn et al., 1997).

Follow up of breast fed and formula fed infants at the first year of life in a longitudinal study is very important to detect the value of breast milk especially when those infants are compared to bottle fed ones. This was not only accomplished through immunglobulins levels assessment in both groups of infants throughout the first year of life, but also through comparing the rate of subjection to gastrointestinal and respiratory tract infections in both infants' groups in their first year of life.

Another great advantage of breast feeding is that it is the initator, and propagator of the mother-infant bonding. It is a preventive measure of the baby's untroubled emotional development. The baby's effort to suck the breast milk expresses an active conquest of the world (DeChateau, & Wilberg, 1977).

Accordingly, the baby will gain harmony, trust, and emotional balance.

From the point of view of social behavior, and depth psychology, infants' reaction to strangers, and their shy acting express their recognization and distingushment of the Ego-self, and the Non-self. Fear from strangers is essential for the early relation to an object and for binding to it (Baumgartner, 1984).

AIM OF WORK

Aim of the Work

The aim of this study is to assess the immunological status of each breast fed and bottle fed infant in the study, and then compare both groups together.

The levels of salivary immungolobulins IgA, IgG and IgM, the rates of respiratory tract and gostrointestinal infections, and anthropometric measurements, all will be measured for assessment, and comparison of both infants groups.

Additionally, this study aims to evaluate and compare the psychological status of both groups of infants via questionnaire to their mothers. It actually investigates the influence of the feeding method on infant temperament and development.

REVIEW OF LITERATURE

Review of Literature

Anatomy of the mammary gland

The mammary gland is made up of three kinds of tissues: adipose, connective, and glandular. The central portion is predominantly glandular, while the peripheral is predominantly fatty or adipose.

The gland consists of 15 to 20 lobes, each of which is actually an independent gland with a duct opening at the apex of the nipple.

Interlober connective tissue containing many fat cells surrounding each lobe also divides it into numerous lobules.

Each lobe is made up of thousands of secretory alveoli which drain into ductules, then ducts, then lactiferous sinuses, and finally in a single ampulla present in the nipple (Lawrence, 1989).

Physiology of lactation

The main hormone concerned with preparing the breast for milk production and then milk secretion after delivery is prolactin. Prolactin levels rise in late preganancy and usually peak around the time of delivery.

During pregnancy, placental oestrogen and progesterone inhibit milk secretion. With delivery, the level of these hormones falls, while prolactin level remains elevated thus exerting a milk-secreting effect(Howie, 1985).

Suckling stimulates and increases further prolactin secretion. This is- explained by the neuro-endocrine pathway or the breast-hypothalamus-pituitary system. Suckling stimulates the areolar area and this stimulation causes nerve impulses to be sent to the hypothalamus to induce secretion of prolactin via the anterior pituitary gland (Neville et al., 1991).

After each episode of suckling, prolactin levels rise and reach a peak at 30-45 minutes after initiation of the feed.

Frequent suckling maintains high levels of prolactin while infrequent suckling causes wide swings in circulating levels.

Administration of supplementary or complementary feeds to breast-fed infants reduces milk secretion. When the number of supplementary feeds taken by the infant increases, the serum prolactin level decreases. Also, mothers who do not supplement their infants have higher serum prolactin levels than those who give supplement (El-Sherbeeny et al., 1991).

Milk output was shown to be affected by both energy intake and protein intake.

Another hormone which governs breast feeding is oxytocin hormone whose release stimulates the "let-down" reflex. Oxytocin is released from the posterior central nucleus of the hypothalamus. Oxytocin influences the contraction of the myoepithelial cells which surround breast alveoli and ducts resulting in expulsion of milk from these structures (Howie et al., 1985).

This let-down reflex (oxytocin reflex) is stimulated by a number of factors other than the infant's tactile stimulation of the areolar area at suckling.

For example:

- Sensory contact with the infant through sight, or sound (crying).
- Arrival of the nursing time.
- Emotional responses which might also inhibit this reflex as in cases of lack of interest in breast feeding, lack of confidence, pain, embarassement, fatigue and anxiety (Prentice, 1991). These latter circumstances increase the circulating levels of epinephrine and nor- epinephrine with a resultant ischaemia of the alveolar capillary network which in turn will prevent the transport of oxytocin to the alveoli.

Advantages of breast feeding

The benefits of breast-feeding for the newborn are so much well recognized that it becomes almost unforgivable not to take positive steps towards reversing the decline in breast feeding (Anderson, 1985).

1. Breast-feeding is safer

Breast-milk has a reduced risk of infection of all sorts. Breast-fed infants are less likely to develop gastroenteritis, protein calorie malnutrition, neonatal tetany, rickets, infantile eczema, malabsorption and cow's milk allergy (Hanson et al., 1985).

2. Breast-feeding is easier

Breast-milk needs no time for preparation and is always available at the proper temperature (Barness, 1992). This is of great importance for mothers of restricted education, living in low hygenic areas, receiving poor health instructions, and having irregular deliveries of milk supplies which can not be adequately stored.

3. Breast-feeding is cheaper

Breast-milk is more economic compared to modified fortified milk whether dried or evaporated. Egypt can save 150 million pounds per year through implementation of breast feeding and this can be used to raise the health standards of lactating mothers and their infants (Gabre, 1984).

4. Breast-feeding is biochemically superior

There is slow progress in the continuous struggles to obtain an alternative feed biochemically approximate to breast milk. Cow's milk needs modifications in its protein and fat content. Replacement of cellular and immunogically specific substances such as secretory IgA has proved to be difficult or impossible (Carlson et al., 1982).

5. Breast-feeding and gut flora

The number of bifido-bacteria in the stool of bottle fed infants is approximately one tenth that of breast-fed infants. The properties of breast milk that promote the growth of bifido-bacteria and suppress the growth of coliforms and other potentially pathogenic organisms, theoretically would help to minimize the incidence of neonatal disease caused by these organisms (Hajime et al., 1983).

6. Anti-allergic properties of human-milk

Breast feeding is the best prophylaxis for food allergy during infancy. This is due to the fact that secretory IgA in human milk promotes closure of the gut and therefore decreases the permeability to allergens (Pipes, 1989). Cow's milk protein ß-lactoglobulin and serum bovine albumin are the most common allergens in infancy. The family allergic history and the cord blood IgE have been significantly reliable factors for predicting infants at high risk for developing atopy. Cord serum total IgE levels greater than 100 μ/ml are associated with 5 to 10 times greater risk than lower levels.

For the present, each mother with an infant at risk is advised to plan to breast-feed exclusively for four months, and continue to breast-feed after weaning until the end of the first year (Atherton, 1983).

7. Breast-feeding is of great psychological value

Breast-feeding promotes strong emotional ties between the mother and the infant (Nelson, 1987).

The mother gives her baby warmth, closeness, and comfort. The baby gets provided also with optimal sensory stimulation in various modalities including tactile, olfactory, gustatory, visual, and auditory.

Mothers themselves gain a lot during breast feeding. The uterus returns rapidly to its normal size. Breast-feeding provides some contraceptive effect because it is commonly associated with a larger period of amenorrhea postpartum and delay of ovulation. Also cancer breast is less common when breast-feeding is prolonged (Burman, 1982).

8. Breast-feeding and intellectual development

Many studies have referred to the superiority of breast-fed infants over the artificially fed ones regarding their intellectual development and later on, their school progress.

Again, a positive correlation between the duration of breast-feeding and the intellignce guotient levels has been confirmed. There was a significant dose-response relation between the proportion of mother's milk consumed and later IQ (Lucas, 1992).

The advantageous effect of human milk upon intellectual development can be explained as follows:

1. The decision to breast-feed the infant may be a manifestation of "positive health behavior", and the desire to be "a good parent", both of which may influence the child's development (Lucas, 1992).

2. Human milk contains long-chain-lipids, important for the structural development of the nervous system, which are not present in formulas. An example of these is docosahexanoic acid which is accumulated in large amounts in the developing brain and retina (Carey, 1982).

3. Human milk also contains numerous hormones and trophic factors that might influence brain growth and maturation (Read, 1988).

9. Breast milk gives immunity

Breast milk contains a lot of antimicrobial factors which reinforce infants' immature system and immunity (Prentice, 1991).

(a) Antibodies

There are four classes of immunoglobulins present in human milk (Ig,A, IgM, IgG, and IgD) (Goldman et al., 1985). The main immunoglobulin, IgA, is principally comprised of secretory IgA throughout lactation.

IgA is resistant to gastrointestinal digestion and can be found in stools. It has been found that the concentration of IgA antibodies in stools is much higher in breast-fed than in non-breast-fed infants.

Secretory IgA is more resistant than other immunoglobulins to degradation by trypsin and thus is better adapted to persist in the intestinal tract (Carlson *et al.*, 1982).

Antibodies against *Haemophillus influenza*, *Staphylococci*, *Streptococci*, *Penumococci*, *Salmonella*, *Shigella*, and Vibrios, as well as Poliomyelitis, Respiratory syncytial, Coxsacie and Rota viruses are predominantly IgA. IgM and IgG.

(b) Growth factor for Lactobacillus Bifidus

Human milk contains a specific growth factor for Bifidiobacterium bifidus. It is a nitrogen containing polysaccharide that inhibits the heat labile enterotoxin from E. Coli.

It also inhibits the binding of the enterotoxins of E. coli and V.cholerae., to erythrocytes (Goldman *et al*, 1985).

This factor is present in high concentrations in colostrum, and human milk contains 40 times as much as cow's milk (Jellife & Jellife, 1978).

Lactobacilli growth is stimulated by high lactose, low protein, low phosphate, and poor buffering capacity of breast milk compared with cow's milk.

(c) Leukocytes

Leukocytes are particularly abundant in human milk during the first few weeks of lactation. They include neutrophils (40-65%), macrophages (30-35%) and lymphocytes (5-10%). Lymphocytes are predominantly T cells.

The total leucocytic count in human milk and its antibacterial activity are not influenced by the nutritional status of the mother (Abd El-Gelil, 1994).

(d) Lysozyme

Lysozyme is an enzyme present in high concentrations in human milk. Its level varies with the phase of lactation where the highest level is present in colostrum (Goldman *et al.*, 1988).

Lysozyme enzyme exerts its effect by destroying bacterial cell wall membrane after the organism has been inactivated by peroxides and ascorbic acid also present in human colostrum and milk (Pipes, 1989). Lysozyme concentration in breast milk is 5000 times as great as cow's milk.

(e) Lactoperoxidase

Lactoperoxidase is active against the following bacteria: *Streptococci, Pseudomonas, E.coli, and Salmonella typhirium.*

Its level in human milk is 20 folds lower than in cow milk, but it is more stable to treatment with gastric juices (Pipes, 1989).

(f) Complement

The presence of nine components of the complement has been demonstrated though at low levels or even very low ones.

Complements may be important because of their opsonic, anaphylactic and chemotactic properties (Nakajima *et al.*, 1977).

(g) Antiviral factors

In addition to IgA antibodies three other types of antiviral agents have been identified in human milk. These are a heat-stable protein, a heat-labile protein and antiviral lipids (Goldman & Goldblum, 1988).

The major lipase in human milk is a bile salt-stimulated lipase which leads to the production of polar free fatty acids and monoglycerols, and these in turn have antiviral activities (Ruff *et al.*,1992).

(h) Inhibitors of bacterial metabolism

Human milk contains an iron-binding protein called lactoferrin which is present in high concentrations there. Lactoferrin inhibits the growth of E.coli, and kills other organisms as *Vibrio cholerae*, and *Streptococcus mutants*.

Another inhibitor of bacterial metabolism present in human milk is vitamin B12-binding protein. Unlike lactoferrin, this protein is degraded by proteolytic enzymes in vitro

Composition of human milk

Breast milk is the most ideal food for infants during their first year of life, not only because it is the natural type of infant feeding but also because it has been confirmed that it yields the best mental and physical growth results (Helayl *et al.*, 1990).

Breast milk passes through three stages:

1. Colostrum stage
2. Transitional stage
3. Mature milk.

(1) Colostrum:

It is a transparent yellowish thick fluid secreted by the mammary gland during the first five days after delivery (Pipes, 1989). Its volume varies between 2-10 ml/feed/day, and its reaction is alkaline. Its mean energy value is 67 k cal/100 ml compared with the 75 k cal/100 ml of mature milk (Lawrence, 1989).

In comparison to mature milk, colostrum is higher in protein, fat soluble vitamins, minerals, sodium, potassium, and chloride. However, colostrum is lower in fat, and lactose.

Fat is contained in the core of fat globules. It increases from 2% in colostrum to 2.9% in transitional milk to 3.6% in mature milk.

Colostrum is considered to be the most suitable food which coincides with the needs and reserves of preterm and full term babies. This is due to the presence of anti-infective components in colostrum as macrophages, lymphocytes, bifidus factor, lysozyme, lactoferrin, interferon, B-vitamins level.

(2) The transitional stage:

The sixth to tenth days comprise the transitional period during which the proportions of chemical and immunologic constituents characteristic of colostrum change toward those of mature milk. Clearly, the process of transition occurs over the first month of lactation.

Within the individual woman, considerable fluctuation in milk constituents occurs through the colostrum and transitional stages of lactation. The inconsistency of composition during these initial days of lactation has been attributed to the physiological and metabolic maturation of the mammary gland for milk production.

(3) Mature Milk:

Compared with colostrum, it is higher in fat, lactose and most B vitamins, but lower in protein, most minerals and fat soluble vitamins (Anderson, 1985).

We will discus each constituent of breast milk by itself:

(1) Water:

Water constitutes 85-95% of breast milk. All other constituents are dissolved, dispersed or suspended in water.

Lactose is the regulating factor for the amount of milk produced, and accordingly the secretion of water into milk is partially regulated by lactose synthesis (Lawrence, 1989).

Water contributes to the temperature regulating mechanism of the newborn. This is because 28% of the newborns's heat loss is due to water evaporation from skin and lungs.

A lactating woman has a greatly increased obligatory water intake.

(2) Lipids:

The lipid fraction of milk is the second greatest constituent according to the percentage of concentration.

Fats are essential for development because they provide fatty acids important for brain development, and the integral part of all cell membranes. They are the only vehicle for fat soluble vitamins, and hormones in milk.

Human milk fat provides 40-50% of the total calories and accordingly it is the main source of energy of the newborn (Hamash *et al.*, 1986).

Triglycerides form 90% of the lipid in human milk while phospholipids, diglycerides, esters, and free fatty acids are all found in small amounts (Gibson and Kneebone, 1981).

The fat content of human milk varies with:

- Maternal nutritional status
- The time of day
- The stage of feed
- The duration of lactation

Fat levels are highest in:

- Well nourished mothers
- After the main meal of the day
- Towards the end of a feed
- In the first month of lactation (Garza et al., 1987).

Dietary fat amount and composition alter the composition of milk fat but do not affect the total amount of fat secreted (Anderson, 1985).

The milk lipid concentration is significantly related to maternal protein intake at least in the later months of lactation (Nommsen *et al.*, 1991).

Cholestrol in human milk is beneficial in all infants for the development of cholesterol control mechanisms needed in adulthood, and in premature infants needing exogenous sources.

Fatty acids appear in milk as a result of dietary intake, metabolism from fat depots, and endogenous synthesis by the mammary gland.

Their composition in milk depends on the amount and type of dietary fat consumed, the total caloric intake, and most important, the carbohydrate intake of lactating women in relation to the total caloric intake.

The high polyunsaturated fatty acid content provides adequate linoleic acid and linolenic acid for myelinization of nerve cells and so they play a crucial role in brain development (Harzer *et al.*, 1983).

Antiviral activity is found in both the free fatty acid fraction, and in the monoglyceride fraction of human milk (Kabara, 1980).

Breast milk also contains the digestive enzymes amylase, bile-salt stimulated lipase, and bile-stimulated esterase, which are present in measurable quantities after 6 months of lactation (Dewit & Prentice, 1990).

(3) Carbohydrates:

Human milk contains a number of carbohydrates mainly lactose which constitutes approximatly 90% of these carbohydrates. Glucose, galactose, fructose, and numerous nitrogen containing carbohydrates are also present but in small amounts.

The percentage of lactose in human milk is 6.5%-7% while in cow's milk it is 4.6% (Fomon et al., 1978).

Lactose has the following functions:

1. It enhances calcium absorption.
2. It may play a role in prevention of rickets.
3. It is metabolized in the infant body to galactose which is essential to the production of galactolipids, including cerebrosides essential for the development of the CNS (Ogra and Greene, 1982).

(4) Proteins:

Human milk contains only 1.0-1.5% protein while cow's milk contains 3.3%. Proteins of human milk include 60% whey proteins and 40% casein. This ratio is reversed in cow's milk, 40:60, (Tikanoja, 1982).

a- Whey proteins

When clotted milk stands, the clot contracts, leaving a clear fluid called whey. Whey contains water, electrolytes, and proteins. The chief fractions of whey proteins are α-lactalbumin, and lactoferrin with no measurable ß-lactoglobulins. Human milk is high in both ß-lactalbumin, as well as lactose (Lawrence, 1989).

b- Casein

Casein is a group of milk-specific proteins characterized by ester-bound phosphate, a high proline content, and low solubility of 4 to 5.

When milk curdles or clots, casein is transformed into an insoluble calcium caseinate-calcium phosphate complex. Milk clots or curdles as a result of heat, enzymes, or pH changes (Tikanoja, 1982).

(5) Enzymes:

There are more than 20 active human milk enzymes of which lipase is one of the most important.

Some of these enzymes are: Lipase, lysozyme, lactoperoxidase, glycose-6-phosphate dehydrogenase, amylase, protease, and others.

Milk enzymes are classified into 3 general groups according to their activity:

1. Enzymes influencing physiological changes that occur in the mammary gland itself during lactation.
2. Compensatory digestive enzymes having digestive functions in the neonate.
3. Enzymes important in neonatal development.

a- Lysozyme

It is a specific protein found in high concentrations in human milk, which is higher than its concentration in cow's milk.

This enzyme is bacteriolytic against enterobacteriae (e.g. *E.coli* and *Salmonella enetritides*). It is capable of lysing the cell wall of bacteria by cleaving its peptidoglycans.

Lysozyme may also play a role in protecting against many viruses including herpes hominis virus. In some traditional cultures, fresh breast milk had been used as eye drops in the treatment of conjunctivitis (Jelliffe and Jelliffe, 1978). Lysozyme is a thermostable and an acid stable enzyme.

b- Lactoperoxidase

The lactoperoxidase system includes thiocyanate, peroxide, and enzyme peroxidase which is a unique peroxidase found in human milk.

This system is active against a variety of bacteria including *E.coli, Salmonella typhimurium, Pseudomonas*, and *Streptococci* (Bjork *et al.*, 1975).

Although lactoperoxidase in human milk is more stable to treatment with gastric juices; still its activity is 20 folds lower than that in cow's milk.

c- Lipase

Milk lipases play an important role in creating the fat emulsion of breast milk. This yields a finer curd and facilitates the digestion of triglycerides.

Human milk lipase has a lipolytic activity breaking down triglycerides to free fatty acids and glycerol (similar to pancreatic lipase activity).

Human milk lipase makes the free fatty acids available in a large proportion even before the intestinal digestive phase. Free fatty acids are important sources of energy for the infant.

(6) Some protein and non-protein compounds

a- Lactoferrin

It is an iron-binding protein that is part of the whey fraction of proteins in human milk.

It inhibits the growth of certain iron-dependent bacteria in the gastrointestinal tract as *E.coli*, by depriving the organism of iron. Again, it has a strong bacteristatic effect on *Staphylococci* (Chierici et al., 1992).

Giving iron to newborn infants appears to inactivate lactoferrin by saturating it with iron. This is because of the suggestion that the bacteriostatic function of lactoferrin depends on its unsaturated state which is, however, unaffected when giving iron to the mother herself.

A significant factor that had been clearly demonstrated in preserving the bacteriostatic effect of lactoferrin is that it is stable in the acid pH of the stomach. It reaches the duodenum without the occurrence of any digestion.Unsaturated lactoferrin also inhibits *Candida albicans*.

b- B12-binding protein

Human milk contains very high levels of the B12-binding protein, compared to lower levels in infants formulae. This protein is also higher in the meconium and stools of breast-fed compared to formula-fed infants. This protein is of a high molecular weight.

The protein binding renders the B12 unavailable for bacterial growth of *E.coli* and bacteroides.

c- Bifidus factor

Human milk contains high levels of a growth-promoting factor for *lactobacillus* bifidus (Gyorgy *et al.*, 1971) which causes the prevalance of lactobacilli in the intestinal tract of breast-fed infants.

This factor is almost absent from or present in negligible amounts in cow's milk. This factor is a nitrogen-containing polysaccharide which is distinct from other growth factors in being thermostable, radiostable, and not destroyed by freeze-drying.

Lactobacillus bifidus metabolizes milk saccahrides, producing large amounts of acetic and succinic acids. These acids cause the pH of the stools of breast-fed infants to be low.

The low pH level of the intestinal environemnt suppresses the growth of enteropathogens as *E.coli*, and other enterobacteria (Goldman et al., 1988).

The number of pathogenic bacteria is kept low because of two apparent actions. The first is the encouragement of *L.Bifidus* growth, and this overgrows other bacteria. The second is the direct action of lysozyme, and lactoferrin which keeps the number of pathogens low.

When the number of pathogenic bacteria is kept low, the immune antibodies can keep the growth under control, and prevent the absorption of bacteria through the gut wall into the blood stream.

d- Antistaphylococcal factor

It appears to be a fatty acid which is distinct from linoleic acid but its final characterization remains incomplete.

It is present in human milk and protects against staphylococcal infection throughout the lactational period.

(7) Vitamins:

A- Fat soluble vitamins

1. Vitamin A

Breast milk is a good source of vitamin A and its precursors.

Its concentration in milk is strongly influenced by the quality and quantity of the dietary Vit. A consumed by the mother (Abd El-Gelil, 1994).

ß-carotene (Vit A precursor) is an important naturally occurring antioxidant present at high concetrations in mother's milk.

Accordingly, breast milk plays an important role in providing the infant with a defense against oxygen toxicity.

2. Vitamin D

The amount of biologically active vitamin D in breast milk had been found to be low. It is influenced by the maternal intake of vitamin D (Roberts *et al.*, 1981).

A vitamin D supplement (400 IU/L) is recommended for breast-fed infants especially in dark skinned ones who had little exposure to the sun far more than light skinned ones (Fineberg, 1981).

3. Vitamin K

Breast milk contains low concentrations of vitamin K, lower than that of cow's milk.

Vitamin K is important for the synthesis of blood clotting factors. It is synthesyzed by the intestinal flora, but because it takes several days for the sterile infant gut to establish an effective micropopulation, therefore it is recommended that all newborn infants should receive an oral or intramuscular supplement (1mg) (Mac Ninch et al., 1983)

4. Vitamin E

It is an important naturally occurring antioxidant in the biological system which protects against the peroxidation of lipids in cell membranes. Its presence in breast milk plays an important role to defend the infant against oxygen toxicity (Guthrie et al., 1977).

It is also required for muscle integrity, resistance of erythrocytes to haemolysis, and other biochemical and physiological functions.

B- Water Soluble Vitamins:

Most of the water soluble vitamins are well provided in breast milk. Supplementation of these vitamins to lactating mothers will raise levels in breast milk. So it may be beneficial in undernourished women (Sneed et al., 1981).

(8) Minerals:

In contrast to vitamins, the mineral content of breast milk is less influenced by recent maternal dietary intake (Vuori et al., 1980). The mineral composition of breast milk is considerably less than that of cow's milk (Picciano et al., 1983).

With the exception of iron and copper, cow's milk contains much more of all the minerals. Adequate balances of calcium and phosphorus are maintained on breast milk inspite of its comparatively low content of these minerals. Surprisingly there are no significant effects of maternal nutrients status on milk mineral content (Abd El-Gelil, 1994).

The bioavailability of minerals is generally higher in breast milk than in infant formulas, due partly to the presence of binding ligands which enhance absorption.

Regulation of certain minerals also occurs through urinary excretion. Simple measurement of dietary intake may not be as accurate as more complex calculations of net retention or tissue excretion.

Breast milk and infant growth

Breast milk contains three important factors which play significant roles in infant growth.

These are:

- Nutrients (discussed in milk composition)
- Growth factors.
- Protective factors

Exclusive breast feeding allows optimum growth mainly in the first 3 months of life and so at that age growth is parallel to all established references (Prentice, 1991). However, there is a decline in the output of milk after the age of 3 months

Actually this decline is obvious by and after the age of 6 months, and so there is growth with small deviation from some established references between 3 and 6 months of age (El-Sherbeeny *et al.*, 1991).

I. Growth factors

Growth factors are also called growth modulators. They include small hormone like proteins such as nerve growth factor (NGF) and epidermal growth factor (EGF). They also include enzymes, epidermal enzyme, interferons (which are protective factors as well as growth modulators), and small molecules such as taurine, ethanolamine and phosphoethanolamine (Hanson *et al.*, 1985).

Growth factors are important in proliferation of cells (Gerald *et al.*, 1985).

A) Epithelial growth factor (EGF)

It is the most potent stimulator of growth (of mitosis) and differentiation of epithelial tissue and epidemial tissue (Carpenter, 1980).

Its presence in milk may be of benefit to the neonate in that it urges the maturation of immature gastrointestinal epithelium.

It could support the rapid growth and differentiation of epithelial cells in other tissues such as the liver. It also inhibits the release of gastric acid, and might participate in the regulation of pH in the stomach of the neonate (EGF is also known as urogastrone) (Gerald *et al.*, 1985).

EGF plays an important role in the stimulation of ornithine decarboxylase activity and DNA synthesis in the digestive tract, and in the acceleration of healing of wounds of the corneal epithelium.

EGF is present in high concentrations in human colostrum (35-438 mg/ml). Its level falls rapidly during the first few days of lactation.

Its concentration in mature milk is 10% that in colostrum but is considerably higher than its concentration in serum. Its concentration in human milk is neither affected by the duration of gestation nor by the time of day (Maran, (1983).

It has been identified in saliva, urine, and amniotic fluid (where it aids increased growth and maturation of the fetal pulmonary epithelium).

B) Nerve growth factor (NGF)

It refers to a family of proteins also present in milk.

It promotes the survival of developing neurons of the peripheral nervous system (Bradshow, 1978).

It maintains the differentiated properties of mature neurons (Edgar, 1985).

It may be involved in the arborization of the sympathetic neurons of the gut.

It may be involved in the maturation of sensory neurons (Wright and Gaull, 1983).

C) Taurine

Breast milk also supplies a growth modulator which is Taurine. Taurine is an amino acid which may function as a growth modulator due to its 1) Membrane stabilizing effect, or 2) an antioxidant effect (Pasantes *et al.*, 1985).

Taurine concentration is particularly high in excitable and developing tissues especially during periods of rapid cellular proliferation (Sturman *et al.*, 1986).

D) Long chain polyunsaturated fatty acids

Breast milk also supplies long chain polyunsaturated fatty acids (LCP) in amounts sufficient to satisfy intra-uterine growth rates (Clandinin, 1981).

LCP are exemplified by arachidonic acid and docosahexanoic (DHA) which are important structural components of membrane systems in all tissues.

Accordingly, they influence:

a. Membrane fluidity and permeability for metabolic exchange,

b. The activity of membrane bound enzymes and receptors, and

c. The electrical response to excitation (Koletzko, 1989).

DHA content in most tissues is very low. However, it is present in large amounts in the central nervous system (Brain grey matter and retinal membranes) (Martinez, 1987).

In the brain DHA is concentrated in the synaptosomes and synaptic vehicles (Hrboticky, 1989).

In the retina, DHA is concentrated in the lipids of the photoreceptor cells (Bazan, 1986).

E) Lipase

Breast milk contains one enzyme called bile salt-stimulated lipase which is active in the intestine, and plays a physiological role in digestion of milk triacylglycerides (Hamash *et al.*, 1985).

II. Protective factors

Breast milk protective factors include:

A) Immunoglobulins

B) Cellular elements :

- Macrophages
- Polymorphonuclear leucocytes
- Lymphocytes

C) Enzymic and protein components

- Lysozyme
- Lactoferrin
- Antistaphylococcal factor
- Lactoperoxidase
- Complement
- B_{12}-binding protein
- Bifidus factor
- Lipase

D) Chemical components

- High lactose
- Low protein
- Low phosphate
- Poor buffering capacity

A) Immunoglobuins

Human milk contains IgA, IgM, IgG, and IgD. However IgA level is higher than that of IgM, and IgG. IgD level in human milk is very low.

In cow's milk, IgG is the major or predominant immunoglobulin.

Immunoglobulin A (IgA)

Synthesis

Evidences indicate that IgA antibody detected in human milk originate from antigenic stimulation at specialized mucosal sites in the intestinal and respiratory tracts. IgA-committed ß cells emerging from mucosal sites, such as peyer's patches in the small intestine, migrate preferentially to other mucosal sites, including the lactating mammary gland.

In the breast, ß cells mature into plasma cells, the predominant product of which is polymeric IgA.

Immunoglobulins (IgA) are transported into colostrum and milk, mainly by the polymeric immunoglobulin receptor (PIgR).

After that there is proteolytic cleavage of PIgR at the apical membrane of the mammary alveolar cell. This will release the polymeric IgA molecule, covalently complexed to a fragment of PIgR termed secretory component (SC).

This complex is called secretory IgA. Also, some of the PIgR molecules are transported and cleaved by the epithelial cells without any attached immunoglobuin. The resulting proteloytic fragment, free SC, is also present in high concentrations in human milk. These molecules (SC) may be able to inhibit enzyme phospholipase A_2. Accordingly there could be a reduction in the inflammatory reactions along mucosal surfaces and in the fluid accumulation produced by some intestinal pathogens. To summarize, bound SC performs 2 jobs:

1) Facilitates the transport of secretory IgA to pass the mucosal surfaces into secretions.

2) Protects the immunoglobulin from proteolytic attacks.

Thus when the mother mucosal immune system is exposed to pathogenic organisms, there'll be production, and secretion of specific antibodies into the milk.

Since the mother and the infant share the same environmental exposure, therefore the previously discussed system will protect the infant from those environmental pathogens. The milk secretory IgA antibodies against enteric pathogens will decrease the incidence and severity of diarrhea (caused by bacteria and viruses) in infants.

Secretory IgA actually coats the gut mucosa, prevents bacterial adherence to mucosal surfaces, and inhibits invasion of the mucosa by enterobacteriae and parasites (Fitzsimmons et al., 1994).

IgA is resistant to the proteolytic effects of gastric acid. Secretory IgA can protect mucosal surfaces other than those of the gut. This is why some mothers put milk in their infants' eyes to treat eye infections.

Concentration of IgA

There is a close link between the production of secretory IgA by the infant, and by the mother's mammary gland.

At the beginning, secretory IgA level in mother's milk is very high due to its accumulated secretion at the latter part of pregnancy (2-4 mg/ml)

Its concentration then falls in the day following labour (1-2 mg/ml), after which it remains at a constant level after the first week of lactation.

As regards the infant, by the time the secretory IgA ingested by the infant (through breast milk) is decreased, there is an increase in the immunoglobulin production in the baby himself which is reflected by a steady rise in its level in saliva (Butte *et al.*, 1984).

Absorption

Although there was no evidence that maternal antibodies are absorbed through the intestinal tract of the newborn infant, still transient intestinal uptake of IgA was

demonstrated in the immediate neonatal period (Ogra *et al.*, 1978).

Stability

Secretory IgA is resistant to proteolytic enzymes and pH changes more than serum IgA.

<u>This resistance is due to either of 2 facts:</u>

1. **Secretory IgA is intrinsically resistant to tryptic digestion, or**
2. **In the first few day after delivery, human colostrum contains an inhibitor of trypsin.**

This resistance allows secretory IgA to function in the variable milieu of the gut, and in some parts of the respiratory tract where it is deposited sometimes during gurgling of the feeding infant (Hanson *et al.*,1978).

Functions of Secretory IgA

(1) The primary function of secretory IgA is inhibition of bacterial adherence, and limitation of colonization to epithelial cells. It keeps bacteria and viruses from invading the mucosa (Weaver et al., 1998).

<u>Three examples to this are:</u>

A) Secretory IgA antibody to the capsule of haemophilus influenza type b *Haemophilus influenza* type b is the cause of most case of sepsis and meningitis in infants.

During breast feeding, an infant's nasopharynx is bathed with milk. Accordingly, secretory IgA will be passively retained on mucosal surfaces by interaction with mucins in the glycocalyx (Walker and Lsselbacher, 1997).

A breast milk antibody to the bacterial capsule of haemophilus influenza type b was detected. This capsule is a virulence factor, and a protective immunogen (Peltola *et al.*, 1977). This antibody could possibly prevent bacterial attachment and colonization in the nasopharynx, and thus preventing systemic invasion (Pichichero *et al.*, 1980).

B) Secretory IgA against Salmonella typhimurium : A study was done in which gastrointestinal infection (via the oral route) with *Salmonella typhimurium* resulted in the production of specific antibodies in colostrum (Allardyce *et al.*, 1974).

C) Secretory IgA against Vibrio cholerae: Breast milk contains two different cholera antibodies:

1. An antibody to the O-antigenic lipopolysaccharide of the outer membrane of Vibrio cholerae O_1, and
2. An antibody directed against cholera toxin.

A study was made and proved that breast milk antibodies against cholera do not protect infants from colonization with *Vibrio cholerae* O_1 but they do protect against disease in those who are colonized.

Breast milk was collected from mothers who had not had diarrhea in the previous week and they were monitored with their breast-fed infants for cholera colnization and diarrhea for 10 days.

Breast milk was assayed for IgA antibodies to cholera toxin and lipopolysaccharide.

The study included 93 mother-child pairs. Thirty infants became colonized with *Vibrio cholera* O_1 and disease developed in 19.

There was no difference between the antibody levels in milk fed to infants who become colonized and in milk fed to infants who did not.

However, amongest the infants who became colonized, those who had diarrhea drank breast milk containing significantly lower levels of both kinds of cholera antibodies than were present in the milk consumed by infants who had no symptoms (Glass et al., 1983).

Finally we can say that exclusive breast-feeding during infancy appears to be associated with nearly absolute protection against severe cholera (Clemens *et al.*, 1999).

D) Secretory IgA against Campylobacter jejuni : Secretory IgA milk antibody titre against the extractable antigen of *C.jejuni* was high in colostrum, decreased during the first month of breast-feeding, and generally persisted throughout lactation. Accordingly, the rate of diarrheal attacks caused by *C.Jejuni* in artificially fed infants was far higher than that in breast-fed infants (Ruiz-Palacios *et al.*, 1990 and Torres & Cruz, 1993).

(2) Secretory IgA plays an important role in resistance against infection with viral diseases:

It prevents colonization of the virus at the portal of entry and accordingly prevents the occurrence of a carrier state.

Circulating IgA plays its role at the stage of systemic infection or viraemia, where it prevents viral replication in peripheral tissue.

Recovery from viral infection probably involves the interplay of both secretory antibody along with phagocytic system and cellular mechanisms as well as interferon.

An example to viral infection is rotavirus and respiratory syncitial virus infection.

Rotavirus is considered to be a major cause of neonatal and infantile gastroenteritis with morbidity and mortality consequences especially in developing countries (Clemens et al., 1993).

Rahman et al. (1987) had seen that all the mothers under study had high titres of rotavirus specific antibodies in breast milk and serum. This indicates that all of them had previous rotavirus infection, which corresponds to the ubiquitous nature of the rotavirus and rotavirus specific antibodies.

Rahman et al. (1987) also detected that titres of rotavirus specific IgA and secretory component in the colostral samples were much higher than in the serum samples. That led them to the assumption that antirotavirus antibody is produced locally in the breast tissue by stimulation of IgA producing cells that have migrated from the gut associated lymphoid tissue, because direct infection of the mammary tissue does not occur. Antigens in the gut lumen are thought to stimulate the precomitted IgA-producing lymphoid cells there, and some of these cells migrate to external secretory tissues- for example, breast tissue for production of antibody.

(3) Secretory IgA to Giardia lamblia

Giardia lamblia is a common intestinal protozoan parasite which represents an important cause of diarrhea throughout the world (Stevens, 1982).

In a certain study, it was found that *Giardia*-positive mothers had significantly higher levels of specific secretory IgA antibodies to *Giardia lambia* in their milk samples than in milk samples from Giardia negative mothers.

Accordingly, the infants of Giardia positive mothers had a low positivity percent of Giardia compared to the high positivity in infants of Giardia negative mothers (Nayak et al., 1987).

Immunoglobulin G (IgG)

It is the major immunoglobulin in cow's milk. However, only small amounts of each of IgG subclasses have been detected in human milk. IgG levels are so much lower in colostrum and breast milk than in normal serum.

Although most of IgG present in mucosal secretions is derived from serum by transudation, still virus-specific IgG antibodies are produced by the mucosa, and can contribute to the total antiviral activity in mucosal secretions (Kim et al., 1992).

In IgA deficient patients, mucosal production of IgG (and IgM) antiviral antibodies can compenste for IgA antibodies' deficient production and secretion (Hahn *et al.*, 1974).

The IgG antiviral antibodies can prevent infection, decrease viral replication, and eliminate or lessen the severity of disease.

IgG_4

As IgG_4 represents 15.3% of total IgG in colostrum, but only 3.5% of plasma IgG. Therefore, it is suggested that IgG_4 may be locally produced in the human mammary gland, or it is selectively transported from serum (Kim *et al.*, 1992).

IgG_4 may be an important immunoglobulin in host defense at mucosal surfaces.

Immunoglobulin M (IgM)

Its concentration is highest in early colostrum and is similar to normal serum concentrations (Hanson et al., 1990).

IgM in milk exists in its typical pentameric form, still some molecules have noncovalently attached SC, sugesting that IgM is transported into milk via the PIgR (Mellander *et al.*, 1986 and Avanzini et al., 1992).

IgD and IgE

Radioimmunoassay techniques showed that colostrum contained IgE at a concentration of 0.5-0.6 IU/ml or even lower, and IgD at a concentration of 2-2000 μg/100 ml.

Their production is more likely to be local mammary production rather than positive transfer (Lawrence, 1989).

IgE is found on the surface membrane of mast cell and basophils in all individuals.

It may play a role in active immunity to helminthic parasties. It is also associated with immediate hypersensitivity diseases such as asthma and hay fever (Andrew, 1982).

IgD is known to be present in large quantities on the membranes of many circulating B lymphocytes. It may play a role in antigen-triggered lymphocyte differentiation.

It may act as an antigen receptor when present on the surface of certain B lymphocytes in fetal cord blood.

B. Cellular elements in breast milk

Breast milk is rich is cells, chiefly macrophages, polymorphs, and lymphocytes.

- Macrophages and polymorphs constitute together 90-95% of the cells.
- They perform the phagocytic function of milk.
- Lymphocytes constitute a very small proportion (Bhaskaram and Reddy, 1981).

1. Macrophages

Macrophages are the next most common milk leucocytes after neutrophils. They constitute 40% of all the leucocytes in colostrum. They are far more active than milk neutrophils. They are more motile than blood macrophages. Together with PMNs, milk macrophages can phagocytose and kill *Staph.aureus, E.coli,* and *C.albicans.*

Milk macrophages apart from being phagocytic, they manufacture lysozyme and so increase its amount in the infant's gastrointestinal tract.

Milk macrophages also probably synthesize lactoferrin. They also can carry the lymphocytes into action against invaders in the digestive tract (Jeliffe and Jeliffe, 1978).

2. Polymorphonuclear leucocytes (PMNs)

The fully develped PMNs can go to their target by chemotactic response, phagocytose and ultimately kill and digest the microbial pathogen.

3. Neutrophils

They represent the most common milk leucocyte. Neutrophils are a type of phagocyte that normally circulates in the blood stream (Goldman, 1988).

Some evidence suggests that neutrophils continue to act as phagocytes in the infant's gut. They are less aggressive than blood neutrophils.

They disappear from breast milk 6 weeks after birth . So perhaps they serve some other function, such as protecting the breast from infection.

4. Lymphocytes:

They constitute the remaining 10% of white cells in the milk. About 20% of these cells are β-lymphocytes which give rise to antibodies. The rest (80%) are T-lymphocytes, which kill infected cells directly, or send out chemical messages that mobilize other components of the immune system (Lawrence, 1989).

How does breast milk offer protection via lymphocytes?

This is performed by either of 2 routes:

The first: is the direct transmission of viable T-lymphocytes from mothers to their suckling infants via milk, and their incorporation in the recipient's tissues.

The second: is the protection offered due to the products of β-lymphocyte clone i.e. colostral antibody (Sarff et al., 1975).

One example to the direct T-lymphocytic protective role is in a report made in which tuberculin-sensitive mothers had adaptively immunized their infants through breast feeding and that immunity might have been long lasting.

An example to the protective effect of the products of β-lymphocyte clone (colostral antibody) is the colonization of the intestinal tract of postpartum women with *E.coli* of the K1 serotype, (the predominant etiological agent in neonatal meningitis). This colonization occurred in about 44% of postpartum women, and it invariably led to the appearance of high-titred antibody of the IgA class in their colostrum. Therefore, intestinal colonization of the mother by an organism that is pathogenic for the newborn leads to the accumulation of lymphocytes and their products in her mammary tissue, which in turn makes them available for her infant (Sarf et al., 1975).

Infant psychology and breast feeding

More than 400 years ago Williams Painter wrote of breast as "that most sacred fountain of the body, and the educator of man Kind".

The process of breast-feeding involves a great deal more than providing physical nourishment for the infant.

It is a psychocultural environment that plays a primary role in the growth and development of the child's capacity to function as a mentally healthy human being. We mean by mental health the ability to love, work, play, and use one's mind critically (Rogan and Gladen, 1993).

The quality of mother-child interaction is essentially influenced by the method of feeding (Lothian, 1995).

The reason for this in that distance and proximity have an essential influence on their relation (Worobey, 1989).

Breast feeding in the first three months of life leads to essential developmental advances in psychomotor and, above all, social maturity. This is due to the intensive visual and olfactorial experiences and perception, the advantages of nutrients in breast-milk, and the infant's autonomy regarding food quantity and time intervals.

The breast is identified with love and security. Accordingly, love for the child begins in the mother's arms at the breast.

Breast feeding is the initiator, and propagator of the mother-infant bonding (Fergusson and Woodward, 1999)

Each is intimately involved with the other on a number of sensory levels. Their behavior is complementary to each other, and serves to lock them together through mutually pleasurable interactions (Bernal & Richards, 1970). An example to this is when the infant becomes hungry, he starts to cry, then the mother starts to breast-feed him. The baby gradually becomes less active, and starts to study her face. He then experiences alleviation of hunger, and pain, tactile contact, and kinesthetic stimulation because of the cradled posture, and the olfactory, and auditory stimulation the mother presents.

Another example is when the mother touches the infant's cheek at the feeding time. He'll turn his head bringing it into contact with her nipple which he will suck. Sucking is pleasurable to both.

This is a "feel-safe" system that ensures proximity of mother and child (Klaus and Kennell, 1992).

Successful breast-feeding brings closer psychological advantages, and satisfactory bonding in the mother-infant relatioships than does bottle feeding (Keay *et al.*, 1982).

All these experiences occur at the same time, and have two consequences:

First: Infants associate the comfortable, and pleasant sensations with the visual-vocal-auditory-olfactory-kinesthetic stimulant qualities of the mother (Wiesenfield et al., 1985).

Second: They establish a predisposition to make the responses of babbling, smiling, and clinging to the caretaker feeding them.

As for the mother, breast-feeding maximizes her pleasure in the feeding situation and therefore strengthens her attachment to her child (Bernal & Richards 1970).

The bottle is an object or a thing. So, with the bottle instead of the breast, and later with toys rather than the mother's caressing hands, the infant is encouraged in the manipulation of things rather than in the handling of people.

There is some sort of neglect on abandoning breast feeding and replacing it with artificial bottle feeding. This neglect is a "neurotic neglect" which consists of lacking nearness, missing body contact, and lacking loving attention during the suckling period.

Also, this neurotic neglect comprises symptoms of passivity, and hostility to order.

In bottle feeding, the bottle might be propped up and the mother leaves the child alone and so bottle feeding will certainly be psychologically less conductive to attachment.

Also, in bottle feeding the infant might be bottle fed on the mother's lap which is less likely to allow continuous eye-to-eye contact as occurs with breast feeding (Kuzela et al., 1990).

This is explained by the fact that human infants have visions from birth, and the distance at which infants can best focus on an object is about 9 to 10 inches, which is the same distance between the eyes of the mother and infant when the mother is breast feeding him (Klaus & Kennell, 1983).

Another factor which facilitates the eye-to-eye contact is the prominence of the mother's breast. Eye-to-eye contact is important for the development of reciprocal recognition and adaptation. Moreover, the human face is the most powerful stimulus for the 2-4 months old child (Baumgartner, 1984).

In bottle feeding, there is less frequent social interaction between the mother ant the baby. The mother's attention is occasionally distracted towards the bottle and its feeds and not towards the baby.

During breast feeding, the mother gives all her attention to the baby, and she spends almost all the feed time looking at him. All these are measures of social interaction between them (Lawrence, 1989).

In bottle feeding, the mother is chiefly responsible for ending bouts of suckling, while in breast feeding there is share between both of them and the baby seems to have more control of what is happening. (Richard, 1982).

Breast feeding allows infants to achieve higher levels of perception, statomotor behavior, dextrity contact behavior, and later on independence.

In breast feeding, there is advancement of perception. This is due to the fact that there is ideal communication between the baby and his mother. The suckling baby perceives predominantly with the senses of nearsress, smell, taste and kinaesthetic sensations. Perception gets advanced by the close contact between the mother and the baby which is established by sight, hearing, and touch (Belsky et al.,1984).

Actually the more frequent, and longer feeding periods (which occur in cases of breast feeding), allow intensive and longer stimulation by touch and accordingly advancement of perception (DeChateau & Wilberg, 1977).

Another point is the baby's independence where he is an active partner from the beginning, determining the quantity, duration, and number of feeds on the basis of his nutritional needs.

Meanwhile, the bottle fed baby can not be considered an independent partner because the mother has to follow the instructions given by the pediatrician when composing the meals. At the same time that bottle-fed baby has to be satisfied with the quantity which is given to him.

In addition, most of the time the bottle fed baby is not able to satisfy his need for suckling because bottle suckling does not demand much effort. In this way the baby frequently experiences the end of feeding as a frustration (Baumgartner, 1984).

As regards the statomotor development, over 50% of breast-fed babies were able to walk when being one year old, however, far less than 50% of bottle fed babies were able to do so (Baumgartner, 1984).

The mother's breast and the baby's facial and oral structures appear to be reciprocally designed for breast feeding.

In breast feeding, the infant presses its jaws and face first against one breast, and then at the other. Accordingly both sides of the face, jaws, and other parts of the body receive a great deal of the kind of stimulation that is denied in the bottle fed infant.

Also in breast-feeding, the baby's various mouth structures especially the tongue receive an exercise not undergone by the bottle-fed infant (Bernal & Richards, 1970).

The amount and quality of exercise that the oral and pharyngeal structures undergo during the process of suckling appear to cause a more speedy development of a clear speech in breast-fed than bottle fed babies.

Two studies showed that breast-fed children were superior to bottle fed ones as regards speech development, clarity of articulation, tone quality, reading ability, and general confidence, at the age of 5-6 years.

This is because of two reasons:

1. The organs of suckling and articulation are the same, and so conditions that influence the development of the suckling response would have an effect on the structures required for speech.

2. Breast feeding decreases the incidence of infections in infancy. Accordingly there is a decrease in the incidence of respiratory tract infections, which will lead to decreased incidence of infection in the auditory apparatus. Since the ability to speak depends upon the ability to hear, therefore defective speech qualities are less in breast-fed than in bottle fed babies.

From the point of view of social behavior and depth psychology, baby's reaction to strangers, and their shy-acting express their recognization and distinguishment of the Ego-Self, and the Non-Self. Fear from strangers is essential for the early relation to an object and for binding to it.

Breast-fed babies show earlier shy-acting, and after the 9^{th} month they were no longer impeded by fear of stranger during exploration and in their movements and locomotion (Morgan & Ricciutti, 1980).

On the other hand, just during this period bottle-fed babies were held back by their fear from strangers. This phase lasts considerably longer than in breast-fed babies.

Breast feeding is therefore considered a preventive measure of the baby's untroubled emotional development. Harmony, trust, and emotional balance arise from the primary trust during the first months of life. The baby's effort to suck the breast milk expresses an active conquest of the world (Baumgartner, 1984).

Attachment in infants

What is attachment

It is the relation between the infant and his mother or another caretaker. In this relation the mother cares for, feeds, cuddles, talks to and plays with her infant. The child's reaction in turn has the following three characteristics:

<u>First</u>: The child approaches that person for playing, when distressed, tired, hungry, in pain, bored, or afraid.

<u>Second</u>: The child is more easily soothed by this person than anyone else.

<u>Finally</u>: the child shows no fear when he is with that person even if there is exposure to unfamiliar events.

Two basic processes contribute to the development of an attachment to another person (Mussen et al., 1979).

The first process is the process of interaction where the infant responds to the signals communicated by the caretaker, who in turn responds to the infant's responses, each providing a continuous "feedback" to the other.

The second process is the establishment of an association between feelings of pleasure, contentment, and relief of distress on one hand, and the presence of the target of attachment on the other.

Several studies strongly suggest that there is a period shortly after birth, called a "sensitive period", that may be optimal for the development of a mother's affectional bond to her infant.

If this period is delayed, the bonding process may take longer, becomes more fragile, and more difficult to complete.

The importance of the mother-infant bonding lies in its being the major source of subsequent attachments, and it is the formative relationship from which the child draws a sense of himself or herself (Klaus & Kennell, 1992).

Three studies were done by three scientists, Johnson (1976) in Seattle, Sousa (1974) in Brazil and De Chateau (1976) in Sweden, had proved that early intimate contact between the mother and her infant is associated with significantly increased breast feeding, and accordingly more significant weight gain with fewer infections through the first year of life.

Again some studies proved that both the first hour following birth, and moreover the first 24 hours of life possess periods of quiet relative alertness "Alter Inactivity' which are exhibited by the normal newborn.

These periods were ideal for initiation of reciprocal responsitivity between the mother and her infant (Klaus and Kennell, 1992).

During this time, there is an eye contact between the baby's opened eyes and his mother. He usually tracks her over

180 degrees and he will look towards her and will move rhythmically with her voice.

As regards the mother, she will have "skin to skin" contact, more "eye to eye" contact, and more oxytocin and prolactin release while nursing the baby. All this will calm her, increase her bond with her baby, and make her more reluctant to leave him with someone else than mothers who have had little contact (Richards, 1982).

SUBJECTS AND METHODS

Subjects and Methods

Eighty infants were recruited for this study from "El-Bayoumia" medical center in Giza after taking their mothers' approval to participate in it. Fourty infants were exclusively breast fed and the other fourty were formula fed.

They were followed up since birth, and till the end of the first year of life. Thirty mothers (and accordingly infants) dropped out during the study course, and did not finish it. Accordingly, we were left with fifty infants, twenty five breast fed, and twenty five formula fed.

All studied infants came from the same low-middle socioeconomic standard. Breast fed infants continued to be breast fed till the end of the twelfth month of age. Their weaning started nearly since the fourth month.

Formula fed infants were never breast fed. Their formula feeding started since birth.

Each infant was subjected to:

1- Immunoglobulins A,M,G levels measurement in saliva at the 1st, 3rd, 6th, and 9th months of age.

2- Measuring the rate of infections of each infant monthly during this first year.

3- Anthropometric measurements at the 1st, 3rd, 6th, 9th, and 12th months of age.

4- Psychological assessment of each infant almost every month by means of questionnaire to the mother.

I. Immunoglobulins levels assessment in Saliva:

Here we measured the level of immunoglobulins in saliva because it was impossible to get the mothers' approval of taking serum samples from their infants every 2-3 months. Mothers were afraid of subjecting their infants to pain, blood losses (even though minute), and risks of repetitions of the samples taking if any failure would happen.

For assessing the immunoglobulins (A,G,M) levels in saliva, we used the immunodiffusion technique.

a- Samples collection:

Salivary samples were collected from each of the 50 infants every 3 months starting from the age of one month, then at 3,6, and 9months of age.

Complete aseptic conditions were fulfilled using sterile syringes without their needles, and sterile small plastic tubes with covers.

The saliva collected each time was not mixed with any milk or food taken by the baby.

The collected saliva was kept frozen at – 10^0C. The National Research Center Child Health Laboratory obtained kits from Hoechst company in Cairo.

Each immunodiffusion plate contained 12 wells. Accordingly, we brought 17 plates for the assessment of Salivary IgA, 17 for IgG and 17 for IgM in order to have the number of wells suitable to measure four samples for each of the 50 infants (at the 1^{st}, 3^{rd}, and 9^{th} months of age).

Storage of plates:

All the plates were stored in their original unopened state at temp + 2^0C to + 8^0C in the refrigerator, and were protected from freezing.

Laboratory Work:

Methodology

(1) Method of Determination of Salivary Immunoglobulins:

IgA level:

The protein standard serum LC-V is supplied with the kit. It serves as a reference preparation for quantitative immunological determination of salivary immunoglobulin A concentration (SIgA).

The protein standard serum LC-V is a lyophilized stabilized mixture of serum from healthy adults. Its IgA concentration is 13.6mgl dl. (Behring). The protein standard serum LC-V was stored in the original state, unopened, at about + 2^0C to + 8^0C untill used but before the expiry date.

The protein standard serum LC-V was supplied as powder. It was reconstituted with exactly 0.5ml of distilled water. It was not to be shaken vigorously in order to avoid the formation of foam.

The samples with different concentrations were made using this standard serum.

The first sample was a $^1/_{25}$ dilution made by using isotonic saline solution as a diluent that made IgA conc. 0.54mgl dl.

The second sample was a $^1/_{50}$ dilution made by using isotonic saline solution that made IgA conc. 0.27mgl dl.

The third sample was a$^1/_{150}$ dilution that made IgA conc. 0.09mgl dl.

The LC partigen IgA plate contains α chain specific antiserum which reacts with the human salivary sample producing simple radial immunodiffusion precipitate rings. The precipitate diameters vary according to the concentration of IgA in the samples.

The LC partigen IgA plate was removed from the refrigerator and was opened.

The opened plate was allowed to stand for five minutes at room temperature for evaporation of any water vapour that might have condensed in the wells during the storage period.

The first three wells were filled with the three different standard dilutions of the LC-Partigen (1:150, 1:50, 1:25). The remaining wells were filled with the salivary samples.

The volume needed to fill each well was 20µl. (0.02ml). After filling the 12 wells of each plate, the plate was allowed to stand open for about ten to twenty minutes to allow absorption of the samples. Afterwards the plate was closed with its plastic lid and was left at room temperature for 3days.

The precipitate rings diameters were measured using a special magnifying lens scaled in millimeters.

The immunoglobulin A concentration was determined by using a graph paper. The horizontal scale represented the known IgA concentration of the protein standard serum (LC-Partigen IgA), and the vertical scale represented the measured precipitate ring diameter of the protein standard serum in mm^3.

<u>SIgG level</u>:

The same steps as for SIgA were followed up but the dilutions were $^1/_{30}$, $^1/_{15}$, $^1/_8$.

<u>SIgM level</u>:

Similarly the same steps were followed up but the dilutions were $^1/_4$, $^1/_2$, $^1/_1$.

(II) Measuring the incidence of infection:

Each infant was clinically examined monthly. The clinical examination included upper respiratory tract, chest, and abdominal examination. Each mother was asked whether each infant caught any infection before the date of the monthly examination.

(III) Anthropometric Measurements:

These were done for each infant at birth and at the first, third, sixth, ninth, and twelfth months of age.

These measurements included:

Weight and Height (Length):

The ability to assess the anthropometric results depends essentially on having valid reference values to which actual measurements may be compared. The use of United States National Center of Health Statistics (N C H S) reference values has been accepted in WHO reports to be internationally used as reference standards (WHO, 1986). Accordingly, in this study evaluation and analysis of results of the anthropometric measurements were done in relation to the N C H S reference using the "Anthro" computer programme. Evidence of growth failure was determined by the analysis of weight for age and height for age. Each of these indices was related to N C H S reference standards either by its standard deviation score from the mean of the reference standards "Z score" or by its position within the centile distribution "percentiles (P)". The correct word for height at this age is length (recumbant length).

a- Weight:

It reflects the current nutritional status (Tenore & Vargas, 1993). The infants were placed almost undressed on the weighing scale (which was adjusted at the zero mark) and the reading was taken when the baby was reasonably still. As it was impossible for the infant to be fully undressed, an equivalent amount of clothes was weighed, and that value was subtracted.

b- Height (Length):

It reflects chronic ongoing malnutrition (Tenore & Vargas, 1993). The recumbant length was measured. A flat table was used. It had a measuring stick fastened along one edge. The soles of the feet were held firmly against a fixed upright placed at the zero mark. A movable upright was brought firmly against the head vertex. The reading was taken in cm.

(IV) Psychological Assessment:

Assessment and follow up of the infants' temperament, to exhibit their behavioral style, were done via questionnaires to their mothers.

This was done starting from the second month of age and up to the end of the first year of life.

Mothers were prepared to answer the questions concerning their infants temperament (and accordingly the behavioral style) since the first month after delivery.

During this month it was explained to them how they could accurately observe their infants behavior and reactions as regards every item in the questionnaire sheet.

It is important to explain why only these items were specifically chosen to evaluate the infants.

After exploring the temperament dimensions, it was found that only six of the nine New York Longitudenal study dimensions showed any significant associations with the Brazelton or Rothbart dimensions, and only four of the six Rothbart dimensions were correlated with the Brazelton or Thomas and Chess factors (Worobey, 1993).

Except for activity, the dimensions that did relate were either positive (e.g. orientation, approach, and positive mood) or negative (e.g., irritability, distress, negative mood) in their emotional tone.

Given this pattern of what would be termed positive and negative emotionality, the dimensions could reasonably be reduced a priori to three areas of temperament, namely responsivity (Worobey and Belsky, 1982), irritability (Worobey, Laub, and Schilmoeller, 1983), and activity (Worobey and Anderson-Goetz, 1985).

Other researchers reached the same conclusions. Buss and Plomin, (1984) removed impulsivity from their earlier framework and settled on three dimensions, namely, sociability, emotionality and activity.

Also, in summarizing the major effects of temperament on the social system during childhood, Bates, (1989) chose to focus on sociability, "difficultness", and activity. Finally, in a study of questionnaire convergence, Goldsmith and his colleagues identified approach-sociability, negative-emotionality, and activity level as representative of the most commonly assessed temperament traits (Goldsmith, Riser-Danner, and Briggs, 1991).

From all the above, it is concluded that these three temperament traits or dimensions were chosen because they are well suited for analysis by feeding method (Worobey, 1993) (ie) the impact of the early feeding regimen on the expression of temperament.

In addition, shy, and fear reactions to strangers were questioned because they are important criteria of emotional experience, intellectual maturity, and Ego-self and non-self development, recognition, and distinguishment.

Finally, the statomator condition of the infant was exhibited by his ability or even his intentional ability to walk but with support (because by the end of the first year of life, it was very normal to find infants still unable to walk).

Psychological Questionnaire

(1a) Irritability or Stress Response:

All mothers whether breast feeding or formula feeding were asked at the end of the first month and the beginning of the second month to observe accurately the reaction of their infants at the moment of DPT vaccination during the second month. Vaccination here is viewed as painful. Each mother was asked to report whether her infant's reaction to this painful stimulus was facial grimacing, fussing, crying and fretting or not. Mothers could answer that question because each mother knew the baselive level of her infant as regards his reactivity to things.

(1b) Soothability:

At the end of the DPT vaccination, mothers, who made efforts to console their infants, were to report the time taken by these infants to stop fretting and be quietened. That time was compared when all infants were at an equivalent level of composure. This was aided by our own reports when we attended the vaccination time.

(2) Motoric Activity:

By the end of the third month and up to the age of three and half months, all mothers were to report their infants' total activity level. This meant the gross motor activity which included squirming, arm movements, and leg movements.

Mothers were to report if their infants' total activity level was high or not, and if the arm movements exceeded the leg movements.

(3) Responsivity:

At the age of eight months, all mothers were asked to report their infants responses in a free play session. They were to answer exactly the following items in the question:

Did the infant, during his free-play session with you at home, exhibit gazing at you, smiling, contingently vocalizing, reaching towards you, and fussing.

Their answers lied in two categories:

Yes (+), they gazed and smiled and were eager to reach out and vocalize.

No, the infant was involved with the toy in a calm manner without paying much attention to the mother (-ve).

The mothers' answers were confirmed by our own observations. Few toys were brought to the outpatient clinic, and the mother was left to play with her infants for nearly 10 minutes while the examiner was out of the infant's sight.

(4) Fear Reaction to Strangers:

This reaction was examined in all infants whether breast-fed or formula-fed. Here we observed and reported how the infant reacted towards the examiner as a stranger. The first examination started at the age of three months (up to 4 months), then it was followed up at six, nine, and twelve months of age.

The infant was made to lie on the examination bed while his mother stayed in his area of vision. Afterwards the baby was placed on the (weighing) scale while his mother stepped out of his view. Soon, there-after the mother reappeared, took up the baby, and consoled it.

The baby's reactions were noted and reported. These induded staring, searching for the mother, crying, and defensive actions with movements of escape.

These reported reactions supported and confirmed the mothers' reports of how their infants reacted to strangers at home and the strength of these reactions.

We were mainly concerned by when did this fear reaction first appear, for how long did it stay (age in months), and when did it disappear.

(5) Motor development and walking:

All mothers whether of breast-fed or artificially-fed infants were asked if their infants were able to walk (while being supported by something) by the age of twelve months or not.

Statistical analysis:

SPSS / PC + computer programme has been used for statistical analysis. It has the advantage of printing the P-values for statistical test.

Mean: The most common measure of central tendency. It is the sum of set of values divided by the number of values involved..

Standard deviation (S.D.) : The most common measure of dispersion. It is the square root of the average of the squared deviation of the observation from their mean.

Variance: It is the square of standard deviation. It is a measure of dispersion in a distribution of observations in a population or a sample.

Percentile : A number that indicates the percentage of a distribution that is less than or equal that number.

The Z score: The deviation of a variable from its mean divided by the standard deviation.

Z = measure – mean / S.D.

P value: The probability of observing a result as extreme or more extreme than the one actually observed based on chance only.

One way analysis of variance:

Analysis of variance technique is a general methodology useful for evaluating differences among two or more sample means. In one way analysis of the variance there is only one variable by which subjects are grouped. F ratio is the fundamental to the analysis.

F = between groups variance estimate / within groups variance estimate.

Correlation analysis :

Correlation analysis describes the systemic association between the values of two variables. When high values of one variable are associated with high values of the other variable, and the low values are associated with low values, we say that the two variables are positively correlated. When high values of one variable are associated with low values of the other variable and vice versa, we say that the two variables are negatively correlated.

Correlation coefficient (r):

It is a well defined numerical index that summarizes the extent of correlation between two variables. The r ranges in value from –1.000 to +1.000. A correlation coefficient of –1 signifies a perfect negative linear correlation.

RESULTS

Results

(I) Assessment of Salivary Immunoglobuins levels:

a- Salivary Immunoglobulin A (SIgA):

Table (1), Fig (1) show the mean values of SIgA level in breast-fed compared to formula-fed infants at the first, third, sixth, and ninth months of age.

Table (2), Fig (2) show these values at all age periods summed up together.

SIgA levels were significantly higher in formula-fed compared to breast-fed infants at each age period and at all age periods summed up together.

At the first month of age:

SIgA in formula-fed infants was 7.26mgl dl, while in breast-fed infants it was 3.22mgl dl.

At the third month of age:

SIgA in formula-fed infants was 6.52mgl dl, while in breast-fed infants it was 4.11mgl dl.

At the sixth month of age:

SIgA in formula-fed infants was 6.34mgl dl, while in breast-fed infants it was 4.79mgl dl.

At the ninth month of age:

SIgA in formula-fed infants was 6.59mgl dl, while in breast-fed infants it was 4.70mgl dl.

***At all age periods*:**

SIgA in formula-fed infants was 6.67mgl dl. while in breast-fed infants it was 4.20mgl dl.

Table (1) : Mean ± SD of Salivary IgA In Breast-fed Compared To That Of Artificially Fed Infants At Different Age Periods

Age in Months		SIgA Level in mg/dl		F-ratio	P-level
		Breast-fed n.=25	Artificially fed n.=25		
1st month of age	Mean ± SD	3.22±0.78	7.26±1.73	112.53	0.000
	Range	1.90-5.20	4.50-9.80		
3rd month of age	Mean ± SD	4.11±1.06	6.52±1.56	40.42	0.000
	Range	2.10-6.30	3.90-8.90		
6th month of age	Mean ± SD	4.79±1.00	6.34±1.41	20.06	0.000
	Range	3.10-6.90	4.40-8.90		
9th month of age	Mean ± SD	4.70±0.86	6.59±1.15	43.37	0.000
	Range	3.40-6.50	4.70-8.80		

n.= Number of infants

Table (2): **Mean ± SD of Salivary IgA In Breast-fed Compared To That Of Artificially Fed Infants At All Age Periods Summed Up Together**

Age in Months		SIgA Level in mg/dl		F-ratio	P-level
		Breast-fed n.= 100	Artificially fed n.= 100		
1-9 months	Mean ± SD	4.20±1.11	6.67±1.50	175.03	0.000
	Range	1.90-6.90	3.90-9.80		

n.= Number of infants

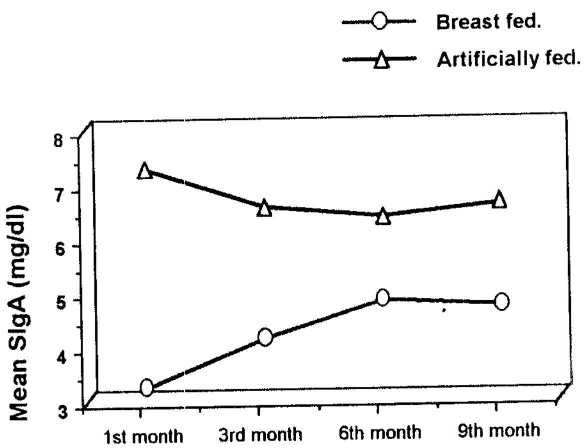

Fig ( ): Mean Of Salivary IgA Level In Breast Fed Compared To That Of Artificially Fed Infants At Different Age Periods

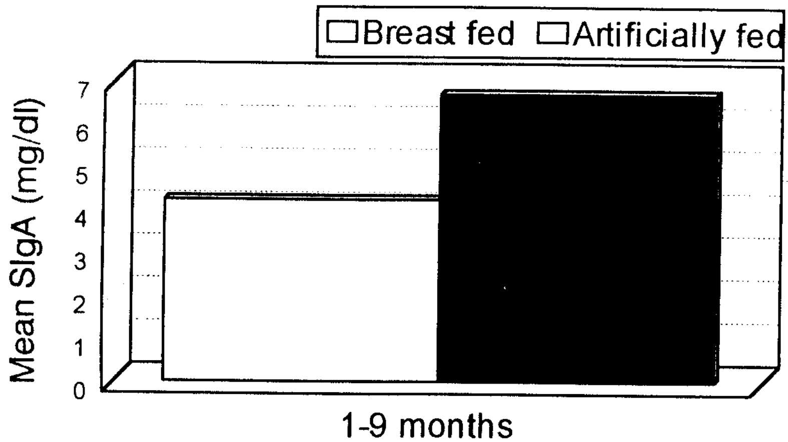

Fig (2): Mean Salivary IgA Levels In Breast Fed Compared To That Of Artifically Fed Infants At All Age Periods Summed Up Together b- Salivary Immunoglobulin G (SIgG):

Table (3), Fig (3) show the mean values of SIgG level in breast-fed compared to formula-fed infants at the first, third, sixth, and ninth months of age.

Table (4), and Fig (4) show these values at all age periods summed up together.

SIgG levels were significantly higher in formula-fed compared to breast-fed infants at all age periods summed up together, and at each age period except at the first month of age where SIgG was higher in breast-fed compared to formula-fed infants.

At the first month of age:

SIgG in formula-fed infants was 0.14mgl dl, while in breast-fed infants it was 0.176mgl dl.

At the third month of age:

SIgG in formula-fed infants was 0.122mgl dl, while in breast-fed infants it was 0.059 mgl dl.

At the sixth month of age:

SIgG in formula-fed infants was 0.060mgl dl, while in breast-fed infants it was 0.043mgl dl.

At the ninth month of age:

SIgG in formula-fed infants was 0.087mgl dl, while in breast-fed infants it was 0.072mgl dl.

At all age periods:

SIgG in formula-fed infants was 0.104mgl dl. while in breast-fed infants it was 0.087mgl dl.

Table (3): Mean ± SD of Salivary IgG In Breast-fed Compared To That Of Artificially Fed Infants At Different Age Periods

Age in Months		SIgG Level in mg/dl		F-ratio	P-Level
		Breast-fed n.=25	Artificially fed n.=25		
1st month of age	Mean ± SD	0.176±0.026	0.147±0.021	18.742	0.0001
	Range	0.140-0.240	0.110-0.180		
3rd month of age	Mean ± SD	0.059±0.016	0.122±0.019	149.003	0.000
	Range	0.030	0.090-0.150		
6th month of age	Mean ± SD	0.043±0.013.	0.060±0.010	27.624	0.000
	Range	0.020-0.070	0.030-0.070		
9th month of age	Mean ± SD	0.072±0.021	0.087±0.013	8.669	0.0050
	Range	0.030-0.110	0.060-0.110		

n.= Number of infants

Table (4): **Mean ± SD of Salivary IgG In Breast-fed Compared To That Of Artificially Fed Infants At All Age Periods Summed Up Together**

Age in Months		SIgG Level in mg/dl		F-ratio	P-level
		Breast-fed n.= 100	Artificially fed n.= 100		
1-9 months	Mean ± SD	0.087±0.056	0.104±0.037	6.0686	0.0146
	Range	0.020-0.240	0.030-0.180		

n.= Number of infants

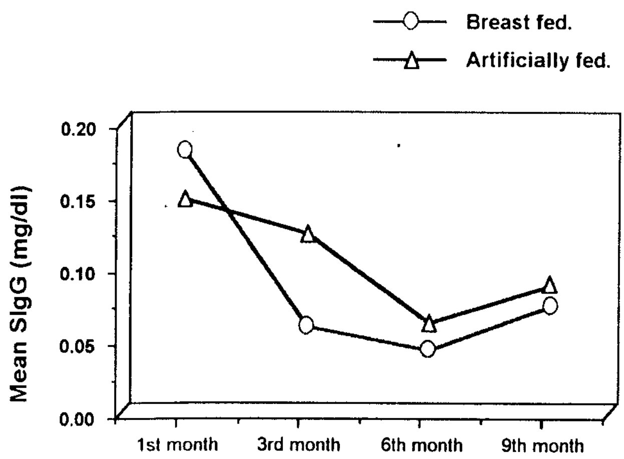

Fig (3): Mean Of Salivary IgG Level In Breast Fed Compared To That Of Artificially Fed Infants At Different Age Periods

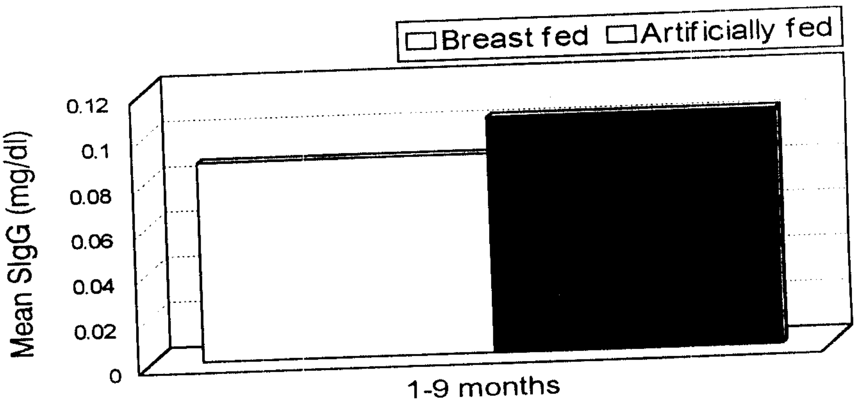

Fig (4): Mean Salivary IgG Levels In Breast Fed Compared To That Of Artifically Fed Infants At All Age Periods Summed Up Together c- Salivary Immunoglobulin M (SIgM):

Table (5), and Fig (5) show the mean values of SIgM level in breast-fed compared is formula-fed infants at the first, third, sixth, and ninth months of age.

Table (6), and fig (6) show these values at all age periods summed up together.

SIgM levels were significantly higher in formula-fed compared to breast-fed infants at each age period and at all age periods summed up together.

At the first month of age:

SIgM in formula-fed infants was 0.396mgl dl, while in breast-fed infants it was 0.150mgl dl.

At the third month of age:

SIgM in formula-fed infants was 0.969mgl dl., while in breast-fed infants it was 0.156gml dl.

At the sixth month of age:

SIgM in formula-fed infants was 0.393mgl dl, while in breast-fed infants it was 0.173mgl dl.

At the ninth month of age:

SIgM in formula-fed infants was 0.380mgl dl, while in breast-fed infants it was 0.173 mgl dl.

At all age periods:

SIgM in formula-fed infants was 0.534mgl dl. while in breast-fed infants it was 0.163mgl dl.

Table (5): **Mean ± SD of Salivary IgM In Breast-fed Compared To That Of Artificially Fed Infants At Different Age Periods**

Age in Months		SIgM Level in mg/dl		F-ratio	P-level
		Breast-fed n.= 25	Artificially fed n.= 25		
1st month of age	Mean ± SD	0.15±0.009	0.396±0.063	366.460	0.000
	Range	0.140-0.170	0.270-0.530		
3rd month of age	Mean ± SD	0.156±0.019	0.969±0.181	497.248	0.000
	Range	0.120-0.190	0.700-1.400		
6th month of age	Mean ± SD	0.173±0.012	0.393±0.073	218.096	0.000
	Range	0.150-0.190	0.240-0.490		
9th month of age	Mean ± SD	0.173±0.010	0.380±0.069	216.823	0.000
	Range	0.160-0.190	0.240-0.480		

n.= Number of infants

Table (6): **Mean ± SD of Salivary IgM In Breast-fed Compared To That Of Artificially Fed Infants At All Age Periods Summed Up Together**

Age in Months		SIgM Level in mg/dl		F-ratio	P-level
		Breast-fed n.= 100	Artificially fed n.= 100		
1-9 months	Mean ± SD	0.163±0.017	0.534±0.273	183.162	0.000
	Range	0.120-0.190	0.240-1.400		

n.= Number of infants

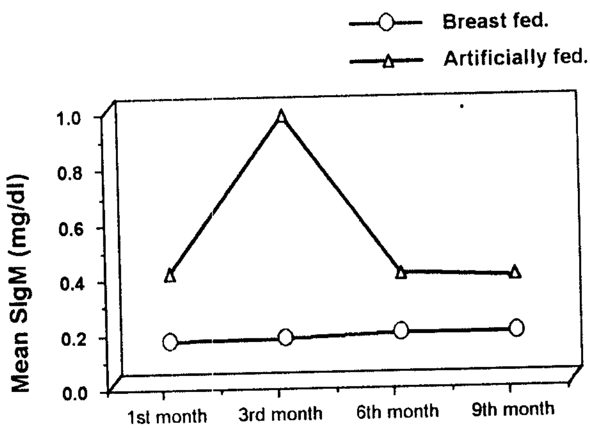

Fig (5): Mean Of Salivary IgM Level In Breast Fed Compared To That Of Artificially Fed Infants At Different Age Periods

Table (7): Frequency of RT and GIT Infections In Breast-fed Compared To That Of Artificially Fed Infants

	RT infections during the study period				GIT infections during the study period			
	BF		AF		BF		AF	
	No.	%	No.	%	No.	%	No.	%
No attacks	6	24	2	8	12	48	1	4
One attack	14	66	7	28	10	40	9	36
Two attacks	4	16	9	36	3	12	6	24
Three attacks or more	1	4	7	28	0	0	9	36
Chi^2	14.256.				19.360			
p-value	0.0269				0.0016			

Table (8): **Comparison Of The Mean Levels Of Salivary Immunoglobulins In Infants Having Different Numbers Of RT Infection Episodes**

Type of Ig	Group I	Group II	Group III	Group IV	F-ratio	P-level
	No episodes per study period	One episodes per study period	Two episodes per study period	Three episodes per study period		
SIgA mg/dl	4.777*	5.807*	6.845*	7.250*	17.193	0.000
SIgG mg/dl	0.106*	0.082*	0.089	0.081	3.819	0.010
SigM mg/dl	0.291*	0.363*	0.549*	0.419	7.008	0.000

* = Denotes pairs of groups significantly different at the 0.05 level.

Salivary Immunoglobulin G levels:

As regards SIgG, it was found that there was a significant difference between the mean level of SIgG when there was no exposure to RT infection episodes, and when there was exposure to one RT infection episodes. In the former situation, the mean level of SIgG was 0.106mgl dl, while in the second situation, the level was 0.082.

Salivary Immunoglobulin M levels:

As regards SIgM, there is a significant difference between the mean level of SIgM when there was no exposure to RT infection episodes, (0.29mgl dl) and when there were two episodes (0.54mgl dl). Again this significant difference was found when there was only one episode (0.36mgl dl) and when there were two episodes (0.54mgl dl).

(B) Gastrointestinal tract Infection Episodes:

Table (9) compares between the mean levels of salivary immunoglobulins A, G, and M, and the number of gastrointestinal tract infection episodes to which the infants were exposed.

Salivary immunoglobulin A levels were found to increase progressively with the increase in the number of GIT infection episodes.

Table (9): **Comparison Of The Mean Levels Of Salivary Immunoglobulins In Infants Having Different Numbers Of GIT Infection Episodes**

Type of Ig	Group I	Group II	Group III	Group IV	F-ratio	P-level
	No episodes per study period	One episodes per study period	Two episodes per study period	Three episodes per study period		
SIgA mg/dl	5.072*	5.675	6.637*	6.675	7.330	0.0001
SIgG mg/dl	0.105*	0.083	0.075*	0.078	4.678	0.0035
SigM mg/dl	0.304*	0.447*	0.414	0.402	3.680	0.0131

* = Denotes pairs of groups significantly different at the 0.05 level.

Table (9) shows a significant difference in the mean salivary levels of IgA when there were no GIT infection episodes (5.07mgl dl) and when there were two GIT infection episodes (6.63mgl dl).

Similarly salivary IgM levels increased with the increase in the number of GIT infection episodes. There is a significant difference in the mean salivary levels of IgM when there were no GIT infection episodes (0.30mgl dl) and when there was exposure to one GIT infection episode (0.44mgl dl).

As regards SIgG there was a significant difference between its level when there were no GIT infection episodes (0.105mgl dl) and when there was exposure to two GIT infection episodes (0.075mgl dl).

Table (10) showed the correlation between SIgA, SIgG, and SIgM and the number of RT and GIT infection episodes in breast-fed infants.

Table (11) showed the correlation between SIgA, SIgG, and SIgM, and the number of RT and GIT infection episodes in artificially fed infants.

Table (12) showed the correlation between SIgA, SIgG and SIgM, and the number of RT and GIT infection episodes in all infants.

Table (10): Correlation Between Salivary IgA, IgG And IgM Levels And The Number Of RT, And GIT Infection Episodes In Breast-fed Infants

	IgA	IgG	IgM
RT infection episodes	R= 0.518 P= 0.000	R= -0.208 P= 0.019	R= 0.444 P= 0.000
GIT infection episodes	R= 0.286 P= 0.002	R= 0.139 P= NS	R= 0.319 P= 0.001

Table (11): Correlation Between Salivary IgA, IgG And IgM Levels And The Number Of RT, And GIT Infection Episodes In Artificially Fed Infants

	IgA	IgG	IgM
RT infection episodes	R= 0.220 P= 0.014	R= -0.333 P= 0.000	R= 0.028 P= NS
GIT infection episodes	R= 0.110 P= NS	R= 0.620 P= 0.000	R= 0.260 P= 0.004

Table (12): **Correlation Between Salivary IgA, IgG And IgM Levels And The Number Of RT, And GIT Infection Episodes In All Infants**

	IgA	IgG	IgM
RT infection episodes	R= 0.442 P= 0.000	R= -0.176 P= 0.006	R= 0.254 P= 0.000
GIT infection episodes	R= 0.311 P= 0.000	R= 0.234 P= 0.000	R= 0.179 P= 0.006

(A) As Regards RT Infection Episodes:

In case of SIgA:

There was a strong positive correlation between SIgA level, and the number of RT infection episodes in case of breast-fed infants (r=0.518) table (10) which means that SIgA level rises with the increase in the number of RT infection episodes.

In case of artifically fed infants: There was still a significant positive correlation but weaker than that in breast-fed infants (r=0.220) table (11).

When considering all infants together: There was always a rise in SIgA production in response to the increase in RT infection episodes (r=0.442) table (12).

In case of SIgG:

There was a weak negative correlation between SIgG level and the number of RT infection episodes in case of breast-fed infants (r= -0.208) table (10) which means that SIgG level did not rise (even was low) with the increase in the number of RT infection episodes.

In case of artificially fed infants, there was still a weak negative correlation and even weaker than that in breast-fed infants (r= -0.333) table (11).

When considering all infants together, there was always that weak correlation. (r= -0.176) table (12).

In case of SIgM:

There was a strong positive correlation between SIgM level and the number RT infection episodes in case of breast-fed infants (r=0.444) table (10).

In case of artificially fed infants: there was still a positive but weak correlation (r=0.028) table (11).

When considering all infants together: there was a moderately positive but significant correlation (r=0.254) table (12).

(B) As Regards GIT Infection Episodes:

In case of SIgA:

There was a positive correlation between SIgA level and the number of GIT infection episodes in both breast-fed and artificially fed infants. This means that the more the number of GIT infection episodes, the higher was the level of SIgA. However this correlation was stronger in breast-fed infants (r=0.286) than in artificially fed ones (r=0.110) tables (10,11). This might be due to the same reasons mentioned in RT infection episodes.

When considering all infants together, there was a moderately positive but significant correlation (r=0.311) table (12).

In case of SIgG:

There was also a positive correlation between SIgG level and the number of GIT infection episodes in both breast-fed and artificially fed infants. However this correlation was stronger in artificially fed infants (r=0.620) than in breast-fed infants whose correlation was not significant (r=0.139) tables (10,11).

When considering all infants together, the correlation was a positive moderately strong but significant one (r= 0.234) table (12).

In case of SIgM:

There was also positive correlation between SIgM level and the number of GIT infection episodes in both breast-fed and artificially fed infants. However this correlation was somewhat stronger in breast-fed infants (r=0.319) than in artificially fed infants (r=0.260) tables (10,11).

When considering all infants together the correlation was a positive (r=0.179) table (12).

(III) Assessment of the Anthropometric Measurements:

These measurements included weight in kgms, and height (length) in cms.

A. Weight:

Table (13) shows that there is no significant difference in birth weights between breast-fed, and formula-fed infants.

Table (14) and Fig (7) compare the mean weight for age Z score (WAZ) in breast-fed, and formula-fed infants throughout their first year of age (every month).

Table (15) compares the mean weight for age percentiles (WAP) in breast-fed, and formula-fed infants throughout their first year of age (every month).

Both comparisons revealed that formula-fed infants were significantly heavier.

However, this does not mean that breast-fed infants were underweight, on the contrary, their weights (WAP) fell within the normal percentiles (40^{th} - 50^{th} percentiles) Tables (15,16)

Table (16) Fig (8) shows that at all ages summed up together, formula-fed infants had significantly heavier weights than breast-fed ones. ($P = 0.000$).

B. Height (Length):

Table (13) shows that there is no significant difference in birth heights between breast-fed, and formula-fed, infants.

Table (17) and Fig (9) compare the mean height for age Z score (HAZ) in breast-fed and formula-fed infants throughout their first year of age (every month).

Table (18) compares the mean height for age percentiles (HAP) in breast-fed, and formula-fed infants throughout their first year of age (every month).

Table (13): Comparison Of Mean Birth Weight And Birth Height Between Breast-fed And Artificially Fed Infants

	Breast-fed	Artificially fed	P level
Birth weight (kg)	3.25 ± 0.32	3.34 ± 0.25	NS
Birth height (cm)	50.38 ± 1.49	50.49 ± 1.13	NS

Table (14): Mean ± SD of WAZ In Breast-fed Compared To That Of Artificially Fed Infants At Different Age Periods

Age in months		Breast-fed WAZ	Artificially fed WAZ	F-Ratio	P-level
1st month of age	Mean ± SD	-0.186 ±0.568	0.324 ±0.484	11.664	0.0013
	Range	-1.300-0.760	-0.420-1.130		
3rd month of age	Mean ± SD	-0.165 ±0.485	0.368 ±0.508	14.403	0.0004
	Range	-1.240-0.83	-0.510-1.260		
6th month of age	Mean ± SD	0.084 ±0.502	0.639 ±0.441	17.303	0.0001
	Range	-0.870-0.860	-0.350-1.400		
9th month of age	Mean ± SD	0.019 ±0.558	0.660 ±0.576	17.946	0.0001
	Range	-0.910-0.650	-0.440-1.450		
12th month of age	Mean ± SD	-0.028 ±0.616	0.792 ±0.517	26.200	0.000
	Range	-1.130-0.930	-0.300-1750		

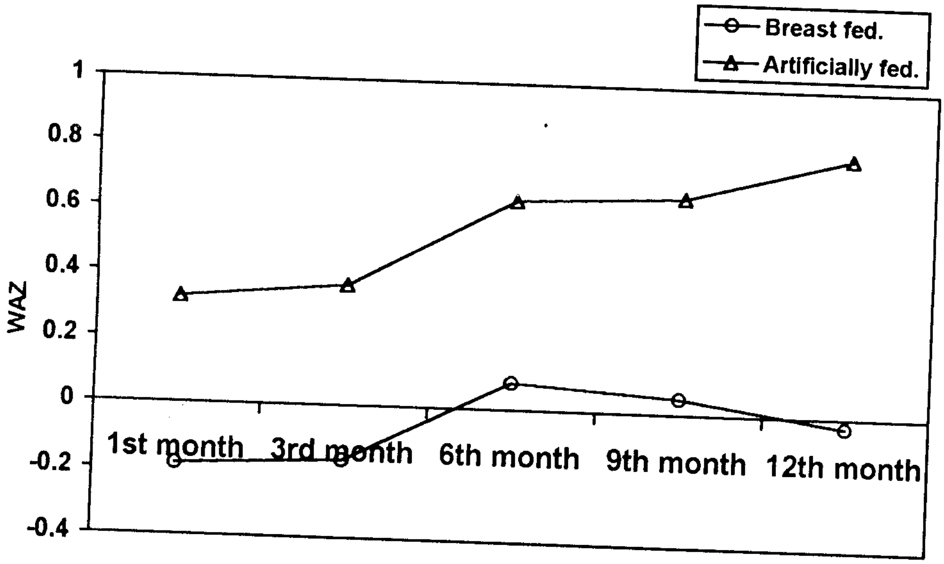

Fig (7): Mean of WAZ in Breast Fed Compared To That of Artificially Fed Infants At Different Age Periods .

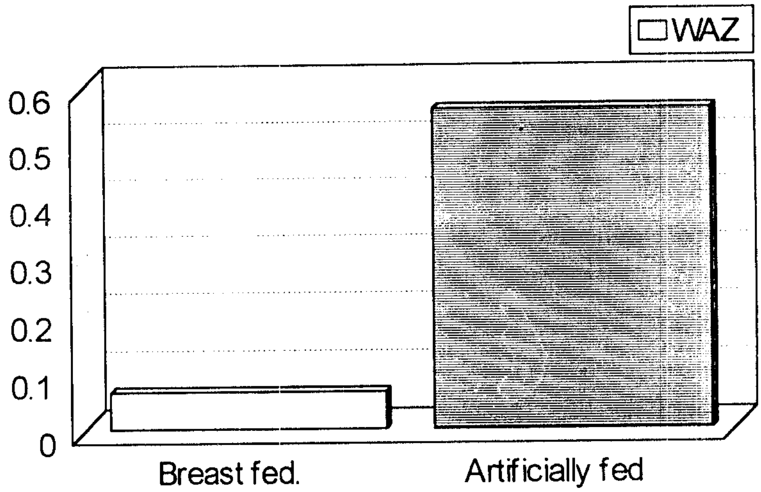

Fig (8): Mean Of WAZ In Breast Fed Compared To That Of Artificially Fed Infants At All Age Summed Up To Periods

Table (15): Mean ± SD Of WAP In Breast-fed Compared To That Of Artificially Fed infants At Different Age Periods

Age in months		Breast-fed WAP	Artificially fed WAP	F-ratio	P-level
1st month of age	Mean ± SD	43.59±20.39	61.44±17.23	11.16	0.005
	Range	9.67 – 77.7	33.57 – 87.03		
3rd month of age	Mean ± SD	44.18±17.36	62.87±17.77	14.13	0.000
	Range	10.70 – 79.55	30.59 – 89.70		
6th month of age	Mean ± SD	53.35±18.36	72.22±14.56	16.19	0.000
	Range	19.31 – 80.54	36.16 – 91.99		
9th month of age	Mean ± SD	49.67±20.59	71.78±18.73	15.76	0.000
	Range	18.17 – 74.09	32.83 – 92.70		
12th month of age	Mean ± SD	49.26±22.03	76.00±15.24	24.89	0.000
	Range	12.85 – 82.42	38.36 – 95.99		

Table (16): Mean ± SD of WAP In Breast-fed Compared To That Of Artificially Fed Infants At All Age Periods Summed Up Together

Age in months		Breast-fed	Artificially fed	F-ratio	P-level
From 1-12 months of age	Mean ± SD	48.01±19.84	68.86±17.47	77.72	0.000
	Range	9.67 – 82.42	30.59 – 95.99		

Table (17): Mean ± SD of HAZ In Breast-fed Compared To That Of Artificially Fed Infants At Different Age Periods

Age in months		Breast-fed HAZ	Artificially fed HAZ	F-ratio	P-level
1st month of age	Mean ± SD	0.164 ±0.511	0.177 ±0.535	0.006	NS
	Range	-1.040-1.200	0.670-1.070		
3rd month of age	Mean ± SD	0.434 ±0.565	0.103 ±0.530	4.526	0.0385
	Range	-0.610-1.360	0.800-0.990		
6th month of age	Mean ± SD	0.339 ±0.542	0.228 ±0.529	0.538	NS
	Range	-1.050-1.080	-0.680-1.160		
9th month of age	Mean ± SD	0.309 ±0.527.	0.170 ±0.538	0.844	NS
	Range	-0.880-1.010	-0.840-1.080		
12th month of age	Mean ± SD	0.278 ±0.557	0.192 ±0.511	0.319	NS
	Range	-0.770-1.060	-0.770-0.950		

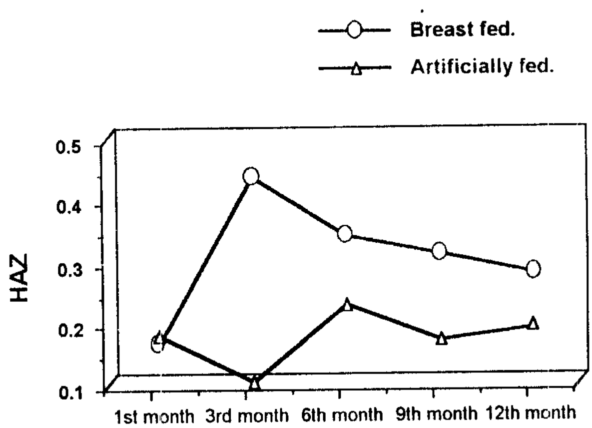

Fig (9): Mean Of HAZ In Breast Fed Compared To That Of Artificially Fed Infants At Different Age Periods

Table (18): Mean ± SD Of HAP In Breast-fed Compared To That Of Artificially Fed infants At Different Age Periods

Age in months		Breast-fed HAP	Artificially fed HAP	F-ratio	P-level
1st month of age	Mean ± SD	55.85±21.93	56.36±19.59	0.007	NS
	Range	14.81 – 88.5	25.03 – 85.76		
3rd month of age	Mean ± SD	64.96±19.76	53.62±19.42	4.18	0.040
	Range	27.18 – 91.14	21.28 – 83.81		
6th month of age	Mean ± SD	62.21±19.14	58.02±19.10	0.60	NS
	Range	14.70 – 86.10	24.92 – 87.71		
9th month of age	Mean ± SD	61.25±19.04	56.05±19.57	0.90	NS
	Range	18.87 – 84.29	19.91 – 85.98		
12th month of age	Mean ± SD	60.07±20.26	56.83±18.67	0.34	NS
	Range	21.98 – 85.50	21.98 – 82.96		

Both comparisons revealed that breast-fed infants were not significantly taller except at the age of three months were the difference was significant (P = 0.03) & (P=0.04).

All infants whether breast-fed or formula-fed had their height (HAP) within the normal percentiles.

- Breast-fed infants HAP was between the 50th and the 70th centiles.
- Formula-fed infants HAP was between the 50th and the 60th centiles.
- Table (19) and Fig (10) show that at all ages summed up together, breast-fed infants were significantly taller (P = 0.05).

Table (19): Mean ± SD of HAP In Breast-fed Compared To That Of Artificially Fed Infants At All Age Periods Summed Up Together

Age in months		Breast-fed HAP	Artificially fed HAP	F-ratio	P-level
From 1-12 months of age	Mean ± SD	60.87±19.95	56.17±19.01	3.62	0.050
	Range	14.70 – 91.14	19.91 – 87.71		

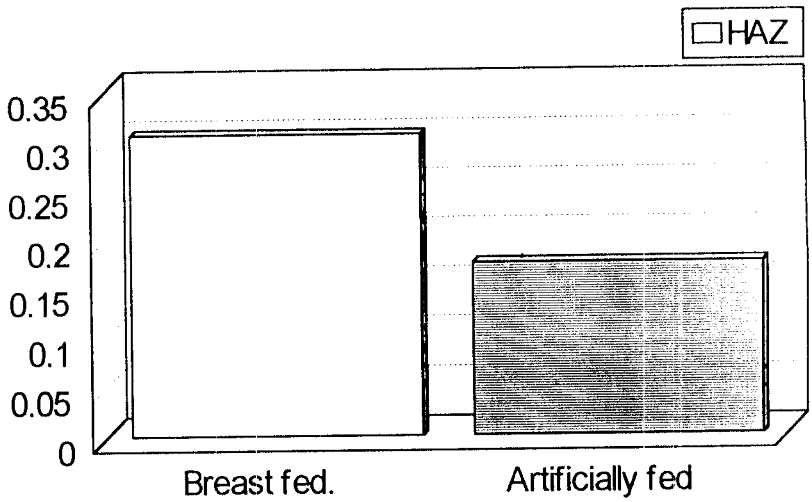

Fig (10): Mean Of HAZ In Breast Fed Compared To That Of Artificially Fed Infants At All Age Summed Up To Periods

(IV) Psychological Assessments:

Psychological assessment of both breast-fed and formula-fed infants was done via questionnaire answered by the mothers, and sometimes confirmed by our own observations.

Ia.) Irritability or Stress Response:

A positive irritability or stress response meant that the infant exhibited facial grimacing, fussing, crying, and fretting.

At the age of two months and after DPT vaccination, twenty three breast-fed infants showed a positive stress response while the other two exhibited a negative response (ie were more or less calm in their manner with mere grimaces).

However, only nine formula-fed infants, exhibited a positive response and the other sixteen were negatively responding Table (20).

Ib.) Soothability

Both groups of infants took more or less the same time interwal (more or less 1 minute) to be consoled by their mothers, and attain an equivalent level of composure.

2. Motoric Activity:

At the age of three to three and a half months, all of the breast-fed infants exhibited a high activity level in the form of squirming, their arm movements exceeded their leg movements.

As for the formula-fed group, only six exhibited this high activity level.

Table (20): Psychological Tests In Breast-fed And Artificially Fed Infants

	Breast fed	Artificially fed	Chi^2	p-level
Stress response				
• +ve	23 (92%)	9 (36%)	17.013	0.000
• -ve	2 (8%)	16 (64%)		
Activity				
• +ve	25 (100%)	6 (24%)	30.645	0.000
• -ve	0 (00%)	19 (76%)		

The remaining nineteen did not exhibit this activity so obviously and there was near equrivalenee of movement frequencies of both arms and legs Table (20).

3. Responsivity:

It was found that at the age of eight months, and in a free-play session, most of the breast-fed infants (21) exhibited a strongly positive responsivity in the form of gazing, reaching towards the mother, contingently vocalizing, and somewhat fussing. The remaining four breast-fed infants did not show that level of responsivity (i.e.) negative.

On the other hand, only seven formula-fed infants exhibited a strongly positive responsivity while the remaining eighteen infants did not.

Breast-fed infants were more irritable (responsive) Table (21).

4. Fear reaction to strangers

At the third month:

Table (22) shows that at the age of three months (even at its end and the beginning of the fourth month), the whole breast-fed infants group (25) exhibited fear reaction to strangers.

As regards the formula-fed group, only three infants exhibited this reaction while the remaining twenty two infants did not show it.

At the sixth month:

Table (22) shows that the whole breast-fed infants group still expressed this reaction. As regards the formula-fed group, still the same three infants exhibited this reaction, and the other twenty two did not show it.

Table (21): Psychological Tests In Breast-fed And Artificially Fed Infants

	Breast fed	Artificially fed	Chi^2	p-level
Responsivity at 8 months • +ve • -ve	21 (84%) 4 (16%)	7 (28%) 18 (72%)	36.56	0.000
Motor development at 12 months • +ve • -ve	12 (48%) 13 (52%)	5 (20%) 20 (80)	4.367	0.0366

Table (22): Psychological Tests In Breast-fed And Artificially Fed Infants

	Breast-fed	Artificially fed	Chi²	p-level
Fear response at 3 months				
• +ve	25 (100%)	3 (12%)	39.79	0.000
• -ve	0 (00%)	22 (88%)		
Fear response at 6 months				
• +ve	25 (100%)	3 (12%)	39.79	0.000
• -ve	0 (00%)	22 (88%)		
Fear response at 9 months				
• +ve	2 (8%)	22 (88%)	32.05	0.000
• -ve	23 (92%)	3 (12%)		
Fear response at 12 months				
• +ve	2 (8%)	3 (12%)	2.06	0.1533
• -ve	23 (92%)	22 (88%)		

At the ninth month:

Table (22) shows that only two breast-fed infants kept expressing this reaction positively, while the remaining twenty three infants stopped showing it.

As regards the formula-fed group, twenty two formula-fed infants exhibited a positive fear reaction to strangers, while the remaining three infants did not exhibit it any more.

At the twelfth month:

Table (22) shows that most breast-fed infants (23) stopped expressing fear to strangers while the remaining two kept showing it.

As regards formula-fed infants most of them too (22) stopped expressing fear to strangers while the remaining three were still frightened.

From all of the above we reached a conclusion which emphasized that breast-fed infants expressed their fear of strangers, as early as the third month of age, and by the ninth month of age, most of them completely lost this reaction.

On the other hand, most of the formula-fed infants exhibited this reaction at the age of nine months (lately) and lost it at the end of the first year of age.

(5) Motor development at the age of twelve months

By the end of the first year of life, twelve breast-fed in infants were able to walk but with support. The remaining thirteen breast-fed infants did not so obviously walk.

On the other hand, only five artificially fed infants were able to walk with support, while the remaining twenty infants did not obviously do so Table (21).

DISCUSSION

Discussion

The immunological benefits of breast feeding emerge from the presence of several antimicrobial factors in breast milk. These antimicrobial factors are thought to reinforce the immature system of the newborn infant (Zaman et al., 1993, Bjorge et al., 1996, Weaver et al., 1998).

They include immunoglobulins, leucocytes, antiviral factors, lysozyme, lactoferrin, and lactoperoxidase (Goldman & Goldblum, 1988).

Immunoglobulins present in breast milk include IgA, IgM, and IgG, (Hahn-Zoric et al., 1997, and Weaver et al., 1998 and Perera et al., 1999).

The main immunoglobulin is IgA which is principally secretory IgA throughout the lactation period. Sustained IgA secretion in likely to protect suckling infants from microbial infections (enteric and respiratory) (Weaver et al, 1998).

As regards IgG, several studies have suggested local production of of IgG_4 in human colostrum and mature milk both of which significantly contribute to higher percentages of IgG_2 (44%) and IgG_4 (6%) compared to the contribution in matched plasma (29% for IgG_2 and 2% for IgG_4) (Kim et al., 1992 and Perera et al., 1999).

IgG antibodies in breast milk offer protection. against Escherichia coli, and poliovirus antigens, to the breast-fed infants (Hahn et al., 1997).

Similarly. breast milk offers protection against these infections via its content of IgM antibodies.

It is worth to state that IgA deficient women are compensated by variable increases of IgG and IgM antibodies in their breast milk (Hahn et al., 1997).

Breast milk is universally recognized as the preferred nutrition for infants. The pattern of growth during infancy is influenced by the feeding mode (Neifert, 1999). Compared to formula-fed infants, breast-fed infants generally gain less weight particularly after the first few months of life (Dewey, 1998).

Exclusive breast feeding adequately supports growth of low birth weight infants during the first six months of life (Chatterjee et al., 1997).

Breast feeding has a unique emotional basis for the health of both mothers and infants (El-Sherbeeny et al., 1991). Breast feeding guarantees in an ideal way the optimum communication of the mother with her baby and simultaneously a close contact is established by touch sight and hearing (Fergusson and WoodWard, 1999). Difficulties in maternal-infant interaction were related to weaning earlier than planned (i.e. weaned from the breast by six weeks postpartum) (Brandt et al., 1998).

Breast feeding ensures better psychomotor development and enhances intellectual development (Riordan, 1997). Accordingly better perception, speech, conception, independence and social contact are ensured (Worobey, 1990).

The aim of this study is to compare the immunological and the psychological effects of breast-feeding with those of formula-feeding on infants in their first year of life.

Our study is a comparative follow up study which comprised fifty infants. Twenty five infants were breast-fed and the other twenty five were formula-fed. The study started when the infants were just born and ended when they became one year old.

Infants of both groups belonged to the same low-middle social class, had similar numbers of males and females, and had more or less similar birth weights and heights table (13).

Salivary immunoglobulins levels, incidence of infections, anthropometric measurements, and psychological aspects were compared in both groups of infants.

The immunological status of each infant in both groups was exhibited in this comparative study via the determination of their salivary immunoglobulins levels in a follow up manner at the first, third, sixth, and ninth months of age.

Immunoglobulins levels were assessed in saliva and not in serum because the infants', mothers did not approve of taking blood samples every 2-3 months from their infants in order not to subject them to any pain or repeated sample-taking if the former failed or was not enough.

The incidence of infections in these infants was followed up monthly at that first year of life and then both groups were compared. This was done via clinical examination of the infants, and questions to the mothers clarifying a previous infection history of the infant.

The anthropometric measurements of both groups were comparatively followed up throughout the first year of life. These measurements comprised the weight in Kgms and the height in cms. The correct word for height at this age is length (Recumbant length).

Weight reflects the current nutritional status. Height is a determinant of chronic ongoing malnutrition (Tenore & Vargas, 1993). In our case it represents long term effect of the mode of nutrition.

Evidence of growth changes was determined in this study by the analysis of weight-for-age (WA), and height - for - age (HA) indices. The ability to assess the anthropometric results depends essentially on having valid reference values to which actual measurements may be compared.

The use of the "United States National Center of Health Statistics" (NCHS) reference values has been accepted in WHO reports to be internationally used as reference standards (WHO and 1986). Accordingly in this study evaluation and analysis of the results of the anthropometric measurements were done in relation to the NCHS standards by using the "Anthro" computer program.

Each of the indices was related to NCHS reference standards by either its position within the centile distribution "percentiles (P)", or as standard deviation score "Z score".

Finally, the comparative follow up and assessment of the psychological status of both groups of infants was done via questions (in a questionnaire sheet) answered by the mothers. According to these answers it was possible to determine the infants responses under normal, and stressful conditions, reactions to strangers, their motoric activity, and their motor development. These criteria, their onset, and their offset times are of great value in determining the development of the psychological health status of the infants.

The results will be discussed in the following manner:

(1) Assessment of the immunoglobulins levels:

In this study, the levels of salivary immunoglobulins IgA, IgG, and IgM were assessed at the first, third, sixth, and ninth months of age in each infant of the two groups.

a- As regards Salivary IgA (SIgA):

The SIgA concentration was significantly higher in formula-fed than in breast-fed infants at the first, third, sixth, and ninth months of age. This is due to the difference in infection acquisition by both infants of the two groups as confirmed by tables (1,7).

Another explanation to that higher SIgA concentration in formula-fed than breast-fed infants is that SIgA antibodies previously have been shown to increase rapidly on antigenic exposure. This antigenic exposure was the cow milk proteins fed to that group of non breast-fed infants (Mellander et al., 1985, and Roberton et al., 1986).

Prolonged breast-feeding leaves infants with significantly lower serum IgA, IgG, and IgM levels than non-breast-fed infants (Savilahti et al., 1987).

The same results were reported by Mckay and Thorn in 1969, South in 1971, and Ostergaard in 1985. They found that SIgA levels were higher in formula-fed than breast-fed infants and that the difference was observed up to the age of nine months.

Again these same results were reported by Stephens in 1986 who found that, in a comparative follow up study of fifteen breast-fed and fifteen formula-fed infants, SIgA concentration was higher in the formula-fed group between six weeks and nine months of age.

Avanzini et al., in 1992 reported that SIgA was significantly lower in breast-fed than in formula-fed infants only at the age of one month. No significant differences between the two groups were observed at two, three, and six months. They also reported that SIgA increased significantly in breast-fed infants at the age of six months than at one month. In the formula-fed groups, no significant changes were found up to the age of six months. This is comparable with our results.

Similarly, Fitzsimmons et al., in 1994 reported that SIgA concentration increased more rapidly during the first six months after birth in infants exclusively breast-fed than in those exclusively formula-fed. They concluded that breast feeding may aid in protection against pathogenic microorganisms by increasing the rate of mucosal IgA maturation.

b- As regards Salivary IgG:

The salivary IgG concentration was higher in breast-fed than in formula-fed infants only at the first month of life. Afterwards and during the third, sixth, and ninth months, this pattern was reversed where the SIgG was higher in the formula-fed infants table (3).

This can be explained by the fact that early in life human colostrum and milk contribute by considerable percentage of IgG_2 and IgG_4 which are subclasses of IgG. Accordingly, formula-fed infants will be deprived of this contribution and will have a lower IgG level because they are deprived of colostrum and early breast milk. These findings were previously reported by Hanson et al., in 1990 and Kim et al., in 1992.

Later on, and when these formula-fed infants were exposed to different infections at a higher rate than that of breast-fed ones (table), SIgG levels were elevated much more in these formula-fed infants.

Again, cow milk proteins, in milk formulae, are considered an antigenic exposure which provoked an increase in IgG antibody response. This result is in accordance with the reports of Mellander et al., in 1985 and Roberton et al., in 1986.

However, our results differ from those reported by Stephens in 1986. He reported that there were no significant differences between breast-fed and formula-fed infants as regards the total SIgG.

c- As Regards Salivary IgM:

The salivary IgM level was higher in formula-fed than in breast-fed infants throughout the first nine months of life table (5).

In our study this was explained by the fact that our formula-fed infants suffered from a higher incidence of infection during the whole first year of life. It can also be explained by the fact that cow milk proteins are considered antigens which provoke an increase in antibody (IgM) response. This explanation was reported by Mellander et al., in 1985, and Roberton et al., in 1986.

Again, Savilahti et al., in 1987 reported that prolonged breast-feeding leaves infants with significantly lower serum IgM levels than non-breast-fed infants.

However, Burgio et al., in 1980, and Avanzini et al., in 1992, reported that there were no significant differences in SIgM concentrations between breast-fed and formula-fed infants up to the age of six months.

At the third month of age, SIgM level was significantly high in formula-fed infants. This can be explained by the fact that respiratory tract, and gastrointestinal tract infection episodes were at their highest rate at that month more than any other month of that first year.

(2) Assessment of the incidence of infections:

In our study concern was mainly directed towards the incidence rate of respiratory tract, and gastrointestinal tract infections among the breast-fed and the formula-fed infants.

a- Respiratory Tract Infections:

The incidence rate of RT infection episodes in formula-fed infants was much higher than that of breast-fed infants throughout their first year of life Table (7).

This is attributed to the fact that breast milk provides protection to the infants via its content of various protective factors. Immunoglobulins, especially SIgA, are of these factors.

Formula-fed infants were deprived of this advantage and consequently they suffered from a higher rate of RT infection episodes. Accordingly, salivary immunoglobulins, especially SIgA and SIgM were much higher in formula-fed than in breast-fed infants because of this higher antigenic acquisition.

In order to confirm this fact, a comparison was made between the mean levels of salivary immunoglobulins (SIgA, SIgG, and SIgM), at different numbers of RT infection episodes throughout that first year of life table (8).

It was found that the more the number of RT infection episodes, the higher was the level of the salivary immunoglobulins.

As Regards SIgA, it was found that there was a significant difference between the mean levels of SIgA when there was no exposure to RT infection episodes (4.77mgl dl), and when there was exposure to one episode (5.80mgl dl), two episodes (6.84mgl dl), and three or more episodes (7.25mgl dl).

This increase in the mean level of SIgA with the increase in the number of RT infection episodes is due to the fact that IgA protects mainly secretory surfaces where exposure to antigens is non vascular.

As regards SIgG, it was found that there was a significant difference between the mean level of SIgG when there was no exposure to RT infection episodes, and when there was exposure to one RT infection episode. In the former situation, the mean level of SIgG was 0.106mgl dl, while in the second situation, the level was 0.082 mg/dl.

This is explained by the fact that the salivary IgG sample was taken very early when the infant has just caught the infection. It is well known that serum IgG antibodies are formed lately and not in the early response when catching infection (ie). in order get a high level of salivary IgG level, it has to be measured later in the course of the infection. Salivary IgG is a reflection of serum IgG.

Another explanation is that it is well known that the IgG offered by the mother to her infant (and detected in his cord serum) gradually disappears during the first 6-8 months of life (Buckley, 1994).

Accordingly, it can generally be explained that the IgG level was naturally decreasing (the portion offered by the mother) and that our salivary sample was taken early in infection before IgG response (late response) was stimulated. Consequently, such low IgG levels were encountered inspite of the increasing number of RT infection episodes.

As regards SIgM, there is a significant difference between the mean level of SIgM when there was no exposure to RT infection episodes (0.29mgl dl) and when there was exposure to two RT infection episodes (0.54mgl dl). Again this significant difference was found when there was only one RT infection episode (0.36mgl dl) and when there were two episodes (0.54mgl dl). This increase in the mean level of SIgM with the increase in the number of RT infection episodes is due to the fact that IgM

is considered the first line of defense against infection. It is the immunoglobulin first formed in response to antigen. It is found most commonly in the vascular spaces and has a high efficiency in enhancing immunity.

All our results especially those concerning SIgA, and SIgM, are in accordance with those reported by Beaudry et al., (1995) and Lopez et al., (1997) Both authors confirmed that breast feeding had a protective effect on RT illness during the first six months of life by lowering its frequency and duration.

Generally speaking, the fact that breast feeding reduced the rate and duration of respiratory illness in infants has been confirmed by several recent authors (Cushing et al., 1998, and Wright et al., 1998). In a more recent report, Perera et al., 1999 from Sri Lanka reported that exclusive breast feeding for periods over than four months had a protective effect against respiratory diseases.

In a study made on Egyptian breast-fed infants in Kalama village in Egypt, Rahmanifar et al., in 1996 reported that breast-fed infants (especially those whose mothers consumed more animal source foods, and vitamin A or vitamin C) had shorter durations of RT infections.

However, Rubin et al., in 1990 stated that no statistically significant relationship was found between the type of infant feeding and the incidence of upper and lower respiratory illnesses.

This was later confirmed by the recent study of Chye, and Lim, in 1999 who reported that breast feeding does not appear to confer significant protection to upper respiratory tract infection.

It is important to mention that these last two conflicts may in part be due to the failure to consider the following methodologic issues which were reported by Rubin et al., 1990:-

1- Collecting data prospectively at frequent intervals for active surveillance of the detection of infections and of feeding practices.

2- Specifying what is meant by infectious illnesses and breast feeding.

3- Controlling for confounding variables such as social class or presence of siblings in the household.

4- Applying appropriate analytical strategies to a population in which both feeding and exposure to illness change over time.

b- Gastrointestinal tract infections:

The incidence of GIT infection episodes in formula-fed was much higher than that in breast-fed infants throughout their first year of life.

This finding was previously reported through the studies made by Ruiz et al., in 1990 and by Torres and Cruz., in 1993. Both authors reported that breast milk secretory IgA was protective against *Ecoli*, C. jejuni, and rotavirus, all of which are causative agents of infantile diarrhea.

Accordingly and because of the higher infection acquisition of formula-fed infants, salivary immunoglabulins SIgA, and SIgM (against enteric pathogens) were higher in these formula-fed than in breast-fed infants.

Salivary immunoglobulin A levels in our study were found to increase progressively with the increase in the number of GIT infection episodes.

A significant difference in the mean salivary levels of IgA was shown between cases with no GIT infection episodes (5.07mgl dl) and when there were two GIT infection episodes (6.63mgl dl.) table ( ).

Similarly salivary IgM levels increased with the increase in the number of GIT infection episodes. There was a significant difference in the mean salivary levels of IgM when there were no GIT infection episodes (0.30mgl dl) and when there was exposure to one GIT infection episode (0.44mgl dl) table ( ).

As regards <u>SIgG</u> the mean level was significantly higher when there were no GIT infection episodes (0.105mgl dl) than that when there was exposure to two GIT infection episodes (0.075mgl dl) table (9).

The finding that SIgG level was comparatively low when there was exposure to GIT infection episodes can be explained by the fact that the salivary samples for IgG detection were taken relatively early in the infection course, and IgG is concerned with the later and not the initial (earlier) response.

Another explanation is that infant IgG offered passively by the mother (Cord serum) gradually disappears during the first 6-8 months of life (Buckley, 1994).

Generally our results are in accordance with those reported by Dewey et al., in 1995, Beaudry et al., in 1995, Kakai et al., in 1995, Yoon et al., in 1996, and Mondal et al., in 1996 who all confirmed that the reduction of the incidence of diarrhea associated with breast feeding is of sufficient magnitude to be of public health significance.

The same findings were reported by Lopez et al., in 1997, al-Ali et al., in 1997, Davies et al., in 1997, Wright et al., in 1998, and Clemens et al., in 1999. The latter study was done in rural Egypt.

The authors emphasized that breast feeding, especially when early initiated and prolonged, reduces the prevalance and severity of infantile diarrhea and accordingly diarrhea related morbidity and mortality.

On the other hand, however, Rubin et al., in 1990, Clemens et al., in 1993, and Chye and Lim, in 1999, all doubted the protective effect of breast-feeding against diarrheal illnesses. They reported that breast feeding might temporarily postpone diarrheal infections, or that it does not appear to confer significant protection to these infections.

This previous conflict may be due to the same four drawbacks in the methologic issues mentioned before in the RT infection.

A correlation coefficient study has been made between the salivary immunoglobulins (IgA, IgG, and IgM) levels and the number of RT, and GIT infection episodes in all breast-fed, and in all formula-fed infants Tables (10, 11, 12).

In case of breast-fed infants, it was found that there was a strong positive correlation between the number of RT infection episodes and the levels of SIgA, and SIgM. This means that the higher the number of infections episodes the higher is the level of SIgA and SIgM. Table (10).

This finding is attributed to two facts. The first is that IgA protects mainly secretory surfaces where exposure to antigens is non vascular. The second states that IgM is considered the first line of defense against infection. It is the first immunoglobulin found in response to antigen. It is found most commonly in the vascular spaces and has a high efficiency in enhancing immunity.

As regards SIgG the correlation was a weak negative one. This can be attributed to one of two reasons or both. The first explanation is that the IgG level offered by the mother to the infant (and detected in his cord serum) gradually disappears during the first 6-8 months of life (Buckely, 1994).

The second explanation is that the salivary sample taken for IgG detection was taken early in the RT infection episode and as IgG is responsible for the late and not the initial response, so no elevation was shown.

In case of GIT infection episodes, similar to RT infection episodes, a positive significant correlation was shown between SIgA, and SIgM, and the number of these GIT infection episodes.

As regards SIgG, the correlation was a non significant one. Apparently, the level of SIgG was too low that it could not be correlated with the number of episodes of GIT infection. This can be attributed to one or both of the two reasons mentioned before in RT infection episodes.

<u>In case of formula-fed infants</u>, it was found that there was a positive correlation between the number of RT infection episodes and the levels of each of SIgA, and SIgM. However as regards SIgG, the correlation was a weak negative one Table (11).

In case of GIT infection episodes, it was found that the correlation, between the number of GIT infection episodes, and the levels of SIgA, SigM, and SIgG was a positive correlation.

As regards all infants together (table 13) there was always a positive correlation between RT and GIT infection episodes and the mean. SIgA and SIgM levels. As regards IgG, the correlation was a negative one as regards RT infections but a positive one in case of GIT infections.

(3) Anthropometric Measurements:

These measurements included weight in Kgms and height in cms. They were assessed first at birth, and then were followed up at one, three, six, nine and twelve months.

There were no significant differences in birth weights and birth heights between breast-fed and formula-fed infants.

a- Weight:

On comparing the mean weight for age Zscores (WAZ), and the mean weight for age percentiles (WAP) of both breast-fed, and formula-fed infants, it was found that throughout that first year of age, formula-fed infants were significantly heavier Table (14) and Table (15).

This is attributed to the fact that formula-fed infants received a highly caloric diet in addition to or instead of their milk formulae. This highly caloric diet is exemplified by rice water, starch pudding (Mehalabia), bread in sugared tea, and biscuits, etc … .

This happened because their mother wanted to ensure their babys' satiety with the minimal expenses suiting their nearly low socioeconomic standard. Throughout that first year of age, breast-fed infants had their WAP falling between the 40^{th} and 50^{th} percentiles.

Similarly, Jooste et al., in 1991, Naing in 1991, Peerson et al., in 1993, Roche et al., in 1993, and Dewey in 1998, all reported that breast-fed infants generally gain less weight than formula-fed ones.

b- **Height:**

On comparing the mean height for age Z scores (HAZ) and the mean height for age percentiles (HAP) of both breast-fed, and formula-fed infants, it was found that breast-fed infants were slightly taller but with no significant difference Table (17) & (18). This is because of the fact that the height is a measure of chronic ongoing malnutrition (ie) may be that year was enough time to show the drawbacks of depriving formula-fed infants from breast milk. Only at the third month of age, breast-fed infants were significantly taller.

Although at the end of that first year there was no significant difference between the heights of breast-fed and formula-fed infants, still the heights of breast-fed infants were slightly better which indicates that they are nutritionally better.

Roche et al., in 1993 reported that at six months of age two groups of formula-fed infants, who were fed Similac and Isomil, had shorter recumbant lengths than breast-fed ones.

(4) Psychological status assessment:

The psychomotor and social development of breast-fed babies clearly differs from that of bottle-fed ones, and leads at the age of twelve months to significant developmental advantages of the psychomotor and social capabilities in the breast-fed infants (Baumgartner, 1984).

Accordingly the feeding method may be considered an important variable in research on newborn temperament (DiPietro et al., 1987).

After exploring temperament dimensions, that were included in the Neonatal Behavioral Assessment Scale (Brazelton, 1973), The Infant Behavior Questionnaire (Rothbart, 1981), and The New York Longitudinal study dimensions (Thomas and Chess, 1977), it was found that not all dimensions of temperament routinely explored with older samples may have merit for studying newborns (Worobey, 1993).

These dimensions were reasonably reduced to three areas of temperament, namely responsivity (Worobey and Belsky, 1982), irritability (Worobey, Laub, and Schilmoeller, 1983), and activity (Worobey and Anderson-Goetz, 1985).

Other researchers reached the same conclusion. Buss and Plomin (1984), settled on three dimensions, namely, sociability, emotionality, and activity. Bates (1989) chose to focus on sociability, "difficultness", and activity. Goldsmith, Rieser – Danner, and Briggs, (1991) identified approach–sociability, negative emotionality, and activity level as representative of the most common by assessed temperament traits.

These three temperament dimensions or traits were chosen because they are well suited for analysis by feeding method.

The infants irritability is manifested by fussing and crying (Brazelton, 1962, Van den Boom, 1989). It is a core ingredient of what has been termed "difficultness" (Hubert and Wachs, 1985).

Responsivity, also called orientation, attentiveness, and sociability, has its unquestionable importance to the developing mother – infant interactive system (Kaye, 1982).

Activity level is included in virtually every theory of temperament. It is generally considered to be the dimension that shows the greatest continuity from infancy through childhood (Hubert et al., 1982).

Shy and fear reactions to strangers were also questioned because of their significance in exhibiting the infants emotional experience, intellectual maturity, and Ego-self and non-self development, recognition, and distinguishment.

Finally, the ability to walk (with support) by the end of the first year displays the statomotor condition and development of the infant.

Our study investigated the influence of feeding method on infant temperament and development.

This was done via questionnaire asked to the mothers as early as the first month of age in order to prepare them to observe their infants behavior accurately later on.

The mothers were mainly relied upon in answering the questionnaire because they were the main caregivers of their infants. They acquainted themselves with the individuality of their newborns and accordingly had increasing skills in reading their offsprings (Worobey and Lewis, 1992).

a- Irritability or stress response:

At the age of two months, and on primary vaccination of the infants with the DPT vaccine (intramuscular injection), the majority of breast-fed infants (23 out of 25) exhibited an obvious stress response, while only a minority of bottle fed infants did that (9 out of 25).

The stress response was elicited in the form of facial grimacing, crying, fretting, and fussing.

Both groups of infants gained an equivalent level of quietening and composure in about 1 minute.

These same results were reported by Bernal & Richards, 1970, DiPietro et al., in 1987 and Worobey and Lewis in 1992.

Simmons et al., in 1967 found the opposite to the above findings. Crockenberg et al., in 1982 found no differences in irritability between both groups of infants.

Our finding that breast-fed infants were more irritable and showed a greater stress response is attributed to either or both of the following hypotheses.

The first hypothesis suggests that breast-fed infants are hungrier than artificially fed ones because breast feeding mothers often report an insufficient milk supply as their reason for early weaning (DiPietro et al., 1987, Obermeyer, and Castle, 1996, Mathews et al., 1998, and Arlotti et al., 1998).

The second hypothesis suggests that colostrum, which is ingested by breast-fed infants, may contain a behaviorally activating agent (DiPietro et al., 1987). On the other hand, varying the concentrations of amino acids in formulae, ingested by formula-fed infants, has been shown to alter state organization in newborns and may exert a depressing effect on behavior (Yogman & Zeisel, 1983; Steinberg et al., 1989).

b- Soothability :

Breast-fed and formula-fed infants attained an equivalent level of quiescence after more or less the same time of composure offered by the mothers on the occasion of DPT vaccination.

This was a surprising finding in light of their different responses to vaccination. The same results were reported by Worobey and Lewis in 1989.

(2) Motoric Activity at 3-3.5 months:

By the age three and a half months, and according to the mothers answers, the activity level of their infants was reported. The activity level meant the gross motor activity, including squirming, arm, and leg movements.

These reports were supported at many instances by our own observations during the monthly visits for clinical examination.

The majority of breast-fed infants (actually all of the 25 infants) exhibited a significantly higher total activity level, than the formula-fed infants (six out of twenty five). The frequency of the arm movements exceeded that of the leg movements in the breast-fed infants group.

The near equivalence of movement frequencies for the formula-fed infants by their arms and legs suggests a stability in responsiveness.

Activity is the most consistent of the temperament traits in demonstrating stability (Hubert et al., 1982). It is a prominent aspect of infant behavior and is a key dimension of individual differences (Worobey and Blajda, 1989 and Goldsmith et al., 1991).

Our results are in accordance with those reported by Eaton and Dureski, 1986, and McDonnell et al., 1989).

(3) Responsivity at eight months of age:

Twenty one breast-fed infants were strongly positive in their responsivity towards their mothers in a free-play session. They smiled, gazed at, and reached towards their mothers. Contingently vocalizing and fussing were elicited.

The remaining four infants did not exhibit the above criteria so clearly and were considered of negative responsivity.

On the other hand, eighteen formula-fed infants exhibited these criteria in a manner that was not so obvious as breast-fed ones (ie) they gazed but were not so keen to reach towards the mother. They were more absorbed by and distracted towards the toy. There was neither fussing nor so obvious vocalization.

The remaing seven formula-fed infants exhibited the criteria in a strongly positive manner.

These results are in accordance with those reported by Wiesenfield et al., in 1985, Worobey and Blajda in 1989 and Worobey, 1993.

The above results are explained by the fact that the affectionate behaviors and extra contact experienced while breast feeding heightens the mother-infant relationship (Blumen, 1980, and Fergusson & Woodward, 1999). The nursing mothers touch, smile, and vocalize more to their infants during feeding than mothers using formulae. They respond more quickly to their infant cries (Walton & Vallelunga, 1989).

The infants bond to a person of long and close contact is the decisive foundation of personality development.

However, missing body contact, lacking nearness, and loving attention during the suckling period are factors which expose the children to emotional lability.

(4) Fear reaction to strangers:

In our study, it was found that all of the twenty five breast-fed infants expressed their first fear reaction to strangers as early as the third month of life and kept showing it till the age of six months. By the age of nine months this fear reaction vanished in all except for two infants who kept showing it till the end of the first year.

On the other hand, twenty two of the formula-fed infants did not express this fear reaction to strangers neither by the third nor by the sixth months of life.

Only three of these infants showed this reaction at both ages (three and six months). By the age of nine months the majority of formula-fed infants (22) started expressing fear reaction to strangers and up to the end of the first year of age where they stopped except for three who kept showing it.

Our study was supported by reports from Morgan and Ricciutti in 1980 Baumgartner, in 1984.

From the point of view of depth psychology, the fear from strangers is considered essential for the early relation to an object and for binding to it (Bowlby et al., 1973 and Baumgartner, 1984).

It is an important sign of intellectual maturity. The intentional phase between the third and sixth months of age has its significance for the emotional experience.

The close symbiosis begins to dissolve itself in favour of individualization and for the later Ego-Integration (Baumgartner, 1984).

For this development, recognition and distinguishing of the Ego-self and the Non-self are absolutely indispensable, and precisely this is closely expressed by the baby's reaction to strangers.

Therefore To summarize:

The early shy-acting of the breast-fed infants who after the 9th month were no longer impeded by fear of strangers, is in close connection with better perception, better social behavior, and greater independence. Formula-fed infants were held back by their fear from strangers.

(5) Motor development (Walking):

At the age of twelve months, twelve breast-fed infants (out of twenty five) were able to walk with support while only five formula-fed infants (also out of twenty five) were able to do so.

This stresses the significance of the effect of breast feeding during the first months on the baby's later statomotor development which is really enhanced (De Chateau et al., 1977).

These results are in agreement which Klaus & Kennel, 1974 and Baumgartner, 1984.

SUMMARY

Summary

The aim of this work was to study and compare the immunological status and the psychological status of both breast fed and bottle fed infants during their first year of life.

The study included fifty infants. Twenty five were breast fed and the other twenty five were bottle fed. They were selected from a medical center in Guiza. This study started since the infants' birth and ended when they were one year old.

At the ages of one, three, six, and nine months, salivary samples were taken from the infants to measure their levels of immunoglobulins A, G, and M.

The incidence of respiratory and gastrointestinal tract infections was measured in both bottle fed and breast fed infants throughout the months of that first year of age.

Anthropometric measurements including weight, and length, were taken at the first, third, sixth, ninth and twelfth months.

Finally the psychological status temperament of infants was assessed via questionnaire to the mother.

It was found that salivary IgA, IgG, and IgM levels were higher in bottle fed than in breast fed ones.

Bottle fed infants suffered from a higher incidence of infections than breast fed ones.

Salivary immunoglobulins levels rose with the increased incidence of infection whether respiratory or gastrointestinal.

There were no major differences in the two groups heights (lengths) throughout that first year except for the third month where means of heights of breast fed infants were higher than those of bottle fed ones.

As regards their weights, bottle fed infants were much heavier than breast fed ones throughout the first year. This is attributed to the fact that mothers of bottle fed infants thought

that rice water, starch pudding, bread, and biscuits supplemented artificial formulae or were compensatory to them, to ensure proper health to their infants.

Breast fed infants were more irritable than bottle fed ones. This was assessed at the age of two months.

Arms and legs movements in breast fed infants were much higher than in bottle fed ones with the arm movements exceeding the leg movements. This was elicited at the age of three - three and a half months.

Fear reaction to strangers, appeared earlier in breast fed infants and vanished earlier too than it did in bottle fed ones.

Responsivity was stronger and more elicited in breast fed than in bottle fed infants at the age of eight months.

A considerable number of breast fed infants walked with support at the age of one year, while only a minority of bottle fed infants were able to do so.

CONCLUSION AND RECOMMENDATIONS

Conclusion and Recommendation

Accordingly and from all the above we have to encourage breast feeding on a wide scale showing off its great advantage and after effects on health and psychology.

It is highly recommended that advertisements of artificial baby foods should be reduced.

Again the following suggestions are appropriate:

- Early placing of the baby on the breast with the purpose of establishing immediate contact between the mother and her baby, and to secure the immunological advantage of colostrum immediately post-partum.
- Rooming of mother and child in such a way that the biological unity is established.
- Assessing the outcomes of breast feeding or bottle feeding on infants temperament, as early as the first weeks of life. This allows the documentation of individual differences in newborns before the family and environment can exert much influence.
- Accordingly, questionnaire has been demonstrated to be applicable from the first weeks throughout the first year of age.
- Longitudinal studies of the possible effects of the kind of feeding on infants' behavior, are encouraged.
- Motoric activity can be rated early, and mechanically measured over the first year with age-appropriate actometer devices.
- The effects of inoculation that we observed at two months, are to be repeatedly observed at 4,6 and 18 months according to the infants' immunization schedule.
- Breast feeding education and support should be an integral part of health care in order to reduce the infant illness level in the community.

- **Breast feeding counseling programs should be focused upon in order to increase exclusive breast feeding and reduce the prevalence of diarrhea in rural communities.**

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ARABIC SUMMARY

الملخص العربى

تهدف هذه الدارسة إلى المقارنة بين الأطفال ذوى الرضاعة الطبيعية والأطفال ذوى الرضاعة الصناعية من الناحية المناعية والسيكولوجية فى خلال العام الأول من العمر.

هذه الدارسة تضمنت خمسين طفلاً خمسة وعشرون مثلوا الأطفال ذوى الرضاعة الطبيعية والخمسة وعشرون الآخرون مثلوا الأطفال ذوى الرضاعة الصناعية. تم جمع هؤلاء الأطفال من مركز طبى بمحافظة الجيزة .

بدأت هذه الدراسة حين كان هؤلاء الأطفال حديثى الولادة وانتهت حين أتموا العام الأول من العمر.

تم أخذ عينات من اللعاب من أطفال المجموعتين عند أعمار شهر، ثلاثة ، ستة ، تسعة أشهر من أجل قياس نسبة الأجسام المضادة المناعية نوعية (أ) ، (ج)، (م).

- وُجد أن نسبة الأجسام المناعية كانت أعلى فى الأطفال ذوى الرضاعة الصناعية أكثر من هؤلاء ذوى الرضاعة الطبيعية.
- تم قياس معدل الإصابة بأمراض الجهاز التنفسى والهضمى فى مجموعتين الأطفال فى خلال العام الأول من العمر.
- تبين فى المقارنة بين المجموعتين أن الأطفال ذوى الرضاعة الصناعية كانوا أكثر عرضى للإصابة بأمراض الجهاز التنفسى والهضمى من ذويهم ذوى الرضاعة الطبيعية.
- كذلك وُجدَ أن نسبة هذه الأجسام فى اللعاب ارتفعت مع ارتفاع معدل الإصابة بأمراض الجهاز التنفسى والهضمى.

- كذلك تم عمل قياسات أنثروبومترية متضمنة قياس الطول والوزن ، وذلك لكل طفل من المجموعتين فى خلال الشهر الأول والثالث والسادس والتاسع والأثنى عشر من العمر.

- لم نصل إلى اختلافات واضحة بين أطفال المجموعتين من حيث الأطوال وذلك فى خلال السنة الأولى من العمر إلا بالنسبة للشهر الثالث من العمر حيث كان الأطفال ذوى الرضاعة الطبيعية أكثر طولاً من هؤلاء ذوى الرضاعة الصناعية.

- أما من حيث مقارنة الأوزان ، فلقد وُجِدَ أن أوزان الأطفال ذوى الرضاعة الصناعية كانت أثقل من أوزان الأطفال ذوى الرضاعة الطبيعية وذلك فى خلال جميع أشهر القياس فى السنة الأولى من العمر.

التفسير لذلك الثقل هو أن أمهات الأطفال ذوى الرضاعة الصناعية يقمن بتغذيتهم ببعض الأغذية مثل الأرز – ماء الأرز – المهلبية – الخبز – البسكويت إلى جانب الألبان الصناعية أو بدونها لضمان عملية الإشباع للأطفال لتعويضهم عن اللبن الطبيعى وذلك من خلال وجهة نظرهم المحدودة وبخاصة أن مستوى الأمهات فى هذه الدراسة كان فى حدود المتوسط أو أقل من الناحية التعليمية والثقافية والاجتماعية.

حين تمت مقارنة هاتين المجموعتين من الأطفال من الناحية السيكولوجية تم اكتشاف الاختلافات الآتية :-

- أن الأطفال ذوى الرضاعة الطبيعية كانوا أكثر قلقاً أو عصبية أو انفعالاً فى خلال الشعر الثانى من العمر. اتضح ذلك فى رد فعلهم حين تم تطعيمهم الطعم الثلاثى وشلل الأطفال. بالنسبة للأطفال ذوى الرضاعة الصناعية فلقد كانوا أكثر هدوءاً وأقل انفعالاً.

- إن الأطفال ذوى الرضاعة الطبيعية كانوا أكثر حركة من الأطفال ذوى الرضاعة الصناعية وذلك بخاصة فى حركة الأذرع والأرجل . كذلك كانت حركة الأذرع اكثر من حركة الأرجل فى هؤلاء الأطفال (ذوى الرضاعة الطبيعية). هذه الدراسة تمت فى خلال الشهر الثالث من العمر.

- حيث تم ملاحظة رد فعل الخجل والخوف من الغرباء في جميع الأطفال من المجموعتين وذلك في خلال العام الأول من العمر تبين أن الأطفال ذوى الرضاعة الطبيعية يمرون بهذه المشاعر قبل الأطفال ذوى الرضاعة الصناعية وذلك ابتداء من الشهر الثالث أو الرابع من العمر.
- يبدأ الشعور بالخوف من الأغراب فى الأطفال ذوى الرضاعة الطبيعية عند الشهر الثالث تقريباً ويستمر حتى الشهر السادس وينتهى تقريباً عند الشهر التاسع.
- فى الأطفال ذوى الرضاعة الصناعية ، يكون الشعور بالخوف من الأغراب متأخراً بعض الشيء فهو يبدأ تقريباً عند الشهر التاسع وربما ينتهى عند نهاية العلم الأول من العمر وقد يستمر بعض الشيء بعد ذلك.

بالنسبة لتجارب الأطفال مع أماتهم وإبراز مشاعر إيجابية ناحيتهم في أثناء فترات اللعب فذلك تم قياسه عند الشهر الثامن من العمر.

لوحظ أن تلك المشاعر كانت أقوى بكثير فى الأطفال ذوى الرضاعة الطبيعية عنها فى الأطفال ذوى الرضاعة الصناعية.

- بالنسبة للتطور العضلى للأطفال فلقد لوحظ أن نسبة كبيرة من أطفال الرضاعة الطبيعية استطاعوا السير ولكن بالمساعدة فى نهاية العام الأول من العمر فى حين أن نسبة ضئيلة من أطفال الرضاعة الصناعية استطاعوا ذلك.
- لقد استخلص من هذه الدراسة مدى أهمية الرضاعة الطبيعية وتأثيرها الإيجابى على الحالة المناعية ، الصحية ، والنفسية ، على الأطفال فى خلال العام الأول من العمر وبالتالى فى السنوات المقبلة.

مستخلص الرسالة

دراسة مناعية وسيكولوجية للأطفال ذوى الرضاعة الطبيعية فى السنة الأولى من العمر مع مقارنتهم بالأطفال ذوى الرضاعة الصناعية

اسم الباحث : علا محيى الدين عبد السميع الشيخ

جهة البحث : مركز البيومية الطبى بالجيزة

هذه الدراسة تضمنت خمسين طفلاً خمسة وعشرون مثلوا الأطفال ذوى الرضاعة الطبيعة والخمسة وعشرون الآخرون مثلوا الأطفال ذوى الرضاعة الصناعية. تم جمع هؤلاء الأطفال من مركز طبى بمحافظة الجيزة. بدأت هذه الدراسة حين كان هؤلاء الأطفال حديثى الولادة وانتهت حين أتموا العام الأول من العمر.

وجد أن نسبة الأجسام المناعية كانت أعلى فى الأطفال ذوى الرضاعة الصناعية أكثر من هؤلاء ذوى الرضاعة الطبيعية. تبين فى المقارنة بين المجموعتين أن الأطفال ذوى الرضاعة الصناعية كانوا أكثر عرضى للإصابة بأمراض الجهاز التنفسى والهضمى من ذويهم فى الرضاعة الطبيعية. كذلك وُجدَ أن نسبة هذه الأجسام فى اللعاب ارتفعت مع ارتفاع معدل الإصابة بأمراض الجهاز التنفسى والهضمى. لم نصل إلى اختلافات واضحة بين أطفال المجمعتين من حيث الأطوال وذلك فى خلال السنة الأولى من العمر إلا بالنسبة للشهر الثالث من العمر حيث كان الأطفال ذوى الرضاعة الطبيعية أكثر طولاً من هؤلاء ذوى الرضاعة الصناعية ، أما من حيث مقارنة الأوزان ، فلقد وُجدوا أن أوزان الأطفال ذوى الرضاعة الصناعية كانت أثقل من أوزان الأطفال ذوى الرضاعة الطبيعية وذلك فى خلال جميع أشهر القياس فى السنة الأولى من العمر.

حين تمت مقارنة هاتين المجمعتين من الأطفال من الناحية السيكولوجية تم اكتشاف الاختلافات الآتية:

أن الأطفال ذوى الرضاعة الطبيعية كانوا أكثر قلقاً أو عصبية أو انفعالاً فى خلال الشهر الثانى من العمر. أن الأطفال ذوى الرضاعة الطبيعية كانوا أكثر حركة من الأطفال ذوى الرضاعة الصناعية وذلك بخاصة فى حركة الأذرع والأرجل. حيث تم ملاحظة رد فعل الخجل والخوف من الغرباء فى جميع الأطفال من المجموعتين وذلك فى خلال العام الأول من العمر تبين أن الأطفال ذوى الرضاعة الطبيعية يمرون بهذه المشاعر قبل الأطفال ذوى الرضاعة الصناعية وذلك ابتداء من الشهر الثالث أو الرابع من العمر. يبدأ الشعور

بالخوف من الأغراب فى الأطفال ذوى الرضاعة الطبيعية عن الشهر الثالث تقريباً ويستمر حتى الشهر السادس وينتهى تقريباً عند الشهر التاسع. فى الأطفال ذوى الرضاعة الصناعية ، يكون الشعور بالخوف من الأغراب متأخراً بعض الشئ فهو يبدأ تقريباً عند الشهر التاسع وربما ينتهى عند نهاية العام الأول من العمر وقد يستمر بعض الشئ بعد ذلك. بالنسبة لتجارب الأطفال مع أمهاتهم وإبراز مشاعر إيجابية ناحيتهم فى أثناء فترات اللعب فذلك تم قياسه عند الشهر الثامن من العمر. لوحظ أن تلك المشاعر كانت أقوى بكثير فى الأطفال ذوى الرضاعة الطبيعية عنها فى الأطفال ذوى الرضاعة الصناعية. بالنسبة للتطور العضلى للأطفال فلقد لوحظ أن نسبة كبيرة من أطفال الرضاعة الطبيعية استطاعوا السير ولكن بالمساعدة فى نهاية العام الأول من العمر فى حين أن نسبة ضئيلة من أطفال الرضاعة الصناعية استطاعوا ذلك.

لقد استخلص من هذه الدراسة مدى أهمية الرضاعة الطبيعية وتأثيرها الإيجابى على الحالة المناعية ، الصحية ، والنفسية على الأطفال فى خلال العام الأول من العمر وبالتالى فى السنوات المقبلة.

الكلمات المفتاحية:

١. المناعة.
٢. الأجسام المناعية فى اللعاب.
٣. طريقة الانتشار المناعى.
٤. علم النفس.
٥. رد الفعل العصبى.
٦. النشاط العضلى.
٧. التجاوب.
٨. خوف من الأغراب.
٩. التطور العضلى.

جامعة عين شمس
معهد الدراسات العليا للطفولة
قسم الدراسات الطبية

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جامعة عين شمس

معهد الدراسات العليا للطفولة

قسم الدراسات الطبية

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الدرجة العلمية : دكتوراه

القسم التابع له : الدراسات الطبية

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سنة التخرج : ٢٠٠٠

سنة المنح : ٢٠٠٠

شروط عامة

يوضع شعار الجامعة على الغلاف الخارجي .

جامعة عين شمس

الكلية :

رسالة ماجستير / دكتوراه

اسم الطالب : علا محمد السيد عبد السميع الشيخ

عنوان الرسالة : دراسة مناعية وسيكولوجية للأطفال ذوي الإصابة الصرعية في السنة الأولى من العمر مع مقارنتهم بالأطفال ذوي الإصابة الصحية

اسم الدرجة : (ماجستير / دكتوراه)

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تاريخ البحث : ٢١ / ٢ / ~~٢٠٠~~١٩٩

الدراسات العليا :

ختم الإجازة : أجيزت الرسالة بتاريخ ٢٢/١١/١٩٩٩

موافقة مجلس ~~الكلية~~ المعهد ١٢ / ٢ /٢٠٠٠

موافقة مجلس الجامعة / / ٢٠٠٠

بسم الله الرحمن الرحيم

والوٰلدٰت يرضعن أولادهن حولين كاملين لمن أراد أن يتم الرضاعة

صدق الله العظيم

جامعة عين شمس
معهد الدراسات العليا للطفولة
قسم الدراسات الطبية

دراسة مناعية وسيكولوجية للأطفال ذوى الرضاعة الطبيعية فى السنة الأولى من العمر مع مقارنتهم بالأطفال ذوى الرضاعة الصناعية

رسالة مقدمة من

الطبيبة / علا محى الدين عبد السميع الشيخ

توطئة للحصول على درجة دكتوراه الفلسفة فى دراسات الطفولة

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٢٠٠٠م