FACTORS ASSOCIATED WITH COGNITIVE DEVELOPMENTAL DELAY AMONG INFANTS ATTENDING REPRODUCTIVE AND CHILD HEALTH CLINICS IN DAR ES SALAAM, TANZANIA

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FACTORS ASSOCIATED WITH COGNITIVE DEVELOPMENTAL DELAY AMONG INFANTS ATTENDING REPRODUCTIVE AND CHILD HEALTH CLINICS IN DARES SALAAM, TANZANIA

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 Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***Factors associated with cognitive developmental delay among infants attending reproductive and child health clinics in Dar es Salaam, Tanzania,*** in (partial) fulfillment of the requirements for the degree of Master of Medicine (Paediatrics and Child Health) of Muhimbili University of Health and Allied Sciences.

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Date _____.

DECLARATION

AND

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I, **Gudila Valentine Shirima**, declare that, this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

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DEDICATION

This work is dedicated to my dear mother, Prediganda Mtorobo, who contributed so much to my early childhood development.

ABSTRACT

Background

Early child cognitive development is important throughout one's life span. It is estimated that more than 200 million children under five years of age fail to achieve full cognitive development in the world and 80% of them are in South Asia and Sub-Saharan Africa. Genetic and environmental factors play a role in early child development (ECD). Most of the ECD occurs in the first 2 years of life, but largely during infancy. Malnutrition, poverty and poor health care to children have been found to have association with poor cognitive development and create a vicious cycle of poverty. This study gives the proportion and factors that are associated with infants' cognitive developmental delay in our setting. Knowing these factors enhance early intervention to break the vicious cycle of poverty.

Objectives

To determine the proportion and factors associated with cognitive developmental delay among infants attending RCH clinics in Dar es Salaam.

Methodology

This was a health facility based descriptive cross-sectional study which was done in three health centers in Dar es Salaam from July to December 2012. A two- stage sampling technique was used. Lottery was used to get the health centers and all infants registered at RCH clinic with odd numbers on data collection day were assessed for cognitive development. A structured questionnaire was used to collect data and analysis was done using SPSS version 16 by Pearson's chi-square, Fisher exact test and logistic regressions.

Results

A total of 350 infants were assessed for cognitive development and 50.6% were males. Participants were aged 1to 12 months with a mean (SD) of 7.26 (3.43) months and birth weight ranging from 1.3 to 4.6kg with mean (SD) of 3.11(0.50) kg. Proportion of infant who were found to have cognitive developmental delay was 12.3%.

Young age of the child, caretakers other than the mother, and wasting were significantly associated with cognitive developmental delays even after adjusting for confounders**.** Infants aged less than 6months were 14 times more likely to have cognitive developmental delay compared to those aged six months and above (aOR=14; 95%CI 5.3-38.3, P<0.001). Absence of the mother, and therefore the use of assistant caretakers especially during day-time, was 12 times more likely for the infant to have cognitive developmental delay compared to infants who stayed with their mothers (aOR=12.1; 95%CI 3.0-53, P=0.001). Wasted infants were 4 times more likely to have cognitive developmental delay (aOR=3.9; 95%CI 1.1-13.3, P=0.032) compared to infants without wasting.

Conclusion and recommendations

The proportion of cognitive developmental delay among infant attending RCH clinics in Dar es Salaam was 12.3%. Young age of the child, use of other caretakers in absence of the mother, and wasting were associated with cognitive developmental delays.

Parents whose infants' are taken care by the assistant caretakers should try as much as possible to spend quality time with them. All infants should be assessed on cognitive development during their visits to the RCH clinics. A longitudinal study is needed to measure the magnitude of cognitive developmental delays and look at the causal relationship of the associated factors and for better interventions.

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LIST OF ABBREVIATIONS

RCH	Reproductive and Child Health
ECD	Early Child Development
SPSS	Statistical Package for Social Scientists
OFC	Occipital frontal circumference
ASQ-3	Ages and Stages Questionnaire third edition
UN	United Nations
HIV	Human Immunodeficiency Virus
DNA	Deoxyribo-Nucleic Acid
PCR	Polymerase Chain Reaction
SD	Standard deviation
aOR	adjusted Odds Ratio
OR	Odds Ratio
95%CI	95% Confidence interval

CHAPTER ONE

1.1.0 Background

Cognitive development is defined as thinking, concept understanding, information processing, problem solving and overall intelligence.[1] Cognitive development reflects the way one perceives, thinks, performs or interacts with the environment or other people. Cognitive development and development in its totality, that is achieved in the first 2 years of life is very important in the future life of an individual.

Early cognitive development goes together with growing capacities to explore the environment, make sense of the world, and discover a sense of self in the world. Cognitive development is directly connected to the development of emotions, language and physical development. Genetic and environmental factors determine the development of a child. The environment in which the infant is raised in and interactions with it contribute to the child's intellectual ability including connection of previous experiences with new information and newly acquired skills.[1]

Emotional and cognitive functioning are strongly affected by what happens in the first few years of life (especially the first 2 years of life) and mostly in the first year of life. Checks in ECD can predict development of disability, incarceration, mental illness, or substance abuse in future.[2] There are simple and affordable interventions that can be used in early life to prevent or reduce the severity of consequences of delay in cognitive development.

1.1.1The role of environment in early cognition

Development of cognition is very important to the development of attachment. Infants demonstrates it by imitating adult facial expressions, smile in response to baby games, repeats chance behaviours that lead to pleasurable and interesting results, and recognize familiar people, places and objects. This starts at early infancy and grows with age. By the end of the first year, infants deliberately look to others for emotional cues and evaluate uncertain events, such as, the approach of a stranger though they cannot describe their feelings. Although

vocalizations and body movements provide some information, facial expression offers the most reliable cue during the age of 18-24 months.[3]

Cross-cultural evidence indicates that when infants in different parts of the world are looking at photographs of different facial expressions they associate them with emotions in the same way. The pragmatic movements in the field of speech-language pathology influenced by social-cognitive learning theory re-established the idea that language is embedded in a social matrix. This movement tells us that children do not talk about objects of interest in isolation but communicate in the context of social interactions often for socially and emotionally driven reasons.[4]

1.2 Literature review

It is estimated that more than 200 million children under 5 years fail to reach their potential in cognitive development worldwide[5.] Mostly because of poverty, poor health and nutrition, and deficient care.[6, 7] Children's development consists of several interdependent domains. These includes sensory-motor, cognitive and social-emotional, all of which are likely to be affected. In late childhood these children will subsequently have poor levels of cognition and education, both of which are linked to later economical potential.

Up to 10%-13% of children have delayed milestones worldwide[8, 9.] Most of these affected children (80%) live in South Asia and Sub-Saharan Africa[9]. A longitudinal study done by Steven et al in United States on children at the age of 9-24 months reported developmental delays of 13%.[8]. Only 10% of those with delayed milestones receive health related services. These disadvantaged children are likely to do poorly in school and therefore have low incomes, high fertility, and provide poor care for their children, thus vicious cycle of poverty[5, 9.] It is possible for these adverse effects to be prevented. [10] The second UN Millennium Development Goal is to ensure that all children get primary school education[11], so early child development is mandatory in achieving this goal.

1.2.1 Factors associated with early child cognitive development

Many factors can disrupt early child development. Socio-demographic characteristics and maternal care giving (especially 'opportunities for stimulation') have been identified as significant predictors of all child outcomes.[12] Sylva et al in the study done in the United

kingdom on children at 18months of age reported non-maternal care giving is significantly associated with cognition delay[12].

Among the factors that may predict delayed cognitive development is the age of the parents or care taker. In particular the age of the mother, it has been shown that, young mothers (<18yrs of age) and those with old age (>35) have been associated with poor cognition of their children[13, 14]. Andrew et al in Australia reported poor cognition with young mothers.[15]

From the studies done by Leibowitz et al and Lehrer in Washington and Canada respectively, reported that, the bigger the size of the family the higher the risk of developmental delay of children. It was also found that, the balance between the family levels of need for child care i.e. the number of young children in the household compared to the number of available supportive adults in the household is associated with the selection of non-parental care[16-18].

Brooks-Gunn et al in Newyork, in their study showed that, the rate at which infants enter non-parental care appears to be higher for smaller families. However, the rate at which this family-size effect occurs is not well understood. Cost considerations become more potent as family size grows, causing more and more mothers, not eligible for subsidies, to stay at home[19]. Burchinal et al reported no relationship between cognition and maternal employment in the first 3years of life[20].

Improved parental education, especially of mothers, is related to reduced fertility and improved child survival, health, nutrition, cognition, and education.[21, 22] Education may serve as a proxy for health literacy associated with child-rearing behaviours (e.g., breastfeeding, reading to the child). Education also reflects the social class i.e. financial and material resources needed to assure the child receives adequate nutrition, receives high quality child care, (if needed) and obtains needed health-related services. Social class may further influence child health through the effect of relative social position that may impact family stress, parent self-esteem, empowerment, and life control.[23, 24]

Better educated parents are consistently more likely to place their children in non-parental care. In US, among families national wide with children ages 3–5, 48% were in non-parental

care when one parent's highest schooling level was less than a secondary school diploma, versus 72% when one parent had attended some college[25] In US, only 46% of Latino families use non-parental care for children under age 5, in comparison to 64% for White families and 75% for Black families[26]. The difference between Latino and non-Latino families is most pronounced among those families who speak Spanish at home.[27] This difference is due to the fact that Latino women are less likely to be employed, either part time or full time.[28] The differences across ethnic communities in the organized supply of centres or family day-care homes may further contribute to differences in the rate of selecting non-parental care.

A comparison study which was done in India on children aged 1-2 years revealed that male and female were equally developing in cognition[29]. The study done by Mc Donald showed that, infant's cognition improves steadily with age and decrease attention to repetitive stimulation[3]. Fergusson et al did a study on children in the first 7years of life and found that, children who were breastfed for a minimum of 3 to `5 months as compared to those who were bottle-fed had an advantage of between 0.15 and 0.25 SD units in mean test performance, even after control for confounders [30]. From the studies done by Morley et al and Lucas et al on feeding practices among preterm infants, it was shown that, children whose mothers chose to express their own milk to feed their infant had higher developmental scores at 18 months and higher intelligence quotient assessed at 7.5 to 8.0 years than those whose mothers chose not to do so even after control of confounders of development and cognition as well[31,32]. The improved cognitive abilities of breastfed children may involve long chain polyunsaturated fatty acids and, particularly, docosahexaenoic acid (DHA) [33]. Clinical studies in which infant formula was supplemented with DHA suggested possible improvements in visual acuity and cognitive ability in preterm infants given the DHA-supplemented formula[34]. In general, research is beginning to provide a compelling case for the view that breastfeeding may have longer-term effects on individual cognitive ability and educational achievement. Children very preterm and free of severe disabilities had mild delays in multiple areas of development[35].

HIV exposure and infection has been reported in several studies to have an effect on cognitive development in children. Christopher et al in the comparable longitudinal study done in

Pretoria-south Africa on 255 infants, found that, HIV-exposed infants have cognitive development delay (p=0.003)[36, 37]. Studies done by Drota et al and Van Rie et al in Uganda and Kinshasa- DRC respectively found that cognitive developmental delay is based on HIV status and not exposure[38, 39]. Springer in the study done in South Africa on 17 HIV-exposed and 20 HIV-unexposed infants found no difference between the two groups[40].

Studies in Latin America reported poverty and malnutrition are related to poor health and increased mortality, [6, 7] with less recognition of their effect on children's development or of the value of early intervention. Proteins, carbohydrates and fats through metabolic process act as building blocks of brain hence influence cognitive development[41]. Cross-sectional studies in Nepal, Ghana and Tanzania reported stunted children being enrolled to school late[42,43]. Further studies done in Kenya, Guatemala and Ethiopia reported that stunting is associated with poor cognition[44, 45]. However some studies done in Philippines and Ghana found no significant difference on stunting in relation to poor school performance [46, 47]. Weight for age instead of length/height for age has been used in measuring nutrition status in young children and association was reported in the studies done in India, Bangladesh and Ethiopia[48-50].

1.2.2 Interventions to prevent poor cognitive development

Several interventions have been pointed out. Examples of these interventions are improving child nutrition, early child education, providing a stimulating environment, parenting training and adult education[51-55]. Young children need to spend time in a caring, responsive environment that protects them from neglect and inappropriate disapproval and punishment. Parents and families are the key to early child development, but need support to provide the right environment. Children benefit when national governments adopt “family friendly” social protection policies that guarantee adequate family income, maternity benefits, financial support, and allow for parents and caregivers to devote time and attention to young children. Worldwide, societies that invest in children and families in the early years – whether rich or poor – have the most literate and numerate people. These are also the societies that have the best health status and lowest levels of health inequality in the world. Early child development (ECD) interventions provide direct learning experiences to children and families. They are

targeted to young and disadvantaged children, high quality and long lasting, integrated with family support, health, nutrition, or education systems and services. The health care system and health providers have roles to play, as they are often the points of early contact with a child and can serve as gateways to other early childhood services. Health care workers are trusted sources of information for families and can give critical guidance about: how to communicate with infants and children, ways to stimulate children for better growth, how to handle such common developmental problems as sleep, feeding and discipline and ways to reduce common childhood injuries.

1.3 Problem statement

It is estimated that, every year more than 200 million children under five years old fail to reach their full cognitive and social potential. Majority (80%) of these children live in South Asia and sub-Saharan Africa. Tanzania being one of these countries might be affected as well. Cognitive development and development in its totality is highly influenced by the environment. Adequate stimulation is essential for brain development during the first two years of life which is important throughout life span. Caretakers, parents and family social environment together with nutrition of the child are among important factors for child development

Poorly developed children especially in cognition are likely to under-perform in school and subsequently to have low incomes as adults. In addition, as adults, they are also likely to have children at a very early age, and provide poor health care, nutrition and stimulation to their children, hence a vicious cycle of poverty and poor development. Despite the evidence available, the health sector has been slow to promote early child development and to support families with appropriate information and skills.

Some of the determinants have been pointed out especially outside Africa. We are different in terms of demographic characteristics, culture, social values and ethnicity different from developed and other developing countries as well. We needed to know what factors are associated with cognitive development in our locality for better interventions.

1.4 Study rationale

Tanzania is struggling to make a policy on ECD. This study aims at giving the factors associated with cognitive development, so that the coming policy, guidelines and strategies will be directed to the real problems in our society. The findings of this study inform on the factors associated with cognitive developmental delay in our locality. It also recommends on interventions in children at risk so that these children are prevented from poor cognition in early life and its consequences in later life. Lastly, this study adds on the available data on child development, areas of research and on counselling of caretakers.

1.5 Research questions

1. What proportion of infants has cognitive developmental delay in Dar es Salaam?
2. What factors are associated with early cognitive developmental delay?

1.6. Objectives

1.6.1 Broad objectives

To determine factors associated with cognitive developmental delay among infants attending RCH clinics in Dar es Salaam.

1.6.2 Specific objectives

1.6.2.1 To determine the proportion of infants with cognitive developmental delay among infants attending RCH clinics in Dar es Salaam.

1.6.2.2 To determine factors associated with cognitive developmental delay among infants attending RCH clinics in Dar es Salaam.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Study design

This was a health facility-based descriptive cross sectional study to determine factors associated with cognitive developmental delay in infants in Dar es Salaam.

2.2 Study area

This study was done in RCH clinics at Magomeni, Buguruni and Kigamboni health centers in Kinondoni, Ilala and Temeke municipals respectively. These health facilities provide primary level health care. Children aged less than five years are followed up, provided with immunization, growth and developmental monitoring, evaluation for illnesses and even treatment and referrals when needed. Each of these clinics serves a total of 60 to 80 children per day and the clinics operates from Monday to Friday.

2.3 Study duration

This was done in a period of one year; from December 2011 to December, 2012.

2.4 Study population

All infants who attended the above RCH clinics during the study period

2.5 Inclusion criteria

Infants aged 1 to 12months with parental/caretaker consent were included

2.6 Exclusion criteria

Children with obvious severe congenital malformations

Severe acute illness i.e. high grade fever, convulsion, loss of consciousness, respiratory distress and acute diarrhoea with signs of dehydration at the time of interview

NB: These conditions were excluded because it is difficult to differentiate those with developmental delay versus illness. Also those with acute illness needed urgent treatment.

2.7. Sample size

The sample size was calculated from the formula

$n= z^2 p (1-p)/e^2$

Where n =expected minimum sample size

Z = standard normal deviate, corresponding to 95% confidence; 1.96

e = maximum likely error taken as 4%

p = Expected proportion of poor cognitive development in children i.e. 13% .[8]

Therefore the minimum sample size calculated was 271 infants

Adding 10% to reduce the effect of non responders to the questionnaire,

The minimum sample size was 300 infants.

However 350 infants were interviewed

2.8. Sampling technique

Two-stage random sampling technique was used to get the sample. The lists of all public health centres in the three municipals of Dar es Salaam were obtained. Using lottery method one health centre was selected from each municipality. Data collection was done on weekly rotation to the three health centres. A list of all infants aged 1 to 12months who registered in the RCH clinics on the day of data collection i.e. Tuesdays and Fridays was obtained. Public holidays were excluded. Odd-numbered infants were invited to participate in the study. History and physical examination was performed by the investigator as routine. Only those who met the inclusion criteria were interviewed until a sample of approximately 50 was reached in each age group (ie 2, 4, 6, 8, 9, 10, 12 +/- 30days) was attained.

2.9. Definition of terms

- In this study, birth weight less than 2.5kg was regarded as low birth weight[41]
- Infants born before 37 completed weeks of gestation were regarded as preterm
- Assistant caretakers in this study are other people who were mostly involved in taking care of the infants in absence of the mother especially during day-time.
- HIV exposed child was defined as any child that was born from a mother who was previously diagnosed at the health facility and with documentation on the RCH card.

- HIV infected children was defined as infants tested by DNA-PCR during their visit to the RCH clinics with clear documentation on the RCH card, not necessarily tested during the study period.

2.10. Data collection

A structured questionnaire was used to collect the following information: smoking habit, maternal age, duration of breastfeeding, paternal education level, number of under fives in the family, maternal education and family size were inquired. Also age of the child, gestation age (term/preterm), birth weight, current body weight, sex, birth order and bad experiences including birth asphyxia/history of illnesses were recorded.

2.10.1 Weight

Participants were weighed using a 25 kilogram Salter hanging scale (Weighing equipment, High Holborn, London, United Kingdom) with a child putting on light cloths and no shoes. A standard beam balance (SECA) was used in weighing the young infants. The readings were recorded to the nearest 0.1kg. Calibration of weighing scale to zero was performed each day of recruitment. A known 1kg weight was used to standardize the scales every day for accuracy and consistency[56]

2.10.2 Length

Length of the participants was measured using a length board. Parents/guardians assisted in removing shoes and gently laying the child in supine position on the board, with their heads placed at 90^{o} to the fixed head piece. The investigator straightened the legs of the child at the knees and ensured that feet were at right angle to the sliding foot piece which was brought into contact to the child's heels. The length was recorded to the nearest 0.1centimeters

2.10.3 Interpretation of nutritional status

Using "Epi Nut" programme on the "Epi Info" statistical package version 6.04d, Z-scores for Weight for Length (WHZ), weight for age (WAZ) and length for age (LAZ) were calculated.
For the purpose of this study Z - Scores were interpreted as follows:

Z- Between Mean & -2SD: Normal nutritional status

Z – below -2SD: wasting/underweight/stunting

2.10.4 Cognitive development assessment

Cognitive development screening was done by using ages and stages questionnaire 3rd edition (ASQ-3).[58] This screening tool has communication, gross motor, fine motor, problem solving and personal social components. It has 21 age-specific questionnaires that are aimed at assessing child development of infants and young children up to 5years of age. Each questionnaire is valid for ±1month. Each developmental component has 6 items that are responded in 3 levels: 'Yes',' Sometimes, or 'Not yet', which are scored as 10, 5, or 0 respectively. There are different cut off points in different age groups (<2SD) on each component. Validity 0.86, sensitivity 86% specificity 85% was reported in US[57]. The tool has also been validated in India in 200 children where the overall sensitivity of ASQ for detecting developmental delay was 83.3% and specificity was 75.4%. [59] Several other studies have been done on Ages and Stages Questionnaire and showed that it is less cost parent-administered questionnaire that is reliable for both risky and low-risk children[58-63].

This screening tool has been used across the world for more than 15 years.

In this study only the problem solving part was used. A caregiver who knew the child well responded to the ASQ-3 together with structured questionnaire. In addition the infants were given some task to perform during the interview especially when the reporter was not sure. Each infant was assessed for 20-30 minutes.

2.10.5 Interpretation of ages and stages questionnaire

Children who scored below the cut-off score were considered having cognitive developmental delay, therefore need for further assessment by professionals; those whose scores lie close to cut-off score needed close follow-up and those lying above the cut-offs were considered

developing normally. The latter two groups were considered not having delayed cognitive development. The cut-off points for different age groups differed.

2.11. Data analysis:

Statistical Package for Social Scientists (SPSS) version 16 was used in data entry, cleaning and analysis. Frequency distribution and two way tables were used to summarize the data. The association between cognitive developmental delay (dependent variable) and the independent variables was obtained through Pearson's chi-square and Fisher's exact for the categorical variable. Univariate logistic regression was used in variable with more than two categories. Multivariate logistic regression was used to adjust for confounders and all independent variables with a p-value less than 0.2 were included. A p-value < 0.05 was considered statistically significant and 95% confidence interval was used.

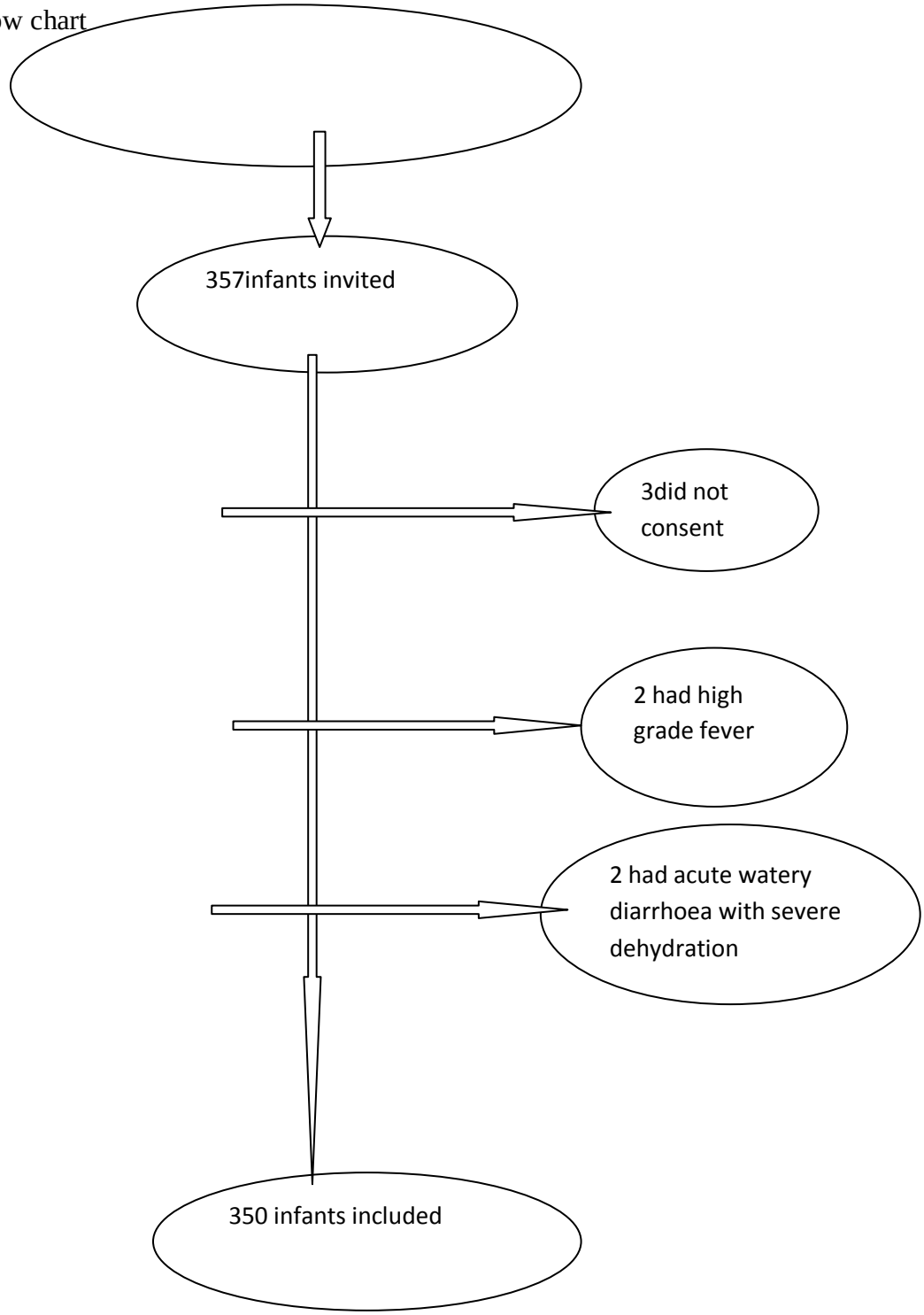
2.12. Ethical clearance and consideration

Ethical clearance was sought and granted by Muhimbili University of Health and Allied Sciences (MUHAS) higher degree research and publication committee and permission to conduct this study at health centres was sought from the three municipals administration (i.e. district medical officers). Parents/caretakers of participants signed a written informed consent prior to recruitment; this was done after receiving information regarding this study. They were informed of the procedures that were involved when they chose to let their children participate in the study. Infants excluded from the study including those whose parents/caregivers did not grant consent for participating in the study received services as per routine protocols. Children who were found to have cognitive developmental delay were referred to Muhimbili National Hospital for follow-up and further assessment. All participants' information was kept confidential.

CHAPTER THREE

3.0 RESULTS

Figure 1: flow chart



3.2 **Socio-demographic characteristics of the participants**

A total of 350 infants were assessed. One hundred and seventy seven infants (50.6%) were males. These infants were aged 1to 12 months with a mean (SD) of 7.26 (3.43) months and birth weight ranging from 1.3 to 4.6kg with mean (SD) of 3.11(0.50) kg. Ninety nine point two percent were term at birth. Majority (94.3%) of them were still breast feeding.

Majority (90.8%) of the mother were aged 19 to 35 years with the mean (SD) of 26.33 (5.17). Most of the parents had a maximum of seven years of schooling. The assistant caretakers' age ranged from 9 to 74 years with the median age of 19years (Table1).

Table 1: **Socio-demographic characteristics of the study participants (N =350)**

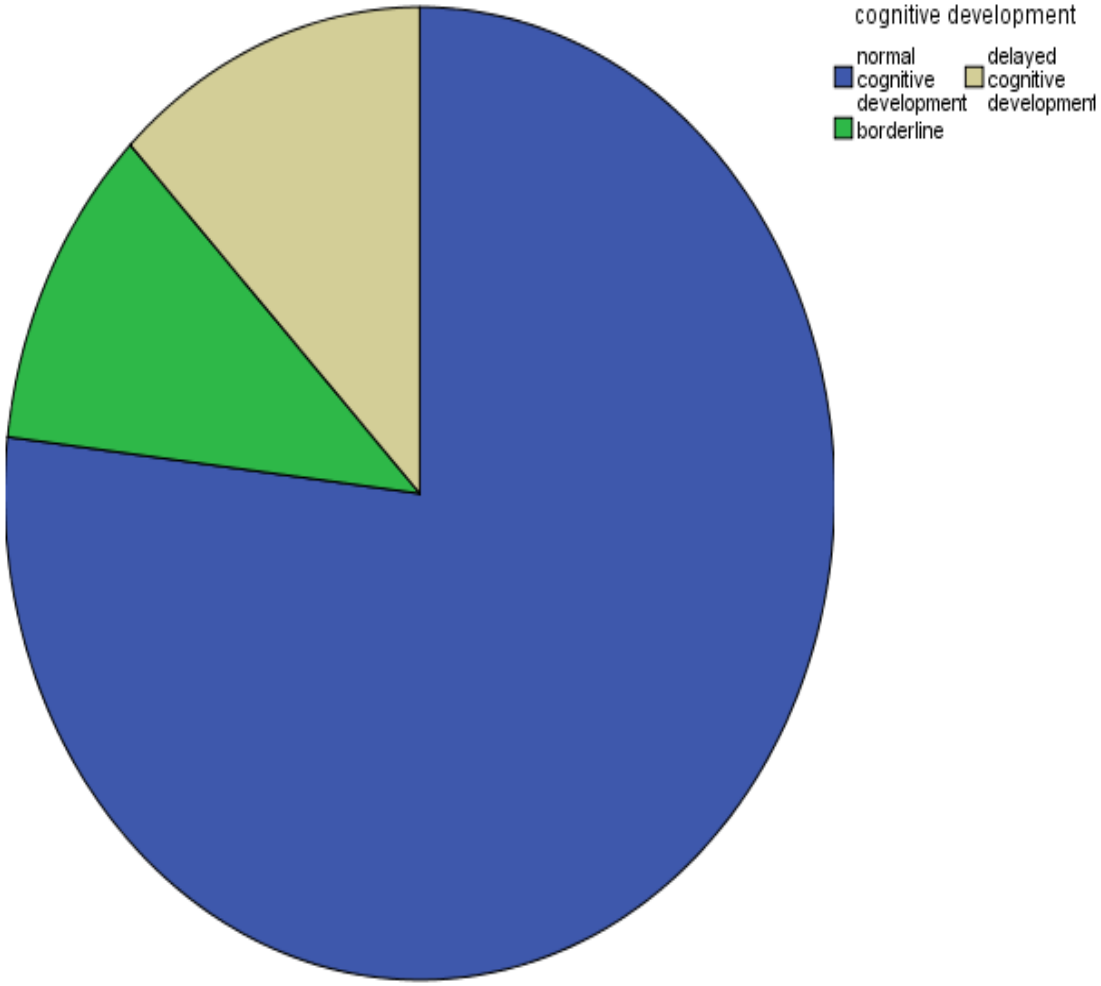
Variable	Mean ± SD	Frequency	Percentage (%)
Sex:			
Male		177	50.6
Female		173	49.4
Residence:			
Kinondoni		134	38.3
Ilala		100	28.6
Temeke		116	33.1
Age of the child(months)	7.26 ± 3.43		
<6		131	37.4
≥6		219	62.6
Birth weight(kg)	3.11 ± 0.50		
<2.5		27	7.7
≥2.5		321	92.3
Mothers' education			
No formal education		34	9.7
Primary education		234	66.9
Secondary education		59	16.9
Tertiary education		23	6.5
Fathers' education:			
No formal education		13	3.7
Primary education		199	57.5
Secondary education		93	26.9
Tertiary education		41	11.8
Assistant caretakers education			
<7years of schooling		40	69
≥7years of schooling		18	31
Family size			
≤5people		291	83.1
>5people		59	16.9
Age of the mother(years)	26.33 ± 5.17		
≤18		15	4.3
19-35		318	90.8
≥36		17	4.9
Age of assistant caretaker	*19		
≤18years		26	44.8
19-35years		15	25.9
≥36years		17	29.3

*Median age of the assistant caretaker; SD=Standard deviation

3.3 Proportion of infants with cognitive developmental delay

Out of 350 infants assessed 43 (12.3%) had delayed cognitive development while 38 (10.8%) were lying on the borderline and 269 (76.9%) were normal (figure 2)

Figure 2



3.4 Factors associated with infant cognitive developmental delay.

Among infants who were assessed for cognitive developmental delay, 25.2% of those aged less than 6 months compared to 4.6% of those aged 6 months and above had cognitive developmental delay. The difference observed was statistically significant. Low birth weight, bad experience of the infant, low paternal education and absence of the mother during day time showed a negative relationship with cognitive developmental delay with statistical significant. However; sex, nutritional status, HIV exposure, maternal education, family size and marital state did not show any statistical significance with cognitive developmental delay. (Table 2)

Table 2: Participants characteristics and cognitive developmental delay on chi-square (N=350)

variable	No cognition Delay n(%)	Cognition delayed n(%)	P-value
Sex			
Male	156(88.1)	21(11.9)	0.808
female	151(87.3)	22(12.7)	
Age (months)			
<6	98(74.8)	33(25.2)	<0.001
≥6	209(95.4)	10(4.6)	
×Birth weight(kg)			
<2.5	20(74.1)	7(25.9)	0.004
≥2.5	285(88.8)	36(11.2)	
Birth asphyxia			
No	298(88.4)	39(11.6)	0.062
yes	9(69.2)	4(30.8)	
*Bad experience			
No	274(89.8)	31(10.2)	0.002
yes	33(73.3)	12(26.7)	
HIV exposure			
Yes	29(85.3)	5(14.7)	0.072
No	275(87.8)	38(12.2)	
Mothers education			
≤7years in school	230(85.8)	38(14.2)	0.050
>7years in school	77(93.9)	5(6.1)	
Fathers education			
≤7years in school	179(84.4)	33(15.6)	0.025
>7years in school	127(92.7)	10(7.3)	
Use of assistant caretaker			
No	264(90.4)	28(9.6)	0.001
Yes	43(74.1)	15(25.9)	
Family size(no. of people)			
≤5	259(89.0)	32(11.0)	0.107
>5	48(81.3)	11(28.7)	
Marital status of the mother			
Single	46(86.8)	7(13.2)	0.824
In marital union	261(87.9)	36(12.1)	
Weight for length(z-score)			
<-2sd	25(78.1)	7(11.9)	0.090
>-2sd	282(88.7)	36(11.3)	
Length for age(z-score)			
<-2sd	83(87.4)	12(12.6)	0.904
>-2sd	224(87.8)	31(12.2)	
Weight for age(z-score)			
<-2sd	15(75.0)	5(25.0)	0.090
>-2sd	292(88.5)	38(11.5)	

*Bad experience includes any history of recurrent illness/birth asphyxia

The third born child was 2.5 times more likely to have cognitive developmental delay compared to the first born; (OR 2.5; 95%CI 1.1- 6.0, p=0.035). However, it was no longer significant with fourth born or more. When the age of the assistant caretaker was above 35yrs the likelihood of infant cognitive developmental delay was 9.8 times more likely than when the age was 19-35yrs (OR 9.8; 95%CI 1.1-92.7, p=0.001) . However, there was no significant difference in infants cognitive developmental delay when the caretakers' age of <18years compared to 19-35years (Table 3).

Table 3: Univariate analysis on the factors associated with cognitive developmental delay

variable	No cognition Delay n(%)	Cognition delayed n(%)	P-value	Crude OR(95%CI)
Birth order				
1st born	138(97.2)	4(2.8)		1
2nd born	98(88.3)	13(11.7)	0.510	1.3(0.6, 2.9)
3rd born	43(79.6)	11(20.4)	0.035	2.5(1.1, 6.0)
≥4th born	27(84.4)	5(15.6)	0.313	1.8(0.6, 5.3)
No. Of under fives				
1	230(89.1)	28(10.9)		1
2	71(86.6)	11(13.4)	0.527	1.3(0.6, 0.7)
3	6(60.0)	4(40.0)	0.120	5.5(1.4, 20.6)
Mother's age(years)				
19-35	278(87.4)	40(12.6)		1
<18	14(93.3)	1(6.7)	0.504	0.5(0.1, 3.9)
≥36	15(88.2)	2(11.8)	0.921	0.9(0.2, 4.2)
*Assistant caretaker age(years)				
19-35	14(93.3)	1(6.7)		1
<18	19(73.1)	7(26.9)	0.601	1.7(0.2, 13.6)
≥36	10(58.8)	7(41.2)	0.046	9.8(1.1, 92.7)
Mother's employment				
housewife	4(66.7)	2(33.3)		1
Not employed	17(77.3)	5(22.7)	0.597	0.6(0.1, 4.2)
**Formal employment	110(89.4)	13(10.6)	0.115	0.2(0.0, 1.4)
peasant	161(88.5)	21(11.5)	0.134	0.3(0.0, 1.5)
***others	15(88.2)	2(11.8)	0.249	0.3(0.0, 2.5)
Father's employment				
Works daily	277(91.1)	27(8.9)		1
Not employed	6(85.7)	1(16.3)	0.701	1.5(0.2, 13.1)
peasant	3(60.0)	2(40.0)	0.053	6.1(0.9, 38.1)
***others	51(79.7)	13(20.3)	0.220	2.3(1.1, 4.8)

**Professional/business/petty trader= formal employment *Assistant caretaker= the person who stayed with the infants whom their mother were absent, especially during the day

*Work daily= Professional/business/petty trader/driver***Others=day workers, no formal employment

3.5 Predictors of infants' cognitive developmental delay (multivariate analysis)

Age of the child, use of caretakers other than the mother, and nutritional status (wasting) were significantly associated with the cognitive developmental delays even after adjusting for confounders**.** Infants aged less than 6months were 14 times more likely to have cognitive developmental delay compared to those aged six months and above (aOR=14; 95%CI 5.3-38.3, P<0.001). Absence of the mother, and therefore the use of assistant caretakers, especially during day-time was 12 times more likely for the infant to have cognitive developmental delay compared to when the mother stayed with the infant (aOR=12.1; 95%CI 3.0-53, P=0.001). Wasted infants were 4 times more likely to have cognitive developmental delay (aOR=3.9; 95%CI 1.1-13.3, P=0.032). However, there was no significant difference with stunting or weight for age. (Table 4)

Table 4: Predictors of cognitive developmental delay among the infants

Variable	Adjusted OR(95%CI)	P-value
Age (months)		
<6	14.2(5.3, 38.3)	<0.001
≥6	1	
Birth weight(kg)		
<2.5	2.6(0.9, 7.0)	0.061
≥2.5	1	
Birth order		
1st born	1	
2nd born	0.8(0.3, 2.3)	0.720
3rd born	2.1(0.7, 6.9)	0.195
≥4th born	0.8(0.1, 4.7)	0.814
*Bad experience		
No	1	
Yes	2.9(1.0, 8.6)	0.059
No. of under fives		
1	1	
2	0.1(0.0, 0.5)	0.008
3	0.1(0.0, 0.5)	0.013
Birth asphyxia		
No	1	
Yes	0.5(0.1, 3.4)	0.469
Mothers education		
≤7years in school	3.3(0.3, 14.7)	0.119
>7years in school	1	
Fathers education		
≤7years in school	2.1(0.7, 6.2)	0.195
>7years in school	1	
**Use of assistant caretaker		
No	1	
Yes	12.1(3.0, 52.0)	0.001
**Assistant caretakers' age(years)		
19-35	1	
<18	10.2(0.7, 138.6)	0.080
≥36	8.6(0.4,163.3)	0.153
Family size(people)		
≤5	0.3(0.1, 1.3)	0.114
>5	1	
Mother's employment		
housewife	1	
Not employed	0.1(0.0, 1.5)	0.098
Professional/business/petty trader	0.1(0.0, 0.9)	0.037
peasant	0.1(0.0, 0.6)	0.018
others	0.0(0.0, 1.5)	0.094
Weight for length(z-score)		
<-2sd	3.9(1.1, 13.3)	0.032
>-2sd	1	
Weight for age(z-score)		
<-2sd	2.9(0.8, 9.7)	0.063
>-2sd	1	

*Bad experience includes any history of recurrent illness/birth asphyxia

**Assistant caretaker=the person who stayed with the infants in absence of their mothers.

CHAPTER FOUR

4.1 DISCUSSION

4.1.1 Proportion of infants with cognitive developmental delay

Early child cognitive development (ECD) which occurs in the first 2years of life and mostly in infancy is very important in ones later life. The objectives of this study was to determine the proportion and associated factors of cognitive developmental delay in infants attending reproductive and child health clinics in Dar es Salaam.

A total of 350 infants participated in the study. The proportion of infants with cognitive developmental delay was 12.3% in this study. These were consistent with the study done by *Gregory et al and Rosenberg et al*, in under fives with 10% and 13% developmental delay respectively [5, 8] . Findings of the current study may be underestimation of the problem in the general population because this study was done in a well baby clinic and a primary level of health care where those with problems might have been referred to higher levels. However, the explanation can also be, infants who attend the well baby clinics are more likely to have access to the health services, including health education, and low risk of developmental delays.

4.1.2 Infant factors and cognitive developmental delay

In the current study, it was shown that there was no significant sex difference in relation to infants' cognitive developmental delay. This was also reported in the comparison study done in children aged 1-2years by *Bimla and Sudha* in India[29.]

Also the developmental delay significantly decreased with increasing age ($p<0.001$). Study done by *Donald* et al had similar findings and reported that it could be due to retention of memory with repetitive stimulation.[3] It can also be due to the cultural aspect as usually young children are mostly kept indoors and therefore less exposure and stimulation.

Low birth weight showed a tendency of cognitive developmental delay although there was no significant difference after adjusting for confounders ($p= 0.061$). This was different from what

was found by Georgrieff et al where low birth weight was significantly associated with poor cognition (p=0.008)[6].

Third born child was found to be 2.5 times more likely to have cognitive developmental delay compared to the first born in the current study; although the significance disappeared after adjusting for the confounders on multivariate analysis. This finding was contrary to the study in South Africa by Christopher et al which found no difference in cognition on first born child versus subsequent [36]. Parental/caretaker excitement following having a child as the first experience and probably more stimulation compared to subsequent infants may explain this. Increasing number of children to 4 or more the difference disappears. This may be due to increased parental experience and stimulation from the other siblings as they grow older.

HIV exposed but uninfected infants showed a tendency of increased cognitive developmental delay compared to HIV-unexposed infants but this was not statistically significant in this study. This finding is consistent with the study by Springer et al[40] which reported no difference in cognition between the two groups although the later study had very small sample size (17 exposed versus 20 infants unexposed). However Filteran et al[37] and Christopher et al[36] in their studies found cognitive delays in HIV-exposed but uninfected compared to HIV-unexposed infants. The difference may be because the later studies were longitudinal, using Bayley scale for infants and toddlers 3rd edition (BSID-III) compared to the current study which was cross-sectional with ASQ-3 which have slight lower sensitivity and specifity[58].

Wasting unlike low weight for age was significantly associated with cognitive developmental delay in the current study. Kasasa et al in a study done in high risk infants in Dar es Salaam, Tanzania reported similar findings[65]. In contrast to this finding, the longitudinal studies done in Ethiopia and Bangladesh by Brewet et al and Hamadan respectively[49, 50] reported low weight for age was association with cognitive developmental delay. Deficiency of the macronutrients i.e. proteins, carbohydrates and fats leading to inadequate raw materials for the brain development explains this[41.] It was also found that there was no significant difference in cognition among stunted infants compared to non stunted infants in this study. Similar findings have been reported in Philippines and Ghana, although these were done in older

children [46,47]. However, cross sectional studies with larger sample size done in Kenya, Guatemala and Ethiopia reported significant association between stunting and cognition[44-45]. Since weight for age represents a combination of stunting and wasting, the mechanism cognition delay in wasting and not stunting is unknown.

4.1.3 Parental characteristics in relation to the infants' cognitive developmental delay

Low maternal educations showed tendency with delayed cognition although not statistically significant. This was also reported in the study done in Uganda *by Bangirana et al*[66.] However, it was contrary to the reported significant association by *Lam and Duryea* in study done in Brazil although this was done in older children [22]. Better education of the mothers has been reported to enhance healthy related behaviours like nutrition, high quality of care[23, 24]. In our case the high proportion of the mothers (76%) of these infants had a maximum of seven years of schooling. The high proportion of low maternal education may explain the difference observed. Surprisingly, low paternal education was associated with cognitive developmental delays, although it was not significant after adjusting for confounders. May be paternal education reflects earnings and socio-economic status of the family and health related behaviours as well.

Use of assistant caretaker during the day-time in this study was significantly associated with cognitive developmental delay even after adjusting for confounders. Similar findings were reported in the longitudinal study done on children at 18month of age by Sylva et al[12]. Infants learn through interaction with familiar adults as well as peers by imitating facial expressions hence the importance of stimulation[3]. Absence of the mother when these infants are awake may have lead to missed opportunity for them to learn adequately. Sixty nine percent (40/58) of these assistant caretakers had a maximum of 7years in school. In addition around 45% of the caretakers were less than 18years of age. It is "children taking care of children". The low education, less or no experience and probably burden of home activities that lead to less interaction with the infants can explain the difference observed.

When the age of the assistant caretakers was greater than 35years or less than 18years of age, the risk of infant cognitive developmental delays were higher compared to those with 19-35years. However the difference was not statistically significant. Maternal age did not show any significant difference regarding cognitive developmental delays. Studies done by Harvey et al and Goldenberg et al reported that young and old age are related to cognitive development delay with statistical significance[13, 14]. Another study in Australia by Andrew et al reports poor cognition with young maternal age[15]. The authors explained that age may be related to maternal care giving experience[15]

There was no statistical difference on cognitive developmental delays with regard to the number of under-fives in the family in the current study after adjusting for confounders. The study done by *Leibowitz et al[16] and Lehrer[18]* in Washington and Canada on pre-school children reported statistical difference on cognition delay with increasing number. These have been explained by the imbalance between the number of caretakers/adults and infants in need of care[16]. In our case, the difference may have been masked by the cultural difference together with extended family. It is easier to distribute the infants to the other family members for care.

The current study also found that maternal employment was significantly protective in infant cognitive developmental delay. Similar findings were reported by Burchinal et al in an analytical study and reported maternal employment is not related to cognitive ability in the first 3years of life[20]. At the same time mother who are employed may be the ones not staying with their children during the day. On the other hand employed mother are more likely to be educated and therefore good health care practices/services to their children which may have counteracted the developmental delays.

Reported breast feeding duration in this study had no difference in terms of the infant cognitive development. This is contrary to several studies which reports significantly higher developmental scores in children who were breastfed for at least 3months [30-32, 67]. Since some of these studies were longitudinal with large sample size, making them more reliable compared to the current study[67]. However, majority (94.3%) of infants in the current study were still breastfeeding hence less likely to show the difference.

4.2 LIMITATIONS

Only public health centers were involved for convenience so these results may not be generalised to represent infant cognitive developmental delay in Dar es Salaam. Infants who did not attend the clinics during the study period missed the opportunity to participate. These may be the infants with high risk and therefore underestimation of the proportion found in this study. Another limitation is the fact that the tool used in assessment of cognitive developmental delays has not been validated in our setting.

4.3 CONCLUSIONS

The proportion of cognitive developmental delay among infant attending RCH clinics in Dar es Salaam is 12.3%. Younger age of the child, use of other caretakers in absence of the mother and wasting were significantly associated with cognitive developmental delays even after adjusting for confounders**.**

4.4 RECOMMENDATIONS

1. Parents whose infants' are taken care by the assistant caretakers should try as much as possible to spend quality time with them
2. All infants should be assessed on cognitive development during their visits to the RCH clinics.
3. A longitudinal study is needed to measure the magnitude of cognitive developmental delays and look at the causal relationship of the associated factors and for better interventions.

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7.0 APPENDICES

Appendix 1: Questionnaire for assessing the factors associated with infant cognitive developmental delay

1. RCH CARD no: ……..
2. Date of interview…….
3. Serial number……..
4. Residence…….phone number……..
5. Tribe…….
6. Sex: A Male B Female
7. Birth order……..
8. How many people lives in the family?.....
9. How many underfives live in the family...
10. Age of the mother at the time of birth of this child……..yrs
11. Does the mother take alcohol? YES……NO……. If yes, how much/day...)
12. Is there any history of mental illness of the parents? YES…….….NO……....
    (If yes explain……)
13. PMTCT status of the mother: one……two…….unknown……..
14. HIV status of the child: positive……..negative……..unknown……
15. Is there any other person who takes care of this child especially day-time?
    YES…NO....(If NO go to question no.19)
16. Caretakers age ---------- (if any, other than the mother)
17. What is the relationship with the child? .....
18. Education level of the caretaker:

    A) Never been to school B) Primary School
    C) Secondary School D) college E) university

19. Marital status of the mother A) Single B)Cohabit C) Married
    D) Divorced E) Widowed

20. Mothers' Highest formal education achieved:

A) Never been to school B) Primary School

C) Secondary School D) college E) university

21. Does the mother smoke cigarette? YES…. NO…. (If YES mention whether it is passive or active). How many pieces per day……
22. Does the partner smoke cigarette? YES …..NO….. (How many pieces per day...
23. Where does the mother works A)Not employed B)A Proffesional (lawyer,Dr,teacher etc) C)Petty trader D)Businesswoman E)peasant F)housewife G) others…….……(.mention)
24. Level of education of the father
    A) Never been to school B) Primary School

    C) Secondary School D) college E) university
25. Where does the father works A)Not employed B)A Proffesional (lawyer, Dr, teacher etc) C)petty trader D)Businessman E)peasant
    F)others……(.mention)
26. Was this child born term?..... or preterm?.....(the investigator should confirm GA at birth by using LNMP of the mother)
27. What was the birth date of your child ----------(-AGE---------months)
28. birth weight of the index child ----------

29. For how long was this child breastfed……..

30. Current body weight……(measured on the interviewing day)

31. Measurements: length……cm, OFC……cm, MUAC……cm

32. Any history of recurrent illness/bad experience/neonatal insult to this child/maternal

    A) YES B) NO. If YES explain.....

33. Cognitive development score on ASQ-3 is.....(the investigator should use corrected age for the premature infants)

34. Cognitive score interpretation

    a) Within normal range (on schedule)

    b) Needs close follow up(lies on monitoring zone)

    c) Needs further assessment with professionals (below cut off point)

Appendix II a: ASQ-3 sample questionnaire

Ages & Stages Questionnaire

By Diane Bricker, Jane Squires and Linda Mounts

with assistance from LaWanda Potter, Robert Nickel and Jane Farrell

Example questions from:

10 Month

Questionnaire

Problem solving part

1. **Does your baby pass a toy back and forth YES SOMETIMES NO from one hand to the other ?**
2. **Does your baby pick up two toys , one each hand, and hold onto them for about 1minute**
3. **When holding a toy in his hand does your baby bang it against another toy on the table?**
4. **While holding a small toy in each hand, does your baby clap the toys together (like pat-a-cake)?**
5. **Does your baby poke at or try to get a crumbor cheerio that is inside a clear bottle (such as a plastic soda-pop bottle or baby bottle)?**
6. **After watching you hide a small toy under a piece of paper or cloth, Does your baby find it? (Be sure the toy is completely hidden)**

Appendix IIb: The cut-off points for cognitive developmental delays

Age in months ±30 days	Cut-off points
2	24.62
4	34.98
6	27.72
8	36.17
9	28.72
10	32.51
12	27.32

Appendix III. Informed consent Form

RCH CARD NO. _____

Consent to participate in the study: assessing the factors associated with cognitive development of infants who attend RCH clinics in Dares salaam.

Greetings! My name is Gudila V. Shirima, a postgraduate student at Muhimbili University of Health and Allied Sciences.

The purpose of the study

I am doing a study aiming at assessing the factors associated with cognitive development of infants who attend RCH clinics in Dares salaam.

What participation involves

If you agree to participate in the study, you will be requested to answer some questions as per my questionnaire and also allow me to assess this child that our taking care off.

Confidentiality

All information collected on questionnaires will be entered into computer with identification number. The questionnaires will be handled with great secrecy in order to maintain confidentiality throughout the study.

Risks

There is no direct risk associated with this study.

Right to withdraw and alternatives

Taking part in this study is completely a voluntary process. You will still receive all services that you would normally get from the health facility even if you don't choose to participate in this study.

Benefits

If you agree to take part in this study, your child will benefit from getting an opportunity to be evaluated in terms of development and if found with developmental delay the child will be referred to Muhimbili National Hospital for follow up and further assessment. The study will also with come out with recommendations regarding early child cognitive development.

In case of any injury

We do not expect any harm from your participation.

Who to contact

If you have any question about the study, you should contact Gudila V. Shirima, mobile no. 0715237119.

If you have any questions/concerns about your rights as a participant, you may contact Prof M. Aboud, Chairman of MUHAS Research and Publications Committee. P.O.BOX **65001 Dar es Salaam. Tel 2150302-6**

Signature

I …… have read the content of this form .My questions have been answered. I agree to participate in this study**.**

Signature of participant …….

Signature of witness ……..

Date of signed consent …/…/ 2012

Participant agrees☐ / Participant does NOT agree ☐

Appendix IV: Kiswahili version of Informed consent

NAMBA YA KADI YA KLINIKI _____

Hati ya ukubali wa kushiriki kwenye utafiti unaoangalia mambo yanayoambatana na ukuaji wa watoto katika utambuzi kwa watoto wanaohudhuria kliniki Dar es salaam.

Salaam! Naitwa Daktari Gudila Valentine Shirima, mwanafunzi wa uzamili katika chuo kikuu cha Tiba za Afya cha Muhimbili.

Lengo la utafiti.

Utafiti huu unaoangalia mambo yanayoambatana na ukuaji katika utambuzi kwa watoto wanaohudhuria kliniki Dar es salaam.

Ushiriki wako ni wa namna gani?

Ukikubali kushiriki, utaombwa kujibu maswali yanayohusu ukuaji wa mtoto huyu na atacunguzwa na mtafiti pia.

Usiri

Taarifa zote zitazochukiliwa kupitia dodoso letu, vitatambulika kwa namba na siyo jina ili kuongeza usiri. Usiri huo utalindwa hata baada ya kukamilika kwa utafiti huu.

Madhara

Hatutegemei kwamba utapata madhara yoyote.

Faida

Mtoto wako atapata nafasi ya kuchunguzwa katika ukuaji na utapewa mrejesho papo hapo kuhusu ukuaji wa mwanao. Atakaeonekana kukua chini ya matarajio atapewa rufaa kwenda hospitali ya Muhimbili kwa ufuatiliaji na uchunguzi zaidi. Mwisho wa utafiti huu tutatoa mapendezo juu ya ukuaji wa awali kwa watoto.

Haki ya kujitoa

Ushiriki wako ni wa hiari, unaweza kujitoa wakati wowote katika utafiti huu. Ukiamua kutokushiriki, utaendelea kupatiwa huduma kama kawaida.

Mawasiliano

Ukiwa na maswali kuhusu utafiti huu, wasiliana nami , Dr. Gudila Valentine Shirima kwa nambari ya simu +255715237119

Ukiwa na maswali kuhusu haki yako kama mshiriki, wasiliana na Prof. Muhsin Aboud, mwenyekiti wa Kitengo cha Utafiti wa Chuo Kikuu cha Afya ya Tiba Muhimbili S.L.P **65001 Dar es Salaam. Tel 2150302-6**

Sahihi

Mimi _____ nimekubali kushiriki utafiti huu baada ya maswali yangu yote kujibiwa.

Sahihi ya mshiriki _____

Sahihi ysa shahidi _____ Tarehe __/___/2012

Mshiriki amekubali ☐/ Amekataa ☐