FAILURE TO THRIVE AMONGST NEONATES, PREVALENCE, CAUSES AND EARLY OUTCOME, AT MUHIMBILI NATIONAL HOSPITAL.

By

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A dissertation submitted in partial fulfillment of the requirements for the degree of Master of Medicine (Paediatrics and Child Health) of the University of Dar es Salaam.

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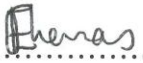
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ACKNOWLEDGEMENTS

I convey my sincere gratitude to Prof. Karim P. Manji for his tireless, supervision, and encouragement for this dissertation.

I thank Ms R. Mpembeni for her great assistance in the statistical work , on the initial and final preparation of this dissertation.

I am grateful to the Head of the Neonatal Unit Dr A. Massawe, and all other senior staff members of the Department of Paediatrics and Child Health for their constructive criticism and cooperation throughout the study period.

I would like to thank Dr G. Msemo, Dr B.Tamim, Dr Leon, Mr Erick E. Kyejo, and Mr Mbiligenda for their great concern and support in the completion of this dissertation.

I wish to thank all mothers, caretakers and their infants who participated in this study, the nursing staff of the Neonatal Unit, maternity wards and the High Risk Clinic for their cooperation.

Lastly though not least, I thank my husband Amos, and my children Daniel and Faith for great support and provision of a conducive atmosphere for my study.

DEDICATION

To Eden and Hilda.

ABBREVIATIONS

AFB - Acid fast bacilli

AGA –Appropriate for gestational Age

BF - Breast feeding.

CMV - Cytomegalo virus.

CAM - Cystic adenomatoid malformation of the lung

DNA - Deoxyribonucleaic acid.

ELISA -Enzyme linked immunosorbent assay.

ESR - Erythrocyte sedimentation rate.

FTT - Failure to thrive.

GER - Gastro esophageal reflux

HIV - Human immunodeficiency virus.

IgA - Immunoglobulin A.

IgG - Immunoglobulin G.

LBW - Low birth weight

M.tb - Mycobacterium. tuberculosis

MNH - Muhimbili National Hospital..

N-O FTT- Non organic failure to thrive.

NICU -Neonatal intensive care unit

PCR - Polymerase chain reaction.

PIH - Pregnancy induced hypertension

RNA - Ribonucleaic acid.

RDS - Respiratory distress syndrome

SD -Standard Deviation.

SFD - Small for dates

TORCHES -Toxoplasmosis, Others, Cytomegalo virus, Herpes virus , Syphilis.

WHO - World Health Organization.

ZN - Zeil Neisten.

ABSTRACT

Introduction:

Failure to thrive in the neonate is the common pathway or outcome for several different underlying conditions. It is defined as failure to regain birth weight by three weeks of age; weight loss of more than 10% of birth weight at 2 weeks of age or more; weight gain below 3rd centile by age 2 weeks or more and a weight gain of less than 5 grams per kilogram per day. Results from other studies, and case reports at this center suggested an increase in the incidence of FTT, partly fueled by maternal HIV and tuberculosis co-infection. Nutritional deficiencies, were not expected to be a cause of FTT in the neonate, ideally since breast feeding suffices an infants nutritional requirement. Could an improper breast feeding technique be a cause? A pilot study done before the beginning of the study showed that infections were a leading cause.

FTT was not comprehensively studied nor rigorously sought at the neonatal unit, its magnitude was not known. The multifactorial causes of FTT could not be ignored.

Objective:

This study intended to systematically determine the pattern of FTT amongst infants up to six weeks of age; and identify probable underlying causes and early outcome.

Study Design:

This was a cross-sectional prospective hospital based study, from April 2001 to January 2002, with a sample size of 88 patients.

Results:

A total of 94 infants were recruited up to September 2001, and a three months period of follow up which ended in January 2002. There was no loss to follow up. Total admissions during the recruitment period were 3914. The prevalence to FTT was found to be 2.4%, with a male to female ratio of 1.23:1, fifty one preterm and 43 term babies. Sixty eight percent of the total recruited babies had a birth weight of 2.5kg and below. The leading cause of FTT was infected followed by anaemia. Perinatal tuberculosis contributed to 2.1%. There was a high percentage of maternal HIV and tuberculosis in the studied group. Majority of the mothers who breastfed had incorrect positioning, and hence incorrect attachment. Mixed feeding was part of the feeding problems found. Most mothers were primipara; adolescent motherhood was not much represented.

Mortality was 25.5%; amongst the 74.5% who survived, 43.6% presented with significant problems during followed up, necessitating rehospitalization, or further work of and management. Anaemia, pneumonia, failure to improve weight, and developmental delay were amongst the presenting problems.

Conclusion:

FTT is a common problem in the young infant; multiple factors underlying it. The most important were low birth weight, infections, anaemia and mixed feeding. Maternal health was a significant contributing factor. The high mortality rate demonstrated indicate that FTT in the young infant is an ominous sign.

Larger community based studies are needed to establish causal relationship between FTT and non organic/ psychosocial factors outlined by this study.

LIST OF CONTENTS

1. Acknowledgement.....iv
2. Dedication.....v
3. Abbreviations.....vi
4. Abstract.....viii
5. Introduction and literature review.....1
6. Rationale and Objectives.....17
7. Patients and methods.....19
8. Results.....28
9. Discussion.....47
10. Conclusions.....56
11. Recommendations.....57
12. References.....59
13. Appendix1.....69
14. Appendix 11.....70
15. Appendix111.....71

INTRODUCTION AND LITERATURE REVIEW

Failure to thrive is synonymous to growth failure, meaning weight less than 2SD below the mean for age.[1] There is no universally accepted definition for failure to thrive. The following diagnostic criteria have proved helpful in identifying inadequate weight gain in young breastfed infants:[2]

- Failure to regain birth weight by 3 weeks of age.
- Weight loss of greater than 10% of birth weight by two weeks of age
- Weight dropping below the 3rd centile.
- Deceleration of growth from a previous established pattern of weight gain.
- Weight gain of less than 5-10g/kg/day.

Fomon states that "failure to thrive should be defined as a rate of gain in length and or weight less than the value corresponding to two standard deviations below the mean during an interval of at least 56 days for infants less than five months of age and during an interval of at least three months for older infants." He further suggests that in managing the breastfed infant, more careful and frequent medical evaluation should be provided for the infant who drops to the tenth percentile for weight, fails to gain weight, continues to lose after the tenth day of life, or does not regain birth weight by 3 weeks of age, rather than waiting for 56 days to establish the trend unquestionably.

In a longitudinal study done by Fomon; breastfed and bottle fed infants in the first few months of life demonstrated similar tenth and ninetieth percentile values for weight and length at birth. The tenth percentile values of the two groups were similar at age 112 days. The significant difference was in the values for the ninetieth percentile. [3]

Failure to thrive (FTT) in children below two years is also defined as failure to gain adequate weight, failure of linear growth, and failure to achieve some or all developmental milestones. Assessing the growth of the breast fed infant is an important tool for evaluating the adequacy of lactation. Currently the most widely used reference data are the growth charts that were based on data compiled by the U.S National Center for Health Statistics (NCHS in 1977, and subsequently adopted for international use by the WHO). For children under 24 months of age, the 1977 NCHS charts were based on data from a single community (Yellow Springs, OH), collected between 1929 and 1975 as part of the Fels longitudinal study. These reference data for infants have a number of limitations, amongst these is: too infrequent measurements made to adequately characterize the pattern of growth in early infancy. [4,5,6.]

Judgments regarding the adequacy of infant growth are strongly influenced by the reference growth curve selected. The typical growth pattern of a breastfed infant is a relatively rapid gain in the first 2-3 months followed by a downward trend in percentile ranking. The downward crossing of percentile lines prompts some health care

providers to conclude that there's growth faltering even if the infant is healthy and thriving.[4] According to Raynor et al; of all anthropometric indices of failure to thrive, weight alone was the simplest and the most reasonable marker of failure to thrive .[7]

Failure to thrive constituted 2.7% (15) of all admissions (574) of the neonatal unit at MNH between October 31 and November 30(Data from a pilot study done by the principle investigator) infections, and congenital malformations constituted 80% (12), and 13.3% (2) respectively. 6.6% (1) had both.

Causes of failure to thrive are grouped into two major categories: Organic and non-organic . An infant's failure to thrive may be the result of prenatal and or postnatal causes. Organic causes can be prenatal and postnatal, similar to non organic causes. The former comprises of: intrauterine infections, placental or chromosomal anomalies; and maternal illnesses, that cause placental insufficiency, can result to compromised preterm or term newborn, examples are hypertension, pre-eclampsia, heart disease, anemia, and advanced diabetes mellitus. When babies are born premature and have associated intrauterine growth restriction, are potentially at increased risk to postnatal growth failure. Inadequate intake, inadequate absorption, and poor absorption and or/inability to utilize the absorbed nutrients, and increased metabolic demands are sub classifications, and mechanisms of postnatal FTT .[8,9]

Breastfeeding is normally the best way to feed young infants. Its benefits go beyond sound nutrition, and children should not needlessly be deprived of it. The benefits of breast feeding for the newborn infant are well recognized and current recommendations on infant feeding generally include a period of exclusive breast feeding for the first 6 months of life. Some of the benefits of breast milk are: Provision of nutrients to infants for at least the first 6 months of life. These nutrients include; high quality protein, long chain unsaturated fatty acids, thought to be essential for the infant's developing brain, micronutrients, in forms that are efficiently absorbed actively protect the infant against infection from the moment of birth. And offer both passive and active immunity in the newborn, these factors include some which are not normally considered part of the immune system e.g oligossacharides and fat globules. IgA accounts for over 90% of the immunoglobulins in milk and plays a key role in passive protection of the neonate. It is selectively produced by epithelial plasma cells of the breast. One of the principle functions of IgA is to block the adhesion of microbial pathogens and their toxins onto the intestinal epithelial surface. The leucocyte concentration is highest during the early phases of lactation and decreases five-tenfold by the eighth day postpartum. Cells in the colostrum are large lipid laden macrophages, which contain IgA, lysozymes, lactoferrin complement components, cytokines, and vitamin A; which protect the infant from sepsis.[10,11,12]

The mechanisms involved in milk production are not yet fully understood but seem to be potentially effective in the vast majority of women Adequate milk production is dependent on three main factors; First Prolactin release from the anterior pituitary, which then binds to the prolactin receptors in the milk glands and stimulates milk manufacture. Second; oxytocin release from the posterior pituitary, which enables the manufactured and stored milk to be released. The last is efficient removal of milk from the breast . The effective functioning of all 3 aspects of milk production is accomplished in the majority of women by means of unrestricted and efficient suckling by the baby. Prolactin release, unlike oxytocin release, is in normal circumstances entirely dependent on suckling. Each suckling episode results in a release of prolactin which reaches a peak between 15 and 60 minutes later and falls away again equally rapidly to reach basal levels within about 2 hours of a feed. This response to suckling can be demonstrated as late as 55 weeks postpartum. [13] Mothers who plan to breast feed need to express milk for a prolonged time until the infant is ready to nipple at the breast. When the baby starts to go to breast milk expression should continue to maintain the milk supply. The transition to full breast -feeding involves: maternal supply, maternal let down, and infant sucking skills.

There are three techniques for estimating breast milk: Test weighing, the use of deuterium oxide, and measurement by doppler ultrasound. The latter two require expensive and sophisticated equipment. Test weighing

of the baby before and after feeds, then calculating the breast milk intake by the difference in weights, has been a common practice for many years. The rationale for routine test weighing is to determine whether babies are taking too much or too little. A digital readout facilitates accurate recording of weight. [15,16] On the basis of long experience as BF consultants, Frentz, Fisher, and Minchin outlined the essentials of successful BF, and stressed the importance of three criteria: Correct positioning of the infant at the breast; correct sucking technique and no rigid time schedule. Chloe Fischer insisted on an early correct start, which has been found to be best for life. Correct sucking can only be possible if there is good positioning and good attachment (see appendix A) the former is defined as: the infant's mouth is wide open, the tongue is under the areola, and milk is expressed in slow, deep sucks. 70-80% of the milk volume is ejected in the first 4-5 minutes of suckling, and infants feed for 5-8 minutes. Each period of suckling separated by sleep for a period of 5-10 minutes of no suckling is considered a separate breast feed. Exclusive breastfeeding gives a young infant the best nutrition and protection from disease.[17,18,19] Exclusive breastfeeding means that the infant takes only breast milk, and no additional food, water or other fluid (medicine and vitamins are exceptions). [14]

FEEDING PROBLEMS:

Lactation related difficulties are responsible for the majority of FTT cases in breastfed babies and a common cause of inadequate intake. Feeding styles of breastfed babies with FTT tend to fall into two categories;

The fretful, underfed baby who cries and is irritable and has frequent short feeds. The contented, underfed baby who gives the impression of being satisfied after feeds, who goes long intervals between feeds and sleeps long hours overnight, the baby may fall asleep after only a few minutes of feeding particularly if the baby has become progressively weaker as his intake declines. Others are; positioning and attachment errors, limited length of feedings, insufficient number of feedings. Disorganized suckling is common in premature babies and those from medicated births. Other problems of breast feeding are: nipple trauma causing cracked nipples due to incorrect positioning; problems of milk flow and supply commonly due to infrequent breastfeeding as occurs in prolonged maternal illness or disease. Milk supply can be affected by, some birth control pills, too much caffeine, nicotine, especially if taken before breast-feeding. The majority of these problems can be prevented by unrestricted breast -feeding by the baby who has been well positioned from the first feed on, and excellent practical and emotional support to the mothers. [2,17,19,20] It is conceivable that milk production may be truly inadequate in a few women as described by Neifert and Seacat[21] who described a rare phenomenon in women who had a congenital lack of

glandular breast tissue which led their infants in failure to thrive. Woolridge et al described FTT in the breastfed infant considering underfeeding due to inadequate milk production as an important cause, yet among symptoms listed. Premature termination from the first breast during a suck results in an incomplete feed causing an infant to miss the high calorie hind milk from the first breast, resulting in calorie deprivation. The infant hence takes more low calorie fore milk from the second breast to obtain some calorie intake. During a feed the protein and lactose concentration in human milk remains fairly constant, whereas the fat concentration of breast milk rises consistently throughout. Thus a baby starts a feed with relatively large amounts of low fat foremilk then goes to progressively smaller volumes of higher fat hind milk. Equal volumes of fore milk and hind milk are not isocaloric with hind milk.[18]

Persistent poor suckling particularly if associated with a delay in reaching developmental milestones suggests neurologic dysfunction, e.g. Downs syndrome and cerebral palsy.[3] A poor let down reflex, is a maternal factor that interferes with milk supply and is influenced by; fatigue, excessive amounts of caffeine, smoking and illicit drug use.

On the other hand maternal milk supply is maintained by unrestricted breastfeeding or manual expression in mothers of sick infants. Severe calorie restriction, anemia hormonal factors such as thyroid disease,

Addison's disease, Sheehan's syndrome, retained placenta and a new pregnancy can also affect supply [20,22]

A high incidence of immature or abnormal feeding pattern have been found in neonates with prolonged respiratory support, delayed enteral and oral feeding compared to neonates who have normal initial feeding. Neonates with disorganized or dysfunctional feeding were six times more likely to vomit and three times more likely to cough when offered solid food at six months of age. Observations done of sick infants feeding patterns suggest that changes occur which are specific to certain illness conditions (acute respiratory condition). These changes disrupt the feeding synchrony, becomes erratic suck-pause pattern, with loosened nipple grip. These can contribute to growth failure and psychosocial distress.[23,24] In another study by Rogers et al oral feeding impairment was the sole risk factor for the occurrence of growth failure in preterm infants with cystic periventricular leukomalacia and cerebral palsy.[25]A defect in or inactivity of appetite control has been found in contented breastfed babies who failed to thrive and after appropriate management were all above 80th percentile for both weight and weight for height. [25]

Any condition interfering with the sucking mechanisms may cause feeding problems that will result to inadequate intake. These are: Cranial facial anomalies such as cleft lip and palate, CNS developmental problems: Cornelia de Lange's syndrome, Leigh's syndrome and dysautonomia, neurological or neuromuscular problems that cause

weakness and or incoordination of the suck and swallow mechanism : asphyxia, kernicterus, bilateral cerebral bleeds, neonatal narcotic abstinence, pseudobulbar palsy , neonatal and congenital myasthenia gravis, congenital myotonic dystrophy; Trisomy 21, Praeder Willi's syndrome, Moebius syndrome etc. [20]

Hence a thorough assesment of an infant with feeding difficulties is mandatory. This should include, a carefull assesment of the rooting reflex, sucking reflex, the palate, tongue, buccal musculature, and the throat. An easier way of telling that a baby is getting enough milk, as recommended by the American Academy of Pediatrics and other Authors is:[20,26,27]

- At least six wet diapers per day with a pale yellow urine after day 3 or4.
- At least 5 stools per day in an infant aged 1-4 weeks old.
- Steady weight gain after the first week of life.
- Baby's feeding pattern of at least 2-3 hours around the clock.

INFECTIONS AND OTHER DISEASES:

Diseases such as hyperthyroidism , bronchopulmonary dysplasia, renal failure, heart failure etc cause FTT through increased metabolic demand. Poor absorption and or utilisation of nutrients occur in chronic infections, and diseases; a few examples are: HIV, tuberculosis, diarrhea,

hypothyroidism, growth hormone deficiency, inborn error of metabolism, renal tubular acidosis etc. Inadequate intake in the presence of increased metabolic demands as occurs in, prolonged infections, conditions causing breathing difficulties such as congenital lung or cardiac malformations, congestive heart failure, bronchopulmonary dysplasia etc. An example of an inborn error of metabolism presenting with FTT is galactosemia. This enzymatic deficiency results into impaired utilization, increased metabolic demand and accumulation of metabolic intermediates. These are responsible for the majority of the symptomatology. Vomiting, and diarrhea that occurs impair absorption and compromise intake. Other conditions such as urinary tract infection, renal insufficiency, may manifest at the time of birth or during the first few weeks of life.

- Gastrointestinal causes lead to FTT by: impaired absorption, inadequate intake as occurs in excessive vomiting, gastroesophageal reflux, diarrhea, and poor feeding due to lethargy. These occur either as part of a symptom complex of certain diseases (inborn errors of metabolism, intestinal obstruction, cow's milk protein intolerance) or as manifestation of infections. Other examples are hypoadrenalism, intestinal atresia , intestinal malabsorption syndrome, megacolon and other gastrointestinal structural malformations that interfere with feeding. [20,28]

Some few examples of infections are tuberculosis, meningitis, septicaemia, pneumonia etc .The Dar es Salaam notification rates of tuberculosis per 100,000 population of 1994 is 100-150.[29] While the National incidence of South Africa is 311 per 100000, one of the highest in the world. [30]

The association between HIV and tuberculosis is well known; these are among the leading causes of debility and death in developing world, the largest burden borne by Sub Saharan Africa and Asia. Both diseases are significant among women of childbearing age, and tuberculosis although uncommon in pregnancy is on the increase. Perinatal tuberculosis is an emerging disease and a cause of morbidity. [30] Manji et al reported three cases of perinatal tuberculosis in a period of one year in Dar es Salaam Tanzania; FTT was the commonest feature. Unless a high index of suspicion is maintained (especially where maternal HIV and tuberculosis are highly prevalent) the diagnosis of perinatal tuberculosis can be missed.[31]

In a study by Adhikari et al in Kwa Zulu Natal South Africa; perinatal tuberculosis was found in association with maternal HIV and tuberculous coinfection; FTT was amongst the predominant clinical findings. The neonates reported in this study with tuberculosis had nonspecific signs of infection initially which could mimic problems of low birth weight babies and diseases such as acute bacterial pneumonia, nosocomial infection, and other transplancental infections such as

congenital syphilis; FTT was a common feature[30]. The transmission of the bacilli from mother to the infant can occur at any time during pregnancy. The normal placenta is usually conceived to be a filter impermeable to bacteria. Thus, in the diagnosis of congenital tuberculosis placental tissue examination and liver biopsies are of paramount importance. Several studies report prematurity and intrauterine growth restriction to be commoner among babies born to mothers with tuberculosis, and a higher mortality, morbidity amongst these infants compared to prematurity or growth restriction from other causes. [32,33,34]

HIV- I prevalence rate among pregnant women delivering at this center was 13.1% in 1999. Current estimates show maternal to child transmission (MTCT) of the virus is responsible for more than 90% of HIV I infection in children. An estimated 600,000 children will be infected in this way each year globally. MTCT is the major source of HIV I infection in infants and in children worldwide. In Papua New Guinea, MTCT of HIV infection ranges from 14-39%. [35,36] While in a study done by Shilalukey et al in a Neonatal intensive care unit Lusaka Zambia showed, FTT and a tendency to prematurity to be a frequent presentation among babies born to seropositive mothers. [37] Manifestation of HIV in young infants was quite early. Therefore early identification is of great importance, and may help to improve survival. In a Rwandan study of mother to child HIV-I transmission failure to thrive, generalized lymphadenopathy, early onset

of HIV related conditions and early infection were associated with subsequent risk of death and or AIDS. Median survival time after estimated infection was 12.4 months. Failure to thrive, is amongst common nonspecific feature described in developing countries in which HIV-I present .[38] In South African children with vertically acquired HIV-1 infection, disease onset is early and deterioration to AIDS and death are rapid. Relative risks in the infected infants were highest for lymphadenopathy, failure to thrive, and neurological abnormalities. Seventy percent of infected infants were symptomatic by 6 months. Infected infants can be easily recognized clinically, the majority by 6 months of age. [39]

Intrauterine infections in the TORCHES group may present with prenatal failure to thrive alone or in combination with other features. Five to ten percent of neonates with congenital CMV may fail to thrive. Ninety to ninety five percent are clinically silent. Congenital syphilis still occurs; failure to thrive has been found to occur in some cases as a sole feature, [40,41,42] though the known common presenting features are osteochondritis, hepatosplenomegaly, symmetrical rash, rhinitis etc

NON ORGANIC CAUSES:

This is a clinical diagnosis that should be considered in parallel with other causes of failure to thrive in infants. There's no typical profile of a parent whose child develops non-organic failure to thrive. The condition

can occur in all social classes but is more common in situations of poverty, poor marital relationships, chaotic family lifestyle and where there is a history of deprivation in the parents own childhood. [43] Gagan et al has found social and psychological differences between non-organic failure to thrive and organic cases. Mother's deficiencies being instrumental in the etiology of non organic failure to thrive (N-O FTT). However these mothers are themselves usually deprived. Lack of cooperation in childcare by both parents has been noted; hence the concept of parental deprivation suggested; which provides a more accurate model. Teen motherhood and socio-economic status also appear to be important, but not necessary as determinants. [44] A preliminary analysis of the socio-economic status of nursing mothers at the Muhimbili neonatal ward show that 80% of the mothers completed primary school, 80 % are unmarried and 80% are 20 years of age and below; personal communication (Sister incharge A.Manger neonatal ward MNH). Infants failing to thrive for organic reasons have been found to be significantly smaller and thinner at birth, independent of pregnancy complications or prematurity. Oates [43] described, non organic failure to thrive to be more likely, in the later toddler stage. In a study by Altemeier et al non organic failure to thrive correlated significantly with ebberrant nature during the mother's childhood and with conflicts between the parents of the infant; perinatal events including complications of pregnancy, short gestation, and residual minor events predisposed to

non organic FTT in early infancy by disturbing the development of mother-infant relationship. [45] Skuse[9] also found: poor parenting, family dysfunction, little or lack of support, together with the infant's behavior at meals to be important variables in non organic FTT. It was for these types of situations the term psychosocial deprivation was created, regardless whether it is intentional or unintentional.

Initially, only few laboratory tests are necessary in evaluating infants, failing to thrive unless the history or physical examination suggests a specific line of inquiry. Intensive laboratory studies are indicated when the reason remains hidden. [28]

Rationale

Failure to thrive or growth failure is an important feature of problems prevalent in the neonate. It remains one of the greatest challenges for the practicing paediatrician and it is a common pathway or outcome of several different underlying infant and maternal conditions, such as;

- Nutritional problems (breast feeding problems)
- Infections
- Environmental (non organic causes)
- Inborn errors of metabolism
- Congenital malformations

The latter two are rare; and nutritional deficiencies are not expected to be a cause of FTT in the neonate, ideally since breast feeding suffices a young infant's nutritional requirement, provided the technique is proper. Results from other studies, and case reports at this centre suggested an increase in the incidence of FTT, partly fuelled by maternal HIV and tuberculosis co-infection. The magnitude, and pattern of FTT in the neonate at this centre have not been studied. The multifactorial causes of FTT could not be ignored, these need a high index of suspicion and rigorous sorting and hence this study.

OBJECTIVES

Broad Objective:

To determine the pattern of Failure to thrive among young infants admitted at the Neonatal Unit at Muhimbili National Hospital.

Specific Objectives.

1. To determine the prevalence of failure to thrive among young infants admitted to the Neonatal Unit in this hospital.
2. To determine the causes of failure to thrive among young infants admitted to the Neonatal Unit at Muhimbili National Hospital
3. To determine the early outcome of young infants failing to thrive in the Neonatal Unit.

(c) Weight below 3rd centile at 2 weeks or more.

(d) Weight gain of less than 5gm/kg/day by age 2 weeks or more.

Young infants seen in the clinic up to age 6 weeks who had the above criteria were also recruited, in order not to miss some who had FTT from the neonatal period.

Any one of the criteria was used (since all these overlapped) for ease of recruitment. For the sake of the study the four individual criteria were indicated categorically in the questionnaire as category (a), (b), (c), (d) as above, but all infants were grouped as FTT.

Exclusion criteria:

(i) Neonates with severe congenital malformations incompatible with life such as anencephaly or gross hydrocephalus were excluded.

(ii) Babies failing to thrive older than six weeks.

Outcome measures:

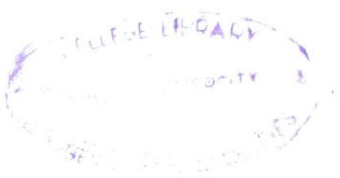
Survival or death, diagnosis and morbidity.

Data Collection:

All young infants with FTT whose mothers consented were recruited.At recruitment birth weight, current weight was recorded; details of the antenatal, birth weight, immediate postnatal history including the

dietary (breastfeeding or artificial feeding) history, relevant mother's medical, family and social history was obtained. Single parenthood in this study meant either of the following: an unmarried mother, or cohabiting, divorced, surrogate, or widowed All neonates and young infants in the study were examined by the principle investigator thoroughly, and observations of a breast feed was done daily to assess the time length of feeds, positioning and attachment. [3,23] Cup feeding technique was also assessed, type of artificial milk used, amount consumed per day, frequency of urine and stools per day, and color of the stools were recorded in the questionnaire. A baby was regarded to receive adequate feeds when it had at least 8 or more feeding frequency, at least 6 wet nappies or pieces of cloths, and stool frequency of at least 5 per day (in the absence of obstructive pathology).

Daily weight of the undressed hospitalized recruited neonate was taken using a standard beam balance (seca) to the nearest 10 grams, test weighing was done in doubtful admitted babies to establish adequacy of feeds. [17]. Age, name address, parity, number of living children and marital status formed part of the introduction in the questionnaire. Occipital frontal circumferences using a graduated non-elastic measuring tape and length using a graduated length board was recorded at recruitment, at discharge and at follow up in all patients. The information obtained together with the clinical findings and the anthropometric measurements (birth weight, weight on admission and at



discharge or death, OFC, and length at birth and discharge) was entered in a structured questionnaire. A detailed questionnaire on the assessment of breastfeeding was administered. (Appendix c)

Blood Collection:

A total of 6 mls of blood was collected from a peripheral vein after thorough cleansing of the area with 70% alcohol for HIV screening, and a strict confidential specimen and result handling, where initials were used each with a code in all recruited babies by ELISA (Enzyme Linked Immunosorbent Assay) an IgG antibody assay method. This determines the presence of maternally acquired antibodies in this age group, (HIV exposure) rather than the true HIV status of the baby. Detection of virus DNA or RNA by PCR was the appropriate method for early diagnosis of HIV-1 infection in infants. But these methods are expensive and technically demanding. It was not possible to do the test; hence the HIV results of infants in this study are interpreted as infant exposure to maternal HIV. Screening for Toxoplasmosis IgM, IgG, Rubella IgM, IgG; CMV IgM, IgG was done using enzyme immunoassay recomb for the detection of IgM, IgG antibodies to the respective viruses of the TORCH group; (EIA recomb for in vitro diagnostic use, Roche) using the Cobas Core immunoassay system analyzer.

More than two thirds of the recruited neonates and young infants were screened for Toxoplasmosis, and Rubella; while a sub-sample of 26

neonates only were screened for CMV, to cut down costs; Serological tests for congenital syphilis used were VDRL Carbon Antigen for in vitro diagnostic use, a reactive result was reported as positive; and a negative result as non reactive. Treponemal passive particle agglutinnation test for detection of antibodies to Treponema pallidum (SERODIA ^{R}-TP.PA) was done. A specimen that was non-reactive with unsensitized particles (1:40 final dilution) but demonstrated reactivity with sensitized particles (1:80 final dilution or more) was interpreted as positive; while a negative result was that which showed non reactivity with sensitized particles (1:80 final dilution) regardless of the reaction pattern with unsensitized particles. Full blood picture ESR was done using the Cobas Mira system analyzer I

Gastric Aspirate:

Gastric aspirate was collected on 3 occasions every morning in a plastic container on an empty stomach. The 3.00am feed was skipped and gastric aspirate was collected using a sterile nasogastric at 6.00 am before feeding. Specimens for culture were collected in empty sterile bottles and these were decontaminated using 4 % sodium hydroxide for 15 minutes; in the laboratory, [30] Acid fast bacilli were stained using auramine stain and examined under a fluorescent microscopy using a 63 objective lens; A negative result was only interpreted after 1000 fields examination. A positive smear was inoculated in 2 Lowenstein Jensen media containing glycerine and pyruvate respectively; incubated at 37^{0} c,

observed weekly for any growth for eight weeks. Niacin test was done to identify M. tuberculosis. [30, 46, 47]

Culture was done only in a few neonates highly suspicious of perinatal tuberculosis.

Radiology:

Chest x-rays antero-posterior views were done in 90 recruited babies. While Skull x-rays were done in 3 neonates who had microcephaly. Radiological reports was provided by a qualified experienced radiologist of the department of Radiology of Muhimbili National Hospital.

Cranial Ultrasound scan

This was done in recruited babies for the presence of periventricular leukomalacia which is reported to contribute to FTT;[25] Besides this it assists in the diagnosis of Toxoplasmosis, CMV, Herpes infections, and others abnormalities. Intracranial haemorrhages and abcsess were easily confirmed ultrsonographically.

Post mortem investigation

Attempts to clinical postmortem were made pending parental consent. One clinical Post mortem was done by a qualified experienced Pathologist. Necropsies of the liver, lungs, adrenals were taken and fixed in 10 % buffered formaldehyde and examined by histology for the

presence of any primary hepatic complex or caseating hepatic granulomas or any other abnormalities. [30,48]

At discharge mothers were counseled on exclusive breastfeeding, care of their babies and urged to bring their infants for follow up visits at 2-4 weeks interval at the High Risk Clinic or whenever they fell sick. Breast feeding mothers of VLBW babies were given calibrated plastic cups at discharge for cup feeding of manually expressed breast milk in addition to breast feeding.

Verbal autopsy was used as a tool to determine the possible causes of death that occurred at home.

All information obtained was entered in the data master sheet including the early outcome, then in the computer using data entry programme in epi info version 6. Frequency distribution tables were used for results tabulation. Differences between means, and significance testing was done using uncorrected, chi square test. Fisher exact test was used where numbers were less than 5. The statistics was considered significant if the p value was less than 0.05.

Interventions/treatment and follow up:

After recruitment, investigations and identification of the underlying problem; infants with remediable problems were treated according to the

ward management protocols. VLBW babies and sick young infants were fed by nasogastric tubes with a slow transition to cup, and breast feeding where appropriate.

Counseling and assistance in correct attachment, positioning and correct cup feeding technique was done during breastfeeding and formula feeding (where appropriate) in the ward and at follow up whenever a faulty feeding technique was found.

VLBW babies were preferably nursed propped at 30° degrees position, to prevent gastro-oesophageal reflux. Preterm LBW babies were prescribed iron, folic and multivitamin supplements from six weeks of life.

Pre and posttest counseling was done. HIV exposed infants were prescribed multivitamin, cotrimoxazole for PCP prophylaxis from age six weeks, mothers or caretakers were counseled to continue giving the medication until when the serostatus of their infants will be known.

Mothers and spouses of infants with congenital syphilis received standard care and treatment. Those who were HIV positive were counseled accordingly.

Follow up period ended in January 2002; for the last patient who survived, and earlier among those who died. At the end of individual patient follow up period, the earliest outcome was documented. At follow up palmar pallor was used to diagnose anaemia. Babies with some or severe palmar pallor were classified as anaemic. All Babies who had

problems were handed over to the High Risk clinic, for further management and follow up including consultations with other disciplines: cerebral palsy clinic, Neurosurgical, Paediatric surgical, Orthopedics and general Paediatric Clinics.

Orphans were discharged through the Hospital Social welfare officer to either orphanage centers or close relatives.

Ethical issues

Ethical approval for the conduction of the study was sought from the College's relevant authorities. Informed consent was sought from the mothers and/or caretakers of the babies to be recruited.

Pre and posttest counseling for HIV test was done. Code numbers were used in handling HIV test results, for patient confidentiality, these results were strictly handled by the investigator.

RESULTS

Total number of admissions at the neonatal unit were 3914 during the seven month recruitment period from April 2001 to October 2001. The total number of LBW and normal birth weight infants admitted during this period was 1701(43.5%); 2213(56.5%) respectively.

A total of ninety-four infants were included in the study; among these 52 (55.3%) were males and 42 (44.7%) were females, with a male to female ratio of 1.23:1.

The distribution of infants according to their background characteristics is shown in table 1. The prevalence of failure to thrive was 2.4%. (94/3914) Of the 94 infants with failure to thrive 51(54.3%) were preterm 43(45.7%) were term. Low birth weight and small for date infants accounted for 57 (60.6%), and 26(26.8%) respectively of the total recruited infants.

The mean birth weight of the recruited infants was 2.165 kg with a standard deviation of 0.757 grams; the least birth weight was 900 grams, the highest was 3.8kg.The mean weight at recruitment was 1.73kg; the lowest 600 grams and the highest 3.5kg with a standard deviation of 0.576 grams. Twenty seven percent of the recruited infant had a birth weight of 1.5 kg and below, while 32 % had birth weights above 2.5 kg. The mean length was 44.75 cm, with a minimum of 36 cm, and maximum of 53 cm; standard deviation of 4.881

There were 9 sets (18 neonates) of twins contributing to 19.1% of the study group. Twelve (12.8%) infants were orphans. Single parent hood accounted for 35(37.2%).

Eighty-three (88.3%); 7(7.4%); and 4 (4.3%) were delivered by spontaneous vaginal delivery, breech, and caesarian section respectively. Majority 52 (55.3%) of the neonates who failed to thrive were first-borns. While only 9(9.3%) had a birth rank order of 5 or more.

Table 1: Distribution of FTT by background characteristic of the infant.

Characteristic	N	%
Sex		
M:	52	55.3
F:	42	44.7
Term:	43	45.7
AGA	33	35.1
SFD	10	10.6
Preterm	51	54.3
AGA	35	37.2
SFD	16	17.0
Orphan	12	12.8
Birthweight		
0.900-1.50	25	26.6
1.51-2.00	21	22.3
2.01-2.5	18	19.1
2.51-3.00	15	16
>3.00	15	16
Birth order		
1	52	55.3
2-4	33	35.1
5-6	6	6.1
>6	3	3.2
Single parent	35	37.2
Mode of delivery		
SVD	83	88.3
Breech	7	7.4
C/section	4	4.3

Diagnosis of Failure to thrive was based on either of the four recruitment criteria shown in table 2.

Table 2: Distribution of neonates with failure to thrive according to category of recruitment.

Recruitment Category	n=94	%
Category A	43	45
Category B	41	43.6
Category C	57	60.6
Category D	69	73.4

Most of the recruited young infants fulfilled more than one criterion. Out of the 85 mothers, 17 (18.1%) were teenagers, while 36 (42.4%)were aged between 20-24 years and were the majority in the study. The youngest mother in the study was 15 years and the eldest 40 years. The mean maternal age was 24 ± 5 years. Sixty (70.58%) of the mothers had completed primary school; and 13(15.3%) secondary education. Seventy-five (88.2%) were not employed. The distribution of mothers by their socio demographic factors is shown in table 3.

Fifty- seven (67.1%) mothers had pregnancy or labor related problems of which Preterm delivery by 44 mothers (51.8%) ranked the highest; pregnancy induced hypertension and eclampsia 5(5.8%)

Table 3: Distribution of mothers by their sociodemographic factors

Socio Demographic Factors	N	%
Age(yrs)		
15-19	17	18.1
20-24	36	42.4
25-29	14	16.5
30-34	15	17.6
35-39	2	2.1
40	1	1.1
Marital status		
married:	50	58.8
single*:	34	40.0
widow	1	1.2
Education:		
Informal	2	2.4
Incomplete primary	9	10.6
Complete primary	60	70.6
Secondary	13	15.3
College	1	1.2
Partner support:	67	78.8

* notice that single here is 34, because it excludes widow and the percentages are different.

The distribution of the mothers according to selected obstetric and medical record is shown in table 4. Most mothers had more than one

medical problem. Anaemia and preterm delivery were the commonest coexisting problems. A total of 19 (22.4%) mothers had a history of tuberculosis, 12 (14.1%) had it in the past, while 7 (8.2%)had tuberculosis during the study period, and 5 (71.4%)of them died. Hospital records of twenty -three mothers (27%) showed HIV infection or HIV defining illnesses. HIV related deaths were the most frequent (75%) among mothers whose orphans failed to thrive.

Table 4: Distribution of FTT according to mothers' obstetric and medical record

Maternal record	N	%
Obstetric problems*		
Polyhydramnios	1	1.8
Oligohydramnios	1	1.8
Anaemia	26	30.6
PIH/Eclampsia	5	5.8
Preterm delivery	44	51.8
Prolonged labour	1	1.8
PPH	1	1.8
Puerperal psychosis	1	1.8
Medical history:		
Past/ Present Tb	19	21.5
HIV	23	27.0
Diabetes mellitus	2	2.3
Maternal deaths n=12		
HIV related deaths:		
Pneumocystis-carinii pneumonia	1	1.2
Chronic diarrhea	2	2.3
Pulmonary tuberculosis	3	3.5
Anemia & tuberculosis	2	2.3
Cryptococcal meningitis	1	1.2
Obstetric related deaths:		
PPH	2	2.3
Eclampsia	1	1.2

*Pregnancy, labor, and postpartum problems

The feeding pattern of the recruited neonates, showed high rates of mixed feeding, which comprised of infant formula, cows milk and clear fluids. Forty one mothers (48.2%) were exclusively breastfeeding. Maternal sickness, debility or death were the commonest reasons for initiating artificial feeding. Seven orphans (58.3%) who were never breast fed, received formula milk since birth. The other five orphans had a longer period of mixed feeding preceding replacement feeding before death of their mothers. Maternal absence during feeding hours (in neonatal ward) was a common reason for mixed feeding; other reasons in 26(30.6%)included: "milk not enough, twinning and baby refusing to breast feed." Mixed feeding accounted for 47.9%.

Seventy seven point seven percent (77.7%)of the babies had adequate feeding, (8 or more times in 24 hours, at least 6 wet nappies/ pieces of cloths, and at least 5 number of stools). Mothers of two babies had insufficient milk. Seventy (82.4%) mothers had at least 3 meals per day, 17.6%(15) had 2 or less meals per day; and only 20 (28.6%)from the former group had in between meals.

Table 5: Feeding pattern and problems of babies who failed to thrive

Feeding Pattern	**N**	**%**
Exclusive breast feeding	41	43.6
Exclusive artificial feeding	8	8.5
Mixed feeding**	45*	47.9
Problems:		
Attachment	60	63.8
Positioning	63	67
Insufficient milk	2	2.3
Inadequate feeds	19	20.2

**cows milk, infant formula, clear fluids
* 5 had replacement feeding , after death of their mothers

Table 6 shows the distribution of neonates with congenital malformations by birth weight in kilograms. Fifty percent (8/16) of infants who had congenital malformations and failed to thrive were low birth weight babies. Congenital cystic adenomatoid malformation of the lung was a diagnosis at post mortem. This was the only postmortem done.

Table 6: Distribution of 16 Congenital malformations by birth weight(kg) of neonates with FTT

Malformation	≤ 1.500	1.500<2.5	≥2.5	total	%
PDA	1	1	-	2	12.6
VSD with microcephaly	-	1	-	1	6.3
Diaphragmatic hernia	-	-	1	1	6.3
Laryngotracheomalacia	-		1	1	6.3
Congenital Cystic Adenomatoid malformation*	-	1	-	1	6.3
Ileal diverticula	-	-	1	1	6.3
Anorectal malformation & hypospadius	-	-	1	1	6.3
Ompalocele	-	1	-	1	6.3
Omphalocele & Macroglosia	-	-	1	1	6.3
Cleft lip and palate with Abscent corpus callosum	-	1		1	6.3
Sacrococcygeal tumor	-	-	1	1	6.3
Posterior urethral valves	-	-	1	1	6.3
Unilateral Talipes equinovarus		1	1	2	12.6
Bilateral TEV & high arched palate	-	1	-	1	6.3
Total				16	100

*Post mortem diagnosis

Table 7: Maternal HIV results and selected abnormal laboratory Results of neonates with failure to thrive.

Test	N	%
Chest radiogragh n=90	25	26.6
AFB + n=93	2	2.2
AFBculture +	2	2.2
Full blood picture n=93	78	83.9
Reactive VDRL n=93	4	4.2
Positive TPPA** n=93	7	7.4
Cranial-ultrasound n=91	42	46.2
HIV Positive Mothers	25	29.4
HIV exposed Infants*	29	30.8

(* 4 sets of twins) **treponema palidum particle agglutination

Table 8: Distribution of failure to thrive according to the final Diagnoses.

Diagnosis	Term		Preterm		n	%
	AFA	SFD	AFA	SFD		
Anaemia	6	5	26	7	44	46.8
Septicaemia	8	4	13	1	26	27.7
Pneumonia	6	4	10	4	24	25.5
Meningitis	2	1	-	-	3	3.1
Congenital syphillis	-	2	2	3	7	7.4
Tuberculosis	-	1	2	1	4	4.3
L/infections	8	1	28	3	40	42.5
Malaria	1	-	1	-	2	2.1
Hepatitis B Exposure	-	1	1	-	2	2.1
Hypoglycemia	1	1	-	1	3	3.1
Hypocalcemia	1	1	-	-	2	2.1
Hydrocephalus	-	-	1	-	1	1.1
HIE	12	1	2	1	16	17.2
Hypernatremic Dehydration	-	2	-	-	2	2.1
GER	-	-	2	-	2	2.1
Congenital malformations	3	5	2	6	16	17.2

OUTCOME

The early, outcome was measured in terms of survival or death. A total of 24 recruited neonates died and 70(74.5%) young infants survived. There was no loss to follow up. Twenty-nine (30.9%)infants were alive and well, and demonstrated a good catch up growth. The commonest follow up problems among the sick infants were anaemia 13 (31.7%)and growth failure 10(24.4%). Fifty percent of the infants who had growth failure were HIV exposed. Sixty three point four percent of the infants who were sick during the three months follow up period were LBW babies.

Table 9: Early outcome of 94 neonates with failure to thrive.

OUTCOME	LBW	NBW	N	%
Died	17	7	24	25.5*
Alive & Well	10	19	29	30.9
Alive & Sick	26	15	41	43.6**
Anaemia	11	2	13	13.8
S/ pneumonia	3	3	6	6.4
Hydrocephalus	4	-	4	4.3
Cerebral abscess	1	-	1	1.1
Developmental delay	3	4	7	7.4
Growth failure	4	6	10	10.6
HIV exposed	3	2	5	
HIE	-	3	3	
Congenital malformation	1	1	2	

*mortality ratio, ** morbidity ratio

The causes of death are shown in table 10 below.

Table 10: Causes of death among neonates who failed to thrive.

Causes	LBW	NBW	N (24)	%
S.Pneumonia	7	4	11.6	45.8
Septicaemia	3	1	4.3	16.7
Severe Anaemia	3	-	3.2	12.5
Acute-renal failure	1	1	2.1	8.3
CCAM*	1	-	1.1	4.2
Sacrococcygeal tumor&Hypoglycemia	-	1	1.1	4.2
CHD**	2	-	2.1	8.3
Total	17	7	24	100

* congenital cystic adenomatoid malformation of the lung

** congenital heart disease

Infections, and congenital malformations were the leading causes of death. Severe anaemia alone comprised of 12.5%, though anaemia

coexisted in eight other young infants who died of septicaemia (3), congenital malformations (2) and severe pneumonia (3).

Table 11 shows the association between maternal health problems and infant death.

Table 11: Association between maternal health problems and infant mortality (N=24)

Maternal medical problem	N	X^2	p- value
Anaemia	11	10.02	0.007
Tuberculosis	4 **	4.75	0.02*
Diabetes-mellitus	0		1.0*
Pregnancy induced hypertension	1		1.0*
HIV	11	10.02	0.001

* Fischer exact p-value
**three infants were born to mothers who had both tuberculosis andHIV

Maternal anaemia, HIV, and tuberculosis, were significantly associated with infant mortality.

Table 12 below shows mortality in relation to an abnormal chest x-ray of the infant.

Table 12 : Mortality in relation to abnormal CXR

CXR	Died		Total
	Yes	No	
Normal	11	54	65
Abnormal	13	12	25
Total	24	66	90

X^2 5.87; P-value 0.01; RR 1.40; 95%CI 1.00 <RR <1.96

Having an abnormal chest x-ray was significantly associated with mortality,(p- value less than 0.05).

DISCUSSION

Prevalence of failure to thrive in this study was found to be 2.4% of all infants admitted to the neonatal unit during the seven months study period. The Muhimbili National Hospital neonatal care unit, being a tertiary referral center admits a highly selected group of sick young infants with either possible serious bacterial infection [49] or congenital malformation. This is the only Government neonatal care unit for sick premature neonates, hence self referrals were common. This prevalence is a higher rate in young infants compared to an annual prevalence of 1-5 % in a developed country.[20]

The mean birth weight at MNH is known to be 2.84 Kg. The morbidity risks of LBW are also known to be 2.5 times higher than normal birth weight babies. [50] In this study majority of infants who failed to thrive were LBW babies (60.6%) with a mean birth weight of 2.165 Kg. LBW babies were more likely to fail to thrive than normal birth weight babies indicating that birth weight is a possible precursor of development of failure to thrive. This shows that, when the beginning is wrong the likelihood of failure to thrive increases; similar to findings by other authors, who reported significant association between failure to thrive and birth weight.[50,51] Growth restricted infants that comprised more than a quarter(27.6%) of the recruited infants is a further evidence

of in utero compromise as an important underlying factor in postnatal failure to thrive. [8] These could be explained by multiple challenges of survival faced by LBW babies, such as increasing susceptibility to infections, and lactation related difficulties (in preterm babies).

Infections (47.8%); were more prevalent among LBW preterm babies who failed to thrive. The possible sources of infection in these neonates were local infections; since almost all who had septicaemia, pneumonia or meningitis had a preceeding or concurrent local infection. LBW and prematurity are known to be major predisposing factors to neonatal septicaemia as reported earlier by Mchomvu [52] at this unit. He found E coli and staphylococcal aureus were the commonest isolates in neonatal septicaemia. In this study Klebsiella and Escherichia coli were the commonest blood culture isolates; while Staphylococcal aureus, Streptococcal group D, and Candida were common causes of local infections. Nosocomial infections contributed to the majority of Klebsiella septicaemia in this study as proved by bacteriological investigations done during the study period (as part of ward audit of possible sources of infections). In this audit , swabs from different areas in the neonatal unit were taken. Prolonged hospitalization beyond first 1-2 weeks, nursery overcrowding, the need for suction, cup, and nasogastric tube feeding were associated with septicaemia. Most of these, in addition to health workers are known risk factors of neonatal infection in most neonatal

care units, as reported by other authors. [53,54] Infection in the neonate may present with nonspecific symptoms and signs, ranging from subtle clinical findings such as growth failure to overt signs.

The prevalence of neonatal tuberculosis was 2.1%. Those with positive gastric aspirate for AFB accounted for 10.5% of babies born by mothers with a history of past or present tuberculosis. Prematurity, in utero growth restriction, and early growth failure seen in these babies, is an indication of either perinatal, or in utero acquisition of tuberculosis. While the latter requires examination of the placenta for mycobacteria, and biopsy of the infant's liver among other diagnostic criteria, the former required a history of early perinatal exposure.[32,33,34] Liver biopsies, nor placenta examination were not done in this study, nor were health workers screened for current tuberculosis. The challenges in the diagnosis of congenital tuberculosis were inevitable in face of limited resources. The term perinatal tuberculosis is used in discussion, since early neonatal and congenital tuberculosis have the same mode of presentation, treatment and prognosis.

The difficulty in the diagnosis of tuberculosis in the young infant is the same as in older infants and children in the general population requiring the use of set guidelines and criteria. The yield of AFB in stained smears of gastric aspirate is generally very low, because the lowest concentration of organisms detectable by microscopic examination is 10/ul of sputum which is higher than the usual load of bacteria in perinatal tuberculosis.

There are no pathognomonic roentgenographic features in primary pulmonary tuberculosis. These findings do not appear until child's skin test is positive. The recent rapid increase in HIV infected women, especially during child bearing years suggests many more pregnant young women are likely to be infected with tuberculosis, (without showing symptoms of the disease) and transmit the infection to their offspring [55,56,57,58] and hence manifestation of tuberculosis in the early infancy.

Twenty nine percent of mothers in this study had HIV, with a total of 29 (30%) exposed neonates. This figure is almost twice as high in failure to thrive, compared to 14-16% prevalence in the antenatal clinics in Dar es salaam.[59] These findings indicate that the manifestation of MTCT of HIV is quite early, similar to findings documented by many authors. [37,60,61,62] They found that FTT in young infancy is a common presentation in HIV/AIDS and other debilitating diseases. Trends in HIV infection among women forecast the impact of HIV in children. In this study, the high percentage of exposed babies who failed to thrive could be due to self selection of high risk mothers (sexually transmitted infections, other medical and obstetric problems.)

Anaemia (46.8%), was fairly common diagnosis in this study, more so among preterm babies. Anaemia in the very low birth weight baby (<1500 grams) is a common problem to both developing and developed countries.

Multiple causative factors documented in other studies are: hemolysis due to sepsis, low vitamin E and iron levels, and blood loss from umbilicus, intracranial (in infants with evidence of IVH) and phlebotomy losses. Vitamin E absorption increases with increasing birth weight and gestation, while the total iron endowment of an infant is directly related to his birth weight. [63] In this study IVH, prematurity, and infection are likely contributors to anaemia. Majority of anemic infants had clinical and haematological evidence of infection as depicted by their full blood pictures. Iron and vitamin E levels were not studied.

Congenital malformations incompatible with life were excluded, those compatible with life whether major or minor were included; 43.8% had low birth weight. This was similar to observations by Manji et al[50] who reported FTT and congenital malformations to be significantly high amongst LBW babies, at this center.

Post operative failure to thrive that occurred in 2 infants who had major surgery, is an indication of lack of provision of appropriate nutrition, in the immediate post operative period. There is no provision of total parenteral nutrition at this center. Other contributing factors were, prolonged hospitalization, coupled with sepsis, and a possibility of maternal anxiety, which was not studied. Supplemental feeding to sick infants, was done according to ward protocols, taking care of the nutritional needs of the sick infants. Existing experience show, cup feeding and manual expression of breast milk, with a slow transition to

full breast feeding suffices, the needs of LBW babies. [64] Despite the advocacy of preterm formulae, and formula concentration by many authors. [1,65,66,67] The benefits of the former practice, as reported by Musoke are cost-effective in the developing world situation. The advantages being: maintaining milk supply, facilitating exclusive breastfeeding, sustaining lactation, and avoiding nipple confusion. [64]

Postnatal weight gain of LBW-preterm babies in this study was slower than postnatal weight gain of babies reported by Muhudhia and Musoke [68] twelve years ago in a developing country NICU. The infants in this study show a tendency to early growth failure as demonstrated by the recruitment categories c and d. In their study babies weighing 1001-1250g regained birth weight at an earlier age compared to babies in this study who had similar weights. These differences could be accounted by the fact that, babies in this study were not all exclusively breast fed, and majority were sick as opposed to well exclusively breast fed babies described by these authors.

A faulty breastfeeding technique is beyond doubt a cause of poor feeding. Mixed feeding, bad positioning and attachment were feeding problems frequently encountered among the studied group. Twinning and maternal sickness or debility were common reasons for mixed feeding. Milk insufficiency was a rare feeding problem in this study, similar to report by other authors.[21]

Key underlying maternal problems significantly associated with an adverse outcome amongst neonates failing to thrive were preterm delivery, maternal infection and under nutrition.

This is similar to a study done by Stafford et al [69] who in addition reported maternal overworking antenatally to be a factor predisposing to preterm deliveries in the developing world. Factors common in the developed world such as cigarette smoking, illicit drug use were not studied.

Pyschosocial stress created by primiparity, lack of partner support, could be contributory maternal factors to nonorganic failure to thrive in this study. Prolonged hospitalization with resultant maternal fatigue, in lactating mothers are important factors in pychosocial stress especially in this hospital setting where meals are not provided for lactating mothers despite the fact that analysis on the frequency of meals showed majority of the mothers had at least 3 meals per days; the quality and frequency may not suffice lactating and sick mothers. This shows that factors underlying maternal psychosocial well being are rather complex. Documentation by other authors showed that maternal health, psychosocial problems and increased stress of parenting to be more important factors than mothers adolescent status in these mothers. [9,70] Contrary to Frienkelstein [71] who reported no abnormalities in physical growth of infants of adolescent, primiparous, and teenage mothers in his

retrospective study. Limitations of such a study design could explain the differences.

MNH Obstetric data base show 19.3% prevalence of adolescent mothers delivering at this center in the year 2000.[72] Teenage percentage was 20(17/85) amongst mothers in this study group.

The differences between mean weights at recruitment and mean birth weights compared to the early outcome, showed no significant difference among the three outcome groups (x2=1.510, p-value >0.05) .

The outcome of babies failing to thrive in this study showed: high morbidity and mortality rates. Highest morbidity rates that were found among LBW babies are common findings reported in other studies, in which adverse outcomes were associated with LBW, and or growth restricted babies, regardless of gestation age.[73] In this study majority of babies who had continued failure to thrive, or presented with problems at follow up had birth weights of 2000grams or below, and most babies required rehospitalization, in other wards. Similarly in the follow up of LBW babies; Kelleher et al[74] found that FTT was a common problem among these babies. The tendency to re-hospitalization was also reported by Manji [50] among a cohort of LBW babies. McCormick and Shapiro also reported higher chances of re-hospitalization in the first year of life in babies with birth weights below 1500 grams who had longer periods of initial growth delay, in developed world.[75]

On comparison of the differences between means, no significant association (x2=1.510, p-value >0.05) was found between the mean birth, and recruitment weights, of the three outcome groups (died, alive and well, alive and sick).

Growth patterns demonstrated by most VLBW babies in this study using Gardner's charts, against time are comparable to Babson's fetal infant growth charts, described by Jeanne. These charts were used in the growth monitoring of the sick high risk neonate (preterm and term). [76, 77]

Multiple factors seemed to interplay in the contribution of failure to thrive in young infants. Organic and non organic causes co exist, in young infants' failing thrive. Intentional, and unintentional mixed feeding was a common practice in the studied group.

This study has indicated the magnitude, pattern, outcome and the associated conditions related to failure to thrive. It has highlighted a problem of early growth failure in the young infants that needs a closer attention. Given the limitations of time, financial constraints in a hospital based cross-sectional study, further long-term multicenter studies are needed to elucidate further the problem of early growth failure in a community-based situation; establish a causal relationship between maternal psychosocial factors and non organic failure to thrive in the young infant; the long term survival and outcome.

CONCLUSIONS

1.Prevalence of FTT in the neonates admitted at Muhimbili National Hospital is 2.4%.

2.Prematurity, infections, anaemia, and mixed feeding are the most prevalent problems in young infants failing to thrive at MNH, indicating a bad start results to a bad progress.

3. Underlying maternal factors are possible contributing factors to postnatal failure to thrive among young infants.

4.A high mortality rate 25% has been demonstrated in failure to thrive, among young infants at Muhimbili National Hospital, indicating that Failure to thrive is an ominous condition.

RECOMMENDATIONS

1. Larger community based studies are needed to establish causal relationships between failure to thrive and problems prevalent in the mother, caretaker and its environment.

2. High rates of mixed feeding in the neonates seen at the baby friendly hospital calls for a prompt re education of the staff and community on importance of exclusive breastfeeding or exclusive artificial feeding.

3 It is recommended that enthusiastic case finding and contact tracing of maternal tuberculosis be done, and special guidelines be set to address neonatal tuberculosis by appropriate authorities.

4 It is recommended that growth monitoring of preterm babies should put into consideration the gestation age, and hence age corrected to gestation age charts be used.

STUDY LIMITATIONS

1. Due to limited finances a sub sample was screened for Toxoplasmosis, CMV, and Rubella.
2. The HIV status of the infants under study could not be determined due to lack of funds for PCR.

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