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The Impact of Feeding Pattern on Oral Health Status and Salivary Adiponectin Level in a Relation to Growth Parameter among Primary School Children in Baghdad city _ Iraq

A Thesis

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بسم الله الرحمن الرحيم

إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ

القمر (49)

صدق الله العظيم

In the name of Allah, Most Merciful.

Verily, all thing have we created in proportion and measure.

Qamar (the Moon)

Sura LIV Verse 49

Ref.: Ali, A.Y. (1934)
The meaning of the Glorious Qur'an.
Vol. 2, p1462; Dar al-Kitab Al-Masri

Dedication

To the soul of my mother and brother
To my dear father
To my gifts from Allah, my sisters and brothers
To my small family, my lovely husband and my little angel (Ali)

Special thanks for all your patience, support and encouragement throughout all my work ...

Alyaa

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Abstract

Background: Breast feeding is the normal way of providing young infants with the nutrients they need for healthy growth and development. It affects oral health, growth and body composition of the children either through its nutritional and immunological properties which differ from formula milk or through its hormonal component especially adiponectin which play an important role in the regulation of growth and development in the neonatal period and infancy, and could influence the programming of energy balance regulation in childhood and adulthood.

Aim of the study: the purpose of this study is to assess the prospective impact of feeding pattern on oral health status in a relation to salivary adiponectin level and their effect on growth status among primary school children in Baghdad city / Iraq.

Subject, Materials and Methods: A1689 primary schools children aged (8-9) years in Baghdad city/Iraq, subjected to prepared questionnaires to determine feeding pattern. The included sample composed of 672 child which returned questionnaires with matched answers. After exclusion of children with mixed feeding, the study sample consisted of 225 child, divided into two groups (breast feeding and formula feeding group). Oral hygiene was recorded using the plaque index by Silness and Löe (1964), Gingival health status was assessed by using gingival index by Loe 1967, while dental caries was assessed by Decay ($_{1\text{-}4}$) Missing-Filled surface index, tooth alignment also measured according to criteria of WHO in 1997. Eighty eight child was selected for salivary adiponectin analysis, which performed by using special kit (Enzyme-linked Immunosorbent Assay) ELISA technique. All 672 children were subjected to anthropometric measurement (height, sitting height and weight) and body composition to assess growth pattern.

Result: Breast feeding group was 15.55% in age 8 years and 48.44% in age 9 years which are higher than formula feeding group. There is a highly significant association between birth order and feeding pattern. Also, there is a significant association between number of sibling in the family and feeding pattern. For oral hygiene and gingival status, the study showed mean value of both indices which were higher in formula feeding group however, all these differences were not significant. For dental caries, mean percentage of caries experience in permanent teeth Decayed Missed Filled surfaces (DMFs) and all its component (Ds, Ms, Fs) were higher among formula feeding group than breast feeding group and the difference between the two groups was statistically significant for DMFs and Ds components. Concerning caries severity, the mean percentage value is higher among formula regarding all caries grades (D_1, D_2, D_3, D_4), while there is no statistical difference between the two groups concerning caries experience and severity in primary teeth except for d_3 as the difference was significant. Also, the study shows no significant association between feeding pattern and crowding score. Concerning permanent teeth eruption there is no significant difference between the two groups however, breast feeding group was higher than formula feeding group in the number of erupted permanent teeth. Concerning salivary adiponectin concentration, its mean was higher among formula feeding group. All body composition were higher among breast feeding group except for fat composition, although no significant difference was found, except for muscle.

Conclusion: The result of the current research revealed that the breast feeding provides protection from dental caries in the permanent teeth and regulates body compositions through the effect of adiponectin hormone.

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List of Abbreviations

AAPD	American Academy of Pediatric Dentistry
Ab	Antibody
A.D.	Anno Domini
ADHA	American Dental Hygiene Association
Adipo-R1	Adiponectin Receptor 1
Adipo-R2	Adiponectin Receptor 2
ADP	Adiponectin
A.H.	Anno Hegirae
BF	Breast-Fed
BIA	Bioelectrical Impedance Analyzing
BMC	Bone Mineral Content
BMD	Bone Mineral Density
BMI	Body Mass Index
CDC	Centers For Disease Control and Prevention
Chi	Chi-square-test
CI	Cormic Index
Cº	Centigrade
df	degree of freedom
DMFs/ dmfs	Decayed, Missed, and Filled surface Index
DMFt/dmft	Decayed, Missed, and Filled teeth Index
DS / ds	Decayed Surface
EBF	Exclusive Breastfeeding
ELISA	Enzyme-linked Immunosorbent Assay
FDA	Food and Drug Administration
FEPT	Fisher Exact Probability Test
FF	Formula-Fed
FS / fs	Filled Surface
GI	Gingival Index
H	Height
HBM	Human breast milk
HDL	High Density Lipoprotein
HM	Human Milk
HMW	High Molecular Weight
HRP	Horseradish Peroxidase

IBD	Inflammatory Bowel Disease
IgA	Immunoglobulin A
IGF-1	Insulin-like Growth Factor-1
IgG	Immunoglobulin G
IQ	Intelligence Quotient
Kg	Kilogram
m	meter
MFG	Milk Fat Globule
mL	milliliter
MS/ms	Missed surface
N	number
NCHS	National Center for Health Statistics
NEC	Necrotizing Enterocolitis
NHANES,	National Health And Nutrition Examination Survey
nm	nanometer
OD	Optical Density
ORS	Oral Rehydration Solution
P	Probability value
Pl I	plaque Index
PPAR-γ	Peroxisomal Proliferator-Activated Receptor-γ
PUFA	Polyunsaturated Fatty Acids
r	Correlation coefficient
RAN κ L	Receptor Activator for Nuclear factor κ Ligand
RPM	Round Per Minute
RSV	Respiratory Syncytial Virus
SD	Standard Deviation
SE	Standard Error
SIDS	Sudden Infant Death Syndrome
SPSS	Statistical Package for Social Science
T	t-test
TNF-α	Tumor Necrosis Factor-alpha
UNICEF	United Nations Children's Fund
W	weight
WHO	World Health Organization
µg	Microgram
µL	Microliter

Introduction

Introduction

Breast feeding is one of most effective ways to ensure child health and survival. There are well-established benefits to the mother and to the infant's growth, mental development and immunological system. The World Health Organization (WHO) recommends that an infant should be exclusively breast fed for the six months and then continued breast feeding for two years with supplemental foods (Singh *et al*., 2017).

Human milk provides complete nutrition for the infant. Its energy, nutrients, and bioactive components directly influence the development of newborn infants. Among its bioactive factors, human milk contains several immune substances, such immunoglobulins, cytokines and chemokines, growth factors, hormones and antibodies. It also contains other nonspecific compounds, such as specific peptides, lactoferrin and other proteins. All these components are transferred to the infant through breastfeeding (Gomez-Gallego *et al.,* 2016). Breast milk is referred to as "functional food" due to its roles other than nutrition as it has advantages on preventing chronic diseases and metabolic disorders (Savino *et al*., 2009). Several peptide\protein breast milk, including leptin, adiponectin hormones have been identified in human and others, these breast milk hormones may transiently regulate various tissue activities, including endocrine organs until the neonate endocrine system begins to function (Gillman, 2010).

Adiponectin is an adipocyte-derived hormone, which regulates glucose and lipid metabolism, improves fatty acid oxidation and insulin sensitivity and inhibits hepatic glucose production. Besides, adiponectin has strong anti-inflammatory properties. In addition to its above-mentioned peripheral actions, adiponectin in breast milk involved in energy balance regulation, may play a role in the regulation of growth and development in the neonatal period and infancy, and could influence the programming of

energy balance regulation in childhood and adulthood. (Savino *et al*., 2009; Catlı *et al*., 2014). Adiponectin is also produced locally in the oral cavity by salivary glands and its level is significantly correlated to plasma level as such salivary adiponectin was used as alternative to blood tests in measuring adiponectin level. (Riss *et al.,* 2016).

Breastfeeding has positive effects on the development and physiological integrity of infant's oral cavity. Breastfed infants have a better chance of improved oral and dental health than their counterparts that were artificially-fed, thus obviating the need for early dental consultations and treatments in the life of the individual. Several components of human milk protect against the development of dental caries and gingival diseases. Additional oral and dental benefits include reduced risk of malocclusion, as breastfeeding promotes development of correct positioning of the dental arches and therefore a good dental occlusion (Anyanechi *et al.,* 2017).

Anthropometry is considered to be an important tool for assessing nutritional status of individuals or of the community. There are many anthropometric measures that are useful in assessing the nutritional status of a population including Body Mass Index (BMI) and Cormic Index (CI) (Ukwuma *et al.*, 2018).

As far as there is no previous Iraqi study concerning prospective impact of feeding pattern on oral health status in relation to salivary adiponectin level and their effect on growth status, this study was conducted.

Aim of the study

This study was conducted to assess the impact of feeding pattern on oral health status in relation to salivary adiponectin level and their effect on growth status among primary school children in Baghdad city, Iraq.

Objectives:

1- Oral health status:

- Dental caries status.
- Oral cleanliness.
- Gingival health condition.
- Number of erupted permanent teeth.
- Eruption status.
- Malalignment status.

2- Salivary adiponectin level.

3- Growth status in relation to above oral variables including:

- Children anthropometric.
- Body composition.

Chapter one

Review of Literature

Review of literature

1.1 Breast Feeding

Breastfeeding is a dynamic biological process in which biochemical, physical, psychological and hormonal exchange takes place, designed for the transmission of much needed nutrients, as well as for building a firm psychological bond between the infants and their mothers (Raju, 2011). It is one of most effective ways to ensure child health and survival, breast feeding failure during the first six months of life participate to over a million preventable child death each year. There are well established benefits to the mother and to the child's growth, mental development and immunological system (Singh *et al.,* 2017).

1.2 Types of Breast Feeding

1.2.1 Exclusive Breastfeeding

Exclusive breastfeeding (EBF) can be defined as "a practice whereby the infants receive only breast milk without mixing it with water, other liquids, tea, herbal preparations or food in the first six months of life, with the exception of vitamins, mineral supplements or medicines". The World Health Organization (WHO) recommended that infants should be exclusively breastfed for the first 6-months, followed by breastfeeding along with complementary foods for up to two years of age, also it is recommended that breastfeeding should begin within one hour after birth (WHO, 2011).

Promotion of exclusive breast feeding is the single most cost-effective intervention to decrease infant mortality in developing countries (Biks *et al.,* 2015). Because of its high levels of antibodies, vitamin A, and other protective factors, colostrum is often considered the first immunization to the babies (Lavender et *al*., 2006). It is estimated that as

many as 4,000 infants and young children die worldwide because they are not breastfed (WHO, 2017).

The major factors that affect duration and exclusivity of breastfeeding include breast problems such as producing inadequate milk, mother's perceptions, sore nipples and societal barriers such as breastfeeding knowledge, length of maternity leave, employment, lack or inadequate familial and societal support and lack of encouragement and guidance from health care professionals. Early cessation of breastfeeding was attributed to other factors such as the advertisement of infant formulas which encourages mothers to select for the use of bottle feeding and pacifiers (Motee and Jeewon, 2014).

The rate of EBF for the first six months of age in Iraq was 30.9% at 2003 (Garfield and Waldman,2003) then, unfortunately, it was reducing to reach a level of 19.6% during the period from 2008 to 2012(IBFAN ,2015) while the study of Aljawady *et al*., in 2017 revealed that 45.6% were exclusively breastfed which was much higher and approximately doubles the last prevalence rate at 2012 but still not the optimum one, in addition, it remains away from the target WHO of 50% (WHO,2016).

1.2.2 Exclusive Breastfeeding and General Health

Infants that are exclusively breastfed have a lower chance of dying or becoming ill from infections and diarrhea and are less likely to acquire meningitis, pneumonia, and ear infections than those who were not exclusively breastfed; breast feeding was protective against single and recurrent incidences of otitis media in particular and the risk of hospitalization for lower respiratory tract infections during the first year of life. (Elyas *et al.,* 2017).

1.2.3 Predominant Breastfeeding

Predominant breastfeeding means that the breast milk was the infants' predominant source of nourishment. However, the infant may also have received liquids (water, fruit juice and water-based drinks), drops or syrup (minerals, vitamins and medicine), oral rehydration solution (ORS), (WHO, 2014). Unfortunately, compliance with recommendations of breast feeding in developing countries is low, and it has been suggested that more attention should be given to increasing BF rates. Many mothers start breast feeding, and then they turn to formula feeding as they think that BF is not sufficient for their children. Accordingly, they tend to practice mixed feeding (Al-Kohji *et al*., 2012).

1.2.4 Mixed Breastfeeding

Infants feeding with breast milk while also receiving non-human milk (also called partial breast feeding). Mixed feeding only refers to the first six months of life. From 6 months of age, all infants need additional complementary foods to enable normal growth and development (WHO, 2014).

1.3 Bottle (Formula Feeding)

Infants are not receiving any breast milk and feed with infant formula only. The complexity of breast milk, which changes as the baby's needs change, cannot be duplicated by manufactured formulas but it is considered as an effective substitute to breast milk and is formulated to mimic the nutritional composition of breast milk. The updated rule of FDA (Food and Drug Administration) on current good manufacturing practices for infant formula, requires, among other things, that formulas satisfy the quality factors of normal physical growth and a sufficient biological quality of protein component (adequate amounts of protein in a form that can be used by infants) (Martin *et al*.,2016).

1.4 Complementary Feeding

Complementary feeding is defined as "the process starting when breast milk is no longer enough to meet the nutritional needs of the infant, and therefore other food and liquids are needed along with breast milk. The transition from exclusive breastfeeding to family foods, referred to as complementary feeding", typically covers the period from 6 to 18-24 months of age, and is a very vulnerable period as it is the time when malnutrition starts in many infants, contributing significantly to the high prevalence of malnutrition in children under five years of age world-wide. (WHO, 2016).

Complementary feeding should be adequate, meaning that complementary foods should be given in amount, consistency, frequency, and using a variety of foods to cover the nutritional needs of growing child while maintaining breast feeding (WHO, 2014).

1.5 Benefits of Breastfeeding

1.5.1 Benefits to Mother

1.5.1.1 Hormones

Breastfeeding benefits for the mother begin after birth when hormones begin to change. Oxytocin is one of the most significant hormones that helps the mother. The stimulation of suckling increases the oxytocin to aid in the ejection of milk. Oxytocin release also stimulates uterus contraction, which will facilitate the uterus back to its normal size (Brown, 2011).Iraqi study by Issa in 2018 found that oxytocin levels decline in disordered mothers that were less frequently breast feed their infants and in which negatively influences the breast feeding. The same result also found by previous investigators as Lara-Cinisomo *et al*., 2017 which concluded that lower levels of oxytocin hormone were observed in women who had stopped breastfeeding their infant by 8-weeks postpartum.

Prolactin, another hormone secreted during lactation, is related to lactation amenorrhea, which acts as a contraceptive to space pregnancies further apart. The longer duration of breastfeeding and stimulation by the infant the higher the prolactin levels are which prolong the time of amenorrhea (Salone *et al.,* 2013).The outcome of prolonged amenorrhea gives longer periods of time between pregnancies, although it should not be used as a major form of contraceptive (Nodo, 2014).In a meta-analysis by Conde- Augdelo, *et al*.,(2006) authors found that the spacing of pregnancies can affect maternal health outcomes such as, puerperal endometritits and anemia, higher maternal mortality, early rupture of membranes and third trimester bleeding (Conde-Agudelo *et al*.,2006).

1.5.1.2 Maternal Weight Loss

According to several studies maternal weight loss can be affected by breastfeeding in the reduction of weight in a shorter amount of time, and weight retention for a longer period of time (Baker *et al.,* 2008). In a study by Ip *et al.,* (2007) the authors found that women who breastfed for a year had less weight retention one year post-partum, compared to their non-breastfeeding counterparts. In a large prospective cohort study, Baker *et al*., in 2008 showed that greater intensity (exclusivity) and duration of breastfeeding was associated with greater weight loss at 6 and 18 months postpartum in women of all body mass index (BMI) categories. The weight loss is also based on the increased metabolism during breastfeeding to supplement the infant which can also lead to weight loss. Mother's that breastfeed may require an additional 500 calories more which can contribute to increased weight loss while lactating than non-pregnant and non-lactating women (Stuebe, 2009).

1.5.1.3 Cancers

The initial long term benefits of breastfeeding combined with length of time spent breastfeeding and for a longer duration can reduce the risks of certain cancers. The reduction of any malignancy as an outcome of breastfeeding is due to hormone released during lactation (Stuebe, 2009). During lactation there is a delay in ovulation or lactation amenorrhea which can lead to changes in the breast tissues (Brown, 2011), also possibly reduces lifetime exposure to hormones such as estrogen (Dieterich *et al.* 2013). According to meta-analysis of Beral *el al.,* in 2004, women with breast cancer were less likely to have breastfed, and they had a shorter average lifetime duration of breastfeeding than did women who had not developed this disease.

1.5.1.4 Decreased Risks of Metabolic Disorders

Breastfeeding is associated with favorable metabolic changes (Dieterich *et al.*, 2013). Pregnancy is an insulin-resistant state, which results from the effects on the mother of placental hormones with anti-insulin effects. These metabolic changes can cause gestational diabetes, and may increase the risk of type 2 diabetes later in life. Conversely, during lactation, insulin-sensitivity improves and may have lasting effects. However 4–12% reduction in the risk of type 2 diabetes was observed for every 12 months of lifetime lactation (Stuebe *et al.,* 2005, 2009).

1.5.1.5 Reduction of Cardiovascular Disease

Breastfeeding duration can be linked to decreased risk of cardiovascular disease and risk factors such as hypertension, diabetes, hyperlipidemia and obesity (Schwarz, *et. al.*, 2009). In a study on women from the Nurses' Health Study, it was found that women that breastfed had lower lipoprotein lipase which can affect lipid metabolism (Stuebe, *et al.*, 2009). When a mother breastfeeds, there is a reduction of serum

triglycerides and cholesterol which can decrease at a faster rate than those that do not breastfeed. Mothers who breastfeed have been found to have higher levels of high density lipoprotein cholesterol (HDL) and Apolipoproteins which can improve heart health in the long term for the mother (Stuebe *et.al.,* 2009). The long term effects on the woman who breastfed for a duration of 12 months was ten percent less likely to have developed cardiovascular disease than women who never breastfed (Schwarz *et al.,* 2009).

1.5.1.6 Psychological Benefits

The short term benefits of breastfeeding also aid the mother in coping postpartum psychologically. Breastfeeding has been reported to impact mood and stress reactivity in mothers (Heinrichs *et al.,*2002) Specifically, breastfeeding mothers report reductions in anxiety, negative mood, and stress when compared to formula-feeding mothers (Groër,2005) . There is evidence to show that breast-feeding mothers have a reduced cortisol response when faced with social stress (Krol and Grossmann, 2018). They also found that the hormones oxytocin and prolactin could have an inhibitory effect when the subjects were breastfeeding thirty minutes prior to a stressor (Nodo, 2014).Breastfeeding mothers also display prolonged and higher quality sleep patterns than those who feed their infants formula, specifically, there is research to show that at 3 months postpartum breastfeeding was associated with an increase of about 45 minutes in sleep and reduced sleep disturbance **(**Doan *et al.,* 2007). Critically, breastfeeding also impacts mothers' responses to emotions and may thereby improve social interactions and relationships. More specifically, they showed that prolonged durations of exclusive breastfeeding are linked to facilitated responses to inviting (happy)facial expressions and that more frequent breastfeeding on a given day is linked

with reduced responsivity to threatening(angry) facial expressions (Krol *et al.*,2014).

1.5.2 Benefits to Child

1.5.2.1 Gastrointestinal Benefits

The composition of the breast milk is much more specific to fit the needs of the infant. In addition, the incidence of many different infectious diseases are decreased in infants that are exclusively breastfed such as necrotizing enterocolitis (NEC), bacteremia, diarrhea, last onset-sepsis, and urinary tract infections. Mainly in premature infants the reduction of NEC is decreased by about 58% in exclusively breast fed infants. A decreased risk of gastrointestinal infections is associated with any duration of breastfeeding. Its effects can last up to two months after the cessation of breastfeeding (Nodo, 2014). According to the American Academy of Pediatrics (2012), a reduction of celiac disease and inflammatory bowel disease (IBD) can be found in breastfed infants (Eidelman, 2012). A 31% reduction of IBD into adult life is seen in breastfed infants, and this reduction is related to the protective benefits of breast milk on the gastrointestinal formation. The most common infection in infants the first year of life is rotavirus gastroenteritis. The rotavirus, as it is commonly known is one of the most severe gastrointestinal viruses that infants and young children suffer from. In the United States about half a million deaths occur each year in children under the age of five years old (Cortese and Parashar, 2009). Newburg states that although rotavirus infection occurs in breastfed infants, the severity of symptoms are substantially less than that in formula-fed infants. The rotavirus binds most often to the mucin in human milk which it can then replicate in the body infecting the infant. The most frequent binder to the rotavirus found in the body was to lactadherin. In human milk lactadherin is an N-linked oligosaccharide that is essential for binding to the rotavirus. The concentration of lactadherin and the

immunoglobin-A varied among the women, but the binding factor that lactadherin has allows for a better defense to the rotavirus. Breastfed infants had a better defense to the rotavirus due to the multiple antibodies in the breast milk (Newburg *et. al.,* 1998).

1.5.2.2 Respiratory Benefits

Breast milk hasan other benefits to the infant that are shown in the overall health from the first year of life and beyond that are physiological. Infants may experience otitis media at least one time in the first year of their life (Duijts *et al*., 2010). The increase in the chance of them having the infection is almost doubled in formula fed infants, as opposed to those exclusively breastfed (Stuebe, 2009). The oligosaccharides that are in the breast milk compared to formula have shown a correlation to decreased risk of otitis media and in respiratory infections in the first year of life. The incidence of respiratory infections and asthma are said to be lower in exclusively breastfed infants. The antiviral factors that are present in breast milk can be protective against certain infections such as respiratory syncytial virus infection (RSV) (Nodo, 2014). A study by Bacharach *et al.*, (2003) found that infants who were formula fed faced a higher risk of being hospitalized by a lower respiratory infection such as RSV than those exclusively breastfed. Asthma can also be found to be preventable by exclusively breastfeeding for the first three to six months of life. The protective effect of the breast milk was much higher in those with a history of asthma or atopy. In infants that were breastfed for four months, the risk of pneumonia increased fourfold, compared to infants breastfed for six months. The severity of asthma and the amount of oxygen needed is also higher in infants that were never breastfed (Eidelman, 2012).

1.5.2.3 Reduction of Infant Mortality and Sudden Infant Death Syndrome

Sudden infant death syndrome (SIDS) is the leading cause of death among infants 1 to 12 months of age (Shapiro-Mendoza *et al.*, 2006). Breastfeeding can play an extremely high role in reducing the rates of SIDS. This is because the mother will keep the infant at a closer range and will often feed frequently throughout the night (Ip *et al.*, 2007). The association can be made between breast milk and the reduction of SIDS due to the protective effects against certain infections (Hauck *et al.*, 2011) the immunological and anti-inflammatory qualities of human milk are mechanisms through which breastfed infants may be protected (Salone *et al.*, 2013). Infant mortality rates in the first year of life are also reduced when breastfeeding lasts for a longer time period the infants first year of life. A study by Chen and Rogan (2004), found that if an infant is breastfed for a longer amount of time, there would be a lower risk of post neonatal death. The idea suggests the longer the duration of breastfeeding will lead to a greater protective effect for the infant. Infant mortality cannot be accurately measured consistently due to the differences in controls because they often have a longer duration to breastfeed the infant (Chen and Rogan, 2004).

1.5.2.4 Cognitive and Motor Skills Development

Cognitive development of infants is determined by heredity, psychosocial factors, and their interactions (Lee *et al.*, 2016). The potential of breast milk to enhance cognitive development has been the focus of numerous studies since Hoefer and Hardy's initial observation in 1929. It is generally agreed that children who breastfeed are more intelligent; however, debate remains whether this is a causal relationship or merely an association with favorable parental socioeconomic class and IQ. The beneficial effects of breastfeeding on the child's neurodevelopment are

hypothesized by some to be mediated by long-chain polyunsaturated fatty acids (PUFA) which are present in human milk, but not in cow's milk or most infant formulas (Koletzko *et al.*, 2008) . However, a systematic review of all randomized trials where mother's diet was supplemented with PUFAs during pregnancy has failed to confirm such an effect. When comparing breastfed and formula fed infants in mobility, or rolling over, there was a significant difference in the two groups (Lo *et al.*, 2012).

The breastfed infants rolled over much earlier in life than infant's formula fed (Dewey *et a*l., 2001). They were also significantly earlier in raising their heads. In the study by Dewey et al., (2001) he also found the infants that were exclusively breastfed were more likely to have walked at an earlier age than those who are formula fed.

1.6 Colostrum

Colostrum is the first fluid that is produced by the mother which is low in quantity but very dense in nutrients this stage is often the first few days after birth. Colostrum is thick yellow material that is expressed within the first week of postpartum. It is higher in proteins and low in carbohydrates and fats compared to mature milk. The colostrum that is expressed is not signaled by suckling by the infant. The release of colostrum is to empty the breast to allow the mature milk to come on. The composition of colostrum is often thick to coat the infant's gastrointestinal tract to prevent the growth of pathogens (Brown, 2011). The colostrum's micronutrient composition is often much different than later stages of milk production. The concentration of sodium, chloride, magnesium levels are higher, and potassium, calcium and lactose are lower (Pang and Hartmann, 2007). The second stage of lactation occurs after the first few days of postpartum, after most of the colostrum has decreased (Lawrence and Lawrence, 2011). The major components of the colostrum are secretory

IgA (immunoglobulin A), lactoferrin, leukocytes and epidermal growth factors (Castellote *et al*., 2011).

1.7 Composition of Breast Milk

Human breast milk is a complex biological matrix with a general composition of (87-90) % water which is considered as the main source of water for newborn infants (Martin *et al.*,2016), the composition of human breast milk is dynamic and changes over time, adapting itself to the changing needs of the growing infant .It contains macronutrients (proteins, lipids and carbohydrates), micronutrients (minerals and vitamins) and numerous biologically active substances, these bioactive substances are defined as " elements that affect biological processes and have an impact on body function or condition and ultimately health". Bioactive components in human milk come from a variety of sources; some are produced and secreted by the mammary epithelium, some are produced by cells carried within them while others are drawn from maternal serum and carried across the mammary epithelium by receptor-mediated transport. Further, the secretion of the milk fat globule (MFG) into milk by the mammary epithelium carries with it a diverse collection of membrane-bound proteins and lipids into the milk. Together these methods produce the variety of bioactive components in human milk (Ballard and Morrow, 2013). Among its bioactive factors, human milk contains several immune substances, such immunoglobulins, cytokines and chemokines, growth factors, hormones, and antibodies. It also contains other nonspecific compounds, such as specific peptides, lactoferrin and other proteins. All these components are transferred to the infant through breastfeeding (Gomez-Gallego *et al.*, 2016). The nutrient composition of human milk can be strongly influenced by the stage of lactation. These changes are consistent with consuming decreasing quantities of milk and ingesting

other foods throughout the course of lactation as the infant matures (Verd *et al.,* 2018).

1.8 Breast Feeding and Obesity

The prevalence and intensity of childhood obesity have been increasing with an alarming rate globally, and it is now considered to be at epidemic level. This nutritional problem has become an issue of international concern, which is common not only in developed but also in developing countries. It is associated with hypertension, cardiovascular, gastrointestinal, endocrine, respiratory and orthopedic diseases as well as psychosocial problems both in adults and children (Vafa *et al*., 2012). Obesity and its consequences account for huge costs for health and social care. While the treatment for obesity is time-consuming and inconclusive, the prevention of obesity is the most effective solution which is impossible without understanding the risk factors of obesity. Knowing that childhood obesity is an important predictor of obesity in adulthood, special attention must be focused on prevention during childhood (Procter, 2007).Breastfeeding was considered a protective factor for obesity in childhood (Yeung *et al*.,2017) .The WHO and United States Department of Health and Human Services reported that during the first year of life particularly for at least 6 months; breastfeeding appears to be associated with decreased risk of development of obesity in childhood and later life (Horta *et al.*,2007). A shorter duration of breastfeeding is probably associated with early introduction of solid food containing protein more than breast milk; and reduced appetite signaling which in turns induces a greater number of feeding times (Makela,*et al.*, 2014). Long-term breastfeeding was associated with a 13 % lower risk of childhood overweight or obesity (Victora *et al.*, 2016). Researchers suppose that breastfeeding promotes healthier feeding pattern as it allows infants to

control intake until satiation is reached. In contrast, formula fed-infants are more susceptible to overfeeding because mothers may support infants to empty their bottles. (Gibbs and Forste,2014) low rates of exclusive breastfeeding may contribute to unhealthy feeding practices such as overfeeding resulting in an increased obesity risk (Cartagena *et al.*, 2014). Epidemiological studies have shown that breastfeeding has a well-established protective role against obesity and metabolic disorders in later life. The protective role of breast milk may be attributed not only to its nutritional composition but also to adipokines, which are investigated and found to be involved in important physiologic functions (Gillman, 2010).

1.8.1 Adipokines in Breast Milk

There are several peptide/protein, hormones have been identified in human breast milk, including leptin, adiponectin, irisin, nesfatin, adropin, resistin, abstain, ghrelin, , copeptin, apelins, pituitary adenylate cyclase-activating polypeptide, motilin and cholecystokinin (Savino and Liguori, 2008). These breast milk hormones may transiently regulate various tissues activities, including endocrine organs until the endocrine system of the neonate begins to function. Some of these peptides are secreted in biologically active forms. Insulin, leptin, adiponectin, ghrelin, resistin, abstain, epidermal growth factor, insulin-like growth factor 1 and platelet-derived growth factor are bioactive substances that play roles in energy intake and regulation of body composition (Karatas *et al*., 2011). Other possible function including regulation of growth and development in neonatal life and infancy, regulation of growth and appetite control later in life. Adipokines also have long term effect (protection against infections and metabolic disease such as obesity and type 2 diabetes). However, functions of some of these peptides in neonatal development are still unknown, these adipokines either synthesized in mammary epithelial cell

or transferred from the maternal circulation to the breast milk (Catli *et al.*, 2014).

1.8.2 Adiponectin

Adiponectin " also known as adipocyte complement related protein " is an adipocyte-derived hormone, which regulates glucose and lipid metabolism, improves insulin sensitivity and fatty acid oxidation and inhibits production of hepatic glucose (anti-diabetic and anti-atherogenic effects) (Savino *et al.*, 2010). Moreover, adiponectin has potent anti-inflammatory properties by affecting the vascular endothelium such as inhibiting local pro-inflammatory signals, preventing pre-atherogenic plaque formation and inhibiting thickening of arterial wall. In addition, adiponectin has a central activity in the energy homeostasis regulation, food intake stimulation and in decreasing energy expenditure (Schondorf *et al.*, 2005). Adiponectin synthesis is regulated by the peroxisomal proliferator-activated receptor-γ (PPAR-γ), a nuclear receptor whose expression in muscle and liver seems to be important in the mediation of obesity-related insulin resistance (Maeda *et al.*, 2001). Adiponectin has two different receptors: Adiponectin receptor R1 (Adipo-R1) is expressed abundantly in skeletal muscle, while adiponectin receptor R2 (Adipo-R2) is expressed predominantly in the liver (Yamauchi *et al.*, 2003). The researcher have demonstrated that circulating adiponectin occurs in three distinct isomeric forms: (trimetric low molecular weight), (hexameric medium molecular weight) and (high molecular-weight, HMW) adiponectin; each of which have different biological activities, including insulin sensitivity improvement, suppression of inflammation and metabolic control. Among these isomeric forms, the HMW adiponectin is the most active form in exerting metabolic functions (Schondorf *et al.*, 2005; Newburg *et al.*, 2010). In 2006 Martin *et al*., and Bronsky *et al*., were the first authors to report the presence of immunoreactive adiponectin in

human breast milk. The expression of Adipo-R1 in the small intestine of neonatal mice (Zhou *et al.*,2005) and the expressions of Adipo-R1 and Adipo-R2 in colon epithelium of human (Yoneda *et al* .,2008) suggested that not only adiponectin derived from adipocyte but also breast milk and cord blood adiponectin might play a key role in infant growth and also involved in energy balance regulation, may play a role in the regulation of growth and development in the neonatal period and infancy, and could affect energy balance regulation programming in childhood and adulthood. (Savino *et al*., 2009). Adiponectin is also produced locally in the oral cavity by salivary glands. As such, adiponectin plays a role in oral inflammation and the oral immune response. The relationship between protein levels in plasma and oral fluids, and makes oral fluid as a biospecimen that could be used as an alternative to blood in tests measuring adiponectin (Riss *et al.*, 2017).

1.9 Breast Feeding and Oral Health

Oral health is one of general health component and is an important factor in the normal child development. Problems or illnesses in oral health can influence the development and general health of a child and can adversely affect quality of life (Petersen and Kwan, 2009). The family is the most important factor in the determination of child medical and dental health. This may be due to the fact that family, especially the mother, greatly affect the child's health related behavior. Most of mothers had very little knowledge about the importance of breast milk for a child’s health and formula milk delivery is expected to replace the breast milk role in providing nutrition for infants which contains very high sugar and low on other nutrition elements (Hashizume *et al.,* 2011).

1.9.1 Breast Feeding and Dental Caries

Dental caries is defined as "an infectious transmissible preventable disease in which several elements affect its formation and development". (McDonald *et al*. 2011). It is regarded as an infectious, contagious and multifactorial disease produced by three primary individual factors: cariogenic microorganisms, cariogenic substrate and susceptible host (or tooth) (AAPD, 2003). These factors interact together in a certain period of time causing an imbalance in the demineralization and remineralization between surface of tooth and the adjacent plaque (biofilm) (Harries *et al.*, 2004). Human milk immune components play a protective role such as secretory IgG and IgA can slow the growth of specific types of streptococcus mutans colonizing the child's mouth (Prabhakar *et al*., 2010). Mothers' milk lactoferrin is also thought to have a bactericidal effect (destroying bacteria) (Ballard and Morrow, 2013). Furthermore, Erickson in his study (1999) evaluated the cariogenic potential of different liquids and reported that breast milk had 0.01 decay potential, close to water, which has a decay potential of 0.00, therefore, it may be hypothesize that human milk is naturally protective to teeth. In addition, breast milk is not thought to be remaining stagnant (collected) in the baby's mouth in the same way as bottle milk because the milk does not flow unless the baby is actively sucking. If babies are actively sucking then they are also swallowing, so pooling of breast milk in the mouth need not be considered a problem. Some consider pooling of the milk as an issue because it acts as a source of carbohydrate for bacteria and could initiate the caries process. Furthermore, breast milk enters the baby's mouth behind the teeth. Conversely, bottle milk does not provide the protection of immunoglobulin's and contains high levels of dietary sugars (Arora *et al.*, 2011, 2013). The relationship between breast feeding and tooth decay development is actually complex and could be confounded by many

variables, mainly infection with *Streptococcus mutans*, enamel hypoplasia, sugar intake in its different forms and social conditions. In Iraq, Al-Assadi study in 2012 concluded that, breast feeding was the predominant feeding method among caries free children and caries active children were mostly feeding by bottles and similar result was found in previous study by Al-Mukhtar in 1995. In contrast, Al-Mendalawi, and Karam in 2014 concluded that there is no association between pattern of feeding during infancy and deciduous teeth decay.

1.9.2 Breastfeeding and Gingival Health

Gingivitis is an inflammatory disease restricted to the gingival soft tissues, with no loss of alveolar bone or apical migration of the periodontal ligament along the root surface; it is common in children (Chauhan *et al.*, 2012). The primary cause is dental plaque related to poor oral hygiene. Inadequate oral hygiene is the most important risk factor in the development of periodontal disease. Gingivitis progress more rapidly in undernourished populations (Scardina, 2012). Breastfeeding is one of the most important activities in infancy and early childhood. More than a nutritional choice (Salone *et al.*, 2013). Human milk has antioxidant properties. It contains vitamin C and E and enzymes, including superoxide dismutase, catalase, and glutathione peroxidase. These are known to protect against the potentially-harmful effects of oxidative stress (Tsopmo and Friel, 2007). Apart from its role in maintaining the viability and texture of human tissue cells, it also modulates immune-mediated mechanisms in the body for a healthy survival. The role of antioxidants has also been depicted in the first window of infectivity, gingival and periodontal diseases, oral infections, and tissue morphogenesis. Hence, antioxidants form an important part of diet and, together with intracellular antioxidant enzyme systems, prevent various diseases (Xavier *et al.*, 2011).

1.9.3 Breastfeeding and Malocclusion

Malocclusion is a developmental disorder of maxillofacial system which can causes functional and esthetic disturbances (Narbutytė *et al*.,2013). Malocclusion can impair the children and adults quality of life (Kragt *et al.*, 2016; Massod *et al.*, 2017). Orthodontic treatment has been shown to produce instant and longer-term improvements on patient's quality of life, including social and emotional well-being (Healey *et al.*, 2017). Based on these findings early prevention of any developing malocclusion could have a major effect on individual's life course and help to avoid orthodontic treatment. The hypothesis that breastfeeding can influence craniofacial development is based on the potential morphological consequences of breastfeeding compared with bottle-feeding and on the oral structures malleability during craniofacial growth and development. Suckling movements that occur during breastfeeding, in contrast to the sucking movements during bottle-feeding, involve tongue peristaltic motions around the nipples of breast that can help guide the morphology of the palate by rounding and flattening it (Woolridge 1986). These movements also help in the development and harmonization of the peripheral oral musculature required for efficient swallowing (Palmer 1998). Additionally, oral functions development facilitates a proper eruption process of primary dentition with functional tooth interdigitation. There is some evidence that tongue and lip movements during breastfeeding encourage the infant to draw breast milk through peristaltic action (Weber *et al.* 1986), allowing for suitable function and maturation of the oral musculature needed for swallowing and adequate growth and development of the maxillo-mandibular complex (Palmer 1998). In contrast, when bottle feeding infants place their tongues in relatively inferior positions, lips do not come together as tightly "depending on the material, size and configuration of the artificial nipple". In those cases, lips

are likely to generate less oral motor stimulation, because fluid flow can be easily stimulated via light lingual pressure. These factors may lead to initial developmental malocclusion due to a combination of a constricted maxillary dental arch with a deeper palate, sometimes, a more retro positioned mandible linked to posterior displacement of the tongue base (Sanchez-Molins *et al.,* 2010).

Two systematic reviews investigate the breastfeeding and malocclusion topic, the first one by Peres *et al.*, (2015), their conclusions were based mostly on the primary dentition studies. This review concluded that breast feeding reduced the risk of malocclusions. The authors suggested that breastfeeding compared with absence of breastfeeding reduced the odds of developing a non-specific malocclusion by 66%; while exclusive breast feeding compared with non-exclusive breast feeding decreased the odds of developing a non-specific malocclusion by 46%; and that a longer period of breast feeding reduced the odds of developing a non-specific malocclusion by 60%. The second review by Abreu *et al.,* in 2016 focused on the association between bottle-feeding with breastfeeding and its effect on mixed and permanent dentition malocclusion. Unlike the other systematic review, this review suggested that there was not enough evidence to support an association between breastfeeding, bottle-feeding and malocclusions occurrence of in mixed and permanent dentitions. No meta-analysis was presented, as the studies included were not considered sufficiently homogeneous.

Al-duliamy study in 2018 concluded that there is strong relationship between the duration of exclusive breastfeeding and the prevalence of normal occlusal features of primary dentition. Therefore, Exclusive breastfeeding for more than 12 months is considered as an early component of preventive orthodontics for developing normal primary dentition (Al-duliamy, 2018)

1.9.4 Breastfeeding and Teeth Eruption

Tooth eruption is a continuous biological activity by which evolving teeth emerge across jaws and the overlying mucosa into the oral cavity. The school age period from childhood to adolescent is a critical life stage when health and oral health behaviors develop. Tooth eruption is defined as the movement of the tooth from its site of development in alveolar bone to the occlusal plane in the oral cavity (Almonaitiene *et al.*, 2010). It is a complex and tightly regulated process and considered as an important aspect of human growth and development, it can be influenced by a number of factors and reflect the general human body development (Soliman *et al.*, 2012). Factors such as genetics, ethnical - racial - geographical differences, hormones, gender and nutritional differences can affect the eruption of teeth (Höffding *et al.*, 1984). A change in tooth eruption timing is one of the important indicators of malnutrition during child development. Many studies have demonstrated the relationship between primary teeth eruption and early childhood malnutrition; however, this relationship was not observed in all studies (Vejdani *et al.*, 2015). Iraqi study by Diab in 2003 found that The mean number of permanent teeth among malnourished children were lower than normal children as eruption is a growth process and therefore have a relation with other process of the body especially height and weight. The emergence of first primary tooth in the oral cavity of the child is of great importance to assess child growth and development. Considering breastfeeding status as a possible source of variation in the timing of emergence of primary teeth, several researches had been conducted with different results. Some reported delayed eruption of teeth in children who were not breast fed (Al-Ansari and Farrag, 2016) and earlier eruption in children with exclusive breast fed compared to those partially breast fed (Kohli *et al.*, 2014). Another study found appreciable associations between breastfeeding status and emergence timing and

patterns of eruptions of first primary teeth (Folayan *et al.*, 2007). On the other hand, some other researchers found that breast feeding did not alter the eruption time of primary teeth (Folayan and Sowole, 2013).

In Iraq, a study by Aziz in 2010 concluded that breast feeding has positive effect on the mean number of the deciduous teeth in all age as the result show that the mean number of the deciduous teeth higher in the children with breast feeding than those with bottle feeding.

1.10 Growth Parameters

1.10.1 Anthropometrics

Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. It is simple, quick, non-invasive and reliable form of obtaining objective information about a person's nutritional status (CDC, 2011).

1.10.1.1 Body Mass Index (BMI)

Body Mass Index (BMI) is calculated as an index of weight-to-height squared (kg/m2) has been used widely as a body classification system to estimate the total body fatness. The BMI is a measure which shows whether people have the right weight for their height (Sharma and Hegde, 2009) and used to determine the nutritional status (weight categories).The BMI is the most widely used diagnostic tool to identify nutritional condition of a population as it is easy method of measurement and it is used usually determines whether a person is underweight, healthy or overweight (Mei *et al.,* 2002).The BMI value thresholds for defining underweight, overweight and obesity in the adults irrespective of age and gender, table1.1 (WHO, 2004). However, BMI may not correspond to the same degree of fatness in different populations, since the ratio does not take into consideration any variation between populations in trunk length or sitting height and length of lower limbs. Body shape is also an important

determinant of risk status. The shape refers to the relative skeletal dimensions of the body and is commonly expressed as a ratio of two linear dimensions. Overweight and obesity have been repeatedly associated with increasing health risks (Bagust and Walley, 2000).

Table 1.1: Weight status categories

BMI	Weight status
Under-weight	Below 18.5
Normal weight	18.5_24.9
Over weight	25_29.9
Obese	30 and above

Childhood obesity has increased and obese children may become obese adults and suffer from associated co-morbidities. Early-life factors could play a role in determining levels of childhood body mass index (BMI) and therefore future obesity levels in adults. Breastfeeding is known to have numerous benefits to both mothers and infants. Policies to promote breastfeeding are well established, and breastfeeding should be encouraged regardless of effects on childhood BMI. Breastfeeding, if found to reduce childhood BMI, could be an important part of wider early life obesity interventions (Gibson *et al*., 2017). Meta-analysis investigated the effect of breastfeeding on mean BMI, but did not find significant effect of breast feeding on BMI after adjustment for certain covariates (Owen *et al.*, 2005). Another study identified a potential protective effect of breastfeeding: children with BMI values between 90th and 97th percentiles had a significance reduction in mean BMI if they had breastfeeding compared with bottle feeding (Beyerlein and Von Kries, 2011).

Numerous studies was carried out In Iraq to identify the prevalence and risk factors associated with overweight and obesity and its relation to breast feeding history. The first study demonstrated that the prevalence of overweight and obesity was 6% and 1.3%, respectively and it is

significantly increased with age. The proportion of overweight and obesity increased from 5% and 0.9% at age 7 reaching 6.5 and 1.8%, respectively, at the age of 12 years. This may give the impression that obesity is a progressing phenomenon that once present tend to increase with time, the study concluded that there is a significant association between breast feeding and normal weight (Lafta and Kadim, 2005). The results of the study of Aldosky and Zakar in 2013 show that for both male and female, the breastfeeding tended to be associated with lower risk of long-term overweight. Another study by Naji and Abdullah in 2013 found that highest proportion of overweight was noticed among children who had history of breast feeding during infancy, children with no added food, when added food started 6 months age and older.

1.10.1.2 Weight Status and Oral Health

The relationship among oral health condition nutritional status and general health are complex with many interrelating factors (Palmer, 2005). Several Iraqi studies revealed that nutritional status may affect the oral health among children of different age groups and geographical locations. Dental caries and childhood obesity are multifactorial complex disease and children's dietary pattern is a common underlying etiological factor in their causation .A study in association between dental caries and age-specific BMI showed that children with more severe dental decay were more underweight (Cameron *et al.,* 2006). While Willershausen *et al.*, in 2007 have shown that high BMI was linked to a high number of caries lesions in primary school children. Some researchers have supposed that frequent sugar intake can be a predisposing factor of both overweightness and dental caries. Therefore, dental caries status of a child may have an effect on what the child eats or drinks, and based on this information there can be a change in the child's dietary habits (Bagherian and Sadeghi, 2013).

A study by Abaas in 2011 in Iraq concerning overweight in relation to dental caries in primary and permanent teeth among children aged 7-9 years concluded that overweight school children had higher mean dental caries scores (DMFT and dmft) and higher dental caries prevalence in deciduous and permanent teeth than normal weight school children but there was no significant association between overweight and dental caries prevalence and severity. Another study by Al-Kamal in 2016 about caries experience in relation to weight status among school children age between 7 and 12 year old in Tikrit city in Iraq concluded that the underweight children were more likely to have caries experience than normal and overweight children for primary dentition and for permanent dentition with no significant differences statistically between the three groups. Also, Muhammad *et al* (2015) study about the prevalence of dental caries, and its relation to nutritional status in Sulaimani city concluded that malnourished children had a higher caries experience than well-nourished group.

Study by Chaloob, and Qasim in 2013, found that no significance in the nutritional status (BMI) of children at 5-16 years of age and plaque index, gingival index, and calculus index, as well as the correlation of significant differences was not found between the nutritional status (BMI) and caries experience. So the study reflected that the oral hygiene, gingival health and dental caries were not affected by nutritional status of children at age of 5-16years. Another study by Muhammad *et al.,* in 2015 revealed that higher gingival, dental plaque and calculus scores were found among malnourished children than that of well-nourished children the same result was found in Diab study (2003) which concluded that the prevalence of sever gingivitis, higher among underweight children.

There are many factors associated with eruption have been widely investigated including nutritional status (Almonaitiene *et al*., 2010). Many

studies have been conducted throughout the world concerning dental development and timing of permanent teeth emergence. A study by Dimaisip-Nabuab et *al*., in 2018 showed that weight status at age 8–9 were significantly associated with the number of erupted permanent teeth: the mean number of erupted permanent teeth was lowest in underweight children and highest in overweight children. In Iraq, there are many studies conducted to relate the eruption time with the weight and height as an anthropometric measures of nutritional status, Yassin and Rifat In 2015 found that the mean number of deciduous teeth was lower in children who were underweight than those who were with normal weight and overweight. This study concluded that nutritional status affects the eruption of deciduous teeth in all age groups and the female dentition erupt earlier than the male dentition.

The occlusion of teeth might be affected by many factors including the genetical and environmental factors. The jaw growth in a good manner requires a favorable environment; one of the most essential factors required is a good nutrition (Proffit *et al.,* 2014). Evidence suggests that malnutrition is associated with impaired the growth and development of bones. Malnutrition of children might result in the underdevelopment of the skeleton and facial structure, which could lead to malocclusion in developing teeth (Khan *et al.,* 2014). In the field of oral health, the association between impaired growth and the development of facial bones and malnutrition has been reported by a number of researchers and has been linked to a reduction in the skull base length and jaw height. There have also been reports of variations in lower facial height, maxillomandibular width and skeletal and dental ages as a result of malnutrition. Therefore, it is believed that malnutrition may also be associated with malocclusion, particularly dental crowding, which is defined as teeth misalignment due to insufficient space for them to erupt in

the correct place. Altered in the growth of bones in the craniofacial complex caused by poor nutrition could be reflected in reduced space for dental eruption (Thomaz, *et al.,* 2010).

The association between malocclusion and nutritional status among Iraqi children are shown in numerous studies, Wadood and Khalaf in 2019 concluded that no relationship between the malnutrition and the malocclusion in primary dentition among preschool children. In contrast Jasim *et al*., in 2016 concluded significant relation found between crowding, facial heights and nutritional status as the results showed significant association between BMI and dental crowding with high prevalence of crowding in over-weight boys and girls.

1.10.1.3 Cormic Index

Stature is one of the most important variables when assessing the growth of children and their nutritional status, evaluating the basic energy requirements, adjusting the measures of physical capacity and predicting appropriate drug dosage and setting standards of physiological variables (Mohanty *et al*., 2001; Golshan *et al*., 2003; Datta Banik, 2011; Ter Goon *et al*., 2011), The cormic index which is sitting height to stature ratio is the most common bi-variate index of shape. It is a measure of the relative trunk length and lower limb and it varies between individuals and groups (Adeyemi *et al.,* 2009). Cormic index has been defined as "the ratio of the sitting height to the total height and as a measure of body shape; which is, sitting height divided by standing height. Thus, cormic index can be said to be the percentage of the sitting height of the total height or the stature " (Al-Isa and Thalib, 2008). Cormic Index provides an estimate of relative trunk length. It is expressed as (Sitting height/stature) x 100 (Ukwuma, 2009).

There is an ethnic or racial variation in the mean cormic index; cormic index has been used as a useful means to study the size of body.

Influences of lifestyle and environment on the cormic index over time have been described in some populations (Wadsworth *et al.*, 2002). Increase in cormic index was observed and was attributed to the modern way of life or better living conditions. While it has been noted that human beings growing-up in unfavorable biocultural environments, including diet, childhood health and family circumstances: parental height, divorce and death; as well as exposure to infection, under nutrition, economic oppression/poverty, have asymmetric body proportions, may be stunted, be overweight, be wasted, and be at greater risk for disease (Bogin *et al.*, 2001).

1.10.2 Body Composition

Accurate assessment of body composition is important in many areas of obesity and nutrition-related research. It aims to quantify the amount and relative proportions of body tissue compartments, analysis of body composition has become a useful tool in both clinical and research settings. Its use in the pediatric population is complicated by the rapid periods of growth and physical development that are characteristic of infancy, childhood, and adolescence. A thorough understanding of the changing nature of body composition during this time is essential for choosing the most appropriate measurement technique for a given individual, population. Growing evidence suggests that tissues such as fat, muscle, and bone are intimately involved in the regulation of whole body energy metabolism (Weber *et al.*, 2012).

Breastfeeding has been implicated in the establishment of infant appetite regulation and body composition (Gridneva *et al.*, 2018). It is identified as one of the most economical preventative measures for non-communicable diseases including obesity later in life (Kelishadi, and Farajian, 2014). The development of body composition in early life is known to play a significant role in the programming of these health

outcomes (Wells *et al.,* 2007). This reduction in risk may be a result of numerous mechanisms associated not only with of human milk (HM) composition but also with infant breastfeeding patterns and behavior (Bartok, 2011), all of which may influence the breastfed infants growth and development . Differences in the weight and body composition between formula-fed and breastfed infants have been attributed to the complete compositional differences of breast milk and formula (Butte, *et al.*, 2000). It is important to understand the mechanisms by which, breastfeeding and components of breast milk may influence infant body composition, as this will allow for more targeted interventions that may potentially decrease both infant and adult overweight and obesity, moreover, longer breastfeeding duration is shown to reduce risk for rapid growth patterns in early childhood (Rzehak *et al.*,2017) and attenuate the adverse effects of body weight and early weight gain on infant fat mass gain suggesting dose-dependent effect of breastfeeding on development of infant body composition, (Ejlerskov, *et al.,* 2015) . Study by Gridneva *et al.* in 2018, sheds new light on the complex mechanisms by which breastfeeding may influence infant body composition and confer some degree of protection from obesity. It is well known that pattern of growth and body composition in the first period of life differ between formula-fed (FF) and breast-fed (BF) infants. It's confirmed that the first year of life is a "critical window" of infant developmental programming that has the potential for intervention to improve outcomes for the infant. It has been suggested that differences in growth pattern and body composition between BF and FF infants might be because of a different endocrine response to feeding or to breast milk bioactive substances that could influence infants' response to energy intake and metabolism (Savino *et al.,* 2009).Earlier, systematic reviews and meta-analyses found significant protective effect of breastfeeding on body composition. (Arenz *et al.,* 2004). In Iraq study by

Aldosky and Zakar in 2013 about the impact of breastfeeding on body composition concluded that exclusive breastfeeding protects from elevating body fat in both gender. Also their results show a higher percentage of muscle mass in breastfeeding than bottle feeding. About oral health and its relation to body composition Irigoyen-Camacho *et al.*, in 2014 study the relationship between body fat percentage and periodontal status they concluded that excess body fat indicators were associated with bleeding on probing and dental calculus in adolescents.

Chapter Two
Subjects, Materials and Methods

Subjects, Materials and Methods

Across sectional comparative study design were used. This study was conducted among primary school children with age range between 8-9 years in Baghdad city (Rusafa Sector), Iraq over period of 6 months, from December 2018, to the end of May 2019. It involved time at which biochemical analysis were carried out.

An ethical approval was obtained from the ethical approval committee, college of dentistry / university of Baghdad to perform this study (appendix I).

Prior to data collection, legal permission was obtained from the Ministry of Education, General Directorate of Education of Second Rusafa Sector (appendix II). The children's parent given an information sheet with simple description about the present study and its importance to insure voluntary precipitation. Also a special consent form prepared and distributed to the parents to obtain permission for including their children in the study and to have their full cooperation (appendix III).

2.1 The Sample

The sample of the present study consisted of primary schools children aged 8-9 years. The age of the sample was recorded according to the criteria of World Health Organization (WHO, 1997), according to the last birthday. According to the information obtained from the General Directorate of Education of Second Rusafa Sector, the total number of primary schools were (573) primary schools and the total number of primary schools children at these ages were (69,962). The representative sample was calculated according to these equations:

$$no = \frac{pq}{25} \quad , \quad n = \frac{\mathrm{no}}{1 + \frac{(\mathrm{no} - 1)}{\mathrm{N}}}$$

As p equal to the prevalence of disease under study and q equal to 100-p. n=sample size, no=sample size which has been calculate by pervious equation, N=the population under study (Cochran, 1963).The sample pooled from forty-three primary schools which were selected randomly as they distributed in different geographical areas in the city and 1689 prepared questionnaires were distributed to the children including demographic variables (appendix IV), the reliability of the questionnaire was assessed by resending the questionnaire to the parent one month after the first time and only the questionnaires with repeated answers were accepted. The included sample in this study composed of 672 primary schools children which of returned questionnaires with matched answers.

Feeding pattern of the children was assessed by a questionnaire which divided the children into three categories: purely breast feeding, mixed feeding, and purely formula feeding.

2.1.1 Exclusion Criteria

- Children with any systemic disease.
- Children with weight below 25 Kg.
- Children with mixed feeding.

The study sample consisted of 225 child, 89 boys and 136 girls divided into two groups children (breast feeding group and formula feeding group).

A subsample included 88 child (44 from breast feeding group and 44 from formula feeding group matched together in age and gender) salivary samples were collected from them for biochemical analysis.

2.2 Materials and Instruments

The materials and instruments that were used in the present study listed below:

2.2.1 Instrument Used for Growth Measurement:

- Automatic Digital Weighing Scale (body fat monitor WF 260 Rossmax, Taiwan) as shown in figure 2.1
- Graduated scale for height

2.2.2 Material and Instrument Used in Oral Examination:

- Sickle-shaped dental explorers
- Dental mirror.
- Gloves
- Face masks.

2.2.3 Material and Instrument Used in Saliva Collection, Storage and Analysis

- Centrifuge machine ,China (figure 2.2)
- Cooler box
- Deep freezer
- Graduated micropipettes and disposable tips.
- Graduated sterile disposable test tubes (10 ml).
- Incubator, France (figure 2.3)
- Marker pen.
- Racks for the test tubes.
- Screw capped Plastic disposable cups.
- standard ELISA microtiter plate reader, Germany (figure 2.4)
- Timer.

2.2.4 Material and Instrument Supplied in Salivary Adiponectin ELISA Kit. Elabscience, China. (Figure 2.5)

- Concentrated Biotinylated Detection Ab (1vial 10mL)
- Concentrated HRP Conjugate (1vial 120μL)
- Concentrated Wash Buffer (25×) (1vial 30mL)
- HRP Conjugate Diluent (1vial 10mL)

- Micro ELISA Plate (8 wells ×12 strips)
- Plate Sealer (5 pieces)
- Reference Standard & Sample Diluent (1vial 20mL)
- Reference Standard (2 vials)
- Stop Solution (1vial 10mL)
- Substrate Reagent (1vial 10mL)

Figure 2.1: Automatic Digital Weighing Scale, Taiwan

Figure 2.2 : Centerfuge, China

Figure 2.3: Incubator, France

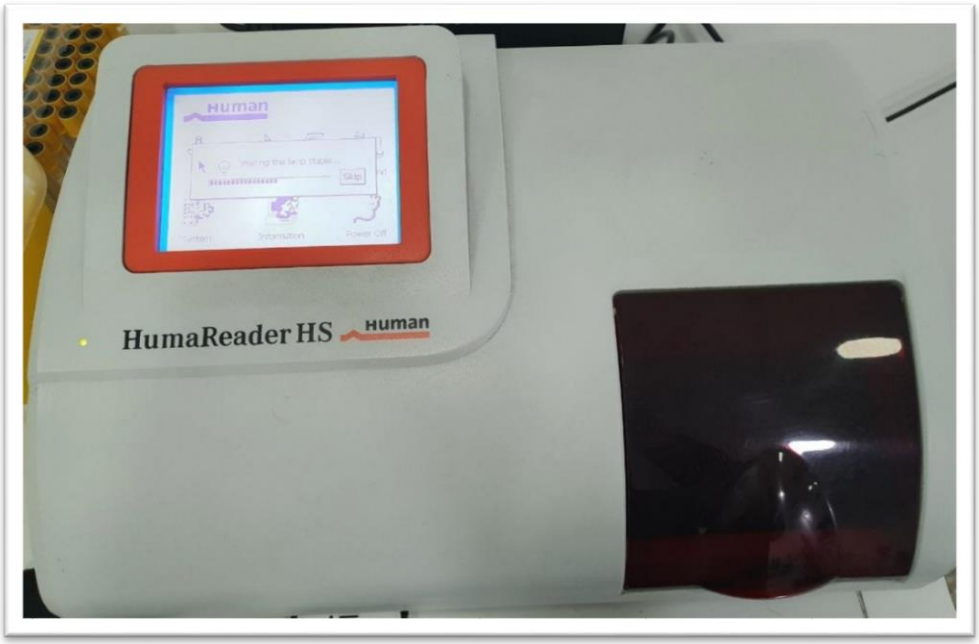

Figure 2.4: Standard ELISA micro titer plate reader, Germany

Figure 2.5: Human adiponectin ELIZA kit, Elabscience, China

2.3 Method

In the first part of the study questionnaire were distributed to all children through the schools, self-administered by the parents and returned back to the researcher to assess feeding pattern of children. Questions covered a wide range of topics related to feeding including type of feeding, duration of feeding in month and time on introduction of complementary feeding in addition to child name, gender, age, order of birth and number of sibling. In the second part, the children included in the study were examined by the researcher. A special case sheet was used for writing all information and data that include: feeding type, dental caries status, dental hygiene and gingival health status, number of permanent teeth and stage of eruption, crowding score, anthropometric measurement, body composition, and salivary status (appendix V).

2.3.1 Oral Examination

The examination of oral cavity was done under standardized condition depending on basic method of oral health surveys of World Health Organization (WHO, 1997).

2.3.1.1 Assessment of Oral Hygiene Status

Oral hygiene was recorded using the plaque index (Pl I) following Silness and Löe (1964) criteria, in which the examination started from buccal surface followed by mesial, lingual and distal surfaces of tooth. Six index teeth were selected to represent the rest of the dentition, these index teeth are the upper right first molar, upper right lateral incisor, upper left first premolar, lower left first molar, lower left lateral incisor and lower right first premolar for permanent dentition and upper right second molar, upper right lateral incisor, upper left first molar, lower left second molar, lower left lateral incisor, lower right first molar for primary dentition. When primary and permanent tooth were present, the permanent teeth were considered and its status recorded.

The criteria for Plaque Index (Pl I):

Scores	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent areas. It can be seen by running the probe across the tooth surface.
2	Moderate accumulation of soft matter within the gingival margin, pocket, and/or adjacent tooth surface, and can be seen by naked eyes.
3	Abundance of soft deposits within the gingival pocket and/or the gingival margin and adjacent tooth surface

2.3.1.2 Assessment of Gingival Inflammation

The gingival index (GI) by Loe and Sillness (1964) was used to evaluate gingival inflammation. The teeth that involve for examination only the fully erupted teeth when occlusal or incisal surface has reached to occlusal plan. A fully erupted permanent tooth was always offset primary teeth; when selected tooth was missing or partially erupted so in this case there was no substituted by adjacent tooth and the area was excluded. The examination and teeth selected was similar to that of dental plaque.

The criteria for gingival index are as follow:

Scores	Criteria
0	Mean the absence of inflammation which appear as normal gingiva.
1	Mild inflammation, slight change in color, slight edema, without bleeding at probing.
2	Moderate inflammation, moderate glazy appearance, redness, edema with bleeding on probing
3	Severe inflammation, marked redness, ulceration and tendency to spontaneous bleeding without probing

2.3.1.3 Dental Caries

The dental caries of the child was recorded using mouth mirror and dental explorer according to decayed, missing, filled index (DMFS). The diagnosis of dental caries was carried out according to Manjie *et al*., (1989) criteria. This allows recording the severity decayed lesion. The criteria for coding D_{1-4}MFS was as follow:

Grade1:

• Smooth surface: White-opaque or brownish color lesion in enamel only, and including minor loss of surfaces, hard look like smooth, glossy and the lesion is more frequently detached from gingival margin.

• Occlusal surface: dark pits or fissures hard when probing and the lesion appear confined to enamel with only extrinsic discoloration, then recorded as sound.

• Proximal surface: clinically appear white /brownish lesion without any obvious cavity when probing; when proximal surface is not in contact with neighboring tooth then the same criteria for smooth surfaces are applied.

Grade2:

• Smooth surface: enamel lesion (White-opaque or brown-dark color) including minor loss of the surface without any suspected dentinal involvement and also surface appear rough or softened and dull.

• Occlusal surfaces: pits and fissures with distinct sticking when probing indicative of continuing caries activity but without any evidence of dentinal involvement.

• A proximal surface dark enamel lesion catching by probing without any evidence of dentinal involvement.

Grade3:

Carious lesion includes the dentin only but the pulpal involvement not suspected.

Grade4:

Carious lesion with possibility or definite pulpal involvement.

(F) Fraction was recognized when one or more than permanent restoration was present without any affected tooth area either by primary or recurrent caries.

(M) Fraction of DMFS recorded for teeth that has been extracted as a result of caries and was estimated as five surfaces for posterior teeth and four surfaces for anterior teeth. Differentiation between unerupted and extracted was made by the evaluation of the status of contralateral and corresponding tooth, the alveolar ridge appearance in the area space in question and caries status of the other teeth (WHO 1997).

2.3.1.4 Malalignment of Teeth

Malalignment of the teeth is measured according to WHO, 1997 which includes crowding of anterior teeth from canine to another canine for both upper and lower jaw.

Scoring for crowding

- Crowding mean the space that available to accommodate four incisor teeth is insufficient to be in proper alignment.
- Crowding not record if the four incisor are in proper alignment but either or both canine are displaced

Scores	Criteria
0	no crowding in both jaw for anterior segment
1	crowding in one jaw for anterior segment
2	crowding in both jaw for anterior segment

2.3.1.5 The Number and Stage of Erupted Permanent Teeth

The permanent teeth were examined and their eruption stage was recorded as described by (Pahkala *et al.*, 1991).The tooth was diagnosed as erupted under one of three stages (stage 1, stage 2 and stage 3) as follows:

- **Stage 0:** the tooth is not visible in the oral cavity.
- **Stage 1:** one cusp is visible in the oral cavity at least.

- **Stage 2:** the entire occlusal surface is visible but it doesn't reached the occlusal level.
- **Stage 3:** the tooth in occlusion or at the level of the occlusal plane if the antagonistic tooth was not fully erupted.

All the students were examined for the eruption stage of their permanent teeth under natural light with mouth mirror.

2.3.2 Growth Measurements

The growth of children was evaluated by anthropometric measurement which involved both height and weight. For children, BMI is specific for age and gender, is often referred to as "BMI-for-age" and known as anthropometric index. The BMI is calculated using the same method as adults, but is expressed, not as an absolute value, but as a percentile which can be got from either a graph or a percentile calculator. These percentiles represent child's BMI and it is relation to other children with the same gender and age. All procedures that used for measurement were recorded according CDC growth chart (2000) and National Health and Nutrition Examination Survey (NHANES, 2007) that used to assess physical growth. BMI (body mass index): is a numerical value that represent a person's weight with his or her height. BMI can be considered as indicator for growth when it is devised on a graph against a child's age. BMI is calculated as follows:

Weight in kg ÷ squared height in meters"

The BMI is measured by using calculator after finding the height in centimeter then convert it to meter and measure the weight. While for measuring BMI percentile for children and teens (age 2-20), after obtaining accurate measures then find BMI percentile by using the CDC's online Child and Teen BMI Calculator that will automatically display the BMI

percentile when calculating the BMI number then find the weight status category for the purpose of calculation BMI-for-age percentile

Weight status categories Percentile range (CDC, 2000).

Under-weight	Less than 5th percentile
Healthy-weight	5th percentile to less than 85th percentile
Over weight	85th percentile to less than 95th percentile
Obese	Equal to or greater than 95th percentile

2.3.2.1 Height Measurement

The height of children was measured by using ordinary measuring tape which secured at the wall, at the same time the top of ear and the outer corner of the eye should be in a line parallel to the floor this plane named as Frankfort plane. With horizontal bar is used on head top with compressing the hair and the measurement was recorded to the nearest 0.5 cm. All these were done after wearing off their shoes, heavy clothes and hair fineries (Mahan, 2008).

2.3.2.2 Sitting Height Measurement

Sitting height gives a measure of the length of the trunk. It is a measurement of the distance from the highest point on the head to the base sitting surface. For measuring sitting height, the child was sitting in erect position on flat stool his or her back in upright position .Arching of the back was avoided as much as with the head in the Frankfort Horizontal Plane. The knees are directed straight ahead with the arms and hands resting at the sides. Ask the child to sit tall, take a deep breath, and then bring the horizontal bar down snugly to the head with sufficient pressure to compress the hair and the height measured to the nearest 0.1 cm (NCHS, 1990).

2.3.2.3 Cormic Index

Cormic index expresses sitting height as a proportion of full height. It is a measure of the relative length of trunk and lower limb, it is represented by the ratio between sitting height and standing height (Sitting Height/Standing Height x 100)

Height status categories by cormic index (Ukwuma, 2009).

Normal cormic index	53-54 % (0.53 - 0.54 ±0.02)
Low cormic index	Less than 53% (<0.53)
High cormic index	More than 54 % (> 0.54)

2.3.2.4 Body Composition

Bioelectrical impedance analyzing (BIA) is the method used to measure the children body composition, a small electrical current passes through the body. Fat, water and lean tissue impede the current difference to give the reading.The BIA body fat monitor scale are used, after the scale is turned on by the examiner the personal data for each child was selected which include gender, age, height in cm and then the child instructed to take off shoes and stocks ant step onto the measurement platform carefully with feet on the stainless steel strips (measuring units) of the monitor and remain stationary, at first the weight appeared after that the body composition analyzing is taking place. A few seconds later after completion the measurement, the measured values (body fat in %, muscles in %, bones in %, body hydration in %) were shown two times alternately and the reading was recorded by the examiner for each child.

2.3.3 Collection of Salivary Sample

The collection of unstimulated saliva from the children was done by drooling passively to the tube of collection by using timer for five minute according to University of Southern California school of Dentistry guidelines for saliva collection (Navazesh and Kumar, 2008).

The children advised to wash out their mouth by distilled water several time then keep calm or relax for five minutes. Then instruct them to minimize their movement specially their mouth during collection then slope the head forward with keeping mouth slightly opened for allowing the saliva to drain to the collecting tube for five minutes.

2.3.3.1 Saliva Storage and Preparation

After the process of collection of saliva. The salivary samples were centrifuged for approximately twenty minute at (1000 rpm at 2 -8℃), according to the manufacturer instruction of human adiponectin ELISA kit. Collect the supernatant into clean test tubes then all samples were stored at temperature about -20 C.

2.3.3.2 Salivary Adiponectin Analysis

Salivary sample were collected from two groups of children (the first group of breast feeding children and the second group of formula feeding children) Saliva storage and analysis was done according to manufacture instruction.

2.3.3.3 The Principle of Procedure

This ELISA kit uses the method of Sandwich-ELISA. The provided micro ELISA plate in the kit has been pre-coated with ADP/Acrp30 specific antibody. Standards or samples are added to the suitable wells of micro ELISA plate and combined with the specific antibody. Then an ADP/Acrp30 biotinylated specific antibody detection and Avidin-Horseradish Peroxidase (HRP) conjugate is added to each micro plate well

successively and incubated. Free components were washed away. The substrate solution was added to each well. Only those wells that contain ADP/Acrp30, biotinylated detection antibody and Avidin-HRP conjugate would appear blue in color. Sulphuric acid solution was added to terminate the enzyme-substrate reaction and the color turned yellow. The optical density (OD) was measured by spectrophotometer rat a wavelength of 450 nm ± 2 nm. The OD value was proportional to the concentration of ADP/Acrp30.

2.3.3.4 Reagent Preparation

Prior to assay, all reagents were prepared to room temperature (18-25℃) before use.

- Wash Buffer: 30 mL of concentrated wash buffer was diluted into 750 mL of wash buffer with deionized or distilled water, unused solution returned back at 4℃. If crystals have formed in the concentrate, warm water bath at 40℃ could be used (heating temperature should not exceed 50℃) and the solution mixed gently until the crystals have completely dissolved. The solution should be cooled to room temperature prior to use.
- Standard: Standard was prepared within 15 minutes before use. The standard was reconstituted with **1.0** mL of sample diluent until it fully dissolved for 10 minutes. This reconstitution produced a stock solution of 250 ng/mL. Then series of dilutions were made as needed (making serial dilution in the wells directly was not permitted). The recommended concentrations of dilution was shown in the figure (2.6). The undiluted standard serves as the highest standard (250ng/mL). The sample diluent (Blank) serves as the zero concentration (0 ng/mL).

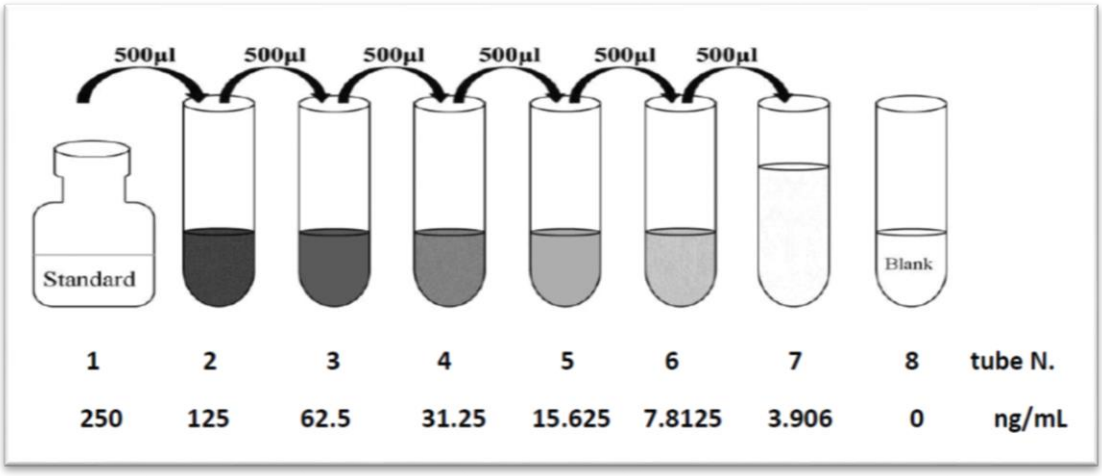

Figure 2.6: Serial dilution procedure

- Biotinylated detection Ab: the stock tube was centrifuged before use; the concentrated biotinylated detection Ab was diluted to the working concentration using biotinylated detection Ab diluent (1:100).
- Concentrated HRP conjugate**:** concentrated HRP conjugate was diluted to the working concentration using concentrated HRP conjugate diluent (1:100).
- Substrate reagent: The vial is remained closed until it needed as it is sensitive to light and contaminants. The needed dosage of the reagent drawn with sterilized tips and the residual reagent shouldn't be dumped back into the vial again.
- Washing procedure (manual wash): a 350µL of wash buffer was added into each well, soaked for 1~2minutes. After the last wash, decant any wash buffer remaining by inverting the plate and blotting it dry by rapping it firmly against clean toweling absorbent paper on a hard surface.

2.3.3.5 Assay Procedure

All reagents and samples were prepared to room temperature before use. Before the assay, the sample centrifuged again after thawing. All the

reagents mixed thoroughly by gently swirling before pipetting, "foaming was avoided".

1. Addition of sample: A100 μLof standard and sample was added per well. The blank well was added with reference standard and sample diluent. Solutions were added to the bottom of micro ELISA plate well, touching of wall and foaming was avoided as possible. After gentle mixing the plate covered with sealer and incubated for 90 minutes at 37℃.
2. Biotinylated detection Ab: The liquid removed from each well, without washing wash. A 100 μL of biotinylated detection Ab working solution immediately added to each well. Then covered with the plate sealer. The plate gently taped to ensure thorough mixing then incubated for 1 hour at 37°C.
3. Wash**:** The solution aspirated from each well and then washed, the process repeated three times. Each well washed by filling with wash buffer (approximately 350μL) (a squirt bottle was used). Complete removal of liquid at each step is essential. After the last wash, the remained wash buffer removed by aspirating or decanting. The plate was inverted and patted against a thick clean absorbent paper.
4. The HRP conjugate: A 100 μL of HRP conjugate working solution added to each well. Then the plate covered with sealer and incubated for 30 minutes at 37°C.
5. Wash: the wash process repeated for five times as in step 3.
6. Substrate:A 90 μL of substrate solution added to each well and covered with a new plate sealer. The plate incubated for about 15 minutes at 37°C and protected from light. The time of reaction could be shortened or extended according to the actual color change, but not more than 30 minutes. When apparent gradient appeared in standard wells, the reaction should be stopped.

7. Stop: A 50 μL of stop solution was added to each well. Then, the color turned to yellow immediately. The order to add stop solution was the same of the substrate solution.
8. The OD Measurement: the optical density (OD value) of each well determined at once, using a micro-plate reader set at 450 nanometer.

2.3.4 Pilot Study

A pilot study had been done to overcome as much as possible limitation that could be found during the study. A number of primary schools have been visited during pilot study with description of the study importance to the school's authority to insure their cooperation methods of oral examination, and the time required have been tested, the proper way of examination, diagnosis of oral health status and supplied facilities. All have been tested before starting the study to ensure successful examination.

2.3.4.1 Calibration Procedure

Inter and intra calibration were performed to overcome any problem that may face the researcher through the research, moreover to assure appropriate application of diagnostic criteria that used in recording the dental and gingival health condition. For inter-examiner calibration, ten subject were chosen randomly from College of Dentistry/Baghdad University, twice they were examined, one by researcher himself and the second by well-trained specialist in Department of Preventive Dentistry (supervisor). Examination involved dental caries and oral hygiene and gingival health condition (table 2.1). Another 10 subjects were examined by investigator and then re-examined after 14 days in order to eliminate any chance for memory bias (table 2.2). No significant differences were appeared between both observations for both inter and intra calibration procedures ($P>0.05$).

Table 2.1: Inter-calibration

variables	Readings						Paired t-test	df	P
	Student			Supervisor					
	Mean	SD	SE	Mean	SD	SE			
PL I	1.327	0.399	0.126	1.315	0.322	0.102	0.074	9	0.942
G I	1.049	0.224	0.071	1.034	0.133	0.042	0.182	9	0.858
d_1	0.300	0.483	0.153	0.300	0.483	0.153	0.000	9	1.000
d_2	0.500	1.080	0.342	0.500	1.080	0.342	0.000	9	1.000
d_3	0.700	1.636	0.517	0.900	2.025	0.640	0.243	9	0.811
d_4	0.600	1.265	0.400	0.500	1.080	0.342	0.190	9	0.851
ds	2.000	4.028	1.274	2.100	4.202	1.329	0.054	9	0.957
ms	0.000	0.000	0.000	0.000	0.000	0.000	---	--	----
fs	0.500	1.080	0.342	0.500	1.080	0.342	0.000	9	1.000
dmfs	2.600	4.993	1.579	2.700	5.187	1.640	0.044	9	0.965
D_1	2.300	2.163	0.684	2.100	1.853	0.586	0.222	9	0.827
D_2	0.500	1.080	0.342	.500	0.850	0.269	0.000	9	1.000
D_3	1.667	1.936	0.645	1.800	2.348	0.742	0.134	9	0.895
D_4	0.500	1.581	0.500	0.400	1.265	0.400	0.156	9	0.878
Ds	4.800	5.224	1.652	4.800	4.894	1.548	0.000	9	1.000
MS	4.000	8.756	2.769	4.000	8.756	2.769	0.000	9	1.000
FS	1.400	2.171	0.686	1.300	2.058	0.651	0.106	9	0.917
DMFS	10.200	13.903	4.396	10.100	13.445	4.252	0.016	9	0.987

PL I: plaque index, G I: gingival index, Ds/ds: decayed surface, Ms/ms: missed surface, Fs/fs: filled surface, DMFs/dmfs: decayed missed filled surfaces

Table 2.2: Intra-calibration

Variables	Groups						Paired t-test	df	P
	First			Two -weeks					
	Mean	SD	SE	Mean	SD	SE			
d_1	0.700	1.252	0.396	1.100	1.101	.348	0.759	9	.458
d_2	1.600	1.578	0.499	1.600	1.578	0.499	0.000	9	1.000
d_3	4.400	4.671	1.477	4.500	4.577	1.447	0.048	9	0.962
d_4	2.300	3.368	1.065	2.400	3.307	1.046	0.067	9	0.947
ds	9.000	5.354	1.693	9.500	5.318	1.682	0.210	9	0.836
ms	.500	1.581	0.500	0.500	1.581	0.500	0.000	9	1.000
fs	0.600	1.897	0.600	0.700	1.889	0.597	0.118	9	0.907
dmfs	10.100	4.864	1.538	10.700	4.785	1.513	0.278	9	0.784
D_1	1.000	1.155	0.365	1.200	1.033	0.327	0.408	9	0.688
D_2	0.300	0.675	0.213	0.600	0.699	0.221	0.976	9	0.342
D_3	1.000	2.539	0.803	1.100	2.514	0.795	0.089	9	0.930
D_4	0.000	0.000	0.000	0.000	0.000	0.000	--	--	---
D**s**	2.300	2.710	0.857	2.900	2.601	0.823	0.505	9	0.620
MS	0.000	0.000	0.000	0.000	0.000	0.000	---	--	---
FS	0.400	1.265	0.400	0.400	1.265	0.400	0.000	9	1.000
DMFS	2.700	2.791	0.883	3.300	2.751	0.870	0.484	9	0.634

2.4 Statistical Analyses

Computer software program as Statistical Package for Social Science (SPSS version 21) used for data description, presentation and analysis. Statistical analysis can be classified in two categories.

2.4.1 Descriptive Analyses

Descriptive analyses include frequency, percentage for nominal variable, while both mean and standard error for numeric variables (Quantitative)

2.4.2 Inferential Analyses

- **Levene test:** which include test the equality of variances between groups.
- **Fisher exact probability test:** this type of test is used for analysis of contingency tables; it is used to measure the strength of association between two categorical variables when the expected cell count is less than 5.
- **Chi-square test:** test the association between two categorical variables when the expected cell count is more than 5.
- **Paired t test**: a parametric test analyzing two related quantitative dependent variables.
- **Two independent sample t-test**: test for the significant differences of mean between two samples.
- **Pearson Correlation**: is type of bivariate analysis that used to measure the strength of association between two quantitative variables.
- **The Spearman correlation**: was used to assess the direction, strength and statistical significance of linear correlation between 2 quantitative variables, one of which being non-normally distributed.
- **Level of significance**: it can be tested as probability of error (P-value):
    - Not significant $P>0.05$
    - Significant $P \leq 0.05$
    - Highly significant $P \leq 0.01$

Chapter Three
Results

Results

3.1 The Sample

After exclusions, the sample of this study consisted of 225 child from both gender at the age between 8 and 9 years. The sample distributed into two groups: breast feeding group (144 child) and formula feeding group (81 child). The distribution according to age and gender is presented in the table 3.1. The table shows that at age 8 years, breast feeding group which is represent 15.55 % was higher than formula feeding group which represents about 13.33%. Also 48.44% from the age 9 years are breast feeding which is higher than formula feeding group which represent 22.66 %. Concerning each gender, the data of present study showed that the girls is higher than boys in both groups.

Table 3.1: Distribution of the sample according to age and gender

Age	Gender	Feeding pattern					
		Breast feeding			Formula feeding		
		N.	% of group	% of sample	N.	% of group	% of sample
8	Boys	9	25.71	4.00	8	26.67	3.55
	Girls	26	74.29	11.55	22	73.33	9.77
	Total	35	100.00	15.55	30	100.00	13.33
9	Boys	52	47.71	23.11	20	39.22	8.88
	Girls	57	52.29	25.33	31	60.78	13.77
	Total	109	100.00	48.44	51	100.00	22.66
Total		144	100.00	64.00	81	100.00	36.00

Distribution of children according to birth order in the family by feeding pattern is displayed in table 3.2. The children with second order of birth constituted higher percentage of the breast feeding group while the children with first order of birth constituted higher percentage among formula feeding group however, statistical analyses showed a highly significant association between birth order and feeding pattern.

Table 3.2: Distribution of children according to birth order in the family by feeding pattern

		Feeding pattern				FEPT	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
Birth order	1	32	22.22	38	46.91	18.175 *	0.008 HS
	2	44	30.56	23	28.40		
	3	31	21.53	12	14.81		
	4	14	9.72	4	4.94		
	5	13	9.03	2	2.47		
	6	4	2.78	2	2.47		
	7	3	2.08	0	0.00		
	8	2	1.39	0	0.00		
	10	1	0.69	0	0.00		

* Highly significant p ≤ 0.01

Table 3.3 shows the distribution of children according to the number of sibling in the family by feeding pattern. The family that have three sibling constituted higher percentage for both groups, however there is a significant association between number of sibling in the family and feeding pattern.

Table 3.3: Distribution of children according to the number of sibling in the family by feeding pattern

		Feeding pattern				FEPT	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
N. of sibling	1	5	3.47	3	3.70	19.066*	0.011 S
	2	17	11.81	21	25.93		
	3	45	31.25	28	34.57		
	4	37	25.69	14	17.28		
	5	18	12.50	11	13.58		
	6	13	9.03	0	0.00		
	7	3	2.08	3	3.70		
	8	3	2.08	0	0.00		
	9	2	1.39	1	1.23		
	10	1	0.69	0	0.00		

* Significant p ≤ 0.05

3.2 Dental Plaque and Gingival Health Status

Table 3.4 illustrates the mean value of plaque and gingival indices according to feeding pattern. Data analysis showed that the mean value of both indices were higher in formula feeding group however, all these differences were not significant.

Table 3.4: Mean value of plaque and gingival index according to feeding pattern

	Feeding pattern				t-test	df	P
	Breast feeding		Formula feeding				
	Mean	SE	Mean	SE			
PLI	1.373	0.019	1.422	0.029	1.498	223	0.136
GI	1.024	0.006	1.029	0.008	0.443	223	0.658

PL I: plaque index, G I: gingival index

3.3 Dental Caries Experience

The percentage of dental caries occurrence was found to be 96 % for both groups. Only 4% of total sample were caries free. Dental caries experience in primary teeth in relation to feeding pattern is displayed in Table 3.5. Results show that the mean percentage of dmfs was higher among breast feeding group and this results are true for ds component. In contrast for ms and fs component mean percentage was higher among formula feeding group. Concerning each gender the same figure was found for boys while for girls the opposite result found concerning ds and fs also for dmfs. However all these differences were statistically non-significant.

Table 3.5: Caries experience dmfs (mean percentage and SE) with its components (ds, ms, fs) according to feeding pattern by gender

Variables (%)	Gender	Feeding pattern				t-test	df	p
		Breast feeding		Formula feeding				
		Mean	SE	Mean	SE			
%ds	Boys	18.744	1.185	16.541	1.682	0.057	87	0.955
	Girls	18.910	1.573	19.064	2.107	1.101	133	0.273
	Total	18.814	0.952	17.413	1.319	0.872	222	0.384
%ms	Boys	5.494	1.166	5.556	1.404	0.565	87	0.573
	Girls	5.349	1.089	6.433	1.542	0.034	133	0.973
	Total	5.432	0.811	5.859	1.057	0.319	222	0.750
%fs	Boys	0.464	0.226	0.632	0.312	0.035	87	0.972
	Girls	0.656	0.361	0.635	0.394	0.446	133	0.657
	Total	0.546	0.201	0.633	0.244	0.269	222	0.788
%dmfs	Boys	24.701	1.612	22.729	2.168	0.363	87	0.717
	Girls	24.914	1.913	26.131	2.656	0.742	133	0.459
	Total	24.792	1.229	23.905	1.690	0.429	222	0.669

ds: decayed surface, ms: missed surface, fs: filled surface, dmfs: decayed missed filled surfaces

Table 3.6 shows dental caries severity in primary teeth represented by four grades among both feeding groups by gender. Concerning d_1, d_2, and d_3 the mean percentage was higher among breast feeding group in contrast for d_4 which is higher in formula feeding group. Taking gender in consideration, the same result was found concerning girls while boys differ in that the mean percentage of d_2 and d_4 were higher among formula feeding group than breast feeding However, all the differences among two groups of feeding and both males and females were not significant except for d_3 as the difference was significant and the same result found concerning girls only.

Table 3.6: Severity of dental caries (mean percentage and SE) represented by grades according to feeding pattern by gender

Variables (%)	Gender	Feeding pattern				t-test	df	p
		Breast feeding		Formula feeding				
		Mean	SE	Mean	SE			
% d_1	Boys	1.333	0.325	0.743	0.280	1.143	87	0.256
	Girls	1.433	0.232	1.150	0.262	0.788	134	0.432
	Total	1.391	0.191	1.010	0.197	1.292	223	0.198
% d_2	Boys	1.714	0.309	2.074	0.454	0.655	87	0.514
	Girls	2.506	0.612	1.784	0.466	0.847	134	0.399
	Total	2.171	0.377	1.885	0.342	0.507	223	0.613
% d_3	Boys	10.717	1.182	9.061	1.485	0.822	87	0.413
	Girls	10.654	0.995	7.487	1.033	2.120*	134	0.03 S
	Total	10.681	0.759	8.031	0.847	2.218*	223	0.02 S
% d_4	Boys	5.141	0.919	7.186	1.866	1.104	87	0.273
	Girls	3.924	0.727	6.120	1.237	1.636	134	0.104
	Total	4.440	0.572	6.489	1.030	1.739	130.039	0.084

* Significant $p \leq 0.05$

Dental caries experience in permanent teeth in relation to feeding pattern is shown in the table 3.7. The table illustrates that the mean percentage of caries experience DMFs and all its component (Ds, Ms, Fs) were higher among formula feeding group than breast feeding group and the difference between the two groups were statistically significant for DMFs and Ds component while for Ms and Fs component the differences were non-significant. Concerning each gender the same picture found for boys while for girls the opposite result found only for FS component however all these differences were not significant.

Table 3.7: Caries experience DMFs (mean percentage and SE) with its components (Ds, Ms, Fs) according to feeding pattern by gender

Variables (%)	Gender	Feeding pattern				t-test	df	p
		Breast feeding		Formula feeding				
		Mean	SE	Mean	SE			
%Ds	Boys	2.457	0.303	3.384	0.526	1.569	87	0.120
	Girls	2.655	0.506	4.055	0.722	1.638	134	0.104
	Total	2.541	0.275	3.616	0.424	2.213*	223	0.028 S
%Ms	Boys	0.097	0.097	0.143	0.143	0.265	87	0.792
	Girls	0.158	0.158	0.232	0.232	0.274	134	0.784
	Total	0.123	0.087	0.174	0.122	0.345	223	0.731
%Fs	Boys	0.039	0.039	0.194	0.194	0.421	87	0.675
	Girls	0.126	0.126	0.046	0.046	0.956	134	0.341
	Total	0.076	0.058	0.143	0.127	0.545	223	0.586
%DMFS	Boys	2.593	0.325	3.720	0.578	1.412	87	0.162
	Girls	2.939	0.558	4.334	0.806	1.832	134	0.069
	Total	2.739	0.301	3.932	0.468	2.145*	145.902	0.034 S

* Significant $p \leq 0.05$

Ds: Decayed surface, Ms: Missed surface, Fs: Filled surface, DMFs: Decayed Missed Filled surfaces

Severity of dental caries in permanent dentition represented by grades of decayed fraction among the two feeding groups displayed in table 3.8. The data of the present study exhibits that for the both groups, the mean percentage value is higher among formula regarding all caries grades (D_1, D_2, D_3, D_4) however these results weren't significant statistically. When taking gender in consideration the same figure was found for boys and girls.

Table 3.8: Severity of dental caries (mean percentage) represented by grades of (D_1-D_4s) according to feeding pattern by gender

Variables (%)	Gender	Feeding pattern				t-test	df	p
		Breast feeding		Formula feeding				
		Mean	SE	Mean	SE			
% D_1	Boys	1.022	0.242	1.939	0.382	2.081	87	0.040
	Girls	1.488	0.206	1.942	0.359	1.178	134	0.241
	Total	1.291	0.157	1.941	0.268	2.239	223	0.026
% D_2	Boys	0.649	0.177	0.677	0.278	0.087	87	0.931
	Girls	0.373	0.093	0.397	0.131	0.157	134	0.875
	Total	0.490	0.093	0.494	0.129	0.027	223	0.978
% D_3	Boys	0.863	0.312	1.071	0.411	0.387	87	0.700
	Girls	0.501	0.176	0.588	0.310	0.262	134	0.793
	Total	0.654	0.166	0.755	0.248	0.347	223	0.729
% D_4	Boys	0.121	0.098	0.369	0.265	1.081	87	0.283
	Girls	0.095	0.067	0.457	0.310	1.386	134	0.168
	Total	0.106	0.056	0.426	0.222	1.402	90.467	0.164

3.4 Alignment of Teeth (Crowding)

The distribution of the children with crowding score according to feeding pattern is shown in table 3.9. This table illustrates that the presence of crowding in one arch (score 1) was higher among formula feeding group. However score 2 was absent, the statistical analysis show no significant association between feeding pattern and crowding.

Table 3.9: Distribution of the children with crowding score according to feeding pattern

Teeth Alignment		Feeding pattern				Chi-square	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
crowding	Score 1	95	65.97	58	71.60	0.756	0.385

3.5 Eruption of Permanent Teeth

The mean number of erupted permanent teeth according to feeding pattern are displayed in the table 3.10, the table shows that no significant difference between the two groups however breast feeding group was higher than formula feeding group in number of erupted permanent teeth.

Table 3.10: Number of erupted permanent teeth according to feeding pattern

	Feeding pattern	Mean	t-test	df	p
Erupted Teeth	Breast feeding	12.813	0.595	223	0.552
	Formula feeding	12.617			

Mean number of erupted permanent teeth in each eruption stage according to feeding pattern was presented in the table 3.11, this table shows that the mean number of erupted permanent teeth in score 1 was higher in the formula feeding group than breast feeding group while the contrast result was found for score 2 and 3 .When taking age in consideration the data shows that in the age 8 years, the mean number of erupted permanent teeth in score 1 and 2 was higher in breast feeding than formula feeding group, in score 3 the mean number of erupted permanent teeth was higher in formula feeding group, while the contrast result was found for the age 9 years. Although all these differences were non-significant.

Table 3.11 Mean number of erupted teeth in each eruption stage (score 1-3) according to feeding pattern by age

Stage of eruption	Age (year)	Feeding pattern						t-test	p
		Breast feeding			Formula feeding				
		N	Mean	SE	N	Mean	SE		
Stage 1	8	35	0.514	0.144	30	0.433	0.149	0.389	0.699
	9	109	0.358	0.072	51	0.529	0.110	1.327	0.186
	T	144	0.396	0.065	81	0.494	0.088	0.901	0.368
Stage 2	8	35	3.057	0.399	30	2.667	0.353	0.721	0.474
	9	109	2.450	0.198	51	2.549	0.259	0.293	0.770
	T	144	2.597	0.179	81	2.593	0.208	0.016	0.987
Stage 3	8	35	8.371	0.553	30	9.100	0.475	0.981	0.330
	9	109	10.284	0.224	51	9.784	0.287	1.308	0.193
	T	144	9.819	0.226	81	9.531	0.253	0.809	0.419

Table 3.12 presented the stage of eruption of permanent teeth in upper right quadrant according to feeding pattern. The result presented that the upper right first molar had the highest number among the teeth that appeared at the level of occlusion (score3),and the teeth number were higher in formula feeding group followed by the upper right central incisors but their number was higher among breast feeding group. On the contrary, the upper right canine was the most tooth not visible in the oral cavity (score 0) followed by upper right second and first premolar consecutively, and the percent of these teeth in score 0 were higher among formula feeding group. For upper right lateral incisor the highest percent is fully erupted (score3) which higher among breast feeding group followed by teeth that erupted but doesn't reached the occlusal level (score 2) which higher among formula feeding group. However all these differences between groups were statistically non-significant.

The stage of eruption of permanent teeth in upper left quadrant according to feeding pattern was displayed in the table 3.13. The table shows that the percentage of upper left first molar had the highest percent

among the teeth that appeared at the level of occlusion (score3), and they were higher in formula feeding group followed by the upper left central incisors but their percentage were higher among breast feeding group. On the other hand the upper left canine was the most tooth not visible in the oral cavity (score 0) followed by upper left second and first premolar respectively, and the percent of these teeth in score 0 were higher among formula feeding group. For upper right lateral incisor the highest percent is fully erupted (score3) which higher among breast feeding group followed by teeth that erupted but doesn't reached the occlusal level (score 2) which higher among formula feeding group , these differences between groups in permanent teeth eruption stage were statistically non-significant.

Table 3.12: Distribution of the children according to stage of permanent teeth eruption (score 0, 1, 2, 3) in the upper right quadrant by feeding pattern

Upper right	score	Feeding pattern				FEPT	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
First molar	0	3	2.08	0	0.00	1.494	0.518
	1	0	0.00	0	0.00		
	2	4	2.78	3	3.70		
	3	137	95.14	78	96.30		
Second premolar	0	129	89.58	73	90.12	0.544	0.805
	1	4	2.78	1	1.23		
	2	11	7.64	7	8.64		
	3	0	0.00	0	0.00		
First premolar	0	109	75.69	65	80.25	1.012	0.879
	1	5	3.47	2	2.47		
	2	29	20.14	14	17.28		
	3	1	0.69	0	0.00		
canine	0	140	97.22	80	98.77	1.748	0.864
	1	2	1.39	0	0.00		
	2	1	0.69	1	1.23		
	3	1	0.69	0	0.00		
Lateral incisor	0	26	18.06	18	22.22	3.088	0.385
	1	6	4.17	4	4.94		
	2	49	34.03	33	40.74		
	3	63	43.75	26	32.10		
Central incisor	0	4	2.78	1	1.23	2.621	0.429
	1	0	0.00	1	1.23		
	2	12	8.33	9	11.11		
	3	128	88.89	70	86.42		

Table 3.13: distribution of children according to stage of permanent teeth eruption (score 0, 1, 2, 3) in the upper left quadrant by feeding pattern

Upper left	score	Feeding pattern				FEPT	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
Central incisor	0	1	0.69	0	0.00	1.205	0.894
	1	2	1.39	1	1.23		
	2	12	8.33	9	11.11		
	3	129	89.58	71	87.65		
Lateral incisor	0	27	18.75	21	25.93	4.482	0.197
	1	1	0.69	2	2.47		
	2	49	34.03	30	37.04		
	3	67	46.53	28	34.57		
canine	0	140	97.22	80	98.77	0.902	0.792
	1	2	1.39	1	1.23		
	2	2	1.39	0	0.00		
	3	0	0.00	0	0.00		
First premolar	0	113	78.47	66	81.48	0.937	0.923
	1	6	4.17	2	2.47		
	2	24	16.67	13	16.05		
	3	1	0.69	0	0.00		
Second premolar	0	135	93.75	78	96.30	1.219	0.899
	1	1	0.69	0	0.00		
	2	7	4.86	3	3.70		
	3	1	0.69	0	0.00		
First molar	0	3	2.08	0	0.00	1.409	0.711
	1	0	0.00	0	0.00		
	2	3	2.08	2	2.47		
	3	138	95.83	79	97.53		

Table 3.14 illustrates the stage of eruption of permanent teeth in lower right quadrant according to feeding pattern. The result showed that the lower right canine was the most tooth not visible in the oral cavity (score 0) followed by lower right second and first premolar consecutively, breast feeding group have higher percent of unerupted lower right canine ,but the contrast result was found concerning lower second and first premolar. The lower right first molar and central incisor had the highest

percent among the teeth in this quadrant that appeared at the level of occlusion (score3), and their percent were higher in formula feeding group than breast feeding group. For lower right lateral incisor the highest percent is fully erupted (score3) which higher among breast feeding group followed by teeth that erupted but doesn't reached the occlusal level (score 2) which higher among formula feeding group. All these differences between groups were statistically non-significant.

The stage of eruption of permanent teeth in lower left quadrant according to feeding pattern was displayed in the table 3.15. Results showed that the lower left first molar had the highest percent among the teeth that appeared at the level of occlusion (score3) followed by the upper left central incisors and the teeth percent were higher in formula feeding group. Contrariwise the lower left canine was the most tooth that were not visible in the oral cavity (score 0) followed by lower left second and first premolar consecutively, and the percent of these teeth in score 0 were higher among breast feeding group. lower right lateral incisor the highest percent is fully erupted (score3) which higher among breast feeding group followed by teeth that erupted but doesn't reached the occlusal level (score 2) which higher among formula feeding group , these differences between groups in permanent teeth eruption stage were statistically non-significant.

Table 3.14: Distribution of children according to stage of permanent teeth eruption (score 0, 1, 2, 3) in the lower right quadrant by feeding pattern

Lower right	score	Feeding pattern				FEPT	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
First molar	0	1	0.69	0	0.00	2.788	0.261
	1	0	0.00	0	0.00		
	2	7	4.86	4	4.94		
	3	136	94.44	77	95.06		
Second premolar	0	128	88.89	78	96.30	3.826	0.128
	1	3	2.08	1	1.23		
	2	13	9.03	2	2.47		
	3	0	0.00	0	.00		
First premolar	.00	120	83.33	69	85.19	2.113	0.586
	1	5	3.47	5	6.17		
	2	18	12.50	7	8.64		
	3	1	0.69	0	0.00		
canine	0	134	93.06	73	90.12	1.845	0.732
	1	6	4.17	6	7.41		
	2	3	2.08	2	2.47		
	3	1	0.69	0	0.00		
Lateral incisor	0	4	2.78	1	1.23	0.944	0.863
	1	2	1.39	1	1.23		
	2	37	25.69	24	29.63		
	3	101	70.14	55	67.90		
Central incisor	0	0	0.00	0	0.00	0.582	1.000
	1.00	1	0.69	0	0.00		
	2.00	7	4.86	4	4.94		
	3.00	136	94.44	77	95.06		

Table 3.15: Distribution of children according to stage of permanent teeth eruption (score 0, 1, 2, 3) in the lower left quadrant by feeding pattern

Lower left	score	Feeding pattern				Chi-square	p
		Breast feeding		Formula feeding			
		N.	%	N.	%		
Central incisor	0	2	1.39	0	0.00	0.791	0.885
	1	0	0.00	0	0.00		
	2	7	4.86	4	4.94		
	3	135	93.75	77	95.06		
Lateral incisor	0	6	4.17	4	4.94	1.988	0.586
	1	1	0.69	2	2.47		
	2	36	25.00	23	28.40		
	3	101	70.14	52	64.20		
canine	0	134	93.06	75	92.59	0.541	0.844
	1	5	3.47	4	4.94		
	2	5	3.47	2	2.47		
	3	0	0.00	0	0.00		
First premolar	0	113	78.47	63	77.78	4.601	0.162
	1	4	2.78	7	8.64		
	2	26	18.06	11	13.58		
	3	1	0.69	0	0.00		
Second premolar	0	135	93.75	75	92.59	0.003	0.956
	1	0	0.00	0	0.00		
	2	9	6.25	6	7.41		
	3	0	0.00	0	0.00		
First molar	0	2	1.39	1	1.23	1.507	0.839
	1	1	0.69	0	0.00		
	2	5	3.47	1	1.23		
	3	136	94.44	79	97.53		

3.6 Salivary Parameters

Table 3.16 shows the concentration of salivary adiponectin in saliva according to feeding pattern that compere between breast feeding and formula feeding groups. The table shows that the difference between the two groups was not significant. The result was the same concerning each gender however the mean of salivary adiponectin was higher among

formula feeding group than in breast feeding this result also found for girls while for boys opposite figure was found.

Table 3.16: Concentration of salivary adiponectin in saliva (µg/ml) according to feeding pattern

Salivary adiponectin (µg/ml)	Feeding pattern				t-test	df	p
	Breast feeding		Formula feeding				
	mean	SE	mean	SE			
Boys	5.469	1.480	5.435	1.315	1.136	56	0.261
Girls	4.933	1.060	6.591	0.984	0.015	28	0.988
Total	5.164	0.868	6.302	0.804	0.962	86	0.339

3.7 Salivary Parameters and Dental Health

The correlation coefficient between salivary adiponectin value and dental plaque and gingival indices among feeding pattern groups are shown in table 3.17. For plaque index the direction of the relation was gone in positive direction for both groups and the relations were not significant while for gingival index the relation was negative in breast feeding group and positive in formula feeding group this correlation was highly significant statistically (P value< 0.01)

Table 3.17: Correlation coefficient between salivary adiponectin value and dental plaque and gingival indices according to feeding pattern

	Salivary adiponectin			
	Breast feeding		Formula feeding	
	r	p	r	p
PL I	0.143	0.231	0.354	0.132
G I	-0.106	0.406	0.494*	0.006 Hs

* Highly significant p $\leq$ 0.01, PL I: Plaque Index, G I: Gingival Index

Table 3.18 show the correlation coefficient between salivary adiponectin and caries experience of primary teeth among feeding pattern groups. For d_1 and fs the relation was gone in negative direction in breast

feeding group and in positive direction for formula feeding group while for d_2, d_3, ms, dmfs the relation was gone in negative direction for both groups and relating to d_4 and ds the relation was gone in positive direction for both groups except ds in formula feeding group was in negative direction. Although all these correlations were not significant statistically.

Table 3.18: Correlation coefficient between salivary adiponectin and dental caries experience of primary teeth according to feeding pattern.

	Salivary adiponectin			
	Breast feeding		Formula feeding	
	r	p	r	p
d_1	-0.143	0.355	0.052	0.738
d_2	-0.050	0.746	-0.137	0.376
d_3	-0.124	0.423	-0.050	0.748
d_4	0.259	0.090	0.022	0.887
ds	0.028	0.856	-0.039	0.804
ms	-0.049	0.750	-0.039	0.804
fs	-0.029	0.853	0.216	0.160
dmfs	-0.011	0.941	-0.032	0.836

ds: decayed surface, ms: missed surface, fs: filled surface, dmfs: decayed missed filled surfaces

The correlation coefficient between salivary adiponectin value and dental caries indices of permanent teeth among feeding pattern groups are shown in table 3.19. For D_1 and MS fraction, the relation was gone in positive direction in breast feeding group and in negative direction for formula feeding group while for D_2, D_3, D_4, Ds, Fs, DMFs the relation was gone in negative direction for both groups except for D_3 in formula feeding group was in positive direction. At the same time these correlation were not significant statistically.

Table 3.19: Correlation coefficient between salivary adiponectin and caries experience of permanent teeth according to feeding pattern

	Salivary adiponectin			
	Breast feeding		Formula feeding	
	r	p	r	p
D_1	0.037	0.809	-0.268	0.079
D_2	-0.223	0.145	-0.055	0.724
D_3	-0.111	0.475	0.164	0.286
D_4	-0.125	0.418	-0.112	0.469
Ds	-0.162	0.294	-0.140	0.364
Ms	0.172	0.263	-0.127	0.410
Fs	0.000	0.000	-0.214	0.164
DMFs	-0.087	0.576	-0.224	0.145

Ds: Decayed surface, Ms: Missed surface, Fs: Filled surface, DMFs: Decayed Missed Filled surfaces

Table 3.20 shows the correlation between salivary adiponectin and tooth alignment (crowding) score among two feeding group. The direction of relation was negative in breast feeding group and positive in formula feeding group for crowding score. At the same time all the data were not significant.

Table 3.20: Correlation between salivary adiponectin and tooth alignment (crowding) score according to feeding pattern

	Salivary adiponectin			
	Breast feeding		Formula feeding	
	R(spearman)	p	r	p
Crowding	-0.090	0.561	0.025	0.869

3.8 Growth Parameters

The distribution of sample according to feeding pattern by weight status (BMI percentile) is shown in table 3.21 that illustrates no significant association was found between feeding pattern and weight status however among both breast and formula feeding groups the healthy weight showed the higher occurrence followed by obese.

Table 3.21: Distribution of sample according weight status (BMI percentile) by feeding pattern

BMI -percentile	Feeding pattern				Chi-square	p
	Breast feeding		Formula feeding			
	N.	%	N.	%		
Healthy	82	56.94	40	49.38	1.196	0.550 NS
Risk of over weight	30	20.83	20	24.69		
Obese	32	22.22	21	25.93		

Table 3.22 demonstrates the distribution of sample according to feeding pattern by height status which measured by cormic index. The table illustrates that there is no significant association between them however both groups of feeding pattern show that the occurrence of low mean cormic index ratio was higher followed by high cormic index ratio.

Table 3.22: Distribution of the children according to feeding pattern by cormic index

			Feeding pattern		Chi-square	p
			Breast feeding	Formula feeding		
Cormic Index	Low	N.	80	42	1.180	0.554
		%	55.56	51.85		
	Normal	N.	22	17		
		%	15.28	20.99		
	High	N.	42	22		
		%	29.17	27.16		

The mean value of body composition according to the feeding pattern presented in the table 3.23 that shows the percentage of all body composition were higher among breast feeding group than bottle feeding except for fat composition although no significant difference was found except for muscle composition as the difference was significant. The same figure found concerning each gender except for bone composition among girls as the opposite result was found as well as the differences concerning muscle were not significant for each gender.

Table 3.23: Body composition according to feeding pattern

Body composition %	Gender	Feeding pattern				t-test	df	P
		Breast feeding		Formula feeding				
		Mean	SE	Mean	SE			
Fat %	Boys	8.759	0.738	9.732	1.315	0.645	44.682	0.522
	Girls	16.084	0.887	17.858	1.195	1.192	104.913	0.236
	Total	12.981	0.670	15.049	0.998	1.721	151.145	0.087
Muscle %	Boys	60.797	1.141	56.996	1.636	1.905	53.916	0.062
	Girls	43.442	0.507	42.345	0.438	1.637	133.111	0.104
	Total	50.794	0.911	47.410	1.000	2.500*	193.36	.013 S
Bone %	Boys	3.990	0.075	3.600	0.181	1.991	36.516	0.054
	Girls	2.777	0.061	2.847	0.079	.700	107.147	0.485
	Total	3.291	0.069	3.107	0.090	1.621	168.301	0.107
Hydration %	Boys	66.510	0.551	65.943	0.979	.505	44.778	0.616
	Girls	61.076	0.639	59.800	0.856	1.195	105.353	0.235
	Total	63.378	0.489	61.923	0.728	1.658	151.276	0.099

* Significant p $\leq$ 0.05

3.9 Salivary Adiponectin and Growth Parameters

The correlation coefficient between salivary adiponectin value and growth parameters according to feeding pattern was displayed in the table 3.24.The result revealed that salivary adiponectin value have a negative correlation with body mass index (BMI) and cormic index among both groups except for cormic index in formula feeding group in which the correlation was gone in positive direction, however no significant correlations were found relevant to these results.

Table 3.24: Correlation coefficient between salivary adiponectin and growth parameters according to feeding pattern

	Salivary adiponectin			
	Breast feeding		Formula feeding	
	r	p	r	P
BMI	-0.031	0.839	-0.240	0.117
Cormic index	-0.068	0.660	0.279	0.067

BMI: Body Mass Index

Table 3.25 shows the correlation coefficient between salivary adiponectin value and body composition among feeding groups. The results demonstrates that salivary adiponectin value have a negative correlation with fat composition in both groups and the opposite result was found concerning hydration composition. While for muscle and bone, the correlation was positive among breast feeding group and negative among formula feeding group. Although the results weren't significant statistically except for bone among formula feeding group as the result was significant'.

Table3.25: Correlation coefficient between salivary adiponectin and body composition according to feeding pattern.

Body composition	Salivary adiponectin			
	Breast feeding		Formula feeding	
	r	p	r	P
Fat %	-0.092	0.553	-0.194	0.207
Muscles %	0.054	0.726	-0.035	0.823
Bone %	0.003	0.986	-0.324*	0.032 S
Hydration %	0.075	0.627	0.194	0.208

* Significant p $\leq$ 0.05

3.10 Correlations between Growth Parameters and Oral Variables

Table 3.26 shows the correlation coefficient between plaque index (PI) and growth parameters according to feeding pattern. The table shows that there is no significant correlation between plaque index and body mass index, cormic index and body composition although the correlations were negative for BMI, cormic index and fat in both groups while the opposite result was found for muscles, bone and hydration.

Table 3:26: Correlation coefficient between plaque index (PI) and growth parameters according to feeding pattern

Correlations				
	PL I			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	-0.081	0.332	-0.104	0.353
Cormic Index	-0.079	0.345	-.0100	0.374
Fat %	-0.139	0.098	-0.139	0.214
Muscle %	0.119	0.156	0.177	0.115
Bone %	0.020	0.816	0.046	0.684
Hydration %	0.141	0.093	0.146	0.193

Pl I: Plaque Index, BMI: Body Mass Index

The correlation coefficient between gingival index (GI) and growth parameters according to feeding pattern was shown in the table 3.27.the result demonstrates that the relation was gone in positive direction for BMI and fat and negative correlation was found for cormic index and the remaining body composition component among breast feeding group however the opposite result was found among formula feeding group. Although all the correlations were non-significant statistically.

Table 3.27: Correlation coefficient between gingival index (GI) and growth parameters according to feeding pattern

Correlations				
	G I			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	0.030	0.724	-0.062	0.580
Cormic Index	-0.127	0.129	0.017	0.878
Fat %	0.018	0.830	-0.121	0.282
Muscle %	-.044	0.604	0.205	0.067
Bone %	-.051	0.541	0.113	0.317
Hydration %	-.018	0.831	0.119	0.292

G I: Gingival Index, BMI: Body Mass Index

Table 3.28 shows the correlation coefficient between caries experience of primary teeth (dmfs) and growth parameters according to feeding pattern. The table illustrates that there is no significant correlation between caries experience of primary teeth (dmfs) and growth parameters and body composition however the result show that there were a negative correlation between caries experience of primary teeth (dmfs) and BMI and fat composition among both group and cormic index in formula feeding group but an opposite result was found for cormic index among breast feeding group and other parts of body composition among both groups.

Table 3.28: Correlation coefficient between caries experience of primary teeth (dmfs) and growth parameters according to feeding pattern

Correlations				
	dmfs			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	-0.150	0.072	-0.011	0.920
Cormic Index	0.083	0.322	-0.151	0.178
Fat %	-0.114	0.174	-0.045	0.690
Muscle %	0.132	0.114	0.037	0.745
Bone %	0.083	0.324	0.152	0.174
Hydration %	0.093	0.267	0.057	0.612

dmfs: decayed missed filled surfaces, BMI: Body Mass Index

The correlation coefficient between caries experience of permanent teeth (DMFS) and growth parameters according to feeding pattern was shown in the table 3.29. The results found that there is a highly significant negative correlation between DMFS and BMI, fat composition among formula feeding group, the same relation was found for bone among both groups and for fat among breast feeding group but the result was non-significant statistically. In another hand the results shows a highly significant positive correlation between muscles and hydration component of body composition among formula feeding group and the same relation was found in addition to BMI among breast feeding group but the result was non-significant statistically. Also the result illustrate that there was a negative correlation between cormic index and DMFS and the result was significant statistically among formula feeding group and non-significant among breast feeding group.

Table 3.29: Correlation coefficient between caries experience of permanent teeth (DMFS) and growth parameters according to feeding pattern

Correlations				
	DMFS			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	0.107	0.200	-0.363 **	0.001 HS
Cormic Index	-0.080	0.342	-0.230*	0.039 S
Fat %	-0.087	0.302	-0.384**	0.000 HS
Muscle %	0.038	0.650	0.288**	0.009 HS
Bone %	-0.112	0.183	-0.168	0.133
Hydration %	0.080	0.339	0.387**	0.000 HS

* Significant $p \leq 0.05$ ** Highly significant $p \leq 0.01$

DMFs: Decayed Missed Filled surfaces, BMI: Body Mass Index

Table 3.30 shows the correlation coefficient between crowding and growth parameters according to feeding pattern. The result illustrates that the correlation was gone in positive direction for BMI, cormic index and fat among both groups and bone, muscles composition in formula feeding group while a negative correlation was found for hydration part of body composition among both groups and bone, muscles parts of body composition among breast feeding group, however all these correlations were statistically non-significant.

Table 3.30: Correlation coefficient between crowding and growth parameters according to feeding pattern

Correlations				
	Crowding			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	0.096	0.251	0.116	0.304
Cormic Index	0.042	0.621	0.113	0.313
Fat %	0.081	0.336	0.085	0.453
Muscle %	-0.113	0.176	0.014	0.899
Bone %	-0.024	0.773	0.161	0.152
Hydration %	-0.081	0.333	-.0089	0.430

BMI: Body Mass Index

Table 3.31 show the correlation coefficient between number of erupted permanent teeth and growth parameters according to feeding pattern. The result demonstrates that the direction of the relation was gone in positive direction among both groups except for cormic index in breast feeding the direction was gone in negative direction at the same time the results weren't significant statistically.

Table 3.31: Correlation coefficient between number of erupted permanent teeth and growth parameters according to feeding pattern

	Erupted Teeth			
	Breast feeding		Formula feeding	
	r	p	r	p
BMI	0.053	0.527	0.070	0.533
Cormic Index	-0.071	0.399	0.107	0.344

BMI: Body Mass Index

The correlation coefficient between number of erupted permanent teeth and body composition according to feeding pattern was shown in the table 3.32.The result illustrates that number of erupted permanent teeth have a positive correlation with fat and bone composition. In another hand, the opposite result was found relating to muscle and hydration in which the direction of the relation was gone in negative direction in both groups. These correlations were statistically significant in breast feeding group and non-significant in formula feeding group for all composition except for muscles it was non-significant in both groups.

Table 3.32: Correlation coefficient between number of erupted permanent teeth and body composition according to feeding pattern

Body composition	Erupted Teeth			
	Breast feeding		Formula feeding	
	r	p	r	p
Fat %	0.177 *	0.033 S	0.087	0.438
Muscles %	-0.042	0.620	-0.073	0.519
Bone %	0.164 *	0.049 S	0.097	0.387
Hydration %	-0.174 *	0.037 S	-0.087	0.439

* Significant $p \leq 0.05$

Chapter Four
Discussion

Discussion

This study was designed to assess prospective effect of feeding pattern in a relation to oral health status which include the severity of dental caries, oral cleanliness, gingival health condition, teeth alignment and stages of permanent teeth eruption. Moreover, the current study tried to find the impact of feeding pattern on salivary adiponectin level and their effect on oral health and growth status of the primary school children. The sample of the present study consisted of 225 child from both gender aged 8-9 years from primary school children in Baghdad city / Iraq distributed into two groups: breast feeding group (144 child) and formula feeding group (81 child)

4.1 Feeding Pattern

Feeding pattern of the children was assessed by a questionnaire. Detailed questionnaire about pattern of feeding that divided the children into three categories: purely breast feeding, mixed feeding, and purely formula feeding, the duration breast feeding and formula feeding of the child (in month), timing of solid food introduction and socio-demographic characteristics including name ,age, gender, number of sibling, order of birth. The reliability of the questionnaire was assessed by resending the questionnaire to the parent 1 month after the first time and only the questionnaires with repeated matched with first answers were taken.

The results in the current study found a highly significant association between birth order and feeding pattern this finding agree with Veghari *et al*., (2011) study that found the birth order was positively correlated with breast feeding. Also the result of present study revealed that there is a significant association between number of sibling in the family and feeding pattern.

The children with second order of birth constituted higher percentage of the breast feeding group while the children with first order of birth constituted higher percentage among formula feeding group and this result agreed with Fadhil study in 2018 that found, the lower parity, the higher was the rate of breast feeding and the large the family size, the lower breast feeding rate as large family size, the mothers have no time to breastfeed their babies because of heavy work at home. Similarly a study in Saudi Arabia showed that there was a significant association between parity, family size and exclusive breast feeding (Al-Amoud, 2003).

4.1.1 Feeding Pattern in Relation to Salivary Adiponectin

Adiponectin was successfully detected in the saliva, although lower levels was observed, but it was significantly correlated with its plasma levels (Toda *et al.,* 2007). Adiponectin is an adipocyte-derived protein, highly abundant in plasma (Tschritter *et al*., 2003). The relationship between levels of adiponectin in saliva and plasma makes saliva an attractive bio-specimen that could be used as an alternative to blood tests in measuring adiponectin levels. Many studies suggest that immunoassay measurement of salivary adiponectin is suitable, minimally-invasive, and may be a favorable alternative to plasma sampling (Desai and Mathews, 2014; Nigro *et al*., 2015)

One of the most important factors probably confounding the saliva-serum correlation of adiponectin is inflammation in the mucosa of oral tissue, as the activity of adiponectin in saliva might be strongly associated with oral health. In addition to oral inflammation, injury or poor oral health (e.g. abrasion, open wounds) may cause leakage of blood into saliva which can confound salivary adiponectin determinations (Mamali *et al.*, 2012; Akuailou *et al.*, 2013; Thanakun *et al.*, 2013).

Breast milk adiponectin involved in energy balance regulation and play a role in the regulation of growth and development in the neonatal period and infancy, and could affect the energy balance regulation programming in childhood and adulthood. Differences in the body composition between breast-fed and formula-fed infants have been attributed to the evident differences in the composition of breast milk and formula milk (Butte et *al.*, 2000; Luque *et al*., 2015) this also present in the study as all body composition were higher among breast feeding group than bottle feeding except for fat composition which is higher among formula feeding.

First year of life is a "critical window" of infant developmental programming and show a differential effect of doses and concentrations of human milk adiponectin on development of infant. Breastfeeding continuation during the first year of life and beyond, which may facilitate favorable developmental programming and decrease risk of obesity later in life as a result of controlling the appetite and body composition regulating effects of adiponectin (Gridneva *et al*., 2018) this also found in the present study as the occurrence of obesity less among breast feeding group

Adiponectin was an adipocyte products, which produced primarily from white adipocytes, (Nigro *et al.*, 2014) not only transferred through maternal milk, also adiponectin level may be influenced by maternal serum and milk adiponectin (Woo *et al.*, 2012). This explained the result of the present study as the mean of salivary adiponectin was higher among formula feeding group which had higher fat percentage than breast feeding group.

4.2 Dental Caries in Relation to Feeding Pattern and Salivary Adiponectin

Dental caries is a multifactorial disease, many factors, including microbial, genetic, environmental, behavior. All these factors interact together with time for dental caries initiation and development (Selwitz *et al*., 2007; Aas *et al*., 2008).

In this study, the caries experience was recorded using dmfs and DMFS index; this is more sensitive index for caries severity since caries is measured in term of surface rather than teeth. The sensitivity of this index is high when the clinical examination accompanied by radiographic examination (Dirks, 1974), in present study, no radiographs were taken, so caries experience underestimation is expected because inter proximal lesion may failed to be detected during clinical examination alone, this index provide caries life experience for the individual (past and present), internationally approved that dental hard tissue is not self-treated so the tooth is either remain carious or filled or extracted. DMF is measures the cumulative caries aggression of the individuals (Hiremath, 2011). Additionally, caries severity was evaluated according to criteria described by Manji *et al*. in 1989, as the lesion severity scales (D_1-$_4$ MFS) depending on the lesion depth. The most important thing must keep in mind just visual and some tactile aid must be used, during probing, the tip of probe should be used gently in order to check whether presence of roughness or cavitation (loss of tooth structure), and avoid use of sharp tips for prevention of surfaces damage (Manji and Fejerskove, 1994).

The result in the current study found that the decayed surface fraction in primary and permanent teeth (ds, Ds) was the highest proportion as comparing with missing and filling, this explained by poor demand for dental treatment for both primary and permanent dentition, cost

of dental treatment ,oral hygiene and dietary habits of children, the same finding was reported by previous studies (Baram, 2007; Al-Ghalebi, 2011; Al-Ani, 2013; Al-Hassnawy, 2013; Al-Sadam, 2013).

Breast milk is known to contain immunomodulatory factors along with a rich microbiome which is responsible for initial dental caries protection which may be mediated through establishment of a healthy oral microbiome in infants through exposure to breastfeeding and contact with skin and breast milk microbiomes. Additionally, the oral microbiome of the child changes over time with the emergence of new teeth. The essential substrates for cariogenic bacteria are simple carbohydrates (sugars) which can be in a range of forms (e.g. glucose, lactose, sucrose). The longer these sugars are in contact with teeth, the higher the risk of dental caries. The amount of fermentable carbohydrate contained in the different milks and formulas may also help to explain the different results in caries experience and caries severity between children (Bowen and Lawrence, 2005; Peres *et al.*, 2009).

The present study revealed that caries experience DMFs and all its component (Ds, Ms, Fs) were higher among formula feeding group than breast feeding group in permanent dentition this is due to future protective role of breastfeeding during the first year of life. Breast milk contains necessary nutrients for healthy teeth development such as calcium, phosphorus, and vitamins D, A, and C. Calcium and phosphorus are required to form hydroxyapatite crystals and their plasma levels are regulated by Vitamin D. Maxillary and mandibular first molars begin to calcify at birth. They are the first to begin calcification and the process continue to 36 month as the calcification of second molar occur and deficiency in the previous nutrients in this critical period can have an effect on teeth development (ADHA, 2005; Schuurs,2012).

Another future benefit of human breast milk was its component of caries protective elements such as enzymes, maternal immunoglobulin's, leucocytes, and specific antibacterial agents (Hallett ,2003; Oddy and Peat ,2003) and there is long-term health benefits of breast milk for the infant beyond the period of lactation that may continue for decades (Ip *et al*., 2007; . Kramer *et al*., 2012).

Considering that permanent teeth eruption occur long after children weaning, effect of breastfeeding on caries occurrence in the permanent dentition is not reasonable, unless occurring through long-term microbiological changes in the oral cavity environment (El-Shamare, 2007; Febriana *et al.,* 2008). Some authors highlighted the concept that environmental components and genes can modify the susceptibility to caries in children, even within the same dentition (Wang *et al.*, 2012); however, the role of breastfeeding in this relationship has not been investigated. Studies suggested that the genetic diversity of *Streptococcus mutants*, the most common bacterium associated with dental caries development, may be associated with caries susceptibility in those children who present such bacteria (Yu LX *et al*., 2015).

The data of the present study show that the eruption of permanent first molars were earlier in formula feeding group than breast feeding group also the presence of crowding was higher among formula feeding group. The difficulty in cleaning crowded teeth is believed to increase plaque accumulation and consequently predisposes the tooth to develop dental caries (Szyszka-Sommerfeld and Buczkowska-Radlińska, 2010). This could explained the result that formula feeding group have more caries experience than breast feeding group.

While in primary dentition ,the decayed surfaces in caries experience and caries severity (d_1,d_2,d_3) except for d_4 were found to be more elevated in breast feeding group than formula feeding in primary dentition .Some

mechanisms have been proposed to explain such relationship. First, prolonged breast feeding duration may be associated with a higher frequency of breastfeeding (Chaffee *et al*.,2014) and nocturnal breastfeeding on demand (Helderman *et al*.,2006) when teeth cleaning is difficult (Tham *et al.*,2016). Another potential explanation is related to the human milk composition and its potential cariogenicity, because dental caries is a sugar-dependent disease. Human milk produces more caries than cows' milk on smooth surfaces. The high lactose concentration present in human milk has the potential to reduce the dental plaque pH, leading to dental caries (Prabhakar *et al*., 2010).

Adiponectin have different immune functions in several biological systems (Odrowaz-Sypniewska, 2007). Adiponectin is produced by epithelial cells of salivary gland where it might be involved in the regulation of the local immune response (Katsiougiannis *et al*., 2010). Thus adiponectin could help to preserve a good salivary function and maintain the salivary PH (Tremblay *et al*., 2012). This also found in the result of present study as there is negative relation with most caries severity in both formula and breast feeding groups this may be due to the non-significant differences between both groups.

4.3 Gingival Health Condition in Relation to Feeding Pattern and Salivary Adiponectin

Gingival index by Loe (1967) was used to evaluate the gingival condition and its relation to feeding pattern. There are many reasons behind choosing this index including its flexibility, providing certain teeth for examination rather than whole dentition, minimum period of examination, application simplicity (Ciancio, 1986). The results of the present study show that the mean value of gingival index was higher in formula feeding group, this could be explained by the higher plaque index among children

with formula feeding than breast feeding as dental plaque related to poor oral hygiene and inadequate oral hygiene is the most important risk factor in the development of gingival and periodontal diseases (Scardina, 2012). Another possible explanation of this result that human breast milk contains enzymes, leucocytes, immunoglobulin's and specific anti-inflammatory agents (Hallett *et al*., 2003; Oddy *et al.*, 2003).and there is long-term health benefits of breast milk for the infant beyond the period of lactation (Ip *et al*., 2007; Kramer & Kakuma,2012) which led to the current recommendations for duration of exclusive breastfeeding from the American Academy of Pediatrics (Gartner *et al*.,2012) and the World Health Organization as specific human breast milk factors, which lead to the marked health benefits of exclusive breastfeeding, has been ongoing for decades; and human milk contributes to the regulation and development and of both innate (Iwasaki & Medzhitov,2015) and adaptive immune function of the infants (Alexander *et al*., 2014).

The correlation coefficient between salivary adiponectin and gingival index found that the direction of the relation was negative in breast feeding group and positive in formula feeding group this correlation was highly significant statistically (P value< 0.01) this result could be explained by local effect of adiponectin as it was produced locally in the oral cavity by salivary glands. As such, adiponectin plays a role in oral inflammation and the oral immune response (Riis *et al*., 2017). Salivary adiponectin has potent beneficial functions on periodontal health maintenance and homeostasis and highly associated with measures of oral health and oral inflammatory activity (Iwayama *et al*., 2012; Kraus *et al*., 2012).

On the other hand the result could explained by the finding of present study that showed a higher mean percentage of fat among formula feeding children than breast feeding group, to establish such connections of chronic inflammation such as periodontitis and body fat, several hosts mediators

have been recognized functioning as endocrine organ such as adipocytes, generate hormones and cytokines which can result in erratic responses of immunity and increase inflammation of the gingival tissue (Vielma *et al.*, 2013). Adiponectin is produced primarily by adipocytes (as found in the present study to be higher among formula feeding children who had a higher adiponectin in saliva) and play an important role in initiation of periodontal disease by activating monocytes, which increases the production of inflammatory cytokines. Release of inflammatory cytokines causes a modification in the host immune responses that links to a higher susceptibility to bacterial infection (Deng *et al.*, 2010; Deschner *et al.*, 2014). These findings demonstrate that adiponectin function and proprieties may vary based on the hormone, characteristics its receptors and the individuals health (Li and Wu, 2012; Almabouada *et al*., 2013).

4.4 Permanent Teeth Eruption in Relation to Feeding Pattern and Salivary Adiponectin

Tooth eruption is "the process by which developing teeth emerge through the soft tissues of the jaws and the overlying mucosa to enter the oral cavity contact the teeth of opposing arch, and function in mastication" (Avery, 2002). Eruption of deciduous teeth, their exfoliation followed by eruption of permanent dentition is an orderly, sequential, and age-specific event and is considered as an important milestone during child's development. (Alshukairi, 2019).

Exclusive breastfeeding has an overall effect on growth and development of children. (Sahin *et al.,* 2008). For eruption of permanent teeth, the data of present study showed that there was no significant difference between the two groups in the mean number of erupted permanent teeth. Although not significant but still it was higher among breast feeding concerning

latest stages of eruption (stage 2 and 3). It is anticipated that the degree of breastfeeding will be positively correlated with tooth emergence; the maximum degree of breastfeeding (exclusive breastfeeding) will predict the greatest likelihood of emergence, while no breastfeeding (weaned) will predict the least likelihood of emergence (Spence, 2017).

Also this result could be attributed to nutritional advantages of the breast feeding that found in present study as the children on breast fed were higher in mean muscles and bone percentage as bone was positively correlated with number of tooth eruption however the advantages of breast fed could be explained by the milk of the mother has minerals such as calcium and phosphorus and good vitamins especially vitamin A and D that was very important in the tooth formation and development as well as the children receive milk of a controlled composition to which benefits to dental health. (Silver, 1987; ADHA, 2005).

Another explanation of the result is due to differences in pattern of growth between breast feeding and formula feeding children. Growth rates were generally highly associated with teeth eruption, trajectories of growth tend to be different between breast-fed and formula-fed infants. in present study as well as in previous studies of growth patterns in breastfed and formula-fed infants concluded that infant feeding practices influences infant growth and may confound interpretation of the relationship among the factors involved (Martines *et al.*, 1994;Dewey, 1998; Nommsen-Rivers and Dewey, 2009; Victora *et al.*, 2016).

4.5 Malalignment in Relation to Feeding Pattern and Salivary Adiponectin

Malocclusion has a large influence on individual and society in terms of quality of life, discomfort, functional and social limitations (Soh and Sandham, 2004; Sureshbabu et *al.*, 2005).Although it is important to know

the prevalence of malocclusion and distribution in the community, it's important to understand the underlying etiological factors (Blackwelder, 2013; Mitchell *et al.,* 2013).

The results of the present study showed no significant association between feeding pattern with crowding however one arch crowding is higher in formula feeding children than breast feeding this agree with number of studies confirmed the relationships between duration of breastfeeding and the occurrence of malocclusion among different age groups (Montserrat *et al.,* 2017). Breastfeeding promotes harmonious development of maxillofacial system stimulating orofacial muscular activity (Carrascoza *et al.,* 2006). Therefore it has been suggested that longer breastfeeding duration may be related with fewer functional disorders and occlusal abnormalities (Ganesh *et al.,* 2005; Montaldo *et al*., 2011).On the other hand, scientific data claim that bottle-feeding may negatively influence bite development (Luz *et al*., 2006; Peres *et al.,* 2007; Montaldo *et al.,* 2011).However this also could be explained by several theoretical mechanisms by which formula feeding might contribute to the development of malocclusion:

1. less muscle action is need to extract formula milk from a bottle, resulting in reduced muscles development that concerned in sucking, which may act as a functional matrix for inappropriate growth of the mandible.
2. The tongue acts only to control the milk drain during bottle-feeding and formula-fed children have an increased prevalence of tongue thrusting habits or abnormal swallowing patterns (Chen *et al*. 2015).
3. Many children who were predominantly bottle-fed demonstrate mouth breathing or mixed breathing behavior, which may compromise occlusion (Carrascoza *et al.,* 2006).

4.6 Growth Parameters and Feeding Pattern

4.6.1 Body Mass Index (BMI)

Growth is represented by Body mass index (BMI) which use as indicator for growth that is calculated as the weight (W) divided by the height sequared (H^2), in metric units, i.e., kg/m^2 (CDC, 2000). Many previous studies have established the breastfeeding beneficial effect to the human body, However, because the complex pathogenesis of overweight and obesity which involving factors including genetics, environment, and lifestyle, it is very challenging to separate the role that breastfeeding plays in contributing to overweight and obesity (Jing *et al.*, 2014) the result of the present study found no significant association between feeding pattern and weight status however among both breast and bottle feeding the healthy weight showed the higher occurrence followed by obese which is agreed with Owen *et al.*, in 2005 and disagreed with Beyerlein and Von Kries in 2011.

The data of present study found that the obesity occurrence was more among formula fed children than breast fed children. There are various theories suggesting the mechanisms by which breastfeeding might influence BMI. One hypothesis pertains to the ability of breastfed infants to regulate their energy intake to match energy needs (Li *et al.*, 2010).Other hypothesis assumes that high protein intakes in the first months of life increase the risk of later obesity, possibly by inducing distinct hormonal responses, such as stimulating the secretion of insulin and insulin-like growth factor-1 (IGF-1). There are two main reasons that the first years of life may actually represent a critical time window with regard to protein intake and later adiposity. First, infant formula is characterized by 50–80% higher protein content than human milk ,which has accordingly been discussed as one mechanism behind the commonly observed increased risk of later obesity in non-breastfed children .Second,

during the period of complementary feeding and the transition to the family diet, there is a rapid increase in protein intake (Günther *et al*., 2007).

4.6.2 Cormic Index

An index that measures human body form, it represented by the ratio between sitting height and standing height (Sitting Height/Standing Height * 100) gives an indication of the proportion of height that is made up by the torso and head rather than the legs. (Ukwuma, 2009).

The result of the current study illustrates that the occurrence of low mean cormic index ratio was higher followed by high cormic index ratio. These differences could be attributed to the determining factors which grossly include genes, environment and lifestyle (Woodruff and Duffield A. 2002) .Another possible explanation that the cormic index declines throughout childhood because leg length increases faster than trunk length during prepubertal growth (Habicht *et al*., 1974). This may be due to the fact that in ages 6-12 years, tempo of growth in leg length was higher than standing height. Age-wise correlation between leg length and standing height changes dramatically and varies due to the variation in the tempo of growth (Gerver & De Bruin, 1995). Genetic factors also have a part to play in the specific growth. This could be due to evolutionary adaptation as a result of climate and environment (Bogin *et al*., 2002; Frisancho *et al*., 2001).

4.6.3 Body Composition and Feeding Pattern

Human breast milk (HBM) contains numerous bioactive components, shown to be associated with growth and body composition in breast-fed children (De Kroon *et al*., 2011). The data of the present study showed that all body composition were higher among breast feeding group than bottle feeding except for fat composition which is higher among formula feeding

group. The mechanisms behind a potential association between breastfeeding and body fat composition that explained the result as formula feeding group had higher fat percent can be broadly categorized as :

1. Behavioral and nutritional explanations (Singhal and Lanigan, 2007). Behavioral explanation clarifies how breastfed babies may learn to self-regulate their energy intake better than formula-fed babies. Nutritional explanations could include the metabolic outcomes of breast milk ingestion (Gillman *et al.*, 2001). It might include lower serum insulin concentrations in breastfed infants than in infants fed cow's milk based formula, a higher protein intake and consequently higher plasma insulin concentrations in infancy has been suggested to promote later obesity in formula fed infant as insulin is a hormone that promotes fat storage.
2. Other explanation for why early nutrition programs body composition is "the accelerated postnatal weight gain hypothesis" (Koletzko *et al.*, 2014). This hypothesis states that formula feeding increases fat mass (FM) in infancy, and compared with the body composition of breastfed infants, formula-fed infants have more fat mass (Gale *et al.*, 2012).
3. Other Plausible mechanisms for adiposity development during a sensitive, early window of nutritional exposure include permanent structural changes (Druet and Ong, 2008; Temples *et al.*, 2016;) the earliest months of life (3 month of cumulative breastfeeding) are a critical time period during postnatal growth in the development of adipose tissue (Toschke *et al*., 2004; Stettler *et al.*, 2005; Singhal and Lanigan, 2007). It is possible that the number and size of adipocytes increases with formula feeding. Adipocytes release adipokines, such as adiponectin (Antuna et *al.*, 2008) into the circulation, precipitating to a sub-inflammatory condition that

may play a central role in the development of metabolic risk associated with obesity (Kadowaki *et al*., 2006).

4. Another possible mechanism that the breastfed infants absorb less energy per volume than formula-fed infants and receive modifying growth factors. An important difference appears to be in the protein content and presence of growth factors, hormones and bioactive factors in breast milk and not formula milk (Savino *et al.*, 2009) that may inhibit differentiation of adipocyte (Hamosh, 2001).

Relating to bone part of body composition the result of the present study could be explained by many genetic and environmental factors. The plausibility for a protective effect of breast milk has been described as a consequence of increased absorption and bioavailability of nutrients such as calcium and phosphorus, when compared to other types of milk. Another proposed mechanism is the human milk potentiation effect on bone development, which may be due to the presence of some non-nutritional components, such as hormones and growth factors. Furthermore, early exposure to breast milk, even if for short periods, could lead to changes in the programming of bone cells, resulting in increased bone mass later in life (Muniz *et al.*, 2015). The relationship between bone health and bioactive components in human breast milk during the first 6 months of life, there is approximately a 50% increase in periosteal apposition (that is, external bone size), little is known about factors that affect mineral accretion during this active time of bone modeling particularly. In general, the evaluation of dynamic changes in bone parameters in infancy is limited to outcome differences (that is, bone mineral content (BMC) and bone mineral density (BMD)) between breast- and formula-fed infants. Although the causal factor(s) remain unknown, breast-fed infants have been reported to have higher BMC at 3 months, whereas slower

mineralization and maturation of bone at 2–4 months in formula-fed infants relative to breastfed infants has been observed (Casazza, *et al.,* 2014).

The results demonstrates that salivary adiponectin value have a significant negative correlation with bone composition among formula feeding group. In humans, Adiponectin concentration has been reported to be inversely correlated with bone mineral density (BMD) (Napoli *et al.*, 2010) and this found in the result of the present study as formula feeding group have higher adiponectin level and lower bone composition than breast feeding group. The mechanism through which adiponectin regulates bone physiology was explained as adiponectin is structurally similar to tumor necrosis factor alpha (TNF-α) and receptor activator for nuclear factor κ ligand (RANKL), a potent regulators of osteoclastogenesis (Shinoda et al., 2006) Luo *et al*. (2005) reported that adiponectin also promotes osteoclast formation.

Concerning muscle composition as there was a significant difference between both groups, this result explained by breastfeeding which was related to slower growth during the first 12 months of life. Breastfed infants consumed less protein in infancy, several suggestions have been made about the mechanism behind the relationship, the intake of protein by breastfed infants is low, and when infant changes from a diet consisting only of breast milk to a diet based on family foods, the protein intake will markedly increase. The energy percentage from protein increased, the mechanism is that a high protein intake stimulates secretion of insulin-like growth factor 1 (IGF-1) and thereby protein synthesis and cell proliferation. The increased IGF-1 levels may then accelerate growth and increase muscle mass (Gunnarsdóttir & Thorsdottir, 2003).

4.7 Correlations between Growth Parameters and Oral Variables

Gingivitis is "an inflammatory response of the gingival tissues resulting from bacterial plaque accumulation located at and below the gingival margin related to poor oral hygiene " (Murakami *et al*., 2018). Risk factors for gingivitis include poor oral hygiene, age, malnutrition, stress and other chronic diseases groups (Dumitrescu, 2010). In this study, results reported no significant correlation between plaque and gingival indices and growth parameters with differences in the direction of relation between groups that's due to the nature of the disease as it is inflammatory disease its primary cause is dental plaque related to poor oral hygiene. Inadequate oral hygiene is the most important risk factor in the development of gingival inflammation. In addition to the variation knowledge about oral health, dental care and socioeconomic status (Lin and Maukprovide, 2011).

Dental caries and obesity are multifactorial diseases with diet being a common contributory factor (Goodarzi *et al.*, 2019). The relationship between BMI category and dental caries is complex because it is a multifactorial disease varies depending on many factors for example: age, gender, available nutrients (sugar intake), oral hygiene, saliva, and family income (Lves *et al.*, 2013; Kumar *et al*., 2017), However, both poor dietary habits and poor oral health and may be one of the factors linking both multifactorial state together. socioeconomic statuses was another confounding variable that may have influenced this relation such as (parents' education, and family income) (Willershausen *et al.*, 2007).Study finding show a negative correlation between BMI and caries experience of primary teeth in both groups and permanent teeth among formula feeding group only and this relation is highly significant which agreed with Al-

Kamal study in 2016.Under nutrition may trigger the development of dental caries in three ways. First, it contributes to hypoplasia development which in turn increases caries susceptibility. Secondly, it causes atrophy of salivary gland, which results in decreased flow rate and altered composition of saliva. This decreasing salivary buffering capacity and increases the diet acidogenic load. There is also evidence that vitamin A deficiency causes salivary gland atrophy and result in reduced salivary flow. Thirdly, under nutrition delays eruption and shedding of teeth which affects the caries experience at a given age. Also advanced untreated dental caries could affect children's ability to eat it and, later on, impairs adequate nutrients intake (Bhutta, 2006). Infection from dental caries could also affect children growth. Furthermore, severe dental caries can affect quality of life including sleeping abilities which in turn impacts child growth. On the other hand, the relationship between being underweight and dental caries is confounded by inadequate nutritional intake (Oliveira *et al.*,2008), as poor nutrition can increase susceptibility to dental caries due to impaired salivary secretion and altered composition of saliva.

In another hand, positive correlation was found relating to DMFS among breast feeding group which agreed with Abaas study in 2011, this result was explained by multiple variables like socioeconomic factors, dietary pattern, and oral hygiene practice which could have a played a major role in the establishment of a relationship. Factors to be considered in addition to the above are utilization of oral health services and use of fluoridated substances. In addition, obese children usually have a rich carbohydrate diet which could make them liable to more carious teeth (Murray *et al.*, 2003). The children's dietary habits have suffered from significant changes in the last thirty years. Soft drinks consumption are associated with reduced mineral and vitamin intake and an excess of dietary carbohydrates

(Ghasem *et al.,* 2013) These are potential effect modifiers which may result variation in the association between BMI and dental caries (Shivakumar *et al.,* 2018)

Tooth eruption is recognized as an important aspect of human growth and development, and it can be affected by a number of factors, it may reflect the human body general development (Soliman *et al.,* 2012).The number of erupted teeth has been considered as useful complementary data for evaluation of growth and development, The result of the present study demonstrate a positive correlation between the number of erupted permanent teeth with BMI ,fat and bone composition, these findings indicate that nutritional status has an effect on dental maturity (Bagherian and Sadeghi,2011).Research on children obesity and dental development also showed a positive correlation concluding that overweight children mature earlier and teeth tend to erupt earlier as compared to children with normal body mass index (Almonaitiene *et al.,* 2010).

Chapter Five Conclusions and Suggestions

Conclusions

- Caries experiences of permanent teeth (DMFS) and caries severity showed a higher mean percentage among formula feeding group and the opposite result was found concerning primary dentition.
- Both plaque and gingival indices were higher among formula feeding group.
- Higher mean number of erupted permanent teeth was reported among breast feeding group.
- The presence of one arch crowding was higher among formula feeding.
- Salivary adiponectin showed a higher mean value and among formula feeding group.
- The occurrence of obesity was higher among formula feeding group.
- All body composition component exhibit higher percentage among breastfeeding group except of fat which is higher among formula feeding group.

Suggestions for further studies:

- Further studies needed to be done taking into consideration larger samples with other age groups in different Iraqi cities.
- Other studies needed to be conducted for rural areas to compare the records with the findings of the center areas.
- Measuring the level of adiponectin in the serum and compare it with the level of salivary adiponectin.
- Studying the effect of feeding pattern on another salivary biomarker and its effect on oral health and growth status in children.

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Appendices

Appendix I

العدد: ١٨
التاريخ:٩/ ١ /٢٠١٩
رمز البحث: ٠١٨٣١٨

م/ قبول بحث

إلى الزميلة الدكتورة **علياء صباح نوري** المحترمة
والزميلة الدكتورة **بان صاحب ذياب** المحترمة

نود اعلامكم بأن لجنة اخلاقيات البحوث في كلية طب الأسنان – جامعة بغداد اطلعت على مشروع البحث المقدم من قبلكم والموسوم:

The The impact of feeding pattern on oral health status and salivary adiponectin level in a relation to growth parameter among primary school children in Baghdad city _ Iraq.

ولا ترى اللجنة ما يمنع من القيام بالبحث من الجانب الاخلاقي.

مع التقدير.

د. أكرم فيصل الحويزي
رئيس لجنة اخلاقيات البحوث

Appendix II

بسم تعالى

جمهورية العراق
وزارة التربية

المديرية العامة للتربية
محافظة بغداد /الرصافة ٢
الشعبة : البحوث والدراسات
العدد: ٧٩٦٦
التاريخ: ٢٠١٨/١٢/٤٠

إلى / ادارات المدارس الابتدائية كافة.

م / تسهيل مهمة

تحية طيبة..

اشارة الى كتاب وزارة التعليم العالي والبحث العلمي ذي العدد ١٠٢٢٤ في٢٠١٨/١٢/١٨

يرجى تسهيل مهمـــــة طالبة الماجستير (علياء صباح نوري) جامعة بغداد/ كلية طب الاسنان لغرض اكمال متطلبات البحث الخاص برسالة الماجستير .

مـــــع التقديـــــر

عبد حسين ناصر
المعاون الاداري
٢٠١٨/١٢/

نسخة من إلى

- مكتب السيد المدير العام.. للاطلاع مع التقدير
- قسم التخطيط / شعبة الاحصاء.
- البحوث والدراسات/ مع الأوليات.

Appendix III

إستمارة المعلومات

أنت مدعوة للمشاركة في بحث علمي سيجرى في .بغداد.. الرجاء أن تأخذ الوقت الكافي لقراءة المعلومات التالية بتأن قبل أن تقرر بإن كنت تريد المشاركة أم لا. بإمكانك طلب إيضاحات أو معلومات إضافية عن أي شيء مذكور في هذه الاستمارة أو عن هذه الدراسة ككل من الباحث كما يمكنك مناقشتها مع أي شخص آخر.

عنوان الدراسة

❖ **تأثير نمط التغذية على صحة الفم والاسنان ومستوى الاديبونكتين (adiponectin)اللعابي فيما يتعلق بمقياس النمو لدى اطفال المدارس الابتدائية في مدينة بغداد - العراق**

- ❖ الغرض من الدراسة لتقييم تأثير نمط التغذية على صحة الفم والاسنان و على مستوى الاديبونكتين (adiponectin)اللعابي ، فيما يتعلق بمقياس النمو لدى الاطفال .
- ❖ سوف نطلب منك الاجابة على مجموعة اسئلة حول نمط الرضاعة ومدة الرضاعة والاجابة الدقيقة عن الاسئلة مهمة لاغراض البحث العلمي
- ❖ سيتم قياس الوزن والطول وقياس مكونات الجسم باستخدام ميزان خاص حديث مصمم لقياس مكونات الجسم(نسبة الدهون – الكتلة العضلية – الكتلة العظمية)مبدأ عمله تمرير تردد بسيط من بطاريه جافة صغيرة (بطاريةالريموت)و فحص الاسنان واللثة وعدد الاسنان الدائمية واخذ عينات لعاب لاغراض البحث العلمي .
- ❖ ستستمر مشاركتك في الدراسة بضعة ايام الى اسابيع،اي طفل يعاني من امراض مزمنة سوف يستبعد من الدراسة ،فوائد الدراسة ستكون للباحث والطفل،لا توجد اي مخاطر محتملة للمشاركة في الدراسة،لن تتداخل المشاركة في الدراسة مع الانشطة اليومية،من الممكن ان تبلغ بنتائج الدراسة في حالة رغبتك بذلك.

في حال وافقت على المشاركة في هذه الدراسة، سيبقى اسمك طي الكتمان. لن يكون لأي شخص حق الاطلاع على ملفك الطبي باستثناء الباحثين المسؤولين عن الدراسة.
تعتبر المشاركة في هذه الدراسة تطوعية تمامًا وأنت حر في رفض المشاركة أو الانسحاب من الدراسة في أي وقت دون الحاجة إلى إعطاء سبب ودون أن يؤثر هذا على الرعاية الطبية المستقبلية أو علاقتك مع الطاقم الطبي الذي يعتني بك.

نشكرك على قراءة ورقة المعلومات هذه والنظر في مشاركتك في هذه الدراسة

موافقة للإشتراك في بحث علمي

	الرجاء التأشير للموافقة ب √
أؤكد بأني قد قرأت وفهمت المعلومات التي تخص البحث أعلاه وقد كان لدي الوقت الكافي لطرح الأسئلة المتعلقة بالموضوع وتمت الإجابة على أسئلتي جميعا.	
أتفهم أن مشاركتي في البحث تطوعية وأني حرة في الإنسحاب من المشاركة في أي وقت بدون أن يؤثر ذلك على الرعاية الطبية المقدمة لي.	
أتفهم أن معلوماتي ذات الصلة بالبحث سوف يتم الإطلاع عليها من قبل الإشخاص المسؤولين عن البحث في كلية طب الأسنان – جامعة بغداد وأعطي الموافقة بذلك.	
أوافق على المشاركة في البحث المذكور أعلاه.	

	الإسم	التوقيع	التأريخ
المشترك			
الأب/الأم أو الوصي (عند الحاجه)			
الشخص المسؤول عن مليء الأستماره(الأم)			

شخص يمكن الأتصال به:

الاسم:

رقم الهاتف: البريد الإلكتروني:

Appendix IV

الاستبيان

❖الرجاء الاجابة بصورة دقيقة عن الاسئلة التالية:

معلومات الطفل :

اسم الطفل:---------- الصف :---------- الشعبة:----------

العمر : ----------

تاريخ الولادة :----------

الجنس : ذكر ☐ انثى ☐

ترتيب الطفل بين اخوته : ----------

عدد الاطفال الكلي :----------

العنوان : ----------

تقييم نمط التغذية:

نوع الرضاعة :

رضاعة طبيعية فقط ☐ رضاعة اصطناعية فقط ☐ رضاعة مختلطة ☐

مدة الرضاعة الطبيعية :

اقل او يساوي ٦ اشهر ☐ ٦-١٢ شهر ☐

١٢-١٨ شهر ☐ اكثر من ١٨شهر ☐

مدة الرضاعة الطبيعية الحصرية : الرضاعة الطبيعية الحصرية تعني أنّ الطفل لا يتلقى إلاّ لبن الأمّ دون أيّة أغذية أو مشروبات إضافية، بما في ذلك الماء

اقل او يساوي ١ شهر ☐ ١-٤ اشهر ☐ اكثرمن ٤ اشهر ☐

عمر الطفل عندما تم البدء بتقديم الطعام التكميلي اليه:

اقل او يساوي ٤ اشهر ☐ ٤-٦ اشهر ☐ اكثر من ٦ اشهر ☐

مدة الرضاعة الاصطناعية:

اقل او يساوي ٦ اشهر ☐ ٦-١٢ شهر ☐

١٢-١٨ شهر ☐ اكثر من ١٨ شهر ☐

Appendix V

Name: …… **Gender** …… **Class**: …… **school:**…… **case No. :**……

Anthropometric measurement

Height (cm) ---------- Sitting height (cm) ---------- Weight (kg) ---------- BMI ---------- Cormic index --------

Body composition

Fat ---------- Muscles ---------- Bone ---------- Hydration ----------

Feeding pattern ( )

Salivary adiponectin level ( )

Eruption status of permanent teeth

6	5	4	3	2	1	1	2	3	4	5	6
6	5	4	3	2	1	1	2	3	4	5	6

Number of erupted permanent teeth ----------

Oral hygiene and gingival health status

Index	surface	E 6	B 2	D 4	E 6	B 2	D 4	mean
PlI	Buccal							
	Mesial							
	Lingual							
	Distal							
GI	Buccal							
	Mesial							
	Lingual							
	Distal							

Dental caries status

		E	D	C	B	A	A	B	C	D	E		
7	6	5	4	3	2	1	1	2	3	4	5	6	7
7	6	5	4	3	2	1	1	2	3	4	5	6	7
		E	D	C	B	A	A	B	C	D	E		

Malalignment status

Crowding ----------

Spacing ----------

Notes:

_____

الخلاصة

المقدمة: الرضاعة الطبيعية هي الطريقة الطبيعية لتزويد الأطفال الصغار بالمغذيات التي يحتاجونها للنمو والتطور الصحي كما يؤثر حليب الام على صحة الفم ونمو وتكوين الجسم للأطفال سواء بسبب خصائصه الغذائية و المناعية التي تختلف عن الحليب الاصطناعي، أو من خلال مكوناته الهرمونية وخاصة الأديبونيكتين التي تلعب دورًا مهمًا في تنظيم النمو والتطور لدى حديثي الولادة والرضع ، ويمكن أن تؤثر على برمجة تنظيم توازن الطاقة في مرحلة الطفولة والبلوغ .

الهدف من الدراسة: تقييم التأثير المحتمل لنمط الرضاعة على الحالة الصحية للفم وعلاقتها بمستوى هرمون الأديبونيكتين اللعابي وتأثيرها على حالة النمو لدى أطفال المدارس الابتدائية في مدينة بغداد / العراق.

الافراد ، المواد وطرق العمل: خضع 1689 من اطفال المدارس الابتدائية (ممن تتراوح اعمارهم بين8-9 سنوات) في مدينة بغداد / العراق ، لاستبيانات معدة مسبقا لتحديد نمط الرضاعة . العينة شملت 672 طفلاً من الذين اعادوا الاستبيانات مع إجابات متطابقة. بعد استبعاد الأطفال ذوي الرضاعة المختلطة ،اصبحت عينة الدراسة 225 طفلا، مقسمة إلى مجموعتين (مجموعة الرضاعة الطبيعية ومجموعة الرضاعة الاصطناعية). تم تقييم حالة النظافة للفم باستخدام plaque index من قبل قبل.SILNESS, J و LOE, H ، في عام 1964 وتم تقييم الحالة الصحية للثة باستخدام gingival index من قبل LÖE في عام 1967 ، في حين تم تقييم تسوس الأسنان من قبل مؤشر Decay (1-4) مؤشر شدة التسوس، تم قياس ترتيب الأسنان وفقا لمعايير منظمة الصحة العالمية WHO في عام 1997. تم اختيار ثمانية وثمانين طالبا عشوائياً لتحليل الأديبونيكتين اللعابي، والذي تم تنفيذه باستخدام تقنية ELISA الخاصة (مقايسة مناعية مرتبطة بالإنزيم) .وخضع جميع الأطفال البالغ عددهم 672 للقياسات الأنثروبومترية (الطول ، ارتفاع الجلوس ، الوزن) ومكونات الجسم لتقييم نمط النمو.

النتائج: كانت مجموعة االرضاعة الطبيعية تمثل نسبة 15.55 ٪ في سن 8 سنوات و 48.44 ٪ في سن 9 سنوات وهي أعلى من مجموعة الرضاعة الاصطناعية. كان هناك ارتباطاً كبيراً بين ترتيب الولادة وعدد الاخوة في الاسرة ونمط الرضاعة. بالنسبة إلى نظافة الفم وحالة اللثة أظهرت الدراسة أن القيمة المتوسطة لكلا المؤشرين(plaque and gingival indices) كانت أعلى في مجموعة الرضاعة باالاصطناعية. لكن كل هذه الاختلافات لم تكن كبيرة. بالنسبة إلى تسوس الأسنان ، كانت النسبة المئوية لمتوسطات تسوس الأسنان DMFs وجميع مكوناتها (Ds، Ms،

Fs) أعلى بين مجموعة الرضاعة الاصطناعية من مجموعة الرضاعة الطبيعية وكان الفرق بين المجموعتين مهمًا إحصائيًا بالنسبة لمكونات DMFs و Ds ، وكانت متوسط قيمة النسبة المئوية أعلى بين مجموعة الرضاعة الاصطناعية فيما يتعلق بجميع درجات تسوس الأسنان (D1 ، D2 ، D3 ، D4) في حين انه لا يوجد فرق إحصائي بين المجموعتين فيما يتعلق بتسوس الأسنان وشدة التسوس في الاسنان اللبنية باستثناء D3 حيث كان الفرق كبيرًا. كما أظهرت الدراسة عدم وجود ارتباط كبير بين نمط التغذية ترتيب الأسنان وفقا لدرجة الازدحام.

فيما يتعلق بظهور الاسنان الدائمية ، اظهرت النتائج عدم وجود فرق كبير بين المجموعتين إلا أن مجموعة الرضاعة الطبيعية كانت أعلى من مجموعة الرضاعة الاصطناعية في عدد الأسنان الدائمة الظاهرة .

فيما يتعلق بتركيز هرمون الأديبونيكتين اللعابي ، كان متوسطه أعلى بين مجموعة الرضاعة الاصطناعية بينما كانت جميع مكونات الجسم أعلى بين مجموعة الرضاعة الطبيعية باستثناء الدهون وعلى الرغم من ذلك، اظهرت النتائج عدم وجود فرق كبيربين المجموعتين باستثناء مكون العضلات.

الاستنتاج: كشفت نتائج الدراسة الحالية أن الرضاعة الطبيعية توفر الحماية من تسوس الأسنان في الأسنان الدائمة وكذلك تنظم مكونات الجسم من خلال تأثير هرمون ألاديبونيكتين.

بسم الله الرحمن الرحيم

إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ

القمر (49)

صدق الله العظيم

جمهورية العراق
وزارة التعليم العالي والبحث العلمي
جامعة بغداد
كلية طب الاسنان

تأثير نمط التغذية على صحة الفم والاسنان ومستوى الاديبونكتين اللعابي فيما يتعلق بمقياس النمو لدى أطفال المدارس الابتدائية في مدينة بغداد – العراق

رسالة مقدمة الى مجلس كلية طب الاسنان/ جامعة بغداد
كجزء من متطلبات نيل شهادة الماجستير في طب الاسنان الوقائي

من قبل الطالبة
علياء صباح نوري
بكالوريوس في طب وجراحة الفم والاسنان

باشراف
الاستاذ الدكتورة بان صاحب ذياب
ماجستير ودكتوراه في طب الاسنان الوقائي

١٤٤١ هـ ٢٠٢٠ م